

Prevalence of Masked Hypertension: A Systematic Review and Meta-Analysis (2026)

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Abstract

Introduction: Masked hypertension becomes a growing public health concern because it often remains undiagnosed and untreated despite its strong association with cardiovascular morbidity and mortality. Evidences show that individuals with masked hypertension have more cardiovascular risk profile than those individuals with sustained hypertension. Therefore this review was aimed to estimate pooled prevalence of masked hypertension.

Methods and materials: PubMed, EMBASE, Cochrane, Scopus, Web of Science, and grey literatures were used for the searching. We assessed methodological quality using the Newcastle-Ottawa Scale. An inverse variance-weighted random-effects model meta-analysis was performed to estimate the pooled prevalence and odds ratio (OR) of determinants with a 95% confidence interval (CI). The I² test statistic was used to check between-study heterogeneity, and the Egger's regression statistical test was used to check publication bias. A p-value of less than 0.05 used to declare statistical significance.

Results: The 9 studies included 16213 participants. Most of the included studies were cross-sectional studies and conducted in Europe region. Among the included according to this study the global pooled Prevalence of masked hypertension among adults with a random-effects model was 21.9% (95% CI: 10.9-32.9). The highest 24.2% (95% CI: 11.7- 36.7) seen in South America region and the lowest 13.1% (95% CI: -0.93-27.1) seen in Europe region.

Conclusion: Despite the importance of early detection and management of masked hypertension in reducing cardiovascular complications and improving long-term health outcomes, the current study showed that nearly one in five adults had masked hypertension. Therefore, the routine use of ambulatory or home blood pressure monitoring, particularly among individuals with cardiovascular risk factors, is essential to improve early diagnosis and ensure timely intervention.

Keywords: Masked, hypertension, meta-analysis, global, prevalence.

Introduction

Masked hypertension is a serious clinical condition in which individuals present with normal blood pressure readings in the clinical setting but exhibit elevated blood pressure outside the healthcare environment, particularly during ambulatory or home blood pressure monitoring [1, 2]. This condition has become a growing public health concern because it often remains undiagnosed and untreated despite its strong association with cardiovascular morbidity and mortality [3]. Evidences show that

individuals with masked hypertension have more cardiovascular risk profile than those individuals with sustained hypertension, including increased risks of stroke, left ventricular hypertrophy, kidney disease, and other target organ damage [4, 5]. Also, masked hypertension is a precursor of sustained hypertension and other cardiovascular health conditions [6]. Furthermore, better cardiovascular health is associated with a lower prevalence of masked hypertension [7].

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Masked hypertension affects roughly 15% of the general population and is even higher among individuals with prehypertension or diabetes associated with adverse clinical outcome [8]. Early detection by ambulatory or home BP recording in susceptible individuals reduces end-organ damage and progresses to sustained HTN [9].

The challenges associated with masked hypertension are that conventional office blood pressure measurement, which is widely used in healthcare facilities, fails to detect many high-risk individuals. Consequently, patients may not receive timely diagnosis, treatment, or preventive interventions. This hidden burden contributes significantly to poor cardiovascular outcomes and increases healthcare costs associated with complications of uncontrolled hypertension [10-12].

Evidence indicates that the risk of cardiovascular events and all-cause mortality is significantly higher in patients with masked uncontrolled hypertension than in those with controlled hypertension [13].

Furthermore, evidence regarding the prevalence and burden of masked hypertension remains limited. Available studies indicate that masked hypertension is frequent and may be more common in urban populations due to lifestyle changes, stress, obesity, and limited access to regular ambulatory blood pressure monitoring. Therefore, understanding the prevalence of masked hypertension through systematic review and meta-analysis is essential for improving early detection strategies, guiding clinical practice, and reducing the burden of cardiovascular disease associated with undiagnosed hypertension.

Objective of the review

- ✓ To determine the pooled global prevalence of masked hypertension.

Methods and materials

Study design and search strategy

This systematic review and meta-analysis were conducted under the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) statement [14]. A three-step search strategy was utilized in this review. An initial limited search of PubMed was undertaken followed by analysis of the text words contained in the title and abstract, and of the index terms used to describe article. A second search was done by using all identified keywords and index terms across all included databases. Thirdly, the reference list of all identified reports and articles were searched for additional studies. Studies published in English language from 2019 onwards were taken from EMBASE, Cochrane, Scopus, Web of Science, and grey literatures. The search was performed using key terms such as

hypertension, high blood pressure, silent killer, office blood pressure measurement, prevalence, incidence, magnitude, epidemiology, adult, young, and global.

Study selection and eligibility criteria

- ✓ Participants in the studies should be adults.
- ✓ Both published and unpublished studies conducted in globally were included.
- ✓ Studies that reported the prevalence of masked hypertension among adults regardless of study design

Study extraction and quality appraisal

The data were extracted by all authors independently using a data extraction format prepared in a Microsoft Excel 2010 spreadsheet. The extracted data were: the first author's name, publication year, country, design, sample size, and prevalence of masked hypertension. The quality of each study was assessed using the modified Newcastle-Ottawa Scale (NOS) for cross-sectional studies [15]. Studies were included with a score of 5 and more on the NOS [16]. The quality of each study was evaluated independently by all authors and disagreements were resolved by group discussion.

Publication bias and heterogeneity

To assess the existence of publication bias, Egger's test was computed. A p -value < 0.05 was used to declare the statistical significance of publication bias and visually by funnel plots. I^2 test statistics were used to check the heterogeneity of studies. I^2 test statistics of < 50, 50–75% and > 75% was declared as low, moderate and high heterogeneity respectively [17].

Outcome measure

The outcome of this review was the prevalence of masked hypertension.

Data synthesis and analysis

STATA™ Version 14 software was used to conduct the analysis. The heterogeneity test was conducted by using I-squared (I^2) statistics. The pooled prevalence was carried out using a random-effects (DerSimonian and Laird) method. To minimize the potential random variations between studies; the sources of heterogeneity were analyzed using subgroup analysis, and meta-regression. A sensitivity analysis was also conducted.

Results

Study selection and study characteristics

Our literature search retrieved 5749 studies, from which we collected 576 potentially eligible studies after screening the titles and abstracts. Finally, we selected nine studies after a review of the full article (Fig.1).

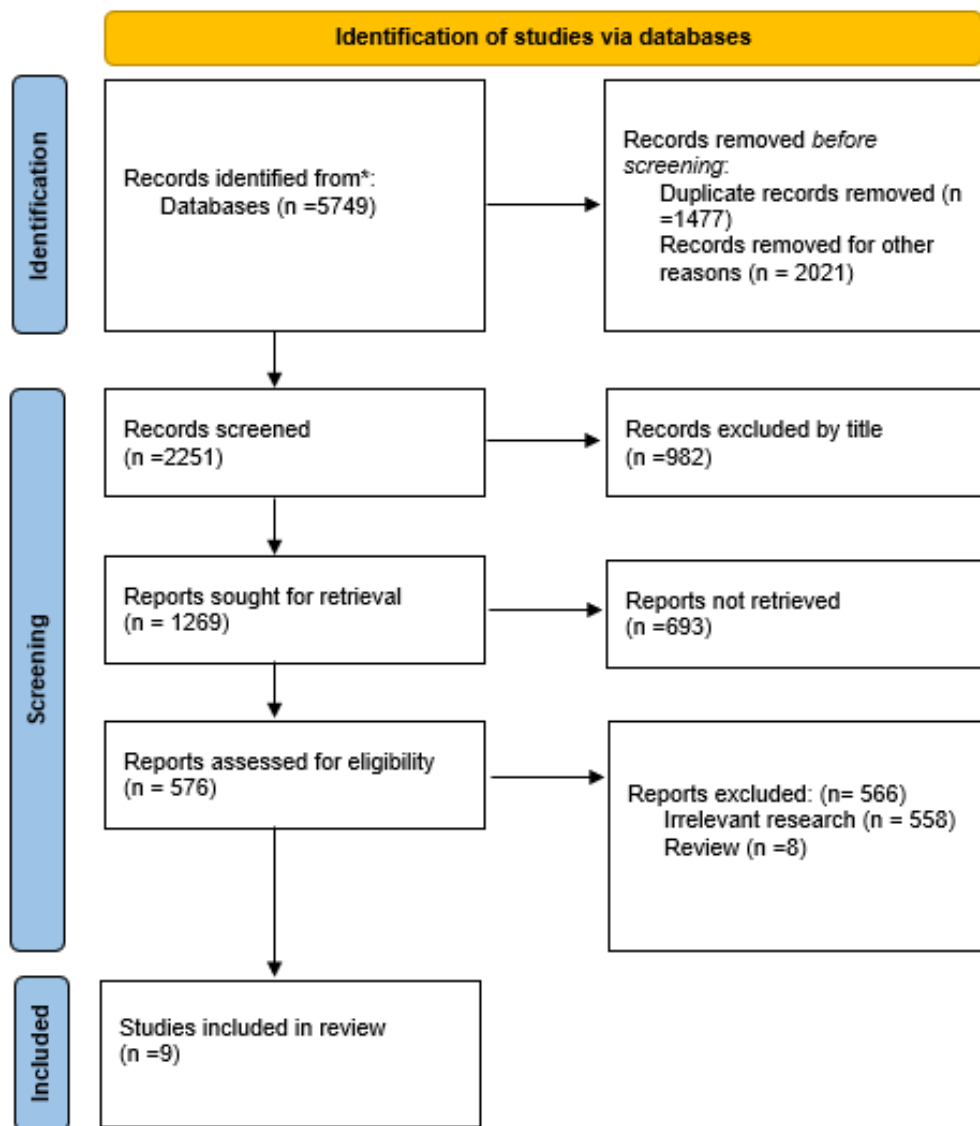


Fig 1: PRISMA flow diagram of study selection for global Prevalence of masked hypertension.

The 9 studies [18-26] included 16213 participants. Most of the included studies were cross-sectional studies and the sample size ranged from 90 [19] to 2836 [20]. Most studies were conducted

in Europe region. Among the included studies, Prevalence of masked hypertension was ranged from 4.2 % [23] to 58.6 % [20] (Table 1).

Table 1: Characteristics of the included studies in the systematic review and meta-analysis.

Authors Name	Publication Year	Study area	Study design	Sample	Prevalence with 95% CI
Odili AN,	2021	Nigeria	Cross-sectional	933	7.9(6.1-9.6)
Hamadou B,	2020	Cameron	Cross-sectional	90	33.3(23.5-43.0)
Xia JH,	2022	China	Cross-sectional	2838	58.6(56.7-60.4)
Trudel X,	2019	Canada	Cohort	1836	10.3(8.9-11.6)
Magalhaes JA,	2021	Brazil	Cross-sectional	3704	18(16.7-19.2)
af Geijerstam P	2023	Sweden	Cross-sectional	4122	4.2(3.5-4.8)
Stergiou GS,	2020	Greece, Finland and UK	Cross-sectional	1971	23(21.1-24.8)
Minetto J,	2025	Argentina	Cross-sectional	506	30.8(26.7-34.8)
Bertram S,	2024	Germany	Cross-sectional	213	12.2(7.8-16.5)

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Pooled prevalence of masked hypertension

A DerSimonian and Laird random-effects model was fitted to determine the pooled effect size.

Accordingly, the global pooled Prevalence of masked hypertension among adults with a random-effects model was 21.9% (95% CI: 10.9-32.9) with heterogeneity index (I^2) of 99.8% ($p < 0.001$) (Fig. 2).

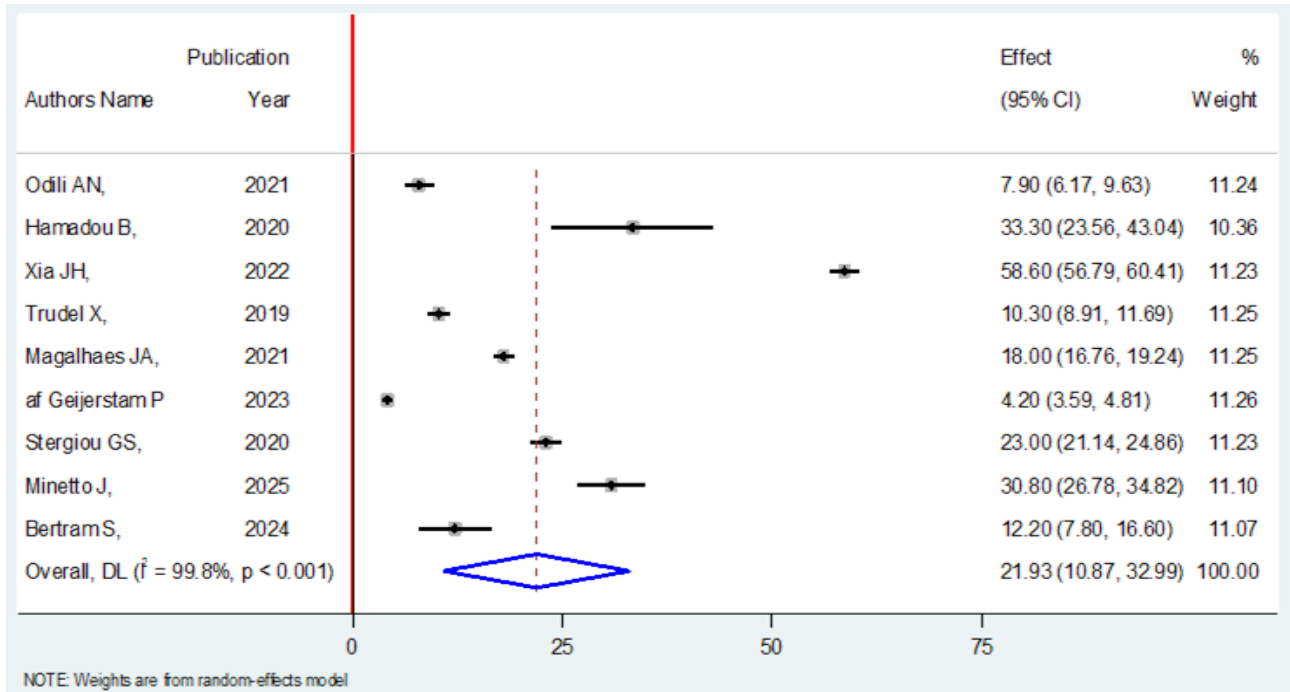


Fig 2. Forest plot showing the pooled global Prevalence of masked hypertension.

Subgroup analysis

Subgroup analyses revealed a marked variation across regions. Based on the subgroup analysis result, the highest at 24.2%

(95% CI: 11.7- 36.7), $I^2 = 97.2\%$) seen in South America region and the lowest at 13.1% (95% CI: -0.93-27.1), $I^2 = 99.4\%$) seen in Europe region (Fig. 3).

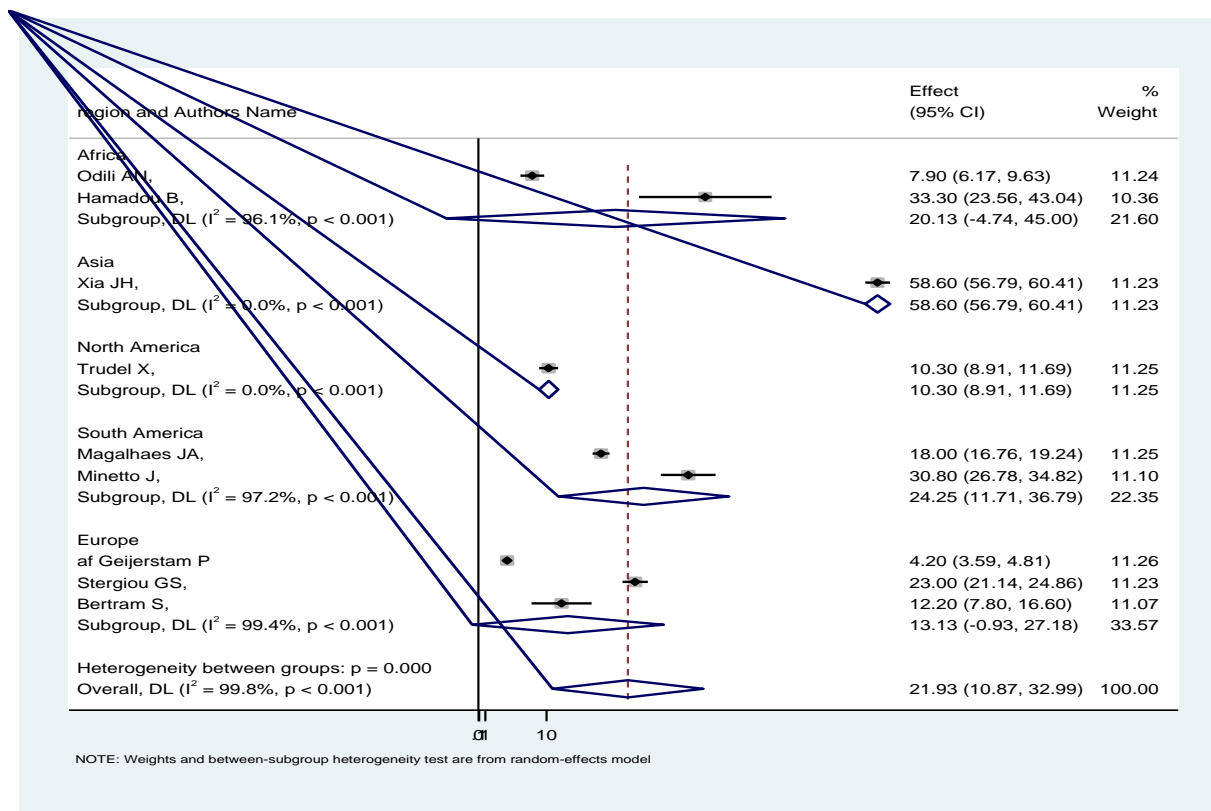


Fig 3: Subgroup analysis of global Prevalence of masked hypertension by region.

Heterogeneity and publication bias

To identify the source reported heterogeneity of this study ($I^2=99.8\%$); meta-regression was conducted using sample size and year of publication as a covariate. It was indicated that there is no effect of sample size and publication year on heterogeneity between studies with a p-value of 0.433 and 0.861 respectively (Table 2).

The presence of publication bias was tested by Egger’s test, (0.055) and visual inspection of the funnel plot showed asymmetrical distribution of studies around the pooled prevalence estimate, suggesting evidence of publication bias (Fig 4).

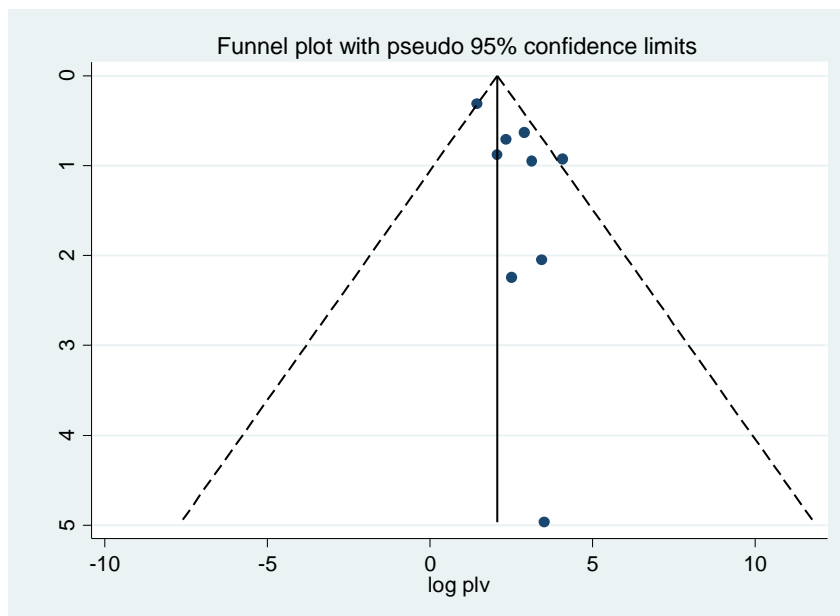


Fig 4: Funnel plot to test publication bias in 9 studies with 95% confidence limits.

Table 2: Meta-regression analysis of factors affecting between-study heterogeneity.

Heterogeneity source	Coefficients	Std. Err.	P-value
Sample size	-.0019748	0.0023528	0.433
Publication year	-.4497966	2.456994	0.861

Sensitivity analysis

Sensitivity analysis was conducted by removing studies step by step to evaluate the effect of a single study on the overall effect

estimate. The analysis showed that omission of any individual study did not substantially alter the pooled prevalence estimate (Fig 5).

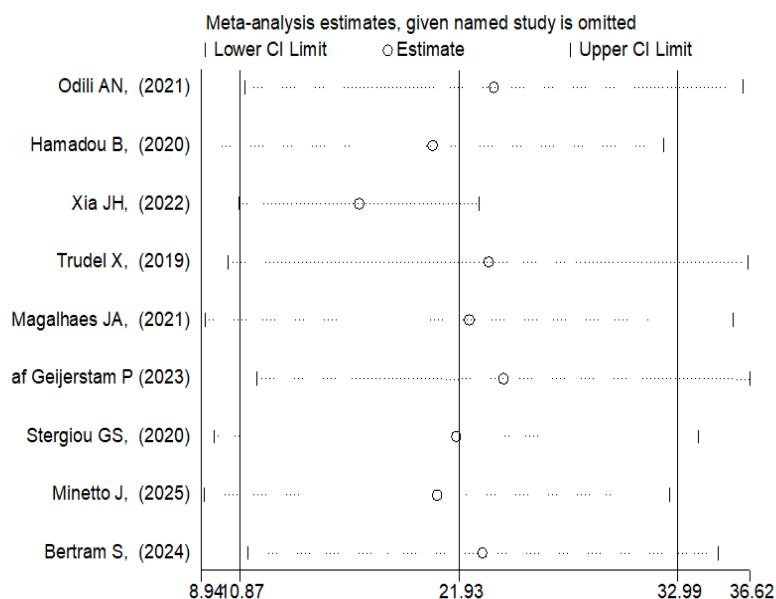


Fig. 5: Sensitivity analysis of pooled global Prevalence of masked hypertension for each study being removed one at a time.

Discussion

Masked hypertension was associated with increased risk of developing hypertension mediated organ damage and major cardiovascular outcomes, such as myocardial infarction, stroke, and hospitalizations due to CV causes, as well as to metabolic abnormalities and diabetes, thus further promoting the development and progression of atherosclerotic disease [27, 28].

The global pooled Prevalence of masked hypertension among adults with a random-effects model was 21.9% (95% CI: 10.9-32.9). This finding suggests that nearly one in five adults with apparently normal office blood pressure may actually have elevated blood pressure outside the clinical setting.

The prevalence in the current study is higher than that reported in several previous systematic reviews and meta-analyses: 14.8% [29] in Africa among adults undergoing ambulatory or home blood pressure monitoring. This difference might be due to variations in study populations, diagnostic criteria, sample size, access to ambulatory blood pressure, and the inclusion of different regions and healthcare settings. Similarly, higher than other study done globally (19%) [30] and (10%) [31], the discrepancy may be due to changes in lifestyle-related risk factors, improvements in out-of-office blood pressure monitoring, and methodological heterogeneity.

Based on the subgroup analysis result, the highest (24.2%; 95% CI: 11.7- 36.7) seen in South America region and the lowest (13.1%; 95% CI: -0.93-27.1) seen in Europe region. Subgroup analysis based on geographic region demonstrated important variation in the prevalence of masked hypertension across different parts of the world. The highest prevalence was observed in South America, where the pooled prevalence reached 24.2% (95% CI: 11.7–36.7), whereas the lowest prevalence was reported in Europe at 13.1% (95% CI: -0.93–27.1). These regional differences may reflect variations in socioeconomic conditions, lifestyle factors, healthcare access, awareness of hypertension, and differences in screening practices.

The higher prevalence observed in South America may be associated with the increasing burden of cardiovascular risk factors in the region, rapid urbanization, lifestyle transitions, and limited access to routine ambulatory blood pressure monitoring [32, 33].

In contrast, European countries generally have better access to regular blood pressure screening, ambulatory blood pressure monitoring, and early management of individuals with high cardiovascular risk [34].

Conclusion

Despite the importance of early detection and management of masked hypertension in reducing cardiovascular complications and improving long-term health outcomes, the current study showed that nearly one in five adults with apparently normal office blood pressure may actually have elevated blood pressure outside the clinical setting. Significant regional variation was also observed. Therefore, the routine use of ambulatory or home blood pressure monitoring, particularly among individuals with cardiovascular risk factors, is essential to improve early diagnosis and ensure timely intervention.

Limitation of the study

This systematic review and meta-analysis had significant heterogeneity of studies, result should be interpreted with caution.

Declaration

Ethics approval and consent to participant

Not applicable

Consent for publication

Not applicable

Availability of data and materials

all the data analyzed during the current systematic review and meta-analysis is available with reasonable request from corresponding author.

Competing interests

all the authors declare that they have no competing interests

Funding

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