

# Eye care service utilization and associated factors among diabetic patients in Africa: A Systematic Review and Meta-Analysis

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## ABSTRACT

**Introduction:** 'Vision 2020, the Right to Sight', jointly coordinated by the World Health Organization's program for the prevention of blindness and deafness and the international agency for the prevention of blindness, was launched in 1999, however, the initiative faces many challenges to hitting its target. One of the challenges for this is, the absence of comprehensive data regarding eye care service utilization among diabetes mellitus patients in Africa. Therefore, this study was aimed at assessing the prevalence of eye care service utilization and associated factors among adult diabetes mellitus patients in Africa.

**Methods:** This systematic review and meta-analysis was conducted as per the international preferred reporting items for systematic review and meta-analysis protocols (PRISMA) guidelines. Published articles were searched using reputable databases (PubMed, Cochrane Library) and Web searches (Science Direct, African Journals Online, and Google Scholar). Quality appraisal was assessed based on the Joanna Briggs Institute's (JBI) critical appraisal checklist. The extracted data was exported to STATA version 11 (STATA Corp., LLC) for further analysis. Heterogeneity between the results of primary studies was assessed using Cochran's Q chi-square test and quantified with the  $I^2$  statistics. Publication bias was assessed by visual inspection of the funnel plot and Egger's regression tests.

**Results:** The database search found 26,966 articles. The pooled prevalence of eye care service utilization among diabetic patients in Africa is found to be 40.92 % (95 % CI: 27.14–54.70,  $P < 0.001$ ). Good knowledge (POR = 3.57, 95 % CI: 2.67–4.76), good attitude (POR = 5.68, 95 % CI: 4.20–7.68), age greater than 65 years old (POR = 7.11, 95 % CI: 3.86–13.10), urban residence (POR = 5.03, 95 % CI: 2.12–11.96), and disease duration greater than 6 years (POR = 3.81, 95 % CI: 2.25–6.45) were factors associated with eye care service utilization.

**Conclusion:** This meta-analysis revealed that a high proportion of people with diabetes failed to use eye care services. Older age, good knowledge, urban residence and longer duration of illness were found to be the contributing factors for the utilization of eye care services in diabetes mellitus patients. Therefore, by considering the negative impact of low eye care service utilization, it is important to improve the habit of regular screening of the eye into routine assessment of diabetes mellitus follow up targeting patients with older age and longer duration of illness to reduce the magnitude of the problem.

## 1. Introduction

Diabetes mellitus (DM) is a group of metabolic disorders characterized by an elevated level of glucose in the blood as a result of a defect in insulin secretion, insulin action, or both [1]. The magnitude of DM is increasing worldwide, especially in developing countries [2]. The global estimation of people living with DM was 451 million in 2017, and this magnitude will increase to 693 million by 2045. The cost of health care

needed for DM reached 162 billion dollars in 2019 and will be 185 billion dollars in 2045 [3,4]. Eye related complications like retinopathy, dry eye, refractive error, cataract and glaucoma are more common among people living with DM than in patients without DM as a result of capillary basement membrane thickening in the eye [5].

Globally, around 37 million people suffer from blindness. Of these, 4.8 % are due to diabetes related retinopathy [6]. The magnitude of diabetes-related retinopathy in Africa was estimated to be 31.6 % [7].

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Eye care service utilization is the use of available services provided by health professionals to prevent and control diabetes related eye complications and promote eye health [8,9]. Timely and recommended utilization of eye care services is vital for the early detection and prevention of visual impairment in diabetic patients [5]. Diabetes related retinopathy, cataract and glaucoma are asymptomatic during their starting phase, which leads to them being left undiagnosed early [10]. Diabetic patients living in low and middle income countries utilize eye care services only when the complication becomes irreversible and sight threatening [10]. The American Academy of Ophthalmology mandates routine and timely eye care service utilization especially for patients living with type 2 diabetes at the time of diagnosis and within 3–5 years after type 1 diabetes diagnosis [11].

Eye care service utilization is limited in developing countries, even in countries where the service is satisfactory. This is the major factor for 36 million worldwide cases of preventable blindness [12,13]. Research conducted in developed nations, including Europe, and the United States of America, revealed that utilization of eye care services among diabetic patients ranges from 30 to 91.3 % [14,15]. Other research findings from Asian countries showed that 15.3 %–67 % of diabetic patients used eye care services [16,17]. In general, comprehensive eye screening programs and eye checkup practices are crucial health promotion and prevention measures to lessen late complications that result in vision loss and impairment [18]. According to available research, managing diabetes mellitus properly, utilizing of eye care services, and identifying and treating abnormalities early will reduce the progression of sight threatening eye complications [19,20].

According to the American Diabetes Association (ADA), retinopathy screening should be conducted three to five years after type 1 DM onset and at least immediately after type 2 DM diagnosis, and both types of diabetes should get routine eye examinations at least once a year [21, 22].

Studies on the use of eye care services revealed that factors that negatively impacted the use of eye care services included lack of health insurance, absence of visual symptoms, poor knowledge of diabetic ocular complications, and a negative attitude toward the necessity of routine eye exams [23–25]. Due to the high cost of care, diabetes-related visual impairment places a heavy financial burden on patients and their families. However, it also has a substantial economic impact on entire countries and their health care systems [5].

Determining the prevalence of eye care service utilization and associated factors will help as an input when health programmers plan prevention and elimination strategies for modifiable risk factors for poor eye care service utilization. 'Vision 2020, the Right to Sight', jointly coordinated by the World Health Organization's program for the prevention of blindness and deafness and the international agency for the prevention of blindness, was launched in 1999, however, the initiative faces many challenges to hitting its target [26]. One of the challenges for this is the absence of comprehensive data regarding eye care service utilization among DM patients in Africa. Therefore, this study was aimed at assessing the prevalence of eye care service utilization and associated factors among adult diabetes mellitus patients in Africa.

## 2. Materials and methods

This systematic review and meta-analysis was conducted as per the international preferred reporting items for systematic review and meta-analysis protocols (PRISMA) guidelines [27] (Supplementary file 1).

## 3. Study setting

This systematic review and meta-analysis on the eye care service utilization and associated factors among DM patients was conducted in African countries.

## 4. Searching strategy of articles

Published articles were searched using the following major electronic databases: reputable databases (PubMed, Cochrane Library), Web searches (Science Direct, African Journals Online, and Google Scholar). All published articles up to February 25, 2024 were included in the review. The search terms were organized following the Medical Subject Headings thesaurus (MESH) using the following terms: "eye care service utilization", OR "compliance to eye care service", OR "eye check-up practice", OR "use of eye care service", OR "adherence to eye care service", AND "diabetes mellitus", AND "determinant factors", OR "associated factors". The search was performed by two authors (WCT and YAF). Snow ball technique from searched articles also used to identify any studies that are not retrieved from electronic databases.

## 5. Eligibility criteria

Cross-sectional and case control studies which report the prevalence of eye care service utilization and associated factors among diabetic patients in any African countries, medium and high qualified articles and published in peer-reviewed journals with English language were included in our review. But studies which are failed to report the prevalence of eye care service utilization, case reports, abstracts and unpublished studies were our exclusion criteria.

## 6. Outcome of interest

The main outcome of interest for this review was the prevalence of eye care service utilization defined in primary studies as if the individual reported that he/she had visited eye care service providing center for eye checkup/examination or for eye problem at least once, within the past 2 years, it was considered as he/she utilized eye care service for this study [28]. For the analysis of the secondary outcomes (factors), we extracted data on factors that were associated with eye care service utilization in primary studies. In examining factors associated with eye care service utilization, data was used from Adjusted Odd Ratio (AOR) of primary studies to find the association between the independent variables and eye care service utilization.

## 7. Article selection and data extraction

All retrieved articles by electronic databases were exported to EndNote X7. After excluding duplication, two authors (AMZ and YAF) independently screened and ineligible articles were further excluded. The full texts of selected articles were retrieved and read thoroughly to ascertain their suitability before data extraction. Articles that fulfilled the eligibility criteria used as sources of data for analysis. Data extraction was done by two authors (WCT and YAF) using standard Microsoft excel format. Data extraction form included the following study characteristics: corresponding author name, publication year, study setting, study design, sample size, participants/response rate, sampling technique, data collection method, prevalence of eye care service utilization and associated factors. Disagreements were solved by discussion with the third author (AMZ).

## 8. Quality appraisal

Quality appraisal was assessed based on Joanna Briggs Institute (JBI) critical appraisal checklist for analytical cross-sectional study using 9 criteria [29]. The checklist consists of nine items: [1] Was the sample frame appropriate to address the target population? [2] Were study participants sampled appropriately? [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 an appropriate statistical analysis? [9] Was the response rate adequate? For each question, a score was assigned (0 for 'not reported or not appropriate' and 1 for 'yes'); the scores were summarized across the items to get a total quality score that ranged from 0 to 9. Studies were then classified as having a low, medium and high quality when the awarded points become 0–4, 5–7 and 7–9, respectively.

## 9. Statistical analysis

### 9.1. Heterogeneity test

The extracted data was exported to STATA version 11 (STATA Corp LLC) for further analysis. Heterogeneity between the results of primary studies was assessed using Cochran's Q chi-square test and quantified with the  $I^2$  statistics. A p-value of less than 0.05 was considered to suggest statically significant heterogeneity. Heterogeneity had taken low, moderate, and high categories when the  $I^2$  values were below 25 %, between 25 % and 75 %, and above 75 %, respectively [30,31]. Thus, the random effect model was used to pool the prevalence of eye care utilization among DM patients since the studies were found heterogeneous. Random effect model specifically DerSimonian and Laird (D + L) pooled estimate method was used due to the presence of high heterogeneity between the included articles [32]. To investigate the source of heterogeneity, the random-effects meta-regression was conducted by taking primary study characteristics such as publication year, sample size, and participants/response rate. Subgroup analyses by study setting and sampling techniques were carried out because of significant heterogeneity between studies (i.e.,  $I^2 = 87.7$  %,  $p < 0.05$ ).

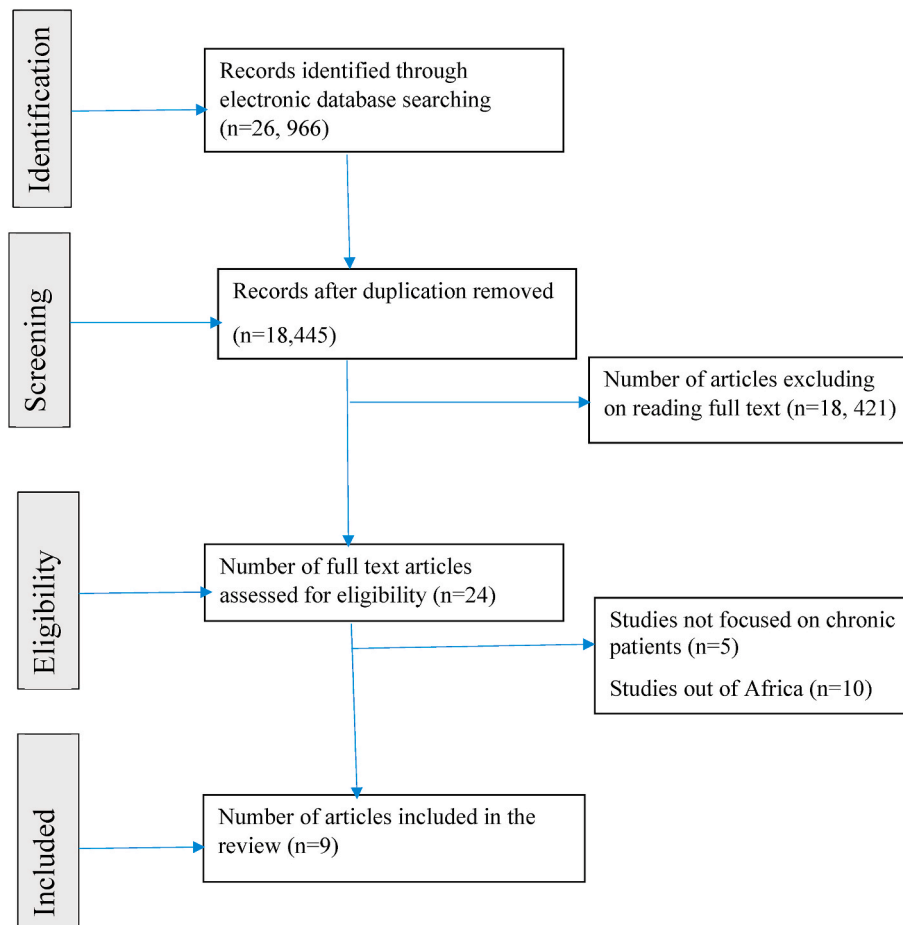
### 9.2. Publication bias

Publication bias was assessed by visual inspection of funnel plot based on the shape of the graph (subjective assessment). The symmetrical graph was interpreted to suggest an absence of publication bias, whereas an asymmetrical one indicates the presence of publication bias. On the other hand, qualitatively (objective assessment), Egger's regression tests was used to assess publication bias with a p-value less than 0.05 considered as indicative of a statistically significant publication bias [33].

## 10. Results

### 10.1. Study selection

The database search found 26,966 articles. Of these 23,300 were from Google scholar, 127 from PubMed, 3451 from science direct, 81 from African journal online and 7 from Cochrane library. After reading the titles and abstracts, we excluded 8521 articles due to duplication. In screening of remaining 18,445, we excluded 18,421 articles because their outcomes were not similar with our study and conducted study population different from ours. The full-text of the remaining 24 articles were assessed for eligibility and quality. Additionally, an article was excluded because its outcomes variable was not reported and conducted out of Africa. The remaining 9 studies were included in the analysis (Fig. 1).



**Fig. 1.** PRISMA flow diagram for a systematic review and meta-analysis of Prevalence and associated factors of eye care service utilization among diabetic patients in Africa (N = 9).

## 10.2. Baseline characteristics of the included publications

Nine published articles were included in this systematic review and meta-analysis. The number of participants in each study ranged from 92 to 546. All studies were cross-sectional design to estimate eye care service utilization. The included articles were published between 2007 and 2022. From the included articles 3 studies are from Ethiopia [34–36], 2 are from Nigeria [23,37] and the remaining are from South Africa, Kenya, Ghana and Tanzania [38–41]. All the studies published in peer-reviewed journals (Table 1).

## 10.3. Quality of the included studies

Based on the quality rating, (77.78 % [n = 7]) of the articles demonstrated high quality, having recorded a score of 8–9 and two studies has medium quality scored 6. The qualities of each of the included studies was evaluated using the nine items of Joanna Briggs Institute (JBI) critical appraisal checklist. Detailed results of the quality assessment of the studies is presented in supplementary file (Supplementary file 2)

## 10.4. Publication bias

We used a Funnel plot and Egger's test to check the presence of publication bias. The Funnel plot is symmetrical (Fig. 2), and Egger's test result was not significant (p-value = 0.825), indicating that there is no publication bias among the included studies

## 10.5. Meta-analysis

The pooled prevalence of eye care service utilization among diabetic patients in Africa is found to be 40.92 % (95 % CI: 27.14–54.70,  $P < 0.001$ ). The analysis showed that there is high heterogeneity between the included articles ( $I^2 = 87.7$  %,  $P < 0.001$ ). As a result, random effect model specifically DerSimonian and Laird (D + L) pooled estimate method was used to estimate the pooled prevalence of eye care service utilization (Fig. 3).

## 10.6. Sub-group analysis

Since there is a high level of heterogeneity in this review, subgroup analysis was done by considering the sampling procedure as a grouping variable. The result showed that the highest prevalence of eye care utilization is reported in articles that used consecutive sampling (46.40 % (CI: 32.7, 60.1) and low prevalence is reported in articles that used simple random sampling (27.25 % (CI: 24.02, 30.48) (Fig. 4).

## 10.7. Sensitivity analysis

Due to the high heterogeneity of results, a sensitivity analysis was done by applying a random effects model. The analysis was done to evaluate the effect of each study on the pooled prevalence of eye care

service utilization by excluding each study step-by-step. Its results showed that the omitted studies did not have a significant effect on the pooled prevalence of eye care service utilization among DM patients (Fig. 5).

## 10.8. Associated factors of eye care service utilization

The pooled estimate showed a significant association between knowledge and eye care service utilization. Patients who had good knowledge are 3.57 times more likely to utilize eye care service as compared to their counterparts [POR = 3.57, 95 % CI:(2.67–4.76)]. In the random-effects model, no heterogeneity was observed among studies, ( $I^2 = 0.00$  %) (Fig. 6).

In a meta-analysis of two studies, attitude was found to be significantly associated with eye care service utilization. Patients who had good attitude were 5.68 times more likely to utilize eye care service as compared to their counterparts (POR = 5.68, 95 % CI: 4.20–7.68). There was no heterogeneity between studies in the model ( $I^2 = 0.00$  %) (Fig. 7).

To estimate the association between age and eye care service utilization, two studies were included. The random pooled effect of these showed that patients whose age greater than 65 years old were 7.11 times (POR = 7.11, 95 % CI: 3.86–13.10) more likely to utilize eye care services as compared to participants aged less than and equal to 65 years old. Moderate heterogeneity was observed from the random effects model ( $I^2 = 55.8$  %) (Fig. 8).

To estimate the association between duration of DM and eye care service utilization, three studies were included. The random pooled effect of these showed that patients who had disease duration greater than 6 years were 3.81 times (POR = 3.81, 95 % CI: 2.25–6.45) more likely to utilize eye care service as compared to patients who had disease duration less than 6 years. Moderate heterogeneity was observed from the random effects model ( $I^2 = 50.2$  %) (Fig. 9). The random pooled estimate of two studies showed that urban residence was associated with eye care services utilization. The result revealed that patients living in urban area were 5.03 times (POR = 5.03, 95 % CI: 2.12–11.96) more likely to utilize eye care services than patients living in rural area (Fig. 10).

## 11. Discussion

To the best of our knowledge, this is the first systemic review and meta-analysis study conducted to show the pooled prevalence of eye care service utilization and factors associated with it in Africa among patients living with diabetes. This study identified that the pooled prevalence of eye care service utilization among diabetic patients in Africa was found to be 40.92 % (95 % CI: 27.14–54.70,  $P < 0.001$ ). This finding is supported by systemic review studies done in Maryland 47.89 % [42] and India 35.5 % [43].

The result of this review is higher than those of studies done in China 11.4 % [44] and Korea 29.5 % [45]. However, the result of this study is lower than the result of studies done in China 56.8 % [46], Turkey 77.3

**Table 1**

Baseline characteristics of the included articles on the prevalence and associated factors of Eye care service utilization among diabetic patients in Africa (N = 9).

Author	Pub Year	Country	Study Design	Study Population	SS	Prevalence (%)	Sampling technique
Fekadu et al. [34]	2022	Ethiopia	IBCS	DM patients	424	75.9	systematic random
Ahmed et al. [35]	2021	Ethiopia	IBCS	DM patients	546	31.5	systematic random
Assem et al. [36]	2020	Ethiopia	IBCS	DM patients	238	39.6	systematic random
Akufo et al. [38]	2020	South Africa	IBCS	DM patients	325	49	census based
Akrofi et al. [40]	2021	Ghana	IBCS	DM patients	360	21.7	systematic random
Mwangi et al. [39]	2017	Kenya	IBCS	DM patients	270	25.6	simple random
Mumba et al. [41]	2007	Tanzania	IBCS	DM patients	316	59.1	consecutive
O.H. Onakpoya et al. [23]	2010	Nigeria	IBCS	DM patients	92	28.9	simple random
E. O. Achigbu et al. [37]	2016	Nigeria	IBCS	DM patients	103	31.1	consecutive

\*IBCS, Institutional Based Cross-Sectional Study, SS, sample size.

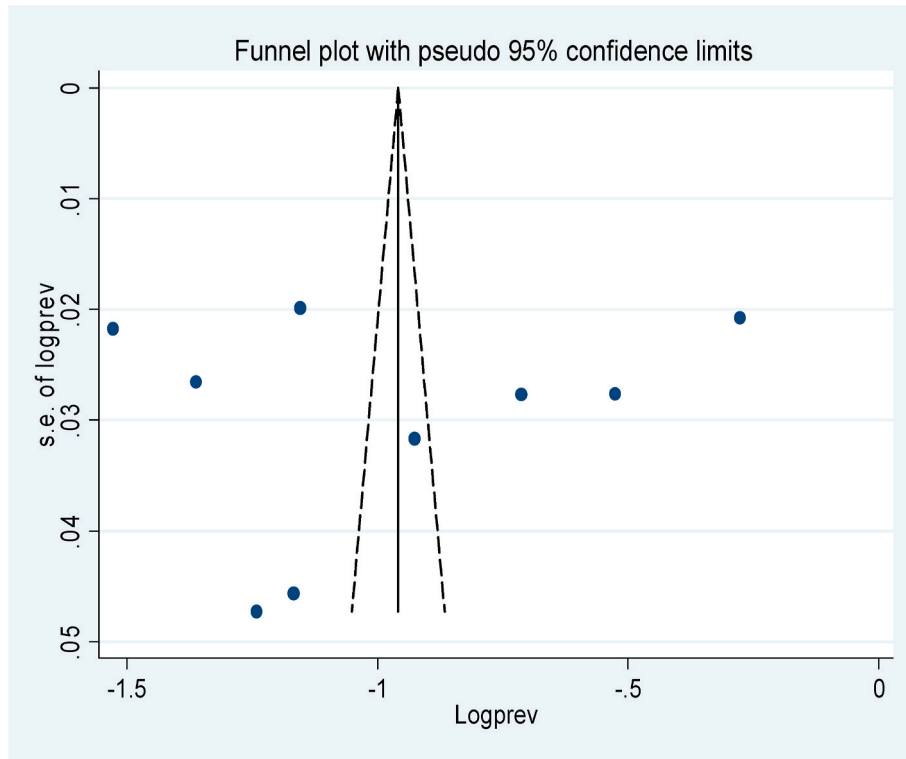


Fig. 2. Funnel plot assessed for publication bias in 9 studies.

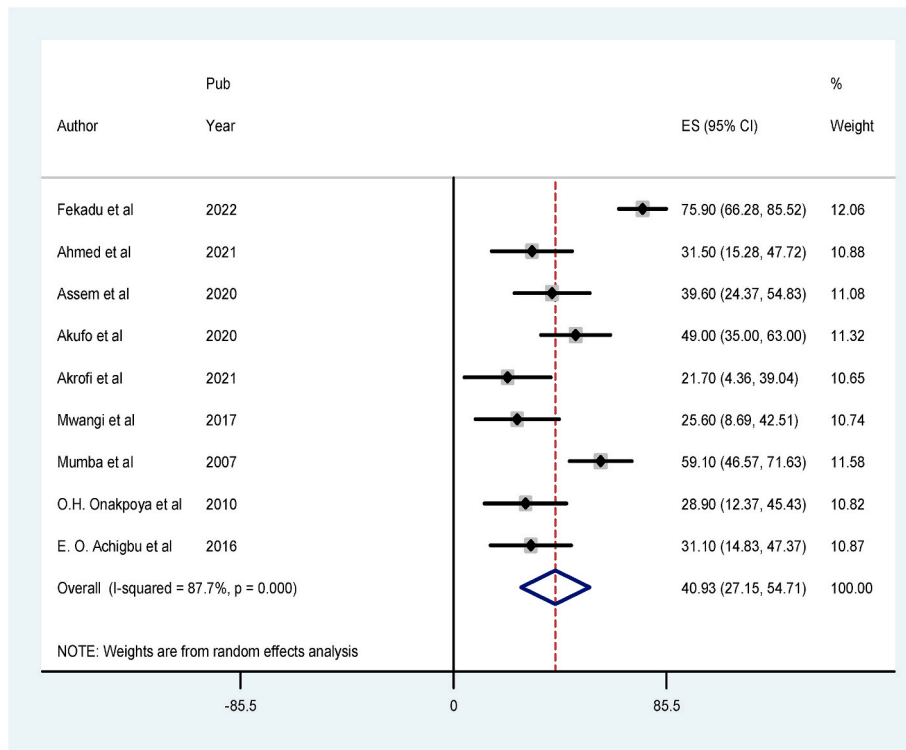


Fig. 3. Forest plot indicating pooled prevalence of eye care service utilization among diabetic patients in Africa (N = 9).

% [47], Canada 57 % [48], America 53 % [49], Germany 56 % [15] and USA 65 %, 72.2 % [14,50]. The discrepancy might be due to differences in the study setting and socio-economic status of the study participants, and operational definitions employed. The other reason for this discrepancy could be due to difference in demographic, exposure and

socio-economic behavior of the study participants. For instance, the studies done in the USA and Germany were done on the elderly population. This leads to overestimating the result since ocular diseases are more likely to occur in an older diabetic patient, which results in a better chance of an eye examination.

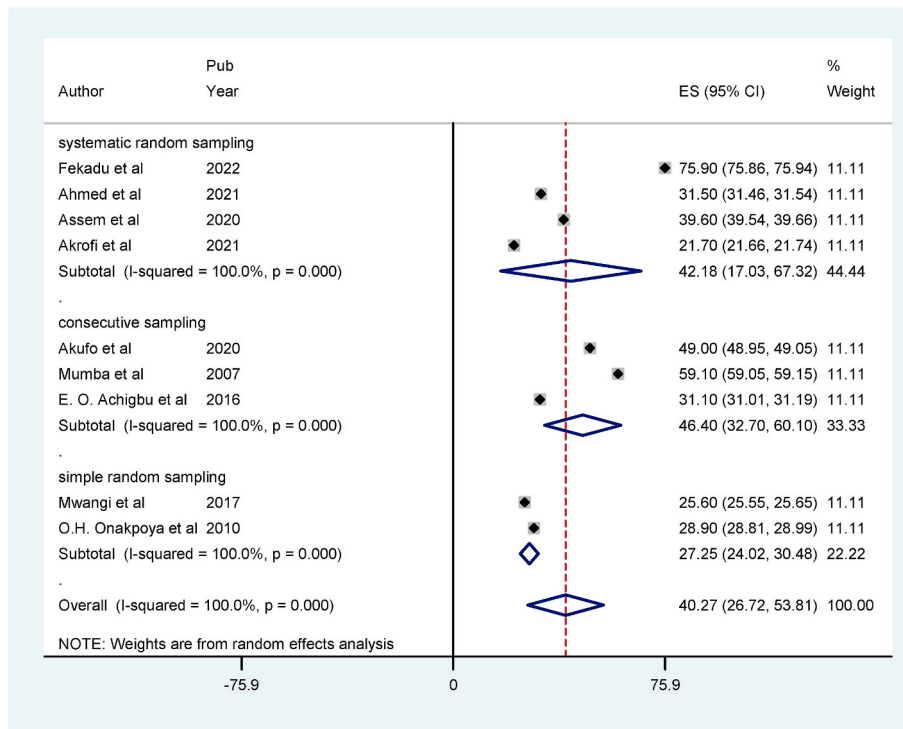


Fig. 4. A forest plot showing sub-group analysis based on sampling procedures.

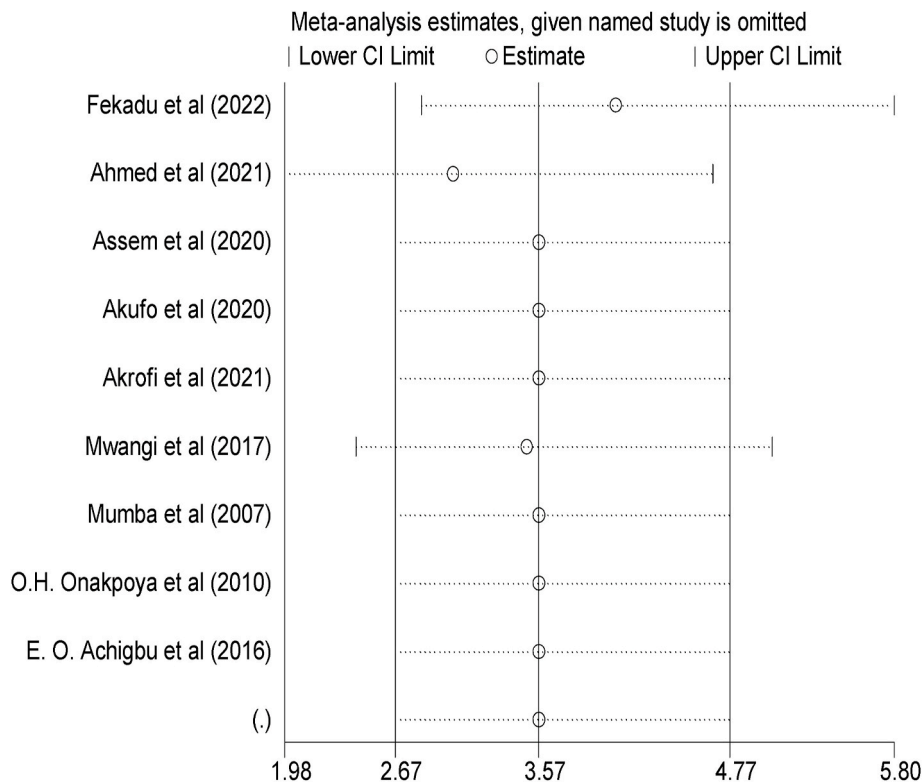


Fig. 5. Results of the sensitivity analysis of the 9 studies.

Patients who have a good knowledge are more likely to utilize eye care services as compared to their counterparts. This finding is in line with studies conducted in Turkey [51] and China [17]. The possible justification for this might be due to patients having good knowledge about diabetic related eye complications which led them to decide to

utilize eye care service to know the status of their eyes. Patients who have a good attitude were more likely to utilize eye care services as compared to their patients with a poor attitude. This finding is consistent with studies done in China [52] and Alabama [53]. Unfavorable attitudes regarding diabetic-related eye complications and other ocular



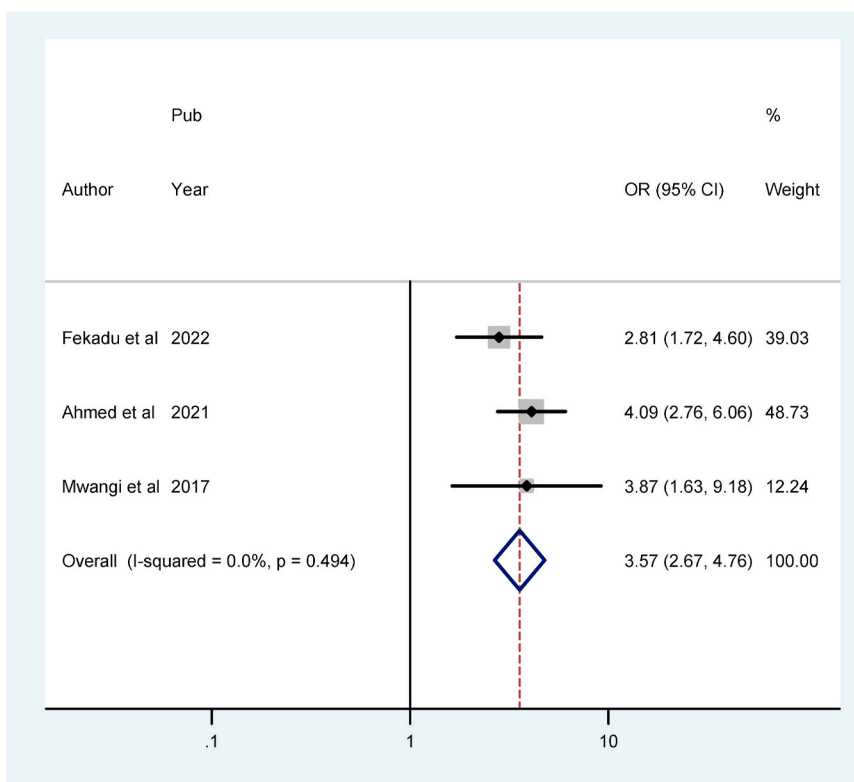


Fig. 6. Forest plot showing the pooled odds ratio of the association between good knowledge and eye care service utilization.

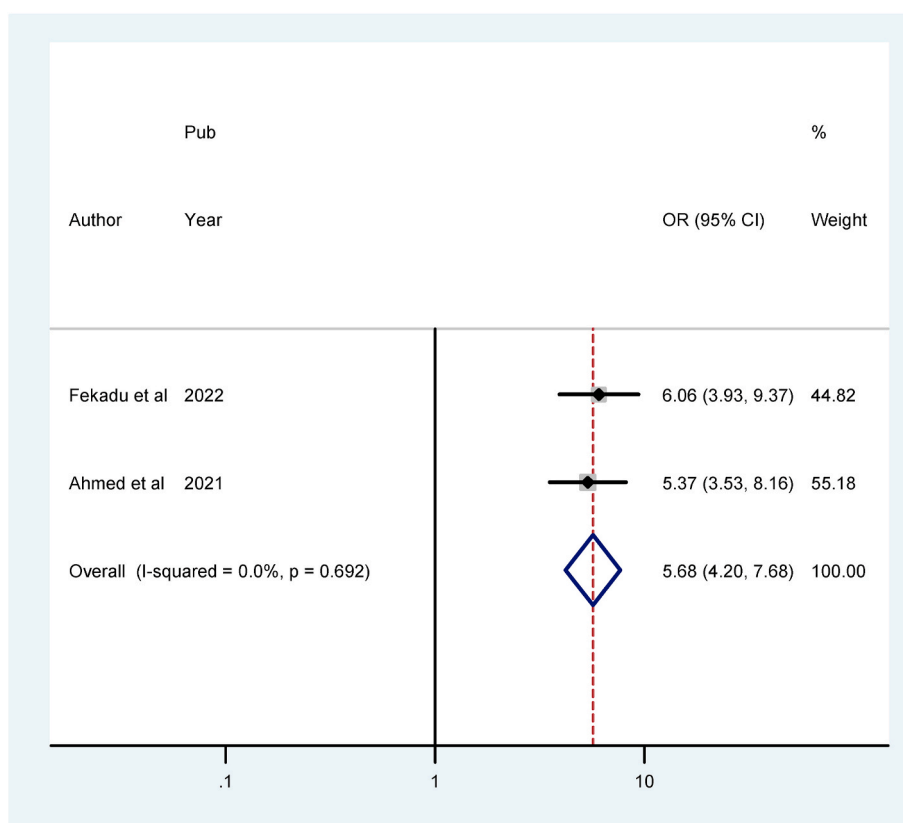


Fig. 7. Forest plot showing the pooled odds ratio of the association between good attitude and eye care service utilization.

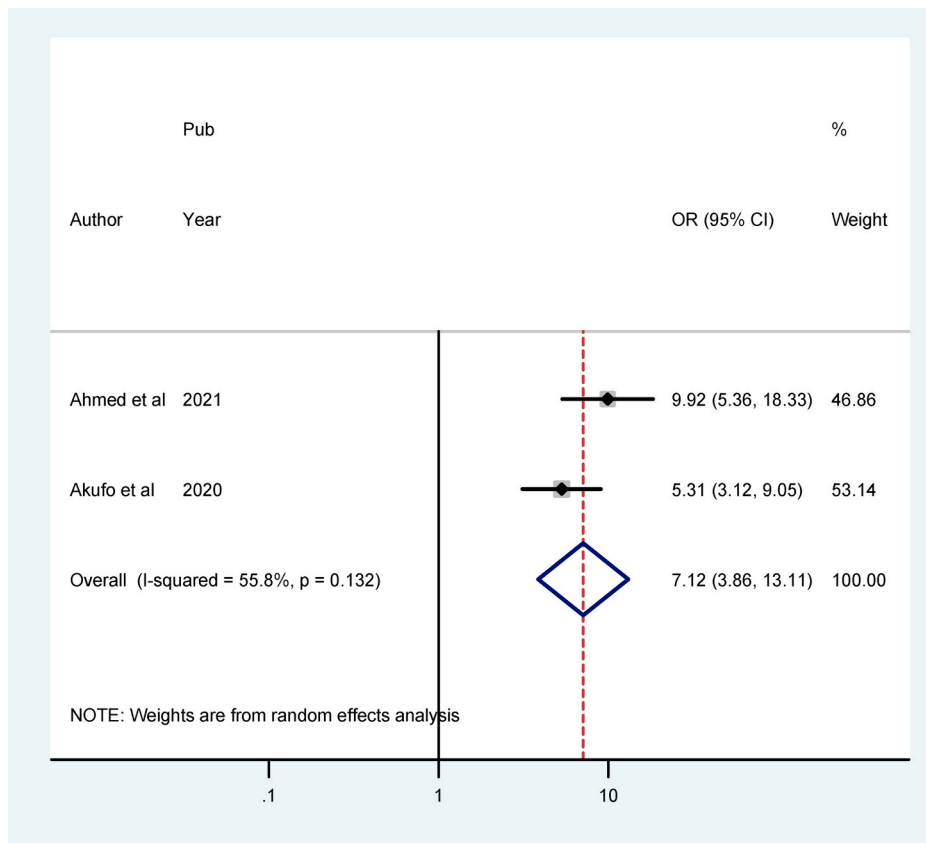


Fig. 8. Forest plot showing the pooled odds ratio of the association between age greater than 65 years and eye care service utilization.

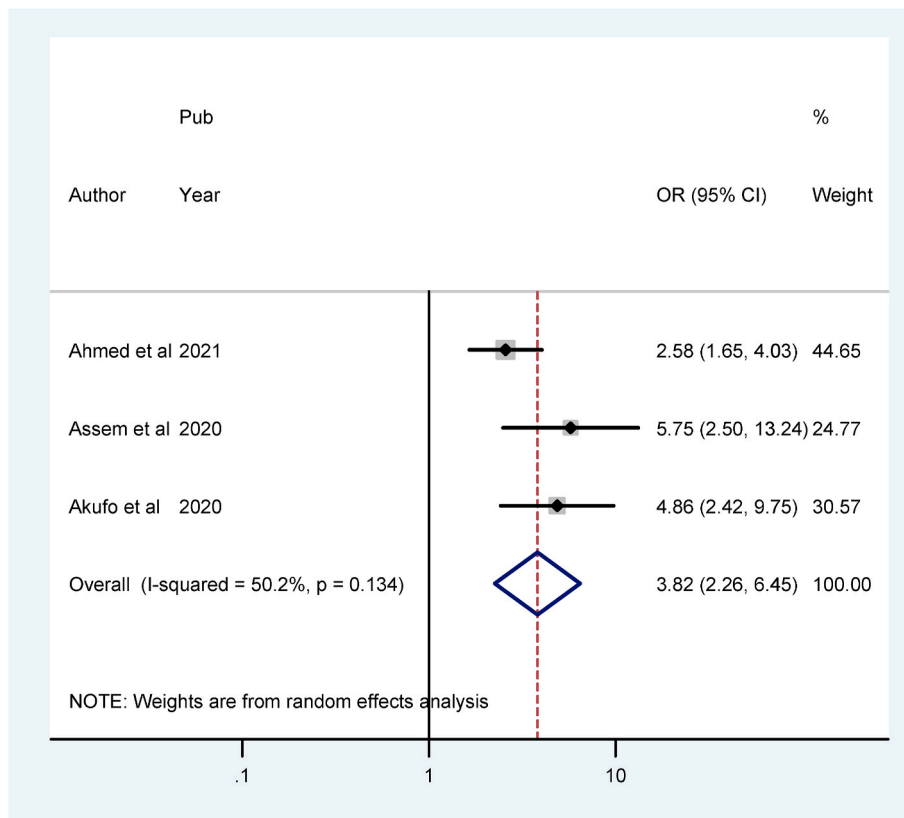


Fig. 9. Forest plot showing the pooled odds ratio of the association between duration of DM greater than 6 years and eye care service utilization.



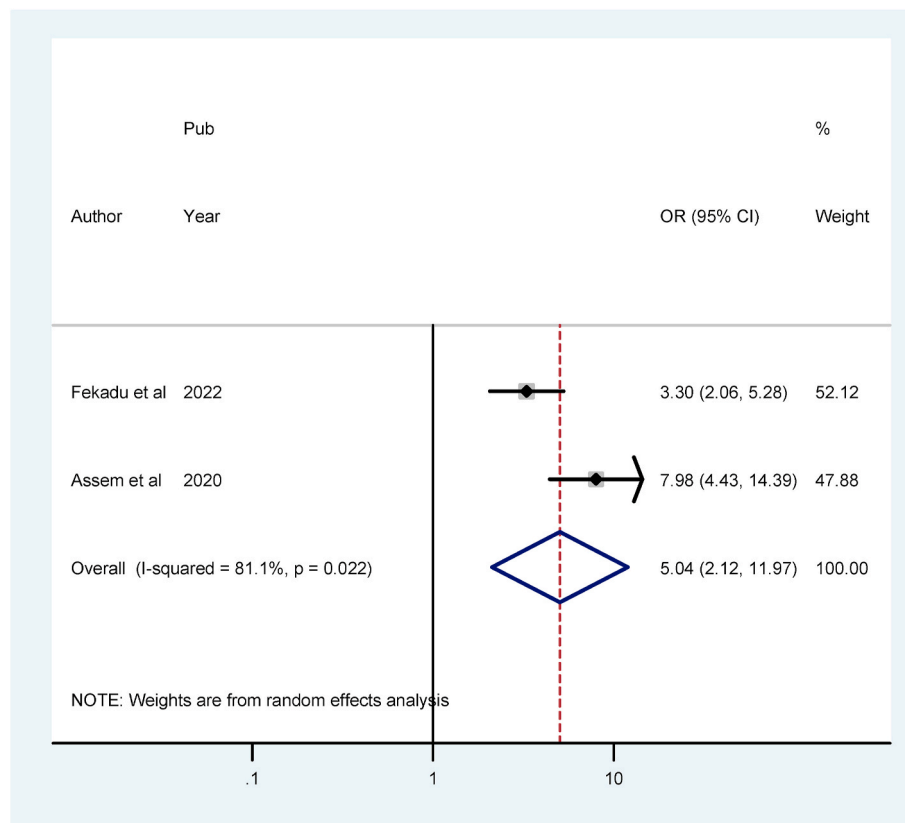


Fig. 10. Forest plot showing the pooled odds ratio of the association between urban residence and eye care service utilization.

complications may have a negative impact on the conduct of eye examinations even after receiving enough guidance regarding the potential loss of follow-up appointments. We can halt the consequences of DM by treating the controllable factors and altering the behaviors and attitudes of DM patients [22].

The random pooled effect of two studies showed that patients whose age was greater than 65 years old were more likely to utilize eye care service as compared to participants aged less than or equal to 65 years old. The finding is similar to studies conducted in Tehran [54] and the USA [55]. The main reason is that one of the key factors contributing to degenerative eye conditions and the necessity for glasses is aging. The aging population's worsening eyesight is forcing them to seek eye care services. The other possible reason might be that due to the increased prevalence of age-related eye illnesses in elderly diabetic patients, such as glaucoma, cataracts, and diabetic retinopathy, the need for eye care services may rise with age [56].

The result revealed that patients living in urban area were more likely to utilize eye care services than patients living in rural area. This could be explained by people living in urban have multiple source of information to utilize eye care services for example they may have information about diabetic retinopathy; heard via mass media and higher chance interactions with people than those live in rural. The other possible reason might be urban residents have better awareness about health, more access to health care facility and got health information from different Media as compared to rural residents.

The random pooled effect of three studies showed that patients who had a disease duration greater than 6 years were more likely to utilize eye care services as compared to patients who have a disease duration less than 6 years. This result is consistent with the results of the studies done in Indonesia [57], Germany [15], Turkey [51] and Canada [24]. The possible reason is that the incidence of diabetic ocular problems, such as diabetic retinopathy, increases with the length of diabetes, potentially leading to a higher need for eye care services. In addition,

health care professionals at the diabetic clinic may push those patients for ocular exams as the patients' diabetes worsens [58].

## 12. Limitations

The result of this review should be considered with some limitations in mind: the levels of heterogeneity between included studies were high, which can be attributed to variation in sample size, study period and geographic location. Furthermore, even with a wide range of search techniques employed to include all relevant literature, some grey literature like conference proceedings was still hard to include in the review.

## 13. Conclusion and recommendation

This meta-analysis revealed that a high proportion of people with diabetes failed to use eye care service. Older age, good knowledge, good attitude, urban residence, and longer duration of illness were found to be the contributing factors for utilization of eye care service in DM patients. Therefore, by considering the negative impact of low eye care service utilization, it is important to improving the habit of regular screening of eye into routine assessment of DM follow up targeting patients with older age and longer duration of illness to reduce the magnitude of the problem. To encourage patients with diabetes to use eye care services more frequently, we recommend teaching them about the risks of diabetic ocular complications and the value of routine eye examination by health care professionals. In general, providing eye health education for the community is paramount in improving eye care service utilization in order to put in to action Vision 2020 Initiative launched with the long-term aim of developing a sustainable comprehensive eye health care system to ensure the best possible vision for all people and thereby improve their quality of life.

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## Ethics approval and consent to participate

Not applicable since the study use systematic review and meta-analysis

## Availability of data and materials

The original contributions presented in the study are included in the article/Supplementary Material, further inquiries can be directed to the corresponding author

## CRediT authorship contribution statement

**Worku Chekol Tassew:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Agerie Mengistie Zeleke:** Funding acquisition, Formal analysis, Data curation, Conceptualization. **Yeshiwas Ayal Ferede:** Supervision, Resources, Project administration.

## Declaration of competing interest

The authors declare that they have no competing interests

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## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.metop.2024.100293>.

## Abbreviations

DM	Diabetes mellitus
IBC	Institutional Based Cross-Sectional Study
POR	Pooled Odds Ratio
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analysis

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