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Prevalence and predictors of metabolic syndrome among psychiatric patients receiving antipsychotic treatment in Africa: a systematic review and meta-analysis

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Abstract

Background Antipsychotic medications, though essential for treating severe mental illnesses, are commonly associated with metabolic side effects that increase the risk of metabolic syndrome (MetS). These metabolic complications significantly undermine treatment adherence and contribute to adverse clinical outcomes. Despite the increasing utilization of antipsychotics in Africa, there remains a critical lack of region-specific data on the prevalence and determinants of metabolic syndrome in this population. This systematic review and meta-analysis aims to synthesize existing data on the prevalence and predictors of MetS among psychiatric patients receiving antipsychotic treatment in Africa.

Method We looked for primary papers on PubMed/MEDLINE, Scopus, African Journal Online, PsycINFO, EMBASE, Psychiatry Online, CINAHL, Science Direct, and the Cochrane Library. We included original research articles that evaluated the prevalence of metabolic syndrome among psychiatric patients treated with antipsychotic medication. Two independent reviewers examined the articles and extracted data. The I^2 statistic was employed to assess statistical heterogeneity, and a random-effects meta-analysis was applied due to the observed heterogeneity. Publication bias was evaluated using a funnel plot and Egger's weighted regression test. This review has been registered with PROSPERO (ID = CRD42024558310).

Results This systematic review analyzed 25 primary studies encompassing a total of 4,064 participants. The pooled prevalence of metabolic syndrome among psychiatric patients receiving antipsychotic treatment in Africa was estimated at 22% (95% CI: 16.33–27.66). Female gender (OR = 3.28, 95% CI: 1.73–6.23), advanced age (OR = 1.07, 95% CI: 1.03–1.12), and elevated body mass index (OR = 5.33, 95% CI: 2.35–12.12) were identified as significant risk factors for metabolic syndrome in this population.

Conclusion Metabolic syndrome is highly prevalent among psychiatric patients receiving antipsychotic treatment in Africa, with female sex, older age, and elevated body mass index identified as significant risk factors. These findings

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underscore the need for routine metabolic monitoring and timely interventions to mitigate cardiovascular risk, enhance treatment adherence, and prevent recurrence of psychiatric symptoms.

Keywords Metabolic syndrome, Antipsychotics medication, Psychiatric patients, Meta-analysis, Africa

Introduction

Medication therapy is one of the most common and successful therapeutic approaches for those with severe mental illnesses, and antipsychotic drugs play a crucial role [1, 2]. Antipsychotic medications represent the cornerstone of pharmacological management for individuals with severe mental illness and are routinely employed in the treatment of a broad spectrum of psychiatric disorders, including schizophrenia spectrum disorders, substance-induced psychotic disorders, bipolar disorder, and major depressive disorder with psychotic features [3, 4]. Since the advent of chlorpromazine more than six decades ago, antipsychotic medications have constituted the primary pharmacotherapeutic approach for the management of schizophrenia, owing to their efficacy in mitigating psychotic symptoms and preventing relapse [5, 6]. Currently, approximately 65 antipsychotic agents are available globally, with 15 to 40 accessible in most countries [7, 8]. These medications are broadly classified into first-generation (FGAs) and second-generation antipsychotics (SGAs), both of which exert their primary pharmacological effects through antagonism of dopamine D_2 receptors [9, 10]. Antipsychotics effectively target positive and negative symptoms, as well as affective and cognitive dysfunction in schizophrenia, enhancing overall symptom control and patient outcomes [11, 12].

Antipsychotics are associated with various adverse effects, including an increased risk of cardiometabolic complications such as dyslipidemia and glucose dysregulation [13–15]. Antipsychotics may influence body weight through two main routes: they interact with dopamine, serotonin, and histamine receptors in neurons, which is likely linked to increased hunger, and induced insulin sensitivity could be associated with additional metabolic disturbance [16, 17]. Haloperidol has the highest propensity for extrapyramidal side effects (EPSEs), while olanzapine and clozapine are most strongly linked to weight gain and metabolic dysfunction [18, 19]. Metabolic syndrome is defined as the presence of at least three out of five interrelated cardiometabolic risk factors—elevated blood pressure, hyperglycemia, hypertriglyceridemia, reduced high-density lipoprotein (HDL) cholesterol, and central obesity—which collectively increase the risk of cardiovascular disease, stroke, and type 2 diabetes [20–22]. It is a state of insulin resistance and chronic low-grade inflammation, often linked to poor lifestyle factors, excess adiposity, and exacerbated by antipsychotic medication use [23, 24]. The idea of Metabolic syndrome (MetS) has been introduced into the psychiatric literature to assist psychiatric physicians in directing their attention toward these cardiovascular disease concerns in individuals with mental illness [25, 26].

Globally, about 25% of people suffer from metabolic syndrome, which has a higher prevalence, according to the International Diabetes Federation (IDF), while in the United States; the pooled prevalence of metabolic syndrome was 34.7% [27, 28]. A study conducted in Iran among 60 patients with schizophrenia reported a 26.7% prevalence of metabolic syndrome after six months of antipsychotic treatment, based on changes in metabolic parameters including fasting glucose, lipids, blood pressure, and anthropometrics—underscoring the metabolic burden of these medications [29]. Similarly, a cross-sectional study conducted in the United Arab Emirates (UAE) reported metabolic syndrome prevalence rates of 58.9% in patients with schizophrenia, 44.2% in those with bipolar disorder, and 34.2% in individuals diagnosed with major depressive disorder [30, 31]. In Africa, the prevalence of metabolic syndrome is thought to be between 17% and 25% [32]. The prevalence of metabolic syndrome in individuals with schizophrenia ranges from 24 to 43%, escalating to 40–60% with the use of antipsychotic medications [13, 33].

Individuals with severe mental illness, particularly schizophrenia, exhibit significantly elevated rates of morbidity and mortality relative to the general population, largely attributable to an increased burden of cardiovascular disease as the leading cause of death [34–36]. MetS is becoming more and more important for individuals with schizophrenia since it can lead to worse quality of life, poor functional results and non-compliance [37–39]. Individuals with mental illness are more likely to engage in health-compromising behaviors, including tobacco use, poor dietary patterns, and physical inactivity, all of which are recognized contributors to an increased risk of developing metabolic syndrome [40, 41]. Numerous interrelated factors contribute to the heightened risk of metabolic syndrome, including the use of second-generation antipsychotics—particularly olanzapine and clozapine—extended duration of treatment, higher cumulative dosages, female sex, advanced age, increased body mass index, physical inactivity, suboptimal nutritional intake, and a personal or familial predisposition to metabolic disorders [42–46]. Consequently, addressing these metabolic risk factors in psychiatric patients may not only mitigate cardiovascular morbidity and mortality but also enhance cognitive function and overall functional outcomes [47, 48].

Despite the well-established association between antipsychotic use and cardiometabolic risks, including metabolic syndrome, comprehensive data specific to the African context remains limited. This systematic review and meta-analysis seeks to address this gap by consolidating available evidence, identifying key predictors of metabolic syndrome among psychiatric patients on antipsychotic treatment, and offering insights to inform clinical practice and public health strategies. Given the increasing prevalence of antipsychotic use in Africa and the significant long-term health implications of metabolic syndrome, a comprehensive understanding of these risks is essential for optimizing patient outcomes, enabling timely interventions, and informing the development of context-specific treatment strategies. Moreover, given the absence of previous systematic reviews or meta-analyses on the pooled prevalence and predictors of metabolic syndrome in this population, the primary aim of this study is to determine the prevalence of metabolic syndrome among African individuals with severe mental illness treated with antipsychotics.

Methods

Protocol and registration

The protocol for the current systematic review and meta-analysis was registered in the International Prospective Register of Systemic Review (PROSPERO) (ID = **CRD42024558310**). We used an appropriate guideline for systematic reviews and meta-analyses reports, which is the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA-2020) [49](additional file 1).

Search strategy

We looked for primary papers on PubMed/MEDLINE, Scopus, African Journal Online, PsycINFO, EMBASE, Psychiatry Online, CINAHL, Science Direct, and the Cochrane Library to search primary papers. Additionally, we have manually searched the reference lists of eligible articles published up to July 8, 2024. We conducted an electronic search in an electronic database using the following MeSH (Medical Subject Headings) terms: (prevalence OR magnitude OR determinants OR proportion OR epidemiology OR correlation) AND (metabolic syndrome OR high blood pressure OR high triglycerides OR waist circumference OR central obesity OR Dyslipidemia OR high-density lipoprotein (HDL) cholesterol OR diabetics mellitus OR diabetic insipidus) AND (psychiatric disorders OR severe mental illness OR manic disorder OR bipolar disorder OR major depressive disorder OR schizoaffective disorder OR schizophrenia disorder) AND (antipsychotic OR typical OR atypical OR first generation OR risperidone OR olanzapine OR clozapine OR haloperidol OR chlorpromazine OR fluphenazine decanoate) AND (factors OR risk factors OR determinants OR predictors OR correlates) AND (Southern Africa OR Central Africa OR East Africa OR North Africa OR Western Africa OR Sub-Saharan Africa OR Africa)(Supplement Table 3).

Eligibility criteria

In this review we included all observational studies on the prevalence of metabolic syndrome and predictors among people with severe mental illness treated with antipsychotic medication in Africa. Which comprised original articles publications published between 2008 and 2021, and data extraction started on April 26, 2024, and was completed on July 8, 2024. The inclusion criteria for this review were as follows: (1) observational studies, such as cross-sectional, case-control, and cohort studies, investigating the prevalence and associated characteristics of metabolic syndrome in psychiatric patients (bipolar disorder, schizophrenia, and major depressive disorder) with participants aged 18 years and older; (2) original studies with complete and accessible data; (3) studies published in English and conducted in Africa up to 2024. Studies were excluded if (1) outcome variables were not reported; (2) they lacked complete data or were difficult to access; (3) Studies that do not report data on metabolic syndrome or its components (e.g., dyslipidemia, hyperglycemia, central obesity, hypertension); (4) they were case reports, reviews, case studies, conference abstracts, qualitative studies, or short communications; (5) they involved a non-representative sample of individuals with mental illness, such as subgroups defined by gender, age, or race; (6) Studies that do not provide clear information on the use of antipsychotic medications in the treatment of psychiatric disorders.

Data extraction

The two authors (MK, and GM) extracted all the pertinent information using a standardized data extraction format setup in Microsoft Excel after carefully going over the titles, abstracts, and full texts of the paper, as well as the originality of the article. The publication year, the name of the first author, the type of diagnosis based on diagnostic and statistical manual of mental disorders or international classification of diseases and the nations in which the study was conducted, the institution's location, sample size, study design, types of tools used for screening MetS (and the prevalence of MetS are all contained in the final data extraction format. The second goal was to extract variables, such as the odds ratio and 95% confidence interval that are linked to MetS Throughout the data extraction process, disagreements between the two authors were addressed by talking to the other author (SF).

Outcome measurements

For this meta-analysis and systematic review, there are two principal objectives. The first aim of the study was to determine the combined prevalence of MetS among African with severe mental illness who received antipsychotic medications. Assessments of metabolic syndrome were conducted using the primary screening instruments, such as the International Diabetes Federation (IDF), the National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III), and a structured questionnaire that was modified from the WHO -steps survey instruments. The WHO Steps Survey created the standardized but adaptable STEPS framework, which allows nations to use questionnaire assessment and physical and biochemical measurements to track the primary risk factors for communicable diseases and the tool's reliability was measured using Cronbach's alpha, which was 0.83 within a cut-off value of 0.7 and above was used as an acceptable internal consistency level [50, 51]. Since its launch, the IDF has been one of the most widely studied and widely utilized screening instruments for metabolic syndrome, with a sensitivity was 79.40% and a specificity was 99.98% [52, 53]. Additionally, some of those primary articles describe laboratory investigations with results > 100 mg/dL fasting blood glucose (FBG) for screening metabolic syndrome [54]. The second goal was to determine the pooled impact size of predictors with MetS among adult psychiatric patients who received antipsychotic medication in Africa. STATA version 14.0 was used to compute the pooled prevalence of metabolic syndrome. The odds ratio was used to determine the pooled impact size of related factors with metabolic syndrome. Using two-by-two tables, the odds ratio was computed from the reports of the original research.

Quality assessment

The authors (MK, and GM) assessed the quality of the primary studies that were part of this systematic review and meta-analysis using the standard critical appraisal tool. The original purpose of the Joanna Briggs Institute's (JBI) quality rating standards was to assess the methodological quality of prospective and cross-sectional research's prevalence and for cohort studies, we used Newcastle-Ottawa Scale is an eight-item measure for evaluating the quality of studies in research journals, It has a scoring system that ranges from 0 to 9 stars, with scores equal to or greater than 7 indicating high quality and scores less than 7 indicating poor quality [55–57]. There are nine items total on this quality assessment tool, with scores ranging from 0 to 9 (0–4 low, 5–7 moderate, and 8 and above good quality). As a result, in this systematic review and meta-analysis includes the studies that a scored greater than five. The other author (SF) arbitrated any disputes between writers about the quality evaluation of the included articles in order to reach a consensus (Supplement Tables 1 and 2).

Data synthesis and analysis

The Microsoft Excel file with the retrieved data was exported to STATA 14.0 in order to conduct additional analysis. To assess the pooled effect size of all relevant studies at a 95% confidence interval, a random-effect meta-analysis model was installed. Using words, figures, and forest plots, the findings of this meta-analysis were presented. The statistical heterogeneity was assessed using the I2 test, and in light of the variability among the included particles, a random effect meta-analysis model was employed [58]. Subgroup analysis was conducted using publication year, types of diagnoses based on DSM-5-TR and ICD-11, type of study design, type of tools used to screen metabolic syndrome, and country, and the presence of any possible source of heterogeneity was checked using sensitivity analysis. Publication bias of the included studies was assessed by using both visual observation of the symmetry in the funnel plots and Egger weighted regression tests at a 5% significance level [59]. In Egger's test, publication bias was considered to occur when the p-value < 0.05.

Results

Search results

A total of 1,456 studies were initially identified through a comprehensive search of multiple electronic databases for this systematic review and meta-analysis. After removing 56 duplicate records, 1,337 studies were excluded based on the following criteria: absence of full-text availability, irrelevance to the topic, studies conducted outside of Africa, and differences in study population or setting. An additional 38 studies were excluded after the full-text evaluation of 63 papers, based on further non-compliance with the predefined inclusion criteria. Ultimately, 25 studies met the eligibility criteria and were included in the final analysis, providing robust data for the estimation of the pooled prevalence and associated factors of metabolic syndrome among psychiatric patients treated with antipsychotic medications in Africa. This rigorous selection process adhered to PRISMA guidelines to ensure the inclusion of high-quality studies for this review (Fig. 1).

Characteristics of included studies

This review includes twenty-five primary studies with a total of 4,064 participants on metabolic syndrome and related determinants among African individuals with severe mental illness who treated with antipsychotic medication. We included twenty studies with a cross-sectional design and five prospective cohort studies that examined the magnitude of metabolic syndrome among individuals with severe mental illness who were taking

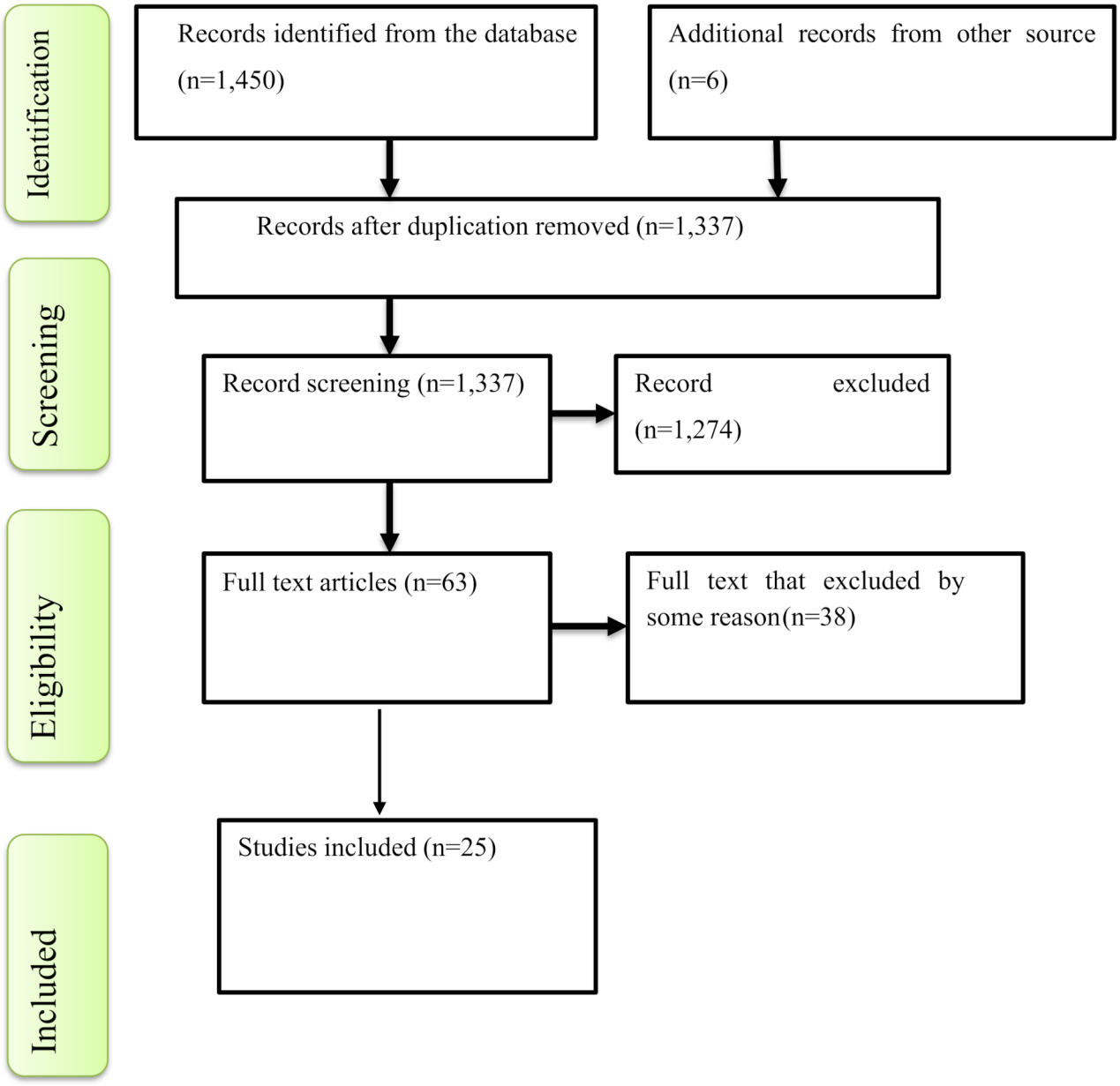

Fig. 1 PRISMA flow chart of study selection meta- analysis of metabolic syndrome among adult psychiatric patients treated with antipsychotic medication in Africa

antipsychotic medications in this meta-analysis. This reviews covered eight African countries: seven studies in Nigeria [60–66], five studies in Ethiopia [67–71], five studies in South Africa [72–76], three studies in Ghana [77–79], two studies in Egypt [80, 81], one study in Kenya [82], one study in Sudan [83] and one study in Cameroon. According to the studies that were considered, the prevalence of metabolic syndrome among individuals with severe mental illness received antipsychotics was highest in Sudan 45% and lowest in South Africa 0.6%. Regarding assessment tools, eleven articles used the International Diabetes Federation(IDF), four articles used the by measuring Random blood sugar (RBS), four used the National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III), two used WHO-survey services, two used joint interim statement (JIS), one used cholesterol oxidase (CHOD) to cholest-4-en-3-one and H2O2, phenol and 4- aminoantipyrine (CHOD-PAP) and one used body mass index (BMI)(Table 1).

Table 1 Characteristics' of studies included in this systematic review and meta-analysis metabolic syndrome among adult psychiatry patients treated with antipsychotic medication in Africa

Authors	Year of publication	Study design	Types of diagnosis (DSM-5-TR)	Types of metabolic syndrome	Antipsychotic types	Country	Screening tools	Sample size	Prevalence MeS%
Daniel A. et al.	2018	Cross-sectional	Severe mental illness	Diabetic mellitus	Typical and atypical	Ethiopia	FBS	205	7.3%
Mulat et al.	2017	Prospective	Severe mental illness	Weight gain	Typical and atypical	Ethiopia	WHO-survey	74	7.46%
Hirigo et al.	2021	Cross-sectional	Severe mental illness	Dyslipidemia	Typical and atypical	Ethiopia	NCEP-ATP	245	58.4%
Amogne et al.	2021	Cross-sectional	Severe mental illness	Metabolic syndrome	Atypical	Ethiopia	FBS	510	17.8%
Hirigo and Teshome	2020	Cross-sectional	Severe mental illness	Diabetic mellitus	Typical and atypical	Ethiopia	FBS	247	6.3%
Ansah et al.	2018	Cross-sectional	Schizophrenia	Metabolic syndrome	Typical and atypical	Ghana	IDF	236	23.6%
Owiredu et al.	2012	Cross-sectional	Severe mental illness	Metabolic syndrome	Typical and atypical	Ghana	IDF	100	29%
Asare et al.	2017	Cross-sectional	Severe mental illness	Metabolic syndrome	Typical and atypical	Ghana	NCEP-ATP	100	21%
Hell et al.	2021	Cross-sectional	Schizophrenia	Diabetic mellitus	Typical and atypical	Cameron	NCEP-ATP	82	42.7%
Hatataet al	2008	Cross-sectional	Schizophrenia	Metabolic syndrome	Typical and atypical	Egypt	IDF	63	38.09%
El-Gabry et al.	2018	Prospective	Schizophrenia	Metabolic syndrome	Typical and atypical	Egypt	IDF	118	38.1%
Olose et al.	2012	Prospective	Schizophrenia	Diabetic mellitus	Typical and atypical	Nigeria	IDF	209	12.4%
Effiong et al.	2018	Cross-sectional	Schizophrenia	Obesity	Typical and atypical	Nigeria	IDF	106	20.6%
Jombo et al.	2021	Cross-sectional	Schizophrenia	Dyslipidemia	Typical and atypical	Nigeria	CHOD-PAP	52	26.9%
lawani et al.	2009	Cross-sectional	Schizophrenia	Metabolic syndrome	Typical and atypical	Nigeria	IDF	61	19%
Olose O et al.	2017	Prospective	Schizophrenia	Dyslipidemia	Typical and atypical	Nigeria	NCEP-ATP	60	13%
Effiong et al.	2018	Cross-sectional	Schizophrenia	Diabetic mellitus	Typical and atypical	Nigeria	FBS	86	3.4%
Oluyomi & Arinola	2021	Cross-sectional	Schizophrenia	Obesity	Typical and atypical	Nigeria	BMI	206	12.6%
Kwobah et al.	2021	Cross-sectional	Severe mental illness	Metabolic syndrome	Typical and atypical	Kenya	IDF	300	28.6
Japir and Osman	2020	Cross-sectional	Severe mental illness	Metabolic syndrome	Olanzapine	Sudan	IDF	100	45%
Saloojee et al.	2014	Cross-sectional	Severe mental illness	Metabolic syndrome	Typical and atypical	South Africa	WHO-survey	331	0.6%
N Faasen et al.	2014	Cross-sectional	Schizophrenia	Metabolic syndrome	Clozapine	South Africa	IDF	29	44.8%
Shamima Saloet al	2016	Cross-sectional	Severe mental illness	Metabolic syndrome	Typical and atypical	South Africa	JIS	276	23.2%
Shamima et al.	2016	Cross-sectional	Severe mental illness	Metabolic syndrome	Typical and atypical	South Africa	IDF	232	19.4%
Shamima Saloojee et al.	2016	Prospective	Severe mental illness	Metabolic syndrome	Typical and atypical	South Africa	JIS	36	5.88%

The pooled prevalence of metabolic syndrome among psychiatric patients who received antipsychotic drug in Africa

The pooled prevalence of metabolic syndrome among psychiatric patients on antipsychotic medication in Africa was found to be 22% with a 95% CI (16.33–27.66) (Fig. 2). The weighted prevalence of metabolic syndrome among nations was also examined in this meta-analysis.

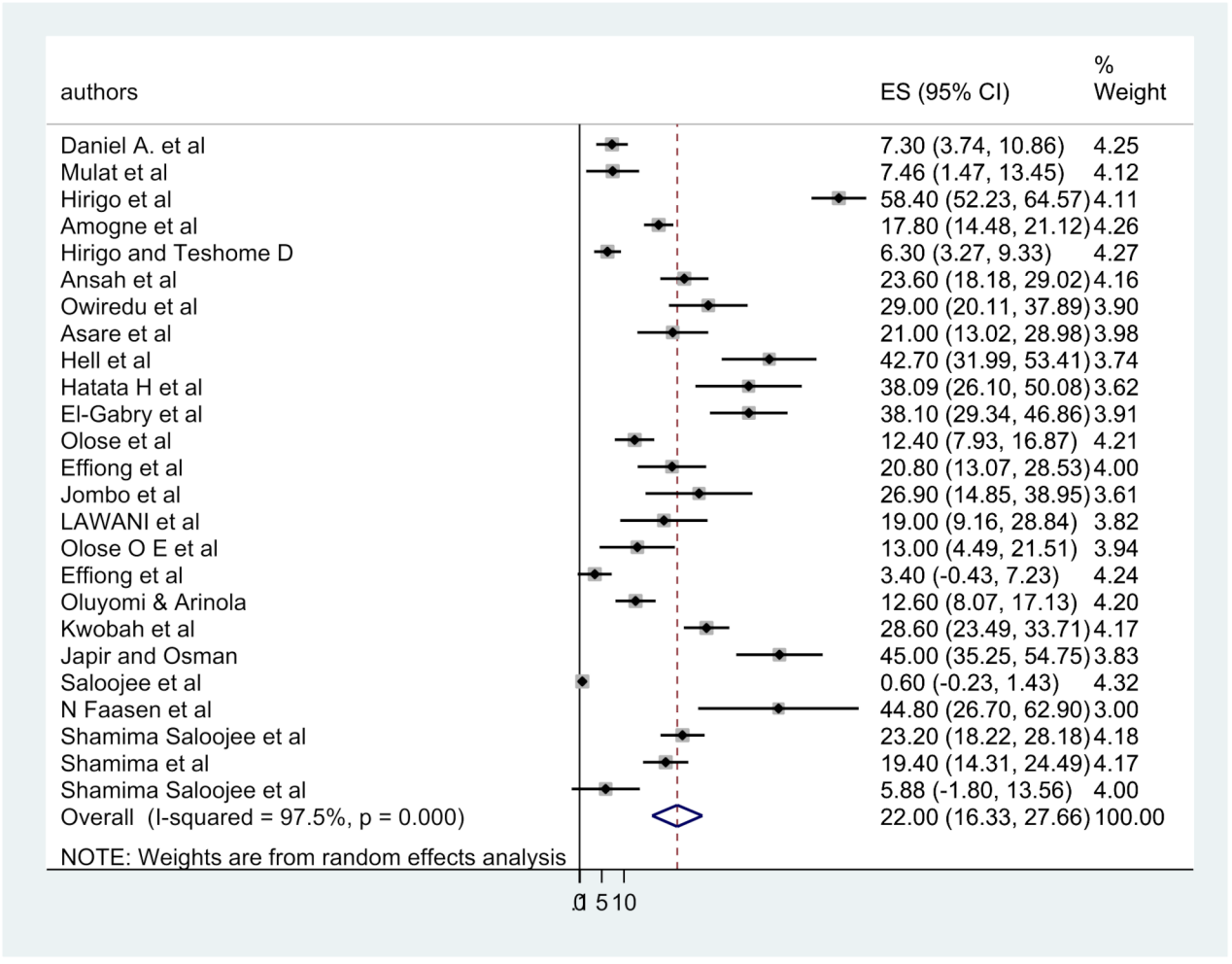

Fig. 2 Pooled prevalence metabolic syndrome among adult psychiatric patients treated with antipsychotic medication in Africa

Heterogeneity and publication bias

The random-effects model accounts for both intra- and inter-participant variation (heterogeneity). The majority of random effect pooled rate prevalence of metabolic syndrome had high (I2 = 98.1%) values, indicating a significant degree of heterogeneity. A meta-analysis should be performed when a collection of studies is homogeneous enough in terms of interventions, participants, and outcomes to allow for a useful summary. Causes should be identified if there is a high degree of heterogeneity. Subgroup analysis or meta-regression was performed utilizing several characteristics. Regarding publication bias, two techniques were used to check if there was a publication bias in the included studies. The first was checked by a funnel plot, which showed the asymmetric distribution and revealed that there was publication bias in the included articles (Fig. 3). Additionally, the Eggers test was used to confirm that there was publication bias, as shown by $p < 0.001$ (Table 2). Therefore, to control for this publishing bias, we employed trim and fill analysis (Fig. 4).

Subgroup analysis

The pooled prevalence of MetS was affected by heterogeneity, subgroup analysis based on study country, publication year, types of screening tools, study design, and types of diagnosis based on The Diagnostic and Statistical Manual of Mental Disorders, types of antipsychotic medications, and classification of mental illness based on DSM-5-TR. The subgroup analysis showed that the pooled prevalence of MetS among psychiatric patients who received antipsychotics was highest in Sudan 45% (95% CI: 35.25, 54.75), followed by Cameroon 42.7% (95% CI: 31.99–53.41), in Egypt 38.1% (95% CI: 31.02–45.17), in Kenya 28.8%(95% CI: 23.49–33.71), in Ghana 24.04% (95% CI: 20.04–28.04), in Ethiopia 19.3% (95% CI: 5.19–33.41), in South Africa 17.23% (95% CI: 4.33–30.13), and the least prevalence of metabolic syndrome was seen in Nigeria 14.3% (95% CI: 8.88–19.72). The pooled prevalence of the MetS among the articles was determined using screening tools; the highest prevalence was seen in NCEP-ATP at 33.82% (95% CI: 11.24–56.41),

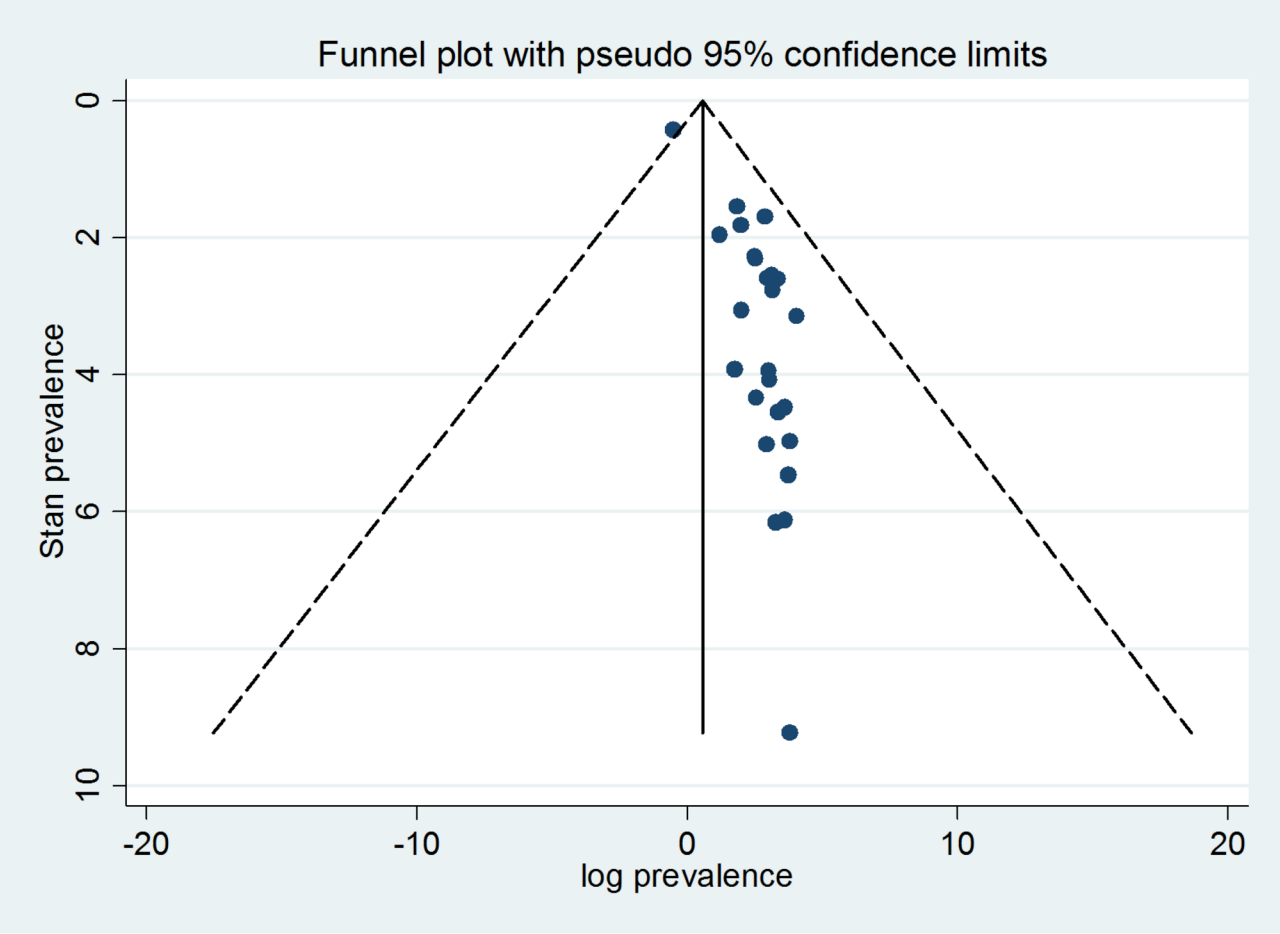

Fig. 3 Funnel plot of metabolic syndrome among adult psychiatric patients treated with antipsychotic medication in Africa

Table 2 Egger test of metabolic syndrome among adult psychiatry patients treated with antipsychotic medication in Africa

Std eff	Coef	Std Err	T	*p* > t	Conf.Interval
Slope	-2.117023	1.761814	-1.20	0.242	-5.761612,1.527566
Bias	7.08566	1.031531	6.87	0.000	4.951775, 9.219545

followed by screening tools using IDF at 27.78% (95% CI: 21.84–33.72), CHOD-PAP at 26.9% (95% CI: 14.85–38.95), JIS criteria at 14.8% (95% CI: 2.71–31.76), BMI at 12.6% (95% CI: 8.07–17.13), and FBS at 8.73% (95% CI: 2.56–14.9), while the least prevalence seen in WHO survey service measurement was 3.36% (95% CI: 3.23–9.96). Regarding the antipsychotic medication class, the highest prevalence was seen in those who were taking olanzapine at 45% (95% CI: 35.25–54.75), followed by those taking clozapine at 44.8% (95% CI: 26.7–62.9), those who were taking both typical and atypical antipsychotics was 20.43% (95% CI: 14.48–26.38), and the least prevalence seen in patients were taking atypical antipsychotics was 17.8% (95% CI: 14.8-21.12). Based on the study design, the prevalence of metabolic syndrome was higher in the cross-sectional study (23.76%; 95% CI: 17.17–30.36) and lower in the prospective cohort study (15.07%; 95% CI: 5.75–24.38). Also, patients who had schizophrenia disorder had a higher prevalence of metabolic syndrome was 23.42% (95% CI: 16.45–30.39%) and patients with severe mental illness was 20.51%(95% CI: 12.35–28.66%) (Table 3).

Sensitivity analysis

In this meta-analysis, a sensitivity analysis was conducted to assess the heterogeneity of the included studies by systematically excluding one study at a time to evaluate its influence on the pooled prevalence of metabolic syndrome. This approach aimed to minimize uncertainty and ensure the robustness of our findings. To enhance the reliability of our meta-analysis and mitigate the risk of bias, we rigorously assessed the quality of primary studies using standardized appraisal tools, including the Joanna Briggs Institute (JBI) checklist and the Newcastle-Ottawa Scale (NOS), ensuring that only high-quality studies were included. The results demonstrated that all estimated values remained within the expected 95%

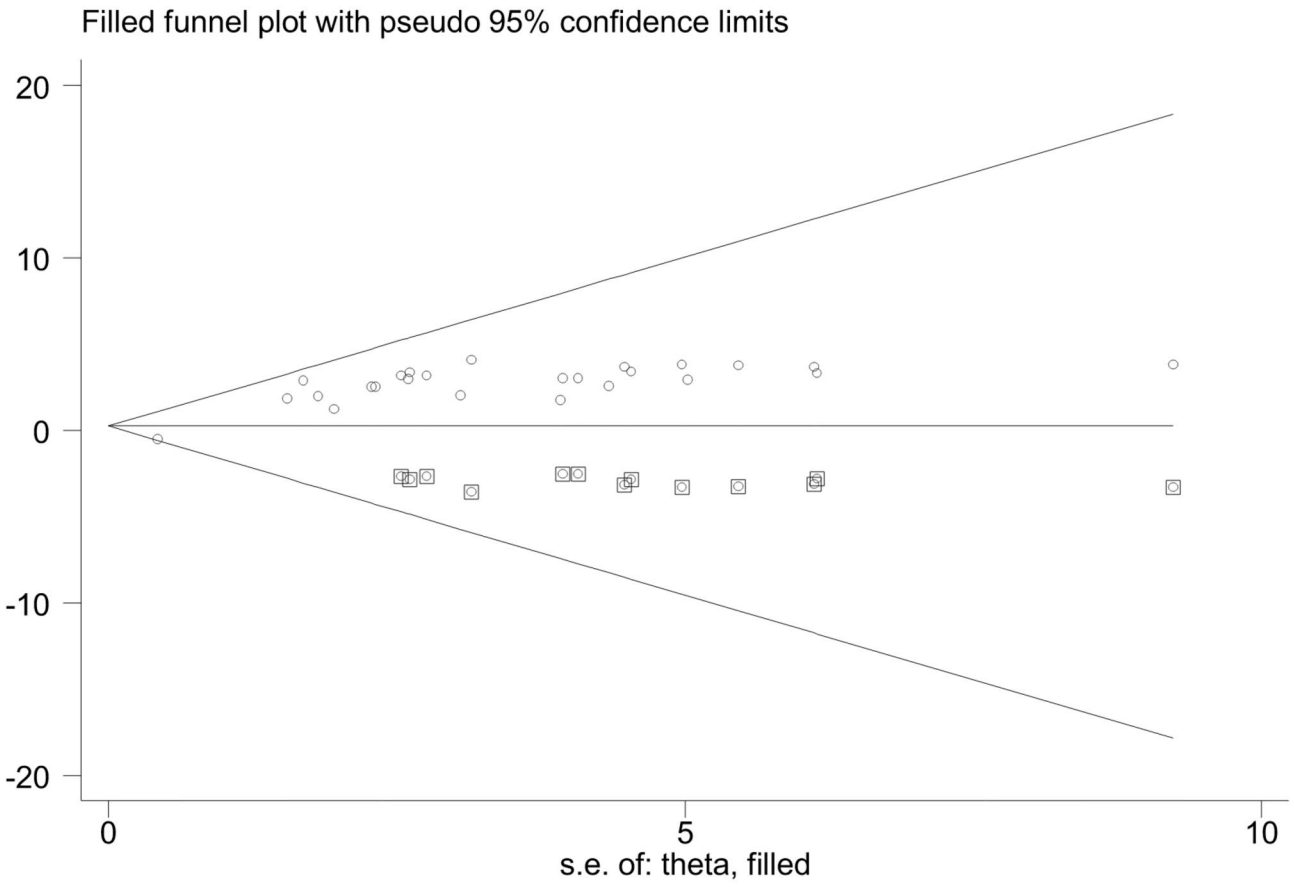

Fig. 4 Trim and fill funnel plot of metabolic syndrome among adult psychiatric patients treated with antipsychotic medication in Africa

confidence interval (CI), indicating that the exclusion of any single study did not significantly impact the overall prevalence estimate, thereby confirming the stability and reliability of our findings (Fig. 5).

Factors associated with metabolic syndrome among adult psychiatry patients in Africa

This meta-analysis identified several factors associated with metabolic syndrome among psychiatric patients receiving antipsychotic treatment in Africa. Female sex, advanced age, and overweight status were significantly linked to an increased risk of metabolic syndrome. Specifically, findings from four primary studies included in this review demonstrated that female patients had a threefold higher likelihood of developing metabolic syndrome compared to male patients (OR = 3.28, 95% CI: 1.73–6.23). Additionally, advanced age was associated with a higher risk, with each unit increase in age raising the likelihood of metabolic syndrome by 1.07 times (OR = 1.07, 95% CI: 1.01–1.12). Finally, individuals with a body mass index (BMI) exceeding the normal range exhibited a fivefold increased likelihood of developing metabolic syndrome compared to those with a normal BMI (OR = 5.33, 95% CI: 2.35–12.12) (Fig. 6).

Discussion

This systematic review and meta-analysis, which included 4,064 participants, aimed to estimate the pooled prevalence and associated factors of metabolic syndrome among psychiatric patients treated with antipsychotic medications in Africa. However, several factors contributed to the observed variability in the findings, particularly with respect to the diagnostic criteria for metabolic syndrome. Notably, the methods used to assess metabolic syndrome varied significantly across studies, with some employing the IDF, NCEP-ATP, and CHOD-PAP JIS criteria, while others utilized Body Mass Index (BMI) and fasting blood sugar (FBS) measurements. This inconsistency in diagnostic approaches likely contributed to the heterogeneity of the results, as these tools differ in their sensitivity and specificity for detecting metabolic syndrome components [84, 85]. Furthermore, the cultural diversity across African countries, combined with variations in research methodologies, may have influenced prevalence estimates, as factors such as dietary habits, physical activity, and healthcare access differ widely across regions. Additionally, the studies were conducted over varying time frames, which may have introduced temporal biases due to changes in healthcare policies,

Table 3 Subgroup analysis of metabolic syndrome among adult psychiatry patients treated with antipsychotic medication in Africa

Variables	Subgroup	Number of studies	Prevalence (95% CI)	I2(%)	*P* value
Type of DSM diagnosis	Severe mental illness	13	20.51%(95% CI:12.35,28.66)	98.6%	0.000
	Schizophrenia	12	23.42%(95% CI;16.45,30.39)	98.1	0.000
Country	Ethiopia	5	19.3% (95% CI: 5.19, 33.41)	95.9	0.000
	Nigeria	7	14.30% (95% CI: 8.88, 19.72)	91.9	0.000
	South Africa	5	17.23% (95% CI: 4.33, 30.13)	99.0	0.000
	Ghana	3	24.04% (95% CI: 20.04, 28.04)	97.3	0.000
	Egypt	2	38.1% (95% CI: 31.02, 45.17)	88.8	0.004
	Sudan	1	45% (95% CI: 35.25, 54.75)	76.6	0.06
	Kenya	1	28.8%(95% CI: 23.49,33.71	48.9	0.09
	Cameron	1	42.70% (95% CI: 31.99, 53.41)	48.6	0.093
Screening tools	NCEP-ATP	4	33.82% (95% CI: 11.24, 56.41)	98.3	0.000
	IDF	11	27.78% (95% CI: 21.84, 33.72)	96.5	0.000
	CHOD-PAP	1	26.9% (95% CI: 14.85, 38.95)		
	JIS criteria	2	14.8% (95% CI: 2.71, 31.76	94.4	0.005
	IBM	1	12.60% (95% CI: 8.07, 17.13)	88.6	0.006
	FBS	4	8.73% (95% CI: 2.56, 14.9)	82.6	0.009
	WHO-service	2	3.36% (95% CI: 3.23, 9.96)	79.0	0.009
Study design	Cross-sectional	20	23.76%; 95% CI: 17.17–30.36)	98.4	0.000
	Prospective Cohort	5	15.07% (95% CI: 5.75–24.38)	94.5	0.009
Class of anti-psychotic	Typical and atypical	22	20.43% (95% CI: 14.48, 26.38)	97.9	0.00
	Atypical	1	17.8% (95% CI: 14.80, 21.12)	86.0	0.056
	Olanzapine	1	45.0% (95% CI: 35.25, 54.75)	76.9	0.089
	Clozapine	1	44.8% (95% CI: 26.70, 62.90)	77.89	0.068

evolving treatment practices, and shifting lifestyle factors over time [86]. These variations underscore the complexity of assessing metabolic syndrome in a continent as diverse as Africa and emphasize the need for standardized diagnostic criteria in future studies. The findings of this review, revealing a pooled prevalence of 22%, are consistent with similar studies conducted in other regions, including the USA 18.5% [87], in Croatia 27% [88], in Spain 27.6% [89], in Japan 20.4% [90], and in Turkey 21% [91].

The pooled prevalence of metabolic syndrome was lower than other studies that were conducted in different countries in USA 45.9% [92], multinational in Europe 28% [93], in France 31.1% [94], in Belgium 28.4% [95], in Germany 28.4% [96], in Denmark 48.2% [97], in Sweden 34.6% [98], in Brazil 28.7% [99], in India 40% [100], other studies did in India 50% [101], in Turkey 42.2% [102], in China 31% [103], in Qatar 31.9% [31], in Iran 29.2% [104]. The present review's prevalence is lower than a systematic review and meta-analysis done in Italy on the prevalence of metabolic syndrome among schizophrenia patients treated with second-generation antipsychotics that was corroborated by randomized controlled trials and observational studies, in which the prevalence was 61% and 39%, respectively [105]. The possible reason for the discrepancy might be that studies, like in France and the USA, involved participants taking only second-generation antipsychotic medication, as well as studies in India and Germany, which were longitudinal, but most of our articles included cross-sectional studies. Studies show that second-generation drugs are a heterogeneous class of drugs with high degrees of metabolic disturbance as compared with first-generation drugs, and with the effectiveness of SGAs for treating schizophrenia, clozapine and olanzapine appear to have the highest risk of weight gain because of the increased prevalence of central obesity and glucose abnormalities, such as impaired fasting glucose and insulin resistance; These findings imply that metabolic disturbances may even be thought of as intermediate phenotypes linked to genetic risk for schizophrenia [106–109].

The pooled prevalence of metabolic syndrome was higher than other studies that were conducted in different countries in Switzerland 10% [110], in Spain 5.1% [111], India 11.66% [112], in Japan 13% [113], in Saudi Arabia.15.8% [114]. The findings of this review are also higher than with the systematic review and meta-analysis done in the UK the prevalence of Metabolic Syndrome and Metabolic Abnormalities Increased in Early Schizophrenia Treated with antipsychotics was 9.9% [115]. The possible reason for the discrepancy might be that studies, like Saudi Arabia around 90% were male and studies in Japan were incorporated patients were in antipsychotics treatment. The study found that women have higher levels of metabolic syndrome, including elevated body weight, waist girth, and low HDL cholesterol, which contribute to insulin resistance, dyslipidemia, and high blood pressure, possibly due to their more favorable fat

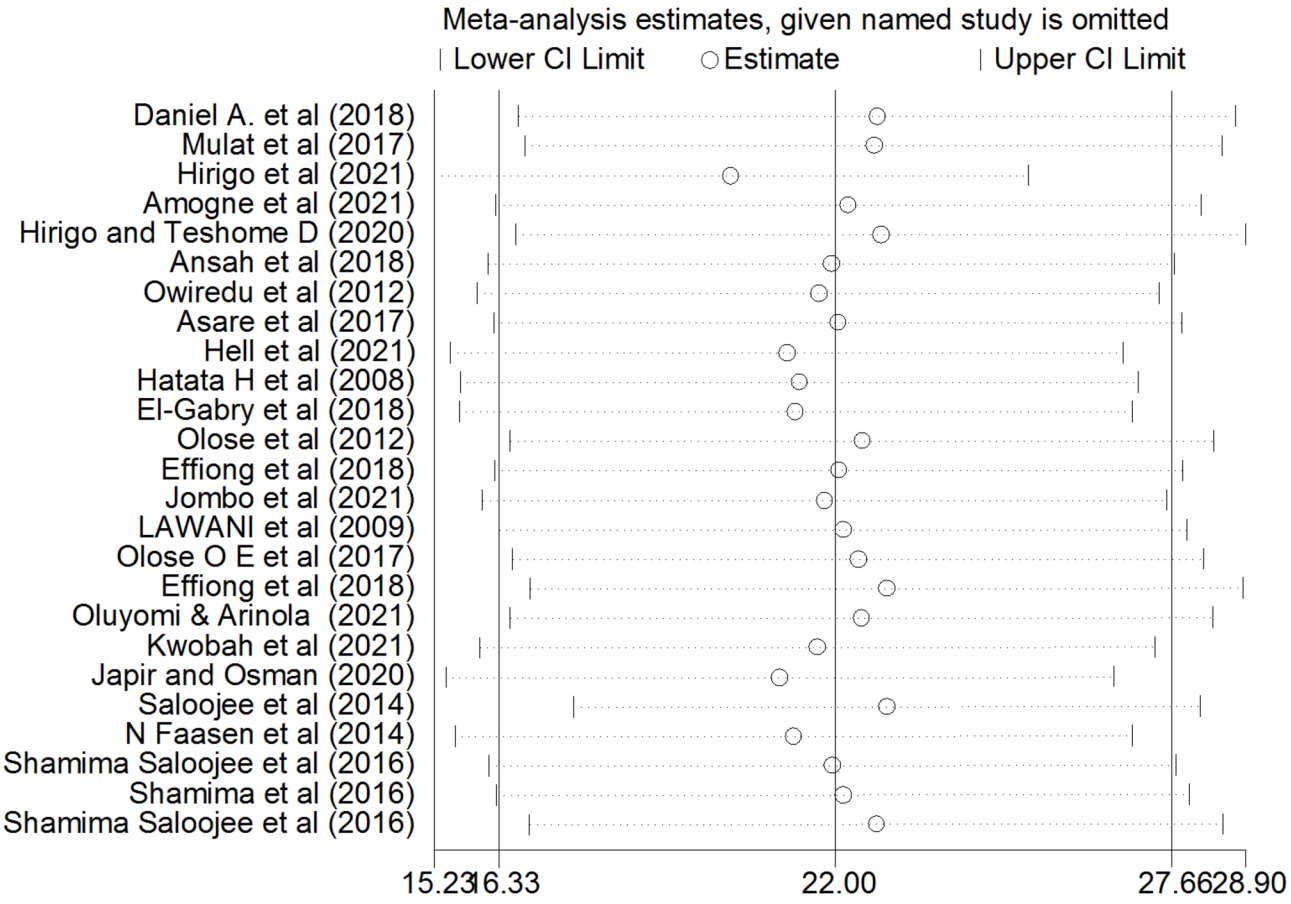

Fig. 5 Sensitivity analysis on metabolic syndrome among adult psychiatric patients treated with antipsychotic medication in Africa

distribution so males have less risk of metabolic syndrome as compared with females [116–118].

As a result, compared to the male gender, being female was a significant predictor of metabolic syndrome among adult psychiatry patients treated with antipsychotic medication. This finding was supported by other studies conducted in South Korea [119] and in Japan [120]. In women compared to men, the metabolic syndrome revealed considerably higher body mass index and low HDL cholesterol; in other words, women had more central obesity and an increased waist circumference [121]. This may increase free fatty acids and cytokines for the liver, which is abdominal fat tissue, which promotes the early onset of impaired fasting glucose, risk of heart disease, and high blood pressure. Additionally, the majority of the women were evenly distributed in terms of fat because of postmenopausal, which may increase the risk of metabolic syndrome in females [122–124].

This review also revealed that participants with advanced ages were at higher risk for metabolic syndrome than those who were younger age. This finding was in supported with the study conducted in India [125], in Southern India [126], in USA [127], in France [128] and in Canada [129]. Mostly fatty acid, glucose levels, and insulin action are primarily regulated by adipose tissue, skeletal muscle, and the liver; the metabolic cascade described may have its origins in extra-cardiac organs. The development of visceral adiposity in advanced age, which is linked to overeating and a decrease in exercise, is directly linked to metabolic syndrome. A more thorough understanding of organ cross-talk may also contribute to our understanding of the primary and adaptive events involved in metabolic heart toxicity. So as age increases the risk of cardiometabolic disease may increase [130–132].

Finally, individuals with elevated body mass index exhibited a fivefold increased likelihood of developing metabolic syndrome compared to those with a normal BMI. This finding was supported by the study conducted in China [133], in Japan [120], and in United State [127]. Chronic obesity has a detrimental impact on the mechanisms regulating blood pressure, lipids, and glucose levels and also dysregulates metabolic processes, including the role of insulin in the metabolism of glucose-lipid-free fatty acids. More visceral fat than any other fat compartment is thought to be the greater correlate of visceral obesity, or excess visceral fat, with metabolic risk factors. While visceral fat takes up a much smaller space,

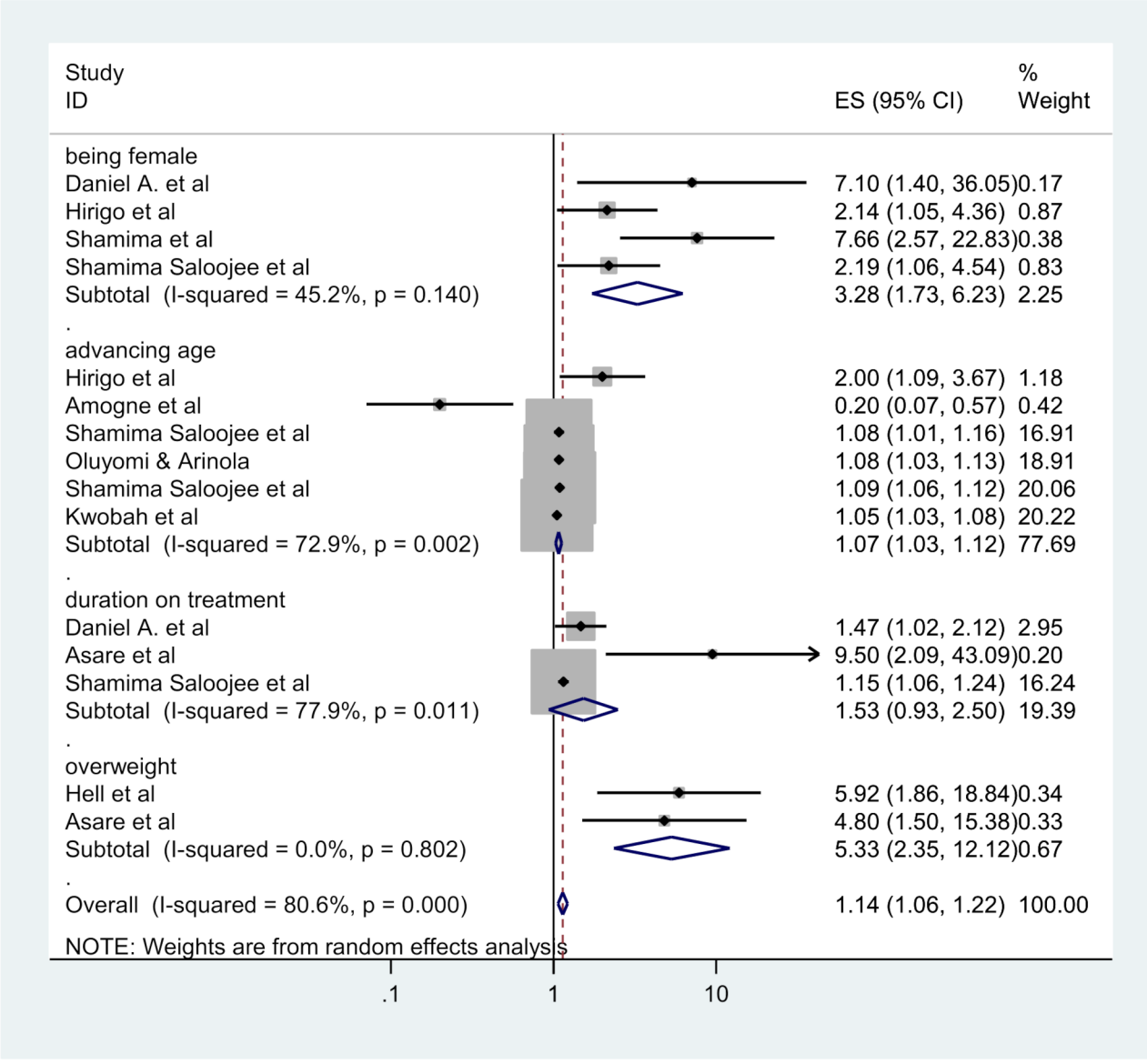

Fig. 6 Factors associated with metabolic syndrome among adult psychiatric patients treated with antipsychotic medication in Africa

subcutaneous adipose tissue does. Usually, the latter is divided into the gluteofemoral and truncal adipose tissue. So overweight may increase risk of metabolic syndrome [134–136].

The significance of this issue in Africa is accentuated by the increasing prevalence of mental health disorders and the expanding use of antipsychotic medications across the continent. Conditions such as schizophrenia, bipolar disorder, and major depressive disorder are widespread, with their treatment often necessitating antipsychotic drugs, which, although effective in alleviating psychiatric symptoms, are associated with an elevated risk of metabolic syndrome, including obesity, dyslipidemia, hypertension, and insulin resistance. In Africa, the impact of metabolic syndrome is further exacerbated by constrained healthcare resources, underdeveloped infrastructure, and inadequate specialized care for individuals with comorbid psychiatric and metabolic disorders. Moreover, genetic, cultural, and dietary factors may contribute to an increased prevalence of metabolic syndrome, amplifying the concern. As the burden of mental health disorders rises in the region, identifying and understanding the risk factors for metabolic syndrome is pivotal for optimizing patient care, enhancing medication adherence, and preventing long-term sequelae such as cardiovascular disease and diabetes. Addressing these multifaceted challenges is essential, not only to improve individual health outcomes but also to alleviate

the broader healthcare burden in Africa, necessitating context-specific prevention and management strategies to mitigate the dual impact of psychiatric and metabolic disorders.

Limitations of the study

This systematic review and meta-analysis offers valuable insights; however, several limitations must be acknowledged in assessing the pooled effect of metabolic syndrome among psychiatric patients treated with antipsychotic medications. A primary limitation is that most of the included studies were cross-sectional, which restricts the ability to establish causality between antipsychotic use and metabolic syndrome. Cross-sectional designs capture associations at a single point in time but do not account for temporal relationships, making it unclear whether metabolic syndrome arises as a direct consequence of antipsychotic treatment or is influenced by preexisting risk factors. Another limitation is the inclusion of only English-language studies, potentially introducing language bias. Additionally, the majority of studies were conducted in psychiatric hospitals, primarily focusing on patients with severe mental illnesses such as schizophrenia, bipolar disorder, and major depression, with an overrepresentation of schizophrenia patients receiving second-generation antipsychotics. This sampling bias may lead to either an overestimation or underestimation of metabolic syndrome prevalence. Furthermore, substantial variability in diagnostic criteria was observed across studies, with the use of IDF, NCEP-ATP, CHOD-PAP JIS criteria, Body Mass Index (BMI), and fasting blood sugar (FBS), each possessing different sensitivities and specificities. The inconsistent application of standardized screening tools for key metabolic syndrome components, such as BMI and FBS, may have contributed to discrepancies in case identification, ultimately affecting the accuracy and reliability of the pooled prevalence and its associated predictors. Lastly, significant heterogeneity was observed in both the overall meta-analysis and subgroup analyses, further limiting the generalizability of the findings across diverse populations.

Conclusion

Metabolic syndrome demonstrates a high prevalence among psychiatric patients receiving antipsychotic therapy in Africa, with female sex, older age, and increased body mass index emerging as key risk factors. These findings highlight the imperative for systematic and routine metabolic monitoring—encompassing assessments of dyslipidemia, hyperglycemia, and hypertension—to facilitate early identification and timely intervention. Proactive management is essential to attenuate cardiovascular risk and enhance long-term health outcomes. Future research should focus on establishing standardized, context-specific screening frameworks and delineating the metabolic profiles associated with different antipsychotic agents within diverse African populations.

Supplementary Information

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Supplementary Material 1

Supplementary Material 2

Supplementary Material 3

Supplementary Material 4

Supplementary Material 5

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Author contributions

In addition to conceptualizing the study, MK worked on its design, data extraction, search strategy, analysis, article evaluation, interpretation, report writing, and manuscript preparation. The data extraction process involved GK, GT, GR and GN. Significant contributions to the manuscript's drafting and the evaluation of the included studies' quality were made by GM, DA, FG, MM, and SF. Each author accepted the submitted version of the paper and made contributions to it.

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Data availability

The original contributions presented in the study are included in the article or supplementary material; further inquiries can be directed to the corresponding author.

Declarations

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Consent for publication

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Competing interests

The authors declare no competing interests.

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