CHAPTER I
INTRODUCTION

1.1 Background

Dental health is vital to children's well-being, because the mouth is the entrance of sustenance for children, and it supports the process of food intake which is crucial for energy and also growth of a child. Though children are prone to dental condition mainly caries or periodontal problems either from children's diet habit or lack of oral hygiene, but there are condition that may effect the child without the parents realizing before it is too late, which is Molar-Incisor Hypo-mineralization (MIH). (Riolina A, Hartini S, Suparyati S 2020).

MIH is a developmental defect that affect the structure of a tooth causing discoloration, and possible hypersensitivity. This condition affects one to all first permanent molar and may affect permanent incisor which occasionally undergoing post eruptive breakdown. (Sisira Padavala, Gheena Sukumaran 2018). MIH comes from a systemic origin that's only evident after the eruption of the affected tooth causing the condition to go undetected resulting in the lack of available data from the local population and its possible prevalence.

MIH is believed to have a complex and multifactorial origin, involving both genetic predispositions and environmental influences. Although its exact cause remains uncertain, researchers suggest it may result from environmental stressors during pregnancy, birth, or early childhood, or from genetic mutations affecting enamel development. Studies, including a Swedish prospective study and a recent umbrella review, have not found any single factor that can be definitively linked to MIH. Several prenatal (e.g., maternal illness, infections, smoking), perinatal (e.g., premature birth, delivery complications, lack of oxygen), and postnatal (e.g., childhood illnesses, antibiotic use, pollution) conditions have been associated with its development. These factors may interfere with the function of ameloblasts cells responsible for forming enamel at critical stages, leading to permanent defects, as enamel cannot repair itself. MIH presents in varying forms, sometimes affecting only one molar, which could be due to differences in gene activity on each side of the mouth or localized disturbances during enamel mineralization. Typically, the damage is seen on the chewing surface of the molars rather than near the gumline, possibly due to molecular protections related to dentin and pulp development. (Jianu M, Muntean A, Mihaltan C, Pacurar M, Munteanu A 2022); (Alhowaish L, Baidas L, Aldhubaiban M, Bello L, Al-Hammad N 2021).

MIH manifestation in the oral cavity which in general define the condition causing not only discoloration but also the weakening of the tooth structure the tooth will appear demarcated, broken down and even coexist with caries. (Z. Almuallem and A. Busuttil-Naudi 2018). This condition causes hypersensitivity which is a common occurrence in patient with MIH, whether it be caused by thermal or mechanical source. MIH is characterized by the reduction of mineral

quantity and quality with the increase of porosity making the tooth more susceptible to stimuli by having their thermal isolation properties reduced. MIH also altered the tooth structure by reducing hardness and elastic modulus and increasing carbon and carbonate concentration with much higher protein content compared to a normal condition leading to a post-eruptive enamel breakdown that leads to an early exposure of the dentine that can deteriorate oral hygiene with increased plaque accumulation making the chance of caries higher (Thomas Linner, Yeganeh Khazaei, Katharina Bucher, Jan Pfisterer , Reinhard Hickel, Jan Kunisch 2021).

The pain sensation that was experienced by the child may affect their willingness to do two important things, which are eating and brushing teeth. Since the child experience pain every time a stimuli comes into contact with the tooth, it is much more preferable for them to not let anything touch the tooth itself. The lack of willingness to brushing their teeth may cause the rising rate of demineralization of any adjacent tooth and if left long enough without being treated the child will eventually be affected by dental caries. (Paula Dresch Portella, Bruna Leticia Vessoni Menoncin, Juliana Feltrin de Souza, José Vitor Nogara Borges de Menezes, Fabian Calixto Fraiz, Luciana Reichert da Silva Assunção 2019)

Since MIH was first recognized, public perception suggests its prevalence is increasing. However, uncertainties remain about its causes, prevention, and treatment, making it an important issue. A systematic review of studies following PRISMA guidelines found 167 studies reporting MIH prevalence, with data from 46,613 individuals. The overall weighted prevalence of MIH was 12.8%, with no significant changes over time. However, a sub-analysis revealed a notable increase in prevalence from 3% in 1992 to 13% in 2013.

According to a study by (Benjamin Sluka and colleagues 2024), merged data from cross-sectional studies do not show a global increase in MIH prevalence. However, age-specific assessments reveal a rise in prevalence from 6% to 14% between 2000 and 2010. The authors suggest that further age-specific re-analysis of existing data, along with high-quality future studies on age-dependent MIH prevalence, may provide deeper insights into the dynamics of MIH prevalence, beyond general reports on mean prevalence rates.

Treatment for MIH comes in various approaches tailored to manage symptoms like dental hypersensitivity, enamel defects, and tooth structure preservation. MIH therapies focus on reducing pain and maintaining pulp vitality, using minimally invasive techniques such as vital pulp therapy and complementary methods like photobiomodulation and preventive analgesia with ibuprofen to improve patient comfort during treatment. the use of dental sealants, topical application fluoride, and casein Products such as casein phosphopeptide–amorphous calcium phosphate (CPP-ACP) helps promote enamel remineralization and reduce hypersensitivity by forming protective layers and supplying essential minerals, although the degree of remineralization can vary depending on lesion severity. (Inchingolo A, et. Al 2023).

In cases where enamel defects are more pronounced, direct and indirect restorations provide structural repair through materials like nano-hybrid composites and glass hybrid restorations, with techniques such as resin infiltration and various adhesive protocols improving restoration longevity and reducing hypersensitivity. Additionally, Hydroxyapatite-based pastes are emerging as a promising domiciliary treatment to desensitize mild MIH lesions and enhance enamel integrity by mimicking natural tooth mineral content. Finally, Low-Level Laser Therapy (LLLT) offers a non-invasive option to reduce hypersensitivity and inflammation in MIH-affected teeth, improving quality of life by decreasing pain and promoting healing. These combined therapies aim to preserve tooth structure, reduce discomfort, and prevent further enamel breakdown in MIH patients, adapting to the severity of lesions and patient needs. (Inchingolo A, Inchingolo A, Viapiano F, Ciocia A, Ferrara I, Netti A, Dipalma G, Palermo A, Inchingolo F 2023).

Several studies conducted in Indonesia mentions MIH but mainly revolves around caries or down syndrome children having MIH, one study looked directly into this problem in Bandung Indonesia taking data from primary school, from 619 children in total age 7-14 from three primary schools using EAPD as their guideline to assess the population condition finding out that 19.1% of children are affected by MIH (118 out of 619 children) with boys being the majority at 62.4% and girls at 37.6% of the overall affected population and 11 years old children are the most affected population. This research also takes into account the socioeconomic status of the participant suspecting middle – lower income families being one reason why this condition happen leaning towards this reason to be the cause of the external or internal factors that make this condition happen such as smoking, or maternal illness, prematurity, birth complication, early childhood illness, antibiotics or even genetics. (Praptiwi.Y, Prayitno.N, Sukmasari.S, 2019).

There are not many data regarding how aware parents are towards the children's mouth condition especially regarding MIH, but one study from (Leal S, Oliveira T, Ribeiro A 2017) give the writer little data that can be gathered from the latest information about how parents and children recognize the tooth condition as a dental problem but none of them actually understands that the child is diagnosed with MIH, both parents and children themselves mostly are concerned about the appearance of the tooth. So in conclusion parents and children actually recognizes this case although without much deeper thought about the condition causing the condition to be left since the condition existed only on the back tooth that causes little to no concern on esthetic which the parents and child mostly concerns.

This study aims to estimate the prevalence of MIH among elementary school children in Makassar City specifically Inpres Baraya 1 Elementary school and to provide baseline evidence to support awareness and preventive strategies with better knowledge and expectations for future cases.

1.2 Problem Formulation

Based on the background described, the research problem is, What is the prevalence of MIH among children aged 6–12 years attending Inpres Baraya 1 Elementary School in Makassar City?

1.3 Research Objectives

To determine the prevalence of Molar Incisor hypomineralization (MIH) in children 6-12 in Inpres Baraya 1 elementary school.

1.4 Research Benefit

a. Enhanced Understanding of MIH on Children
   This study will provide deeper insights into how MIH and dental caries are linked, helping to identify specific patterns, such as whether one condition predisposes the other.
b. Data for Future Studies
   The collected data and outcomes can be a valuable resource for future research on pediatric dentistry, oral health, and socioeconomic health disparities. Other researchers may build upon the findings for longitudinal studies or explore interventions to address these issues.
c. Awareness of Oral Health Habits
   The findings could shed light on the link between oral health habits and the presence of dental caries or MIH, possibly encouraging the adoption of healthier habits in the study population.
d. MIH Prevalence Data
   Providing data to create a prediction and expectation for future pediatric patient that may have MIH and may have the condition overlooked by any dentist

CHAPTER II
LITERATURE REVIEW

2.1 Molar Incisor Hypomineralization (MIH)

2.1.1 Definition

MIH is a qualitative defect affecting the enamel of the first permanent molars, with and without the involvement of incisors. The enamel can present clearly demarcated opacities with an alteration in the translucency, showing a wide variation in color, size, and shape. From a histological perspective, MIH is characterized with a reduction in the mineral quantity, specifically in the calcium and phosphate content, resulting in a decrease in the modulus of elasticity and enamel hardness. Furthermore, it exhibits an increase in the protein content accompanied with an apparent porosity in the enamel's structure. The enamel crystals in MIH have been observed to have a lower density, higher organic content within and between the crystals, and thicker prism sheaths. (Alzahradni A, Almoudi N, Meligy O, 2023)

2.1.2 Etiology

The critical period for the development of molar–incisor hypomineralization (MIH) occurs between the 28th week of intrauterine life and the first 10 days after birth, during which amelogenesis of first permanent molars, permanent incisors, and second primary molars begins. Although permanent teeth erupt years later, disturbances during this early developmental period can permanently affect enamel quality. Any systemic imbalance or exposure to risk factors during the secretion or maturation phase of enamel formation may result in enamel defects, with disruption during the maturation phase leading to hypomineralization. Therefore, prenatal, perinatal, and early postnatal factors can influence both deciduous and permanent dentition, explaining why MIH becomes clinically evident long after birth. (Goel N, Jha S, Dash B, Sarangal H, Namdev R, 2021)

2.1.3 Classification of MIH

MIH is a qualitative defect of enamel classified as hypomineralised type that follows the natural incremental lines of enamel formation extending from cuspal to cemento-enamel junction. Mostly cervical enamel is sound with no evidence of defective structure. At a more occlusal level, the defect is confined to the inner enamel while the outer enamel does not appear to be affected. In the occlusal region, the hypomineralisation is more evident eventually spreading to the entire thickness of the enamel. The defects usually did not involve the cusp tips; the involvement of margin caused reduction in the height. (Ganapathy D, 2021)

2.1.3.1 MIH severity index according to European Academy of Pediatric Dentistry (EAPD)

To assess the extent of MIH among the participants, the severity of the condition was classified according to the criteria established by the EAPD. The grading system distinguishes between mild and severe forms of MIH based on the presence of enamel opacities, enamel breakdown, hypersensitivity, and aesthetic concerns. The classification is summarized in Table 2.1

Table 2. 1 Severity grade of MIH

Severity grade of MIH	Definition
Mild	Demarcated enamel opacities without enamel breakdown. Occasional sensitivity to external stimuli (e.g., air) but not brushing mild aesthetic concerns on discoloration of incisors
Severe	Demarcated enamel opacities with breakdown caries persistent/spontaneous hypersensitivity affecting function (e.g., brushing) strong aesthetic concerns that may have socio-psychological impact

(Lygidakis N, et al. 2021)

2.1.3.2 MIH scoring criteria according to EAPD

The EAPD scoring system is wide and contains some non MIH condition because of how similar MIH can be to conditions such as amelogenesis imperfecta or fluorosis or even hypoplasia and a combination of both MIH and hypoplasia, it is important to properly identify what type of MIH to see its severity and how it affects the individual affected by MIH and the explanation of the score and the criteria can be seen in table 2.2

Table 2. 2 MIH Scoring

Code	Criteria
0	Enamel defect free
1	White/creamy demarcated opacities, no PEB
1a	White/creamy demarcated opacities, with PEB
2	Yellow/brown demarcated opacities, no PEB
2a	Yellow/brown demarcated opacities, with PEB

3	Atypical restoration
4	Missing because of MIH
5	Partially erupted (i.e., less than one-third of the crown high) with evidence of MIH
6	Unerupted/partially erupted with no evidence of MIH
7	Diffuse opacities (not MIH)
8	Hypoplasia (not MIH)
9	Combined lesion (diffuse opacities/hypoplasia with MIH)
10	Demarcated opacities in incisors only

(Krishnan R, Ramesh M, et al. 2011)

Figure 2. 1 Example image of MIH scoring according to EAPD (Seloglu A, et al. 2024)

2.1.3.3 MIH-TNI (Treatment Need Index)

The MIH-TNI captures the clinical key symptoms of MIH. It includes the presence and the extent of the breakdown and the problem of hypersensitivity. A total of four different grades of MIH can be distinguished, depending on the presence/absence of breakdown and hypersensitivity. The index can be applied to all teeth and is not restricted to permanent teeth or individual groups of teeth. It is suitable for use and study in larger populations as well as for accurate description of findings in individual patients.

Table 2. 3 MIH treatment need index

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

(Bekes K, Steffen R, et al. 2023)

2.1.4 *Treatment*

Various therapeutic strategies have been developed to address the hypersensitivity, enamel fragility, and aesthetic concerns associated with MIH. These treatments range from minimally invasive desensitization approaches to restorative and regenerative procedures, depending on the severity of the condition and the patient's symptoms.

a. Therapy for Dental Hypersensitivity

MIH is recognized as condition characterized by the hypomineralization of dental enamel, which makes it more susceptible to damage and painful sensations. MIH hypersensitivity can cause significant discomfort to patients, making it difficult to consume cold or hot food and drinks, as well as normal oral hygiene activities. Its consequences, such as tooth sensitivity and reduced quality of life. Diago A, and Hernandez P. et al. proposed treatment

for MIH should be minimally invasive, aiming to protect, strengthen and preserve tooth.

Fossati A, et al. explore the role of photobiomodulation and glass ionomer cement as complementary therapy for hypersensitivity to MIH patient, then Fernanda L. Mendonça et al. developed a protocol for tooth sensitivity in MIH patient by doing trials on different therapies.

Ola B. Al-Batayneh et al. find success in Vital pulp therapy procedure providing symptom relief to the patient and finally Fernanda Vicioni-Marques et al. roposed the use of preventive analgesia as a method to reduce trans- and post-operative hypersensitivity during dental procedures the analgesia being Ibuprofen.

b. Dental sealants, application of topical fluoride and casein Products

For managing MIH, Topical fluoride and casein-based agents have become key tools in both prevention and treatment. Topical Fluoride enhance enamel remineralization, helping protect against decay and reducing sensitivity by forming a temporary protective coating on weakened enamel. This slows demineralization and promotes fluoride absorption by the tooth. Similarly, casein phosphopeptide–amorphous calcium phosphate (CPP-ACP) products, derived from milk protein, sustain a high concentration of calcium and phosphate ions near the tooth surface. This environment encourages remineralization and prevents further enamel loss. When used together, topical fluoride and casein-based products offer a comprehensive approach that supports enamel repair and helps preserve tooth structure in MIH-affected teeth.

c. Direct and Indirect Resin composite Restorations

Both mild and severe MIH cases often necessitate restorative treatment to maintain oral health and functionality. Studies have identified composite restorations as an effective option for such teeth. By addressing the unique challenges presented by MIH, these restorations aim to improve both the durability and appearance of affected molars. Research into this area provides important guidance for optimizing restorative outcomes in children with MIH.

d. Hydroxyapatite

Hydroxyapatite paste is another approach for treating MIH. In a study by Butera et al., a paste was applied to affected teeth in one quadrant, while another quadrant was left untreated for comparison over a nine-month period. Results showed modest but positive effects reduced tooth sensitivity and improved enamel strength demonstrating that hydroxyapatite can enhance enamel integrity and comfort for MIH patients.

e. Low-Level Laser Therapy

Muniz et al. conducted a study at a pediatric dental clinic in São Luís, Brazil (March–December 2018) to evaluate the effects of low-level laser therapy (LLLT) on children aged 6–12 with MIH-affected molars or incisors showing sensitivity. Participants received LLLT, Topical fluoride, or a combination of both. The findings revealed that both LLLT and topical flouride provided effective desensitization, with similar results by the end of treatment. However, LLLT offered immediate pain relief, whereas topical fluoride acted more gradually.

f. Fluorinated Silver Diamine Therapy

In a randomized prospective trial by Ballikaya et al., researchers examined treatments for MIH-affected molars in children aged 6–13 using a split-mouth design. Although blinding was not feasible, experienced dentists carried out the procedures. Both silver diamine fluoride (SDF) alone and SDF combined with Hybrid Glass Ionomer Cement (SMART) sealants successfully reduced sensitivity and demonstrated good retention. However, discoloration around margins was a noted drawback with SDF use. The study concluded that these minimally invasive methods are effective options for managing MIH in pediatric patients.

g. Biomimetic Mineralization

Biomimetic mineralization aims to replicate the natural biological processes that form enamel and dentin. For MIH treatment, this method seeks not just to repair damaged enamel but to stimulate true tissue regeneration. By mimicking the natural actions of ameloblasts, enamel proteins, and hydroxyapatite crystal growth, researchers hope to develop bioactive materials and scaffolds that guide new enamel-like structures to form on affected teeth. This technique has the potential to move beyond symptom control, instead restoring the tooth's original strength and resilience through the body's own regenerative capacity. (Inchingolo A, Inchingolo A, Viapiano F, et al. 2023)

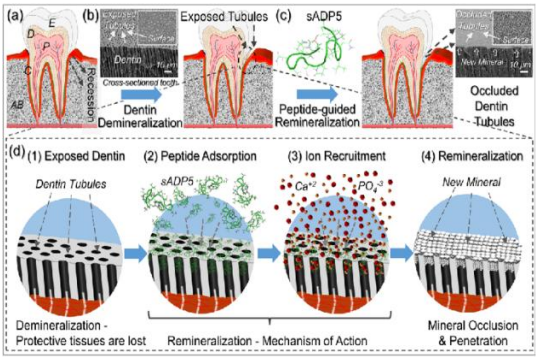

Figure 2. 2 Biomimetic remineralization process (Yucesoy D, et al. 2023)

2.2 Theoretical Framework

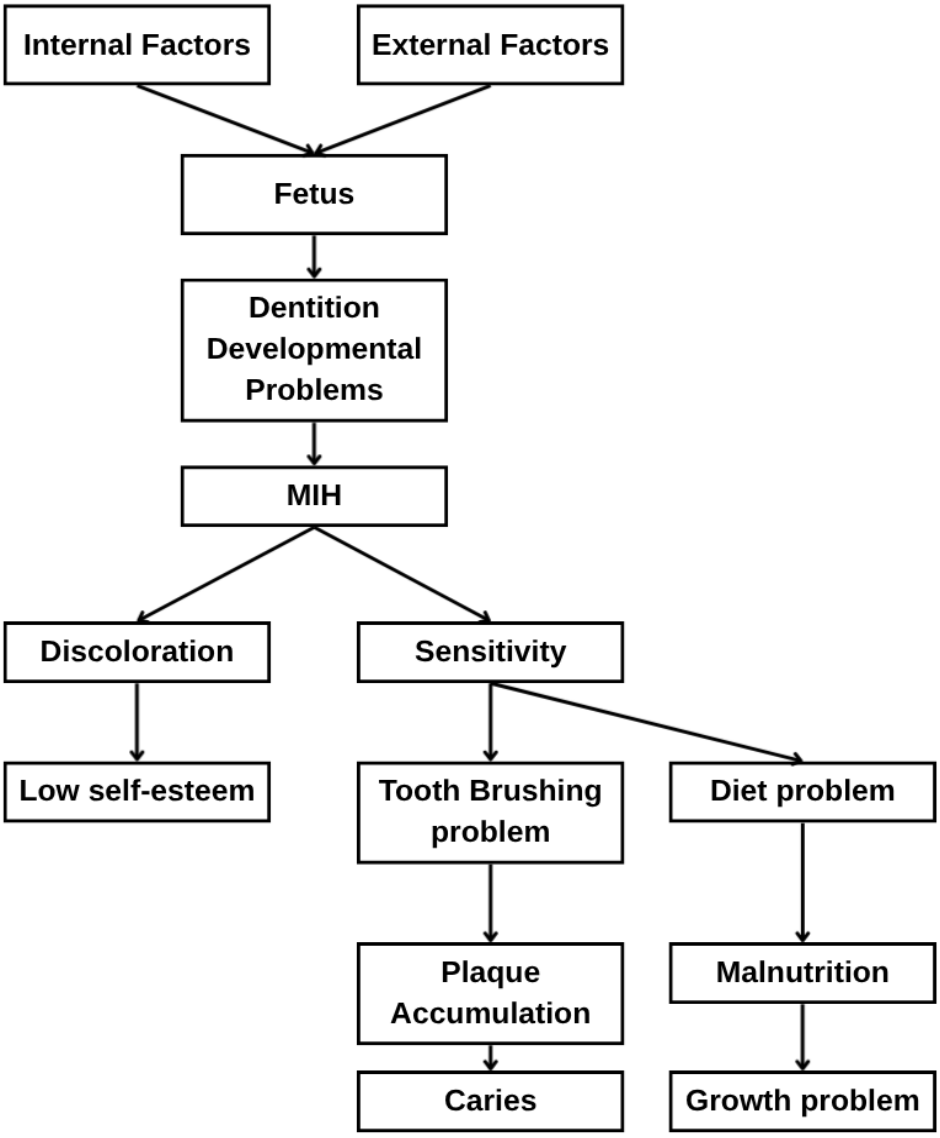

Figure 2. 3 Theoretical framework of study