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Review article

Global burden of molar incisor hypomineralization

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ABSTRACT

Objectives: We aimed to systematically review and meta-analyze the global, super-regional, regional and national prevalence of molar-incisor-hypomineralization (MIH) and to determine the numbers of prevalent and incident cases on different spatial scales. The review was registered (PROSPERO CRD42017063842).
Sources: Five electronic databases (Medline, EMBASE, LILACS, Web of Science, Google Scholar) were searched systematically.
Study selection: Observational studies on the prevalence of MIH were included and the prevalence on different spatial scales (global, super-regional, regional, national) synthesized using random-effects meta-analyses. The prevalence was then regressed on a large set of methodological, socioeconomic and environmental variables to estimate the global burden (incident and prevalent cases) of MIH.
Data: Of 2239 identified studies, 99 studies on 113,144 participants from 43 countries were included. The meta-analysis yielded a mean (95% CI) prevalence of 13.1% (11.8–14.5%), with significant differences between super-regions, regions and countries. The number of prevalent cases in 2015 was estimated at 878 (791–971) million people, while the number of incident cases in 2016 was 17.5 (15.8–19.4) million. Of these, 27.4% (23.5–31.7%) (in mean, 240 million prevalent and 4.8 million incident cases, respectively) were or will be in need of therapy due to pain, hypersensitivity or posteruptive breakdown. Heavily populated countries contribute significantly to the burden of prevalent cases, while growing countries like India, but also Pakistan or Indonesia rank first with respect to the number of incident cases.
Conclusions: MIH is highly prevalent across the globe. Certain (mainly low- and middle income) countries shoulder the majority of this burden.

Clinical significance The consistently high prevalence and the large proportion of cases in need of care should be considered by both clinicians in their daily practice and healthcare planners and policy makers.

1. Introduction

Molar incisor hypomineralization (MIH) is defined as “demarcated, qualitative developmental defects of systemic origin of the enamel of one or more first permanent molar with or without the affection of incisors” [1–3]. MIH was found to be putatively associated with prenatal exposures to possible risk factors (like maternal smoking or illness during pregnancy), perinatal exposures (like premature birth or low birth weight), postnatal exposures (like early childhood illness or underweight) and, generally, medications [4–9]. However, a multifactorial pathogenesis with a possible genetic component seems likely [4–8].

Histologically, MIH-affected teeth show a changed arrangement of enamel crystals and less distinct prism sheaths. The hypomineralized enamel shows inferior mechanical properties, with reduced hardness and modulus of elasticity compared with normal enamel [10–15]. Increased amounts of proteins are also present in MIH-affected compared with normal enamel [16,17].

Clinically, hypersensitivity, post-eruptive enamel breakdown and the development of carious lesions in affected and broken enamel or exposed dentin are relevant [1,2,18,19]. The variation in clinical appearance and the broad spectrum of treatment modalities, which range from prevention, restorations to extraction and orthodontic management, makes the treatment of MIH-affected patients challenging for

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dentists [1–3].

The reported prevalence of MIH varies significantly between studies [20]. A recent study found the pooled global prevalence to be 14.2% [21]; no significant differences between continents were found. However, continents are not the ideal unit for comparing prevalence values. The global burden of disease (GBD) studies, for example, analyze prevalence and incidence within super-regions and regions, which share certain socioeconomic but also geographic (environmental) similarities [22]. Analyses accounting for the association of such socioeconomic and environmental variables with disease prevalence allow the estimation of the prevalence also for countries where no epidemiologic data are available [23]. This, in turn, allows the global burden of a disease like MIH to be quantified, for example as prevalent (existing) and incident (new) cases.

We aimed to systematically review and meta-analyze the global, super-regional, regional and national level prevalence of MIH data. Furthermore, we applied regression techniques to impute the prevalence for countries were no observational data were reported from, and then computed the number of prevalent and incident cases of MIH, i.e. the global burden of MIH, in 2015/2016.

2. Methods

The main research question was: what is the global, super-regional, regional and national burden of MIH? The definitions of the different spatial scales were in accordance with the Global Burden of Disease (GBD) studies [24], as shown in Fig. 1. To estimate the burden, we systematically compiled and then meta-regressed reported prevalence rates of MIH, and applied them to super-regional, regional and national population data. This review and meta-analysis was performed in line with the STROBE, GATHER, PRISMA and MOOSE statements [25–29]. The study protocol was registered after the initial screening stage (PROSPERO CRD42017063842).

2.1. Sources

Electronic searches were carried out in MEDLINE via PubMed, EMBASE via OVID, LILACS via BIREME, Web of Science, and Google Scholar. The search strategy was three-pronged, combining the condition (hypomineralization OR hypomineralisation OR hypomineralized OR hypomineralized OR hypoplasia OR demarcated OR opacities OR MIH OR cheese molars), the study type/outcome (survey OR questionnaire OR cross-sectional OR prevalence OR frequency OR population OR sample OR sampling), and the teeth of interest (molar OR molars OR incisors). Blocks were combined using the Boolean operator AND.

The date of publication was restricted to studies published from 2000 to May 2017. No further restrictions or limitations to the search were made. The search was complemented by cross-referencing, by screening through available reviews on this topic and hand searches as well as web-pages of conferences, governments and international health organizations.

2.2. Study selection

We included the following studies:

(1) Observational studies, regardless of the type (cross-sectional, cohort, case-control), published after peer-review. Studies which were so far only published as theses, reports, audits etc., but did not undergo peer-review, were not included (note that abstracts were included, if sufficient details were reported, as these usually undergo some kind of peer-review). Case-control studies where the case definition was MIH, studies where populations with general diseases possibly affecting the prevalence of MIH, and studies which focused on non-representative samples (like institutionalized populations, particular professions, those with specific dental outcomes like high caries experience) were also excluded.
(2) Studies needed to report on the prevalence of MIH in a sample of

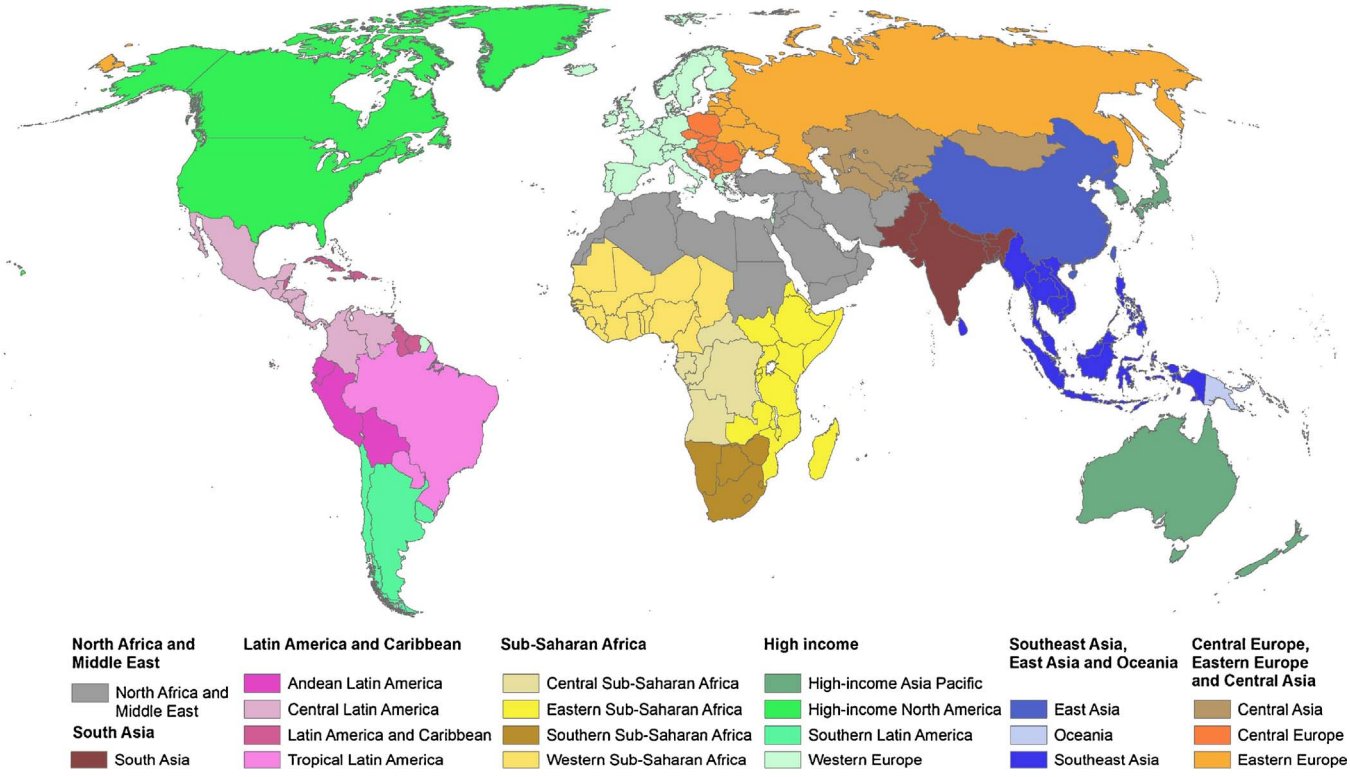

Fig. 1. Super-regions and regions, as used in the Global Burden of Disease (GBD) studies.