Systematic Review / Meta-analysis

Metabolic syndrome among people with mental illness in sub Saharan Africa: Female gender as a factor. A Systematic review and meta-analysis

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ABSTRACT

Background: The prevalence of metabolic syndrome among psychiatric patients in developing nations is mounting alarmingly and it is a reason for decreased life expectancy and quality of life of people with mental illness. Although great discrepant epidemiological studies have been carried out in Sub Saharan African countries, there has no systematic review and meta-analysis conducted. Therefore, summarized evidence has a paramount importance for policy makers and health planning. This study aims to estimate the prevalence of metabolic syndrome and to examine the effect of gender on metabolic syndrome among people with mental illness in sub Saharan Africa.
Method: Systematic literature search was performed using PubMed, CINAHL, Web of science, Global health electronic databases. In addition, gray literatures were retrieved from Google and Google scholar. Two authors independently extracted all the necessary data using a format prepared in Microsoft Excel. Data analysis was done using STATA Version 14 (software). The heterogeneity of the studies was assessed using I^2 test. Random-effects model was used to estimate pooled prevalence of MetS and its odds ratio. Publication bias was checked using Funnel plot and Egger's test.
Result: 1306 studies were reviewed and nine studies fulfilling the inclusion criteria were selected for the meta-analysis. The meta-analysis of nine studies that included 1896 participants found a prevalence rate of meta-bolic syndrome which was performed based on assessment criteria; JIS criteria prevalence 21.11% (95% CI: 17.93–24.29), IDF criteria 23.77% (95% CI: 15.41–32.12) and NCEP ATP-III criteria 21.63% (95% CI: 16.30–26.96). Female gender (AOR = 3.00; 95% CI: 1.98–4.55) was found to have a significant association with metabolic syndrome.
Conclusion: The prevalence of metabolic syndrome among people with mental illness in sub Saharan Africa is high in various assessment criteria. The likelihood is significantly increased in females than males. Metabolic syndrome increases by three folds among females with mental illness as compared to their counterparts.

1. Background

There are various definitions of metabolic syndrome given by different health care organizations such as World Health organization, National Cholesterol Education Program-the third Adult Treatment Panel, International Diabetes Federation, European Group for Study of Insulin Resistance and American Heart Association [1]. However, commonly it can be explained as constellation of conditions including abdominal obesity, insulin resistance, dyslipidemia (elevated tri-glycerides levels and low high-density lipoprotein cholesterol), and hypertension [2]. Although it was highly prevalent in the westerns in the far before, nowadays; metabolic syndrome represents a global epidemic [3]. The burden of metabolic syndrome is very high prominently among patients with mental illness as compared to the general population [4,5] for which recent literatures provide that there is significant association between mental illness and metabolic syndrome [4,6]. Metabolic

syndrome (MetS) risk factors are traits, conditions or habits that can increase level of risks for chronic health problems such as heart disease, diabetes, hyperbaton and strokes [7].

Mental illness is a major global public health issue, which has a significant contribution to develop co-morbid medical health problem and suicidal death. Globally, mental illness is burdensome and it accounts for 32.4% of years lived with disability (YLDs) and 13% of disability-adjusted life-years (DALYs), with the significant proportion is in developing world [8].

Patient with mental illness are especial populations who are at high risk to develop metabolic syndrome due to poor nutritional habit, more prone to substance intake (smoking), poor life style and taking medicines (the single most important factor)especially antipsychotics that can cause weight gain or changes in blood pressure, blood cholesterol, and blood sugar levels [6,9].Even though the mechanism is not clearly understood, mental illness has an a role in increasing the risk of metabolic syndrome. Psychiatric condition co-morbid with metabolic syndrome is strongly associated with increasing of mortality and morbidity. Persons with major mental disorders lose up to 30 years of potential life lost in comparison with the general population. Of which, cardiovascular related condition is the primary reason for death.Given the worldwide burden of metabolic syndrome, currently the prevalence of metabolic syndrome among psychiatric patients in low income countries is increasing alarmingly and it is among the reasons that decrease the life expectancy and quality of life of patients with mental illness [10]. However, there is no systematic review and meta-analysis on this topic to inform recommendations to the regional and international health policies. Therefore, estimating the pooled prevalence and identifying the associated factors of metabolic syndrome among psychiatric patients in sub-Saharan regional level will potentially support the policymakers in addressing the burden. We, therefore, conducted a systematic review and meta-analysis of studies on metabolic syndrome among patients with mental illness and systematically summarized the epidemiology and tried to identify the main factor affecting metabolic syndrome i.e. Gender, among psychiatric patients in sub-Saharan Africa.

2. Method

2.1. Reporting and registration

This review followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analysis) 2020 statement: an updated guideline for reporting systematic reviews (**Additional file-1**) [11]. Quality of this systematic review was assessed using AMSTAR 2 criteria and it was found to be a high quality review [12]. The study was registered on

Www.researchregistry.org with a unique identification number of researchregistry1124.

2.2. Search methods

In our systematic search both published and unpublished were retrieved if it is related with the prevalence of metabolic syndrome and/ or if female gender is considered for an association among people with mental illness. A systematic literature search was performed using electronic databases like PubMed, CINAHL, Web of science and Global health. Gray literatures were searched from Google and Google scholar. In addition to this, we also performed a search of local (Ethiopian) websites manually. We applied Boolean operator like "AND", "NOT" and "OR". Through consideration of the Boolean operator we searched as follows: ((("metabolic syndrome"[MeSH Terms] OR metabolic syndrome [Text Word]) AND ("mental disorders" [MeSH Terms] OR mental illness [Text Word])) AND ("Africa south of the Sahara" [MeSH Terms]. Based on the above strategies, we have accessed the following articles in number (Table 1).

Table 1
Summary of search results for the PubMed, Google Scholar and other databases.

Databases	Searching terms	Number of studies
Google scholar	Metabolic syndrome or syndrome X among mentally ill patients in sub Saharan Africa	1136
PubMed	Search ((("metabolic syndrome" [MeSH Terms] OR metabolic syndrome [Text Word])) AND ("mental disorders" [MeSH Terms] OR mental illness [Text Word])) AND ("Africa south of the Sahara" [MeSH Terms] Filters: published in the last 10 years	152
From other databases[a]		18
Total retrieved articles		1306
Full text papers appropriate to our review		9

[a] Web of science, CINAHL and global health.

2.3. Eligibility criteria

First duplicated articles were removed after we exported the whole articles to End-Note citation manager. Then we assessed articles thoroughly for the eligibility of articles to be included in this systematic and meta-analysis. Based on the mentioned inclusion and exclusion criteria, abstracts were reviewed from search results.

2.4. Inclusion criteria

Study settings: studies conducted in a wide range of people living with mental illness either from the community or at outpatient level in sub Saharan Africa was in included in this review.

Study design: observational studies (cross-sectional, case-control and cohort studies) having original data reporting the magnitude or burden of metabolic syndrome among mentally ill patients in sub Saharan countries were included.

Language: studies published/written in the English language/having English language version were eligible for this study.

Population: primary studies conducted among adults living with mental health problems were considered for this review.

Publication issue: both published and unpublished primary articles available in the databases.

2.5. Exclusion criteria

Initially, availability of full text titles, and abstracts of the articles were assessed. Then the full papers of relevant articles were reviewed. In the full-text evaluation of articles, we considered study settings, study populations, participants' age, and study design, quality of the study and outcomes of interest. Studies conducted among age less than 18 years old, papers out of sub Saharan population or not on people with mental illness, non-observational studies, papers with low quality score and studies that did not have reports of magnitude/prevalence, and/or associated factors of metabolic syndrome were not eligible for this study. In addition, Case reports and case series were excluded from this study.

2.6. Data extraction

Two authors (RH and BM) independently extracted all the necessary data using a standardized data extraction format prepared in Microsoft Excel. The prepared data extraction format, the first single row had different variable of interest (first author name, publication year, name of sub-Saharan country, sample size, response rate, magnitude of metabolic syndrome and diagnostic method) and each section of column were filled with a data from each included studies. To measure the effect

size of female gender on metabolic syndrome, we used a data extraction format prepared in a two by two table in which the odds ratio was calculated based on the findings of the original studies. Disagreements between the authors during data extractions was discussed and reached in to consensus.

2.7. Outcome measurement

There are two main outcomes in this systematic review and meta-analysis study. The first outcome is the prevalence of metabolic syndrome which was estimated as total number of cases having metabolic syndrome divided by the total number of participants with mental disorder in the studies multiplied by 100. Secondly, we have seen gender as a determinant in which the odds ratio was calculated based on binary outcomes from the primary studies. The determinant included in this review was: gender (Female versus Male). In addition, we performed the subgroup analysis based on the diagnostic methods used to quantify metabolic syndrome.

2.8. Risk of bias

Two authors (RH and BM) independently assessed the risk of bias for each article. For assessing the quality of the studies, Newcastle-Ottawa Scale quality assessment tool for cross-sectional studies was adapted [13]. This quality assessment tool has three main categories contain sub subcomponents under each category. Methodological quality and comparability of the included studies were assessed using the first and the second categories, respectively. The last part assessed the quality of primary articles following to their statistical analysis. Using the assessment tool as a guideline, two authors independently evaluated the qualities of the original articles. Quality of each study was evaluated using these parameters; those with medium (fulfilling 50% of quality assessment criteria) and high quality ($\geq$ 6 out of 10 scales) were included for analysis. Disagreements between assessors were solved through discussion and by taking the mean score of their assessment results.

2.9. Data processing and analysis

After extraction, the data were imported directly to STATA Version 14.0 statistical software for analysis from Microsoft Excel data extraction format. The standard error of prevalence for each study was calculated using the binomial distribution formula. Heterogeneity among reported prevalence was assessed by using I^2 test static and its p value [14]. As a result, the test statistic showed as there is significant heterogeneity among the studies except primary articles assessed by JIS criteria to assess level of metabolic syndrome. A random effects meta-analysis model was executed to estimate the pooled effect size of metabolic syndrome and it association with gender among people with mental illness [15]. To reduce the random effect variations between the point estimates of the primary studies, a subgroup analysis was done based on method of diagnosis of metabolic syndrome. Egger's test at 5% significant level and funnel plot was used to assess publication bias. The test results showed that there was no small study effect in the included primary studies as it has evidenced with P = 0.889 and there was relatively symmetrical distributions of studies in the funnel plot test.

3. Result

3.1. Search results

In the initial step of the screening, we have accessed a total of 1306 articles (pub med = 152, Google scholar = 1136, CINAHL = 4, Global health = 5 and web of science = 9). Of these, 627 articles were excluded due to duplication. During the titles and abstract assessment 666 papers were excluded. Thirteen full text papers were screened for suitability but

3 of them do not report the outcome of interest for our study and the other one has different study population. The quality of 9 full text papers was assessed. Finally, 9 studies were included for meta-analysis (Fig. 1).

3.2. Study characteristics

All the included nine studies were cross sectional studies in their design. These studies were conducted across different countries of sub-Saharan Africa (two primary articles from Ethiopia [16,17], three from South Africa [18–20], two studies from Nigeria [21,22] and the rest two were from Ghana [23] and Uganda [24]. The sample size of primary studies included in this review was considerably variable ranging 88 to 450 participants (Table 2).

The burden of metabolic syndrome among patients with mental illness was varied considerably across different sub-Saharan studies as it is measured by various method of diagnosis.The highest prevalence of metabolic syndrome was 32.0% as reported by a study conducted in South Africa [20]and the smallest prevalence of metabolic syndrome was 11.3% reported from a study conducted in Ghana [23].

Regarding the techniques used by primary studies to screen out metabolic syndrome among psychiatric patients, three studies used the 2009 joint interim statement only. Three studies used national cholesterol education programme adult treatment panel III (NCEP-ATP III) only. Other three studies used both international diabetes federation (IDF) and national cholesterol education programme adult treatment panel III (NCEP-ATP III) criteria's to diagnose metabolic syndrome.

3.3. Risk of bias

All included studies were assessed for risk of bias using Newcastle-Ottawa quality assessment tool for cross sectional study and all nine of them have a good quality (>6/10).

3.4. Metabolic syndrome

The result of this meta-analysis indicated that there was a slight variability of between reports of primary studies regarding the magnitudes of metabolic syndrome depending on the difference of screening tools/techniques used to measure it. Studies that used international diabetic federation (IDF) showed a relatively high prevalence (23.77%) of metabolic syndrome among psychiatric patients, and the lowest prevalence (21.11%) of metabolic syndrome was observed among studies used the 2009 joint interim statement (JIS) method of diagnosis to measure metabolic syndrome (Fig. 2).

Presence of publication bias was evaluated by using Funnel plot. The result of funnel plot showed that there was relatively symmetrical distribution for metabolic syndrome across included articles (Fig. 3).

3.5. Female gender as a predictor of metabolic syndrome

From the total of 9 primary articles included in this systematic review and meta-analysis, five studies (55.5% of the included studies) reported female gender as a predictor of metabolic syndrome among patients with mental illness. Although there were numerous factors being reported as predictors of metabolic syndrome among patients with mental illness, several factors were found inconsistent or infrequent and used variety of variable categories across the included studies to determine for metabolic syndrome. Gender as a variable, clearly depicted across various studies as a determinant. In this study, female gender increases the likelihood of metabolic syndrome by three fold among patients with mental illness in Sub-Saharan Africa countries (Fig. 4).

4. Discussion

As per the authors' review, this is the first systematic review and meta-analysis in sub-Saharan Africa to estimate the pooled prevalence
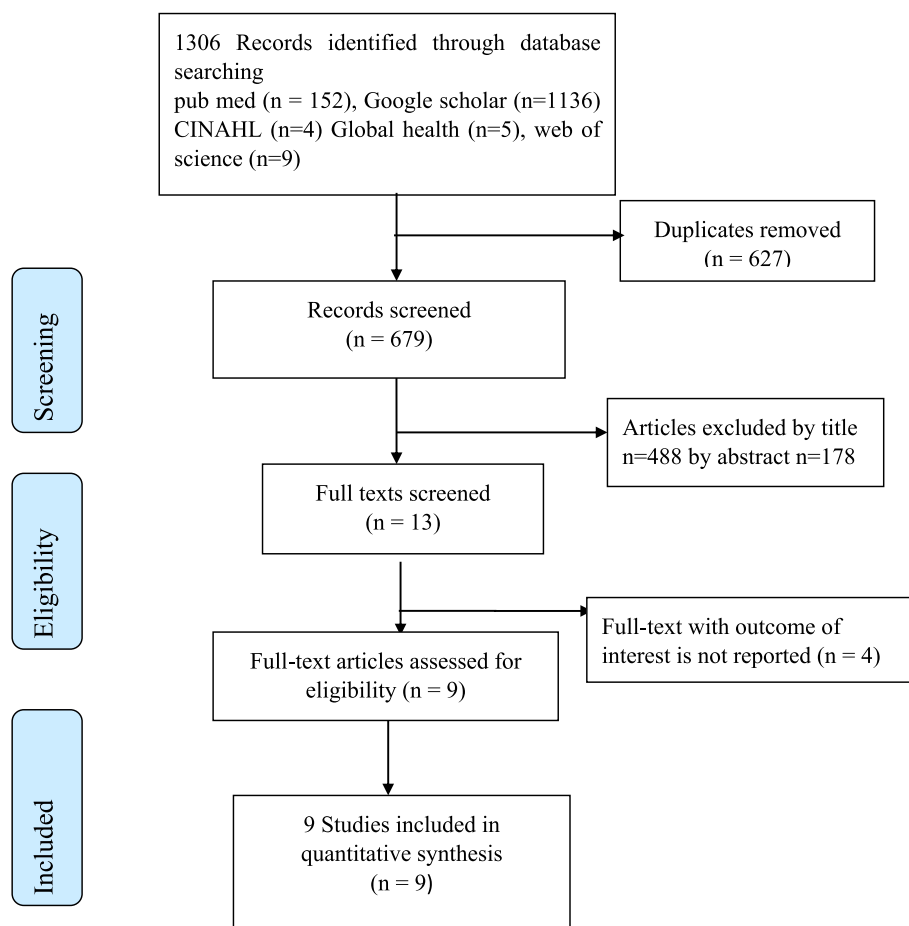
Fig. 1. PRISMA flow diagram showing data extraction process for systematic review and meta-analysis of the metabolic syndrome among peoples with mental illness and its association with gender in sub Saharan Africa.

Table 2
Summary description of 9 studies included in the systematic review and meta-analysis of metabolic syndrome among peoples having mental disorder and its association with gender in sub Saharan Africa.

Author	Year	Country	Sample size	Study design	Prevalence of MetS based on diagnostic methods (%)		
					JIS	NCEP ATP III	IDF
Saloojee et al.	2016	South Africa	276	Cross sectional study	23.2	–	–
Teshome et al.	2020	Ethiopia	250	Cross sectional study	–	24.5	26.9
Asaye et al.	2018	Ethiopia	360	Cross sectional study	–	22.2	28.9
Akinlade et al.	2016	Nigeria	124	Cross sectional study	20.2	–	–
Saloojee et al.	2017	South Africa	232	Cross sectional study	19.4	–	–
Lawani et al.	2009	Nigeria	61	Cross sectional study	–	18.9	
Owiredu et al.	2012	Ghana	200	Cross sectional study	–	11.3	15.5
Maaroganye et al.	2013	South Africa	90	Cross sectional study	–	32	–
Agaba et al.	2019	Uganda	304	Cross sectional study	–	23.5	–

and investigating the relation of gender with metabolic syndrome among patients with mental illness. The result of this systematic review has a remarkable importance to improve the quality of care for people suffering from metabolic syndrome with mental illness by depicting the pooled estimate and the determinant factors of metabolic syndrome among patients with mental illness and suggesting possible strategies to improve the treatment facilities and qualities. Moreover, the review and meta-analysis can have clinical importance and potential policy response for health care systems (Qualifying and improving Bio Psychosocial treatment approach for patients with mental illness whom develops metabolic syndrome). Therefore, treating mentally ill patients whom develop metabolic syndrome is crucial, and also a challenging duty that needs holistic and collaborative efforts from multi-sectored or discipline dimensions.

Although metabolic syndrome was assessed using different assessment criteria in which the findings of our current systematic review and meta-analysis showed that nearly one fourth of patient with mental illness have metabolic syndrome in Sub-Saharan Africa.

The finding of the current systematic review and meta-analysis reported a lower magnitude of metabolic syndrome among patients with mental illness as compared to other review conducted worldwide excluding African countries (32.6%) [25]. The possible explanation for the variation is consistent enough with the evidences as explained the significant burden of metabolic syndrome is found in developed countries (westerns) as compared to developing nations [26]. Lifestyle and nutrition difference could be also the possible reasons for the variation
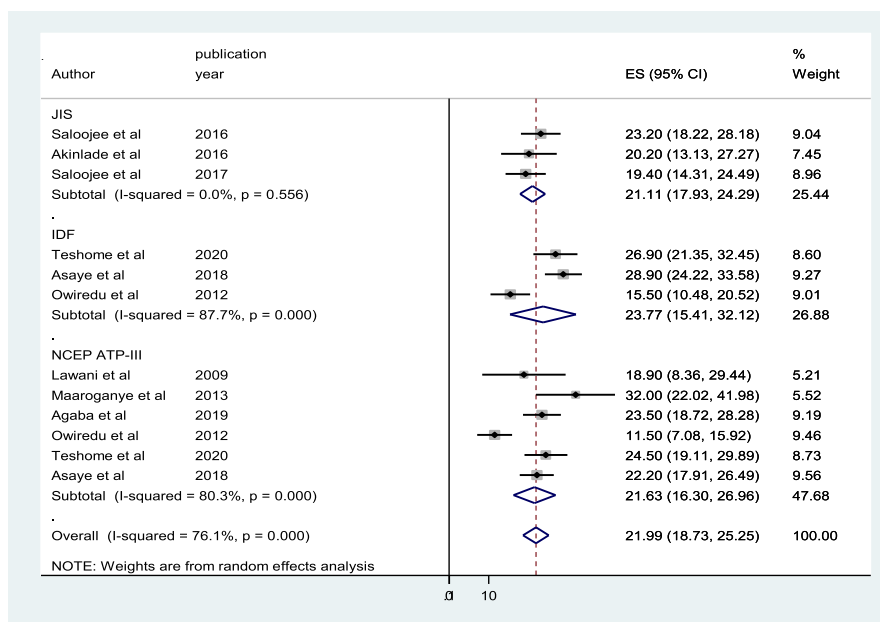
Fig. 2. Pooled prevalence rate of metabolic syndrome among patients with mental illness in sub-Saharan Africa.
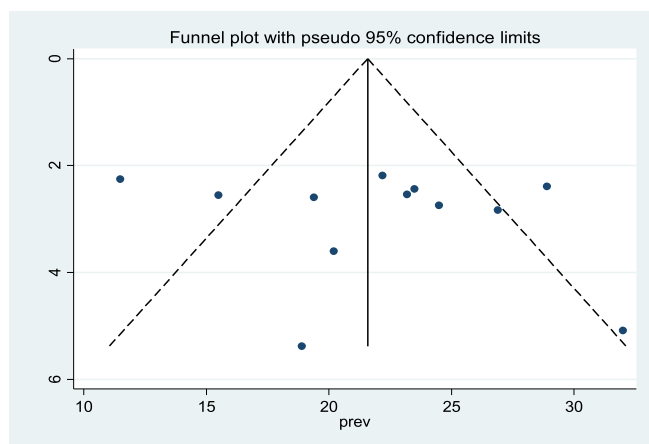

Fig. 3. Funnel plot showing the distribution of included studies on metabolic syndrome among patients with mental illness in sub-Saharan Africa.

of burden of metabolic syndrome. The other reason could be difference in population composition and using various diagnostic criteria could be also a reason for the variation of summary findings of metabolic syndrome prevalence rate among patients with mental illness.

Regarding the relation between metabolic syndrome and gender among mentally ill patients, being female signify that it increase in three folds of developing metabolic syndrome among patients with mental illness as compared to their counterparts (males) in sub-Saharan Africa. Regarding gender, the results show that showed that females had higher likelihood of being diagnosed with metabolic syndrome when compared to males. Different reviews done elsewhere among apparently healthy people showed similar results [27–30]. The possible reason for the observed finding might be the additional risk females may have due to increased body weight, increased waist circumference, and reduced low high density lipoprotein compared to male gender [31–34]. Another main reason could be gender specific factors for instance use of hormonal contraceptives and menopause which may increase the risk of metabolic syndrome in females [30].28 Another possible explanation may be, epidemiologically females are more prone to develop mood

disorders in which the illness and its treatment has direct and indirect contribution for risks of metabolic syndrome [35]. Therefore, this implies that gender-related clinical, psychosocial interventions and research activities are very essential.

4.1. Limitations of the study

Inclusion of articles written in English only was only among the limitations of this study. This meta-analysis represented study reported from few countries of the region, which may reflect as under-representation.

5. Conclusion

The prevalence of metabolic syndrome among mentally ill patients is sub Saharan Africa is high. The likelihood of metabolic syndrome is significantly increased in females than males. Focusing on gender-related clinical, psychosocial interventions and research activities are very essential.

Ethical Approval

Not applicable.

Sources of funding

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Authors' contributions

RK conceived the idea. RK and BM done data extraction, and analysis. All authors have contributed to the analysis, writing, drafting, and editing. All the authors read and gave final approval for the manuscript.

Research registration number

1. Name of the registry: Research Registry.
2. Unique Identifying number or registration ID: reviewregistry1124.

Study

ID   OR (95% CI)

Saloojee et al (2016)   3.41 (1.91, 6.09)

Agaba et al (2019)   1.78 (1.02, 3.10)

Teshome et al (2020)   1.88 (1.04, 3.38)

Asaye et al (2018)   4.25 (2.63, 6.87)

Saloojee et al (2017)   5.25 (2.62, 10.50)

Overall (I-squared = 62.1%, p = 0.032)   3.00 (1.98, 4.55)

NOTE: Weights are from random effects analysis
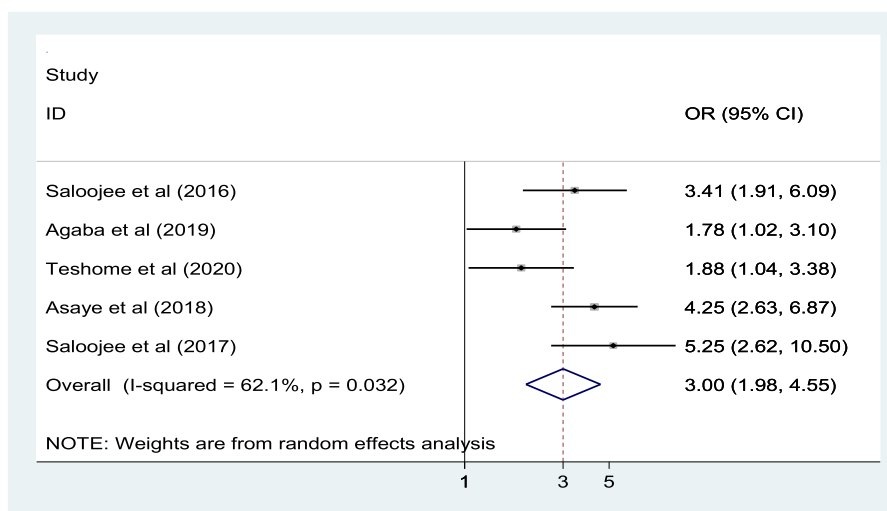
1   3   5

Fig. 4. Female gender as a predictor of metabolic syndrome among patients with mental illness in Sub-Saharan Africa.

3. Hyperlink to your specific registration (must be publicly accessible and will be checked): https://www.researchregistry.com/browse-the-registry#registryofsystematicreviewsmeta-analyses/.

Guarantor

Robel Hussen Kabthymer.

Consent for publication

Not applicable.

Availability of data and materials

Data will be available upon reasonable request of the corresponding author.

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Declaration of competing interest

Authors declare that they have no conflict of interest

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List of abbreviations

CI	Confidence interval
EDHS	Ethiopian demographic health survey
IDF	International diabetic federation
JIS	Joint interim statement
NCEP-ATP III	National cholesterol education programme adult treatment panel III
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
WHO	World health organization

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.amsu.2021.102351.

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