

**MOLAR INCISOR HYPOMINERALISATION: PREVALENCE,
RISK FACTORS AND TREATMENT NEEDS IN CHILDREN OF
LUCKNOW CITY**

DISSERTATION

Submitted to

**BABU BANARASI DAS UNIVERSITY,
LUCKNOW, UTTAR PRADESH**

*In the partial fulfilment of the requirements for the degree
of*

MASTER OF DENTAL SURGERY

In

PEDIATRIC AND PREVENTIVE DENTISTRY

By

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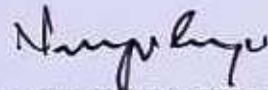
**Department of Pediatric and Preventive Dentistry
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BATCH: 2020-2023

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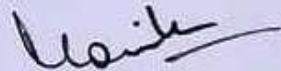
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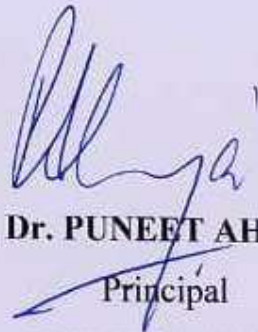
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DECLARATION BY THE CANDIDATE

I hereby declare that this dissertation entitled "**MOLAR INCISOR HYPOMINERALISATION: PREVALENCE, RISK FACTORS AND TREATMENT NEEDS IN CHILDREN OF LUCKNOW CITY**" is a bonafide and genuine research work carried out by me under the guidance of **Dr. Neerja Singh, Professor**, Department of Pediatric and Preventive Dentistry, Babu Banarasi Das College of Dental Sciences, Babu Banarasi Das University, Lucknow, Uttar Pradesh.

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Acknowledgements

There have been many people who have guided me, placed opportunities in front of me, and showed me the way and lead by example. I would like to thank each and every one of them.

First and foremost, I thank the **Almighty** who has always guided me and never let me lose faith in my endeavours.

I am deeply indebted to my late grandfather **Gopi Prasad Roy Chowdhury** who has been my ray of hope in all tough times. He has been my strength, my backbone and my guiding angel all throughout my life. He made me believe that if there's anyone who can do it, it's me. He made me the person I am and anything that I am capable of doing is because he was standing there right by my side, motivating me and pushing me to do better throughout my journey. My source of inspiration and power are my parents, **Mr. Partha Roy Choudhury** and **Mrs. Bani Roy Chowdhury**. I would like to thank them for always reminding me that no obstacle is insurmountable. They have always believed in me and their efforts to provide me with the best of everything can never be matched.

The entire duration of the course has been challenging but, with the constant motivation, suggestions and support of my teachers it has been a valuable learning experience and a journey worth remembering. I humbly acknowledge the care and affection of all my teachers.

I would like to express my deepest appreciation and gratitude to my Guide **Dr. Neerja Singh** ma'am, Professor, Department of Pediatric and Preventive Dentistry, BBDCODS, who with her illuminative guidance, brilliant foresightedness and expert evaluation has motivated me to do the best academically as well as clinically. She has always given her valuable inputs and limitless efforts for the completion of my dissertation. She has walked alongside me to help me become better at my work and add value to my profession. I thank you ma'am for being the perfect mentor and for always leading by example.

With heartfelt reverence, I would like to thank my Co guide **Dr. Monika Rathore** ma'am, Professor and Head, Department of Pediatric and Preventive Dentistry, BBDCODS, Lucknow, for her endless efforts, guidance and constant suggestions in making my work better. She has always looked out for me and has motivated me to be

a better academician and an appropriate clinician. I thank you ma'am for investing your time and providing interesting and valuable feedbacks throughout my course.

I offer my heartfelt gratitude to **Dr. Subash Singh** sir, Reader, Department of Pediatric and Preventive Dentistry, BBDCODS, Lucknow, who with his strict but always helpful nature has made me understand the importance of being a good listener and a good student. He has always showed me the right path. Thank you sir for all the valuable suggestions and the constant push to do better.

I express my sincere regard and appreciation to **Dr. Somya Govil** ma'am, Reader, Department of Pediatric and Preventive Dentistry, BBDCODS, Lucknow, for her unending encouragement and constant moral support.

I would like to thank **Dr. Monisha Moses** ma'am, **Dr. Sharlin Ahmad** ma'am, **Dr. Mansi Semwal** ma'am, **Dr Anu Bhat** ma'am and **Dr. Khyati Kaushal** ma'am for making sure that I didn't stress myself out of my wits at any point.

I wish to place in record my deep sense of gratitude to Principal Sir, **Dr. Puneet Ahuja** who is the linchpin of our college system and who made sure that all the functioning of college went smoothly.

I would also thank **Dr. Ashish** who helped me with statistical analysis which helped me in completing my dissertation.

I also extend my special thanks to my seniors **Dr. Shubham Gupta**, **Dr. Srishti Beera** and **Dr. Vishaka Vatsa** who have been there for me when the challenges during the course seemed to weigh on me. Thank you for standing by me and making me believe in myself. You all have been like a family for me throughout my tenure.

I am especially grateful to my colleagues, **Dr. Raunaq**, **Dr. Saheli**, **Dr. Bibhav** and **Dr. Needhi** for their assistance, criticism and useful insights. They have stood by me when times were tough and their co-operation despite their own work schedule helped me in completing my study calmly and comfortably.

I would like to express my love and gratitude to my immediate juniors, **Dr. Sadia**, **Dr. Aayushi**, **Dr. Ajay**, **Dr. Nina** and **Dr. Sarwani** who have supported me and boosted my confidence always.

I would like to appreciate and acknowledge my juniors, **Dr. Spandan**, **Dr. Anushka**, **Dr. Shreeja**, **Dr. Sushmita** and **Dr. Shifa** for their willingness to help me with any task. They made sure to check on me everytime I was feeling low and making me feel

better instantly with their cheerful attitude.

Friends are the family we choose and I am forever grateful for having the best family who I chose and can rely on without thinking twice. I am blessed to have **Moumita Mitra** who have kept me sane and been there for me in my toughest times.

I feel obliged to **Dr. Pratik, Dr Aman, Dr. Rajatava, Dr. Suman, Dr. Ayush, Dr Sandip, Dr. Sumit, Dr. Arijit, Dr. Debashish, Dr Manasi, Dr Raghunath, Dr Somnath** and **Dr Soumyadeep** for always being there for me and lifting my spirits. You have helped me grow as an individual and made me see the light at the end of the tunnel.

My family has always been my greatest strength and they have shaped me to be a better human being. They are the silent supporters of my life. My brothers **Abir Roy Chowdhury, Ankit Roy Chowdhury**, sister-in-law **Paromita Roy Chowdhury**, sisters **Papri Roy Chowdhury, Veeya Roy Chowdhury, Shreeya Roy Chowdhury**, nephew **Avyukth Dutta**, my grandmother **Mrs. Mamta Roy Chowdhury** and the whole of my “**Roy Chowdhury Dynasty**” group.

Last but not the least I would like to thank all my lovely friends and juniors from my

extended family- **BBD family** and **Triveni family** for their warm presence in my life.

I am thankful to the non-teaching staff of the department – **Mr. Vaibhav** and **Mr. Indrapal** for their help whenever required.

Finally, I take this opportunity to acknowledge the services of everyone and all my well-wishers who collaborated in producing this work. Any omission in this brief acknowledgement does not mean the lack of gratitude.

Dr. Akash Roy Chowdhury

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LIST OF ABBREVIATIONS

S.NO	ABBREVIATED FORM	FULL FORM
1.	%	Percentage
2.	MIH	Molar Incisor Hypomineralisation
3.	MIHTNI	Molar Incisor Hypomineralisation Treatment Need Index
4.	HSPM	Hypomineralised Secondary Primary Molars
5.	i.e	that is
6.	EAPD	European Academy of Pediatric Dentistry
7.	CPP ACP	Casein phosphopeptide– amorphous calcium phosphate complexes (CPP–ACP)
8.	DDE	Developmental Defects of Enamel
9.	DMFT	D (Decayed), M (Missing) and F (Filled) permanent teeth
10.	dmft	d (Decayed), m (Missing) and f (Filled) deciduous teeth
11.	ICDAS	International Caries Detection and Assessment System
12.	PUFA	P–Pulpal involvement, U- Ulceration, F-Fistula and A- abscess
13.	OHRQoL	Oral Health Related Quality of Life
14.	WHO	World Health Organization
15.	FPMs	First Permanent Molars

ABSTRACT

Background:

Molar Incisor Hypomineralization is one of the most common developmental disturbances that dental practitioners encounter which may influence the child's quality of life and can change their future dental health. Therefore, it is important to study its prevalence which can aid in its effective prevention, intervention and management.

Aim:

To determine prevalence, risk factors and treatment needs of molar incisor hypomineralization in children of Lucknow.

Material and Method:

A total of 800 children aged 7-9 years, were clinically screened for the presence of MIH. A self-designed questionnaire containing demographic details and risk factors of MIH was drafted and filled by the examiner in communication with the parents. Examination was performed using The Wurzburg MIH concept: the MIH treatment need index (MIH TNI) and significant findings related to MIH were noted.

Results:

The prevalence of MIH in the children examined was 5.12% with a higher prevalence in males than females. Perinatal factors such as premature birth, excessively prolonged labour, Caesarean mode of delivery, medications used in asthmatic children had a greater impact in the development of MIH compared to postnatal and prenatal factors. The majority of teeth impacted by MIH showed signs of hypersensitivity, affecting less than one-third of the tooth surface and in such cases non-invasive treatments such as fluoride varnish, fluoride toothpaste, remineralizing agents containing CPP-ACP, and the use of sealants were effective enough in managing the condition.

Conclusion:

The study showed a lower prevalence of MIH in Lucknow city with increased prevalence in permanent mandibular teeth than maxillary. The severity of MIH was highest in permanent mandibular molars followed by permanent maxillary incisors

and permanent mandibular incisors and least in the permanent maxillary molars. There are many events that can cause MIH which we cannot control or predict. Therefore, it is necessary to conduct long-term studies with a large number of participants to determine the impact of the various potential etiological factors for the development of MIH.

INTRODUCTION

Molar Incisor Hypomineralization is a particular kind of enamel defect that affects the first molars and incisors in the permanent dentition. MIH is regarded as a global issue and typically affects children under 10 years old¹. This developmental disease is brought on by the enamel's failure to mineralize throughout its maturity phase as a result of an ameloblast function disruption². Numerous causes have been put forth, including heredity and pregnancy - related health issues, preterm delivery, cyanosis, illnesses in infancy like chickenpox and otitis media, urinary tract infections and tonsillitis, but mainly childhood illnesses—particularly fever—seem to be linked³. One to four permanent molars and the associated incisors frequently exhibit discoloration as the first sign of MIH. The damaged teeth's enamel appears yellow, brown, cream, or white, leading to the nickname "cheese molars"⁴. Children with MIH and their parents experience distress because of the perception that these teeth are less aesthetically acceptable. Compared to children without the lesion, children with MIH have a higher risk of developing dental decay. Furthermore, because the enamel is less mineralized, tooth decay develops very quickly. Opacities on the tooth, if it is affected, can be seen when the permanent molars begin to emerge and MIH becomes obvious. In order to avoid any additional issues impacting their dental health, it will be beneficial for children who are thought to have MIH to see their dentist more frequently when their first permanent molars erupt.

To describe hypomineralized molars, a variety of terminology were used, including nonfluoride enamel opacities, internal enamel hypoplasia, nonendemic mottling of enamel, opaque patches, idiopathic enamel opacities, enamel opacities, and cheese molars⁵. The term MIH was originally used in 2001 by **Weerheijm et al.**⁶ who defined MIH as the hypomineralization of one to four systemically derived permanent first molars that typically coexist with the affected incisors.

In 2003, MIH was further defined as a developmental, qualitative enamel defect that results in enamel discoloration and fractures of the affected teeth due to impaired mineralization and inorganic enamel components. The first permanent molars (FPMs) and incisors were initially identified as being affected by the condition, however more recently it has been observed that these defects can affect any primary or permanent tooth⁷.

The prevalence of MIH varies greatly over the world, from 2.8 percent in Hong Kong⁸ to 42 percent in Brazil⁹. The prevalence of molar incisor hypomineralization in India varies from one geographical location to another with 0.48 % in Bengaluru¹⁰, 4.19% in Jaipur¹¹, 9.46% in Udaipur¹² and 21.4% in Muradnagar, Ghaziabad¹³.

The unexplained discrepancies in the stated prevalence rate are mostly a result of the absence of a consistent method for recording MIH data in epidemiological research. A global team of professionals in the field of MIH (Molar-Incisor Hypomineralization) created a new index called MIH-TNI¹⁴, which serves as an evaluation tool for determining the requirement of treatment for MIH and for routine monitoring of patients by dentists. The MIH-TNI evaluates the extent of damage to the teeth, along with any associated hypersensitivity, in individuals with MIH. It is recommended as a foundation for personal dental evaluations addressing all typical issues associated with MIH or for creating a treatment plan.

Children with MIH require first permanent molar treatment more frequently than children without MIH—nearly ten times more frequently. There are many different treatment options for MIH, but choosing the best one is a difficult and complicated decision. The severity of the illness, the patient's dental age, the child's or parent's social background, and expectations are only a few possible factors. There are therapy options available to manage children with MIH, however the evidence for these options is still insufficient.

There is no epidemiological survey carried out using The Wurzburg MIH Concept: MIH Treatment Need Index (MIH TNI)¹⁵ to find out the prevalence of MIH in Lucknow city, India. The purpose of this study is to assess the prevalence, risk factors and treatment needs in 7 to 9 years old school children with molar incisor hypomineralization in Lucknow city.

AIM AND OBJECTIVES

AIM

To determine prevalence, risk factors and treatment needs of molar incisor hypomineralization in children of Lucknow.

OBJECTIVES

1. To determine prevalence of molar incisor hypomineralization in 7 to 9 years old children of Lucknow City.
2. To determine the prevalence of hypomineralised second primary molars in 7 to 9 years old children of Lucknow City.
3. To evaluate associated etiological factors and treatment needs in children with molar incisor hypomineralization.

REVIEW OF LITERATURE

Parikh DR, Ganesh M and Bhaskar V (2012)¹⁶ conducted a study in Gandhinagar, Gujarat, India to determine the prevalence and characteristics of MIH in 1,366 children between the ages of 8 and 12 and used the EAPD 2003 criteria for diagnosis. The results showed that the prevalence of MIH in the studied population was 9.2%, and both males and females were affected equally. The incisors were found to be more affected than the molars, and the number and degree of damage to teeth increased with age.

Sulaiman MA, Sumer MA, and Omar ASEM (2014)¹⁷ conducted a study in Jeddah, Saudi Arabia, to assess the prevalence and potential etiological characteristics associated with molar incisor hypomineralization (MIH). Demographic information, medical histories of children, and pregnancy-related data were gathered. Children were diagnosed with MIH if one or more first permanent molars, with or without incisor involvement, matched the diagnostic criteria. The study discovered an 8.6% prevalence. The most common type of MIH was demarcated opacities and the upper central incisors were affected more severely than the lower ones. The study also found that the prevalence of MIH was strongly associated with childhood diseases such as asthma, adenoid infections, tonsillitis, fever and the use of medications in the first four years of life.

Petrou MA et al. (2014)¹⁸ determined the frequency of Molar-Incisor-Hypomineralisation (MIH) in 2395 children aged 8.1 ± 0.8 years in Germany. They evaluated the children's first permanent molars, permanent incisors, and second primary molars using EAPD criteria. The study found that the incidence of MIH varied greatly, with an average rate of 10.1%. The study also found a correlation between MIH in primary and permanent teeth. The majority of the affected teeth had defined opacities, and more than half of the children had at least one tooth with significant opacity.

Bhaskar SA and Hegde S (2014)¹⁹ examined the frequency, clinical features, distribution, severity, and association of MIH with caries in children aged between 8 and 13 years in Udaipur, Rajasthan. They followed the European Academy of Pediatric Dentistry criteria (2003) for MIH diagnosis. The occurrence of dental caries

and the requirement for treatment in MIH-affected teeth were reported using WHO criteria. It was determined that the frequency of MIH in children was 9.46%, and that it increased with age. The most commonly affected teeth were the mandibular first permanent molars and maxillary central incisors. The study also found that the severity of caries increased with MIH affected first permanent molars.

Shrestha R, Upadhaya S and Bajracharya M (2014)²⁰ conducted a study in Nepal to determine the prevalence and characteristics of Molar Incisor Hypomineralisation in children aged 7-12 using the EAPD criteria. They found that the prevalence of MIH in the studied population was 13.7%. Demarcated opacities were more common than breakdowns, and the hypomineralized defects were more prevalent in maxillary teeth than in mandibular teeth. The severity of the defect increased with age and there was no difference in prevalence between males and females.

Rodrigues et al. (2015)²¹ conducted a study in Sao Luis, Brazil to evaluate the presence of Molar-Incisor Hypomineralization (MIH) in the permanent dentition of 1179 students aged 7-14 years old, and to identify any potential factors related to these alterations. They used the methodology established by the FDI in 1992, the modified index of enamel development defects (modified DDE), to evaluate the MIH. They also administered a questionnaire to the students' mothers to identify possible factors associated with MIH. The study found a 2.5% prevalence of MIH and no correlation was established between the studied factors and the development of MIH.

Yannam SD, Amarlal D and Chamarthi VR (2016)²² evaluated the occurrence and severity of MIH in 2,864 school children between the ages of 8 and 12 in Chennai, India. The diagnosis of MIH was made using the EAPD guidelines. The study found that the overall prevalence of MIH in this population was 9.7%, with no significant difference between males and females. The study also found that the severity of MIH was higher in molars, particularly the right mandibular first molar, and that it was more prevalent in government schools than private schools.

Subramaniam P, Gupta T and Sharma A (2016)¹⁰ conducted a study to determine the prevalence of molar incisor hypomineralization (MIH) in 7-9-year-old children in Bengaluru City, India. The study involved a single trained and calibrated examiner. The results of the study indicated that the overall prevalence of MIH in this

population was 0.48%, with no significant difference between males and females. Additionally, the mandibular molars were more affected than maxillary molars.

Tourino LF et al. (2016)²³ examined the occurrence of MIH among 8-9-years-old Brazilian schoolchildren and identified factors related to MIH that occurred before, during, and after birth. The study collected information on demographics, socioeconomic status, and prenatal, perinatal, and postnatal factors through questionnaires. The diagnosis of MIH was based on the EAPD criteria. The study found that the overall prevalence of MIH in this population was 20.4%. They also found that MIH was more common among children with a history of dental caries and asthma/bronchitis in the first four years of life.

Mishra A and Pandey RK (2016)²⁴ determined the prevalence of molar incisor hypomineralization (MIH) in 1,369 Indian children of age 8 to 12 years old and analysed the possible etiological factors. First permanent molars and all permanent incisors were examined by two calibrated observers using Weerheijm criteria. The parents of the children were also asked to fill out a questionnaire about the child's medical history before and after birth. The results of the study showed that 13.9% of the children had MIH, and there was a strong correlation between history of infection in the child and the likelihood of developing MIH.

Steffen R, Kramer N and Bekes K (2017)¹⁴ developed a simple tool for dental practitioners to use when evaluating the need for treatment of molar incisor hypomineralization (MIH). The new index, called the MIH - treatment need index (TNI), takes into account the amount of damage to the tooth structure as well as any pain or sensitivity associated with MIH. This tool was found to be useful for individual dental examination and for planning treatment for MIH.

Ghanim A, Mariño R and Manton DJ (2018)²⁵ conducted a study to evaluate the accuracy of a new assessment tool for molar incisor hypomineralization (MIH). The tool combines elements from existing guidelines and indices to evaluate the clinical status, amount of tooth surface affected and other enamel defects that are similar to MIH. The study found that the new index correlated well with the expected frequency and severity of MIH. The index also demonstrated good sensitivity, specificity, positive predictive value and negative predictive value. The results showed that there

is a high degree of agreement between the new index and the clinical presentation and extent of the lesions.

Saber F, Waly N and Moheb D (2018)²⁶ conducted a study to determine the frequency of molar incisor hypomineralization (MIH) among Egyptian children aged 8 to 12. They used a standardized charting form to evaluate 16 index teeth of each child for the presence of MIH, including the eruption status, clinical status, and extent of the lesions. The study included 1,001 children, with 49.85% being male and 50.14% being female. The overall prevalence of MIH was 2.3%, with males showing a higher prevalence than females. The most common type of MIH identified was demarcated opacity.

Padavala S and Sukumaran G (2018)¹ conducted a study to determine the prevalence and characteristics of MIH in school going children of age 7–12 years in Chennai using the EAPD criteria. The results showed a prevalence of 12.9%. Distribution of MIH was more in males, more in 9 years of age and molars were more affected than the incisors. Mandible was affected more in comparison with the maxilla. The distribution of MIH was more in government schools compared to private schools.

Rai A et al (2018)¹³ conducted a study to determine the frequency and potential causes of permanent molar incisor hypomineralization (MIH) among 7–9-year-old children in Muradnagar, India. They used a Modified Developmental Defect of Enamel index, developed by Clarkson and O' Mullane in 1989, to identify MIH and a Decayed Missing Filled Tooth index, modified by the World Health Organization in 1997, to measure dental caries. The study found that the overall prevalence of MIH was 21.4%. The study identified age, complications during pregnancy, normal delivery, and childhood illnesses and infections as the risk factors that were most strongly associated with MIH.

Elzein R, Chouery E, Abdel-Sater F, Bacho R and Ayoub F (2019)²⁷ conducted a study to determine the frequency of molar incisor hypomineralization (MIH) in Lebanese children between the ages of 7 and 9, and to evaluate the characteristics of the affected teeth. They used the short-form grading method (MIH index) developed by Ghanim et al in 2015 to assess the clinical status, extent, and severity of MIH lesions in the first permanent molars and incisors. They found that the overall

prevalence of MIH was 26.7%, with no significant difference between boys and girls. The most common type of lesion was demarcated opacity, with less than one-third of the tooth surface affected. The degree of severity increased with age.

Gambetta-Tessini K, Mariño R, Ghanim A, Calache H and Manton DJ (2019)²⁸ carried out a study to determine the prevalence of Molar Incisor Hypomineralization (MIH)/Hypomineralised Secondary Primary Molars(HSPM) and their association with caries lesion severity in a sample of 6-12-year-old school children from Talca, Chile. The study used a modified EAPD protocol to assess MIH/HSPM and measured caries experience using DMFT/dmft/merged ICDAS II and PUFA/pufa in primary and permanent dentitions. The results showed that the prevalence of MIH and HSPM was 15.8% and 5% respectively and that MIH/HSPM lesions were associated with an increased occurrence of carious lesions and disease severity.

Ordóñez-Romero I, Jijón-Granja Y, Ubilla Mazzini W, Porro-Porro L and Álvarez-Giler G (2019)²⁹ aimed to determine the distribution of Molar Incisor Hypomineralization (MIH) in 249 Ecuadorian children between the ages of 7 and 12. The children were clinically evaluated and diagnosed using the EAPD criteria. The results showed that 9.24% of the children were affected with MIH, with a greater representation in girls. The study also found that the frequency of MIH was higher in permanent first molars than in permanent incisors, and the most frequent clinical defect was demarcated opacities.

Sidhu N, Wang Y, Barrett E and Casas M (2019)³⁰ aimed to investigate the prevalence and patterns of molar incisor hypomineralisation (MIH) and hypomineralised second primary molars (HSPM) in children in Toronto, Canada. The study included 429 participants and used the EAPD criteria for diagnosis and documentation of MIH and HSPM defects. The results showed that the prevalence of MIH and HSPM was 12.4% and 5.2%, respectively. The majority of lesions were less than 1/3 of a tooth surface, and this was more common in teeth affected by HSPM than MIH. Individuals with HSPM were more likely to have two affected molars than those with MIH. Additionally, HSPM was not found to be a predictor for MIH.

Rai PM et al. (2019)³¹ aimed to determine the prevalence of molar incisor hypomineralization (MIH) among 9–12-year-old school children in Virajpet, Karnataka. The study used a stratified cluster sampling method to select 1600

participants, and MIH diagnosis was based on the EAPD criteria. The results found that the overall prevalence of MIH was 13.12%, with no significant difference between genders. The highest prevalence was found among 10-year-olds, at 15%. The majority of children with MIH had lesions in both molars and incisors, with demarcated opacities and atypical restorations being the most common types of defects.

Singh PH and Bhat M (2019)¹¹ conducted a study to determine the prevalence of molar incisor hypomineralization (MIH) in 430 school children between the ages of 6 and 9 in Jaipur, India. They examined and found that 18 children had MIH, resulting in a prevalence of 4.19%. No significant difference in prevalence was observed between boys and girls, but involvement of only molars was more common in girls and combined involvement of both molars and incisors was more common in boys.

Portella PD et al. (2019)³² conducted a study to examine the relationship between molar incisor hypomineralization (MIH) and oral health-related quality of life in children with mixed dentition. The study included 8-year-old children from public schools in Curitiba, Brazil. The researchers used the Child Perception Questionnaire for 8–10-year-olds to evaluate oral health-related quality of life and diagnosed MIH using the EAPD criteria. The study found that 12.1% of the 728 children examined had MIH and that children with MIH had a greater impact on their oral health-related quality of life.

Gutiérrez TV, Ortega CCB, Pérez NP and Pérez AG (2019)³³ evaluated the impact of Molar Incisor Hypomineralization (MIH) on Oral Health-Related Quality of Life (OHRQoL) in a group of 8-10-year-old Mexican schoolchildren. The presence and severity of MIH was evaluated using EAPD criteria. The OHRQoL was evaluated using the Child Perceptions Questionnaire (CPQ). The study found that the prevalence of MIH in the permanent dentition was 40.4%. Additionally, the study found that children with moderate to severe MIH experienced a greater negative impact on their OHRQoL compared to children without MIH.

Mejía JD et al. (2019)³⁴ conducted a study to find the prevalence, severity, and risk factors of Molar Incisor Hypomineralization (MIH) among schoolchildren aged 6 to 15 in Medellin, Colombia. Using the EAPD criteria, two examiners diagnosed MIH in 11.2% of children, who mostly had mild defects. The study also found associations

between MIH and problems during the last trimester of pregnancy, type of childbirth, and respiratory issues.

Kılınc G, Çetin M, Köse B and Ellidokuz H (2019)³⁵ determine the prevalence, severity, and risk factors of Molar Incisor Hypomineralization (MIH) in 9-10 year old children living in Izmir City, Turkey. Using the EAPD criteria, the study found that 11.5% of children had MIH. Children with low birthweight, premature delivery, high fever and asthma/bronchitis were found to have more severe cases of MIH.

Tagelsir Ahmed A, Soto-Rojas AE, Dean JA, Eckert GJ and Martinez-Mier EA (2020)³⁶ determined the prevalence and severity of molar-incisor hypomineralization (MIH) in a cohort of school-aged children in Indiana. The examiners used the integrated Modified Developmental Defects of Enamel Index and the European Academy of Pediatric Dentistry criteria to examine MIH. The prevalence for MIH was 13%. Demarcated opacities were the most prevalent defects followed by atypical restorations.

Abdalla HE, Abuaffan AH and Kemoli AM (2020)³⁷ conducted a descriptive cross-sectional study from schools in Khartoum State in Sudan involving 568 children of age 8-11 years. The results concluded that the prevalence of MIH in Sudanese children was 20.1%. In both dental arches, the permanent molars and incisors were frequently affected, with the demarcated opacity type of MIH being the most common form of defect.

Mahmoud AH , Eman AA, Mariam A and Lamis DR (2020)³⁸ A cross-sectional study of a group of 3rd year class school children of age 8-9 years was assessed to find the prevalence and severity of MIH in Amman, Jordan. 1412 school children aged were examined using the chart of Ghanim et al. based on the criteria of European Academy of Paediatric Dentistry (EAPD) by a single calibrated examiner. MIH was found out in 13.17% school children. Demarcated opacities were the most common defect. The severity of the lesions increased with the number of affected teeth.

Ray P, Mohanty UK, Sethi D, Mahakur M and Sharma G (2020)³⁹ determined the prevalence, severity and treatment need of MIH among 8-12-year-old school going children in Cuttack, Odisha. MIH was diagnosed using EAPD criteria. The results showed that the prevalence of MIH in the study population was 5.7%, with a higher occurrence in boys than girls. Additionally, the mandibular molars and maxillary

incisors were found to be affected more frequently compared to other teeth. The study also found that teeth affected by MIH are more susceptible to developing dental caries than healthy teeth. Treatment for MIH may include a range of measures, such as preventive care, application of pit and fissure sealants, restoration, pulp therapy, and extraction.

Sakly EH, Amor WB, Zokkar N, Charavet C and Amor FB (2020)⁴⁰ evaluated the prevalence and the characteristics of Molar Incisor Hypomineralisation (MIH) in 7-12-year-old children in Tunis, Tunisia using EAPD criteria. The prevalence of MIH in Tunis was 35.4%, with no difference between girls and boys. The most common type of MIH was white/creamy demarcated opacities.

Jurlina D et al. (2020)⁴¹ conducted a study to detect molar–incisor hypomineralization (MIH) and caries prevalence in eight-year-old children with early mixed dentition in Eastern Croatia. The recognition of MIH was done according to EAPD criteria. The prevalence of caries was determined using the standard DMFT (Decayed, Missing, and Filled Teeth) index from WHO. The results showed that the prevalence of MIH in the study population was 13%. Additionally, the study found that the prevalence of caries in the population of examined children was 11.48%, and it was more commonly seen in children affected by MIH.

Emmatty TB et al. (2020)⁴² did a cross-sectional epidemiological study among 5318 healthy Malayalee school children aged between 8 and 15 years in and around Muvattupuzha, Kerala to find out the prevalence of MIH . The first permanent molars (FPMs) and all permanent incisors were examined using the European Academy of Paediatric Dentistry 2003 diagnostic criteria. A total of 216 children were diagnosed with MIH with a prevalence of 4.1%.

Ghofran SS, Lama OH and Hanadi SL (2020)⁴³ conducted a study to determine the prevalence of MIH among 1,000 randomly selected female school children in Makkah, Saudi Arabia. All included children were diagnosed using EAPD criteria. The results of the study showed that the prevalence of MIH among the schoolgirls in Makkah was 20.96%. Additionally, the study found that there were no significant associations between MIH and prenatal, perinatal, or postnatal factors..

Fatturi AL et al. (2020)⁴⁴ investigated the relationship between molar incisor hypomineralization, dental caries, socioeconomic factors, and polymorphisms in the vitamin D receptor gene. MIH, HPSM, and dental caries were clinically assessed using European Academy of Pediatric Dentistry (2003) criteria, the modified Developmental Defects of Enamel (DDE) index, and the Decayed, Missing, or Filled Teeth (DMFT) index by the World Health Organization (2013), respectively. The VDR rs739837 and rs2228570 polymorphisms were genotyped using real-time polymerase chain reaction. Children with MIH presented a higher prevalence of dental caries than children without MIH. Children with at least one G allele in rs739837 was associated with higher prevalence of MIH in molars and incisors.

Thakur H et al. (2020)⁴⁵ A cross-sectional study was conducted with 2000 children from various schools of Baddi, Himachal Pradesh. Molar–incisor hypomineralization was diagnosed on the basis of EAPD 2003 criteria revised in 2009. Prevalence of MIH found was to be 2.9%. Demarcated opacities were predominant among all the defects. Postnatal illnesses were highly associated with MIH. The prevalence of dental caries reported in MIH patients was 82.7%.

Dourado DG et al. (2021)⁴⁶ investigated the prevalence and factors associated with molar-incisor hypomineralization (MIH) in children aged 8 to 14 years old in Brazil. They collected data on socio-demographic and health-related information from prenatal, perinatal, and postnatal health records and performed a clinical examination to diagnose MIH using the EAPD criteria. The study found that the prevalence of MIH was 46.6%, and it was associated with gestational diabetes and acute fetal distress.

Amend S et al. (2021)⁴⁷ assessed and compared the prevalence of MIH among 6-12-year-old school children living in Germany. The prevalence of HSPM/MIH was examined using EAPD criteria/severity scale by Wetzel and Reckel and the caries experience by dmft/DMFT (WHO). The prevalence of HSPM/MIH was 3.2%/9.4% in rural area and 2.9%/17.4% in urban area. Most common MIH defects were demarcated opacities. The caries experience among children under investigation was low (DMFT 0.14-0.15).

Sosa-Soto J et al. (2021)⁴⁸ estimated the prevalence and severity of molar incisor hypomineralization (MIH) in 8 years old children living in an endemic fluorosis area in Mexico. MIH prevalence rate was determined from a study sample of 613 participants which were recruited from 11 urban public schools with similar socio-economic status. Oral evaluations were performed and diagnosed MIH teeth were classified under Ghanim et al.'s criteria. The MIH prevalence in this study was 12.4 percent. According to the MIH severity, degree 2 was the most frequently detected (76.4 percent).

Abdalla HE, Abuaffan AH and Kemoli AM (2021)⁴⁹ conducted a descriptive cross-sectional study involving 568 children, aged 8–11 years from schools in Khartoum State in Sudan to determine the prevalence and distribution of MIH in Sudanese children. The results showed that the prevalence of MIH in Sudanese children was 20.1%. In both dental arches, the permanent molars and incisors were frequently affected, with the demarcated opacity type of MIH being the most common form of defect.

MATERIALS & METHODS

The present cross-sectional study was conducted in the Department of Pediatric and Preventive Dentistry, Babu Banarasi Das College of Dental Sciences (BBDCODS). After obtaining clearance from institutional ethical committee of BBDCODS, Lucknow, participants who fulfilled the inclusion and exclusion criteria, were enrolled in the study (**Annexure I**). A written informed consent was obtained from the school authorities and parents of children between 7 to 9 years old before the study was initiated (**Annexure III**). The study was done with an aim to evaluate prevalence, risk factors and treatment needs of molar incisor hypomineralization in children aged 7 to 9 years of Lucknow city.

SAMPLE SIZE CALCULATION:

This *in-vivo* cross-sectional study consisted of children, both male and female of age 7 to 9 years old, attending schools in different blocks of Lucknow city, Uttar Pradesh.

According to a similar study conducted in Ghaziabad, expecting 9% prevalence of molar incisor hypomineralization in children between 7 to 9 years old in Lucknow city and considering 95% confidence level, the sample size was decided according to the following formula: -

$$N = \frac{Z^2 p (1-p)}{d^2}$$

Here,

Z= 1.96 at 95% Confidence Level

P = 0.09 is the expected prevalence

1-p= 0.91

d = 2% precision (0.02)

Putting the values in the formula, we get the sample size as:

$$N=786.5$$

Therefore, sample size for this prevalence study is 787.

ELIGIBILITY CRITERIA:

INCLUSION CRITERIA:

- Both genders between the ages 7-9 years present in the selected schools on the day of survey.
- Children with all permanent first molars, permanent incisors and second primary molars present in oral cavity.
- Subjects for whom consent was obtained from parents.

EXCLUSION CRITERIA:

- Children undergoing orthodontic treatment.
- Those who were not unwilling to participate in the study.

INSTRUMENTS AND EQUIPMENTS

- Examination gloves
- Mouth mask
- Head cap
- Mouth mirror
- Blunt probe
- Kidney Tray
- Green cloth
- Sanitizer
- Questionnaire

STUDY DESIGN:

The target population were 800 children between the age group 7-9 years old attending various private and public schools in the city of Lucknow. The participants were selected using the stratified sampling method, where schools from different zones were randomly picked. The examination was conducted in one session and focused on primary school students in grades 1 to 3, who were evaluated in their classroom or in a field with sufficient lighting. The examination

was conducted on the first permanent molars, second primary molars, and permanent incisors, as long as they had fully erupted. In addition to the examination, the examiners filled out a questionnaire by contacting the children's parents over the telephone, as they were not present at the school during the examination.

METHODOLOGY:

The present study was conducted in the Department of Pediatric and Preventive Dentistry, Babu Banarasi Das College of Dental Sciences (BBDCODS). After obtaining clearance from institutional ethical committee of BBDCODS, Lucknow, participants who fulfilled the inclusion and exclusion criteria, were enrolled in the study. The study included a self-designed questionnaire consisting of questions regarding demographic data and various parameters related to the study. The questionnaire was drafted based on previous studies that had been performed for the same and necessary changes were made according to the structure of the study design (**Annexure XI**). A schedule was prepared which was made available to the principals of schools and dean of the dental college. The principals were informed about the possible outcomes of the study and their importance for well-being of the society and the scientific community. The schedules took into account some adaptability, so that the unexpected delays don't cause significant upsets in the survey. The calibration of the two investigator was done by the research head who has thorough knowledge of the subject.

The duration of the present study was from 2020 to 2022 and the camps were conducted twice a week. In this time period, the survey was carried out through community camps conducted in various schools in and around Lucknow. A total of 800 children were included and examined. The examination started by evaluating the primary school children from standard 1-3 in one appointment. The study was carried out in the class room or field of the school under adequate light.

All ideal guidelines for sterilization were followed and to avoid cross contamination, multiple sets of instruments were carried along and those used once, were segregated. Disposable hand gloves and surgical masks were discarded appropriately, after being used on each subject.

A total of 800 participants were included and examined for molar incisor hypomineralization/ hypomineralised second primary molars. Two calibrated examiners assessed the participants and recorded all the details in the case sheet. Initially, all the demographic details were recorded and a rapport was established with the children by the means of communication which helped in behaviour modification and a positive response from the children. The evaluation was done according to The Wurzburg MIH concept: the MIH treatment needs index (MIH TNI)¹⁴ (**Annexure IX**). All the index teeth first permanent molars, second primary molars and permanent incisors were examined provided that they were fully erupted.

After conducting the evaluation, the examiners filled out a questionnaire by contacting the child's mother over the telephone. The questionnaire contained questions related to the child's demographic information, maternal education, prenatal factors including birth complications, use of paracetamol and use of additional medications during pregnancy, perinatal factors including premature birth of the child, excessively prolonged labor, type of birth delivery, oxygenation without intubation and postnatal factors including breastfeeding duration, and medical history in the first three years of life like occurrence of chickenpox, otitis, bronchitis, pneumonia, atopic dermatitis, asthma, high fever, use of antibiotics, analgesics and asthmatic medication. The information collected from the questionnaire was used to determine the child's potential exposure to environmental factors that could cause molar incisor hypomineralization.

Evaluation Criteria

The following evaluation criteria was applied to both primary and permanent teeth. The criteria set by the EAPD served as the basis for the examiner to determine the presence or absence of molar incisor hypomineralization / hypomineralised second primary molars (MIH/HSPM). Once a decision was made regarding the presence or absence of MIH/HSPM, patients with other enamel developmental defects was ruled out. The presence of MIH/HSPM was detected if any of the following characteristics were observed: defined opacity on occlusal and buccal surfaces of the teeth, varying shapes, sizes, and patterns of defects, deviations in colour (white, cream-colored, or yellow-brown), varying sizes of defects (defects with a diameter/expansion <1 mm are not recorded), presence of hypersensitive teeth, atypical restoration, missing

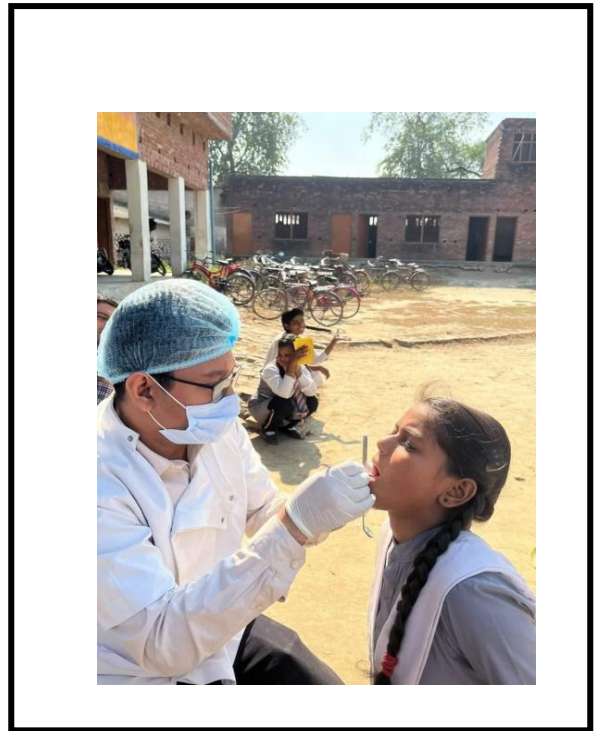
permanent teeth for suspected MIH reasons, or a combination of these characteristics. After determining the presence of MIH/HSPM, further classification was made from levels 1 to 4.

Grading/classification of the MIH-TNI

The grading was determined by the two primary clinical indicators: sensitivity and disintegration. The levels 1 to 4 are displayed in **Annexure IX**. The assessment was conducted using visual inspection with a mirror, tactile examination with a probe, and under adequate lighting.

Measurements were taken in a clockwise direction starting with the maxillary right as the first quadrant. Values were noted viewing the patient from the front. All these values were taken by two calibrated examiners. Interexaminer reliability between the two examiners was determined by kappa coefficient.

MIH-TNI therapy plan based on the grading of MIH-TNI was assessed using The Wurzburg MIH concept: Part 2. The treatment plan¹⁵ (**Annexure X**). The MIH-TNI index was used to create a customized treatment plan for each instance of molar incisor hypomineralization (MIH). The range of options includes preventive measures, such as cleaning and sealing, as well as restorative treatments, such as temporary or permanent fillings, or tooth extraction. The most suitable treatment for each individual case of MIH was determined based on the specific symptoms present.



Oral Screening of Children



Community Camps Organised in schools

RESULTS AND OBSERVATIONS

Table 1: Prevalence of molar incisor hypomineralisation

N	MIH Present	MIH Absent	Chi Square value	P value
800	41(5.12%)	759(94.88%)	101.718	0.001 (Sig)

Table 1 depicts the occurrence of MIH among 800 individuals who were examined. Out of the 800 individuals, 41 (5.12%) were found to have MIH. The results showed a significant p-value of 0.001.

Table 2: Gender-wise prevalence of molar incisor hypomineralisation

Gender	MIH Present	MIH Absent	Chi Square value	P value
Male	28(7.0%)	372(93%)	5.718	0.016 (Sig)
Female	13(3.25%)	387(96.75%)		

Table 2 illustrates the prevalence of molar incisor hypomineralisation according to gender. It was found that males had a higher prevalence of molar incisor hypomineralisation at 7.0% compared to females who had a prevalence of 3.25%. The disparity between males and females in terms of molar incisor hypomineralisation prevalence was statistically significant with a p-value of 0.016.

Table 3: Age-wise prevalence of molar incisor hypomineralisation

Age of children	MIH Present	MIH Absent	Chi Square value	P value
7 years (N=265)	10(3.77%)	255(96.23%)	2.564	0.277 (Non-Sig)
8 years (N=265)	18(6.79%)	247(93.21%)		
9 years (N=270)	13(4.81%)	257(95.19%)		

Table 3 shows the prevalence of molar incisor hypomineralisation in the studied population grouped by age. The highest prevalence was found in the 8-year age group at 6.79%, while the lowest was in the 7-year age group at 3.77%. The statistical analysis revealed that there was no significant difference between the different age groups.

Table 4: Prevalence of hypomineralised second primary molars

	Score 0	Score 1	Score 2	Score 3	Score 4
Tooth No 55	35(85.37%)	0(0%)	1(2.4%)	4(9.8%)	1(2.4%)
Tooth No 65	39(95.1%)	0(0%)	0(0%)	02(4.9%)	0(0%)
Tooth No 75	36(87.8%)	0(0%)	0(0%)	05(12.2%)	0(0%)
Tooth No 85	31(75.6%)	0(0%)	0(0%)	10(24.4%)	0(0%)
Overall	141(85.97%)	0(0%)	1(0.60%)	21(12.80%)	1(0.61%)

Table 4 displays the frequency of hypomineralization in the secondary primary molars among the teeth that were examined. The overall occurrence was 14.02%.

In the upper right secondary primary molar, 85.37% had a Score of 0 and 9.8% had a Score of 3. On the upper left side, 95.1% of the secondary primary molars had a Score of 0 and 4.9% had a Score of 3.

The right lower jaw's secondary primary molar had 87.8% with a Score of 0 and 12.2% with a Score of 3. On the left lower jaw, 75.6% of the secondary primary molars had a Score of 0 and 24.4% had a Score of 3.

Table 5: Prevalence of molar incisor hypomineralisation based on mother's education

Mother's education	MIH Present	MIH Absent	Chi Square value	P value
>8 years	09(2.63%)	333(97.37%)	3.346	0.524 (Non-Sig)
≤8 years	32(6.99%)	426(93.01%)		

Table 5 shows the prevalence of molar incisor hypomineralisation based on mother's education level. According to the mother's education level, the prevalence of molar incisor hypomineralisation was higher among subjects whose mothers had less than 8 years of schooling. However, the statistical analysis indicated that this difference was not significant with a p-value of 0.524.

Table 6: Prevalence of molar incisor hypomineralisation based on prenatal factors

Variables		MIH Present	MIH Absent	Chi Square value	P value
Birth complication	Yes	10(37.5%)	25 (62.5%)	90.763	0.001 (Sig)
	No	31(4.01%)	726 (95.91%)		
Use of additional medications during pregnancy	Yes	10 (23.25%)	33 (76.74%)	31.169	0.001 (Sig)
	No	31 (4.09%)	726 (95.91%)		
Use of paracetamol	Yes	05 (5.15%)	92 (94.84%)	0.044	0.833 (Non-Sig)
	No	36 (5.12%)	667 (94.88%)		

Table 6 depicts the prevalence of molar incisor hypomineralisation according to prenatal factors. The incidence of MIH was found to be more common among individuals who experienced complications during birth (37.5%) and those whose mothers took additional medications during pregnancy (23.25%). However, there was no significant impact on the incidence of MIH from the use of paracetamol during pregnancy (p-value = 0.833).

Table 7: Prevalence of molar incisor hypomineralisation based on perinatal factors

Variables		MIH Present	MIH Absent	Chi Square value	P value
Premature birth	Yes (46)	11 (23.91%)	35 (76.09%)	35.432	0.001 (Sig)
	No (754)	30 (3.91%)	724(96.09%)		
Excessively prolonged labour	Yes (21)	04 (19.04%)	17 (80.96%)	8.597	0.001 (Sig)
	No (779)	37 (4.74%)	742 (95.26%)		
Birth delivery	Normal (610)	30 (4.91%)	580 (95.08%)	0.226	0.634 (Sig)
	Caesarean(190)	11 (5.78%)	179 (94.21%)		
Place of Delivery	Home (92)	05 (5.43%)	87 (94.56%)	0.021	0.884 (Sig)
	Hospital (708)	36 (5.08%)	672 (94.91%)		
Oxygenation without intubation	Yes (67)	04 (5.97%)	63 (94.03%)	0.107	0.743 (Non-Sig)
	No (733)	37 (5.04%)	696 (94.96%)		

Table 7 displays the influence of perinatal factors such as premature birth, excessively long labor, method of delivery, location of delivery, and oxygenation without intubation on the occurrence of MIH.

The results showed that there was a significant increase in MIH prevalence in subjects whose mother had experienced premature birth (23.91%), excessively prolonged labor (19.04%), underwent caesarean delivery (5.78%) and neonates delivered in a hospital (5.08%). However, the factor of oxygenation without intubation in the subjects was not found to have a significant effect on the prevalence of MIH (5.97%).

Table 8: Prevalence of molar incisor hypomineralisation based on postnatal factors

		MIH Present	MIH Absent	Chi Square value	P value
Breastfeeding duration	<6 month)130	07 (5.38%)	123 (94.62%)	0.022	0.882 (Non-Sig)
	≥6 month 670	34 (5.22%)	636(94.78%)		
Illnesses up to 4 years of age	Yes (95)	08 (8.42%)	87 (91.58%)	2.409	0.120 (Non-Sig)
	No (705)	33 (4.68%)	672 (95.32%)		
Pneumonia	Yes (49)	03 (6.12%)	46 (93.87%)	0.107	0.743 (Non-Sig)
	No (751)	38 (5.05%)	713 (94.95%)		
Use of antibiotics	Yes (92)	06 (6.52%)	86 (93.47%)	0.417	0.518 (Non-Sig)
	No (708)	35 (4.94%)	673 (95.05%)		
Use of analgesics	Yes (67)	04 (5.97%)	63 (94.03%)	0.107	0.743 (Non-Sig)
	No (733)	37 (5.04%)	696 (94.96%)		
Use of medication for asthma	Yes (21)	04 (19.04%)	17 (80.96%)	8.597	0.001 (Sig)
	No (779)	37 (4.74%)	742 (95.26%)		
Fever higher than 38.5°C	Yes (49)	03 (6.12%)	46 (93.88%)	0.743	0.107 (Non-Sig)
	No (751)	38 (5.05%)	713 (94.94)		

Table 8 depicts the impact of postnatal factors such as duration of breastfeeding, illnesses up to 4 years of age, pneumonia, use of antibiotics, use of analgesics, use of asthma medication, and fever higher than 38.5°C on the prevalence of MIH. The results showed that there was a significant increase in MIH prevalence among subjects who used asthma medication (19.04%). However, breastfeeding duration (5.22%), postnatal illnesses up to 4 years of age such as jaundice, chicken pox (8.42%), pneumonia (6.12%), use of antibiotics (6.52%) and analgesics (5.97%) did not have a significant relationship with MIH. Additionally, fever higher than 38.5°C (6.12%) was not found to have a significant effect on the prevalence of MIH.

Table 9: Distribution of teeth on the basis of severity of molar incisor hypomineralisation

<u>MIH-TNI Index</u>	N = 136 teeth	Percentage
Score 1(teeth with MIH having no breakdown and hypersensitivity)	75	55.14%
Score 2(teeth with MIH having breakdown but no hypersensitivity)	10	7.35%
Score 3(teeth with hypersensitivity but no breakdown)	41	30.14%
Score 4(teeth with both hypersensitivity and breakdown)	10	7.35%
Total	136	100%

Table 9 shows that out of the 136 teeth examined, the largest number of teeth, 75 (55.14%), received a score of 1, meaning they had no breakdown or hypersensitivity. This was followed by 41 teeth (30.14%) which received a score of 3, indicating they had hypersensitivity but no breakdown. The smallest number of teeth, 10 received scores of 2 and 4, with breakdown and both hypersensitivity as well as breakdown, respectively.

Table 10: Distribution of teeth on the basis of treatment intervention

Intervention	N=136	%
Therapy A (use of fluoride toothpaste and CPP-ACP remineralizing agents (at home) and varnish application (in office))	54	39.70%
Therapy B (application of sealants and low viscosity GIC)	53	38.97%
Therapy C and D (short term and long-term restorations including SSC crown)	10	7.35%
Therapy E (extraction)	19	13.97%

Table 10 illustrates that out of the 136 affected, the most frequently required treatments were therapy A and therapy B, which were carried out on 39.70% and 38.97% of the teeth respectively. The next most common treatment was therapy E, performed on 13.97% of teeth. On the other hand, the least frequently required treatments were therapy C and therapy D, which were carried out on 7.35% of teeth in both groups, respectively.

Table 11: Archwise distribution of teeth according to molar incisor hypomineralisation

Arch	Score 1	Score 2	Score 3	Score 4	P value
Maxillary	32(23.52%)	4(2.94%)	17(12.5%)	4(2.94%)	0.032 (Sig)
Mandibular	43(31.61%)	6(4.41%)	24(17.64%)	6(4.41%)	

Based on maxillary and mandibular arches, scores of 1, 3 and 4 were higher in mandibular arch as compared to maxillary arch. The distribution of MIH was also higher in mandibular arch (58.08%) as compared to maxillary arch (41.91%) and difference between the arches was statistically significant (p-value = 0.032).

Table 12: Distribution of teeth according to maxillary and mandibular sextants and severity of molar incisor hypomineralisation

<u>Sextants</u>	MIH-TNI Index			
	Score 1	Score 2	Score 3	Score 4
Maxillary Right	0(0%)	4 (2.94%)	8 (5.88%)	3 (2.20%)
Maxillary Front	31 (22.79%)	0(0%)	7 (5.14%)	0(0%)
Maxillary Left	1 (0.73%)	0(0%)	2 (1.47%)	1 (0.73%)
Mandibular Right	24 (17.64%)	0(0%)	1 (0.73%)	0(0%)
Mandibular Front	17 (12.5%)	3 (2.20%)	9 (6.61%)	3 (2.20%)
Mandibular Left	2(1.47%)	3 (2.20%)	14 (10.29%)	3 (2.20%)

Table 12 illustrates that the overall prevalence of incisors (51.47%) was more than molars. (48.12%).

However, the prevalence of molar incisor hypomineralisation on the basis of sextants was highest in mandibular molars (34.55%) followed by maxillary incisors (27.94%), mandibular incisors (23.52%) and maxillary molars (13.97%). Mandibular and maxillary molars had higher levels of severity (scores 3 and 4), while lower levels of severity were m found in maxillary and mandibular incisors (scores 1 and 2).

Table 13: Extension of molar incisor hypomineralisation according to MIH-TNI index

N = 136 teeth	Less than 1/3 rd	1/3 rd to 2/3 rd	More than 2/3 rd
Extension	61(44.85%)	40(29.41%)	35(25.73%)

Table 13 depicts extent of molar incisor hypomineralization (MIH) was analysed using the MIH-TNI index. Among the total teeth examined with MIH, 25.73% had more than 2/3rds of the tooth surface affected by MIH, 29.41% had 1/3rd to 2/3rds of the surface affected and 44.85% had less than 1/3rd of the surface affected. Hence, it was concluded that the majority of teeth affected by MIH had less than one-third of their surface impacted.

Table 14: Interexaminer Agreement on the prevalence of molar incisor hypomineralisation

		Examiner 2		Kappa Agreement	P value
		MIH present	MIH absent		
Examiner 1	MIH present	41 (100.0%)	00(0.0%)	1.000 (Perfect Agreement)	0.001 (Sig)
	MIH absent	0(0%)	759(100.0%)		

Table 14 indicates that there was perfect inter examiner agreement between observer 1 and Observer 2 for the prevalence of MIH.

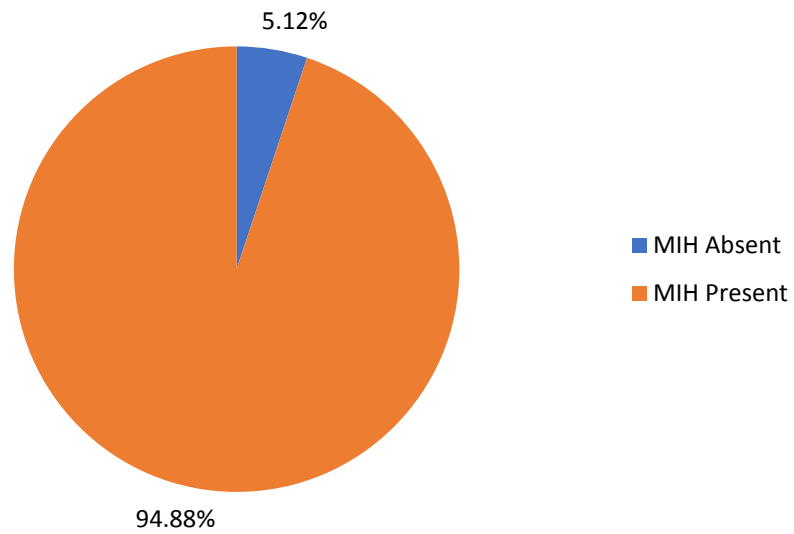
Table 15: Interexaminer Agreement in scoring severity of MIH

Examiner	Score 0	Score 1	Score 2	Score 3	Score 4	Interexaminer reliability coefficient	P value
Examiner 1	528(80.48%)	51(7.77%)	51(7.77%)	8(1.22%)	18(2.74%)	0.96 (Almost Perfect Agreement)	0.001 (Sig)
Examiner 2	521(79.41%)	56(8.54%)	52(7.93%)	8(1.22%)	19(2.90%)		

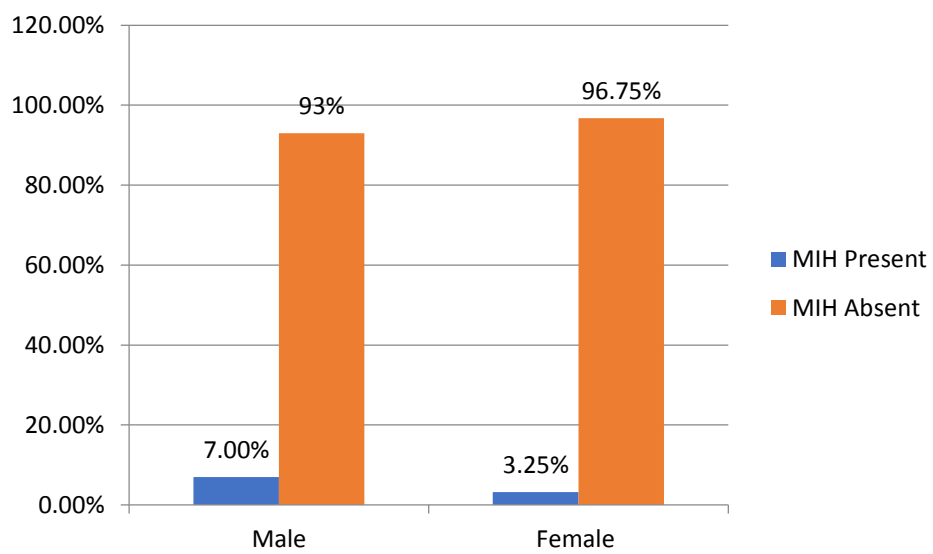
Table 15 shows that there was almost perfect agreement between examiner 1 and examiner 2 for the severity of MIH.

GRAPHS

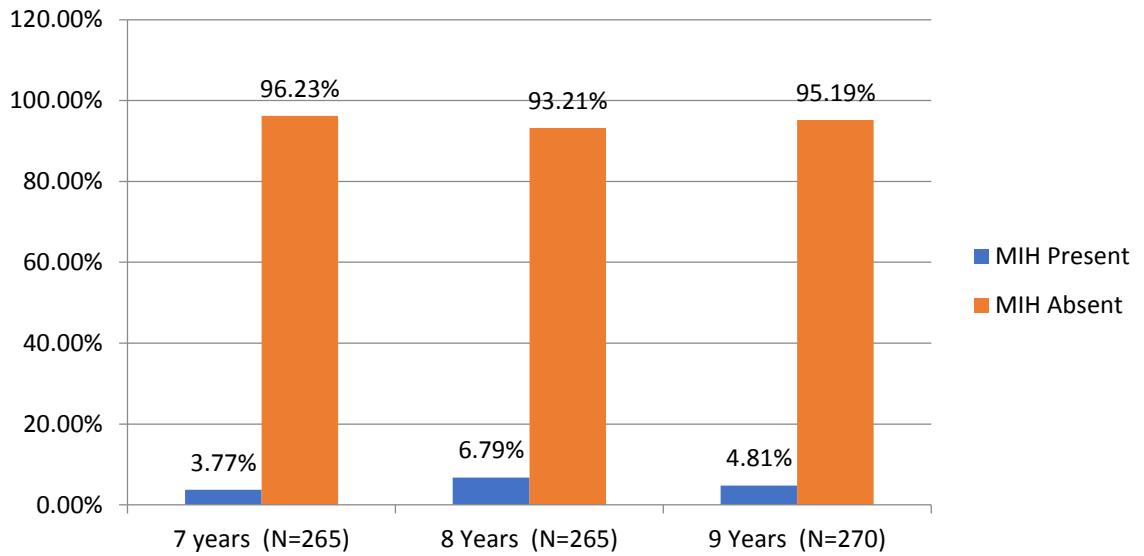
Graph 1: Prevalence of molar incisor hypomineralisation



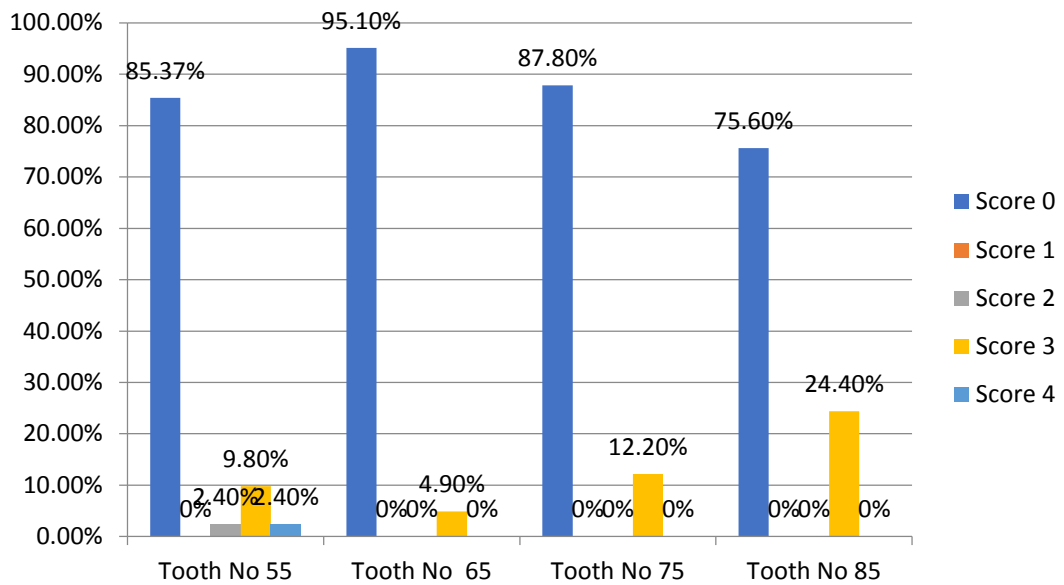
Graph 2: Gender-wise prevalence of molar incisor hypomineralisation



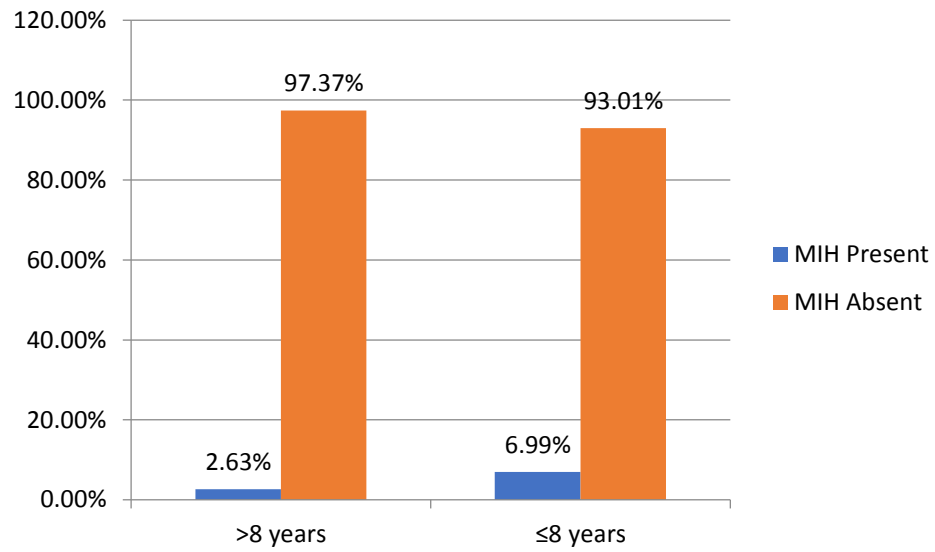
Graph 3: Age-wise prevalence of molar incisor hypomineralisation



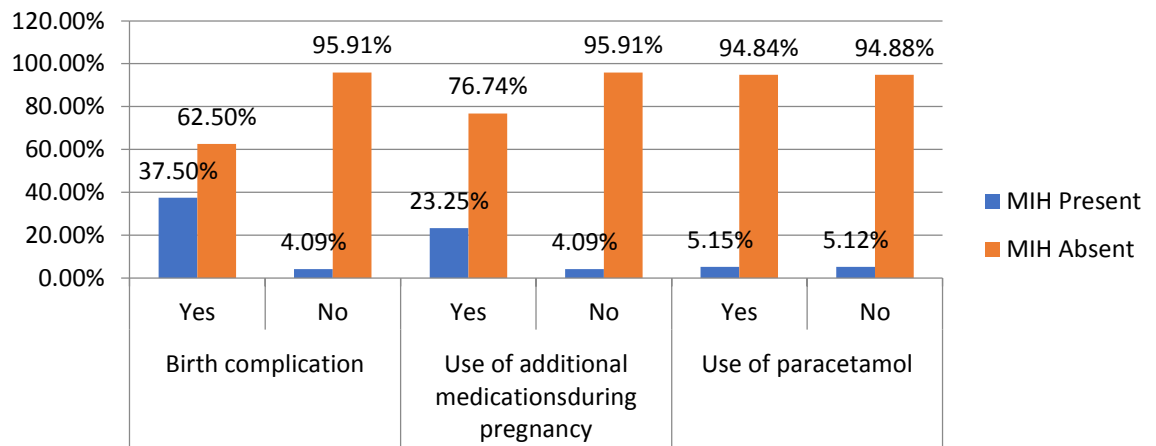
Graph 4: Prevalence of hypomineralised second primary molars



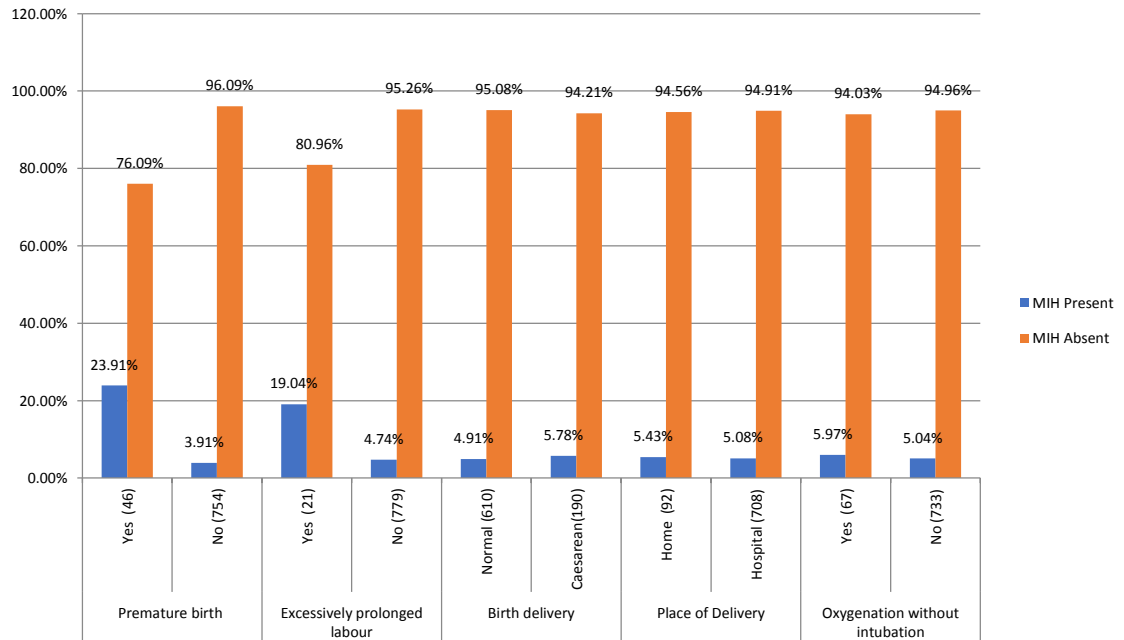
Graph 5: Prevalence of molar incisor hypomineralisation based on mother education



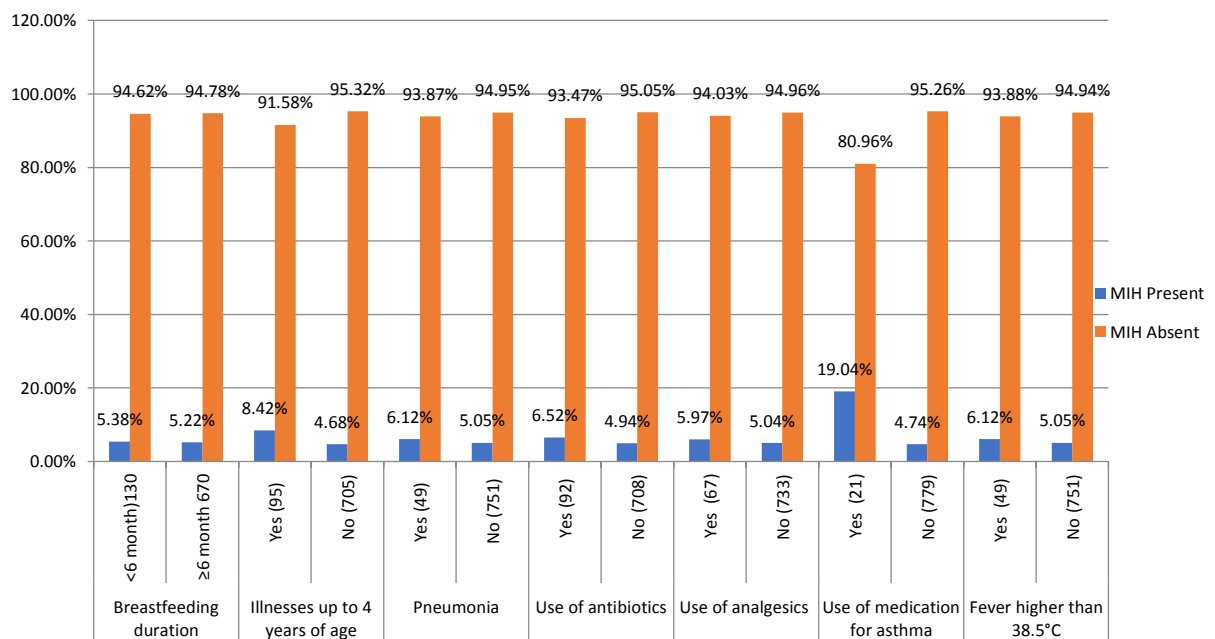
Graph 6: Prevalence of molar incisor hypomineralisation based on prenatal factors



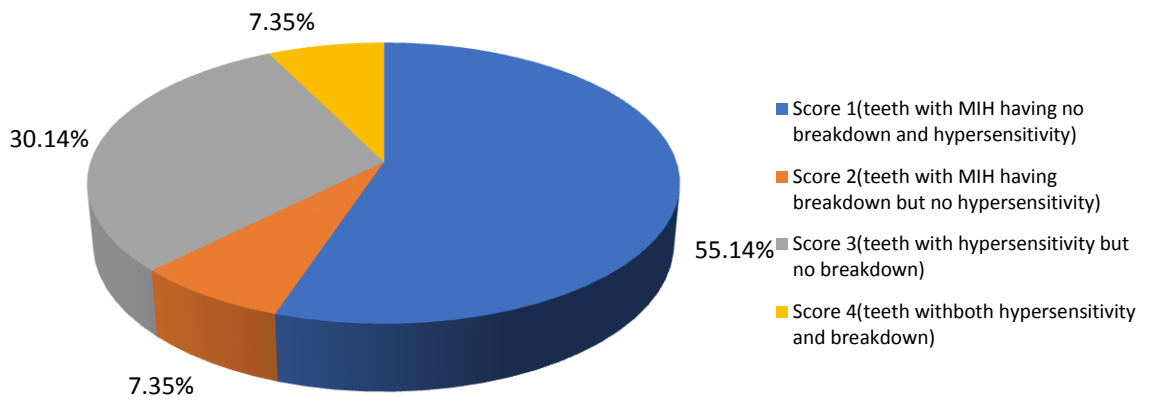
Graph 7: Prevalence of molar incisor hypomineralisation based on perinatal factors



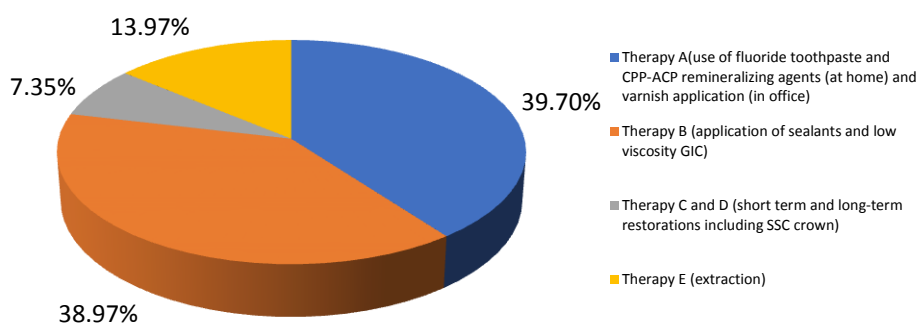
Graph 8: Prevalence of molar incisor hypomineralization based on postnatal factors



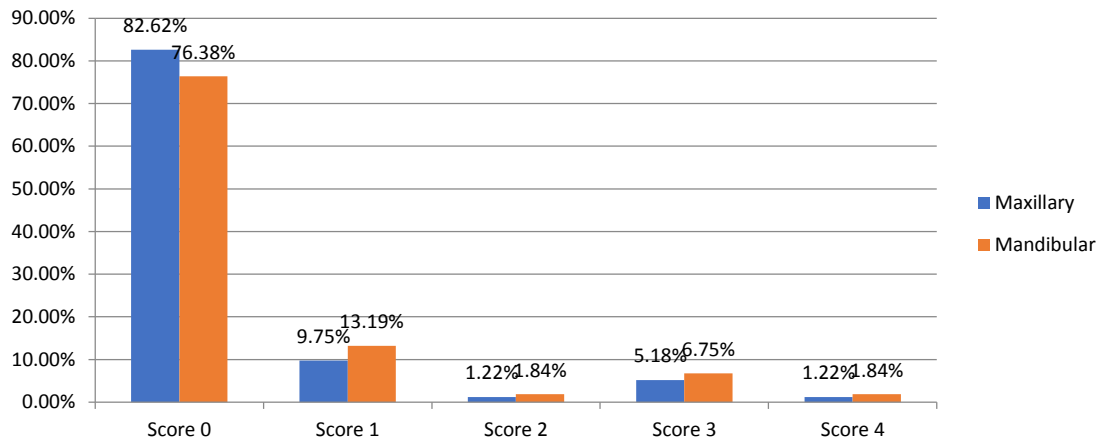
Graph 9: Distribution of teeth on the basis of severity of molar incisor hypomineralisation



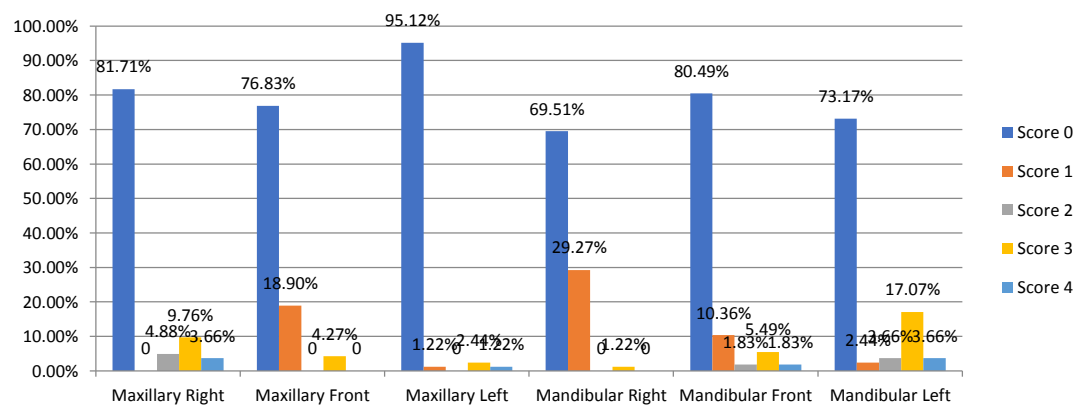
Graph 10: Distribution of teeth in subjects on the basis of treatment intervention



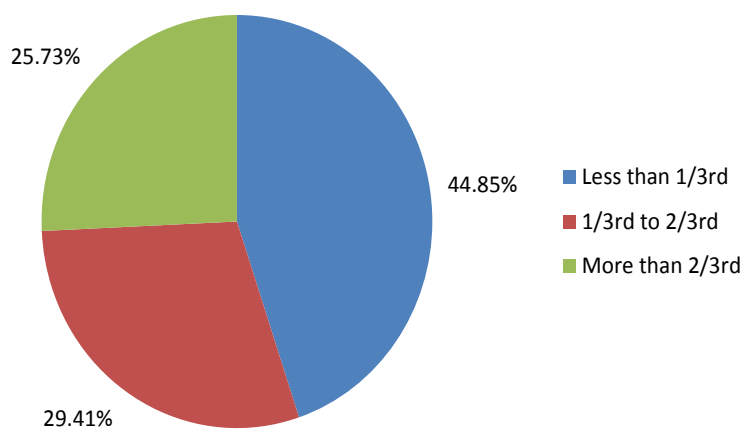
Graph 11: Archwise distribution of teeth according to molar incisor hypomineralisation



Graph 12: Severity of MIH In Maxillary and Mandibular Sextants based on total number of teeth examined in subjects affected by MIH



Graph 13: Extension of molar incisor hypomineralisation according to MIH-TNI index



DISCUSSION

This cross-sectional study was conducted to determine the prevalence, risk factors and treatment needs of molar incisor hypomineralization in children of Lucknow, in the Department of Paediatric and Preventive Dentistry, BBDCODS, BBDU, Lucknow.

MIH is the most common structural abnormality that dental practitioners encounter which can lead to significant damage if not detected and treated early. This anomaly in tooth enamel formation is becoming increasingly prevalent in developing as well as developed nations and has been on the rise over the past three decades. It can affect the overall health and quality of life of an individual. Prevalence studies are crucial for both patients and dental professionals to take effective measures to mitigate the impact of MIH. They also provide policymakers with a comprehensive understanding of the nature of this defect in a specific population, allowing for accurate diagnosis and predictions both for individuals and the population as a whole.

The European Academy has long acknowledged MIH as a widespread issue, and called for more research and knowledge to fully understand the defect. Additionally, the European Academy of Paediatric Dentistry (EAPD) has established specific criteria for evaluating MIH in 2003⁸³.

In this study, a diagnosis of MIH was given if a single first permanent molar was affected along with the permanent incisors. However, schoolchildren who only had opaque incisors were not diagnosed with MIH by definition, because it does not match the typical pattern of this type of enamel defect. This could lead to inaccuracies in diagnosis and estimates of prevalence¹.

The prevalence of MIH varies considerably across the world, primarily due to the inconsistent use of criteria and indices, which makes it challenging to compare data⁸². Several other countries have also reported a significant range in the prevalence of MIH, ranging from as low as 2.8% in Hong Kong⁸ to as high as 40.2% in Brazil^{51–52}.

The prevalence of MIH was reported to be 5.12% in the current study (**Table 1 and Graph 1**), which is comparable to studies done in Cairo, Egypt (2.3%)²⁶, China

(4.45%)⁸, and other regions of India (3.96% in Moradabad⁵⁰, 5.7% in Odisha³⁹, 4.2% in Jaipur¹¹, and 4.1% in Muvattupuzha⁴²). However, MIH is more prevalent in other parts of India (10.48% in Gautam Buddh Nagar⁵³, 9.46% in Udaipur¹⁹, 14.9% in Jammu⁵⁴, 8.9% in Devangere⁵⁵, and 9.7% in Chennai²²). The wide ranges in MIH prevalence may be attributed to variations in ethnicity, age groups, sample sizes, diagnostic criteria, and the presence of caries. In older children, the presence of caries and occlusal wear may alter the diagnosis of MIH. In the study, the prevalence of MIH was examined by the two calibrated examiner using The Wurzburg MIH Concept: MIH treatment need index (MIH-TNI) and perfect agreement was established between the two examiners to determine the presence or absence of MIH which is statistically significant. **(Table 14)**

The present study examined visible enamel defects larger than 1mm based on MIH-TNI criteria which supports the previous studies which have also included defects equal to or larger than 1mm, as recommended by the European Academy of Pediatric Dentistry in 2003⁸³.

The development of the second primary molars happens around the same time as the development of the first permanent molars and permanent incisors. However, the permanent teeth take longer to mature. If a risk factor occurs during this overlapping period, it could cause hypomineralization in both the primary and permanent teeth. As a result, defective development of tooth enamel can be used as an indicator of MIH⁸⁰⁻⁸¹. The fact that the second primary molar and the first permanent molar develop in parallel, both in terms of their development and location in the jaw, suggests that they may have a common cause for hypomineralization. Therefore, it is necessary to find out the prevalence in the hypomineralised second primary molars.

The present study discovered that the prevalence of hypomineralised second primary molars (HSPM) was 14.02%. **(Table 4 and Graph 4)** However, lower prevalence reported by Gambetta Tessini et al (2018)²⁸ was 8%, whereas Sidhu et al (2020)³⁰ reported 5.2%, Mittal N et al (2015)⁵³ concluded it to be 5.6%, and Figueiredo et al (2017)⁵⁷ found it to be 6.48%. In a recent systematic review and meta-analysis conducted by McCarra et al (2021)⁵⁸, a global prevalence of 6.8% among children and 4.1% among teeth was reported. The EAPD criteria⁸³ have been used in various

studies, and the prevalence rates for hypomineralised second primary molars have varied across different studies.

The European Academy of Pediatric Dentistry (EAPD) recommends diagnosing HSPM at 5 years old, and diagnosing MIH at 8 years old when most permanent incisors and primary molars are present⁸³. In this study, the age groups of children examined for MIH did not show a significant difference in prevalence (**Table 3 and Graph 3**), which is similar to a study in Sudan⁴⁹. However, other studies conducted in Udaipur¹², Riyadh⁵⁹, and Jordan⁶⁰ found that the prevalence of MIH increases with age, which contrasts with the results of this study. The higher prevalence of MIH observed in older children may be attributed to the fact that it is easier to detect and diagnose the condition when there is post-eruptive discoloration and breakdown. In mild cases, which may go unnoticed in younger children, these signs become more apparent as the child ages.

The current study found that the prevalence of MIH was higher in males compared to females (**Table 2 and Graph 2**), which aligns with the results of studies conducted in Iraq by Ghanim et al (2011)⁶¹, in Iran by Ahmadi R et al (2012)⁶² and in Ghaziabad by Rai A et al (2018)¹³. However, this finding is in contrast to studies in Jordan by Zawaideh FI et al (2011)⁶⁰ and Jammu by Anjum K et al (2015)⁵⁴ which showed a higher prevalence of MIH in females, which was attributed to the fact that during the growing years females are more advanced than males in dental development, affecting their first permanent molars.

The present study found a higher incidence of MIH in mandibular teeth compared to maxillary teeth (**Table 11 and Graph 11**), which is comparable with the results of Jasulaityte et al. (2007)⁶³, Zawaideh et al. (2011)⁶⁰ and Padavala et al (2018)¹. Higher prevalence in mandibular arch may be due to the early eruption of mandibular teeth than maxillary which resulted in earlier recognition of the defect. However, this contradicts the findings of other studies, such as Weerheijm et al. (2001)⁶, Cho et al. (2008)⁸, and Chawla et al. (2008)⁶⁴, which reported negligible difference between upper and lower teeth.

In the current study, majority of the teeth (75 teeth or 55.14%) that were examined received a score of 1, which meant they had no hypersensitivity or breakdown. The second largest group consisted of 41 teeth (30.14%) that received a score of 3, which

indicated that they had hypersensitivity, but no breakdown. A smaller number of teeth (10 in total) received scores of 2 and 4, which indicated breakdown and both hypersensitivity as well as breakdown, respectively. Most of the teeth had extension less than one third of the enamel surface (44.85%). **(Table 9 and Table 13) (Graph 9 and Graph 13)**. The severity of the defect in this study was determined by The Wurzburg MIH Concept: MIH treatment need index (MIH-TNI). This is different to the studies conducted by Parikh et al (2012)¹⁶, Kevrekidou et al. (2015)⁶⁵, Mejia et al. (2019)³⁴, Silva et al. (2020)⁶⁶, in which the severity of MIH was detected by criteria given by Lygidakis et al. (2010)⁶⁷. According to Lygidakis et al. (2010), severity is recorded as mild or severe. In mild cases there are demarcated enamel opacities without enamel breakdown, occasional sensitivity to external stimuli, i.e., air/water but not brushing and only mild aesthetic concerns on discolouration of the incisors. In severe cases there are demarcated enamel opacities with breakdown, caries, persistent/spontaneous hypersensitivity affecting function, i.e., during brushing and finally strong aesthetic concerns that may have socio-psychological impact. In the study by Parikh et al (2012)¹⁶, the majority of the defects were mild using Lygidakis et al. (2010)⁶⁷. In a study by Silva et al. (2020)⁶⁶, the most frequent defects were also mild using the same criteria. In the present study, the severity and the extension of the MIH was demarcated opacities with less than one third of the tooth surface as the most prevalent defect without any hypersensitivity and breakdown. The severity of scoring the teeth according to MIH-TNI index was done by two calibrated examiners in the study which showed almost perfect agreement (0.96) in the inter examiner reliability **(Table 15)**.

A study done by Abdalla HE et al (2021)⁴⁹ showed the distribution of severity in the occurrence of molar incisor hypomineralization with mandibular molars more affected than the maxillary molars and maxillary incisors more affected than mandibular incisors. This distribution pattern of MIH is consistent with our current study in which the occurrence of molar incisor hypomineralization was most frequent in mandibular molars (28.65%) followed by maxillary incisors (23.10%), mandibular incisors (19.50%) and maxillary molars (11.50%). The lower and upper molars showed more severe cases with scores of 3 and 4, while less severe cases were more common in the upper and lower incisors, with scores of 1 and 2 **(Table 12 and Graph 12)**.

In a study by Villanueva-Gutiérrez T et al (2019)⁶⁸, there was association between maternal education and molar incisor hypomineralization which is contradictory to the findings of the present study which showed that the occurrence of molar incisor hypomineralization was related to the education of the mother but it was not statistically significant (**Table 5 and Graph 5**). This may be due to mothers with higher levels of education may have higher incomes, which can give them better access to preventative oral care methods like toothpaste, toothbrushes, and mouthwashes, as well as more opportunities to receive preventative dental care from professionals⁸⁴. Mothers who have lower levels of education are more likely to have an unhealthy diet, which may include consuming a higher amount of fermentable carbohydrates.

There is little evidence of an association between the most frequently investigated prenatal factors and MIH. There was considerable variability in the terms used to describe maternal illness during pregnancy, with some specific to pregnancy-related disease and others reporting more broadly in terms of maternal illness. Enamel defects in primary teeth and permanent first molars are believed to be significantly influenced by factors during the prenatal period. The potential contributing factors include extended maternal illnesses such as viral infections, hypertension, diabetes, renal insufficiency, vomiting, and malnutrition, as well as the medication taken during this period.

In the present study, the prenatal factors included were birth complications, additional medications during pregnancy and use of paracetamol. Individuals who experienced birth complications had a higher incidence of MIH, with 37.5% being affected. This is similar to the study done by Jimenez et al (2014)⁸⁶ in which they had found a significant relation between MIH and complications during pregnancy.

Maternal medication use was investigated by Whatling R et al (2008)⁶⁹, Ghanim A et al (2013)⁷⁰ and Durmus B et al (2013)⁷¹ and they found that there was no possible association with medications during prenatal period which was in contrast to the present study showing significant relation in medications taken during pregnancy and MIH. In the current study, use of paracetamol during pregnancy was also studied and no association was found similar to a study by Tourino LF et al. (2016)²³ (**Table 6 and Graph 6**).

In the perinatal period different medical conditions alone or in combination may affect the welfare of a child. Medical problems related to birth, such as mode of delivery, prematurity, respiratory distress and excessively prolonged duration of birth had been associated with MIH or opacities in molars and incisors. The perinatal factors included in the present study were premature birth, excessively prolonged labour, type of birth delivery, place of delivery and oxygenation without intubation. The results showed that there was the highest prevalence in subjects whose mother had experienced premature birth (23.91%). In a study by Noor Mohamed R et al (2021)⁸⁷, premature children presented with significantly higher frequency of MIH which is similar to present study. There was significant association found between MIH and excessively prolonged labor similar to a study by Rai A et al (2018)¹³. Garot E et al (2016)⁸⁸ investigated the association of peripartum events with the occurrence of MIH and found significant association between Caesarean delivery and MIH which is similar to our study. Tourino LF et al. (2016) studied the relation of perinatal factor, oxygenation without intubation at birth with MIH and found it to be strongly associated with the occurrence of MIH whereas in our study there was no association found between them (**Table 7 and Graph 7**).

There was significant association found between MIH and medications taken by asthmatic children in the current study (**Table 8 and Graph 8**). There may be several potential reasons for this, such as the asthma disease itself, the extent of its severity, or it may be due to the effect of corticosteroids, or a combination of both b2-agonists and corticosteroids which interferes with the amelogenesis process. The development of enamel in the first permanent molars occurs in the latter stages of pregnancy and the initial three years after birth. Therefore, it is presumed that this timeframe is when the enamel of the first permanent molar is at highest risk of systemic exposure. However, in a study using a Danish medication prescription database, Wogelius et al. (2010)⁷⁸ found that asthma medication was not associated with MIH.

During the early stages of life, there are several diseases that are prevalent, such as asthma, otitis media, tonsillitis, chicken pox, measles, and rubella. These illnesses have the potential to cause MIH (molar incisor hypomineralization). In the present study, association between postnatal illnesses upto 4 years of age and MIH was studied and no significant relation was found which is different from study by Thakur H et al (2020)⁸⁹ where postnatal illnesses were strongly linked with MIH.

Antibiotics often play a role in the demineralisation of enamel causing MIH as they hamper in the process of amelogenesis during the early years of life. In our current study, no association was found between use of antibiotics and MIH. However, in a study by Ess A et al (2008)⁹⁰, they found that among all the antibiotics taken during childhood illnesses amoxicillin was most significant in causing MIH.

There was no significant association found between duration of breastfeeding milk and MIH in the present study similar to the studies by Jälevik et al. (2001)⁶ and Whatling et al (2008)⁶⁹. However, in a study conducted in Finland by Alaluusua S et al⁸⁵, MIH (molar incisor hypomineralization) was observed in children with long duration of breast feeding. The authors of the study speculated that pollutants present in human milk could be a contributing factor, but they did not measure the levels of pollutants, such as dioxins, in the milk. Therefore, the exact role of pollutants in causing MIH remained uncertain.

The symptom of fever associated with infectious childhood illnesses makes it difficult to determine its specific impact. The current study found no relationship between fever and MIH (**Table 8 and Graph 8**). However, in a study using turpentine as an exogenous pyrogen, Tung et al. (2006)⁹¹ showed that a high fever could cause enamel hypomineralization in rat incisors. The test rats had a fever that lasted for 57 hours, resulting in a temperature increase of 1.5°C compared to the control group. After 5 days, micro radiographs showed a radiolucent line along the incremental line, indicating that high fever had a negative effect on enamel formation. The occurrence of fever is caused by the communication between the immune system in the peripheral regions of the body and the brain. When the body comes into contact with a pathogen or is exposed to an inflammatory agent, immune cells like macrophages get activated and start to release cytokines.

The MIH-TNI determines a treatment plan for each individual case of MIH. The options range from preventive measures like prophylaxis and sealing, to restorative treatments like temporary or permanent restoration, and extraction. The appropriateness of each treatment depends on the specific symptoms of MIH in each case. The ultimate goal is to prevent tooth decay, reduce enamel loss, restore the form and function of the tooth in cases of enamel loss, and address any aesthetic concerns. These treatments are generally implemented in a step-by-step manner. In

the present study, out of all subjects with MIH, the most frequently required treatments were use of fluoride toothpastes, CPP-ACP remineralizing agents (at home), varnish application (in office) and application of sealants and low viscosity GIC. On the other hand, the least frequently required treatments were short term and long-term restorations including composite restorations, SSC crown and extractions **(Table 10 and Graph 10)**.

In the present study, as the most prevalent MIH defect was demarcated opacities without any breakdown or hypersensitivity, minimal intervention and non-invasive procedures with prophylaxis followed by use of fluoride toothpastes and remineralising agents were enough to treat them. According to a systematic review by K. Elhennawy and colleagues (2016)⁷⁹, the most commonly recommended treatment approach for managing molar incisor hypomineralization was to use desensitizing agents (CPP-ACP) followed by applying sealants, composite restorations, or crowns which also supports our current study. The least recommended option was extraction. **(Table 10 and Graph 10)**

This study has some strengths and weaknesses. One weakness is the study design, which is a cross-sectional study. This type of study does not assess the effect over time, but only measures it at a specific moment in the participant's life. It is not feasible to extend the findings of this study to the entire population of children in the Lucknow city as a whole. Further studies are required to examine the potential causes and the risk of developing MIH. Secondly, it does not take into account all the faces of teeth examined for MIH.

One of the major strengths of this study is it gives a perspective for the early diagnosis, intervention and management of MIH for the dental practitioners. The treatment protocols as per the severity of MIH can be easily identified with the help of this study.

CONCLUSIONS

The present cross-sectional study was conducted in the Department of Pediatric and Preventive Dentistry, Babu Banarasi Das College of Dental Sciences (BBDCODS), Babu Banarasi Das University, Lucknow.

On the basis of observations made during the course of the study, following conclusions were drawn:

- The overall prevalence of MIH in 7 to 9 years old children of Lucknow was 5.12% with a higher prevalence in males (7 %) than in females (3.25%).
- The overall prevalence of hypomineralised second primary molars (HSPM) was 14.02% in 7 to 9 years old children of Lucknow.
- Mandibular arch showed a higher prevalence compared to maxillary arch.
- Permanent mandibular molars were most affected teeth followed by permanent maxillary incisors and permanent mandibular incisors. and least in the permanent maxillary molars.
- Perinatal factors such as premature birth, prolonged labour, and delivery via caesarean section had a greater impact in the development of MIH compared to postnatal and prenatal factors.
- The majority of teeth affected by MIH exhibited hypersensitivity with involvement of less than one third of the tooth surface. In most cases, non-invasive treatments such as the application of fluoride varnish, fluoride-containing toothpastes, remineralizing agents containing CPP-ACP, and sealants, were sufficient enough for managing the condition.

Detecting demarcated opacities of the enamel on second primary molars can help predict an increased risk of MIH and allow for early intervention to prevent tissue damage and sensitivity. By identifying children at risk for MIH and providing them with appropriate information and preventive care, it is possible to reduce the negative impact of enamel defects. This emphasizes the importance of early detection and management of MIH to prevent further complications.

Therefore, increasing awareness about MIH can aid in taking preventative and therapeutic measures to address this concerning development disturbance of the teeth.

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ANNEXURE-I

**Institutional Research
Committee Approval**

**Babu Banarasi Das University
Babu Banarasi Das College of Dental Sciences,
BBD City, Faizabad Road, Lucknow – 226028 (INDIA)**

Dr. Lakshmi Bala
Professor and Head Biochemistry and
Member-Secretary, Institutional Ethics Committee

Communication of the Decision of the IXth Institutional Ethics Sub-Committee

IEC Code: 15

BBDCODS/04/2022

Title of the Project: Molar Incisor Hypomineralisation: Prevalence, Risk Factors and Treatment Needs in Children of Lucknow City.

Principal Investigator: Dr Akash Roy Chowdhury **Department:** Pediatric and Preventive Dentistry

Name and Address of the Institution: BBD College of Dental Sciences Lucknow.

Type of Submission: New, MDS Project Protocol

Dear Dr Akash Roy Chowdhury,

The Institutional Ethics Sub-Committee meeting comprising following four members was held on 07th April, 2022.

- | | | |
|----|--------------------------------------|--|
| 1. | Dr. Lakshmi Bala
Member Secretary | Prof. and Head, Department of Biochemistry, BBDCODS,
Lucknow |
| 2. | Dr. Amrit Tandan
Member | Prof. & Head, Department of Prosthodontics and Crown &
Bridge, BBDCODS, Lucknow |
| 3. | Dr. Rana Pratap Maurya
Member | Reader, Department of Orthodontics, BBDCODS, Lucknow |
| 4. | Dr. Akanksha Bhatt
Member | Reader, Department of Conservative Dentistry & Endodontics,
BBDCODS, Lucknow |

The committee reviewed and discussed your submitted documents of the current MDS Project Protocol in the meeting.

The comments were communicated to PI thereafter it was revised.

Decisions: The committee approved the above protocol from ethics point of view.

Forwarded by:

Lakshmi Bala

(Dr. Lakshmi Bala)
Member-Secretary
IEC

Member-Secretary
Institutional Ethic Committee
BBD College of Dental Sciences
BBD University
Faizabad Road, Lucknow-226028

Puneet Ahuja

(Dr. Puneet Ahuja)
Principal
PRINCIPAL
BBDCODS

Babu Banarasi Das College of Dental Sciences
(Babu Banarasi Das University)
BBD City, Faizabad Road, Lucknow-226028

ANNEXURE-II

**Institutional Ethical
Committee Approval**

**BABU BANARASI DAS COLLEGE OF DENTAL SCIENCES
(FACULTY OF BBD UNIVERSITY), LUCKNOW**

INSTITUTIONAL RESEARCH COMMITTEE APPROVAL

The project titled “Molar Incisor Hypomineralisation: Prevalence, Risk Factors and Treatment Needs in Children of Lucknow City” submitted by **Dr Akash Roy Chowdhury** Post graduate student from the **Department of Pediatric and Preventive Dentistry** as part of MDS Curriculum for the academic year 2020-2023 with the accompanying proforma was reviewed by the Institutional Research Committee present on **12th October 2021** at BBDCODS.

The Committee has granted approval on the scientific content of the project. The proposal may now be reviewed by the Institutional Ethics Committee for granting ethical approval.

Prof. Vandana A Pant
Co-Chairperson

Prof. B. Rajkumar
Chairperson

ANNEXURE-III

Babu Banarasi Das College of Dental Sciences

(Babu Banarasi Das University)

BBD City, Faizabad Road, Lucknow – 227105 (INDIA)

Consent Form (English)

Title of the Study- " MOLAR INCISOR HYPOMINERALISATION: PREVALENCE, RISK FACTORS AND TREATMENT NEEDS IN CHILDREN OF LUCKNOW CITY"

Study Number.....

Subject's Full Name.....

Date of Birth/Age

Address of the Subject.....

Phone no. and e-mail address.....

Qualification

Occupation: Student / Self Employed / Service /

Housewife/Other (Please tick as appropriate)

Annual income of the Subject.....

Name and of the nominees(s) and his relation to the subject.....(For the purpose of compensation in case of trial related death).

1. I confirm that I have read and understood the Participant Information Document datedfor the above study and have had the opportunity to ask questions. **OR** I have been explained the nature of the study by the Investigator and had the opportunity to ask questions.
2. I understand that my participation in the study is voluntary and given with free will without any duress and that I am free to withdraw at any time, without giving any reason and without my medical care or legal rights being affected.
3. I understand that the sponsor of the project, others working on the Sponsor's behalf, the Ethics Committee and the regulatory authorities will not need my permission to look at my health records both in respect of the current study and any further research that may be conducted in relation to it, even if I withdraw from the trial. However, I understand that my Identity will not be revealed in any information released to third parties or published.
4. I agree not to restrict the use of any data or results that arise from this study provided such a use is only for scientific purpose(s).
5. I permit the use of stored sample (tooth/tissue/blood) for future research. **Yes** **No**

Not Applicable

I agree to participate in the above study. I have been explained about the complications and side effects, if any, and have fully understood them. I have also read and understood the participant/volunteer's Information document given to me.

Signature (or Thumb impression) of the Subject/Legally

Acceptable Representative:.....

Signatory's Name.....

Date

Signature of the Investigator.....

Date.....

Study Investigator's Name.....

Date.....

Signature of the witness.....

Date.....

Name of the witness.....

Received a signed copy of the PID and duly filled consent form Signature/thumb impression
of the subject or legally acceptable representative Date.....

ANNEXURE-IV

बाबू बनारसी दास कॉलेज ऑफ डेंटल साइंसेज

(बाबू बनारसी दास विश्वविद्यालय)

बीबीडी सिटी, फैजाबाद रोड, लखनऊ - 227105 (भारत)

प्रतिभागी के लिए सूचना पत्र

1. अध्ययन शीर्षक

मोलर इंसिडर हाइपोमिनरलाइजेशन: लखनऊ शहर के बच्चों में व्यापकता, जोखिम कारक और उपचार की जरूरतें।

2. निमंत्रण अनुच्छेद

आपको एक शोध अध्ययन में भाग लेने के लिए आमंत्रित किया जा रहा है। इसलिए, आपके लिए यह समझना महत्वपूर्ण है कि शोध क्यों किया जा रहा है और इसमें क्या शामिल होगा। कृपया निम्नलिखित जानकारी को ध्यान से पढ़ने के लिए समय निकालें। हमसे कोई स्पष्टीकरण या अधिक जानकारी के लिए पूछें। आप हिस्सा लेना चाहते हैं या नहीं यह आपका निर्णय है।

3. अध्ययन का उद्देश्य क्या है?

इस अध्ययन का उद्देश्य लखनऊ के बच्चों में मोलर इंसिडर हाइपोमिनरलाइजेशन की व्यापकता, जोखिम कारक और उपचार की जरूरतों को निर्धारित करना है।

4. मुझे क्यों चुना गया है?

प्रतिभागियों को लखनऊ की आबादी का प्रतिनिधित्व करने के लिए चुना गया है। केवल 7 से 9 वर्ष की आयु के किसी भी लिंग के स्वस्थ बच्चे, सभी स्थायी प्रथम दाढ़, स्थायी कृन्तक और मौखिक गुहा में मौजूद दूसरे प्राथमिक दाढ़ के साथ और जिनके माता-पिता स्वेच्छा से लिखित रूप में सहमति प्रस्तुत करते हैं, अध्ययन में शामिल हैं।

5. क्या मुझे भाग लेना है?

शोध में आपकी भागीदारी पूरी तरह से स्वैच्छिक है। यदि आप ऐसा करते हैं, तो आपको यह सूचना पत्रक रखने के लिए दिया जाएगा और सहमति प्रपत्र पर हस्ताक्षर करने के लिए कहा जाएगा। अध्ययन के दौरान आप किसी भी समय और बिना कोई कारण बताए वापस लेने के लिए स्वतंत्र हैं।

6. अगर मैं भाग लूंगा तो मेरा क्या होगा?

अध्ययन घटना के बारे में जागरूकता पैदा करेगा और दांतों की सड़न को रोकने के लिए MIH के संबंधित जोखिम कारक महत्वपूर्ण हैं। रोगियों में रोग की घटना और गंभीरता की पहचान की जाएगी और उचित उपचार के लिए पेडोडॉण्टिक्स विभाग बीबीडीसीओडी को भेजा जाएगा।

7. मुझे क्या करना है?

अध्ययन में एमआईएच और एचएसपीएम की उपस्थिति के लिए बच्चों की जांच की आवश्यकता है। प्रतिभागियों को बच्चों के माता-पिता को भेजे जाने वाले प्रश्नावली के साथ अध्ययन के उद्देश्यों और लाभों के बारे में बताते हुए सहमति पत्र दिया जाएगा। माता-पिता जो अपने बच्चों की भागीदारी के लिए सहमत हैं, उन्हें प्रश्नावली भरने के लिए कहा जाएगा। प्रश्नावली में जनसांख्यिकीय और सामाजिक आर्थिक स्थिति के बारे में जानकारी शामिल है, साथ ही साथ दाढ़ कृन्तक हाइपोमिनरलाइजेशन के जोखिम कारकों पर प्रश्न, जैसे कि जन्म के पूर्व, प्रसवकालीन और प्रसव के बाद के जीवन के तीन साल तक के इतिहास।

8. वह प्रक्रिया क्या है जिसका परीक्षण किया जा रहा है?

लखनऊ शहर के 7 से 9 साल के बच्चों में मोलर इंसीजर हाइपोमिनरलाइजेशन और हाइपोमिनरलाइज्ड सेकेंड प्राइमरी मोलर्स की व्यापकता का आकलन करने के लिए अध्ययन किया जाएगा।

9. अध्ययन के लिए हस्तक्षेप क्या हैं?

अध्ययन के लिए कोई हस्तक्षेप नहीं होगा।

10. भाग लेने के दुष्प्रभाव क्या हैं?

चूंकि यह एक प्रचलन अध्ययन है, इसलिए भाग लेने के कोई दुष्प्रभाव नहीं होंगे।

11. भाग लेने के संभावित नुकसान और जोखिम क्या हैं?

प्रतिभागियों के लिए ऐसा कोई नुकसान नहीं है।

12. भाग लेने के संभावित लाभ क्या हैं?

अध्ययन एमआईएच और एचएसपीएम की घटना और संबंधित जोखिम कारकों के बारे में जागरूकता पैदा करेगा जो आगे दांतों की सड़न को रोकने के लिए महत्वपूर्ण है। प्रतिभागियों की जांच की जाएगी और बीमारी की गंभीरता की पहचान की जाएगी। इलाज का खर्चा पीडोडोंटिक्स विभाग, बीबीडीसीओडीएस, लखनऊ द्वारा वहन किया जाएगा।

13. यदि नई जानकारी उपलब्ध हो जाए तो क्या होगा?

यदि प्रतिभागियों को अनुसंधान कार्य के बारे में कोई नई जानकारी उपलब्ध हो जाती है, तो उन्हें सूचित किया जाएगा। यदि प्रतिभागी वापस लेना चाहते हैं, तो निकासी की व्यवस्था की जाएगी। यदि वे अध्ययन में जारी रखने का निर्णय लेते हैं, तो प्रतिभागियों को एक अद्यतन सहमति प्रपत्र दिया जाएगा। नई जानकारी को बिरादरी के साथ वैज्ञानिक रूप से संवाद किया जाएगा।

14. जब शोध अध्ययन रुक जाता है तो क्या होता है?

प्रतिभागियों को कुछ नहीं होगा।

15. अगर कुछ गलत हो जाए तो क्या होगा?

समस्याओं / शिकायत को HOD या IRC द्वारा नियंत्रित किया जाएगा। अगर कुछ गंभीर होता है, तो संस्थान समस्याओं का ध्यान रखेगा।

16. क्या इस अध्ययन में भाग लेने को गोपनीय रखा जाएगा?

अनुसंधान के दौरान आपके बारे में एकत्र की गई सभी जानकारी को कड़ाई से गोपनीय रखा जाएगा। कोई भी जानकारी जो प्रयोगशाला को छोड़ देती है, आपका नाम और पता हटा दिया जाएगा ताकि आपको उससे पहचाना न जा सके।

17. शोध अध्ययन के परिणामों का क्या होगा?

प्रतिभागियों को परिणामों के बारे में सूचित किया जाएगा। उनकी पहचान किसी रिपोर्ट / प्रकाशन में नहीं की जाएगी।

18. अनुसंधान का आयोजन कौन कर रहा है?

शोध पेडोडिक्स एंड प्रीवेंटिव डेंटिस्ट्री विभाग, बाबू बनारसी दास कॉलेज ऑफ डेंटल साइंसेज में किया गया है। अनुसंधान स्व-आधारित है। प्रतिभागियों को कुछ भी भुगतान करने की आवश्यकता नहीं है।

19. क्या अध्ययन के परिणाम अध्ययन के बाद उपलब्ध कराए जाएंगे?

एक बार अध्ययन समाप्त होने के बाद यह निर्णय लिया जाएगा।

20. अध्ययन की समीक्षा किसने की?

संस्था के एचओडी और आईआरसी / आईईसी के सदस्यों ने अध्ययन की समीक्षा और अनुमोदन किया है।

21. अधिक जानकारी के लिए संपर्क करें

पीआई का नाम- डॉ आकाश रॉय चौधरी

पता- बाल रोग और निवारक दंत चिकित्सा विभाग

बाबू बनारसी कॉलेज ऑफ डेंटल साइंसेज।

लखनऊ-227105

ई-मेल पता- roychowdhuryakash2014@gmail.com

टेलीफोन नंबर 7389185205

डॉ लक्ष्मी बाला

संस्था की आचार समिति के सदस्य सचिव,

बाबू बनारसी कॉलेज ऑफ डेंटल साइंसेज।

लखनऊ

अध्ययन के दौरान दस्तावेजों और साझेदारी के लिए आपका समय निकालने के लिए धन्यवाद।

प्रमुख अन्वेषक के हस्ताक्षर

नाम

दिनांक.....

ANNEXURE-V

Babu Banarasi Das College of Dental Sciences

(Babu Banarasi Das University)

BBD City, Faizabad Road, Lucknow – 227105 (INDIA)

PARTICIPANT INFORMATION DOCUMENT

1. Study Title

Molar incisor hypomineralisation: Prevalence, risk factors and treatment needs in children of Lucknow city.

2. Invitation Paragraph

You are being invited to take part in a research study. Before you decide it is important for you to understand why the study is being done and what it will involve. Please take time to read the following information carefully and discuss it with friends, relatives and your treating physician/family doctor if you wish. Ask us for any clarifications or further information. Whether or not you wish to take part is your decision.

3. What is the purpose of the study?

This study aims to determine prevalence, risk factors and treatment needs of molar incisor hypomineralization in children of Lucknow.

4. Why have I been chosen?

The participants have been chosen to represent Lucknow population. Only healthy children of either gender in the age group 7 to 9 years old with all permanent first molars, permanent incisors and second primary molars present in oral cavity and whose parents willingly submit the consent in writing, are included in the study..

5. Do I have to take part?

Your participation in the research is entirely voluntary. If you do, you will be given this information sheet to keep and will be asked to sign a consent form. During the study you are still free to withdraw at any time and without giving a reason.

6. What will happen to me if I take part?

The study will create awareness about occurrence and associated risk factors of MIH is important to prevent further tooth decay. The occurrence and severity of the disease will be identified in the patients and referred to the department of Pedodontics BBDCODS for proper treatment.

7. What do I have to do?

The study requires examination of children for the presence of MIH and HSPM. The participants will be given consent letter explaining the aims and benefits of the study along with questionnaires that will be sent to the parents of the children. Parents who agree for the participation of their children will be asked to fill the questionnaire. The questionnaire includes information regarding demographic and socioeconomic status, as well as questions on risk factors for molar incisor hypomineralization, such as prenatal, perinatal, and postnatal history up to three years of life.

8. What is the procedure that is being tested?

The study will be carried out to assess the prevalence of molar incisor hypomineralization and hypomineralised second primary molars in 7 to 9 years old children of Lucknow City.

9. What are the interventions for the study?

Depending upon the severity, minimal invasive procedures(SDF, Resin based sealants and fillings and crowns) will be done on the respective patients.

10. What are the side effects of taking part?

Since it is a prevalence study, so there will be no side effects of taking part.

11. What are the possible disadvantages and risks of taking part?

No such disadvantages are there for the participants.

12. What are the possible benefits of taking part?

The study will create awareness about occurrence and associated risk factors of MIH and HSPM which is important to prevent further tooth decay. The participants will be screened and the severity of the disease will be identified. The treatment cost will be borne by the department of Pedodontics, BBDCODS, Lucknow.

13. What if new information becomes available?

The participants will be informed if any new information becomes available about the research work. If the participants would like to withdraw, then arrangements for withdrawal will be done. An updated consent form will be given to the participants if they decide to continue in the study. The new information will be scientifically communicated with the fraternity.

14. What happens when the research study stops?

Nothing will happen to the participants.

15. What if something goes wrong?

The problems/complaint will be handled by the HOD or the IRC. If something serious happens the institute will take care of the problems.

16. Will my taking part in this study be kept confidential?

All information collected about you during the course of the research will be kept strictly confidential. Any information which leaves the laboratory will have your name and address removed so that you cannot be recognized from it.

17. What will happen to the results of the research study?

The participants will be informed about the results. They will not be identified in any report/publication.

18. Who is organizing the research?

The research is been done in the DEPARTMENT OF PEDODONTICS AND PREVENTIVE DENTISTRY, BBDCODS. The research is self -funded. Participants do not need to pay anything.

19. Will the results of the study be made available after study is over?

This will be decided once the study is over.

20. Who has reviewed the study?

The HOD and the members of IRC/ IEC of the institution has reviewed and approved the study.

21. Contact for further information

Dr. Akash Roy Chowdhury

Department of Pediatric and Preventive Dentistry

Babu Banarasi College of Dental Sciences.

Lucknow-227105

Mob- 7389185205

Dr. Laxmi Bala

Member Secretary of Ethics Committee of the institution,

Babu Banarasi College of Dental Sciences.

Lucknow

bbdcods.iec@gmail.com

THANK YOU FOR TAKING OUT YOUR PRECIOUS TIME FOR READING THE DOCUMENTS AND PARTICIPATING IN THE STUDY.

Signature of PI.....
Name.....
Date.....

ANNEXURE-VI

बाबू बनारसी दास कॉलेज ऑफ डेंटल साइंसेज

(बाबू बनारसी दास विश्वविद्यालय)

बीबीडी सिटी, फैजाबाद रोड, लखनऊ - 227105 (भारत)

बच्चों के लिए सूचना पत्र

अध्ययन का शीर्षक: -

मोलर इंसीजर हाइपोमिनरलाइजेशन: लखनऊ शहर के बच्चों में व्यापकता, जोखिम कारक और उपचार की जरूरतें।

परिचय

अध्ययन का उद्देश्य लखनऊ शहर के बच्चों में मोलर इंसीजर हाइपोमिनरलाइजेशन और हाइपोमिनरलाइज्ड सेकेंड प्राइमरी मोलर्स की व्यापकता और संबंधित जोखिम कारकों का मूल्यांकन करना है।

हम आपको इस अध्ययन में भाग लेने के लिए आमंत्रित करते हैं।

आपको क्या करना होगा?

इस शोध अध्ययन में भाग लेने के लिए, आपकी बाल दंत चिकित्सक द्वारा जांच की जाएगी और यदि पूर्व-निर्दिष्ट मानदंडों को पूरा करने के लिए पाया जाता है, तो आप इस शोध अध्ययन में नामांकित होने के पात्र होंगे।

चूंकि आपकी आयु 7 से 9 वर्ष के बीच है, इसलिए हम आपके साथ आने वाले माता-पिता / अभिभावक से भी इसी तरह के एक फॉर्म पर हस्ताक्षर करने के लिए कहते हैं, जिसे अभिभावक सूचित सहमति फॉर्म कहा जाता है।

जोखिम और असुविधाएँ

यदि आप अध्ययन में भाग लेना चाहते हैं, तो आपके स्वास्थ्य के लिए कोई महत्वपूर्ण जोखिम/खतरा नहीं है।

लाभ

रोगियों में रोग की घटना और गंभीरता की पहचान की जाएगी और उचित उपचार के लिए पेडोडॉटिक्स विभाग बीबीडीसीओडी को भेजा जाएगा।

अध्ययन में आपकी भागीदारी से दूसरों को मदद मिल सकती है क्योंकि इस बीमारी की प्रकृति से रोकथाम की जा सकती है। अध्ययन एमआईएच/एचएसपीएम की घटना और संबंधित जोखिम कारकों के बारे में जागरूकता पैदा करेगा जो आगे दांतों की सड़न को रोकने के लिए महत्वपूर्ण है।

गोपनीयता

रोगियों में रोग की घटना और गंभीरता की पहचान की जाएगी और उचित उपचार के लिए पेडोडॉटिक्स विभाग बीबीडीसीओडी को भेजा जाएगा।

अध्ययन में आपकी भागीदारी से दूसरों को मदद मिल सकती है क्योंकि इस बीमारी की प्रकृति से रोकथाम की जा सकती है। अध्ययन एमआईएच/एचएसपीएम की घटना और संबंधित जोखिम कारकों के बारे में जागरूकता पैदा करेगा जो आगे दांतों की सड़न को रोकने के लिए महत्वपूर्ण है।

मना करने या वापस लेने का अधिकार

यदि आप ऐसा नहीं करना चाहते हैं तो आपको इस शोध में भाग लेने की आवश्यकता नहीं है। आप अपनी इच्छानुसार किसी भी समय शोध में भाग लेना बंद कर सकते हैं। अध्ययन अन्वेषक आपको अध्ययन से वापस लेने का निर्णय ले सकता है यदि उसे लगता है कि यह आपके सर्वोत्तम हित में है।

आपको अध्ययन के दौरान विकसित किए गए महत्वपूर्ण नए निष्कर्षों के बारे में सूचित किया जाएगा ताकि आप नई जानकारी के आलोक में अध्ययन में अपनी भागीदारी पर विचार कर सकें।

माता-पिता की जिम्मेदारियां

यह आपके माता-पिता/अभिभावक की जिम्मेदारी है कि वे शोधकर्ता द्वारा मांगी गई सभी आवश्यक जानकारी प्रदान करें। हम अध्ययन के दौरान आपके सहयोग की अपेक्षा करते हैं।

ANNEXURE-VII

Babu Banarasi Das College of Dental Sciences

(Babu Banarasi Das University)

BBD City, Faizabad Road, Lucknow – 227105 (INDIA)

CHILD INFORMATION DOCUMENT

Study title: – Molar incisor hypomineralisation: Prevalence, risk factors and treatment needs in children of Lucknow city.

Introduction

The study aims to evaluate the prevalence and associated risk factors of molar incisor hypomineralization and hypomineralised second primary molars in children of Lucknow city.

We invite you to participate in this study.

What will you have to do?

To participate in this research study, you will be examined by pediatric dentist and if found to fulfill pre-specified criteria, you will be eligible to be enrolled in this research study.

Since you are in the age group between 7 to 9 years old we ask your accompanying parent / guardian will also sign a similar form called as the Parent Informed Consent Form.

Risks and discomforts

There is no foreseen significant risk / hazard to your health, if you wish to participate in the study.

Benefits

The occurrence and severity of the disease will be identified in the patients and referred to the department of Pedodontics BBDCODS for proper treatment.

Your participation in the study may help others as the disease is preventable in nature. The study will create awareness about occurrence and associated risk factors of MIH/HSPM are important to prevent further tooth decay.

Confidentiality

Your existing medical records may be accessed; personal health information about you may be collected and processed by study investigators for the purpose of performing the study. Information about you will be collected and stored in files with an assigned number, and not directly with your name. All documents related to the study will only be accessed by the study investigator, sponsor, the Ethics Committee and the Regulatory authority.

Your parent / guardian will have the right to access personal information about you at any time with the study doctor and the right to correct this personal information. Your parent / guardian can take away your authorization to collect process and disclose data about you at any time.

Right to refuse or withdraw

You do not have to take part in this research if you do not wish to do so. You may stop participating in the research at any time you wish. The study investigator may decide to withdraw you from the study if he/she considers it is in your best interest.

You will be informed of important new findings developed during the course of the study so you will be able to consider your participation in the study in light of new information.

Parents responsibilities

It is the responsibility of your parent / guardian to provide all the necessary information as asked by the researcher. We expect your co-operation throughout the study.

ANNEXURE-VIII

TOOLS FOR STATISTICAL ANALYSIS

The data for the present study was entered in the Microsoft Excel 2007 and analyzed using the SPSS statistical software 23.0 Version. The descriptive statistics included frequency and percentage. The level of the significance for the present study was fixed at 5%.

The intergroup comparison for the difference of frequency between independent groups was done using Chi Square test.

Chi Square Test

Chi-square is a statistical test commonly used to compare observed data with data we would expect to obtain according to a specific hypothesis. When an analyst attempts to fit a statistical model to observed data, he or she may wonder how well the model actually reflects the data. How "close" are the observed values to those which would be expected under the fitted model? One statistical test that addresses this issue is the chi-square goodness of fit test. This test is commonly used to test association of variables in two-way tables, where the assumed model of independence is evaluated against the observed data. In general, the *chi-square test statistic* is of the form

$$X^2 = \sum \frac{(\text{observed} - \text{expected})^2}{\text{expected}}$$

If the computed test statistic is large, then the observed and expected values are not close and the model is a poor fit to the data

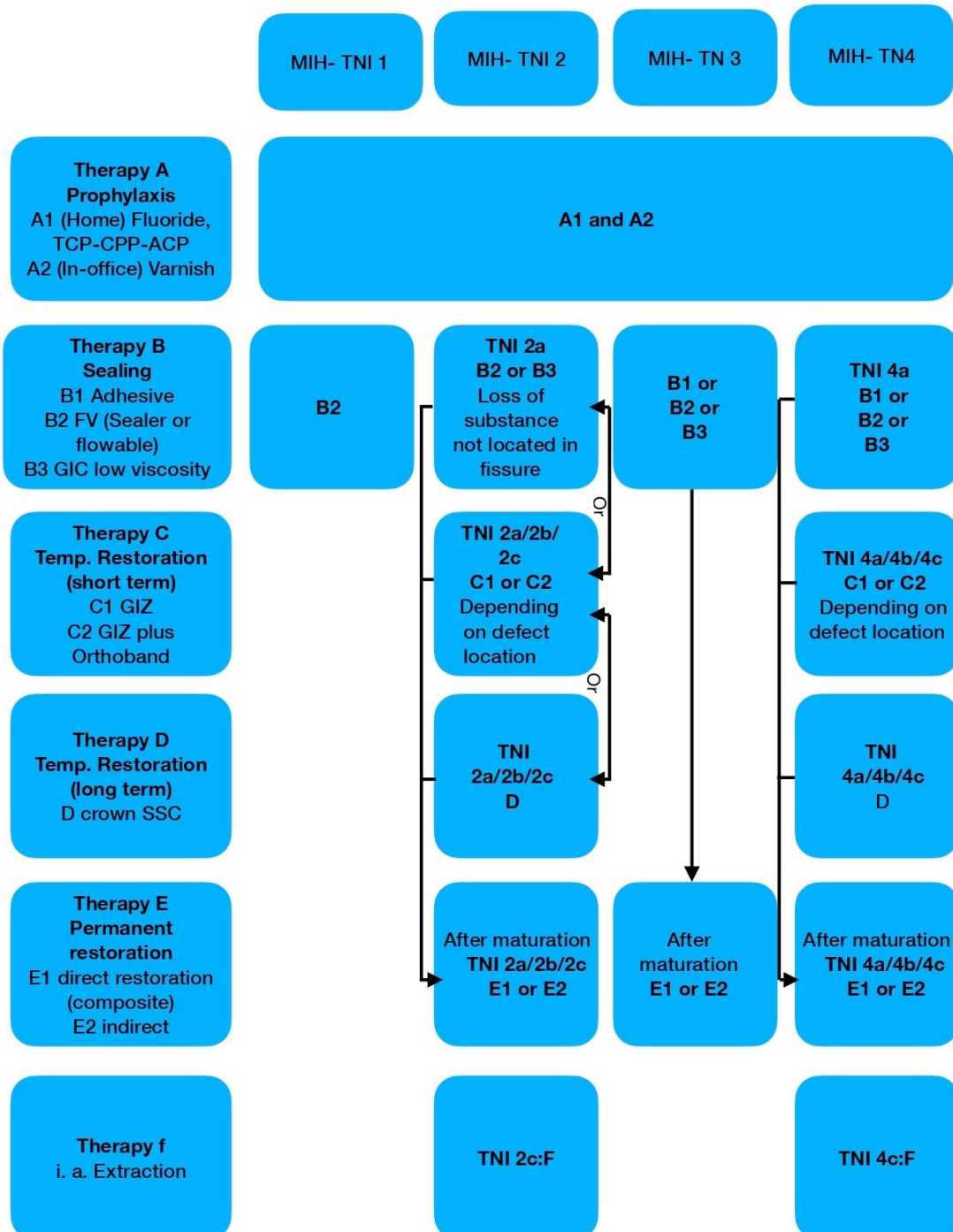
ANNEXURE-IX

MIH-TNI INDEX

Index	Definition
Index 0	No MIH, clinically free of MIH
Index 1	MIH without hypersensitivity, without defect
Index 2	MIH without hypersensitivity, with defect
2a	<1/3 defect extension
2b	>1/3 < 2/3 defect extension
2c	>2/3 defect extension or/and defect close to the pulp or extraction or atypical restoration
Index 3	MIH with hypersensitivity, without defect
Index 4	MIH with hypersensitivity, with defect
4a	<1/3 defect extension
4b	>1/3 < 2/3 defect extension
4c	>2/3 defect extension or/and defect close to the pulp or extraction or atypical restoration

ANNEXURE-X

MIH TNI Therapy Plan



ANNEXURE-XI

QUESTIONNAIRE

TO BE FILLED BY THE EXAMINER

Details of the child and maternal education

1. Child's sex
 - Male
 - Female
2. Child's age
 - 7 years old
 - 8 years old
 - 9 years old
3. Mother's Schooling
 - >8 years
 - ≤8 years

Prenatal characteristics

4. Birth Complications
 - Yes
 - No
5. Use of additional medication during pregnancy
 - Yes
 - No
6. Use of paracetamol
 - Yes
 - No

Perinatal characteristics

7. Premature birth
 - Yes
 - No
8. Excessively prolonged labour
 - Yes
 - No
9. Birth delivery
 - Normal
 - Caesarean
10. Place of Delivery
 - Home
 - Hospital
11. Oxygenation without intubation
 - Yes
 - No

Postnatal characteristics

- 12. Breastfeeding duration
 - <6 month
 - ≥6 months
- 13. Illnesses up to 4 years of age
 - Yes
 - No
- 14. Pneumonia
 - Yes
 - No
- 15. Asthma/bronchitis
 - Yes
 - No
- 16. Use of antibiotics
 - Yes
 - No
- 17. Use of analgesics
 - Yes
 - No
- 18. Use of medication for asthma
 - Yes
 - No
- 19. Fever higher than 38.5°C
 - Yes
 - No

ANNEXURE-XII

PLAGIARISM REPORT

Document Information

Analyzed document	URL: INCISOR HYPOMINERALIZATION: PREVALENCE, RISK FACTORS AND TREATMENT NEEDS IN CHILDREN OF LUCKNOW CITY
Submitted	2023-02-13 09:26:00
Submitted by	
Submitter email	1180327004@bbdu.ac.in
Similarity	5%
Analysis address	1180327004bbdu@analysis.arkund.com

Sources included in the report

SA	Dr. Mukul Joshi.docx Document: Dr. Mukul Joshi.docx (D139494363)	1
W	URL: https://www.researchgate.net/publication/265791540_Molar-incisor_hypomineralization_Prevalence Fetched: 2020-11-27 14:32:26	1
SA	0340.pdf Document: 0340.pdf (D55027396)	1
SA	final mih (Repaired)-1.docx Document: final mih (Repaired)-1.docx (D143424847)	1
W	URL: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4034724/ Fetched: 2021-03-16 14:18:59	1
W	URL: https://www.nature.com/articles/sjbdj.2018.814 Fetched: 2019-11-25 02:20:22	2
W	URL: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6811942/ Fetched: 2020-11-22 11:39:59	3
W	URL: https://bmcoralhealth.biomedcentral.com/articles/10.1186/s12903-016-0253-5 Fetched: 2021-07-11 08:26:11	1
W	URL: https://www.researchgate.net/publication/319703574_The_Wurzburg_MIH_concept_the_MIH_treatment Fetched: 2021-01-18 00:57:19	1

Entire Document

DISCUSSION This cross-sectional study was conducted to determine the prevalence, risk factors and treatment needs of molar incisor hypomineralization in children of Lucknow, in the Department of Paediatric and Preventive Dentistry, BBDCODS, BBDU, Lucknow. MIH is the most common structural abnormality that dental practitioners encounter which can lead to significant damage if not detected and treated early. This anomaly in tooth enamel formation is becoming increasingly prevalent in developing as well as developed nations and has been on the rise over the past three decades. It can affect the overall health and quality of life of an individual. Prevalence studies are crucial for both patients and dental professionals to take effective measures to mitigate the impact of MIH. They also provide policymakers with a comprehensive understanding of the nature of this defect in a specific population, allowing for accurate diagnosis and predictions both for individuals and the population as a whole. The European Academy has long acknowledged MIH as a widespread issue, and called for more research and knowledge to fully understand the defect. Additionally,

1/11

<https://secure.arkund.com/view/151322786-900269-306108#details/fulltext>

Namgyal

