PREVALENCE, PATTERN AND DISTRIBUTION OF MOLAR INCISOR HYPOMINERALIZATION AMONG EIGHT-YEAR-OLD CHILDREN IN UASIN GISHU COUNTY, KENYA

BY

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DECLARATION

Declaration by the Candidate:

This proposal is my original work and has not been presented for a degree in any other university. No part of this proposal may be reproduced without prior written permission of the author and /or Moi University.

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DEDICATION

I dedicate this project to my family.

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ABBREVIATIONS AND ACRONYMS

AAPD	American Academy of Pediatric Dentistry
CPQ	Child Perceptions Questionnaire
DBMPs	Dental Behavior Management Problems
DFA	Dental Fear and Anxiety
DHLE	Demarcated Hypomineralized Enamel Lesions
EAPD	European Academy of Pediatric Dentistry
FPMS	Four First Permanent Molars
HSPM	Hypomineralized second primary molars.
IREC	Institution Research and Ethics Committee
MIH	Molar Incisor Hypominerazation
NACOSTI	National Commission for Science, Technology and Innovation
OHRQoL	Oral Health-Related Quality of Life
PEB	Post Eruptive Breakdown
POQL	Pediatric-Oral-Health-related-Quality-of-Life
SPSS	Statistical Package for Social Science

OPERATIONAL DEFINITIONS OF TERMS AND KEY CONCEPTS

Children	School-going pupils aged 8 years at their last birthday and enrolled in public primary schools within Uasin Gishu County.
Molar incisor hypomineralisation	A developmental condition affecting the enamel of one or more first permanent molars, frequently involving permanent incisors, diagnosed by the presence of demarcated opacities, post-eruptive enamel breakdown, atypical restorations, or missing molars due to MIH, in the absence of other systemic or syndromic causes.
Opacities	Clearly demarcated enamel discolorations visible on the surface of first permanent molars or incisors, indicating areas of reduced mineral content without initial loss of enamel structure.
Post-eruptive breakdown	Loss or fracture of enamel occurring after tooth eruption, observed as structural loss in areas previously affected by demarcated opacities, typically due to the weakened nature of hypomineralised enamel.

ABSTRACT

Background: Molar incisor hypomineralization (MIH) is a disorder characterised by enamel hypomineralization that affects molars and incisors in the secondary dentition. Its effects start at the amelogenesis stage, manifesting clinically from the age of six when these teeth erupt. The aetiology of (MIH) has been linked to genetic, environmental, and nutritional factors, among others.

It is a significant cause of dental morbidity, often leading to the extraction of the first molar, which is a key tooth in the stability of dental occlusion. The pain and sensitivity associated with MIH can disrupt children's lives, and the challenge of achieving local anaesthesia for MIH teeth is well-documented. However, most data on MIH come from other continents, with only a few studies conducted in Africa, particularly in Kenya.

Objective: To determine the prevalence and identify the pattern of MIH and its distribution among eight-year-old children attending public primary schools in Uasin Gishu County.

Methodology: A descriptive cross-sectional study design was adopted. A multistage sampling technique where three schools per subcounty were sampled, and then twenty-two pupils were randomly selected using a digital sampling frame. A sample size of 396 school-going children, aged 8 years, from public primary schools in Uasin Gishu was included. The European Academy of Pediatric Dentistry validated questionnaire was applied to collect data. Descriptive statistics comprising frequencies, mean and percentages as well as chi-sqaure tests were used to analyze data. Ethical approval from the Institutional Research Ethics Committee (IREC) and the Ministry of Education.

Results: 51.8% of the participants were female, while 48.2% were male. The study revealed that 11.9% of the children had MIH. However, no statistically significant difference in occurrence was found between males and females($p=0.918$).

The first permanent molars were the most frequently affected teeth. Specifically, the lower right first molar (index 46) was the most affected, with 10.9% of children showing hypomineralization. This was closely followed by the lower left first molar (index 36) at 10.6%, the upper right first molar (index 16) at 10.4%, and the upper left first molar (index 26) at 9.6%. Presentations of MIH varied widely among the affected children, with most cases involving demarcated opacities, either with or without post-eruptive breakdown. The least common being dental restorations and missing due to MIH.

Conclusion: MIH is a prevalent dental condition with a distinct distribution pattern and varied clinical presentations in Kenya. Despite the high prevalence rates, proactive measures for early detection remain insufficiently implemented. Its clear pattern distinguishes it from other dental conditions, thus facilitating diagnosis. The timing of clinical presentations and the known distribution of MIH are crucial for timely intervention to mitigate the deleterious effects of MIH and for achieving a good prognosis.

Recommendation: There is a need to incorporate MIH screening into school health programs and provide further education to dental health practitioners to ensure early detection and management.

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CHAPTER ONE: INTRODUCTION

1.1 Background of the Study

Oral diseases are among the most prevalent diseases globally and have serious health and economic burdens, significantly reducing the quality of life for those affected. The WHO Global Oral Health Status Report (2022) estimated that oral diseases affect nearly 3.5 billion people worldwide, with 3 out of 4 people living in middle-income countries. Globally, an estimated 2 billion people suffer from caries of permanent teeth, and 514 million children suffer from caries of primary teeth. The most prevalent and consequential oral diseases globally are dental caries (tooth decay), periodontal disease, tooth loss, and cancers of the lips and oral cavity. According to Peres et al. (2019), the personal consequences of chronic, untreated oral diseases are often severe and can include unremitting pain, sepsis, reduced quality of life, lost school days, disruption to family life, and decreased work productivity. The costs of treating oral diseases impose significant economic burdens on families and healthcare systems.

Hypomineralization is a developmental defect in dental enamel characterised by inadequate mineral content, leading to softer, discoloured enamel. This condition manifests as a qualitative alteration in enamel structure, leading to a range of clinical presentations that can significantly impact oral health (Elfrink & Weerheijm, 2024). Hypomineralisation can manifest in various forms, with two of the most clinically significant being molar incisor hypomineralisation (MIH) and enamel hypoplasia. Enamel Hypoplasia is characterised by a quantitative defect in enamel formation, resulting in a thinner enamel layer. MIH, on the other hand, predominantly affects the first permanent molars and incisors. According to Almuallem and Busuttil-Naudi (2018), MIH is characterised by enamel opacities that can appear as white, yellow, or

brown spots on the affected teeth. The most notable form of hypomineralisation is MIH, which explicitly affects the first permanent molars and incisors.

The aetiology of hypomineralisation is multifactorial, encompassing genetic predispositions, environmental influences, and systemic factors. Genetic factors may predispose individuals to enamel defects, while environmental influences such as nutritional deficiencies, exposure to excessive fluoride, and maternal health during pregnancy can exacerbate the risk (Palipana & Adikari, 2023). Additionally, childhood illnesses, particularly those associated with high fever or systemic infections during critical periods of tooth development, have been implicated in the pathogenesis of hypomineralisation. Clinically, hypomineralisation is characterised by the presence of enamel opacities, which may appear as white, yellow, or brown spots on the affected teeth (Wang, 2018). These opacities are often well-defined and can vary in size and severity. The compromised enamel structure is not only aesthetically concerning but also functionally detrimental, as it increases the susceptibility of teeth to caries and post-eruptive enamel breakdown. Patients with hypomineralized teeth frequently report heightened sensitivity to thermal stimuli and certain food textures, which can lead to discomfort and pain during normal oral functions (Saitoh & Shintani, 2021).

MIH has been reported as a global burden affecting many parts of the world. The prevalence of MIH varies substantially globally, ranging from 2.8 to 40.2% (Goswami et al., 2019). A systematic review by Lopes et al. (2021) reported that the pooled prevalence of MIH was 13.5%. Zhao et al. (2017) report that the pooled prevalence of MIH is 14.2% globally. In subgroup analysis, South America (18.0%) and Spain (21.1%) had the highest prevalence. There was no significant difference between

males and females. The known global prevalence stands at a mean of 14%(Garot et al., 2021). In Africa, several studies have been done, though the prevalence has been varying from as low as 2.8% to as high as 40.2%. This is probably due to the lack of standardized tools while conducting these studies (Almuallem & Busuttil-Naudi, 2018). A study done in Eastern African communities, specifically South Sudan reported a prevalence of 20.1% higher than that in Western Africa in Nigeria, which was reported at 17% (Abdalla et al., 2021a). In Kenya, a study in the eastern part of Kenya in 2008 found a prevalence of 13.73% of these girls at 76% while boys at 24% (Kemoli, 2008).

Recently, MIH has become more evident and one of the most common reasons for the loss of teeth in children after dental caries. This condition predisposes affected teeth to various complications, including heightened susceptibility to dental caries, increased enamel breakdown, and sensitivity, which can severely impact a child's oral health and overall quality of life (Elfrink & Weerheijm, 2024). Children with MIH often experience not only physical discomfort but also psychological distress due to the aesthetic and functional challenges posed by their dental condition (Saitoh & Shintani, 2021). Studies conducted elsewhere suggest that the prevalence of MIH has been reported to be alarmingly high, leading to a growing recognition of its implications for paediatric dentistry. However, studies in Kenya are scarce. It is for this reason that the study seeks to determine the prevalence and identify the pattern of molar incisor hypomineralisation as well as its distribution among eight-year children

1.2 Problem Statement

Molar incisor hypomineralisation (MIH) is a defect of the enamel, which is qualitative in nature and systemic in origin, characterised by advanced and concurrent hypomineralisation of the enamel affecting the first permanent molars together with frequent association of the incisors (Verma et al., 2022). It is one of the most common developmental disturbances that dental practitioners encounter, which may influence the child's quality of life and impact their future dental health (Chowdhury et al., 2024).MIH causes dental sensitivity and predisposes the teeth to dental caries.

The prevalence and pattern of presentation have not been determined, particularly in the western part of Kenya. Data on MIH is mainly from other continents, but in Africa, only a few studies have been done on prevalence and distribution. In Kenya, some studies could be done in various areas, but not published at the national level on the prevalence of MIH.

Determining the exact distribution of MIH among the teeth will be a key breakthrough for timely intervention based on the eruption date of the various teeth in the oral cavity. The most typical pattern, once determined, will ease the diagnosis process and, consequently, the management process. Post-eruptive breakdown caused by MIH necessitates early detection and interventions. Failure to diagnose MIH at primary health care in Kenya increases the chances of losing teeth early or a high finance burden to the family involved.

The study will find out between the upper and lower jaws the one affected most. MIH may present with different patterns this study will also show the commonest pattern displayed by the affected teeth. Diagnosis of the MIH remains a challenge with it mimicking other teeth discolorations. This return compromises the quality of care for

the patients where the long-term prognosis is not considered, but rather gets the management as if it is a dental caries case with good bonding to the teeth.

1.3 Justification of the Study

Early enamel breakdown that follows MIH may present with functional and social problem to children and adolescent that affects them both in school and at home. It is important to treat this condition early especially at the self-confidence formation period of the child. At this critical age MIH, affected teeth are prone to caries interfering with normal function. These children end up missing schools. Children with MIH are 4.2 times more likely to seek oral services. (Stephanie Shields 1, 2024). No prevalence studies have been published on MIH within Uasin-Gishu County, hence the need to have baseline data. There had been an increase in the number of MIH cases at the MTRH dental clinic, but no precise data on the prevalence as well as the pattern of these MIH within Uasin Gishu County.

Conducting this research has a direct impact on the community and provides useful information for oral health professionals. The data gathered will help bridge the gaps that already exist both locally and internationally, especially on the prevalence and distribution. Depending on the burden, the disease, the data informs policy on oral health within Uasin Gishu County and Kenya. Early detection would help in early intervention, which would be economical for the patient and reduce the anxiety that is associated with many dental visits for treatment of MIH at its late stages or its complications.

There is insufficient data on the prevalence, pattern, and distribution of MIH among Kenyan children, particularly in Uasin Gishu County. This study provides the first systematic assessment of MIH in this population, generating essential epidemiological evidence to guide clinical practice, public health planning, and future research.

Clinical implication of the study

By determining the prevalence of the Mih within Uasin Gishu county, it will alert the clinician on the level of disease burden in the county, triggering them do early screening. The moderate to severe form of MIH presents with sensitivity that leads to increased dental fear and anxiety during dental treatment. By establishing the commonest pattern of MHI, it will help in behavior management for these children as well as a referral system to the specialist. The epidemiological data will act as a baseline for coming up with clinical guidelines and government policies on the management of MIH.

1.4 Research Question

i.) What is the prevalence, pattern, and distribution of molar incisor hypomineralization among eight-year-old children attending public primary schools in Uasin Gishu County in Kenya?

1.5 Objectives

The study was guided by the following objectives.

1.5.1 Broad objective

To ascertain the prevalence and distinguish the pattern of molar incisor hypomineralisation as well as distribution among eight-year-old children attending public primary schools in Uasin Gishu County in Kenya.

1.5.2 Specific Objectives

i.) To determine the prevalence of molar incisor hypomineralization among eight-year-old children attending public primary schools in Uasin Gishu County in Kenya

ii.) To assess the distribution of molar incisor hypomineralization among eight-year-old children attending public primary schools in Uasin Gishu County in Kenya

iii.) To identify the pattern of molar incisor hypomineralization among eight-year old children attending public primary schools in Uasin Gishu County in Kenya.

1.6 Study Variables

This study that seeks to determine the prevalence and identify the pattern of molar incisor hypomineralisation as well as its distribution among eight-year old children attending public primary schools in Uasin Gishu County in Kenya has both dependent and independent variables

1.6.1 Dependent Variable

Prevalence of molar incisor hypomineralisation among eight-year-old children attending public primary schools in Uasin Gishu County in Kenya has both dependent and independent variables.

1.6.2 Independent Variables

Demographic characteristics, pattern, and distribution of MIH among eight-year-old children attending public primary schools in Uasin Gishu County in Kenya has both dependent and independent variables

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter presents the literature review related to the study. It includes a synthesis of theoretical and empirical review of prevalence and identify the pattern of molar incisor hypomineralisation as well as its distribution among eight-year-old children

2.2 Overview of Molar Incisor Hypomineralisation.

2.2.1 Definition

MIH is defined as a hypomineralisation of systemic origin of one to four permanent first molars, frequently associated with affected incisors (Weerheijm, 2015). A developmental dental anomaly presents with hypomineralised enamel. It affects one or more first permanent molars or together with incisors (Rodd et al., 2021b). It is a qualitative defect of the enamel that is present at the time of eruption of the first permanent molar and the incisors. Though the exact cause of the MIH is not known a number of agents have been singled out as possible causes: childhood illness, dioxin in the breast milk, neonatal jaundice, industrial poisons are among the major agents that have been pointed out (Abdalla et al., 2021a)(Williams et al., 2020). One would view it as a qualitative disorder where enough enamel is formed but its weaker than normal predisposing it to breakdown on the severe cases according (Kemoli, 2008). Due to this weakness in enamel, it leads to teeth being sensitive as well as being predisposed to dental caries. Molar incisor hypomineralization (MIH) was first defined in 2001 by Weerheijm as hypomineralization of systemic origin, manifesting as demarcated, qualitative defects of enamel affecting one to four first permanent molars (FPMs) frequently associated with incisors. Earlier nomenclature included non-fluoride enamel opacities, internal enamel hypoplasia, non-endemic mottling of enamel, idiopathic enamel opacities and cheese molar (Weerheijm et al., 2001).

MIH presents many challenges to dentists in terms of the best treatment modality and correct diagnosis. When it come to the patient it has both aesthetic and functional challenges (Rodd et al., 2021a) (Abdelaziz et al., 2022). The teeth are usually very sensitive and those that are adversely affected they present with severe pain and feeding difficulties. Due to the discolorations, the children present with self-esteem problems and are bullied in learning institutions. The exact aetiology of MIH is not well known, although current hypotheses point out that it is multifactorial (Jeremias et al., 2021; Rodd et al., 2021c). The global prevalence of MIH pooled to 14.2%, with South America having the highest at 18% and Africa lowest at 10.9 % (Dave & Taylor, 2018; Williams et al., 2020). MIH affects both boys and girls almost in equal measure, though some studies have shown more boys being affected than girls (Abdalla et al., 2021a).

2.2.2 Aetiology

The aetiology of MIH is not very well established. However, several studies have been done that have attributed MIH to be caused by several factors when exposed to the teeth during amelogenesis at the maturation stage and calcification stage (Abdalla et al., 2021a; some of these factors are environmental, childhood delivery problems premature birth dioxin among many other agents. Mainly it affects the teeth at calcification stage of amelogenesis. Environmental irritants may also affect the tooth at maturation stage, leading to qualitative defects (Abdalla et al., 2021c). A recent meta-analysis has attributed MIH to maternal illness with these children being 40% more likely to have MIH than those whose mothers were generally health (Rodd et al., 2021c). Some other studies have linked the MIH with the antibiotic use but it is not clear if the MIH comes as result of the antibiotics or is due to the disease. Currently, there are ongoing studies that are linking the MIH with genes like enamelin, tuftelin

interacting protein11 and tuftelin 1 but no association with the amelix gene, which is key in amelogen deposition (Rodd et al., 2021c).

2.2.3 Pattern of MIH

MIH is a qualitative defect of the enamel that presents with the right quality but with weaker than the normal strength of enamel. Teeth affected by MIH have discrete discoloration, with colour varying from white to brown cheese. The affected area of the tooth other than the colour change is usually weak and breaks off easily, even during chewing or dental examination. Some teeth will present with post-eruptive breakdown depending on the grade of the MIH, and worse-level patients will have undergone one or more restorations and extractions due to the MIH (Abdalla et al., 2021a). European Academy of Pediatric Dentistry(2003) has come up with criteria for diagnosing molar incisor hypomineralization (Farias et al., 2019)(K. Weerheijm, 2015).

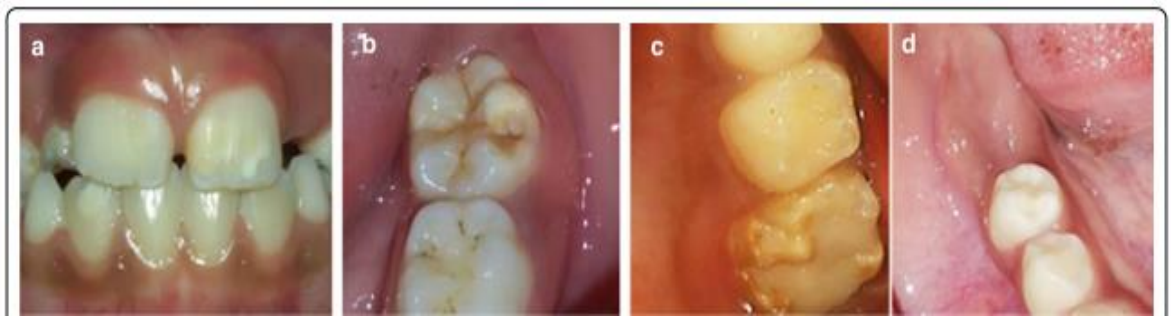

Figure 2.2.1: Various levels of the MIH (Bekes, 2021, p.47)

a) Demarcated enamel opacities, b) post-eruptive breakdown, c) atypical restoration (note the irregular margins extended to the palatal surface and opacity at the border of the restoration), and d)extraction because of MIH (Abdalla et al., 2021a).

The borders of enamel in cases of MIH are irregular, while those of fluorosis are diffuse and may affect more teeth than the MIH that mainly affect FPM and incisors (Bavinton et al., 2021). For one to classify the lesion as mih, it should also be more

than 2mm in diameter and affect MIH index teeth. Mathu-Maju came up with a classification of MIH according to the severity of the presentation. Mathu –Muju classified the MIH depending on severity as mild MIH that have opacities in non-stress bearing areas and caries associated with the affected enamel. This mild form does not have any sensitivity.

Figure 2.2.2: Mild form of MIH

Moderate MIH involves mild post-eruptive breakdown with one or two surfaces of both molar and incisors affected. The cusps are not involved, and these teeth may present with sensitivity, hence a need for restoration.

Figure 2.2.3: Moderate level of MIH

Severe MIH presents with post-eruptive enamel breakdown, crown destruction, caries associated with affected enamel, history of dental sensitivity and aesthetic concerns

Figure 2.2.4: Moderate level of MIH

Severe MIH: Post eruptive enamel breakdown, crown destruction, caries associated with affected enamel, history of dental sensitivity, and aesthetic concerns.

As a clinician, one must distinguish the MIH from other developmental and environmental discolorations in the oral cavity at this age. One of the most common teeth discoursing conditions is fluorosis, which also has a very high prevalence in our country at 41.4% (Ministry of Health, 2015). Fluorosis presents as generalized discoloration with diffused enamel opacities, unlike the demarcated borders of MIH, while in amelogenesis imperfecta, the defects are generalized, and there is usually a family history. For enamel hypoplasia the borders of the normal enamel are mostly smooth, while in MIH molars, where the enamel matrix is initially formed to its normal shape, the borders to the normal enamel are irregular when post eruptive enamel loss had occurred(K. L. Weerheijm et al., 2003).

Colour of the teeth

Molar incisor hypomineralisation teeth are clinically characterized by a change in enamel translucency. They can vary from white to yellow, and a severe form of it is brown. The colour of the margins is distinguishable from the healthy tooth surface. This clear margin is the basis of the complete removal of soft enamel during restoration to ensure the restoration lasts. (bekes, 2021).

Localization of molar incisor hypomineralization

The defect may be limited to a single cusp or may extend over the entire smooth surface or fissure relief to the cervical region. The size varies from one tooth surface to another, where some may be extensive while others are small. For incisors, the buccal surface is usually affected compared to the palatal surface. (bekes, 2021).

Characteristics of molar incisor hypomineralization.

Mildly altered teeth tend to show white to yellow or yellow to brown, irregular discoloration. In contrast, the severe form clinically has chipped or missing enamel, exposing the dentin and triggering pain from hot or cold drinks.

When subjected to chewing forces, there is a breakdown that can be predicted from the colour present. When the incisors are affected, there are aesthetic concerns other than the sensitivity that occurs. Severity is dependent on the depth of the hypomineralization, not on the number of teeth affected. Early detection of these teeth helps in the prevention of complications that occur with time.

Hypersensitivity of the molar incisor hypomineralized teeth.

Molar incisor hypomineralised teeth are susceptible to both tactile and temperature changes. It has been hypothesized that the porous enamel allows bacteria to penetrate the dentinal tubules, causing subclinical pulpal inflammation. This hypersensitivity restricts children from carrying out their oral hygiene practices as well as feeding. This pulpal inflammation leads to challenges in achieving local anaesthesia among this group.

Deviations from the classical definition

There are documented cases where MIH affects second permanent molars, premolars, and canines. (mittal, 2016).

2.2.4 Treatment and Management

The management of MIH is guided by several key principles aimed at preserving tooth structure, preventing caries, and alleviating symptoms. The European Academy of Paediatric Dentistry (EAPD) and other professional organizations have established guidelines emphasizing early diagnosis and intervention (Weerheijm, 2015). Restorative treatments such as composite resin fillings or crowns may be necessary for teeth with significant structural defects or carious lesions. The choice of material is critical, as MIH-affected teeth may present challenges in achieving adequate adhesion. Research indicates that newer adhesive systems and materials specifically designed for hypo mineralized enamel can improve the success rates of restorations. Many children with MIH experience sensitivity, particularly to temperature changes. Applying desensitizing agents, such as potassium nitrate or fluoride varnishes, can help alleviate discomfort and improve the quality of life for affected children (Elfrink & Weerheijm, 2024).

In cases where the structural integrity of the tooth is severely compromised, extraction may be the only viable option. This is particularly true for molars that are extensively decayed or non-restorable (Almuallem & Busuttil-Naudi, 2018). The decision to extract should be made judiciously, considering the potential impact on the child's occlusion and future dental development. The effectiveness of treatment for MIH varies based on the severity of the condition and the specific interventions employed. Preventive measures, such as fluoride treatments and sealants, have significantly reduced the incidence of caries in MIH-affected teeth. Wang (2018) indicates that restorative treatments can be effective in managing the symptoms and functional impairments associated with MIH, although the success of these interventions is contingent upon the careful selection of materials and techniques. However, the long-

term prognosis for MIH-affected teeth remains a concern, as these teeth are more prone to post-eruptive enamel breakdown and recurrent caries. Continuous monitoring and follow-up care are essential to ensure restorations' longevity and promptly address any emerging issues.

2.2.5 Effects of MIH

MIH is associated with negative sequelae, including hypersensitivity, post-eruptive breakdown, the rapid development of carious lesions and poor aesthetics. Other concerns pertain to the clinical management of MIH and include difficulty in achieving local anaesthesia, increased dental fear and anxiety (DFA) and increased behaviour management problems (Shields et al., 2024). A systematic review and meta-analysis by Amrollahi et al. (2023) aimed to evaluate the impact of MIH on various aspects of oral health-related quality of life (OHRQoL) in children aged 8 to 10 years. The researchers conducted a systematic review and meta-analysis following the PRISMA protocol and registered in PROSPERO. They performed an electronic search in August 2022 across Scopus, Web of Science, and PubMed databases, initially retrieving 130 papers. After applying the eligibility criteria, 21 studies were included in the systematic review, with 9 studies contributing to the meta-analysis. The main results indicated that children with MIH experienced a significant increase in the total score of the CPQ 8-10 questionnaire, with a pooled mean of 15.89. Significant increases were also observed in the domains of oral symptoms, functional limitation, and emotional well-being, with pooled means of 6.25, 3.88, and 3.24, respectively. However, the social well-being increase was insignificant, with a pooled mean of 1.65. Subgroup analysis based on MIH severity showed no significant difference in OHRQoL means for all variables. The study concluded that MIH negatively affected the total score and all domains of the CPQ 8-10 questionnaire,

except for social well-being. Additionally, different severities of MIH had no significant impact on OHRQoL in children.

A recent review by Shields et al. (2024) sought to outline the current evidence regarding the impact of MIH on children's oral health and their daily activities. The main results indicated that MIH was associated with negative sequelae such as hypersensitivity, post-eruptive breakdown, rapid development of carious lesions, and poor aesthetics. The review also highlighted the challenges in clinical management of MIH, including difficulty in achieving local anaesthesia, increased dental fear and anxiety, and behaviour management problems. The impact of MIH on oral health-related quality of life (OHRQoL) was found to be inconsistent across studies, with some reporting a negative impact and others finding no significant effect. The study's conclusion emphasized the need for more patient-centred delivery of care to improve outcomes for children affected by MIH.

In a similar review by Jaleveik et al. (2022) investigated whether MIH could cause dental fear and anxiety (DFA) or negatively impact the oral health-related quality of life (OHRQoL) in children and adolescents. The researchers systematically reviewed existing literature to summarize the evidence on this topic. The main results indicated that children and adolescents with diagnosed MIH did not exhibit increased dental fear and anxiety. However, the studies showed that MIH negatively impacted affected individuals' oral health-related quality of life. Specifically, MIH was associated with greater negative impacts on the 'oral symptoms' and 'functional limitations' domains of OHRQoL. The conclusion drawn from the review was that while MIH did not seem to increase dental fear and anxiety, it did impair the oral health-related quality of life in children and adolescents.

Joshi et al. (2021) compared OHRQoL in children with and without MIH and to assess the impact of MIH severity on OHRQoL in children aged 8–10 years. The German version of the Child Perceptions Questionnaire (CPQ-G8-10) was used for this purpose. The methodology involved recruiting 188 children aged 8–10 years from a pediatric dental clinic in Hannover, Germany. Half of the participants were affected by MIH. The presence and severity of MIH, plaque, and dental caries status were evaluated. Children were asked to complete the CPQ-G8-10. Statistical analysis was performed using GraphPad Prism software version 8. The main results indicated that children with MIH had significantly higher CPQ-G8-10 mean scores compared to those without MIH (13.87 [± 8.91] vs. 4.20 [± 3.74]; $p < 0.0001$), demonstrating a negative impact of MIH on OHRQoL. The severity of MIH also correlated with increased CPQ-G8-10 scores, indicating more impaired OHRQoL in severe cases. The conclusion drawn was that children affected by MIH exhibited impaired OHRQoL compared to those without MIH, with increasing severity leading to greater impairment. The study highlighted the importance of understanding patients' perceptions and individual oral health needs to prioritize MIH and recognize its impact.

A survey by Kisacik et al. (2024) evaluated the impact of MIH and tooth sensitivity on the oral health-related quality of life (OHRQoL) in children aged 8–12 years. Additionally, it sought to assess the influence of tooth maturity on tooth sensitivity. The methodology involved a descriptive cross-sectional study with children both with and without MIH, selected through convenience sampling. The Pediatric-Oral-Health-related-Quality-of-Life (POQL) scale was used to assess OHRQoL, while the Shiff-Cold-Air-Sensitivity-Scale (SCASS) and the Demirjian method were employed to evaluate tooth sensitivity and dental maturity, respectively. Statistical analysis was

conducted using Pearson Chi-Square Test and Mann-Whitney U test. The main results indicated that children with MIH had higher POQL scores, signifying a negative impact on their OHRQoL. The study found that teeth with MIH exhibited greater sensitivity to stimuli compared to healthy teeth. Furthermore, children with lower dental maturity and younger dental age showed increased sensitivity. The conclusion drawn was that MIH negatively affected OHRQoL, with teeth exhibiting more sensitivity than healthy ones.

2.3 Prevalence of Molar Incisor Hypomineralisation

MIH is prevalent worldwide, particularly among children under 10 years of age. However, its prevalence rates vary significantly even within the same country. A metanalysis by Sluka et al. (2024) investigated whether there was a rise in the prevalence of MIH over time. The researchers conducted a systematic literature search following PRISMA guidelines across multiple databases, including Medline, Cochrane Database, EMBASE, LILACS, Web of Science, Google Scholar, and Scopus. They included 167 articles, primarily of moderate to high quality, based on data from 46,613 individuals. The studies varied significantly in cohort size and age range. The main results indicated that the weighted mean prevalence of MIH was 12.8% (95% CI 11.5%-14.1%). No significant changes in prevalence were found concerning either publication year or birth year. However, a sub-analysis of eleven studies reporting different age groups revealed strong evidence of an increasing prevalence between 1992 (3%) and 2013 (13%). The study concluded that, based on cross-sectional data, a possible rise in MIH prevalence remained unclear. The researchers emphasized the need for future prospective large-scale studies under standardized examination conditions with an emphasis on examiner calibration to better understand the evolution of MIH prevalence. The study's limitations included

the included studies' heterogeneity, cohort characteristics variations, and potential biases due to differing examination settings and operator sensitivity. Additionally, the lack of standardized diagnostic criteria before 2001 excluded earlier studies, which might have provided valuable insights.

A systematic and metanalysis by Reis et al. (2023) evaluated whether children with MIH exhibited higher levels of dental fear and anxiety (DFA) and dental behavior management problems (DBMPs) compared to those without MIH. The researchers conducted a systematic review and meta-analysis, including seven observational studies with a total of 3,805 patients. The main results indicated that most studies observed no significant difference in DFA between children with and without MIH. The meta-analysis did not show a significant effect of MIH on DFA scores. However, two studies found that DBMPs were significantly more frequent in patients with MIH. The overall certainty of evidence was very low for both outcomes assessed. The study's conclusion suggested no difference in DFA between children with and without MIH, but DBMPs were more common in patients with MIH.

Another systematic review and meta-analysis of observational studies by Jawdekar et al. (2022) assessed the impact of MIH on oral health-related quality of life (OHRQoL) in children. The researchers conducted a systematic review and meta-analysis of observational studies. Using appropriate keyword combinations, they searched three electronic databases PubMed, Cochrane Library, and Google Scholar. The selection criteria included observational studies on otherwise healthy children aged 6–18 years, and interventional studies were included only to collect baseline data. From 52 studies, 13 were included in the systematic review and 8 in the meta-analysis. The main variables were the total scores of OHRQoL measures reported in the child

perceptions questionnaire (CPQ) 8–10, CPQ 11–14, and parental-caregiver perception questionnaire (P-CPQ) scales. The results showed that children with MIH were about 17–25 times more likely to have impacts on their OHRQoL compared to children without MIH. The pooled risk ratio (RR) confidence intervals (CI) were statistically significant ($P < 0.001$) for both CPQ and P-CPQ scales. The study concluded that MIH significantly affected the OHRQoL in children. However, the evidence was of low quality due to high heterogeneity. The risk of bias was moderate, and publication bias was low.

A systematic Review by Lopes et al. (2019) aimed to comprehensively estimate the overall prevalence of MIH and its associated characteristics. The methodology involved a systematic review and meta-analysis, adhering to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines. The researchers searched multiple databases, including PubMed, MEDLINE, CENTRAL, Web of Science, SciELO, LILACS, and TRIP, up to July 2021. They included 116 observational studies, with one study of moderate methodological quality and the rest of high methodological quality. Heterogeneity and publication bias were assessed using the I^2 test statistics and Egger's significance test, respectively. Random-effects meta-analysis of prevalence was conducted, and the Strength of Recommendation Taxonomy (SORT) was used to grade the strength of evidence. The main results indicated that the pooled prevalence of MIH was 13.5% (95% CI 12.0–15.1, I^2 = 98.0%). Affected incisors were observed in 36.6% (95% CI 30.0–43.7, I^2 = 92.5%) of cases, and the prevalence of hypomineralization of the second primary molars was 3.6% (95% CI 1.9–6.8, I^2 = 96.3%). The highest prevalence was found in America (15.3%, 95% CI 12.8–18.3, $p < 0.001$, I^2 = 96.3%), while Asia had the lowest prevalence (10.7%, 95% CI 8.5–13.5, $p < 0.001$, I^2 = 98.7%). No significant

continental differences were found. Sample size and year of publication were slight contributing factors to the heterogeneity in the analysis. The study concluded that MIH is a prevalent condition globally, with significant regional variations. However, the study acknowledged several limitations, including high heterogeneity among the included studies, potential publication bias, and the influence of different case definitions on prevalence estimates.

A systematic review and meta-analysis by Bukhari et al. (2022) investigated the prevalence and risk factors of MIH in the Middle East. The researchers conducted a systematic review and meta-analysis, including studies on children aged 5-18 years with at least one first permanent molar affected by MIH. The studies were sourced from four databases: PubMed, Google Scholar, Science Direct, and the Cochrane Library, following specific eligibility criteria. The Joanna Briggs Institute quality assessment tool was used to evaluate the included studies, and meta-analyses were conducted to assess the effect of risk factors. The main results indicated that the frequency of MIH in the Middle East ranged from 2.3% to 40.7%, with a mean prevalence of 15.05%. Significant associations were found between MIH and illnesses during pregnancy and early childhood, as well as factors related to delivery. The odds ratio for pregnancy and early childhood illnesses was 2.26, and for delivery-related factors, it was 2.4. The study concluded that the mean prevalence of MIH in the Middle East aligned with the global prevalence rate. However, the study acknowledged high heterogeneity in the meta-analyses and recommended further research to assess the prevalence and other associated environmental risk factors for MIH in the Middle East.

In Australia, Owen et al. (2017) studied the prevalence of hypomineralized second primary molars (HSPM) in Melbourne preschool children, examine the relationship between demarcated hypomineralized enamel lesions (DHLE) severity and extent, and explore the association between early childhood caries (ECC) and HSPM. The methodology involved a cross-sectional study of 623 children aged 3-5 years from 30 randomly selected kindergartens in inner metropolitan Melbourne. The HSPM were recorded using a combination of the European Academy of Paediatric Dentistry MIH Judgment Criteria and the modified Developmental Defects of Enamel (DDE) Index. Caries were assessed using the International Caries Detection and Assessment System (ICDAS) criteria. The main results indicated that 14.1% of the children had HSPM, with a tooth-level prevalence of 5.8%. The prevalence of dentinal carious lesions was 13.2%, and caries prevalence (d2-6 mft > 0) was 36.4%. A statistically significant relationship was found between the extent of HSPM lesions and the number of HSPM per child, as well as between HSPM severity and extent at the tooth level. However, children with HSPM did not have an overall greater caries experience. The study concluded that HSPM were prevalent among Melbourne preschool children and that there was a positive association between the extent of HSPM and carious lesion severity. However, the presence of HSPM did not correlate with a higher overall caries experience. However, the study was limited by its cross-sectional design, which did not allow for the assessment of changes over time. Additionally, the study population was from a relatively advantaged socioeconomic background, which may limit the generalizability of the findings to other populations.

A study in the USA by Ahmed et al. (2020) aimed to determine the prevalence and severity of MIH in a cohort of school-aged children in Indiana. A calibrated examiner screened eligible school-aged children for MIH and other enamel defects using the

integrated Modified Developmental Defects of Enamel Index and the European Academy of Pediatric Dentistry criteria. The permanent first molars, permanent incisors, and primary second molars were examined. Descriptive statistics, exact 95% confidence intervals, and χ^2 tests were used for analysis. The study examined 337 participants with a mean age of 9.1 years. The prevalence estimate for MIH was 13%, while the prevalence estimate for any enamel defect (AED) of any of the index teeth was 52%. Living in an area with water fluoridation levels greater than 0.7 parts per million or being non-Hispanic black was significantly associated with higher prevalence of AED but not with the prevalence of MIH. Demarcated opacities were the most prevalent defects (43%), followed by atypical restorations (32%). Higher age and a higher number of MIH-affected surfaces were associated with larger MIH defect extension. The study concluded that nearly 1 in 6 children in Indiana had at least one permanent first molar with MIH. Water fluoridation levels and race or ethnicity were associated with the prevalence of AED but not with MIH prevalence. The study suggested that US dental practitioners should be aware that MIH is a common finding and that early identification and management are crucial for children with a high number of MIH-affected surfaces, as the extension of the defects tends to worsen with age. However, the study's limitations included the potential for selection bias, as the sample may not have been representative of the entire population of school-aged children in Indiana. Additionally, the cross-sectional design of the study limited the ability to establish causality between the observed associations.

A study in Turkey by Koruyucu et al. (2018) assessed the prevalence and risk factors of MIH in children in Istanbul, Turkey. The methodology involved examining 1511 children aged 8 to 11 years using the European Academy of Paediatric Dentistry (EAPD) criteria for MIH. The study also included a questionnaire to parents to gather

data on potential etiological factors. The main results indicated that MIH was observed in 14.2% of the children, with a higher prevalence in 11-year-olds (18.2%) compared to 8-year-olds (9.9%). Significant associations were found between MIH and various factors such as complications during pregnancy, birth prematurity, average breastfeeding period, diarrhea frequency, digestive system diseases, asthma, frequent high fever, ear infection, renal failure, rubeola, chickenpox, and parotitis. The study concluded that MIH is a common condition in Istanbul and is associated with numerous pre- and postnatal factors. However, the study acknowledged limitations, including the inability to control or predict many of the etiological factors and the need for longitudinal studies with larger sample sizes to better understand the etiological role of these factors.

A study aimed to investigate the etiology of MIH in Saudi school children. The researchers Alhowaish et al. (2021) conducted a cross-sectional study involving 893 children aged 8-10 years from Riyadh, Saudi Arabia. The children were examined for MIH using the European Academy of Pediatric Dentistry Criteria, and their parents were surveyed about the children's pre-, peri-, and postnatal conditions through a structured and validated questionnaire. The main results indicated that 362 children (40.5%) were affected by MIH. Among the analyzed etiological factors, only newborn jaundice was found to be significantly associated with MIH (OR = 1.35, p = 0.047). Multivariate logistic regression analysis confirmed that newborn jaundice was the only significant etiological factor for MIH (p = 0.04). The study concluded that newborn jaundice was the sole etiological factor significantly associated with MIH in the sample of Saudi school children. However, the study had limitations, including its retrospective design and reliance on parental recall, which could introduce recall bias.

A systematic search of literature by Afshari et al. (2022) focused on the prevalence of MIH in Iranian children. The researchers conducted a comprehensive search of literature from 2000 to 2021 across multiple databases, including Scopus, Pubmed, Ovid, Embase, Web of Science, and Google Scholar, as well as national Iranian databases and digital archives of dental schools. The study included cross-sectional, cohort, and case-control studies on the prevalence of MIH among 6-13-year-old children. The methodology involved assessing the methodological quality and risk of bias of the included studies using a modified version of the Newcastle-Ottawa Scale. Due to significant clinical and statistical heterogeneity, a meta-analysis was not feasible, and a descriptive synthesis of data was performed instead. Fifteen cross-sectional studies with a total of 12,011 participants were included in the review. The main results indicated that the prevalence of MIH in Iranian children ranged from 5.1% to 25.6%, with the lowest prevalence reported in Kerman (5.14%) and the highest in Tehran (25.6%). All included studies were at a moderate risk of bias. The study highlighted substantial methodological, clinical, and statistical heterogeneity among the included studies. However, the study had limitations, including a limited number of included studies, large heterogeneity, and moderate quality of the included studies.

In another study in Iran, Hali et al. (2020) sought to estimate the prevalence of MIH among school children aged 7 to 12 years in Sari, Iran. The researchers conducted a descriptive cross-sectional study involving 700 randomly selected school children, equally divided between males and females. Clinical examinations were performed to identify MIH, and data were recorded through interviews and questionnaires. The analysis was carried out using Chi-square, Fisher's exact, and Mann-Whitney U tests with SPSS version 17. The main results indicated that the prevalence of MIH was

20.2%, with 21.1% in males and 19.4% in females. There was no significant difference between genders in terms of prevalence and intensity of MIH. The study concluded that MIH had a moderate prevalence in Sari primary schools and was not significantly associated with gender. However, there was reliance on clinical examinations, which might have introduced observer bias. Additionally, the study did not explore potential environmental or genetic factors contributing to MIH, nor did it investigate the impact of socio-economic status on the prevalence of MIH.

Saitoha and Shintani (2021) reviewed the prevalence, aetiology, and clinical management of MIH in Japan. The purpose was to provide a comprehensive overview of MIH, a condition characterized by hypomineralization of one to four first permanent molars, often affecting incisors as well. The methodology involved a review of existing literature and data on MIH prevalence, aetiology, and clinical management. The study also included an epidemiological survey conducted in Japan to determine the prevalence and severity of MIH among school children. The main results indicated that the prevalence of MIH varied significantly across different regions and age groups. In Japan, the prevalence ranged from 11.9% to 19.8%, with regional differences observed. The study found that MIH was associated with various genetic and environmental factors, including prenatal and postnatal conditions, maternal health, and early childhood illnesses. The conclusion of the study emphasized the need for early diagnosis and effective clinical management of MIH to prevent further dental complications. The study highlighted the importance of preventive measures, such as fluoride application and remineralization therapy, to manage MIH-affected teeth. However, the study had several limitations. The true prevalence of MIH might have been slightly overestimated due to the clinic- and hospital-based study design. Additionally, the study acknowledged the need for

further research to identify specific causal factors and to explore the genetic and environmental interactions contributing to MIH.

Grieshaber et al. (2023) aimed to obtain representative epidemiological data on the prevalence of MIH among schoolchildren in the canton of Basel-Landschaft, Switzerland. The researchers sought to analyze the impact of various potential influencing factors such as age group, gender, nationality, and place of residence on MIH prevalence. The methodology involved examining a representative population of schoolchildren from three different age groups: 1st grade (mean age: 7.4 years), 6th grade (mean age: 12.6 years), and 9th grade (mean age: 15.7 years). The presence or absence of MIH was recorded, along with potential influencing factors. The dental examinations were conducted by three teams, each consisting of one dentist and one dental assistant, following the principles of clinical oral health surveys recommended by the World Health Organization. The main results indicated that the average prevalence of MIH in the study population was 14.8%. No statistically significant differences were found for nationality, gender, or place of residence. Although not statistically significant, children from the youngest age group had the highest MIH prevalence, while children from the oldest age group had the lowest prevalence. Logistic regressions showed that the level at 9th grade might be an influencing factor for MIH, with a statistically significant difference between level E (extended requirements) and level P (baccalaureate-level requirements). The study concluded that MIH prevalence among schoolchildren in the canton of Basel-Landschaft is comparable to global mean values. However, the presence or absence of MIH was recorded regardless of the affected tooth and the severity of the disease, making it impossible to estimate the overall treatment need or potential differences in treatment needs between the age groups. Additionally, the ongoing COVID-19 pandemic led to

some restrictions in the clinical evaluation process. Further studies are needed to clarify these points and to confirm a potential increase in MIH prevalence over time.

A Croatian study by Jurlina et al. (2020) sought to detect the prevalence of MIH and caries in eight-year-old children with early mixed dentition in Eastern Croatia. The researchers sought to address the lack of data on MIH in Croatia and its impact on children's dental health. The methodology involved examining 729 children, with 356 females and 373 males, from randomly selected primary schools in urban and rural areas of Eastern Croatia. The clinical examinations were conducted over two years, and the presence of MIH and caries was recorded. The study followed the criteria advocated by the European Academy of Paediatric Dentistry (EAPD) for identifying MIH. The main results indicated that the prevalence of MIH was 13%, with 95 children affected. The prevalence of caries in the overall population was 11.48%, while in the group with MIH, it was 24.14%. The study found that MIH was more common in girls than boys and had a significant impact on the occurrence of caries. The DMFT index for children with MIH was 2.1, compared to 1.1 for non-MIH children. The conclusion of the study emphasized the seriousness of MIH in Eastern Croatia and the need for further research to gain a more comprehensive understanding of its prevalence and impact. The study highlighted the importance of early detection and preventive measures to improve oral health in children. All the same, the study's limitations included the exclusion of children who were ill, absent, or afraid of the dentist on the day of examination, which may have affected the sample size and representation. Additionally, the study was limited to Eastern Croatia, and further research is needed to assess MIH prevalence across the entire country.

A study in Brazil Damares Lago et al. (2022) aimed to evaluate the prevalence evolution rate of MIH over a six-year period in Araraquara, São Paulo. The researchers conducted a population-based study involving 545 schoolchildren aged 6 to 12 years. They assessed MIH and other associated dental conditions, such as dental caries and dental fluorosis, using clinical examinations and a semistructured questionnaire to gather socioeconomic data from the children's parents or guardians. The methodology included a cross-sectional design, with data collection through clinical examinations performed under natural light in a school environment. The researchers used the European Academy of Pediatric Dentistry (EAPD) criteria to diagnose MIH and employed Poisson regression analysis with robust variance to analyze associations between MIH and clinical characteristics. The main results indicated that the prevalence of MIH in Araraquara increased from 12.3% in 2010 to 14.3% in 2016. The majority of affected teeth exhibited mild demarcated opacities, with the mandibular first molars being the most commonly affected. There was no significant association between MIH and dental caries experience in either permanent or primary dentition. However, children with MIH had a significantly lower prevalence of dental fluorosis. The study concluded that the number of MIH cases had increased over the six-year period, highlighting the need for further research to identify etiological factors and establish early intervention strategies. The researchers acknowledged limitations, such as the cross-sectional design, which precluded causal inferences, and the reliance on self-reported socioeconomic data, which may have introduced bias.

In a similar review Verma et al. (2022) aimed to evaluate the prevalence of MIH, its possible risk factors, and its association with dental caries and enamel surface defects in schoolchildren aged between 8 and 16 years in the Lucknow district. The

researchers sought to understand the extent of MIH and its correlation with various dental issues. The methodology involved examining the indexed teeth (first permanent molars and incisors) of 5,585 schoolchildren, selected through stratified random sampling. A trained and calibrated examiner conducted the examinations, recording data in a predesigned pro forma. The study utilized the Developmental Defects of Enamel (DDE) Index for diagnosing MIH and the decay-missing-filled teeth (DMFT) index for assessing dental caries. Enamel surface defects were recorded using the Smith and Knight tooth wear index. The main results indicated a prevalence of 7.6% for MIH, with females being more affected than males. A significant correlation was found between MIH prevalence and childhood infections. The study also highlighted that early diagnosis of MIH is crucial to prevent rapid tooth morphology destruction, necessitating complicated treatments. However, the study acknowledged limitations, such as the lack of comprehensive medical history for infants in the initial four years of life.

A Venezuelan study by Rodriguez-Rodriguez et al. (2021) sought to find out the prevalence and distribution of MIH and Hypomineralized Second Primary Molar (HSPM) in children aged 6 to 12 years who received dental care in the Caracas Metropolitan Area, Venezuela. A cross-sectional prospective study was conducted on 145 children, with 121 selected through stratified random sampling. A calibrated examiner evaluated all patients using MIH diagnosis criteria established by the European Academy of Paediatric Dentistry. Data were analyzed with a significance level of 5%. The main results indicated that the prevalence of MIH and HSPM was 25.6% and 20%, respectively. Both enamel defects were more prevalent in females. Severe MIH and HSPM were present in 21.8% and 31.2% of cases, respectively. The study concluded that the prevalence of MIH in Venezuelan children was higher than

previously estimated for South America, with a predominance of mild affectation and more frequent occurrence in upper molars. However, the study faced limitations related to the economic crisis in Venezuela, which affected public services and general living conditions. Additionally, the COVID-19 pandemic halted data collection, though the minimum sample size had been reached.

Shetty et al. (2022) sought estimate the pooled prevalence of MIH in children from India.\ The researchers followed the PRISMA guidelines and conducted an electronic search of databases to find prevalence studies of MIH in children above the age of six years in India. Data from 16 studies, representing seven states of India and including a total of 25,273 children, were extracted and analyzed. The risk of bias was assessed using a modified version of the Newcastle–Ottawa Scale adapted for cross-sectional studies. The pooled prevalence of MIH in India was estimated to be 10.0% with significantly high heterogeneity between the included studies. The prevalence did not vary according to sex, and the proportions of MIH-affected teeth were similar in the maxillary and mandibular arches. The proportion of children with the MH phenotype was higher (56%) than those with the M + IH phenotype (44%). The study concluded that MIH is a significant public health issue in India. However, there was lack of uniform distribution of studies across the country and the high heterogeneity among the included studies, which may have affected the generalizability of the results.

In a study in India, Shah et al. (2023) evaluated the prevalence, severity, and associated risk factors of MIH among children aged 8–13 years in the Vadodara District of Gujarat, India. The researchers conducted a cross-sectional study involving 3,000 children from government schools, with an equal number of participants from urban and rural areas. The study utilized the diagnostic criteria established by the European Academy of Paediatric Dentistry (EAPD) in 2003 to

clinically diagnose MIH. The data were analyzed using Pearson's Chi-squared test and Fisher's exact test to determine the relationship between variables. The results indicated that 286 children (9.6%) were affected by MIH, with a higher prevalence in rural areas (12.6%) compared to urban areas (6.47%). The study found that the primary risk factors for MIH in rural areas were prolonged illness (>15 days), while in urban areas, the prolonged use of antibiotics before the age of four was a significant risk factor. Additionally, males were more affected than females, and the severity of MIH was greater in molars compared to incisors. The study concluded that MIH was a prevalent condition among children in the Vadodara District, with significant differences in prevalence and risk factors between urban and rural populations. The researchers recommended early diagnosis and follow-up protocols to manage the condition effectively. However, the study had limitations, including reliance on parents' recall for past medical history and drug intake, and the study's focus on a specific region, which may not be representative of the entire population of India.

Tarannum et al. (2021) evaluated the prevalence of MIH among schoolchildren aged 8 to 14 years in Gannavaram Mandal, Krishna district, Andhra Pradesh, India. The researchers conducted a cross-sectional study involving 2,250 children randomly selected from various schools. The children were screened for MIH using the European Academy of Paediatric Dentistry (EAPD) 2003 diagnostic criteria, and the severity of MIH was assessed using the Wetzel and Reckel scale. The main results indicated that the prevalence of MIH was 2.1%, with a higher occurrence of mild severity cases. There was no significant difference in MIH prevalence between males and females. The study concluded that early diagnosis and treatment of MIH could significantly reduce associated complications. However, the study did not investigate the etiological factors related to MIH, and the fluoride levels in school water were not

considered, despite the region being an endemic fluorosis zone. Additionally, the study's sample size and age range might have influenced the results, and further studies with larger sample sizes and consideration of etiological factors were recommended to gain a more comprehensive understanding of MIH.

A recent study by Chowdhury et al. (2024) sought to determine the prevalence and treatment needs of MIH in children aged 7 to 9 years in Lucknow city. The researchers conducted a cross-sectional study involving 800 children from various schools. The participants were selected using a stratified sampling method, and the examination was performed using the Würzburg MIH concept: MIH-TNI. The overall prevalence of MIH was found to be 5.12%, with a higher prevalence in males (7%) compared to females (3.25%). The study concluded that the prevalence of MIH in children of Lucknow city was 5.12%. The characteristics of MIH defects were predictive of the treatment needs for the affected first permanent molars and incisors, guiding their management. However, the study had limitations, including its cross-sectional design, which did not assess the progression of the disease over time, and the exclusion of all faces of teeth examined for MIH.

In a similar study, Khan et al. (2022) sought to determine the prevalence, pattern, and severity of MIH in 8–12-year-old schoolchildren in Moradabad city. The researchers conducted an epidemiological cross-sectional survey in various schools, targeting a sample of 2,300 children. The examination was performed by a calibrated examiner in natural daylight using the European Academy of Pediatric Dentistry diagnostic criteria for MIH 2015. The data were statistically analyzed using Pearson’s Chi-square test. The study found a prevalence of 3.96% for MIH among the children, with no significant gender predilection. Molar hypomineralization showed a prevalence of

1.3%, while hypomineralization of second primary molars was 1.4%. The study concluded that MIH is a relatively common condition among schoolchildren in Moradabad city. However, did not record the etiological factors that might influence the development of MIH, and the data obtained from Moradabad may not represent the entire nation.

Goswami et al. (2019) T study aimed to determine the prevalence MIH in children aged 6–12 years in Central Delhi, India. This cross-sectional descriptive study involved 1,026 children selected through random sampling. The dental examination was conducted by trained pediatric dentists using the European Academy of Pediatric Dentistry (EAPD) 2003 criteria for diagnosing MIH. Data were statistically analyzed using the Chi-square test. The study found that the prevalence of MIH was 1.17%, with a statistically significant higher prevalence in males. The study concluded that MIH is a developmental disturbance requiring a multidisciplinary treatment approach. However, the study faced limitations, including incomplete natal and postnatal histories provided by parents and the inability to obtain relevant medical records, which may have led to an underestimation of the risk factors associated with MIH.

2.4 Distribution of Molar Incisor Hypomineralisation

Distribution in terms of the teeth affected and jaw that will present with more teeth affected. By the end of the study I will be able to know who are being affected more by MIH(Abdalla et al., 2021b). MIH affects permanent first molars and incisors however one patient may have only one of the teeth affected. A study done at Brazil showed that most of the children had three teeth affected and mainly molars excluding the incisors. Other studies have showed two of the teeth being affected by the mih while the rest of the teeth were basically normal(Abdalla et al., 2021a). Apart from

differences in teeth distribution variations there has been some differences in jaw where maxillary are usually more affected as compared to the mandibular jaw(Abdalla et al., 2021a). There is clear variation in different teeth and well as jaws. There is no known explanation why some regions will have more cases presenting with, upper jaw molar affected than incisors.

A study by de Farias et al. (2020) assessed the association between MIH and enamel hypomineralization of the second permanent molars in terms of presence and severity. The researchers conducted a retrospective cross-sectional study, evaluating permanent teeth in 453 patients aged 13 to 16 at a dental clinic using intraoral photographs. A calibrated examiner classified enamel hypomineralization using the MIH index and dental caries experience using the DMFT and DMFS indices. Statistical analyses were performed using a linear generalized model and ordinal logistic regression. The main results indicated that permanent molars were the most affected teeth by enamel hypomineralization, while incisors, premolars, and canines were less affected. Severe defects in the first permanent molars were associated with mild defects in the second permanent molars (OR = 4.01; 95% CI: 2.50-7.77). Additionally, enamel hypomineralization was associated with increased caries experience (PR = 5.54; 95% CI: 3.81-9.06). The study concluded that enamel hypomineralization primarily affects the first and second permanent molars. Mild defects in the second permanent molars were more frequent in patients with severe MIH in the first permanent molars. The presence of enamel hypomineralization was associated with higher dental caries experience. However, the study had limitations, including its retrospective design and reliance on intraoral photographs, which may have introduced bias.

A systematic review by Shetty et al. (2022) which sought estimate the pooled prevalence of MIH in children followed the PRISMA guidelines and conducted an electronic search of databases to find prevalence studies of MIH in children above the age of six years in India. Data from 16 studies, representing seven states of India and including a total of 25,273 children, were extracted and analyzed. The risk of bias was assessed using a modified version of the Newcastle Ottawa Scale adapted for cross-sectional studies. The main results indicated that the pooled prevalence of MIH in India was estimated to be 10.0% with significantly high heterogeneity between the included studies. The prevalence did not vary according to sex, and the proportions of MIH-affected teeth were similar in the maxillary and mandibular arches. The study's limitations included the high heterogeneity between the included studies and the lack of uniform distribution of studies across the country, which may affect the generalizability of the results. Additionally, the diagnostic criteria and examiner calibration varied among the studies, potentially influencing the prevalence estimates. Further research is needed to address these gaps and provide more reliable data on the prevalence of MIH in India.

A study by Davenport et al. (2019), investigated the prevalence of MIH among third-grade school children in Milwaukee, Wisconsin, USA. The researchers employed a cross-sectional design, utilizing a convenience sample of third-grade students from the Milwaukee Public School System. The children were examined by calibrated examiners trained on the European Academy of Paediatric Dentistry (EAPD) MIH recommendations. The examinations took place between December 1, 2014, and June 30, 2015, using a flashlight and mirror at the children's schools, following consent from parents/caregivers and assent from the children. The study found that out of 375 children examined, 36 (9.6%) exhibited signs consistent with MIH. The prevalence of

severe defects was higher in lower molars. The analysis revealed no statistically significant differences in MIH prevalence based on sex, race/ethnicity, or socioeconomic status. The study concluded that MIH affected 9.6% of the children in the sample, highlighting the need for further statewide and nationwide surveys to better understand the extent and severity of MIH in the United States. However, it is difficult to generalize findings to the entire population of Milwaukee's children due to the convenience sampling method and the relatively small sample size. Additionally, the high prevalence of Hispanic participants may have influenced the results, as this demographic was overrepresented compared to the general population of Milwaukee.

A study by Khan et al. (2022) aimed to determine the prevalence, pattern, and severity of MIH) in 8–12-year-old schoolchildren in Moradabad city. The researchers conducted an epidemiological cross-sectional survey in various schools, targeting a sample of 2,300 children. The examination was performed by a calibrated examiner in natural daylight using the European Academy of Pediatric Dentistry diagnostic criteria for MIH 2015. The results were statistically analyzed using Pearson’s Chi-square test. The study reported a prevalence of 3.96% for MIH, with no gender predilection. Molar hypomineralization showed a prevalence of 1.3%, while hypomineralization of second primary molars was 1.4%. The most common type of defect was type 2, and most of the affected teeth were of grade I. Mandibular molars were more commonly affected compared to maxillary molars. The study acknowledged limitations, including the lack of recording etiological factors influencing MIH development and the representation of only a small part of the country.

In a study by Goswami et al. (2019), the prevalence of MIH in children aged 6–12 years in Central Delhi, India was investigation. This cross-sectional descriptive study involved 1,026 children selected through random sampling. The dental examination was conducted by trained pediatric dentists using the European Academy of Pediatric Dentistry (EAPD) 2003 criteria for diagnosing MIH. The data were statistically analyzed using the Chi-square test. The prevalence of MIH was found to be 1.17%, with a statistically significant higher prevalence in males. A total of 77 teeth were affected, including 44 molars and 33 incisors. The severity of MIH was greater in molars (52.27%) compared to incisors (24.24%). All four first permanent molars were affected in 83.3% of the children with MIH. The study concluded that MIH is a developmental disturbance requiring a multidisciplinary treatment approach. The high esthetic demand and the challenges in delivering successful restorative care to hypomineralized teeth were noted. However, the study faced limitations, including incomplete natal and postnatal histories provided by parents and the inability to obtain relevant medical records. This may have led to an underestimation of the risk factors associated with MIH.

A study in India by Mittal et al. (2016) aimed to investigate the association between hypomineralized second primary molars (HSPMs) and MIH, as well as their prevalence and severity of dental caries in school-going children in Nagpur, Maharashtra, India. The methodology involved a cross-sectional survey conducted among 1,109 pupils aged 3-12 years. The sample was divided into two groups: Group I (3-5 years) and Group II (6-12 years). The European Academy of Pediatric Dentistry criteria were used to score HSPM and MIH, while the International Caries Detection and Assessment System II (ICDAS II) was used to assess caries status. A single calibrated dentist conducted the examinations in schools under natural daylight. The

main results indicated that 4.88% of children in Group I had HSPM, and 7.11% of children in Group II had MIH. Among the children with MIH, 48% also had HSPM.

The study found that hypomineralized molars were more susceptible to severe carious lesions. The conclusion drawn was that there was a significant association between HSPM and MIH, with a notable prevalence of both conditions in the study population. The study highlighted the increased likelihood of caries development in hypomineralized teeth. However, the study had limitations, including the age group selection, which might not represent the exact prevalence, and the small sample size used for analyzing the susceptibility of hypomineralized teeth to caries. These gaps suggest the need for further research with a larger and more diverse sample.

A study by Subramaniam et al. (2016) aimed to determine the prevalence of MIH in 7–9-year-old children in Bengaluru City, India. A cross-sectional epidemiological study was conducted on a random sample of 2500 school children. Oral examinations were performed by a single trained examiner under natural daylight. The results indicated that 0.48% of the children were diagnosed with MIH, affecting a total of 68 teeth. Among the affected teeth, mandibular molars were more frequently affected than maxillary molars. The study concluded that the prevalence of MIH in the sample was 0.48%, with no gender predilection. A significant association was observed between childhood illness and MIH. The study had limitations, including reliance on retrospective data from parental questionnaires, which could lead to recall bias. Additionally, the cross-sectional nature of the study limited the ability to establish causality.

A recent study by Chowdhury et al. (2024) sought to determine the prevalence and treatment needs of MIH in children aged 7 to 9 years in Lucknow city. The methodology involved clinically screening 800 children for the presence of MIH using the Würzburg MIH concept. Demographic details were collected through communication with parents, and the examination was performed by two calibrated examiners. The main results indicated that the overall prevalence of MIH was 5.12%, with a higher prevalence in males (7%) compared to females (3.25%). The distribution of MIH was more pronounced in the mandibular arch than in the maxillary arch. Mandibular molars were the most affected teeth, followed by maxillary incisors, while maxillary molars were the least affected. In terms of severity, 55.14% of teeth with MIH had no breakdown or hypersensitivity, 30.14% had hypersensitivity but no breakdown, and 7.35% had both hypersensitivity and breakdown. The characteristics of MIH defects were predictive of the treatment needs for the affected first permanent molars and incisors, guiding their management. However, the study had limitations, including its cross-sectional design, which did not assess the progression of the disease over time. Additionally, the study did not account for all the faces of teeth examined for MIH, which could have provided a more comprehensive understanding of the condition.

A study in Sri Lanka by Palipana and Adikari (2023) aimed to determine the prevalence of MIH among primary school children in the Colombo district and to describe the pattern of disease involvement. The researchers conducted examinations on a sample of 1161 Grade 3 students, aged eight years, from 20 randomly selected schools. A single dentist diagnosed MIH based on the judgment criteria established by the European Academy of Paediatric Dentistry (EAPD) in 2003. The results indicated that MIH was diagnosed in 118 children, representing a prevalence rate of 10.2%.

Among those affected, 61 were girls (51.7%) and 57 were boys (48.3%), suggesting no significant gender association with MIH. The findings revealed that the first permanent molars were more frequently affected by MIH than the incisors, with first incisors being more commonly involved than second incisors. In conclusion, the study highlighted the relatively high prevalence of MIH in the population examined, emphasizing the importance of early diagnosis and management to prevent potential complications related to the condition.

A Venezuelan study by Rodriguez-Rodriguez et al. (2021) reviewed the prevalence and distribution of MIH and HSPM in children aged 6 to 12 years who received dental care in the Caracas Metropolitan Area, Venezuela. A cross-sectional prospective study was conducted on 145 children, with 121 selected through stratified random sampling. A calibrated examiner evaluated all patients using the MIH diagnosis criteria established by the European Academy of Paediatric Dentistry. Data were analyzed with a significance level of 5%. The study found that the prevalence of MIH and HSPM was 25.6% and 20%, respectively. Both enamel defects were more prevalent in females. Severe MIH and HSPM were present in 21.8% and 31.2% of cases, respectively. The average number of affected teeth was 4.16 for MIH and 1.68 for HSPM, with the condition being more frequent in upper molars. The study concluded that the prevalence of MIH in Venezuelan children was higher than the previously estimated prevalence for South America, with a predominance of mild affectation and more frequent occurrence in upper molars. However, the study faced limitations due to the Venezuelan economic crisis, which affected public services and healthcare conditions. Additionally, the COVID-19 pandemic forced the researchers to stop data collection prematurely, though the minimum sample size had been

reached. These limitations suggest that the results should be interpreted with caution and used as a reference for similar dental healthcare services.

Zameer et al. (2024) evaluate the prevalence, severity, and associated aetiological factors of MIH in children seeking dental care at Armed Forces Hospital, Jazan, Saudi Arabia. The researchers conducted an observational cross-sectional study on 1405 children from military families, aged 8-12 years, using convenience sampling. The diagnostic criteria were based on the molar incisor hypomineralization severity scoring system (MIH-SSS), and data were collected through clinical examinations and questionnaires. The main results indicated that the prevalence of MIH was 8%, with maxillary incisors and mandibular first molars being more frequently affected. The study found that MIH in incisors had mild to moderate severity, while molars presented with severe defects. Significant associated factors for MIH development included maternal anaemia, vitamin D deficiency, caesarean delivery, low birth weight, perinatal jaundice, early childhood tonsillitis, and early childhood anaemia. The study concluded that MIH was prevalent among the children studied, with prenatal, perinatal, and postnatal factors playing a significant role in its development. However, the study had limitations, including its focus on children from military families in Jazan, which may not be representative of the entire population. Additionally, the reliance on parental recollection for data collection could introduce bias, and the retrospective nature of the study only established associations rather than causality.

Zakirulla et al. (2023) evaluated the prevalence, severity, and clinical characteristics of MIH in 8-13-year-old Saudi children. The methodology involved screening 596 children (346 males and 250 females) for MIH at the Department of Pediatric

Dentistry, College of Dentistry. Experienced clinicians conducted dental examinations using a standard mouth mirror and dental probe, examining the four permanent first molars and eight permanent incisors for demarcated opacities and atypical restorations under a portable light source. The results were analyzed for statistical significance using the Chi-square test and t-test with a P value of <0.05 considered significant. The main results indicated that the prevalence of MIH varied with age, being 17% at 8-9 years, 14% at 10-11 years, 30% at 11-12 years, and 39% at 12-13 years. A total of 633 teeth were affected by MIH, with 225 (36%) being central incisors, 94 (15%) lateral incisors, and 314 (49%) first permanent molars (FPM). The study concluded that MIH is a clinically and epidemiologically important issue in Saudi school children, with a higher rate of serious forms being of medical concern. However, the study did n not record the severity of hypomineralization in clinical notes and only including boys due to separate schools for boys and girls in Saudi Arabia.

A study by Hussain et al. (2018) evaluated the prevalence and severity of MIH among schoolchildren in Dubai, UAE. A randomized cluster sample of 342 eight to 12-year-old schoolchildren had their permanent first molars and incisors evaluated for prevalence and severity of MIH using the European Academy of Paediatric Dentistry criteria. The prevalence of MIH in Dubai was found to be 27.2 percent and was significantly higher in girls (32.6%) compared to boys (18.1%; P=0.002). The prevalence of molar hypomineralization (MH) was higher than MIH: of the 27.2 percent diagnosed children, 65.6 percent had only MH while 34.4 percent had MIH. MH prevalence in maxillary molars was 20.8 percent, significantly higher than 14.6 percent in mandibular molars (P≤0.005). Almost nine percent of maxillary incisors were affected by MIH compared to 0.9 percent of mandibular incisors (P≤0.001). The presence of demarcated opacities was significantly higher in females than males (P

=0.002). Fifty-three percent of the children with MIH had mild defects, 17 percent had moderate defects, and 30 percent had severe defects.

Another study in UAE by Osama et al. (2021) aimed to determine the prevalence, pattern, and distribution of MIH in school-going children. The researchers conducted a cross-sectional study involving 1200 children aged 8-12 years, with 656 boys and 544 girls. The children were examined for the presence of MIH using disposable diagnostic sets, and the results were analyzed using SPSS version 20. The study found that the prevalence of MIH was 21.16%, with a higher prevalence in girls compared to boys. The mandibular molars were more commonly affected than the maxillary molars, and the results were statistically significant. The most common defect observed was Demarcated Opacities, followed by Post-Eruptive Breakdown, Atypical Restorations, and Extractions. The study concluded that MIH was prevalent in Arab children in Ras Al Khaimah, UAE, with mandibular molars being more commonly affected than maxillary molars. However, there was the potential for bias due to the exclusion of children with medical conditions and the reliance on parental consent for participation.

Oyedele et al. (2015) study aimed to determine the prevalence, pattern and severity of MIH in school children resident in a suburban population in Nigeria. This was a cross-sectional study involving pupils aged 8–10 years resident in suburban Nigeria. Details of each pupil's socio-demographic variables were collected. Intra-oral examination was conducted to determine the presence of MIH, the affected tooth and the severity of the lesion. The association between the prevalence of MIH and socio-demographic variables of each child was determined. The predictors of MIH were also determined using a binomial regression analysis. The prevalence of MIH was

17.7%. The most commonly affected teeth were the left mandibular molars. The occlusal surfaces of the first molars were mostly affected by MIH and the severity of MIH on the teeth examined varied from mild (80.8 %), moderate (14.0 %) to severe (5.2 %).

A study in Nigeria by Temilola et al. (2015) reviewed the prevalence, pattern, and clinical presentation of MIH and Deciduous Molar Hypomineralization (DMH) in children residing in Ile-Ife, Nigeria, and to explore their association with sex and socioeconomic status. The methodology involved collecting information on age, sex, and socioeconomic status from 563 children aged 3 to 5 years and 8 to 10 years through a structured questionnaire administered via a household survey. Clinical examinations were conducted to assess the presence of DMH and MIH, and the prevalence of these conditions was determined. Associations between sex, socioeconomic status, and the prevalence and pattern of DMH and MIH were analyzed using Pearson's Chi-squared test and Fisher's exact test. The main results indicated that 4.6% of children aged 3 to 5 years had DMH, while 9.7% of children aged 8 to 10 years had MIH. There were no significant associations between DMH and sex ($p = 0.49$) or socioeconomic status ($p = 0.32$), nor between MIH and sex ($p = 0.31$) or socioeconomic status ($p = 0.41$). MIH/DMH co-morbidity was observed in 34.8% of children with MIH. The mandible and maxilla were equally affected, and no specific pattern of presentation was identified. The study concluded that the prevalence of DMH and MIH in the study population was high and that these conditions were not associated with sex or socioeconomic status. The high prevalence of MIH/DMH co-morbidity suggested that children with DMH should be screened for MIH. However, there is inability to generalize the findings to the entire country, as the study was conducted in only one local government area. Additionally, the cross-

sectional design limited the ability to establish causal relationships between DMH and MIH.

2.5 Pattern of MIH

2.5.1 Pattern of molar incisor hypomineralisation

Diagnostic criteria for MIH have been established to distinguish it from other developmental defects of enamel since 2001 by Weehjm, which has undergone improvement with time.

European Academy of Pediatric Dentistry (EAPD) criteria

According to this criterion, the tooth should be examined while wet, when the client is eight years of age, when the permanent molars and the incisors have erupted.

Absence or presence of clearly demarcated opacities

Post-eruptive enamel breakdown

Atypical restorations

Extractions of molars due to MIH

Failure of eruption of a molar or an incisor

Assessment criteria for the diagnosis of MIH according to Weerheijm et al

Table 2.5.1: Clinical Presentations

Feature	Description
Demarcated opacity	This is demarcated by a defect involving a change of translucency of the enamel. The degree of this defect is variable. The enamel defect has normal thickness and a smooth surface. The colour is white, yellow, or brown. Defeats>1mm are not to be reported.
post-eruptive breakdown	The surface defect becomes visible after tooth eruption. Enamel loss from an initially formed surface after tooth eruption is present. The loss of enamel is usually associated with the existing enamel opacity.

Atypical restoration	The size and the shape of the restorations do not correspond to the temporary caries picture. The atypical restoration frequently extends to the buccal, palatal /lingual surfaces in molars. An opacity may be visible on the margin of the restorations. In the incisors, a buccal restoration may be noticed that may not be related to trauma.
Extraction of molars due to MIH	The absence of the first permanent molar should be related to other teeth of the dentition. The following factors are suspicious for the extraction due to MIH: Opacities or atypical restorations on the other first molars in combination with the absence of the first permanent molar. Absence of the first permanent molar in an otherwise healthy dentition in combination with the demarcated opacities in the incisors.
Failure of eruption of the molar incisor	The first permanent molar or the incisor to be examined has not yet erupted.

Differential diagnosis of molar incisor hypomineralisation

MIH needs to be differentiated from other structural disorders as part of its precise identification. Patient history may also help in differentiating this condition from other endemic lesions like fluorosis. Some lesions may mimic mih (bekes, 2021):

Amelogenesis imperfecta.

It is a heterogeneous group of conditions characterized by an inherited developmental enamel defect. (claire .E.L.Smith, 2017).

This condition affects enamel differentiation or the function of ameloblasts, which results in the formation of chemically, quantitatively, and /or structurally abnormal enamel. The dentin is normal in this case. Being genetic, it is generalised in nature, affecting the thickness of the enamel. Hypomaturation form of amelogenesis of the enamel may be normal but mottled in appearance. Severe forms of AI will present with reduced bite height. Clinically hypocalcified amelogenesis presents as yellow to orange discoloration (bekes, 2021).

Dental fluorosis

Dental fluorosis results from chronic exposure to systemic fluoride during enamel formation and maturation, which is irreversible. (Paolo Demarchi 1, 2023). Increased fluoride concentration impairs the activity of ameloblasts during the late secretion and early maturation phases, resulting in the formation of inferiorly mineralised enamel. It presents as endemically and symmetrically on a homogenous pair of teeth according to their mineralization time. It is a dose-dependent phenomenon: the more the teeth are exposed to fluoride during development, the more severe the fluorosis. The clinically mild form appears as white, diffuse, opaque patches and streaks. With increasing severity, the white spots become more distinct and occupy a larger part of the enamel. Pitting with dark brown that becomes stained from the incorporation of exogenous pigments in the very severe forms. One can differentiate MIH from fluorosis anamnestically and clinically.

Tetracycline

Tetracycline belongs to the group of broad-spectrum antibiotics. Use of tetracycline during pregnancy or childhood to the age of eight causes a gray and yellow discoloration in primary and permanent teeth. Tetracycline forms a chelate complex with calcium, which is irreversibly incorporated into the enamel or dentin during hard tissue formation of the teeth. The discoloration affects the entire tooth or the specific part that was in the process of developing during the antibiotic exposure.

Traumatically induced disorders of the teeth

Enamel formation due to trauma is characterized by a solitary, clearly circumscribed mineralization disorder. The buccal surface is predominantly affected. Clinical appearance ranges from demarcated white, yellow, or brownish opacities to hypoplasia on the buccal surface of the clinical crown to its malformation, as well as

inhibition of the root development or presents with dilaceration. The severity depends on the intensity and the timing of the injury.

Turner tooth

Turner's teeth are caused by inflammation and may result from periapical infection of the preceding primary teeth. Turner's teeth are usually found in the premolars and not in the molars. Hypoplastic lesions are usually regular and smooth, whereas the margins of MIH-defects are sharp and regular. (Asha Karadwal1, 2021).

White spot lesion

These are initial caries, the first clinical sign of a carious lesion in the enamel, and a representation of an early stage of caries. (Pedro C. Lopes1*, 2024) Occurs due to prolonged plaque accumulation on the affected tooth surface. It can be diagnosed by its localization at the characteristic predilection site. On the buccal surfaces, the wite spot usually appears as an extended line just above the gingival margin. For Mih, it is a distinct lesion that mainly affects the molar cusp or the buccal surface.A systematic review and meta-analysis by Santos et al. (2024) investigated the prevalence of dentin hypersensitivity (DH) and toothache in patients diagnosed with MIH and to evaluate whether these patients had a greater likelihood of presenting DH/toothache compared to controls. The methodology involved a systematic review and meta-analysis of studies evaluating DH/toothache in patients with MIH. Eight databases, including grey literature, were searched in January 2024. The methodological quality of the studies was assessed using the Joanna Briggs Institute checklist for Cross-sectional studies. Proportion and association meta-analyses, subgrouped by diagnostic methods, were conducted. The certainty of evidence was assessed using the GRADE approach. The main results indicated that the overall prevalence of DH/toothache among patients with MIH was 45%. Prevalence rates of 30%, 47%, and 55% were estimated

based on proxy reports, self-reports, and air stimulation, respectively. The overall prevalence of DH/toothache per tooth was 22%, ranging from 16% to 29% according to the diagnostic method. Patients with MIH demonstrated a higher likelihood of presenting proxy reports of DH/toothache compared to those without MIH (OR: 1.51, 95% CI [1.23–1.85], P < 0.01, I2: 0%). The study concluded that the global prevalence of DH/toothache was 22% per tooth and 45% per patient, with estimates varying according to diagnostic methods. Patients with MIH showed a higher likelihood of presenting proxy reports of DH/toothache than controls. The gaps related to the limitations of the study included the low methodological quality of the included studies and high inconsistency, which resulted in very low certainty of evidence.

In Canada, Wang (2018) studied the prevalence and presentation patterns of MIH and hypomineralised second primary molars (HSPM) among paediatric dental patients at The Hospital for Sick Children in Toronto, Canada. The methodology involved a cross-sectional study of 429 participants, examined by nine calibrated examiners using the European Academy of Paediatric Dentists criteria to diagnose and document MIH/HSPM based on clinical presentation, size, and location of defects. The main results indicated that the prevalence of MIH was 12.4% (n=29) and 5.2% (n=19) for HSPM. The most common clinical finding for both MIH and HSPM was demarcated white opacities, observed in 60% of MIH cases and 67% of HSPM cases. Single surface hypomineralised lesions were significantly more common than multi-surface lesions, and lesions affecting less than one-third of a tooth surface were more prevalent than those affecting greater areas. The study concluded that the prevalence of MIH and HSPM in this North American sample was within the range of published studies from other continents. However, the higher prevalence of enamel

hypomineralisation was expected due to the medical comorbidities of the participants and the steep learning curve associated with the grading system used.

A descriptive, cross-sectional, and multicentre study in Spain included children aged between 8 and 16 years who were users of the dental services at eight primary oral health units of the Madrid Health Service (SERMAS). The researchers calibrated their diagnostic criteria according to the European Academy of Paediatric Dentistry (EAPD) guidelines. The children underwent dental examinations, and their parents completed questionnaires. The study found that the prevalence of MIH was 28.63%, with the age cohorts most affected being 8 years (21.4%) and 11 years (20.7%). Girls were more affected (60.71%) than boys (39.28%). On average, each patient had 4.46 affected teeth. The upper right first molar was the most frequently affected molar (74.3%), and the upper left central incisor was the most affected incisor (37.85%). Opacities were the most common defects recorded (63.57%). The study concluded that the prevalence of MIH in this population was the highest among relevant studies conducted in Spain. The researchers noted that the high prevalence of MIH necessitates the promotion of multidisciplinary awareness and prevention programs for primary health care personnel. However, the study used a short data form suggested by the EAPD, which only analyzed index teeth, and a smaller number of participants in the oldest age groups, which decreased the representativeness of the sample (Ortega-Luengo et al., 2024).

In a study among schoolchildren in Geneva, Switzerland, Abdelaziz et al. (2022) sought to quantify the prevalence of MIH. Thirty-eight dentists from the state school dental services were trained to detect and classify MIH cases. The study examined 32,142 children aged 4 to 12 during the annual dental screening offered by the state.

MIH cases were scored as mild, moderate, or severe. The results indicated that the prevalence of hypomineralizations was 7.45% when all hypomineralized teeth were considered, with MIH cases specifically at 6.6%. Among the MIH cases, 51% were mild, 36% were moderate, and 13% were severe. The study found that upper molars were the most frequently affected teeth, followed by lower molars and upper incisors. Lower incisors were the least affected. The study concluded that the mean prevalence of MIH in Geneva schoolchildren was 6.6%, which was lower than the European and global averages. However, with almost half of the cases being moderate or severe, the study emphasized the need for a proper management protocol. However, the study used simplified criteria and lacked intra- and inter-examiner agreement calculations, which may have compromised the results.

In a study in Brazil, Silva et al. (2020) aimed to define the prevalence of MIH in Brazil, given the wide range of reported prevalence rates from 2.5% to 40.2%. The methodology involved examining 407 children aged 7 to 14 years using the European Academy of Paediatric Dentistry criteria from 2003. Clinical data were collected by a calibrated dentist, and the severity of MIH was categorized as mild or severe. Mild cases were identified by demarcated opacity without structural loss, while severe cases involved structural loss or required treatment. The main results indicated that 14.5% of the children were affected by MIH, with most cases being mild (77.4% of affected teeth). The affected teeth included first permanent maxillary molars (33%), first permanent mandibular molars (28.3%), permanent maxillary incisors (22.2%), and permanent mandibular incisors (16.5%). Severe cases predominantly involved the first permanent molars. The study concluded that the prevalence of MIH in Brazil was 13.48% based on a meta-analysis of nine published reports and the original data.

However, there was high heterogeneity among the included studies due to varying diagnostic criteria and age groups.

In another Brazilian study, Takahashi et al. (2022) aimed to determine the prevalence and consequences of MIH in children attending a public school in São Paulo, Brazil. The methodology involved clinical examinations of 457 children aged 7 to 11 years, conducted by a single trained and calibrated examiner using the criteria proposed by the European Academy of Pediatric Dentistry (EAPD, 2009). The examinations were performed under natural light with wooden spatulas. Results showed that 15% of the students (79 children) were affected by MIH, with only one case exhibiting sensitivity. The affected teeth showed hypoplastic enamel defects characterized by white-yellowish spots on the cusp tips of molars and free surfaces of incisors. These defects made the teeth vulnerable to carious lesions, early loss of enamel, and increased sensitivity. The study concluded that the prevalence of MIH was significant, although symptoms related to sensitivity were rare. The study highlighted the need for further clinical research to understand the severity and implications of MIH better. One of the gaps identified was the lack of differentiation between diffuse and demarcated lesions, which could affect the accuracy of prevalence data. Additionally, the study's reliance on a single examiner might have introduced bias, and the sample was limited to one school, which may not be representative of the broader population.

Ismail and Saleem (2023) investigated the prevalence of MIH and its association with certain risk factors among children attending two specialized dental centers in Erbil city. The methodology involved a cross-sectional study design, where a sample of children aged 7-12 years was examined for MIH. Data on potential risk factors were collected through questionnaires filled out by the children's parents. The results indicated that MIH was present in a significant proportion of the children examined.

The teeth most commonly affected were the first permanent molars and incisors. These teeth exhibited various degrees of hypomineralization, ranging from mild discoloration to severe structural defects, which could lead to increased sensitivity and a higher risk of dental caries. The study concluded that MIH is a prevalent condition among the children in the sample, and it highlighted the need for early diagnosis and management to prevent further complications. However, there was overreliance on parental reports for risk factor data, which could introduce bias.

Thakur et al. (2020) investigated the prevalence and etiology of MIH in children aged 8 to 16 years in the industrial town of Baddi, Himachal Pradesh. A cross-sectional study was conducted with a sample of 2,000 children selected through simple random sampling from various schools in Baddi. MIH was diagnosed based on the EAPD 2003 criteria revised in 2009, and data were collected using clinical examinations and a self-prepared questionnaire. The main results indicated that the prevalence of MIH was 2.9%, with demarcated opacities being the most common defect observed. Postnatal illnesses were significantly associated with MIH, and the prevalence of dental caries in MIH patients was 82.7%. The study concluded that postnatal illnesses played a significant role in the development of MIH and that MIH predisposed teeth to dental caries. However, the study had limitations, including potential diagnostic errors due to enamel demineralization from other causes and the reliance on self-reported data for prenatal, perinatal, and postnatal health conditions.

Praptiwi et al. (2019) sought to determine the prevalence of MIH in primary school children. A cross-sectional study was conducted with purposive sampling on 619 primary school children in Pasteur Urban Village, Bandung City, Indonesia. The European Association of Paediatric Dentist (EAPD) MIH scoring sheet was used to

score all dentition and oral hygiene status was assessed using a simplified Oral Hygiene Index (OHI). Data were descriptively described using distribution tables. The main results indicated that 19% (118 out of 619 participants) of the children had MIH.

The highest prevalence was found in the 11-year-old group, with 49 participants (36.84%), and the prevalence in boys (83, 62.4%) was higher than in girls (50, 37.59%). The teeth affected by MIH showed white, yellow, or black discoloration due to insufficient minerals during tooth development. The abnormal prismatic enamel structures and tooth hypersensitivity in patients with MIH could disturb the success rate of restoration. The study concluded that the prevalence of MIH in primary school children was quite high. However, the study had limitations, including the broad causative factors of MIH, which could be environmental, medical, or genetic.

In a study among Syrian Children, Al-Nerabieah et al. (2023) aimed to determine the prevalence of MIH and to provide information about the clinical patterns and severity of MIH lesions. The researchers conducted a cross-sectional study involving 1138 children aged 8–11 years from public primary schools in Damascus, Syria. The diagnosis of MIH was made using the criteria of the European Academy of Paediatric Dentistry (EAPD), and the MIH/HPSMs short charting form was used to score the index teeth. The results indicated that the prevalence of MIH in Syrian children was 39.9%. Demarcated opacities were the most prevalent pattern of MIH defects on permanent first molars (PFMs) and permanent incisors (PIs). The study found a significant correlation between the number of affected PFMs and the number of affected PIs and hypomineralized primary second molars (HPSMs). Girls exhibited a higher number of severe PFMs compared to boys, and the number of severe PFMs was higher than the number of severe PIs. Additionally, the mean dmft/DMFT index

in children with MIH was significantly higher than in children without MIH. The study concluded that early identification and management of MIH in children are crucial to prevent adverse effects on their oral health. However, the study had limitations, including its cross-sectional design, which did not allow for causal inferences, and the lack of assessment of the quality of oral health care, socio-economic status, or other environmental factors that could be associated with MIH. The study was also conducted in only one city, which may limit the generalizability of the results.

Abdalla et al. (2021) aimed to determine the prevalence, pattern, and distribution of MIH in school children in Sudan. This descriptive cross-sectional study involved 568 children aged 8-11 years from schools in Khartoum State. Socio-demographic data were collected, and the children were examined for hypomineralization on the 12 MIH-index teeth. The data were analyzed using descriptive statistics, chi-square test, and Spearman Rank Correlation, with the significance level set at $p<0.05$. The study found that the prevalence of MIH in the study population was 20.1%. The majority of the participants had both permanent first molars (PFMs) and permanent incisors affected (12.5%), while 7.6% had only molars affected. Maxillary teeth were more affected than mandibular teeth, with maxillary incisors significantly more affected than mandibular ones. Demarcated opacities were the most common pattern of MIH defects (69.9%). The study concluded that the prevalence of MIH in Sudanese children was 20.1%, with both dental arches frequently affected. The demarcated opacity type of MIH was the most common form of defect. However, the study had limitations, including the potential for missing some cases of MIH due to the reliance

on daylight inspection and the lack of recording other socio-demographic data such as residence, place of birth, parents' education, and income.

In Egypt, Saber et al. (2018) aimed to estimate the prevalence of MIH in a group of children aged 8 to 12 years, using both the Enamel Defect Index (EDI) and diagnostic criteria. The methodology involved a convenience sample of 1001 children, with clinical visual examinations conducted under natural light. Teeth were cleaned and wet with saliva during examination. The study used the EDI and diagnostic criteria to score MIH data, and statistical analysis was performed using IBM® SPSS®. The results indicated that the prevalence of MIH in the studied group was 2.3%, with a higher prevalence in females (60.9%) compared to males (39.1%). Among the affected teeth, 77% were mildly affected, showing signs of opacity, while 23% were severely affected, exhibiting enamel disintegration and post-eruptive enamel loss. The most prevalent clinical defect was opacity, with 38.6% of incisors and 19.6% of first permanent molars (FPM) showing signs of both hypoplasia and opacity. The study concluded that the EDI and diagnostic criteria provided an acceptable estimate for MIH in the Egyptian population. However, the study used a convenience sample and lacked standardization in diagnostic criteria. Additionally, the study did not evaluate the psychological impacts and costs associated with MIH.

Another study in Egypt also aimed to assess the prevalence of MIH among children and investigate its correlation with factors such as age, sex, birth complications, and endogamous marriage. Etman et al. (2024) involved a cross-sectional investigation conducted in Egypt's Delta region, recruiting approximately 3000 children aged between eight and twelve years. The European Academy of Pediatric Dentistry (EAPD) criteria were used to diagnose MIH cases. Parents were queried about potential birth complications or endogamous marriages upon detection of MIH

clinical signs. Lesion severity levels were diagnosed using Mathu-Muju and Wright criteria. The main results indicated a prevalence rate of 7.2% for MIH. Molars exhibited higher susceptibility rates than incisors (64.8% vs 35.2%), with approximately 37% of participants displaying severe scores, followed by mild (33.8%) and moderate (29.2%) scores. Male subjects had significantly more occurrences than females. Positive correlations were identified between MIH incidence rates and each gender category, as well as both birth complications and endogamous marriages. The conclusion emphasized the need for frequent check-ups by pediatric dentists for children born from complicated pregnancies or whose parents are related, to facilitate early detection and timely intervention of MIH. Hwoever, there was the potential for selection bias, as the sample was primarily sourced from pediatric outpatient dental clinics, which may not accurately represent the overall population. Additionally, distinguishing MIH from other developmental defects or early caries could be challenging, potentially leading to underestimation or overestimation of MIH prevalence.

2.6 Conceptual Framework

The conceptual framework shows the variables in the study.

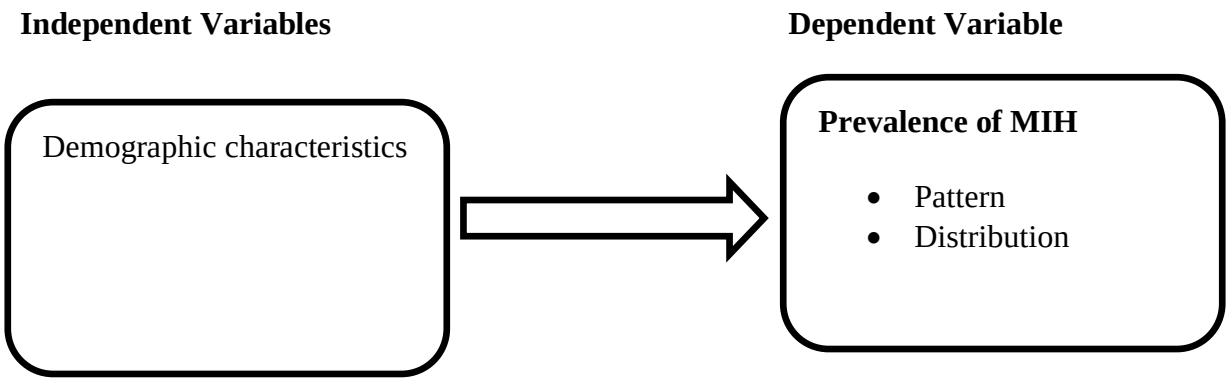

Figure 2.6.1: Conceptual Framework

CHAPTER THREE: METHODOLOGY OF THE STUDY

3.1 Study Site

Uasin-Gishu County is one of the forty-seven counties in Kenya. Uasin Gishu County is situated in the Rift Valley region of Kenya. It is bordered by Elgeyo-Marakwet to the east, Trans Nzoia to the north, Kakamega to the west, Nandi and Kericho to the southwest, and Baringo to the southeast. The county's administrative and commercial centre is Eldoret, which is also the largest population centre. As of the 2019 census, Uasin Gishu County had a population of approximately 1,163,186 people. Eldoret is a cosmopolitan city. The county covers an area of 3,345.2 square kilometres and has a population density of about 390 people per square kilometre. The county's economy is predominantly based on agriculture, with key activities including the cultivation of maize, wheat, and dairy farming. Additionally, the county engages in forestry and fishing, contributing significantly to its Gross County Product (GCP). Regarding the population of school-going children, the county has a substantial number of young residents. The 2019 census data indicates that there are approximately 260,152 children aged 6 to 14 years. In terms of educational infrastructure, Uasin Gishu County boasts a considerable number of public primary schools, with a total of 49 primary educational institutions.

3.2 Study Design

This study used a descriptive cross-sectional study design. In this study, the descriptive cross-sectional design was the most appropriate because the primary objective was to determine MIH prevalence, distribution, and patterns among school-going children in a specific geographic area. This design facilitated data collection from a large sample of children at a single point in time, allowing for a snapshot of the condition within the population. The cross-sectional nature of the design provided

a cost-effective and efficient means of achieving these objectives, as it required fewer resources and less time compared to other designs, such as cohort or longitudinal studies. This is compounded also by the fact that the time allocated for data collection is one month, and no funding are provided.

3.3 Study Population

The study was among the children who were eight years of age at the time of the study. This was considered the age when the first permanent molars and the incisors would have erupted into the oral cavity. The other consideration for this studying this age group was based on the fact that most of the research conducted globally has been done either at 8 years of age or within a range where 8 years was included (A. Kemoli, 2014). By this age, one can appreciate the tooth before being exposed to environmental factors, and the development of diseases like dental caries that may confuse one during the diagnosis. There were 494 public primary schools in Uasin Gishu County with an enrolment of 175,556 pupils in 2023, of which 39,600 were aged 8 years.

3.4 Study Period

Data collection was carried out between September and October 2024.

3.5 Eligibility Criteria

3.5.1 Inclusion Criteria

Participants were included based on the following criteria.

i.) Children must have been exactly 8 years old at their last birthday.

ii.) Children must have had all the index teeth erupted i.e. permanent first molars and all incisors.

iii.) Children must have been enrolled in public primary schools within in Uasin Gishu County

iv.) Children must have been present in school on the day of the examination.

v.) Parental/guardian informed consent must have been obtained.

vi.) Assent from the child to participate in the study must have been obtained

3.5.2 Exclusion Criteria

Children with the below criteria were excluded:

i.) Children with fixed orthodontic appliances that obscure clinical assessment of permanent molars or incisors.

ii) Children with restorations on any of the permanent first molars and incisors.

iii) Children with known systemic or syndromic conditions affecting enamel development.

iv) Children who are uncooperative or unable to undergo oral examination due to behavioral or medical issues.

3.6 Sample Size and Sampling Techniques

3.6.1 Sample Size Determination

Slovin's formula was used to calculate the sample size

$n = N / (1 + N e^2)$ (Tejada & Punzalan, 2012).

Where "n" represents the sample size, "N" represents the population while e is the margin of error

Therefore, in a population of 39,600 children

$n=39,600 / (1+39,600 *0.05^2) =396$

The study had a sample of 396 children.

3.6.2 Sampling Technique

This was a multistage sampling technique. Uasin-Gishu County has six sub-counties, all of which were included in the study. After this, the public primary schools within each sub-county were listed, after which three schools were conveniently sampled. Convenient sampling was considered for those schools near the road network for accessibility, and the time allocated for the research was short. The schools per Sub County were obtained from the Ministry of Education through the office of the County director of education. According to the current Kenyan enrolment age, those eight years old were in grade three; however, the class teacher confirmed their age through their birth certificates. Twenty-two 8-year-old children were selected randomly from each school using a digital sampling frame. Three hundred ninety-six pupils participated in the study.

3.7 Data Collection Methods

The data collection happened while the primary schools were in session. The data collection took place in the morning hours, because pupils in grade three and below were released to go home at lunchtime. The process started by gathering all children, those participating in the study or those not, for a brief oral health talk given by the principal investigator. The second phase involved gathering children who met the inclusion criteria in well-ventilated rooms with natural light, where the assent form was read to them. Those who agreed to participate were then examined after a brief review of their biodata. The biodata form included the age of the children, as per the birth certificate, sex, and occupation. The assent form was explained to study participants, and those not willing to be part of the study were excluded. With a dental mirror and a probe, each child was examined.

Examination of teeth under natural light without drying the teeth. Examination instruments were sterile gloves, a dental mirror, probe gauze, tweezers, disposable sterile gloves, and a facemask for each child. Probe to remove the plaque and the food remains while the cotton cleans the tooth prior to examination. Each participant's index teeth (i.e., permanent first molars and incisors) were examined while wet for the presence of demarcated opacities, post-eruptive enamel breakdown, atypical restorations (AR), and extraction due to MIH. Hypomineralization defects were recorded following EAPD scoring criteria for MIH. Lesions that were less than 2mm in diameter were not considered as MIH according to the current EAPD guidelines, which states that lesions smaller than 2mm may be other developmental defects of enamel. Children were regarded as having MIH when one or more FPMs were affected, with or without the involvement of incisors. Study participants who required dental treatment referral for appropriate management to either the School of Dentistry, Moi University, or Moi Teaching and Referral Hospital, or any other public facility of their convenience.

3.8 Study procedure

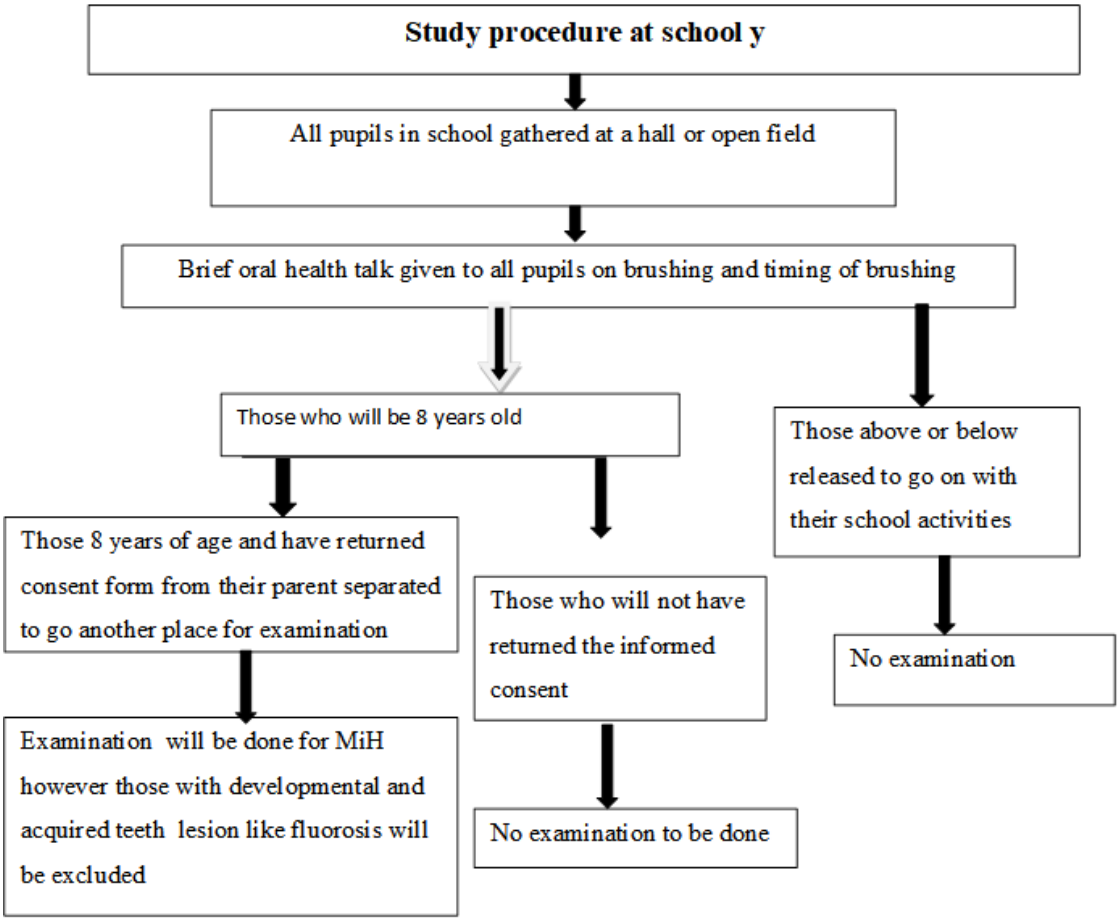

Figure 3.8.1: Data Collection Process

3.9 Data Management and Analysis

The data collected using the structured interviewer schedule was entered into Microsoft Access database. Verification was done continuously in the course of the study by the principal investigator to ensure quality data. Backups were created to safeguard against loss of information. The data entered was de- identified and the database password protected. This password was available to the principal investigator and later to the statistician for analysis. The questionnaires were kept in a safe cabinet under a lock after data entry and cleaning completion. The principal investigator was responsible for the keys to avoid anyone accessing the documents.

3.10 Data Analysis and Presentation

Data was imported, coded, cleaned and analysed using STATA IC version 16. Descriptive statistics summarized the data. Categorical data was summarized as frequencies and proportions and presented in tables or graphs. For numeric data such as age, measures of central tendency (mean/median) and dispersion (standard deviation/inter-quartile range) were computed where appropriate; Histograms/box plots were plotted to show the distributions. The main outcome was the prevalence of MIH that was summarized as a frequency and its corresponding percentage. The description of the distribution of MIH summarized as frequencies their corresponding proportions across different variables. Prevalence of MIH was categorised as either present (yes) or absent (no). Chi-square tests were conducted to test the associations between characteristics of participants and prevalence of MIH. The chi-square test is an appropriate statistical method for assessing associations between two categorical variables. Results were presented in form of and figures.

3.11 Ethical Considerations

The proposal was presented to Moi University Institutional/Moi Teaching and Referral Hospital Institutional Research and Ethics Committee for approval (IREC). After the review, their input considered the proposal was approved under the reference NO FAN0004582

The proposal was also presented for approval from the National Commission for Science, Technology and Innovation (NACOSTI). This approval was also granted after two weeks of review under reference number REF NACOSTI/P/24/32447

This study involved children in public primary schools, an age group considered vulnerable. The study had to be approved by the Ministry of Education for easy entry to these schools within Uasin-Gishu. After the IREC, the proposal was submitted to

the Ministry of Education, the County Director of Education for approval, REF MOE/UGC/TRN/9/VOLLV/80

Requested informed consent from the parents of the children who were participating in the study. The researcher also obtained an assent form from all the children participating in the study.

3.12 Pilot study

Pretesting the study instruments

The study instruments were pretested at Tugen Estate Primary School, where forty pupils were examined by the principal investigator and repeated by the supervisors for reproducibility. The number represented 10 % of the sample size as recommended. The pretest findings were used to improve the study instruments before the main data collection

3.12.1 Reliability Results

Reliability of the questionnaire used in the study was assessed by gauging internal consistency of pilot data. Spearman rank correlation (rs) was used. The highest reliability scores were observed for the upper right first molar (index 16) and upper left first molar (index 26), both with rs=0.93. The lowest reliability scores were observed for the lower left central incisor (index 31,) and the upper right lateral incisor (index 12, rs=0.71). Overall, the composite reliability for all indices was rs=0.82, reflecting good internal consistency. These results suggest that the questionnaire was a reliable tool for assessing MIH in the study population

Table 3.12.1: Reliability Results

index	r_s
index16	0.93
index12	0.71
index11	0.80
index21	0.80
index22	0.79
index26	0.93
index36	0.86
index32	0.88
index31	0.74
index41	0.76
index42	0.80
index46	0.87
All	0.82

CHAPTER FOUR: RESULTS

4.1 Introduction

This chapter presents the study's results, which sought to determine the prevalence and identify the pattern of molar incisor hypomineralisation and its distribution among eight-year children attending public primary schools in Uasin Gishu County in Kenya. Results include the prevalence of MIH among the school going children, distribution of molar incisor of MIH among the school going children and the pattern of MIH among school going children.

4.1.1 Response Rate

A total of 396 eight-year children attending public primary schools in Uasin Gishu County in Kenya took part in the study representing a maximum (100%) response rate. This response rate is deemed adequate to justify generalization of results since it is well above the 70% recommended by Kothari (2017).

4.1.2 Demographic Characteristics

Data on the participants' gender was collected. As shown in Figure 4.1.1, most (51.8%) of the participants were female, whereas the male children accounted for 48.2% of the sample, as shown in Figure 4.1.1

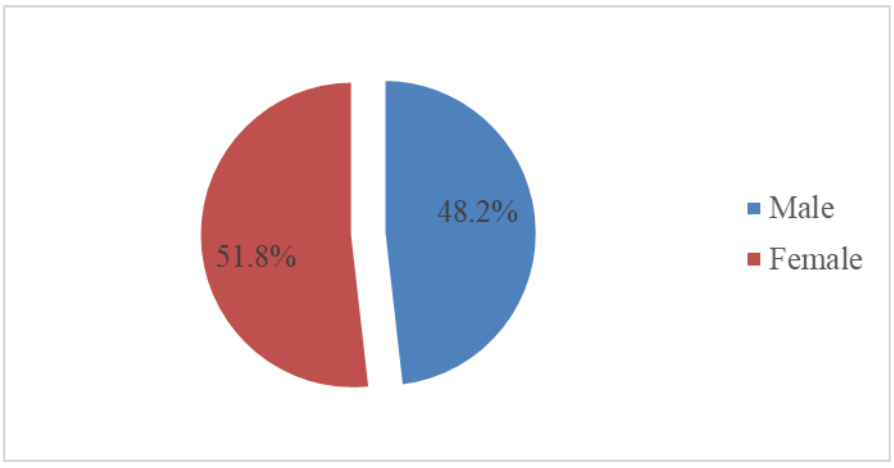

Figure 4.1.1: Distribution of Participants by Gender

4.2 Prevalence of MIH

The study sought to determine the prevalence of MIH among school-going children. As shown in Figure 4.2.1, 47 participants, representing 11.9%, had molar incisor hypomineralisation.

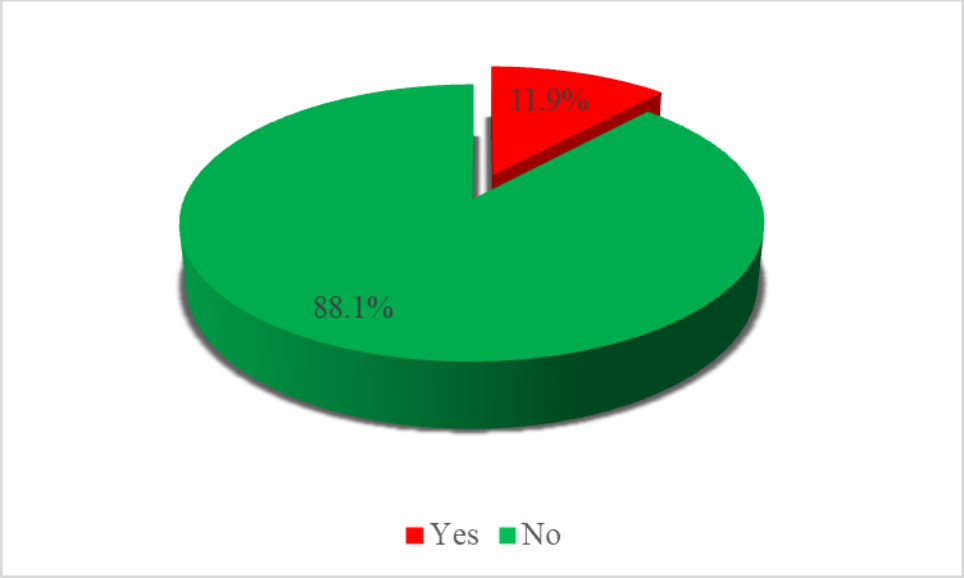

Figure 4.1.1: Prevalence of MIH

The researcher sought to find out if there was a relationship between participants' gender and the prevalence of molar incisor hypomineralisation. This was achieved by conducting a chi-square test. The results show that there is no statistically significant association between gender and the prevalence of MIH among eight-year-old children attending public primary schools in this study (χ^2 (1, N=396) = 0.011, p = 0.918). The prevalence of MIH is similar between male (12.0%) and female (11.7%) children. Therefore, gender does not appear to influence the occurrence of MIH in this population."

Table 4.2.1: Relationship between Gender and MIH Prevalence

				Gender		**Total**			
				Male	Female		Value	df	p
MIH	No	Count		168	181	349	0.011	1	0.918
		% Gender	within	88.0%	88.3%	88.1%			
	Yes	Count		23	24	47			
		% Gender	within	12.0%	11.7%	11.9%			
Total		Count		191	205	396			
		% Gender	within	100.0 %	100.0 %	100.0%			

4.3 Distribution of MIH

The study sought to assess the distribution of the molar incisor of MIH among school-going children. This was done by assessing which molars were affected by MIH using the standard dental numbering system. The first permanent molars were the most frequently affected teeth. Specifically, the lower right first molar (index 46) was the most affected, with 10.9% of children showing hypomineralisation. This was closely followed by the lower left first molar (index 36) at 10.6%, the upper right first molar (index 16) at 10.4%, and the upper left first molar (index 26) at 9.6%.

In contrast, the lateral incisors were the least affected. The lower right lateral incisor (index 42) exhibited the lowest prevalence, with only 0.8% of children affected. Similarly, the lower left lateral incisor (index 32) and the upper left lateral incisor (index 22) were affected in 1.8% of the children. Other incisors, such as the upper right central incisor (index 11) and the upper left central incisor (index 21), exhibited slightly higher prevalence rates of 5.1% and 4.3%, respectively. The findings indicated that molars were significantly more affected by MIH than incisors.

Table 4.3.1: Distribution of MIH

	Yes		**No**	
	N	%	N	%
index16	41	10.4%	355	89.6%
index12	10	2.5%	386	97.5%
index11	20	5.1%	376	94.9%
index21	17	4.3%	379	95.7%
index22	7	1.8%	389	98.2%
index26	38	9.6%	358	90.4%
index36	42	10.6%	354	89.4%
index32	7	1.8%	389	98.2%
index31	11	2.8%	385	97.2%
index41	8	2.0%	388	98.0%
index42	3	0.8%	393	99.2%
index46	43	10.9%	353	89.1%

4.4 Pattern of MIH

The study also sought to determine the pattern of MIH among school-going children. This was done by assessing the form of MIH among those affected. The most common pattern observed was white or creamy demarcated opacities without post-eruptive breakdown (PEB), accounting for 32.8% of the affected cases. Yellow or brown demarcated opacities followed this without PEB, observed in 28.7% of the cases. Yellow or brown demarcated opacities with PEB were present in 24.7% of the children, while white or creamy demarcated opacities with PEB were noted in 11.3% of the cases. Atypical restorations and missing teeth attributed to MIH were the least common forms, each representing 1.2% of the cases.

Table 4.4.1: Pattern of MIH

Pattern	N	%
White/creamy demarcated opacities with no PEB	81	32.8
White/creamy demarcated opacities with PEB	28	11.3
Yellow/brown demarcated opacities with no PEB	71	28.7
Yellow/brown demarcated opacities with PEB	61	24.7
Atypical restorations	3	1.2
Missing due to MIH	3	1.2
Total	247	100.0

CHAPTER FIVE: DISCUSSION

5.1 Introduction

The discussion of the results of this study, which sought to determine the prevalence and identify the pattern of molar incisor hypomineralization as well as its distribution among eight-year-old children attending public primary schools in Uasin Gishu County in Kenya, is presented in this chapter.

5.2 Prevalence of MIH

This study sought to determine the prevalence of MIH among school-going children. The study found that 11.9% had molar incisor hypomineralization. The EAPD MIH index was used for the diagnosis of MIH because it is easy for clinicians to record and has also been tested in other studies. A prevalence of 11.9% indicates that roughly one in every ten children in the sample is affected by MIH. While this figure may appear moderate, it aligns with findings from similar studies in developing countries, where prevalence rates typically range from 2% to 25%. For instance, Garot et al. (2021) found a prevalence of 14%. The results of this study are in line with the findings of Almuallem and Busuttil-Naudi (2018), MIH prevalence of 2.8% to 40.2%. The prevalence is also comparable with the results of a study in Kenya by Kemoli (2008), who found a prevalence of 24%. However, the prevalence in this study is much lower than in a study by Abdalla et al. (2021), where the prevalence was 20.1%. The prevalence of MIH in this study can be considered significant given the potential impact of MIH on dental health, including increased susceptibility to dental caries, sensitivity, and challenges with restorative treatments.

The presence of MIH in this population may be linked to a range of early childhood exposures that affect enamel development during the first years of life. The development of first permanent molars and incisors begins during the prenatal and early postnatal periods, and disturbances during this time can result in enamel defects. Possible causes include frequent childhood illnesses, high fevers, nutritional deficiencies, and exposure to environmental toxins. Infections such as respiratory diseases or gastrointestinal disturbances during the enamel formation period have also been associated with MIH. The observed prevalence may also reflect socioeconomic and environmental conditions specific to the study area. Limited access to quality maternal and child healthcare, inadequate nutrition, and poor sanitation may contribute to early-life conditions that predispose children to MIH. The study included children at the age of eight years, as this is the age at which the first permanent molars and incisors will have erupted. At this age, the tooth will not be exposed to many environmental irritants that may confuse the diagnosis or lead to the loss of teeth. (Eriksen, 2024)

5.2.1 Distribution of molar incisor hypomineralisation

The study assessed the distribution of the molar incisor of hypomineralisation among school-going children. The findings indicated that MIH significantly affected molars more than incisors, aligning with established patterns observed in prior studies. For instance, Elfrink and Weerheijm (2024) found that MIH and hypomineralized second primary molars (HSPMs) are common dental developmental problems with a mean prevalence of around 14% and 9%, respectively. Similarly, a study conducted in Brazil by Reis et al. (2021) showed that most of the children had three teeth affected, mainly molars, excluding the incisors. The result is similar to a study in India where

Mittal and Sharma (2015) discovered that the severity of hypomineralisation was milder in FPM compared to SPM.

The high prevalence in first permanent molars likely reflects their early development and mineralization, which may make them more susceptible to environmental and systemic factors during critical growth periods. First permanent molars begin forming earlier than incisors and continue mineralizing over a longer period. This extended developmental window increases their vulnerability to early life factors that can interfere with enamel mineralization. Molars require more mineral content during development, and any disturbance during this phase can interrupt normal enamel formation. In addition, molars are located deeper in the jaw, which may make them more prone to systemic disruptions affecting blood supply during their development. The molars have a high amount of enamel thickness compared to the anterior teeth, increasing the surface of the affected area and hence being more visible. As a result, they tend to show more severe and frequent enamel defects compared to incisors. Early childhood infections, frequent high fever, low birth weight, and prenatal or perinatal complications may influence molars' enamel development more strongly than incisors.

5.2.2 Pattern of molar incisor hypomineralisation

The researcher also aimed to determine the pattern of MIH among school-going children. The findings indicated that the presentation of MIH varied widely among the affected children, with most cases involving demarcated opacities, either with or without PEB. These findings are consistent with existing literature, which highlights the broad spectrum of MIH presentations. The predominance of demarcated opacities with or without PEB is commonly reported in studies of MIH. For instance, Abdalla

et al. (2021) reported that demarcated opacities were the most common pattern of MIH defects, accounting for 69.9% of the cases. Similarly, a study in Tunisia by Skaly et al. (2020) showed that demarcated opacities were more prevalent than PEB. Specifically, the study found that white/creamy demarcated opacities were more frequent than yellow/brown demarcated opacities, and PEB was present in a smaller proportion of cases. The finding also aligns with the results of the study conducted in Jeddah, Saudi Arabia, which also observed a significant prevalence of MIH characterized by demarcated opacities and PEB (Baghlaf et al., 2024).

The relatively higher prevalence of yellow or brown opacities compared to white or creamy opacities with PEB suggested that the severity of hypomineralisation might progress over time, particularly in cases with post-eruptive breakdown. Demarcated opacities are one of the earliest and most common signs of MIH and typically appear as well-defined areas of discoloration, often white, yellow, or brown, on the enamel surface. The presence or absence of PEB indicates whether the enamel has broken down after eruption due to its weakened structure. Less severe interference may result in opacities alone, while more pronounced disturbances may weaken the enamel to the point that it fractures soon after eruption. Factors such as the child's health during early life, the nature and timing of any illness, and nutritional status during the enamel formation period can all affect the severity of MIH. Children exposed to repeated infections, fevers, or early use of certain medications might develop more noticeable defects. Additionally, the strength of chewing forces applied to molars and the level of oral hygiene may influence whether initially intact opacities progress to PEB.

The severity of MIH can be related to the level of the pattern. White opacities without post-eruptive breakdown represent a mild form of MIH. The yellow to brown opacities associated with post-eruptive breakdown represent a moderate form, while atypical restoration is a severe form of MIH. MIH presents with sensitivity, especially in the moderate and severe forms, which leads to dental anxiety. Due to the chronic inflammation of the pulp, there is a challenge in achieving local anesthesia whenever one is doing any procedure. The affected person finds it very challenging even to use a three-way syringe, air blowing, or even the use of the salivary ejector. The inflammation is due to the entry of the bacteria after a post-eruptive breakdown, where the enamel is lost, exposing dentinal tubules, which allow bacterial penetration.

Molar incisor hypomineralisation correlates with dental caries. Post-eruptive breakdown acts as a plaque-retentive surface on the affected tooth. Prolonged exposure to plaque leads to lowered pH, which leads to demineralization of the teeth. Post-eruptive breakdown leads to increased sensitivity that prevents the child from doing her regular hygiene practices, which has a direct link with dental caries. One affected by MIH is subjected to chronic pain that increases dental anxiety and presents with behavioral management challenges in the dental clinic. The third mechanism of dental caries is due to the weak enamel that demineralizes faster as compared to fully mineralized teeth without

CHAPTER SIX: CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

The conclusion and the researcher's recommendations of this study, which sought to determine the prevalence and identify the pattern of molar incisor hypomineralization as well as its distribution among eight-year-old children attending public primary schools in Uasin Gishu County in Kenya are provided in this chapter.

5.2 Conclusion

The study established that the prevalence of MIH among school-going children was 11.9%. This prevalence highlights MIH as a notable dental condition in the study population. The findings indicated that molars were significantly more affected by MIH than incisors. Among the molars, mandibular first molars showed the highest prevalence of MIH. This distribution pattern aligns with the susceptibility of molars due to their earlier eruption and prolonged exposure to etiological factors during enamel development. The study revealed that the clinical presentation of MIH varied among affected children. Most cases involved demarcated opacities, with or without PEB. Severe cases included atypical restorations and missing teeth due to MIH. This diversity in presentation reflects the progressive nature of MIH and the impact of factors such as delayed diagnosis and intervention. Overall, the study concluded that MIH is a prevalent dental condition among school-going children, with a distinct distribution pattern and varied clinical presentations.

5.3 Recommendations

The county government of Uasin Gishu ought to incorporate routine screening for MIH into school health programs. Early detection of MIH at school-entry age will enable timely management and reduce the long-term impacts of the condition on children's oral health and quality of life.

Dental care strategies should focus on molars, particularly mandibular first molars, which were found to be the most affected. There is a need for targeted diagnostic and preventive efforts focusing on first permanent molars. Early interventions, such as the application of dental sealants or restorative treatments, would be essential in mitigating the effects of MIH on these teeth.

Early identification and preventive care should be provided, such as applying dental sealants and fluoride varnishes to protect vulnerable molars. This can be done through school-based oral health programs that can facilitate routine screenings and early interventions. A study should also be undertaken in different counties for comparative purposes. Future studies should investigate the potential environmental, genetic, and systemic health factors contributing to molar incisor hypomineralization (MIH) development in children in this region. Studies should also evaluate the efficacy of various treatment approaches for MIH, including preventive, restorative, and minimally invasive techniques.

5.4 Limitations of the study

Many other socio-demographic data were not recorded, such as residence, place of birth, parents' education, and income. This study relied solely on clinical examination without the use of radiographs. As a result, subclinical or less obvious enamel and dentine involvement may have been under-detected, potentially leading to

underestimation of the true prevalence and severity of MIH. Radiographs could have provided additional diagnostic information, particularly for assessing underlying structural changes and associated carious lesions

Despite these limitations, the study provides useful information on the situation of MIH in Uasin Gishu County, and the need for more studies on this subject to enlighten clinicians on the severity of MIH in children in Uasin Gishu County.

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APPENDICES

APPENDIX I: INFORMED CONSENT

TITLE OF STUDY: PREVALENCE PATTERNS AND DISTRIBUTION OF MOLAR INCISOR HYPOMINERALIZATION AMONG EIGHT-YEAR-OLD CHILDREN IN UASIN GISHU COUNTY, KENYA

Name – Naftaly Muthuuri

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The main purpose is to inform and request your child to participate in the study on teeth that will be conducted as explained.

This study will find out the prevalence distribution and pattern of molar incisor hypomineralization among your children. The study is for academic purposes.

It will be conducted by one person where child will be examined while sitting on a normal school desk. I will use sterile dental mirror and a probe to examine and those found with problem will be referred to school of dentistry Moi university where we shall use waiver system for those who may be in need . There are no risks anticipated in this study now that it's not invasive in any way.

Those who shall be participating will have opportunity of being examined and advised on any dental concerns they may present with.

Special code will be used for identification of those participating in the study for ensuring confidentiality.

Your participation in this study is voluntary. If you decide to take part in this study, you will be asked to sign a consent form. After you sign the consent form, you are

still free to withdraw at any time and without giving a reason. Withdrawing from this study will not affect the relationship you have, if any, with the researcher. If you withdraw from the study before data collection is completed, your data will be returned to you or destroyed.

CONSENT

I have read and I understand the provided information and have had the opportunity to ask questions. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving a reason and without cost. I understand that I will be given a copy of this consent form. I voluntarily agree to take part in this study.

Participant's Signature _____ Date _____

Researcher’s Signature _____ Date _____

KISWAHILI VERSION

MAAMBUKIZI, USAMBAZAJI NA MUUNDO WA MENO YALIYOPATA KUTU NA KUWA HAFIFU KATI YA WATOTO UMRI WA MIAKA NANE KATIKA KATA YA UASIN-GISHU KENYA.

Jina – Naftaly Muthuuri

Idara ya meno ya watoto

Shule ya meno, Chuo Kikuu cha Moi, Eldoret Kenya

Simu – + 254729343036

Barua pepe – nafmakunyi@gmail.com

Utangulizi

Lengo ni kukuomba idhini ya mtoto wako kushiriki kataika utafiti wa meno ambao nitaelezea. Huu ni utafiti ambao utagundua usambazaji na muundo wa meno yaliyopata kutu na kuwa hafifu kati ya mtoto wako. Imefanywa kwa madhumuni ya kitaaluma

Itafanywa na mtu mmoja ambapo mtoto atachunguzwa wakati amekaa kwenye dawati la kawaida la shule. Nitatumia kioo cha meno,pamba. kwa wale watakaopatikana kuwa na haina yoyote ya shida watapelekwa kwa shule ya meno ya Moi Kufundisha. Hakuna hatari zinazotarajiwa katika utafiti huu sasa kwa kuwa sio vamizi kwa njia yoyote.

Wale ambao watashiriki watapata fursa ya kuchunguzwa na kushauriwa juu ya wasiwasi wowote wa meno ambao wanaweza kuwasilisha.

Nambari maalum itatumika kwa kitambulisho cha wale wanaoshiriki kwenye utafiti ili kuhakikisha usiri.

Ushiriki wako katika utafiti huu ni wa hiari. Ukiamua kushiriki katika utafiti huu, utaulizwa kutia saini fomu ya idhini. Baada ya kusaini fomu ya idhini, bado uko huru kujiondoa wakati wowote bila kupeana sababu. Kujiondoa kutoka kwa utafiti huu

haitaathiri uhusiano uliyonayo, na mtafiti. Ukijiondoa kwenye utafiti kabla ya ukusanyaji wa data kukamilika, data yako itarudishwa kwako au kuharibiwa.

Taarifa ya indhini

Nimesoma na ninaelewa habari iliyotolewa na nimepata nafasi ya kuuliza maswali. Ninaelewa kuwa ushiriki kwa mtoto wangu ni wa hiari na kwamba niko huru kujiondoa wakati wowote, bila kutoa sababu na bila gharama. Ninaelewa kuwa nitapewa nakala ya fomu hii ya idhini. Ninakubali kwa hiari kushiriki katika utafiti huu.

Saini ya Mshiriki _____Tarehe _____

Saini ya Mtafiti _____ Tarehe _____

APPENDIX II: ASSENT FORM

RESEARCH TITLE: PREVALENCE, DISTRIBUTION AND PATTERN OF MOLAR INCISOR HYPOMINERALIZATION AMONG EIGHT YEAR OLD CHIDREN IN UASIN-GISHU COUNTY IN KENYA.

INTRODUCTION

I am Naftaly Muthuuri, student of Master of Dental Surgery in Pediatrics Dentistry, College of Health Sciences, School of dentistry, Moi University. Telephone number: +254729343036, E-mail address: nafmakunyi@gmail.com.

You are kindly requested to take part in the study that is assessing the prevalence, distribution and pattern of molar incisor hypomineralisation among 8 years old children in Uasin-Gishu County in Kenya (A type of teeth discoloration). As such, your consent is being sought first, and thereafter you will be examined on how your teeth look like. Be assured that entry into the study is entirely voluntary and no penalty will be incurred for non-participation, and to the best knowledge of the researcher no risk associated with participating in this study. Should you choose to withdraw from the study anytime and for any reason, you are free to do so at your own will.

Confidentiality: Your identity cant revealed in any presentation or publications of this study, and information provided is for research purposes only. In fact, information obtained in the course of conducting this study will not be communicated to anyone without your written permission and consent.

Consent statement: I have been explained to the purpose, nature, benefits and risks associated with this study including my participation being free of charge. I have as well been informed that the information given will be kept confidential and that my

participation in this study is entirely voluntary and no consequences will result if I refuse to participate or withdraw from the study.

I therefore hereby give my informed consent to participate in this study

Name of Child (8 years)	Signature	Date
…….....	……	……
Name of Investigator	Signature	Date
…….....	……	…… …….

KISWAHILI VERSION

FOMU YA ASSENT

MAAMBUKIZI, USAMBAZAJI NA MUUNDO WA MENO YALIYOPATA KUTU NA KUWA HAFIFU KATI YA WATOTO WENYE UMRI WA MIAKA NANE KATIKA KATA YA UASIN-GISHU KEN

Utangulizi

Mimi naitwa Naftaly Muthuuri,

mwanafunzi wa upasuaji wa meno katika meno ya watoto, Chuo cha Sayansi ya Afya, Shule ya meno, Chuo Kikuu cha Moi.

Nambari ya simu: + 254729343036,

Anwani ya barua-pepe: nafmakunyi@gmail.com.

utangulizi

Unaombwa kushiriki katika utafiti huu ambao unakagua kiwango cha maambukizi, usambazaji na muundo wa meno yalitopata kutu na kuwa hafifu kati ya umri wa miaka nane katika Kata ya Unasin-Gishu nchini Kenya. Kama hivyo, idhini yako inatafutwa kwanza, na baadaye utachunguzwa juu ya jinsi meno yako yanaonekana. Hakikisha kuwa kuingia kwenye utafiti ni kwa hiari kabisa na hakuna adhabu itakayopatikana kwa kutoshiriki, na kwa ufahamu bora wa mtafiti hakuna hatari inayohusiana na kushiriki katika utafiti huu. Ikiwa utachagua kujiondoa kwenye utafiti wakati wowote na kwa sababu yoyote, uko huru kufanya hivyo kwa hiari yako mwenyewe.

Usiri: Kitambulisho chako hakitafunuliwa katika uwasilishaji wowote au machapisho ya utafiti huu, na habari iliyotolewa itatumika kwa madhumuni ya utafiti tu. Kwa kweli, habari iliyopatikana wakati wa kufanya utafiti huu haitawasilishwa kwa mtu yeyote bila idhini yako ya maandishi na idhini.

Taarifa ya idhini: Nimeelezewa kwa kusudi , faida na hatari zinazohusiana na utafiti huu pamoja na ushiriki wangu kuwa huru. Nimearifiwa pia kuwa habari iliyotolewa itahifadhiwa siri na kwamba ushiriki wangu katika utafiti huu ni wa hiari kabisa na hakuna matokeo yoyote yatakayotokea ikiwa nitakataa kushiriki au ondoa kutoka kwa utafiti.

Kwa hivyo ninatoa idhini yangu ya kushiriki katika utafiti huu.

Jina la Mtoto (miaka 8)	Tarehe	Saini
……...	……	……
Jina	Tarehe	Saini ya Upelelezi
……	…….	…… ……

APPENDIX III: BIODATA FORM

NAME OF THE SCHOOL

UID NO

SEX

RELIGION

AGE

DATE

DOB

ADDRESS

APPENDIX IV: INDICES

Indices for data collection was that adopted from EAPD 2003

Index tooth	**White/creamy demarcated opacities with no PEB)**	**White/creamy demarcated opacities with PEB**	**Yellow/brown demarcated opacities with no PEB**	**Yellow/brown demarcated opacities with PEB**	**Atypical restorations**	**Missing due to MIH**
16						
12						
11						
21						
22						
26						
36						
32						
31						
41						
42						
46						

APPENDIX V: ETHICAL APPROVAL

MTRH/MU-INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE (IREC)

MOI TEACHING AND REFERRAL HOSPITAL
P.O. BOX 3
ELDORET
Tel: 33471/2/3

MOI UNIVERSITY
COLLEGE OF HEALTH SCIENCES
P.O. BOX 4606
ELDORET
Tel: 33471/2/3

7th December, 2023

Reference: IREC/491/2023
Approval Number: 0004582

Dr. Naftaly Muthuuri Makunyi,
Moi University,
School of Dentistry,
P.O. Box 4606-30100,
ELDORET-KENYA.

Dear Dr. Makunyi,

PREVALENCE PATTERNS AND DISTRIBUTION OF MOLAR INCISOR HYPOMINERALIZATION AMONG 8 YEAR OLD CHILDREN IN UASIN GISHU COUNTY, KENYA

This is to inform you that ***MTRH/MU-IREC*** has reviewed and approved the above referenced research proposal. Your application approval number is ***FAN: 0004582***. The approval period is **7th December, 2023- 6th December, 2024.** This approval is subject to compliance with the following requirements;

i. Only approved documents including (informed consents, study instruments, Material Transfer Agreements (MTA) will be used.
ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by ***MTRH/MU-IREC***.
iii. Death and life threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to ***MTRH/MU-IREC*** within 72 hours of notification.
iv. Any changes anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to ***MTRH/MU-IREC*** within 72 hours.
v. Clearance for export of biological specimens must be obtained from ***MOH at the recommendation of NACOSTI*** for each batch of shipment.
vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.
vii. Submission of an executive summary report within 90 days upon completion of the study to ***MTRH/ MU-IREC***.

Prior to commencing your study; you will be required to obtain a research license from the National Commission for Science, Technology and Innovation (NACOSTI) https://oris.nacosti.go.ke and other relevant clearances from study sites including a written approval from the CEO-MTRH which is mandatory for studies to be undertaken within the jurisdiction of Moi Teaching & Referral Hospital (MTRH) and its satellites sites.

INSTITUTIONAL RESEARCH & ETHICS COMMITTEE
07 DEC 2023
APPROVED
P. O. Box 4606-30100 ELDORET

Sincerely,

PROF. E. WERE
CHAIRMAN
INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE

cc CEC - MTRH
Principal - CHS
Dean - SOP
Dean - SON
Dean - SOM
Dean - SOD

APPENDIX VI: RESEARCH AUTHORISATION

REPUBLIC OF KENYA

MINISTRY OF EDUCATION

State Department for Basic Education

Email: cdeuasingishucounty@gmail.com
: cdeuasingishucounty@yahoo.com
When replying please quote:

County Director of Education,
Uasin Gishu County,
P.O. Box 9843-30100,
ELDORET.

Ref: No. MOE/UGC/TRN/9/VOLL. V/80

20TH FEBRUARY , 2024

Naftaly Makunyi Muthuuri
Moi University,
P.O Box 4606- 30100
ELDORET

RE: RESEARCH AUTHORIZATION.

In reference to your License Ref no. **NACOSTI/P/24/32447** dated 7th February,2024 from National Commission for Science, Technology and Innovation (NACOSTI), you are hereby granted the authority to carry out research on ***"Prevalence pattern and distribution of molar incisor hypomineralization among eight – year old children ." Period Ending 7th February, 2025,"*** Within Uasin Gishu County.

We take this opportunity to wish you well during this data collection.

COUNTY DIRECTOR OF EDUCATION
UASIN GISHU COUNTY
0 FEB 2024
P.O. Box 9843 - 30100, ELDORET
TEL 0719127212

Mibei K. Andrew
For: County Director of Education
UASIN GISHU.

APPENDIX VII: RESEARCH PERMIT

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

COUNTY GOVERNMENT OF UASIN GISHU
19 FEB 2024
CHIEF OFFICER OF HEALTH
PREVENTIVE & PROMOTIVE SERVICES
P.O. Box 40 - 30100, ELDORET

Ref No: 712030

Date of Issue: 07/February/2024

RESEARCH LICENSE

This is to Certify that Dr., Naftaly makunyi Muthuuri of Moi University, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Uasin-Gishu on the topic: PREVALENCE PATTERN AND DISTRIBUTION OF MOLAR INCISOR HYPOMINERALIZATION AMONG EIGHT-YEAR-OLD CHILDREN IN UASIN GISHU COUNTY ,KENYA for the period ending : 07/February/2025.

License No: NACOSTI/P/24/32447

712030

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

PROCEED FOR
19/02/24

COUNTY COMMISSIONER
UASIN GISHU COUNTY

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.

See overleaf for conditions