



Hypothesis

Quo Vadis Temporomandibular Disorders? By 2050, the Global Prevalence of TMD May Approach 44%

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Abstract

Background/Objectives: Currently, temporomandibular disorders (TMDs) represent a significant public health concern, affecting approximately 34% of the global population. The primary aim of this study was to determine the prevalence of TMDs in the year 2050. A secondary objective was to estimate the prevalence for the years 2030, 2075, and 2100. **Methods:** The methodology of a prognostic study was replicated and adapted to develop prevalence projections for TMDs, utilising the most recent meta-analysis of the global prevalence of temporomandibular disorders and analyses conducted within the R environment. **Results:** Projections indicate a gradual increase in the global prevalence of TMDs over the coming decades. In 2030, the estimated prevalence is 39% (95% confidence interval: 34–44%). This figure is expected to rise to 41% [36–46%] by 2040 and reach 44% [39–49%] by 2050. The upward trend continues, with projections suggesting a prevalence of 47% [42–52%] in 2075 and 49% [44–54%] by 2100. These data highlight a steadily increasing global burden of TMDs. **Conclusions:** By the year 2050, the global prevalence of TMDs is projected to reach 44%, which, according to estimates, corresponds to approximately 4,252,160,000 individuals. By 2030, 39% of the population is projected to experience TMDs. By 2075, the global TMD prevalence is expected to rise to 47%, and, by 2100, it could increase further to 49% of the global population. Urbanisation affects TMD prevalence in a region-dependent manner; a significant decrease was observed in Asia, while, in the Americas and Europe, the association was negligible. Globally, the lack of a clear impact of urbanisation on TMD occurrence suggests the influence of environmental and cultural factors.



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Keywords: TMDs; temporomandibular disorders; meta-analysis; trends; prevalence; 2050; 2075; 2100; prediction; epidemiology

1. Introduction

“Quo vadis, Domine?”—this question is not only a symbolic inquiry into spiritual direction, but also a profound reflection on humanity’s future in the face of suffering [1,2].

The Latin phrase “Quo vadis” means “Where are you going?” in English. In the context of medicine and biomedical sciences, the question “quo vadis?” refers to the search for ways to understand, diagnose, and treat diseases. It often arises in medical literature [3–7]. This question has also been posed in the present study in relation to temporomandibular disorders (TMDs).

TMDs refer to a group of dysfunctions involving the temporomandibular joint, the masticatory muscles, and adjacent structures, presenting with pain, limited jaw mobility, and joint sounds [8,9]. Currently, the global prevalence of TMDs is estimated at approximately

30% [10,11]. However, according to the latest meta-analysis (2024), there is geographical variation in the prevalence of TMDs: South America (47%), Asia (33%), Europe (29%), and North America (26%) [10].

The aetiology of TMDs is complex and involves multiple co-existing factors [12–15]. The development of TMDs may be influenced by biomechanical, neuromuscular, biopsychosocial, and biological elements [14]. Psychosocial factors, including stress, anxiety, and depression, also play a significant role, as they can exacerbate muscle tension and pain symptoms [16,17]. Recent studies have highlighted the comorbidity of bruxism and TMDs [18–20]. Bruxism, through the chronic overload of the masticatory muscles and temporomandibular joints, can lead to increased muscle tension and degenerative changes within the joint, significantly contributing to the development and exacerbation of TMD symptoms [18–21]. The global co-prevalence of bruxism and TMDs is around 17%, with regional variations similar to TMDs alone [10]: 70% in North America; 24% in South America; 14% in Europe; and 9% in Asia [18].

Due to its complex aetiology and high prevalence, TMDs represent a significant economic burden both for healthcare systems and for individual patients [22–24]. The treatment of TMDs involves a multidisciplinary approach, including conservative methods and, in more severe cases, invasive interventions [25–28]. Fundamental therapeutic strategies include occlusal splints, physiotherapy, and relaxation techniques aimed at reducing muscle tension. Pharmacotherapy is often used as an adjunct, including non-steroidal anti-inflammatory drugs, analgesics, and, sometimes, botulinum toxin to reduce masticatory muscle activity [25,27,29]. In chronic cases that are resistant to conservative treatment, surgical procedures may be considered [30,31].

Based on the data presented, it is evident that TMD constitutes a significant issue from epidemiological, diagnostic, and therapeutic perspectives, holding an important position within the interdisciplinary field of modern medicine. Therefore, this study was undertaken to analyse future trends in the prevalence of TMD. At the outset, it is important to emphasise that determining disease trends in medical research always carries a risk of error [32–35]. Nevertheless, even if forecasts are not entirely precise, they remain of great importance as they enable preventive actions and the more effective planning of resources such as hospital bed availability, medical staff, and medicine supplies. Accurate prognostic forecasts enhance the value of diagnosis, allowing for more efficient crisis management [36].

Moreover, identifying health trends allows for the development of prediction-based health policies, including increased preventive efforts such as educational campaigns, vaccination programmes, or the adaptation of medical infrastructure. A lack of such information may, in the long term, pose a greater threat to prevention than the potential inaccuracy of forecasts, which can be corrected over time. In the context of the COVID-19 pandemic, forecasts based on mathematical models played a crucial role in addressing the global health crisis [37–39].

Forecasting the incidence of TMDs may constitute a significant contribution to long-term planning at both the clinical and systemic levels. As predicted, an increase in the prevalence of TMDs could lead to a greater burden on healthcare systems, necessitating appropriate adjustments in training strategies, resource allocation, and the development of policies focused on prevention and early diagnosis [22,40–43].

Adopting a long-term perspective on this issue enables the identification of potential gaps in the availability and quality of care, while also promoting the development of integrated treatment models based on epidemiological analyses [44–46]. In this context, the question “Quo vadis?” in relation to TMDs takes on particular significance, acting as a stimulus for policymakers and clinical practitioners to initiate measures that prepare healthcare systems for future challenges.

To the best of the author's knowledge, no studies have yet been published that forecast the future global prevalence of TMDs in a long-term framework. The projection presented in this work for the years 2030, 2050, 2075, and 2100 is, therefore, novel in nature and represents a meaningful expansion of the current body of knowledge. It may serve as a tool for enhancing the understanding of future epidemiological trends and predicting the potential burden on healthcare systems.

Incorporating long-term forecasts allows for the more precise planning of medical resources and the formulation of effective preventive and therapeutic strategies, which is of crucial importance both from a public health policy perspective and for clinical management within the field of TMD [47].

Therefore, in reference to the question posed in the title—Quo Vadis Temporomandibular Disorders?—a study was undertaken to determine the prevalence of TMDs in the year 2050. A secondary aim was to estimate the prevalence in the years 2030, 2075, and 2100.

2. Materials and Methods

The study design was registered with the Open Science Framework (OSF) under the identification number <https://doi.org/10.17605/OSF.IO/U846T>.

Based on the model proposed by Holden et al. [34], an attempt was made to estimate the hypothetical prevalence of TMDs in the years 2050 and 2100. The analysis covered six continents: North America, South America, Europe, Africa, Asia, and Australia. Data were grouped into three age categories, consistent with the classification used in the meta-analysis on TMD [10]: under 18 years, 18–60 years, and over 60 years.

Baseline prevalence data for TMDs in each age group were obtained from [10]—Supplementary Material S1. In cases where complete data were unavailable (partly for North America and entirely for Africa and Australia), global prevalence estimates by age group were used: 0–18 years (27%), 18–60 years (41%), and 60+ years (36%) [10]. These values were assumed to refer to the year 2020, in line with the cut-off date for the literature search in the meta-analysis [10], rounded to the nearest whole year (consistent with Holden et al. [34]).

2.1. Modelling and Estimation of Changes

The model developed by Holden et al. [34] was adapted for this analysis, employing linear regression to estimate future changes in TMD prevalence. This approach was deemed appropriate given the parallels between the increasing epidemiological trends observed in both myopia [34] and TMDs [10,11,48], as well as the shared multifactorial aetiology of these conditions (myopia [49–51] and TMDs [52–54]). The model incorporated current prevalence rates, changes in urbanisation ($R^2 = 0.07$) [34], and the Human Development Index (HDI, $R^2 = 0.74$) [55].

To translate the strength of the relationship between exposure variables and outcome, the hazard ratio (HR) was converted into a correlation coefficient (r), following a logistic regression and Cox-model-based approach [56,57]. Based on Bair et al. [58], a mean pseudo-R value of 0.57 was obtained. A 95% confidence interval was calculated for each forecast outcome [59,60].

2.2. Impact of Urbanisation on TMD Prevalence

Due to a lack of clear studies examining the effect of urbanisation on TMD prevalence, a systematic search of the PubMed and Scopus databases was conducted [21,61,62]. The keywords used were “TMD”, “temporomandibular disorder”, and “rural”, with no date restrictions. Of 190 identified articles, 66 abstracts were reviewed, and 18 full texts were analysed. Due to the inability to export data based on urban or rural regions, the following

studies were excluded after full-text assessment: [63–67]. Ultimately, 13 studies [68–80] comparing TMD prevalence in urban and rural populations were included. The summary of the PICO standards (population, intervention, comparison, and outcome) [81,82] is found in Table 1.

Table 1. PICO summary.

P (Population)	I (Intervention/Exposure)	C (Comparison)	O (Outcome)
Individuals from urban and rural populations studied for TMD prevalence.	Urbanisation (percentage of population living in urban areas).	Populations with different levels of urbanisation (rural vs urban regions).	Prevalence of temporomandibular disorders.

Urbanisation rates (%) corresponding to the year of data collection were assigned based on literature values [55]. Studies were categorised by continent: America, Europe, and Asia. For each, linear regression (OLS—ordinary least squares) [83,84] was used to model the relationship between urbanisation (%) and TMD prevalence (%). Influential observations were removed using Cook’s distance ($>4/n$) [85,86]. Coefficients of determination (R^2) were calculated, and regression coefficients were interpreted as the change in TMD prevalence per 1% increase in urbanisation.

These results were compared with the United Nations projections, indicating that 55% of the global population currently lives in cities, a figure expected to rise to 68% by 2050 [87]. As no forecast for the year 2100 was available, a linear extrapolation to 75% was adopted as a moderate and realistic assumption.

Assumed regression coefficients were as follows (Supplementary Material S2):

- For the Americas: -0.023 (i.e., a 0.023 percentage point decrease in TMD prevalence per 1% urbanisation increase);
- For Europe: ~ 0.000 (negligible effect of urbanisation);
- For Asia: -0.316 (i.e., a 0.316 percentage point decrease per 1% increase in urbanisation);
- Global coefficient: -0.0034 . This indicates a negligible and likely clinically insignificant decrease of 0.0034 percentage points in TMD prevalence per 1% increase in urbanisation; yet, this was used in the analysis.

2.3. Annual Growth Model

To model a realistic rate of TMD prevalence increase, an exponential fit function was developed, based on the approach by Holden et al. [34]. The model accounts for a decreasing growth rate as prevalence approaches upper biological limits near 100%. The function was calibrated so that, for a baseline prevalence of 12% [58,88], it yielded an annual growth rate of exactly 3.5% [58] (Supplementary Material S3).

Final formula is as follows:

$$\Delta p_{annual} = 6.99 * e^{-0.057 * p_{2020}}$$

where:

- Δp_{annual} = annual change in TMD prevalence (percentage points);
- p_{2020} = baseline TMD prevalence in the year 2020;
- e = Euler’s number (approx. 2.718) [89].

2.4. Age Adjustment Coefficients

To reflect age-related differences in growth rates, correction factors were developed. According to Bair et al. [58], annual prevalence growth was 2.9% (ages 18–24, $n = 1421$),

3.8% (ages 25–34, $n = 736$), and 4.7% (ages 35–44, $n = 580$). A weighted average annual growth rate of 3.52% for ages 18–44 was calculated and adopted as the reference for the broader 18–60 age group, in line with the meta-analysis range [10].

For the 0–18 group, a growth rate of 1.75% (correction factor: 0.50) was assumed, while, for the 60+ group, a rate of 1.3% (factor: 0.37) was applied. These values are based on empirical data and biological–demographic reasoning [10,11,21,34].

2.5. Model Limitations and Saturation Threshold

The adoption of a saturation threshold in forecasts is supported by both empirical evidence and methodological principles, in accordance with the standards of prognostic modelling and trend analysis. From a statistical perspective—particularly in linear regression applied to forecasting temporal values—the absence of anchoring the model within a realistic limit may result in the overestimation of future values and an illogical escalation of the trend [90–93].

Consequently, predictive analyses frequently employ the so-called saturation threshold [92–94], which defines the maximum level of a variable beyond which its growth rate diminishes, and forecasted values either stabilise or begin to decline.

Models of this nature have been known since the nineteenth century; for instance, the Belgian mathematician Pierre François Verhulst (1804–1849) developed the logistic model to describe constrained population growth in the context of finite environmental resources [90,91].

In the context of the epidemiology of TMDs, a 60% threshold has been grounded in empirical data: it represents twice the prevalence estimated by meta-analyses (~30% in 2020) [10,11], while simultaneously being corroborated by selected studies reporting values near or exceeding 60% in large population samples ($n > 500$) [95–97]. Although such values lie at the upper boundary of known data, they are observable in specific populations or under broad definitions of symptoms.

Therefore, the adoption of a 60% saturation threshold is methodologically justified and appropriate within the framework of modelling limited growth functions. This approach helps to avoid distortions arising from linear extrapolation and enhances the accuracy of predictions concerning the epidemiological dynamics of the phenomenon.

2.6. Omission of Gender Factor

Gender differences were not included in the model. A 2024 meta-analysis [10] found no statistically significant differences in TMD prevalence between men and women. Although female sex hormones may influence pain symptom severity, their role in TMD aetiology remains unclear [61,62].

2.7. Comparison with INED Data

The obtained results were compared with the exported data from the Institut national d'études démographiques (INED). The data referred to the projections available in May 2025, based on the Medium Scenario for the entire world [98].

2.8. Data Analysis

Analyses were conducted using the R Statistical language (version 4.1.1; R Core Team, 2021) on Windows 10 Pro 64 bit (build 19045), using the packages *metafor* (version 3.8.1; [99]), *dplyr* (version 1.1.2; [100]), *ggplot2* (version 3.4.0; [101]), *readxl* (version 1.4.5; [102]), *scales* (version 1.4.0; [103]), *tidyr* (version 1.3.1; [104]), and *purrr* (version 1.0.4; [105]).

3. Results

Based on the conducted analyses, it was observed that, by 2030, the global prevalence of TMDs will reach 39%. In 2040, it will exceed 40%, reaching 44% by 2050. In subsequent years, it is projected to be 47% in 2075 and 49% in 2100. Detailed data are presented in Table 2 and Figure 1.

Table 2. Projected prevalence of TMDs for the years 2050, 2075, and 2100, including 95% confidence intervals.

Year	Projected Proportion	95% CI
2020	0.34 *	[0.29; 0.39] *
2030	0.39	[0.34; 0.44]
2040	0.41	[0.36; 0.46]
2050	0.44	[0.39; 0.49]
2075	0.47	[0.42; 0.52]
2100	0.49	[0.44; 0.54]

*—The data were added to illustrate the current state based on the work of [10].

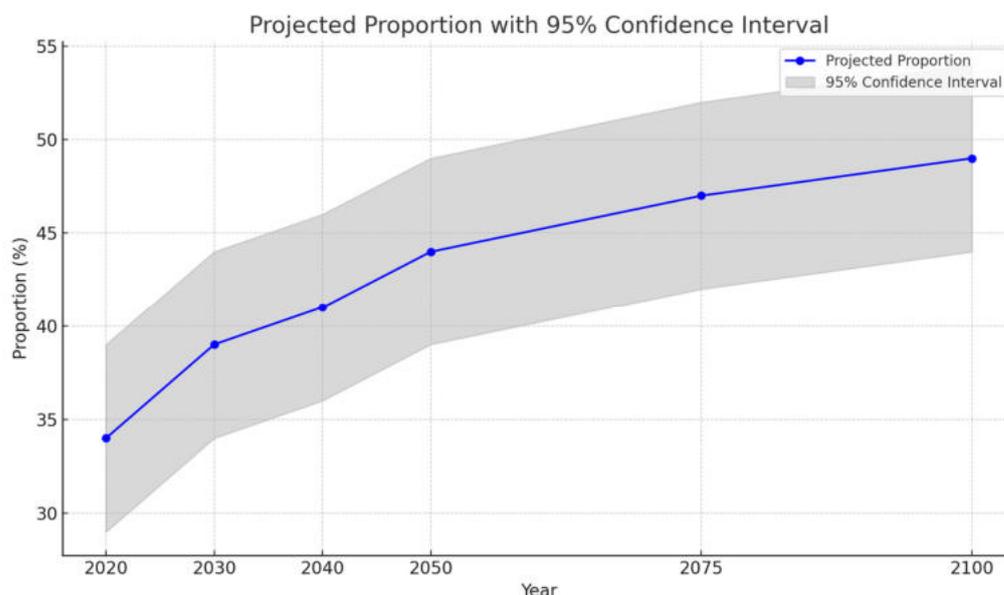


Figure 1. Graphical representation of the projected prevalence of TMD for the years 2050, 2075, and 2100, including 95% confidence intervals.

The results were compared with INED data [98]. According to estimates, the global population is projected to reach 9664 million people by 2050, 10,250 million by 2075, and 10,180 million by 2100 [98]. A comparison of the percentage data (Table 2) with INED projections suggests that, by 2050, at least one symptom of TMD will be present in approximately 4252.16 million people worldwide. By 2075, this number is expected to rise to 4817.50 million, and, by 2100, to 4988.20 million people globally.

In 2050, the estimated prevalence of TMDs in North America is projected to be 44%, while, in South America, it will reach 51%, representing the highest prevalence globally. In comparison, the prevalence in Europe is estimated at 37%, in Asia at 32%, in Africa at 43%, and in Australia at 43% (Figure 2). Due to a lack of detailed data for Africa and Australia, these figures have been averaged based on global estimates, as shown in Supplementary Material S1.

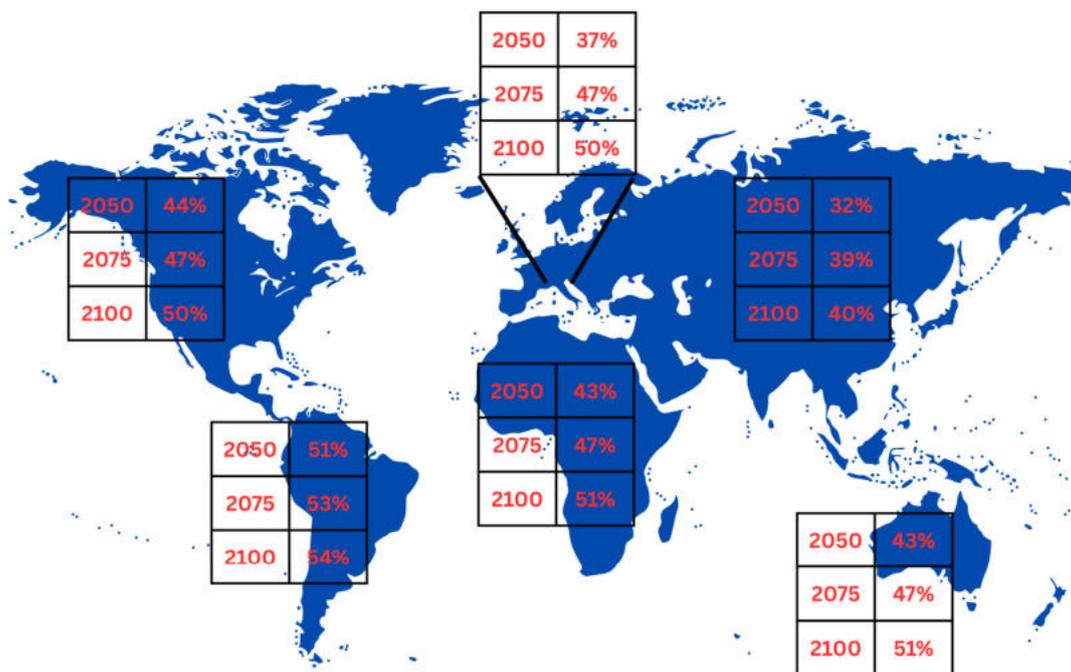


Figure 2. Graphical representation of TMD prevalence for the years 2050, 2075, and 2100 by continent.

In the following decades, a systematic increase in TMD prevalence is expected. By 2100, South America, Africa, and Australia are projected to exceed a 50% prevalence of TMDs in the population. Europe is expected to approach 50%, and Asia will near 40% (Figure 2). Detailed data on age distribution are presented in Table 3.

Table 3. Projected TMD prevalence for the years 2050, 2075, and 2100 by age group and continent.

Region	Age Group	Projected Proportion	95% CI						
		2030		2050		2075		2100	
Africa	0–18	0.31	[0.26; 0.36]	0.40	[0.35; 0.45]	0.45	[0.40; 0.50]	0.49	[0.44; 0.54]
Africa	18–60	0.43	[0.38; 0.48]	0.49	[0.44; 0.54]	0.52	[0.47; 0.57]	0.55	[0.50; 0.60]
Africa	60+	0.37	[0.32; 0.42]	0.42	[0.37; 0.47]	0.45	[0.40; 0.50]	0.48	[0.43; 0.53]
Asia	0–18	0.29	[0.24; 0.34]	0.34	[0.29; 0.39]	0.37	[0.32; 0.42]	0.39	[0.34; 0.44]
Asia	18–60	0.42	[0.37; 0.47]	0.42	[0.37; 0.47]	0.44	[0.39; 0.49]	0.45	[0.40; 0.50]
Asia	60+	0.36	[0.31; 0.41]	0.35	[0.30; 0.40]	0.36	[0.31; 0.41]	0.37	[0.32; 0.42]
Australia	0–18	0.31	[0.26; 0.36]	0.40	[0.35; 0.45]	0.45	[0.40; 0.50]	0.49	[0.44; 0.54]
Australia	18–60	0.43	[0.38; 0.48]	0.49	[0.44; 0.54]	0.52	[0.47; 0.57]	0.55	[0.50; 0.60]

Table 3. Cont.

Region	Age Group	Projected Proportion	95% CI						
		2030		2050		2075		2100	
Australia	60+	0.37	[0.32; 0.42]	0.42	[0.37; 0.47]	0.45	[0.40; 0.50]	0.48	[0.43; 0.53]
Europe	0–18	0.25	[0.20; 0.30]	0.38	[0.33; 0.43]	0.44	[0.39; 0.49]	0.48	[0.43; 0.53]
Europe	18–60	0.43	[0.38; 0.48]	0.49	[0.44; 0.54]	0.52	[0.47; 0.57]	0.55	[0.50; 0.60]
Europe	60+	0.34	[0.29; 0.39]	0.40	[0.35; 0.45]	0.44	[0.39; 0.49]	0.47	[0.42; 0.52]
North America	0–18	0.38	[0.33; 0.43]	0.43	[0.38; 0.48]	0.46	[0.41; 0.51]	0.50	[0.45; 0.55]
North America	18–60	0.43	[0.38; 0.48]	0.48	[0.43; 0.53]	0.52	[0.47; 0.57]	0.54	[0.49; 0.59]
North America	60+	0.37	[0.32; 0.42]	0.41	[0.36; 0.46]	0.44	[0.39; 0.49]	0.47	[0.42; 0.52]
South America	0–18	0.35	[0.30; 0.40]	0.41	[0.36; 0.46]	0.45	[0.40; 0.50]	0.49	[0.44; 0.54]
South America	18–60	0.56	[0.51; 0.61]	0.56	[0.51; 0.61]	0.57	[0.52; 0.62]	0.57	[0.52; 0.62]
South America	60+	0.56	[0.51; 0.61]	0.56	[0.51; 0.61]	0.56	[0.51; 0.61]	0.56	[0.51; 0.61]

Detailed results of the analyses can be found in Supplementary Material S4.

4. Discussion

The primary aim of this study was to determine the prevalence of TMDs in the year 2050. A secondary objective was to estimate the prevalence for the years 2030, 2075, and 2100. In response to the titular question, “Quo Vadis Temporomandibular Disorders?”, the answer proposed is that TMDs are on a trajectory to exceed the 40% prevalence threshold worldwide. It is suggested that, by 2050, approximately 44% of the global population will be affected. This is expected to increase steadily, reaching 47% by 2075 and approaching 50% by the year 2100. The present article serves as a hypothesis which may be validated by future research.

TMD is an umbrella term that encompasses a range of diagnoses sharing common features such as pain, dysfunction, and restricted movement, although these conditions may have distinct aetiologies and require different therapeutic approaches [9,10,48,61,106]. It is important to emphasise that this analysis and its associated projections refer to TMDs in terms of this collective designation. The results presented here concern the occurrence of at least one TMD symptom within the studied population, based on data used as the foundation for the primary analysis [10].

Another key source instrumental in forming this analysis was the study by Holden et al. [34], which focused on myopia. It suggested that, by 2050, approximately 50% of the global population may experience myopia. Scientific literature indicates associations between refractive errors and TMDs, which provides a basis for comparing the findings of the two conditions [107–112]. Therefore, the 44% prevalence projected for 2050 in the current study may be considered a plausible and realistic hypothesis.

Even at present, some studies report TMD prevalence rates exceeding 40% [106,113,114], and, in certain populations, figures as high as 60% have been observed [96,115,116].

However, as noted in a recent meta-analysis concerning the global prevalence of TMDs [10], geographic variability and related factors play a crucial role. These include genetic predispositions [117–119], anthropological characteristics [14,120], disparities in access to healthcare [121,122], the incidence of bruxism [18,21], and population-specific differences in pain perception [123,124].

In light of these considerations, the assumption adopted in this study—that, by 2050, approximately 44% of the global population may exhibit at least one TMD symptom—appears to be both realistic and well-founded in the existing epidemiological data.

4.1. Geographic Differences in the Prevalence of TMD

The geographical variation in the prevalence of functional disorders of the masticatory system, known as TMDs, is a complex, multifactorial phenomenon. Among the key determinants of this variation are genetic predispositions, which are increasingly recognised as a significant component in the aetiopathogenesis of TMDs [117–119]. At the same time, environmental and cultural factors, as well as differing population exposures to risk factors such as bruxism, are also highlighted.

Recent meta-analyses point to a significant co-occurrence of bruxism and TMDs [18,19]. The global average prevalence of both conditions occurring together is approximately 17%, though this figure varies widely by region. In North America, the prevalence reaches as high as 70%; in South America, it is 24%; in Europe, 14%; and, in Asia, only 9% [18]. These differences may reflect both the distinct aetiological factors and variations in diagnostic methodologies employed in different regions [10].

One potential factor influencing these differences is the variation in pain perception and tolerance [123,124]. Global epidemiological studies covering 52 countries have shown that the average prevalence of chronic pain is 27.5%, with rates ranging from 9.9% to 50.3% depending on the country [125]. Furthermore, numerous scientific reports indicate differences in pain thresholds between ethnic groups. For instance, studies conducted in the United States have found that members of racial and ethnic minority groups tend to have a lower pain tolerance and greater sensitivity to pain stimuli [126].

Another important aspect is the accessibility and quality of healthcare, which can significantly affect epidemiological data. The literature highlights the substantial variation in healthcare spending between countries and regions, which does not always correlate with the quality of medical services or treatment outcomes [127]. Increasingly, research emphasises the need for systemic health policy interventions aimed at reducing regional disparities in access to healthcare services [128,129].

In summary, the observed geographical differences in the prevalence of TMDs may result from an interplay of biological, cultural, environmental, and systemic factors. This phenomenon requires further multi-centre epidemiological studies and an interdisciplinary research approach to deepen our understanding of the pathomechanisms of TMD and to develop more effective preventive and therapeutic strategies.

4.2. The 44% of the Population with TMD by 2050—What Comes Next?

Contemporary diagnostic and therapeutic approaches to the management of TMDs are demonstrating increasing efficacy and precision. Technological advancements, the expansion of medical knowledge, and the adoption of interdisciplinary strategies are contributing to a deeper understanding of the aetiopathogenesis of TMD and the optimisation of treatment pathways [27,130–132]. As outlined in the introduction to this paper, the current spectrum of available treatment modalities for TMDs encompasses both conservative strategies and more invasive interventions, selected individually based on the patient's clinical phenotype [25–28].

Despite significant progress in this field, there remains a pressing need for continued intensive clinical and experimental research aimed at further refining diagnostic, therapeutic, and preventive methods. Particular emphasis should be placed on the development of strategies grounded in personalised medicine, taking into account genetic, environmental, and psychological factors that influence the clinical manifestation of TMD [8,10,16,17,117,119,130,132].

In the coming years, the advancement of artificial intelligence (AI) is likely to play a pivotal role, as its application in medicine becomes increasingly widespread [133–135]. Within the context of TMD, AI-based technologies may significantly enhance diagnostic processes, for example, through the analysis of imaging data (e.g., MRI, CBCT), symptom patterns, or data collected via digital tools [136,137]. Furthermore, machine-learning algorithms may, in the future, assist in therapeutic decision-making and the identification of high-risk patients, thereby enabling the implementation of early preventive interventions [133–137].

4.3. Limitations of the Forecast

Although this forecast is based on available data and reasonable assumptions, it is subject to a number of significant methodological limitations, which have been discussed in detail in the Introduction and the Materials and Methods sections. However, it is important to emphasise these issues explicitly here.

One of the main limitations of this analysis is the necessity of applying averaged global epidemiological values to estimate forecasts for entire continents such as Africa, Australia, and—in some cases—North America. This approach was necessitated by the lack of sufficiently detailed local source data, which represents a common challenge in modelling and prognostic studies of this kind [34].

An additional limitation involves the use of averaged urbanisation indices for the aforementioned regions, which may not fully capture the internal diversity within each continent. Despite these shortcomings, it should be noted that the substitution of missing data with estimated or averaged values is a widely accepted practice in population analyses and epidemiological forecasting, provided that such substitutions are properly documented and interpreted [34].

Another limitation of the analysis is the omission of sex-related differences. This decision was based on the findings of a recent meta-analysis, which did not reveal statistically significant differences in the prevalence of TMD between women and men [10]. Nevertheless, in light of the ongoing debate regarding the potential influence of hormonal factors on the pathophysiology of TMDs [61,62], as well as reports indicating a higher prevalence of the disorder among women, this omission should be acknowledged as a potential limitation that may influence future findings and their interpretation.

It should be clearly emphasised that the presented projection constitutes a prognostic hypothesis which—like any prediction based on statistical modelling—may or may not be confirmed by future empirical data. Its accuracy may be influenced by numerous dynamic and unpredictable external factors that were not accounted for in the present meta-analysis. Potential confounding variables include, among others, global health crises (e.g., pandemics), international conflicts, and political and regulatory changes (both those facilitating and those limiting access to healthcare services), as well as shifts in the demographic structure of the population. A significant impact may also arise from the advancements in the diagnosis and treatment of TMDs, including the development of new, more effective therapeutic approaches. In light of these considerations, the results presented herein should be interpreted as an approximation of a potential epidemiological trajectory rather than as a definitive or unchallengeable prediction.

In light of the above, the results presented here should be interpreted with caution—as an approximation of a potential trend, rather than a definitive prediction. They are intended to serve more as a starting point for further research than as a conclusive statement regarding the future prevalence of TMDs.

5. Conclusions

- By the year 2050, the global prevalence of TMDs is projected to reach 44%, which, according to estimates, corresponds to approximately 4,252,160,000 individuals.
- By 2030, 39% of the population is projected to experience TMDs. By 2075, the global TMD prevalence is expected to rise to 47%, and, by 2100, it could increase further to 49% of the global population.
- Urbanisation may exert varying effects on the prevalence of TMDs depending on the geographical region. The strongest association has been observed in Asian countries, where an increase in urbanisation levels correlated with a statistically significant decrease in TMD prevalence. In the Americas and Europe, this relationship was weak or not demonstrated. On a global scale, the analysis did not confirm a significant impact of urbanisation on TMD epidemiology, which may suggest the importance of environmental and cultural determinants in its aetiopathogenesis.

Supplementary Materials: The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/jcm14134414/s1>, Supplementary Material S1—Exported Data; Supplementary Material S2—Analysis of the Impact of Urbanisation on TMD Prevalence; Supplementary Material S3—Annual Growth Model; Supplementary Material S4—Detailed Results.

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