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Exploring the occurence and risk factors of post-stroke depression among stroke survivors in Africa: a comprehensive systematic review and meta-analysis

Techilo Tinsae[1*], Wondale Getinet[1], Setegn Fentahun[1], Shegaye Shumet[1], Girmaw Medifu[1], Fantahun Andualem[1], Girum Nakie[1], Tesfaye Segon[2], Selam Koye[1], Gebresilassie Tadesse[1] and Gidey Rtbey[1]

Abstract

Background Post-stroke depression is a significant health concern, especially in developing countries. The high prevalence, incidence, and complexity of depression among stroke survivors pose a substantial occurence on vulnerable individuals. This study aimed to investigate the prevalence, incidence, and risk factors of post-stroke depression among stroke survivors in Africa.

Methods PubMed, WHO Global Index Medicus, Web of Science, Cochrane Library, Google Scholar, ScienceDirect, HINARI, and Google were the sources of data searching. Literature reporting the prevalence, incidence and risk factors of post-stroke depression in Africa was included. The quality of each study was evaluated using the Newcastle-Ottawa Quality Assessment Scale (NOS). Data were extracted using a Microsoft Excel spreadsheet, and data analysis was performed using STATA version 11. Heterogeneity between studies was checked using the I^2 statistical test. Publication bias was checked using Egger's statistical test and funnel plot.

Results A total of twenty-two relevant studies with 3175 stroke patients were included in this systematic review and meta-analysis. The overall estimated pooled prevalence and incidence of depression among stroke survivors in Africa were found to be 42.5% (95% CI = 26.9, 58.1) and 33.2% (95% CI = 23.3, 43.0), respectively. The subgroup analysis further revealed that Nigeria had the highest prevalence of depression at 47.6% (95% CI: 15.1, 80.1), followed by Ethiopia at 44.4% (95% CI: 28.2, 60.6). This study did not identify any factors that were positively associated with post-stroke depression.

Conclusion The prevalence and incidence of depression among stroke survivors are notably high. Despite the high occurence, this study did not identify specific risk factors positively associated with post-stroke depression. Consequently, addressing post-stroke depression through integrated care models, routine screening, and targeted interventions is crucial for enhancing the quality of life and rehabilitation outcomes for stroke survivors in Africa.

Keywords Depression, Stroke, Post-stroke, Post-stroke depression, Prevalence, Incidence and stroke depression

*Correspondence:
Techilo Tinsae
techilotinsae@gmail.com

[1]College of Medicine and Health Science, Department of Psychiatry, University of Gondar, Gondar, Ethiopia
[2]Department of Psychiatry, Mettu University, Metu, Ethiopia

Introduction

Stroke is a serious chronic and emergency disease that endangers human health [1–3]. It is the second-leading cause of death in the world after ischaemic heart disease and the most common cause of severe physical disability [4]. Globally, in 2023, an estimated 6.5 million people died by stroke, and 113 million suffered from disability-adjusted life years (DALY) lost from stroke [5, 6]. The most common emotional challenge following a stroke is post-stroke depression (PSD) [7]. Depression is characterized by a depressed mood, loss of interest, disturbance of sleep, difficulty concentrating or making decisions, problems in appetite and psychomotor activity, easily tiredness, guilty or sinful feelings, and recurrent thoughts of death or suicide [8, 9].

Numerous studies have demonstrated that PSD diminishes the quality of life, speeds up the disability rate, and increases mortality [10–13]. Previous systematic review studies showed that the prevalence of post-stroke depression was 29% [14] and in a study done in Ireland, the prevalence of PSD was 20% [15]. Stroke severity, physical disability, and cognitive impairment were the most common risk factors associated with post-stroke depression [16]. Based on a systematic review and meta-analysis, the pooled estimated prevalence of PSD was 31% [17].

The impact of post-stroke depression was around 85% increasing the complication of stroke and is linked to significant functional impairment, social withdrawal, and poor rehabilitation outcomes after a stroke [18–20]. The chief complaints of post-stroke depression are depressed mood, sleep disturbance, weight loss or gain, worthlessness, hopelessness, exhaustion, and anhedonia, which are the most prominent clinical presentations of post-stroke depression [3, 21–25]. Those with post-stroke depression had a higher chance of recurrent cerebrovascular health issues, poor functional recovery, increased mortality and morbidity, and a lower quality of life when compared to stroke survivors who do not have post-stroke depression [1, 26–28].

Post-stroke depression (PSD) is a significant yet often overlooked neuropsychiatric consequence of stroke, contributing to poor recovery outcomes, reduced quality of life, and increased mortality among stroke survivors. While PSD is a global health concern, its occurence is particularly pronounced in low- and middle-income countries (LMICs), including Africa, where healthcare systems face numerous challenges in stroke management and mental health care. Despite this, research on PSD in Africa remains limited, and previous reviews have largely focused on high-income countries, failing to account for the region-specific factors that influence the prevalence, incidence, and risk factors of PSD.

Several previous systematic reviews and meta-analyses have attempted to estimate the global occurence of PSD and its associated risk factors. However, these studies often exhibit methodological weaknesses, such as reliance on hospital-based data, small sample sizes, and inconsistent diagnostic criteria for depression. More importantly, most reviews do not sufficiently capture data from African populations, resulting in a lack of generalizability of findings to this region. The few studies that have examined PSD in Africa report highly variable prevalence estimates, reflecting disparities in study designs, screening tools, and healthcare access across different countries. Furthermore, the risk factors associated with PSD remain poorly understood in the African context, where cultural beliefs, stigma surrounding mental illness, and inadequate mental health services may play a crucial role in shaping the disease occurence. This systematic review and meta-analysis seek to address these gaps by providing a comprehensive assessment of the prevalence, incidence, and risk factors of PSD among stroke survivors in Africa. By synthesizing available evidence, this study aims to: [1] determine the pooled prevalence and incidence of PSD in African populations [2], examine variations in PSD occurence across different countries, and [3] identify key risk factors associated with PSD in this region. The findings from this review will contribute to a better understanding of PSD in Africa, guiding future research, policy development, and targeted interventions to improve stroke rehabilitation and mental health outcomes in resource-limited settings.

Up-to-date evidence is needed to raise awareness among stakeholders and policymakers about the magnitude and risk factors of post-stroke depression in people with stroke. which means that the focus of care in the future will shift towards reducing morbidity, including mental health disorders. Despite the growing number of empirical studies on post-stroke depression in Africa, there is a lack of robust systematic evidence that looks not only at the overall occurence of post-stroke depression but also its associated risk factors. Our current understanding of the epidemiology of post-stroke depression is largely dependent on a few regional studies, with very few nationwide data. Hence, the current review was done to fill this gap by providing an updated estimate of the occurence of post-stroke depression in Africa, synthesizing the important risk factors, and providing evidence-based data for prioritizing post-stroke mental health care. This should inform world nations about the occurence and risk factors of post-stroke depression to address the problem and reduce vulnerabilities. Therefore, this systematic review and meta-analysis investigated the pooled prevalence, incidence, and risk factors of depression among stroke survivors from the available pieces of evidence in Africa.

Method and materials

Population

Stroke survivors in Africa: The population of interest includes individuals who have experienced a stroke and are living in African countries. This study aimed to explore post-stroke depression in this specific population, which is particularly relevant given the socio-cultural and healthcare differences across African nations.

Intervention

The intervention or focus of the study is post-stroke depression (PSD). The study does not involve a specific clinical intervention but focuses on understanding the occurence and risk factors associated with PSD in stroke survivors.The review examines the impact of different factors such as age, gender, stroke severity, and other potential contributors to PSD.

Comparison

There is no specific comparison group in this study. The systematic review and meta-analysis aim to synthesize data across various studies without a direct comparison group, as the objective is to estimate the occurence (prevalence and incidence) and risk factors of PSD in the population of stroke survivors.

Outcome

Primary outcomes

The prevalence and incidence of post-stroke depression among stroke survivors in Africa.

Secondary outcome

Risk factors of post-stroke depression, including both modifiable and non-modifiable factors such as age, gender, comorbidities, stroke severity, etc.

Study design

Observational studies (cross-sectional, cohort, and case-control studies).These study designs are chosen because they provide insights into the prevalence, incidence, and potential risk factors of post-stroke depression, without needing an intervention. The studies included in the review are analytical descriptive studies (non-interventional) focused on populations in African countries.

Searching strategy

The details of this systematic review and meta-analysis were registered in PROSPERO with a reference number CRD42024519418. This study was conducted based on the findings of previous original studies conducted on the prevalence, incidence, and risk factors of depression among stroke survivors in Africa. To identify relevant articles we used the following major searching databases such as MEDLINE/PubMed, Scopus, Embase, Science Direct, Web of Science, Google Scholar, Google, all available published, and grey literature covering until January 2024. The searching process was performed in the English language using Boolean operator keywords, including post-stroke depression, stroke survivors, stroke depression, depression, neurological disorders, depression among neurological disorders, prevalence of depression, and risk factors for post-stroke depression. The AND/OR operator was also used to provide more comprehensive access to all articles. PubMed searching strategies: (((post-stroke depression [title/abstract]) OR stroke-depression [title/abstract]) OR stroke-survivors OR neurological disorder [title/abstract]) OR depression among neurological disorder [title/abstract]) OR affective disorder among neurological disorder (title/abstract]) OR mood disorder [title/abstract]) AND prevalence of depression among stroke-survivors [title/abstract]) OR determinant of post-stroke depression [title/abstract]). We followed the preferred Reporting Items for Systematic Review and Meta-analysis (PRISMA) guidelines during the system article review.

Eligibility criteria

Inclusion criteria

The studies' inclusion criteria include observational studies (cross-sectional, cohort, and case-control studies); population- and community-based studies; studies that examined the prevalence, incidence and risk factors of post-stroke depression; analytical descriptive studies (non-interventional studies); studies published in the English language; and studies conducted in Africa.

Exclusion criteria

Case reports, interventional studies, qualitative studies, studies without full-text accessibility, editor's letters, studies with inadequate data, studies unrelated to the topic, review studies, and duplicate studies are among the exclusion criteria in this research. (Table 1)

Data extraction and quality assessment

Two authors (author one and author four) were individually involved in the extraction of relevant studies from the databases. All the eligible studies were screened. After the selection of eligible studies, study characteristics, and relevant data, the name of the author, publication year, study location and setting, study design, sampling method, mean age of the study, sample size, response rate, screening tool, and prevalence were extracted. We contacted authors through email for additional information whenever required. The differences in the inclusion and quality of individual articles between the two authors were resolved by discussion with the third author (TT). The quality of articles was assessed using the Newcastle-Ottawa Scale (NOS) critical appraisal checklist [29]. This

Table 1 Inclusion and exclusion criteria for PICOS in Meta-Analysis on the prevalence, incidence and risk factors of post-stroke depression among stroke survivors in Africa

Criteria	Inclusion criteria	Exclusion criteria
Population	Stroke survivors in Africa	Not applicable (no specific population restrictions)
Exposure	Observational, non-interventional studies	Interventional studies, clinical trials
Comparision	-	-
Outcome	Prevalence, incidence, risk factors of post-stroke depression	Studies not related to post-stroke depression
Study design	Cross-sectional, cohort, case-control studies, analytical descriptive studies	Case reports, qualitative studies, editor's letters, review studies
Language	English	Non-English publications
Accessibility	Full-text accessible	Studies without full-text accessibility, duplicate studies

tool has three main sections. The first section, scored based on one to five stars, focuses on the methodological quality of each study (i.e., sample size, sampling technique, and response rate). The second section of the tool considers the comparability of the study cases or cohorts, with the possibility of two stars being gained. The last section is concerned with the outcomes and statistical analysis of the original study, with the possibility of three stars being gained. Any disagreement between the two reviewers was resolved by discussion with the third reviewer. Finally, studies assessed with a score of ≥6 out of 10 were considered to be of high quality, medium (fulfilling 50% of the quality assessment criteria), or poor for <4. This cut-off point was declared after reviewing relevant literature. In the evaluation, we assessed 22 articles to satisfy the quality assessment in terms of selection, outcome measurement, statistical test, and non-response rate. Stars were assigned to evaluate study quality: 9–10 stars indicate' very good' quality, 7–8 stars indicate 'good' quality, 5–6 stars indicate 'satisfactory' quality, and 0–4 stars indicate 'unsatisfactory' quality. The risk of bias in each study was assessed using kappa values, which range from 0.77 to 1 [29].

Outcome variables

The primary outcome of this systematic review and meta-analysis was to determine prevalence, incidence and risks of poset-setroke depression among stroke survivors in Africa.

Heterogeneity and publication bias

The heterogeneity of the study was checked by I^2 statistics of 25, 50, and 75% used to declare low, moderate, and high heterogeneity, respectively [30]. The publication bias was assessed using subjective assessment methods by funnel plot, and the objective assessment was done using Egger's statistical test and its corresponding p-values to check the publication bias (Egger's statistical test, $P>0.05$) [31] to declare the absence of potential publication bias.

Data analysis

Data were retrieved in Microsoft Excel spreadsheet format and imported to STATA statistical software version 11 for analysis. The logarithm and standard error of the odds ratio (OR) for each included study were generated using the generate command on STATA. The pooled prevalence and incidence of PSD and its risk factors were presented in the form of a forest plot. The presence of heterogeneity among the included studies was checked by the inverse variance index (I^2), and the authors considered I^2 values > 50% to represent significant heterogeneity [32]. A random effect model was computed to estimate the pooled prevalence and incidence of PSD among stroke survivors as a high degree of heterogeneity was observed. Thus, a subgroup analysis was conducted based on the country. The presence of publication bias was checked using through inspection of a funnel plot. In addition, the Egger statistical test was used to check the statistical significance of publication bias. The sensitivity analysis was conducted with the random effect model to observe the effect of a single study on the overall pooled estimate of PSD.

Results

Literature searches, selection, and characteristics of the original studies

We identified 456 articles in the electronic search database of MEDLINE/PubMed, Scopus, Embase, Science Direct, Web of Science, HINARI, Google Scholar, and Google, and a reference list of previous relevant studies to identify from related literature in the initial screening. From this search, 213 records remained after the removal of duplications. After assessing and screening the titles and abstracts, 175 articles remain. Then we assessed the full texts of 38 articles. After assessing the full texts, 16 records were further excluded for not incorporating the study's outcomes. Finally, 22 of the retrieved studies were included in this meta-analysis (Fig. 1). In this systematic review and meta-analysis, twenty-two studies were included without publication year restrictions. Among the included studies, eight were done in Nigeria [33–39], five in Ethiopia [40–44], two in Ghana [45, 46], two in Tanzania [47, 48], one in Kenya [49], one in Uganda [50], one in Gabon [51], and one in the Democratic Republic of the Congo [52]. Among the included studies, thirteen articles were done using a cross-sectional study design, eight articles were done using a cohort study design, and one was done by surveillance. Regarding the publication

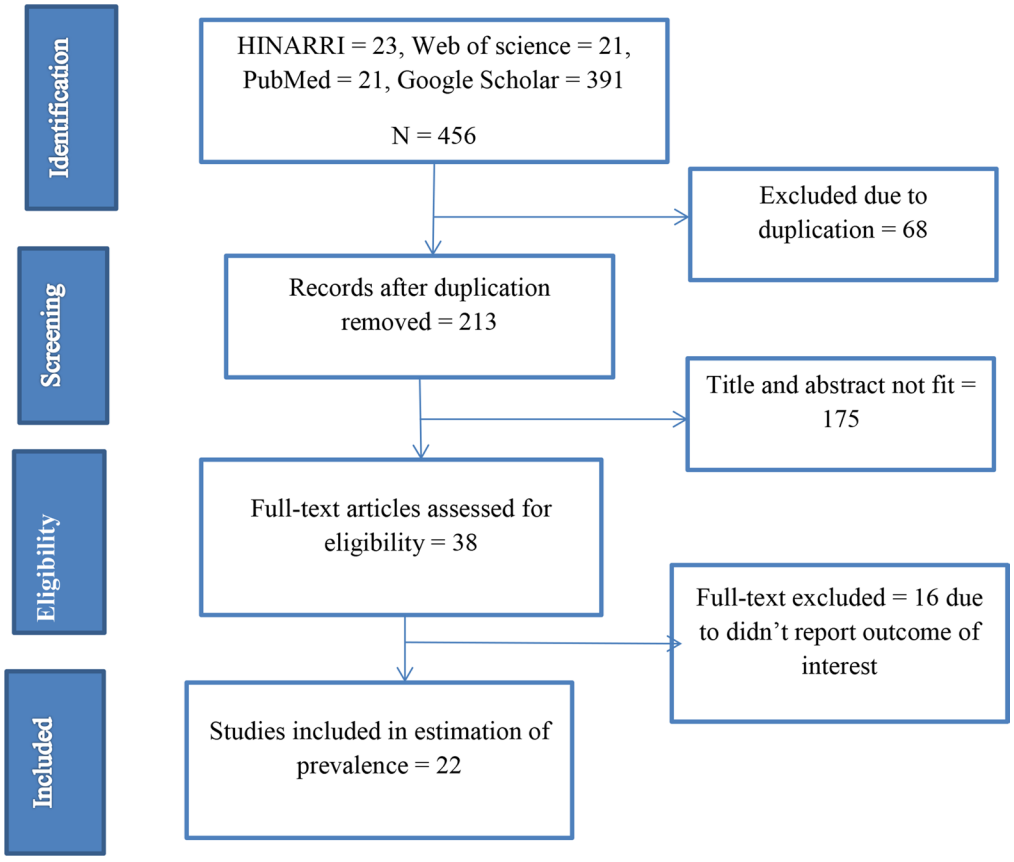

Fig. 1 PRISMA flow chart showing the selection process of eligible studies for this review, 2020

years, all the included studies were done between 2009 and 2023. Regarding the tool measurement of outcome, nine studies were done using the Patient Health Questionnaire Version Nine (PHQ-9), one study was done using the hospital anxiety and depression (HAD) scale, and three studies were assessed using the structured Clinical Interview for DSM-IV-Clinician Version (SCID-CV), one study using the Statistical Manual of Mental Disorders (DSM-IV), one study using the Statistical Manual of Mental Disorders (DSM-V), one study was assessed using 20-item Center for Epidemiologic Studies Depression Scale24 (CES—D) and the 15-item Geriatric Depression Scale (GDS), one study was assessed usind Depression, Anxiety and Stress Scale – 21 Items (DASS-21), two studies were done using Mini International Neuropsychiatric Interview (MINI), and one study Beck's Depression Inventory-II (BDI-II), one study usintg the Hamilton Depression Rating Scale (HDRS), but in two studies the assessment tool was not clearly reported (Table 2).

Quality assessment of the included studies

The Newcastle-Ottawa Scale (NOS) was used to assess the quality of the included studies methodologically. In the evaluation, we assessed 22 articles to satisfy the quality assessment in terms of selection, outcome measurement, statistical test, and non-response rate. The risk of bias in each study was assessed using kappa values, which range from 0.77 to 1— almost perfect (Table 3).

Question codes

1. Was the sample frame appropriate to address the target population?
2. Were study participants sampled in an appropriate way?
3. Was the sample size adequate?
4. Were the study subjects and the setting described in detail?
5. Was the data analysis conducted with sufficient coverage of the identified sample?
6. Were valid methods used for the identification of the condition?
7. Was the condition measured in a standard, reliable way for all participants?
8. Was there appropriate statistical analysis?
9. was the response rate adequate, and if not, was the low response rate managed appropriately?

Table 2 Characteristics of included studies in this study: depression among stroke survivors in Africa ($n = 22$)

Authors	Publication years	Study population	Country	Study design	Tools	Mean age	Sample size	Prevalence (%)
Wubshet et al., 2022	2022	stroke patients	Ethiopia	Cross-sectional	PHQ-9	N/R	229	27.5
Zemed et al., 2021	2021	stroke patients	Ethiopia	Cross-sectional	PHQ-9	59.22 years	180	49.6
Fantu et al., 2022	2022	stroke patients	Ethiopia	Surveillance	PHQ-9	60.8 years	240	68.75
Tsehayneh and Tafesse, 2020	2020	stroke patients	Ethiopia	Cross-sectional	PHQ-9	57.1 years	84	32.2
Worku et al., 2021	2021	stroke patients	Ethiopia	Cross-sectional	PHQ-9	58.4 years	159	43.4
Gyagenda et al., 2015	2015	stroke patients	Uganda	Cross-sectional	PHQ-9	N/R	73	31.5
(Wairoto et al., 2020)	2020	stroke patients	Kenya	Cross-sectional	SCID-CV	N/R	210	19
Camara et al., 2018	2018	stroke patients	Gabon	Cross-sectional	DSM-IV	N/R	153	48.4
Agbola, Akpa, Ojagbemi, & Afolabi, 2020	2020	stroke patients	Nigeria	Cross-sectional	N/C	N/R	130	41.5
Amaibi and Okeafor, 2023	2023	stroke patients	Nigeria	Cross-sectional	BDI-II	60.54 years	381	36.75
Sarfo et al., 2017	2017	stroke patients	Ghana	Cross-sectional	GDS & CES-D	62 years	200	36.5
Rufa'i, Oyeyemi, Fidelis, & Ahmad, 2018	2018	stroke patients	Nigeria	Cross-sectional	PHQ-9	46.2 years	249	93.6
Oni, Olagunju, Olisah, Aina, & Ojini, 2018	2018	stroke patients	Nigeria	Cross-sectional	N/C	57.43 years	140	22.9
Olibamoyo, Coker, Ola, Adewuya, & Atilola, 2019	2019	stroke patients	Nigeria	Cross-sectional	MINI	56.71 years	112	42.9
Sy et al., 2019	2019	stroke patients	Senegal	cohort	DSM V	58.5 years	33	33.7
Salihu, Abiodun, Ajiboye, Wahab, & Makanjuola, 2023	2023	stroke patients	Nigeria	cohort	MINI	59.5 years	90	22.2
Ojagbemi, 2013	2013	stroke patients	Nigeria	cohort	N/A	N/R	30	30
Oladiji, Akinbo, Aina, & Aiyejusunle, 2009	2009	stroke patients	Nigeria	cohort	DASS 21	52.5 years	51	25.5
Mpembi et al., 2013	2013	stroke patients	Democratic Republic of the Congo	cohort	N/R	54.7 years	58	53.6
Saadi et al., 2018	2018	stroke patients	Tanzania	cohort	PHQ-9	N/R	116	30
Jones et al., 2012	2012	stroke patients	Tanzania	cohort	HAD	N/R	116	53
Sarfo et al., 2019	2019	stroke patients	Ghana	Cohort	HDRS	55.1 years	57	18.2

The estimated pooled prevalence of depression among stroke survivors

Using a random-effects model, the findings of this systematic review and meta-analysis indicate that the overall pooled prevalence of depression among stroke survivors in Africa is estimated to be 42.5% (95% CI: 26.9, 58.1; I^2 = 98.9%) (Fig. 2). This suggests that nearly half of stroke survivors in Africa may experience depression, highlighting the significant mental health occurence associated with stroke. Among the included studies, the highest reported prevalence of post-stroke depression was observed in Nigeria (47.6%), indicating that nearly one in two stroke survivors in the country are affected. In contrast, the lowest prevalence was recorded in a study conducted in Kenya (19.0%), suggesting potential variations in depression rates due to differences in healthcare systems, access to mental health support, or cultural attitudes toward mental health. These findings emphasize the importance of early screening and targeted interventions to address post-stroke depression in Africa.

Heterogeneity and publication bias in the prevalence of depression among stroke survivors

There was evidence of high heterogeneity among the included studies according to the I^2 test ($I^2 = 98.9\%$). Hence, we implement the random effect meta-analysis model to estimate the overall pooled prevalence of depression among stroke survivors. Publication bias was assessed using the funnel plot and Egger's test statistics. We found that the funnel plot was a symmetric distribution of the involved studies through visual inspection, which indicates that there was no potential publication bias (Fig. 3). In addition, Egger's regression test ($p = 0.264$) demonstrates no evidence of potential publication bias (Table 4). The sensitivity analysis was done with the random effect model to observe the effect of a single study on the overall pooled estimate. The result showed that the included studies did not show significant differences (Fig. 4).

Sub-group analysis on the prevalence of depression among stroke survivors

The subgroup analysis was conducted based on the country to explore variations in the prevalence of post-stroke depression (PSD) among stroke survivors across different regions in Africa. The findings revealed that Nigeria had the highest estimated prevalence of PSD, with 47.6% (95% CI: 15.1, 80.1) of stroke survivors experiencing

Table 3 The quality and agreed level of bias and level of agreement on the included articles in this systematic review and meta-analysis based on a sample, outcome, objective, response rate, and analysis method ($n = 22$)

Author, year of Publication	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Total score (9%)	Kappa value	Level of agreement
Wubshet et al.	Y	Y	Y	Y	Y	Y	Y	Y	Y	9	1	Almost perfect
Zemed et al.	Y	Y	Y	Y	Y	Y	Y	Y	Y	9	1	Almost perfect
Fantu et al.	Y	Y	Y	Y	Y	Y	Y	Y	Y	9	1	Almost perfect
Tsehayneh and Tafesse	Y	Y	Y	Y	Y	Y	Y	Y	N/R	8	0.88	Almost perfect
Worku et al.	Y	Y	Y	Y	Y	Y	Y	Y	N/R	8	0.88	Almost perfect
Gyagenda et al.	Y	Y	Y	Y	Y	Y	Y	Y	Y	9	1	Almost perfect
Wairoto et al.	Y	Y	Y	Y	Y	Y	Y	Y	N/R	8	0.88	Almost perfect
Saadi et al.	Y	Y	Y	Y	Y	Y	Y	Y	N/R	8	0.88	Almost perfect
Jones et al.	Y	Y	Y	Y	Y	Y	Y	Y	N/A	8	0.88	Almost perfect
Amaibi and Okeafor	Y	Y	Y	N/A	Y	Y	Y	Y	Y	8	0.88	Almost perfect
Camara et al., 2018	Y	Y	Y	N/A	Y	Y	Y	Y	N/R	7	0.77	Almost perfect
Agbola, Akpa, Ojagbemi, & Afolabi, 2020	Y	Y	Y	N/A	Y	Y	Y	Y	N/R	7	0.77	Almost perfect
Sarfo et al., 2017	Y	Y	Y	Y	Y	Y	Y	Y	N/R	8	0.88	Almost perfect
Rufa'i, Oyeyemi, Fidelis, & Ahmad, 2018	Y	Y	Y	Y	Y	Y	Y	Y	N/R	8	0.88	Almost perfect
Oni, Olagunju, Olisah, Aina, & Ojini, 2018	Y	Y	Y	Y	Y	N/A	Y	Y	N/R	7	0.77	Almost perfect
Olibamoyo, Coker, Ola, Adewuya, & Atilola, 2019	Y	Y	Y	N/R	Y	Y	Y	Y	N/R	7	0.77	Almost perfect
Sy et al., 2019	Y	Y	Y	N/R	Y	Y	Y	Y	N/R	8	0.88	Almost perfect
Salihu, Abiodun, Ajiboye, Wahab, & Makanjuola, 2023	Y	Y	Y	N/R	Y	Y	Y	Y	N/R	7	0.77	Almost perfect
Ojagbemi, 2013	Y	Y	Y	Y	Y	N/R	Y	Y	N/R	7	0.77	Almost perfect
Oladiji, Akinbo, Aina, & Aiyejusunle, 2009	Y	Y	Y	Y	Y	Y	Y	Y	N/R	8	0.88	Almost perfect
Mpembi et al., 2013	Y	Y	Y	Y	Y	Y	Y	Y	N/R	8	0.88	Almost perfect
Sarfo et al., 2019	Y	Y	Y	Y	Y	Y		Y	N/R	8	0.88	Almost perfect

Key: Y = yes; **NR** = not reported; **NA** = not appropriate; **N/C** = not clearly stated

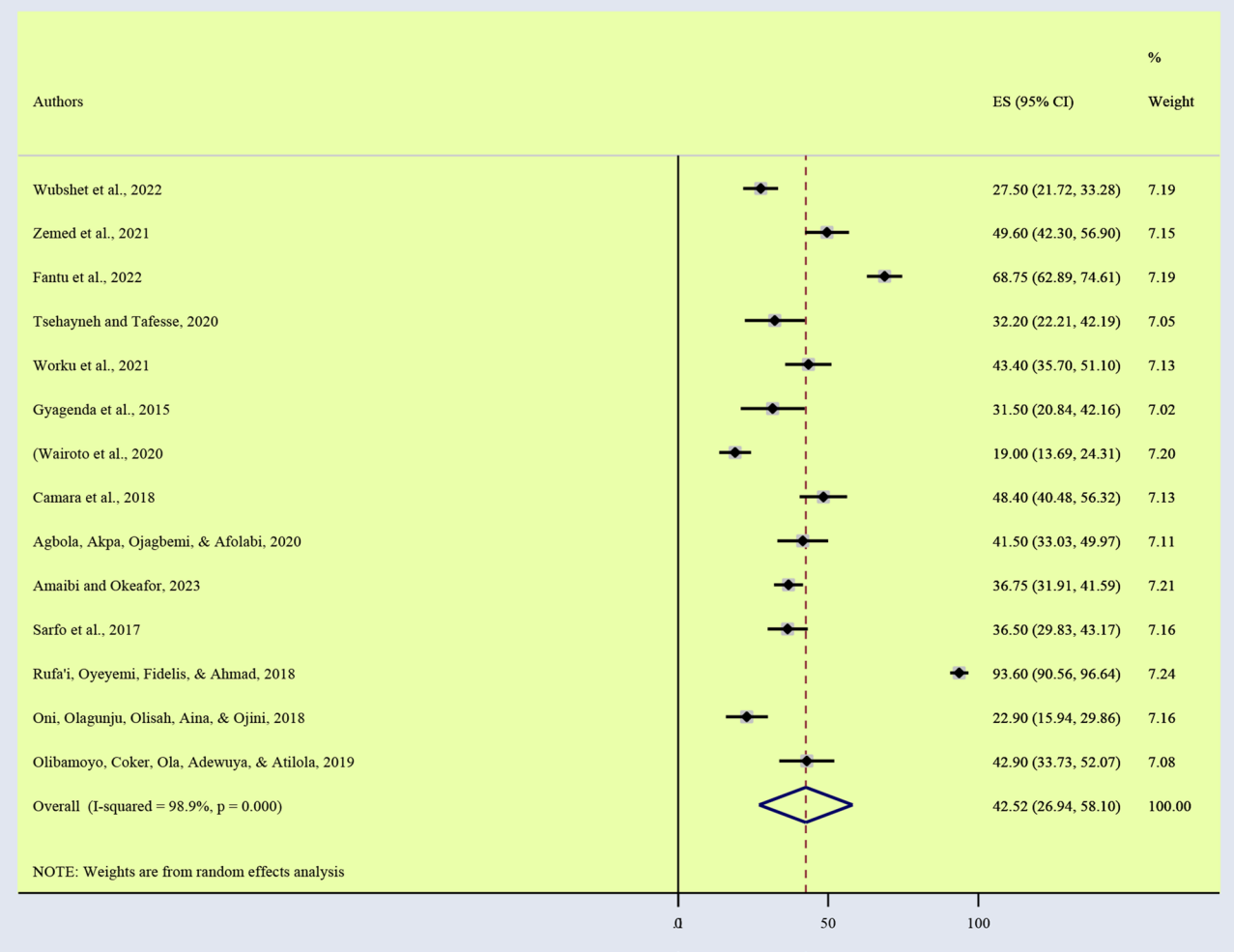

Fig. 2 Forest Plot describing the pooled prevalence of depression among stroke survivors in Africa with a 95% CI

depression. Ethiopia also reported a high prevalence, with 44.4% (95% CI: 28.2, 60.6) (Fig. 5).

The estimated pooled incidence of depression among stroke survivals in Africa

Using a random-effects model, our meta-analysis estimated that the overall pooled incidence of post-stroke depression (PSD) in Africa is 33.2% (95% CI: 23.3, 43.0; I^2 = 84.5%) (Fig. 6). This finding suggests that approximately one-third of stroke survivors in Africa develop depression over time, highlighting the substantial mental health impact of stroke. Among the included studies, the highest reported incidence of PSD was observed in the Democratic Republic of Congo (53.6%), indicating that more than half of stroke survivors in the country experienced depression following their stroke. Conversely, the lowest incidence was reported in Ghana (18.2%), suggesting that fewer than one in five stroke survivors were affected. These variations in incidence rates may be influenced by factors such as differences in healthcare infrastructure, availability of post-stroke rehabilitation services, cultural perceptions of mental health, and socioeconomic conditions. This highlights the need for targeted mental health interventions and support systems for stroke survivors across different African countries.

Heterogeneity and publication bias of the incidence of post-stroke depression

Our analysis revealed a high degree of heterogeneity among the included studies, as indicated by the I^2 statistic (84.5%), suggesting substantial variability in the reported incidence rates of post-stroke depression across different studies. To assess the potential presence of publication bias, we utilized both a funnel plot for visual inspection and Egger's regression test. The funnel plot demonstrated a symmetrical distribution of the included studies, which suggests that there was no significant publication bias (Fig. 7). Furthermore, the results of Egger's test (P-value > 0.05) confirmed the absence of statistical evidence for publication bias (Table 5). Additionally, we conducted a sensitivity analysis using a random-effects model to determine whether any single study

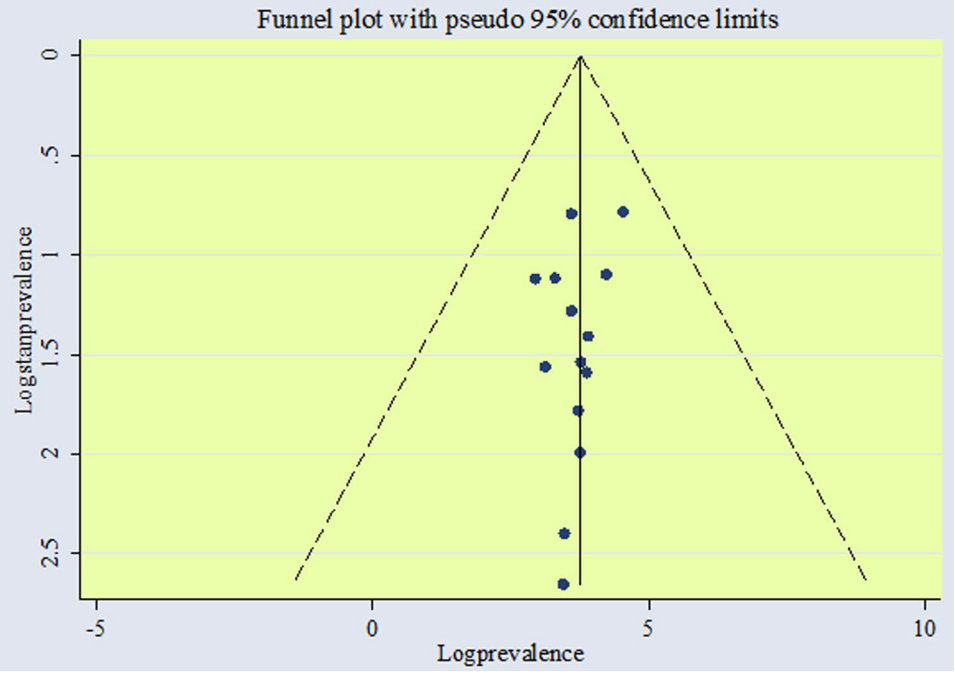

Fig. 3 Funnel plot with a pseudo-95% confidence interval that investigated the heterogeneity of the pooled prevalence of depression among stroke survivors in Africa

Table 4 Egger's test of prevalence of depression among stroke survivors in Africa ($n = 14$)

Egger's test

Std_Eff	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
slope	4.209486	.4003976	10.51	0.000	3.337095	5.081878
bias	-.3726897	.3183772	-1.17	0.264	-1.066374	.3209947

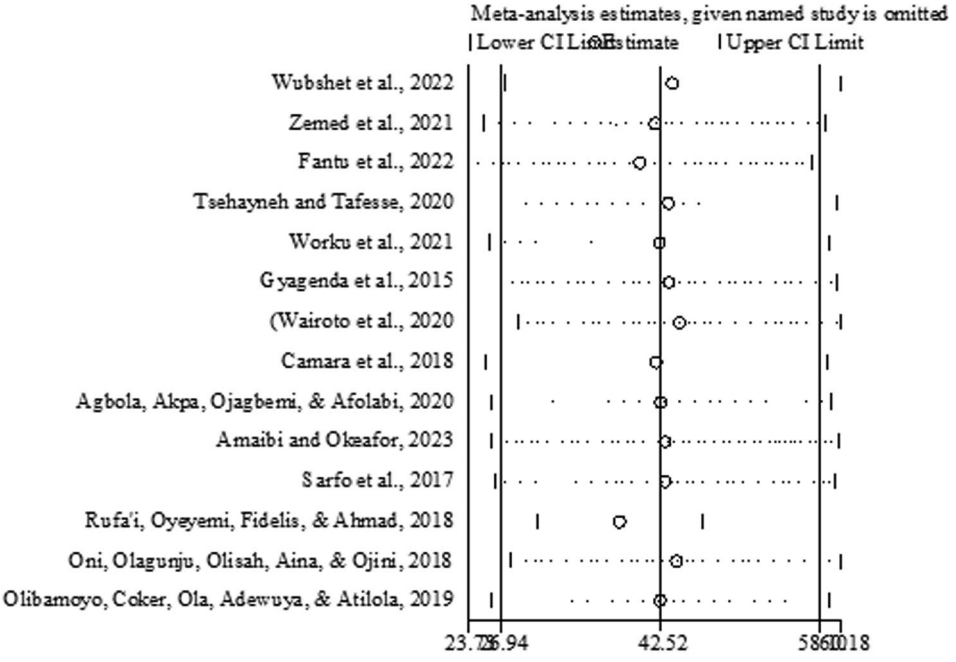

Fig. 4 The sensitivity analysis of the pooled estimated prevalence of depression among stroke survivors in Africa

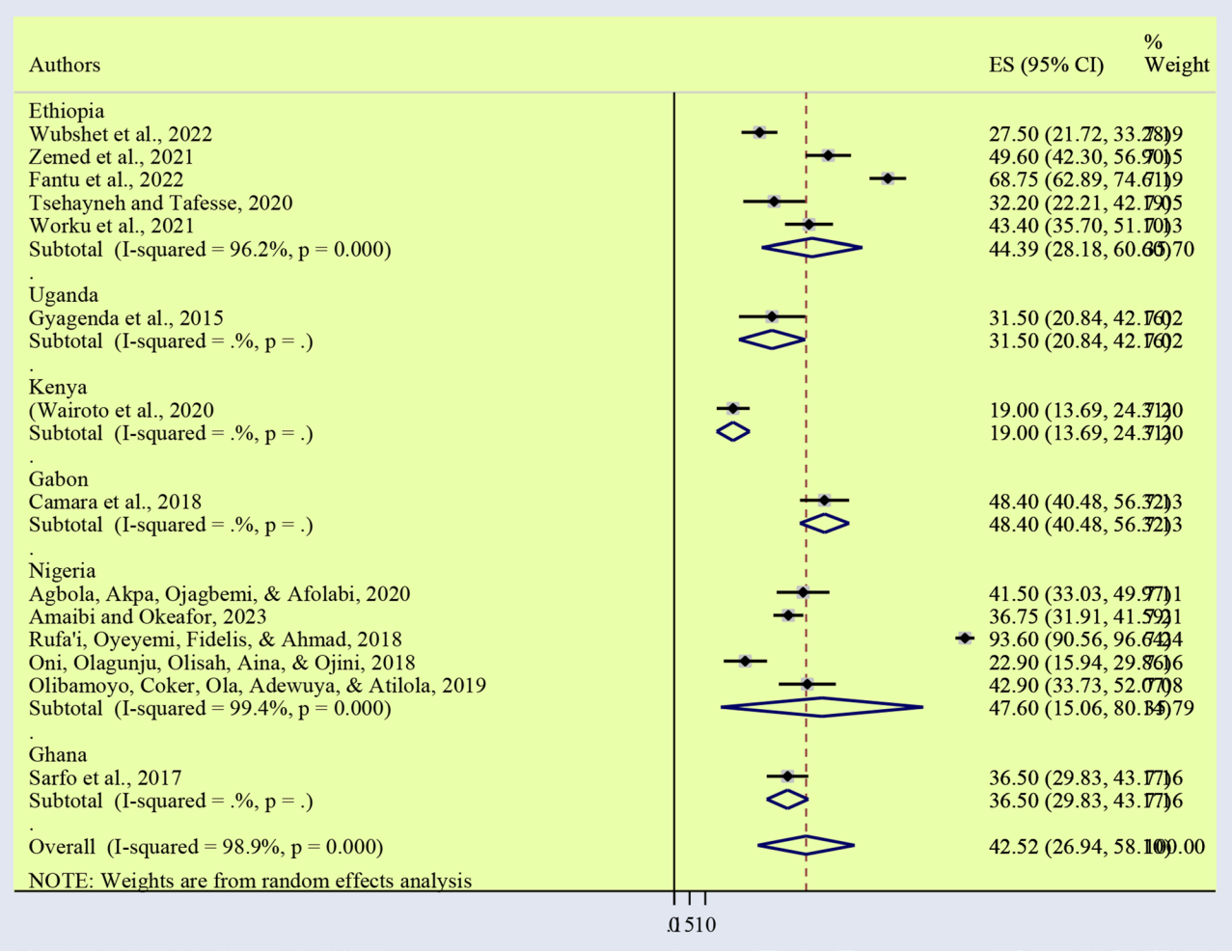

Fig. 5 Forest Plot describes the sub-group analysis of the prevalence of depression among stroke survivors based on the country in Africa with a 95% CI

significantly influenced the overall pooled estimate. The findings indicated that the exclusion of individual studies did not result in substantial variations in the pooled estimate, reinforcing the robustness and reliability of our meta-analysis results (Fig. 8).

Factors associated with depression in people with stroke survivors in Africa

In our study, we examined three key variables—male sex, unemployment, and the duration of time since the stroke occurred—as potential risk factors for post-stroke depression. These factors had been identified as significant in at least one previous study. However, when we analyzed them within our meta-analysis, we found that none of these variables showed a statistically significant association with post-stroke depression (Fig. 9). This suggests that their impact may vary across different study populations or that other unexamined factors could play a more substantial role in influencing depression among stroke survivors.

Discussion

The current systematic review and meta-analysis were carried out to determine the estimated pooled prevalence, incidence, and determinant factors of depression among stroke survivors in Africa. In this meta-analysis, twenty-two original studies were incorporated into the analysis. Of them, fourteen original studies were used for the prevalence of PSD, and eight original studies were used for the incidence of PSD.

Our finding revealed that the estimated pooled prevalence and incidence of depression among stroke survivors were 42.5% (95% CI = 26.9, 58.1) and 33.2% (95% CI = 23.3, 43.0%), respectively. Studies similar to this finding were conducted in Iran at 46.9% [53], systematic reviews and meta-analyses done in rehabilitative centers (55%) [54], in India, which reported 55% [55] and meta-analyses done in developed countries reported 33% [56], 41% [57], 27% [58], 28.6% [59], 30% [60], a study in sub-Saharan Africa (31%) [61], and China [62]. This indicates that post-stroke depression remains a common public health problem. Therefore, early identification

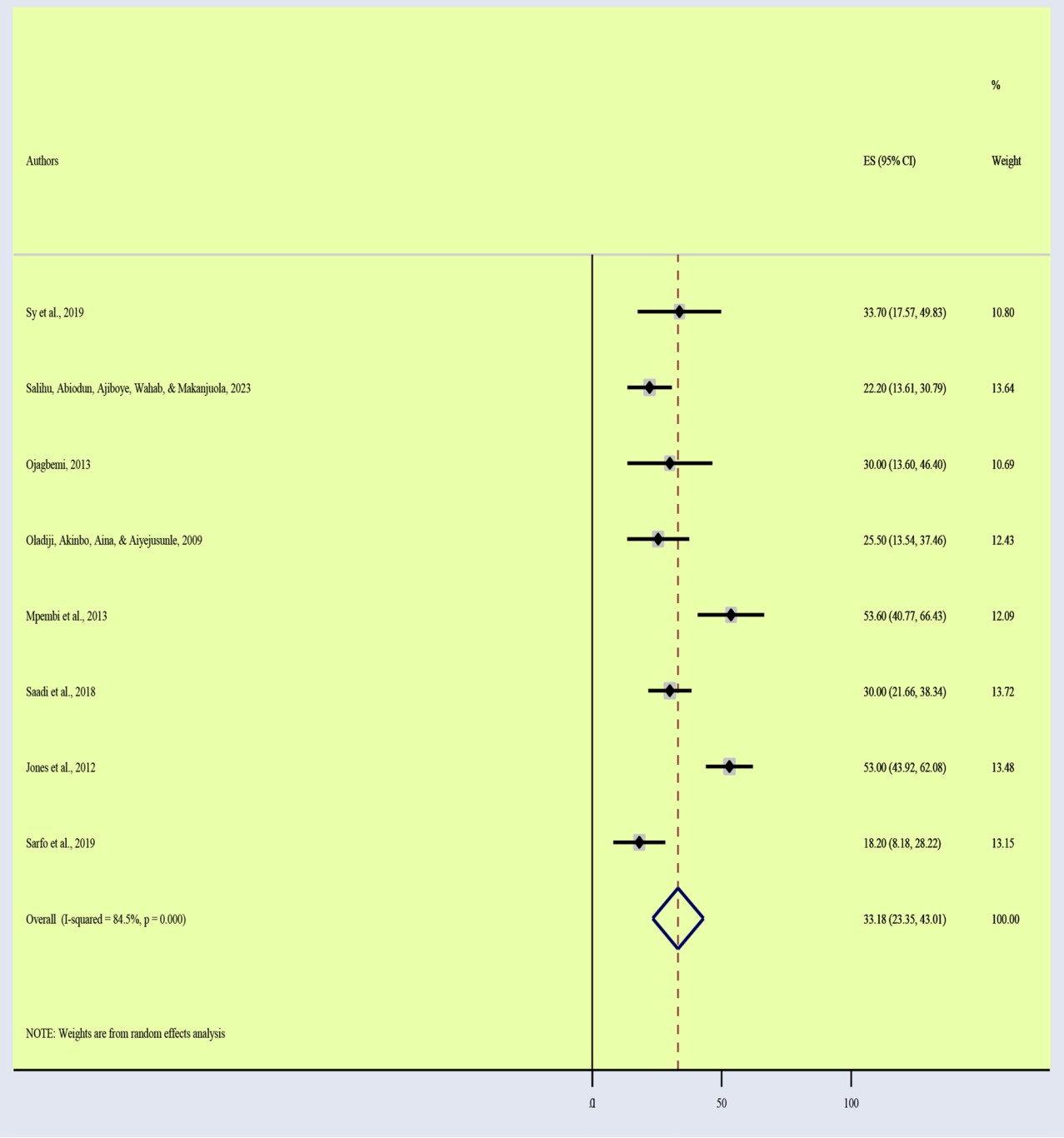

Fig. 6 Forest Plot describing the pooled incidence of depression among post-stroke survival in Africa with a 95% CI

and diagnosis of post-stroke depression can prevent its complications and impairment and enhance the recovery process after stroke. In our study, the prevalence rate of post-stroke depression was higher than in previous systematic reviews and meta-analyses, which accounted for 26.3% [63] and 11.6% [64]. The reason for this difference might be due to the early identification and prevention strategies differences of the countries to decrease the risk factors for chronic medical and neurological disorders. In addition, the discrepancy might be due to comorbidity screening differences, the health policy of the country, and the mental health awareness of the community.

According to this systematic review and meta-analysis, determinant factors of depression among stroke survivors did not indicate any positive or negative associations. The possible reason should be due to confounding Variables: Many potential confounding variables, such as pre-existing mental health conditions, social

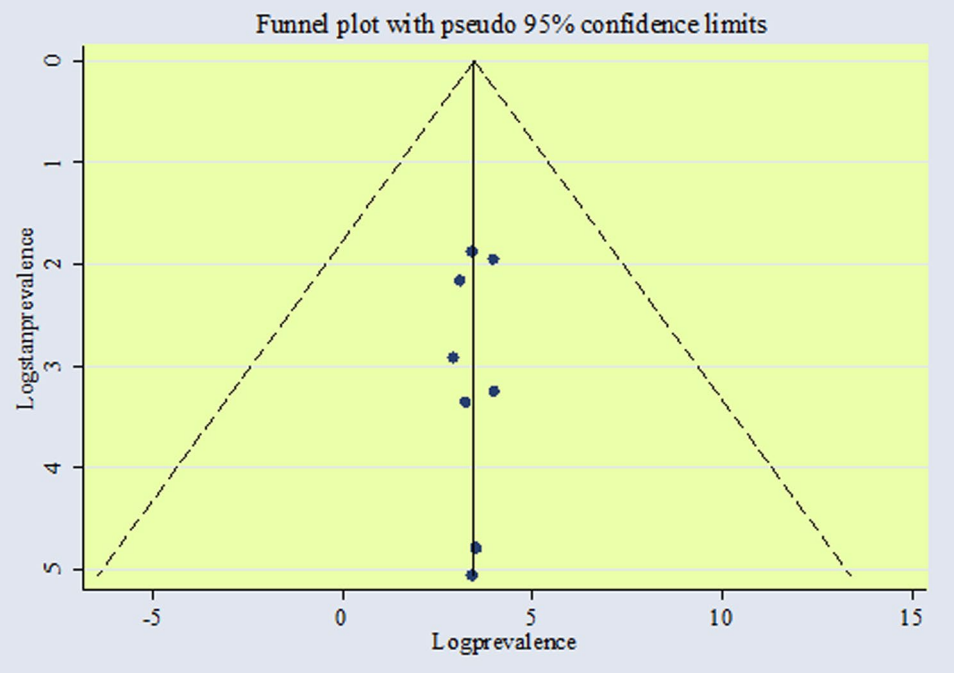

Fig. 7 Funnel plot with a pseudo-95% confidence interval that investigated the heterogeneity of the pooled incidence of post-stroke depression in Africa

Table 5 Egger's test of the incidence of depression among stroke-survivors in Africa ($n=8$)

Egger's test

Std_Eff	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
slope	3.594271	.4743838	7.58	0.000	2.433495	4.755046
bias	-.0522592	.179565	-0.29	0.781	-.491639	.3871207

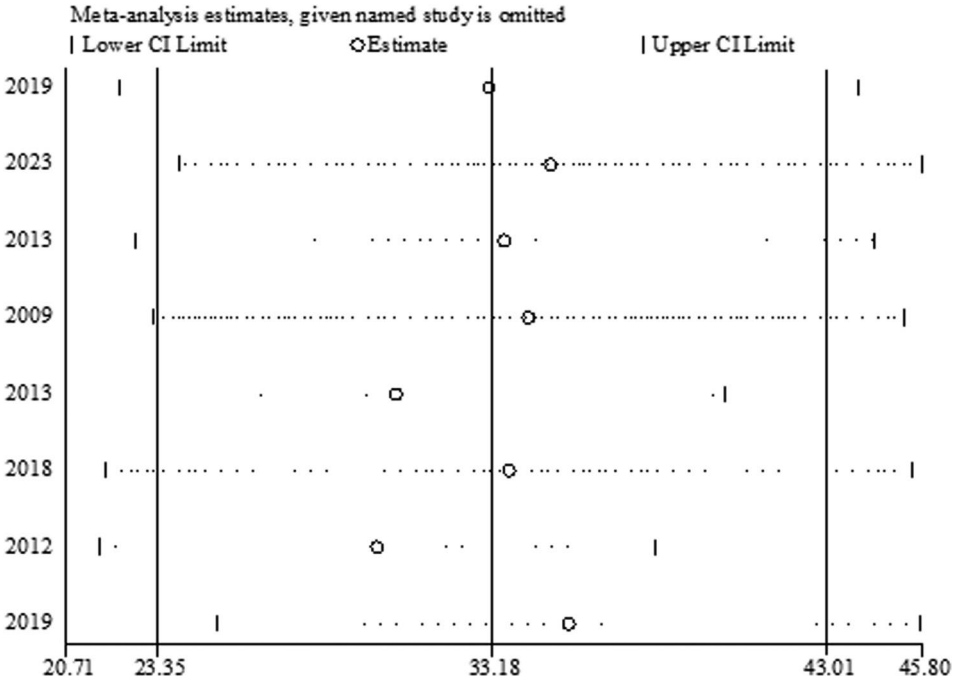

Fig. 8 The sensitivity analysis of the pooled estimated incidence of depression among stroke survivors in Africa

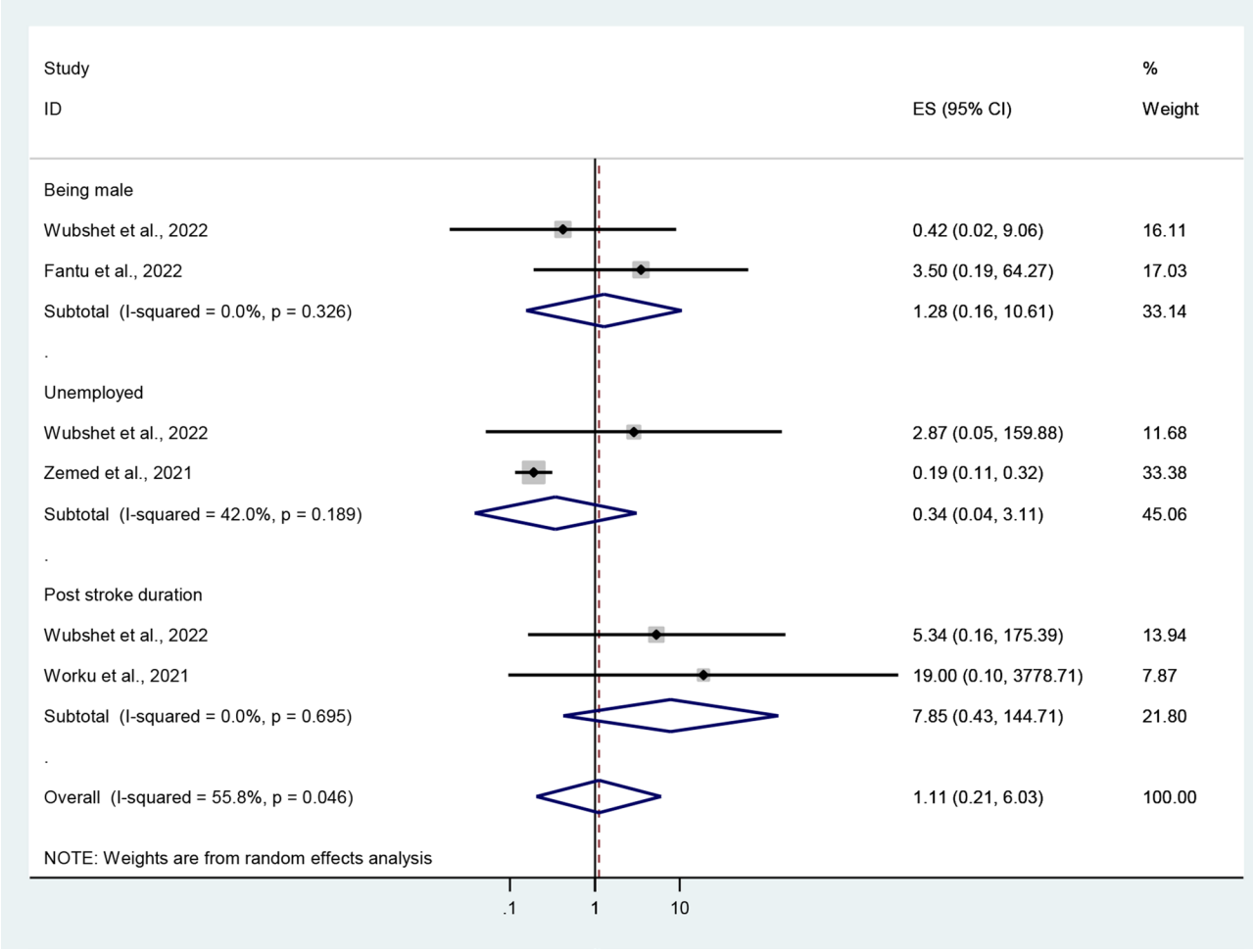

Fig. 9 Factors associated with post-stroke depression in East Africa with a 95% CI

support, and individual resilience, might not have been adequately controlled or uniformly reported across the included studies. These factors can obscure the relationships between specific determinants and depression. Another possible reason might be due to publication Bias: The meta-analysis may be influenced by publication bias, where studies with null results are underrepresented. This bias can affect the overall findings, making it challenging to identify true associations. Or might be due to variability in depression assessment: Differences in the methods used to assess depression (e.g., clinical interviews vs. self-report questionnaires) and the timing of these assessments relative to the stroke event can introduce variability that complicates the detection of consistent determining factors. Or might be due to Statistical Power and Sample Size: While meta-analyses generally aim to increase statistical power by pooling data, some included studies may have small sample sizes. This limitation can result in insufficient power to detect significant associations, particularly if the effects are subtle. Or might be due to the complex nature of post-stroke depression: Depression after a stroke is a multifaceted condition influenced by a complex interplay of biological, psychological, and social factors. The interaction between these factors might not be easily captured in a meta-analysis focused on isolating individual determinants. The absence of clear risk factors for PSD highlights the need for more rigorous research in this area. Identifying risk factors is essential for the development of targeted interventions and preventive strategies for stroke survivors. Future research should focus on longitudinal cohort studies that can identify causal relationships between risk factors and PSD. Furthermore, studies should consider a broader range of potential risk factors, including both clinical variables (e.g., stroke type and severity) and psychosocial factors (e.g., social support and mental health history).

In this meta-analysis, the disparity in prevalence and incidence of PSD was observed in the included country. Thus, subgroup analysis was conducted based on the specific country. The highest prevalence and incidence of PSD were observed in Nigeria followed by Ethiopia.

The possible justification for the discrepancy might be that in Nigeria and Ethiopia, the numbers of the included original studies were higher than in other countries. This indicates that the occurrence of PSD in Nigeria and Ethiopia is relatively researched and reported. The strengths of this study, we tried to identify all the potential articles published on post-stroke depression in Africa. In addition, we used comprehensive searching strategies and the PRISMA checklist to improve the quality of the review. The limitation of this study is that it was conducted only on one specific continent, which may result in an underrepresentation of the remaining continents. In addition, another limitation of this study is that we did not include a comparison group. Furthermore, sample representativeness is another limitation, since the majority of the studies included came from Nigeria and Ethiopia. Therefore, the authors recommended that future researchers should Encourage and support research efforts in underrepresented countries: This can be achieved through international collaborations, increased funding, and capacity-building initiatives. Promote publication of research from diverse regions: Journals and funding bodies can play a role by encouraging submissions from a wider range of countries and providing platforms for researchers from less represented areas. Conduct targeted studies in underrepresented regions: Specific calls for research proposals that focus on underrepresented areas can help to fill the gaps in data.

Conclusion

The prevalence and incidence of depression among stroke survivors are noticeably high. Despite the high prevalence and incidence, this study did not identify specific risk factors positively associated with post-stroke depression. Therefore, the findings might help stakeholders, mental health policymakers, and mental health professionals to address the prevention, early screening, and management of PSD among stroke survivors and to give attention to vulnerable individuals.

Implications

Depression is a day-to-day challenge that every individual experiences in their life. The current study contributes to showing the magnitudes of depression and factors that are related to post-stroke depression among stroke survivors.

Abbreviations

PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
NOS	Newcastle-Ottawa Scale
POR	Pooled odds Ratio
CI	Confidence Interval
PSD	Post-stroke depression
DALY	Disability-adjusted life years

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Author contributions

Conceptualization: TT, WG, GM. Data correction: WG, GR and SF. Analysis: TT, GT, GN, and SF. Funding acquisition: WG, TT, and SS,. Investigation: TT, FA, SK, and GR. Methodology: WG, TT, SS, GT. Supervision: TT, WG, SS, SF. Writing: TT, TS, WG. All authors approved the manuscript.

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Data availability

No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate

Not Applicable.

Consent for publication

Not Applicable.

Competing interests

The authors declare no competing interests.

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