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Systematic Review and Meta-Analysis of Global Prevalence of Uncontrolled Hypertension among Hypertensive Comorbid Diabetic Patients: Implications for Integrated Care 2025

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ABSTRACT

Elevated blood pressure can worsen both microvascular and macrovascular complications associated with diabetes mellitus, as well as cerebrovascular and cardiovascular complications Studies show that successfully controlling blood pressure can reduce the risk of stroke, coronary heart disease, congestive heart failure, and overall mortality. So this study was aimed to estimate global pooled prevalence of uncontrolled hypertension among hypertensive comorbid diabetic patients. A systematic search of published studies from PubMed, Scopus, web of Science, and manually on Google Scholar. This meta-analysis follows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines. , The quality of studies was assessed by the JBI assessment tool. Meta-analysis was carried out using a random-effects method using the STATA™ Version 14 software. The 21 studies with high good methodological quality including 11368 participants enrolled on this study. The prevalence of uncontrolled hypertension among patients with hypertensive comorbid diabetes varies significantly, ranging from 29.1% to 93.9%. Using a random effects model, the pooled prevalence of uncontrolled hypertension in this group is estimated to be 68.3% (95% Confidence Interval: 60.1-76.6). Additionally, the prevalence differs by region, with 78.7% (95% CI: 66.4-91.1) in Asia and 67.2% (95% CI: 57.7-76.7) in Africa. Despite the increased complexity and complication of hypertension, the prevalence of uncontrolled hypertension among patients with diabetes and hypertension remains alarmingly high. Therefore, a multifaceted approach is necessary to manage hypertension in patients with both hypertension and diabetes.

INTRODUCTION

Uncontrolled hypertension is diagnosed when a patient's blood pressure remains above 140/90 mmHg despite of taking antihypertensive medications for at least six months. This indicates that the medication is not effectively managing the blood pressure, which may be due to factors such as non-adherence to the treatment, lifestyle choices, or other underlying health conditions (1, 2).

High systolic blood pressure is the leading risk factor for preventable deaths, accounting for about one-fifth of all deaths globally (approximately 11 million) and is the primary preventable risk factor for cardiovascular disease (CVD) and all-cause mortality worldwide (3, 4).

Hypertension remains a significant public health concern, contributing to the development of cardiovascular diseases, strokes, and premature deaths. Reports indicate that only 54% of adults with hypertension are diagnosed, 42% receive

treatment, and just 21% have their hypertension effectively controlled. The prevalence of uncontrolled hypertension can reach up to 50% among hypertensive patients, and it is particularly common in those with diabetes (5-8).

Achieving the target blood pressure in individuals with hypertension poses a serious global health challenge (9). Studies show that successfully controlling blood pressure can reduce the risk of stroke, coronary heart disease, congestive heart failure, and overall mortality (10). Furthermore, managing both hypertension and diabetes mellitus is crucial for preventing cardiovascular diseases (11).

Evidence indicates that, despite the availability of improved diagnostic and therapeutic interventions that have proven benefits in reducing cardiovascular morbidity and mortality, control rates of hypertension remain poor (12).

In cases of comorbid conditions, effectively managing these conditions can optimize blood pressure control in patients with uncontrolled hypertension (13). Elevated blood pressure can worsen both microvascular and macrovascular complications associated with diabetes mellitus, as well as cerebrovascular and cardiovascular complications (14, 15). Since hypertension and diabetes are both significant risk factors for cardiovascular diseases, estimating the pooled prevalence of uncontrolled hypertension in patients with diabetes is essential for addressing their healthcare needs and ensuring effective management strategies.

Objective of the Study

To estimate the pooled prevalence uncontrolled hypertension among hypertensive comorbid diabetic patients.

METHODS AND MATERIALS

Eligibility criteria

The below mentioned criteria were used to select the studies included in this systematic review and meta-analysis.

- ✓ All published studies/articles conducted regarding the global burden of prevalence uncontrolled hypertension among hypertensive comorbid diabetic patients.
- ✓ Studies that reported the prevalence of uncontrolled hypertension among hypertensive comorbid diabetic patients and published in English until August 2025 were included in this study. Review articles were excluded from this study.

Information sources, search strategy, and study selection

Both manual and electronic searches were used to extract studies for this meta-analysis. First Medical Subject Heading terms were used to retrieve studies from PubMed. The search strategies were carried out using controlled vocabularies (MeSH) terms. The synonym of hypertension and diabetes was identified. Then, the search string was established using the databases. Articles were searched by title and abstract. Finally "AND" and "OR", were used to combine the search terms. The search terms was expressed as "hypertension", ''high blood pressure" OR "hypertensives" AND "DM" OR "diabetes" OR "diabetes mellitus" OR "hyperglycemia" AND "prevalence" OR "incidence" OR "proportion", OR "occurrence", OR "epidemiology" AND "global": then, other databases, namely, Scopus, Web of Science, and African journal online databases, were utilized to identify related articles and Google used for gray literatures. Finally, the identified articles were exported into EndNote version 7 software used to export, organize, and review, the eligible articles. The search limiters, such as study design, age group, and language of publication were used.

Reporting

Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) statement 2020 guidelines were used to report this study (16).

Study population

- ✓ Adult patients with both hypertension and diabetes

Data collection process and data items

To avoid missing information, data extraction was performed by all authors independently by using a data extraction format prepared in a Microsoft Excel 2013 spreadsheet containing the author's name, publication year, study design, sample size, study setting/region, type of diabetes, and prevalence of uncontrolled hypertension. The data extraction was done independently by all authors and discussed for any discrepancy.

The outcome of the review

- ✓ The prevalence of uncontrolled hypertension among hypertensive comorbid diabetic patients. In this study, hypertensive comorbid diabetic was measured as the presence of both diseases on same individual.

Quality assessment

The Joanna Briggs Institute (JBI) quality appraisal tool for prevalence studies was used to assess the quality of the studies (17). To assess the methodological quality of a study in terms of the possibility of bias in its design, conduct and analysis by using the following parameters: inclusion , study subjects and the setting clearly mentioned, used valid measurements, objective clearly set, confounding factors identified and controlled, the outcomes measured in a valid and reliable way, and appropriate statistical analysis method used. If the quality assessment indicator score was 50% or higher, then the study was considered low risk. The quality was assessed independently by all authors and discussed for any discrepancy.

Data synthesis and analysis

After the abstraction of all eligible studies; it was exported to Stata software version 14 for analysis. A random-effects meta-analysis model was used to estimate the heterogeneity by assuming that the observed estimates of uncontrolled hypertension can vary across studies and that the variation occurs by chance. Study heterogeneity was assessed using Higgin's I^2 and Cochran's Q methods. The variance created due to heterogeneity is estimated by the statistic I^2. By focusing on the situation where the number of studies in this meta-analysis.I^2 values of 25%, 50%, and 75% were considered low, moderate, and high heterogeneity, respectively. Subgroup analysis and meta-regression was conducted to find out source of heterogeneity. Additionally, a funnel plot that shows the relation between a study's effect size and its precision visually and statically with Egger's test was used to check publication bias. Also sensitivity analysis was conducted to identify outliers.

RESULTS

Study selection

Initially, a total of 12,187 studies were retrieved from the databases and manual searching. From this, 8,340 duplicates were found and removed. After title and abstract screening, 2958 irrelevant studies were removed. 889 articles were assessed for eligibility, and 868 of them were excluded due to not reporting the outcome of interest. Finally, a total of 21 studies was fulfilled the inclusion criteria and enrolled in the study.

The detailed retrieval process is shown in figure 1.

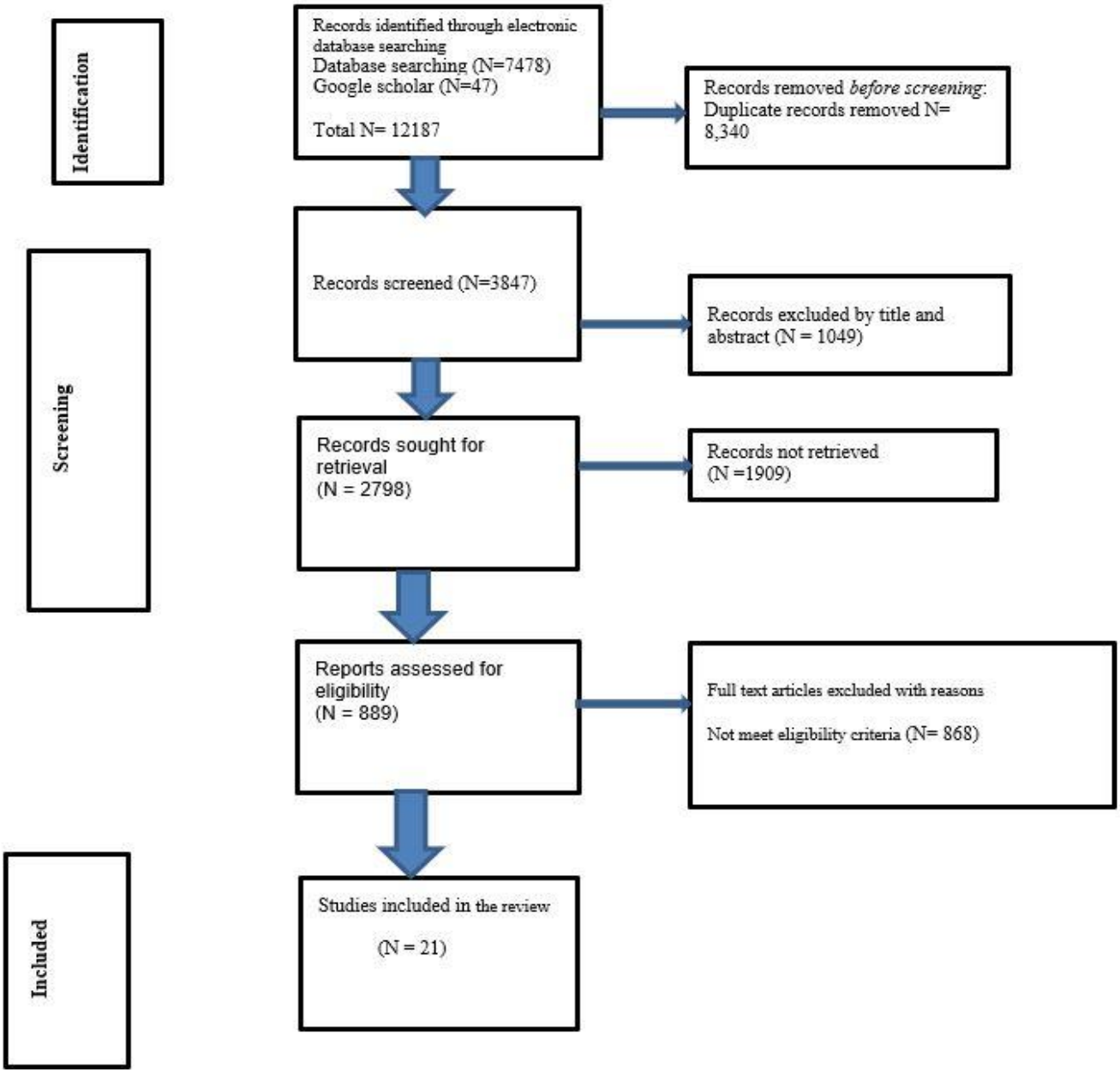

Figure 1. PRISMA flow diagram of study selection on prevalence uncontrolled hypertension among hypertensive comorbid diabetic patients.

Study characteristics

The 21 studies with high good methodological quality (18-38) included 11368 participants. Majority of studies are cross-sectional studies. The sample size ranged from 55 (28) to 3993 (26). Most the studies were conducted in the Africa region. Among the included studies, the prevalence of uncontrolled hypertension among hypertensive comorbid diabetic patients ranges from 29.1 (28) to 93.9 (29) (Table 1).

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Table 1- characteristics of included studies

Author Name	Publication Year	Study area	Type of DM	Study design	Sample size	Prevalence with 95% CI
Desta F,	2024	Ethiopia	Type 2	Cross-sectional	378	82.5(78.6-86.3)
Dedefo MG,	2020	Ethiopia	not specified	cross-sectional	186	44.1(36.9-51.2)
Muleta S,	2017	Ethiopia	not specified	Cross-sectional	131	46.5(37.9-55.0)
Gebreziher LH,	2024	Ethiopia	Type 2	Cross-sectional	400	61(56.2-65.7)
Alhassan Y,	2022	Ghana	Type 2	Cross-sectional	329	41.3(35.9-46.6)
Jarab AS,	2023	Saudi Arabia	Type 2	Cross-sectional	522	63.4(59.2-67.5)
Wong N,	2009	Australia	not specified	cross-sectional	220	72(66.0-77.9)
Cheong AT	2015	Malaysia	not specified	Cross-sectional	540	75.7(72.0-79.3)
JL LC,	2014	Spain	not specified	Cross-sectional	3993	43.6(42.0-45.1)
Serra N	2011	Spain	not specified	Cross-sectional	526	82.5(79.2-85.7)
Sousa AC,	2017	Brazil	not specified	Cohort	55	29.1(17.0-41.1)
Akbar DH,	2003	Saudi Arabia	not specified	Cross-sectional	230	93.9(90.8-96.9)
Obara T,	2006	Japan	not specified	Cross-sectional	466	82(78.5-85.4)
Lozano V,	2003	Spain	not specified	Cross-sectional	583	86.4(83.6-89.1)
Marshall D,	2008	Colorado	not specified	Cross-sectional	1445	64.8(62.3-67.2)
Ndege BW,	2014	Kenya	Type 2	Cross-sectional	185	79(73.1-84.8)
Anakwue RC,	2012	Nigeria	not specified	Cross-sectional	252	82(77.2-86.7)
Kilonzo SB,	2017	Tanzania	not specified	Cross-sectional	295	84.5(80.3-88.6)
Saasita PK,	2021	Uganda	not specified	Cross-sectional	206	82.5(77.3-87.6)
Mbwete GW,	2020	Tanzania	Type 2	Cross-sectional	161	59.1(51.5-66.6)
Adeniyi OV,	2016	South Africa	not specified	Cross-sectional	265	75.5(70.3-80.6)

Prevalence of uncontrolled hypertension among hypertensive comorbid diabetic patients

The pooled prevalence of uncontrolled hypertension among hypertensives comorbid diabetic patients with random effect model was 68.3 % (95% CI: 60.1-76.6) with a heterogeneity index (I^2) of 99.0% ($p \leq 0.001$) (Figure 2).

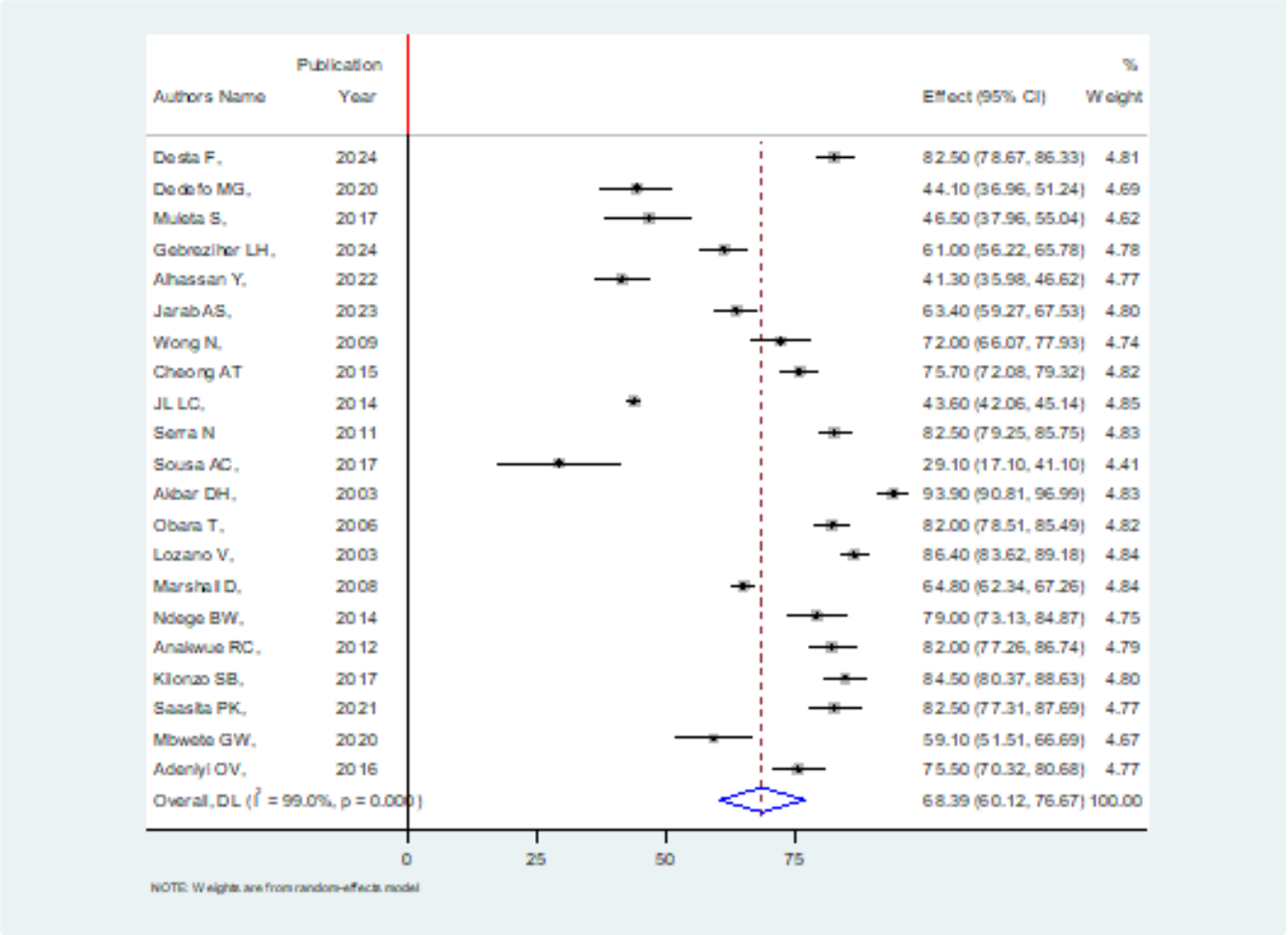

Figure 2. Forest plot showing global pooled prevalence uncontrolled hypertension among hypertensive comorbid diabetic patients.

Subgroup analysis

Subgroup analyses was conducted by the region and type of diabetes; the result based on the region revealed variation across the regions, with highest prevalence 78.7%; (95% CI: 66.4-91.1), I^2 = 97.9%) seen in Asia region and the lowest 67.2 %;(95% CI: 57.7-76.7), I^2 = 97.2%) seen in Africa region. Based on type of diabetes those participants with type 1 DM had a prevalence of uncontrolled hypertension 64.4% (95% CI: 52.2-76.6), I^2 = 97.2 %(p≤=0.001) and non- specific DM (either type 1 & type 2) was 69.9 %(95% CI: 59.5- 80.3), I^2 = 99.2 %(p≤=0.001) (Figure 3 & 4).

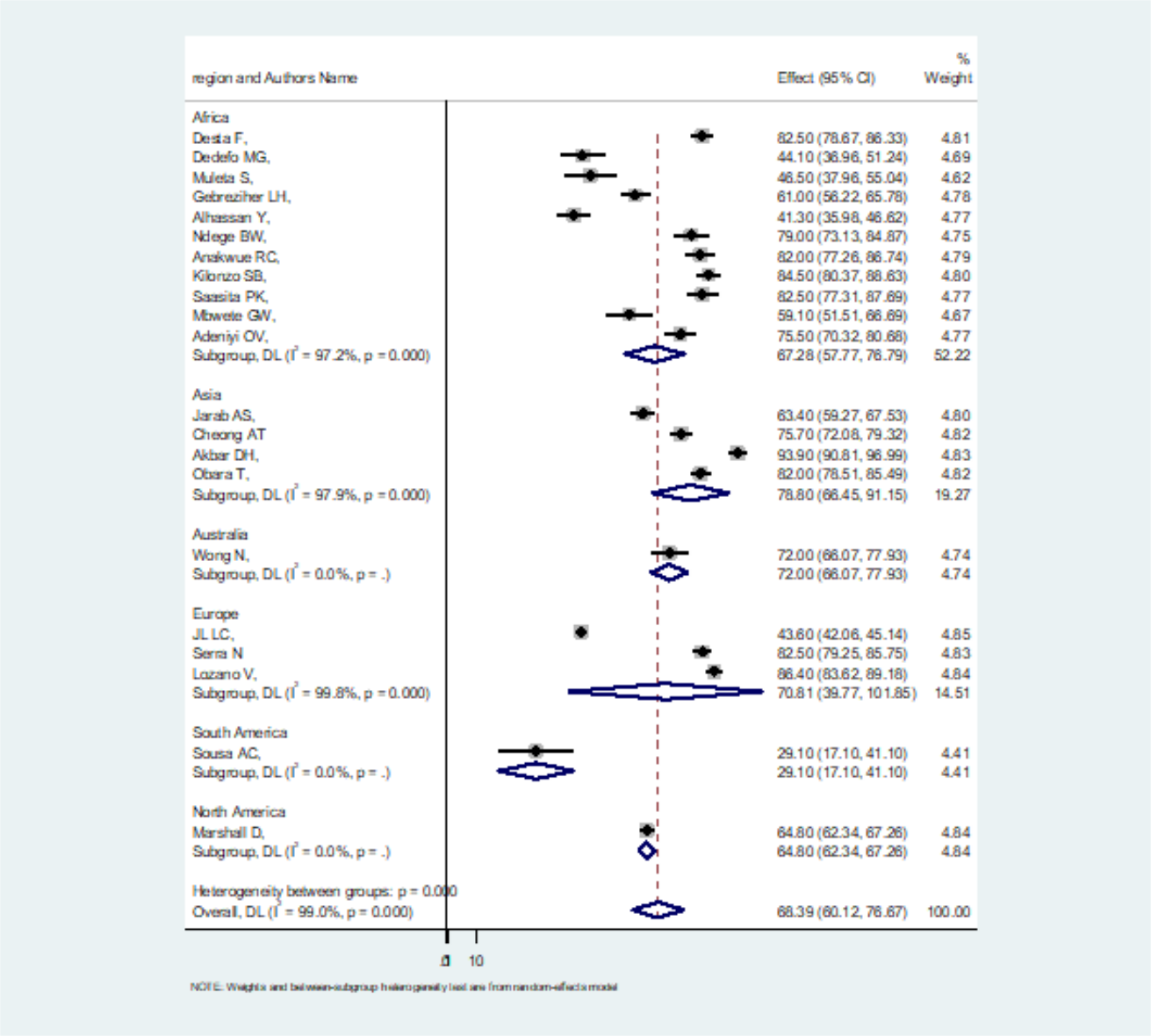

Figure 3. Subgroup analysis of prevalence uncontrolled hypertension among hypertensive comorbid diabetic patients by region.

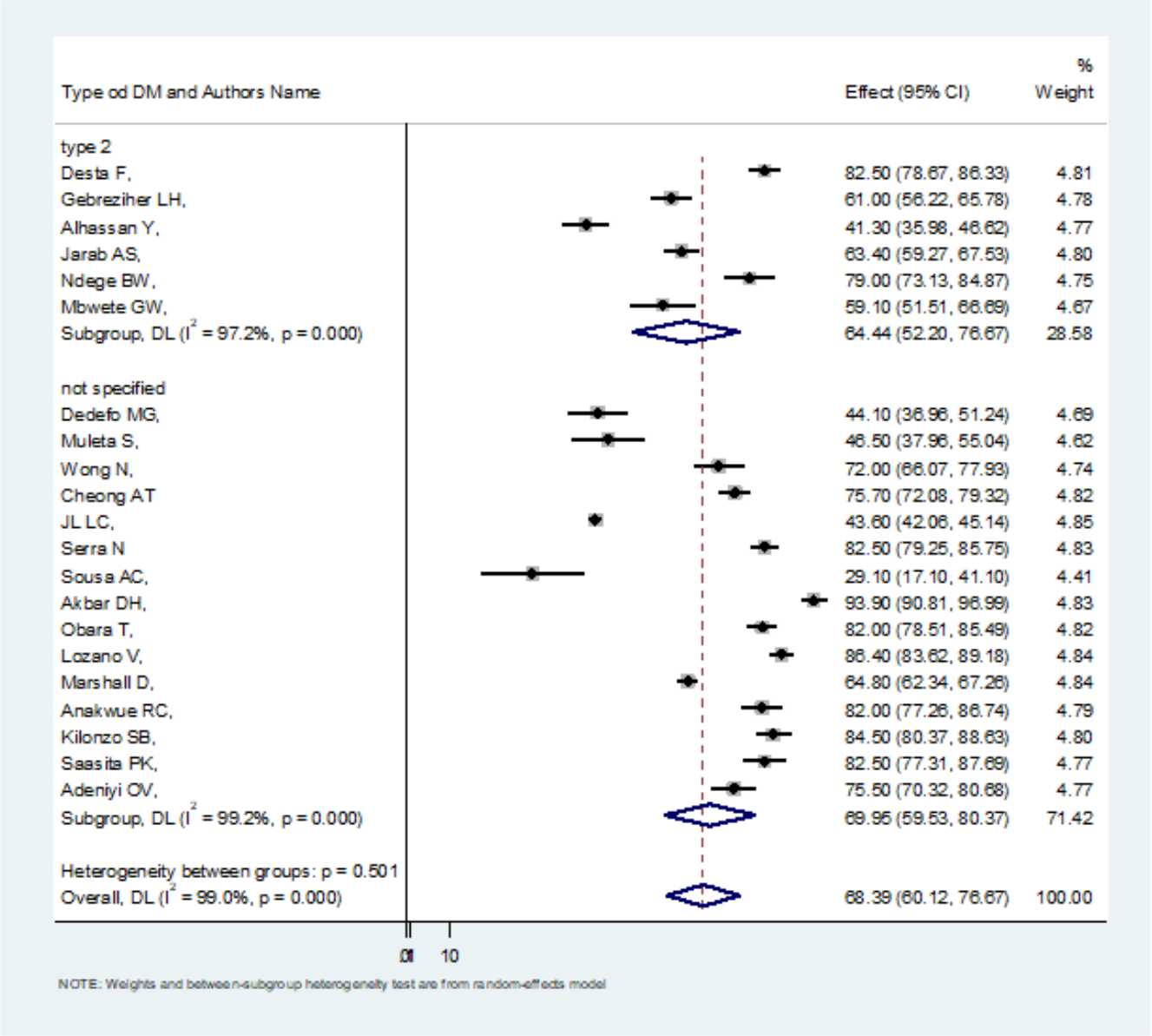

Figure 4. Subgroup analysis of prevalence uncontrolled hypertension among hypertensive comorbid diabetic patients by type of DM.

Publication bias

The visual inspection of the funnel plot indicated asymmetrical distribution (Figure 5). Additionally, Egger's linear regression test had used to identify publication bias. The result showed that Egger's linear regression test was statistically significant (P = 0.200) and the presence of publication bias (Figure 6).

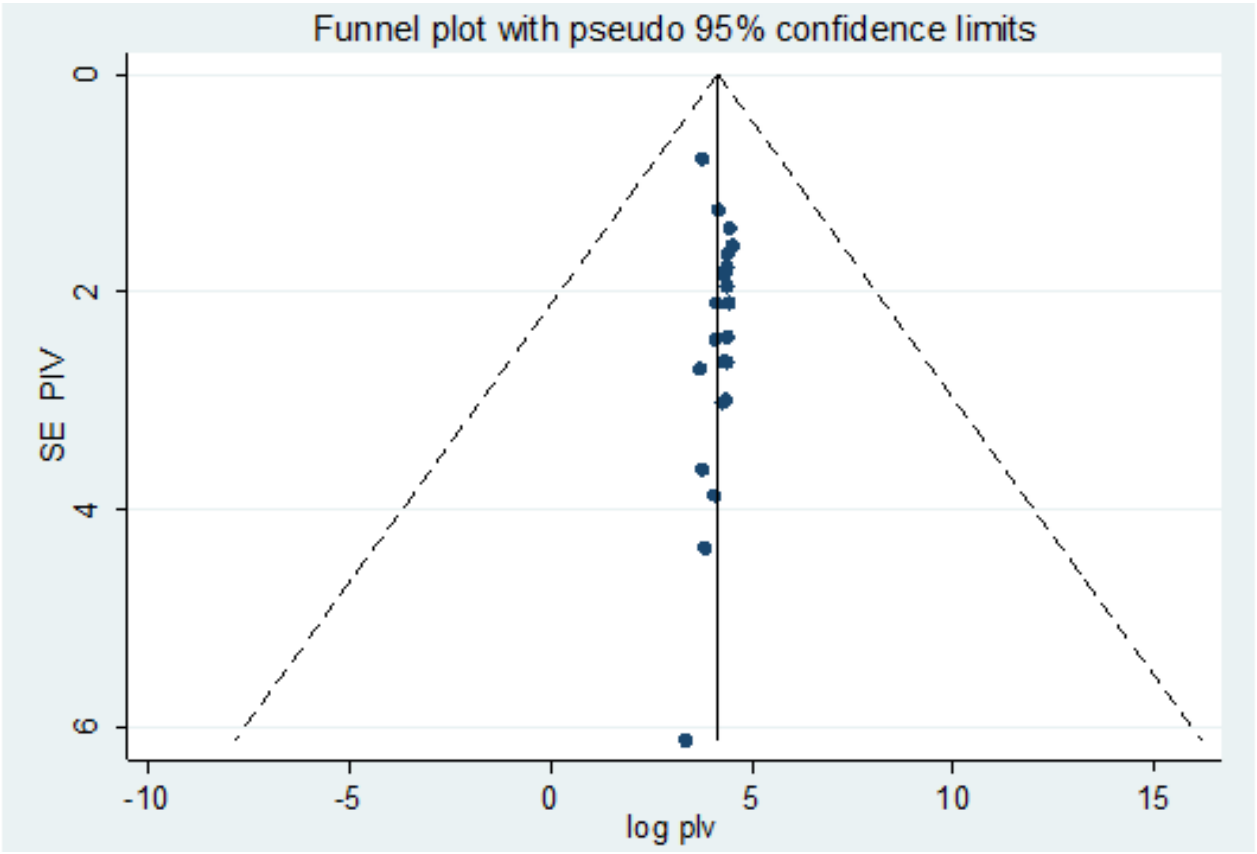

Figure 5. Funnel plot to test the publication bias in 21 studies with 95% Confidence limits.

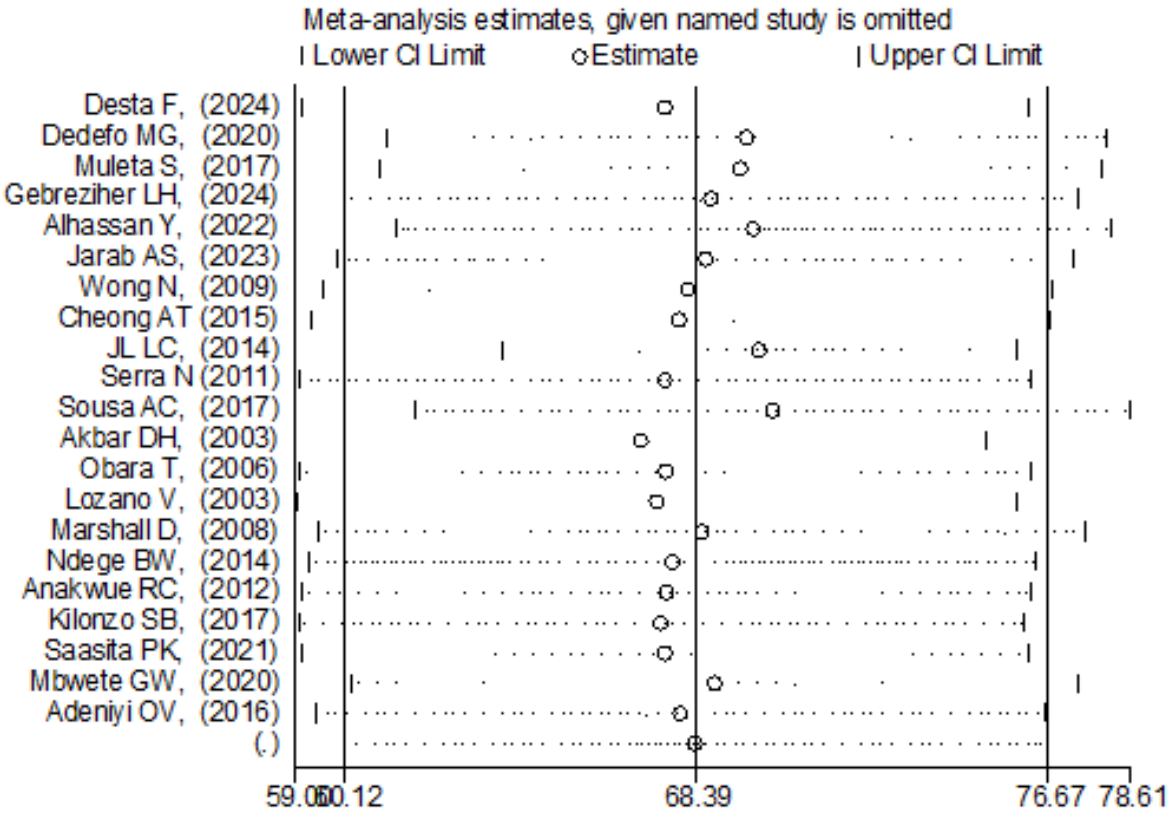

Figure 6. Sensitivity analysis of global prevalence uncontrolled hypertension among hypertensive comorbid diabetic patients for each study being removed one at a time.

Meta-regression

Due to significant variability in the subgroup analysis, meta-regression was performed to explore the sources of statistical heterogeneity. This involved examining how study-level variables relate to different effect sizes across studies, using sample size and publication year as covariates. The meta-regression results indicated that neither sample size nor publication year had an impact on the heterogeneity observed between studies (Table 2).

Table 2. Data regarding the meta-regression.

Heterogeneity source	Coefficients	Std. Err.	P-value
Sample size	-.0029916	.0122529	0.810
Year of publication	-1.617109	2.51772	0.529

Sensitivity analysis

Sensitivity analysis was done by removing studies step by step to assess the robustness of the study's findings. The result indicated that the removal of a single study did not have a significant influence on pooled prevalence (Figure 6).

DISCUSSION

Uncontrolled hypertension is a significant concern for patients who have both hypertension and diabetes, often referred to as hypertensive comorbid diabetic patients. Hypertension occurs twice as frequently in individuals with diabetes compared to those without the condition. Both diseases share similar risk factors for the onset of diabetes mellitus, including unhealthy dietary and lifestyle habits, obesity, and smoking. Additionally, hypertension is a major risk factor for both microvascular and macrovascular chronic complications associated with diabetes (39-41).

The prevalence of uncontrolled hypertension among patients with hypertensive comorbid diabetes ranges from 29.1% to 93.9%. Using a random effects model, the pooled prevalence of uncontrolled hypertension in this group is 68.3% (95% CI: 60.1-76.6). This finding is lower than the rate reported in a systematic review and meta-analysis conducted in Sub-Saharan Africa (78.6%) (44). The variation in the prevalence of uncontrolled hypertension among hypertensive diabetic patients might be due to disparities in healthcare access, disease management practices, socioeconomic factors, the number of studies included in Meta-analysis, the number of comorbidities, and behavioral factors.

Research shows that many diabetic patients find it challenging to stick to their prescribed treatment plans. This difficulty often arises from the need to take medication twice daily and the complexities involved in managing diabetes. Consequently, this may contribute to the high rates of poor hypertension control among these patients (43, 44).

Subgroup analyses was conducted by the region and type of diabetes; the result based on the region revealed variation across the regions, with highest prevalence 78.7%; (95% CI: 66.4-91.1) seen in Asia region and the lowest 67.2 % (95% CI: 57.7-76.7) seen in Africa region. The results indicated significant regional disparities in the prevalence of uncontrolled hypertension. This might be associated with variation on environmental, socio-economic status, urbanization, lifestyle changes, and diet, which may contribute to higher rates of uncontrolled hypertension.

The prevalence of uncontrolled hypertension among participants with type 1 diabetes mellitus was 64.4%, while for those with non-specific diabetes mellitus (which includes both type 1 and type 2), it was 69.9%. This discrepancy may be due to the fact that type 2 diabetes is often linked with a variety of co-morbidities, including obesity; patients with type 2 diabetes are typically older and may have had their condition for a longer duration. Furthermore, variations in lifestyle are significant risk factors for hypertension.

Effective management of uncontrolled hypertension in hypertensive comorbid diabetic patients requires a multifaceted approach, including regular monitoring of blood pressure and blood glucose levels, patient education about the importance of adherence to treatment, and lifestyle modifications aimed at improving both conditions. Cooperative care involving endocrinologists, cardiologists, and primary care physicians can significantly enhance management outcomes.

This systematic review and meta-analysis it might have faced the following limitations. First, lack of studies from many regions of world like Australia and North America may affect the generalizability of the finding. Secondly, due to presence of significant heterogeneity and presence of publication bias, the result should be interpreted cautiously.

CONCLUSION

Despite the increased complexity and complication of hypertension, the prevalence of uncontrolled hypertension among patients with diabetes and hypertension remains alarmingly high. Regional differences indicate a need for targeted interventions. Furthermore, both type 1 diabetes and non-specific diabetes populations exhibit significant rates of uncontrolled hypertension. Therefore, a multifaceted approach is necessary to manage hypertension in patients with both hypertension and diabetes.

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