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Review

Diabetic retinopathy in Ethiopia: A systematic review and meta-analysis

Robera Olana Fite*, Eyasu Alem Lake, Lolemo Kelbiso Hanfore

Department of Nursing, College of Health Sciences and Medicine, Wolaita Sodo University, Ethiopia

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ABSTRACT

Aims: this systemic review and meta-analysis was aimed at determining the level of diabetic retinopathy among diabetes mellitus patients in Ethiopia.
Materials and methods: PubMed, Science Direct, Google Scholar and Excerpta Medica Database (EMBASE) were searched. The data were extracted using Microsoft Excel and analyzed by using STATA version 11. Publication bias was checked by funnel plot and more objectively through Egger's regression test, with $P < 0.05$ considered to indicate potential publication bias. Heterogeneity of studies was checked using the I^2 test. Pooled analysis was conducted. Subgroup analysis was done by region. Sensitivity analysis was employed to see the effect of single study on the overall estimation. STATA version 11 statistical software was used for meta-analysis.
Results: The overall prevalence of retinopathy was 19.48% (95% CI: 15.95, 23.01) Based on the subgroup analysis the prevalence of retinopathy was 12.48% in SNNPR, 24.8% in Oromia, 19.99% in Amhara, and 16.29% in Addis Ababa.
Conclusion: The prevalence of diabetic retinopathy among Diabetes mellitus patients is high. Therefore, close monitoring of the patient prognosis and appropriate prevention techniques is essential.

1. Background

Diabetes Mellitus (DM) is a group of metabolic disorders characterized by elevated level of glucose in the blood. It is related to the defect in insulin secretion defect and insulin action. Insulin is essential to, stimulate glucose and fat storage, and signal the liver to stop the release of glucose. It helps to transport glucose, metabolize glucose, and accelerates the transport of amino acids [1–4].

DM is related to the acute and chronic complications. The acute complication leads to hyperglycemia that may result in diabetic ketoacidosis and hyperglycemic hyperosmolar non-ketotic syndrome [5]. A long-term effect of hyperglycemia contributes to micro vascular and macro vascular complications. The micro vascular defects are retinopathy and nephropathy. The macro vascular complications include the coronary artery disease, cerebrovascular disease and peripheral vascular disease. DM also leads to neuropathic complications [6,7].

DM is one of the major causes of mortality associated with disease and has physical, social, and economic consequence on the community. It leads to non-traumatic amputation and blindness among the productive age group [8–10].

People with diabetes are subject to multiple visual complications. There are three main stages of retinopathy: non-proliferative retinopathy, pre-proliferative retinopathy, and proliferative retinopathy [11]. 10%–50% of patients with pre-proliferative retinopathy will develop proliferative retinopathy within a short time [12].

Diabetic retinopathy is caused by changes in the small blood vessels in the retina, the area of the eye that receives images and sends information about the images to the brain. It is richly supplied with blood vessels of all kinds: small arteries and veins, arterioles, venules, and capillaries [13].

Diabetic retinopathy is diagnosed with the use of Ophthalmoscope or fluorescein angiography. Many patients are asymptomatic. Sometimes, patients may experience major visual changes including blurred, spooty and double vision. It may even lead to opacity of the lens, swelling of the lens and a complete loss of vision [14,15].

The annual incidence of diabetic retinopathy ranged from 2.2% to 12.7% (xx). Maintenance of blood glucose level and patient education decreased the risk for development of retinopathy by

* Corresponding author. PO Box 138, Wolaita Sodo, Ethiopia.
E-mail addresses: rolana2000@gmail.com (R.O. Fite), eyasmsc208@gmail.com (E.A. Lake), lolemo2001@gmail.com (L.K. Hanfore).

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Ref. [16]. Therefore, implementation of primary and secondary prevention will be very helpful in decreasing the complication. Furthermore, lifestyle modifications involving control of hypertension and cessation of smoking are recommended [17,18]. The study aimed at determining the level of diabetic retinopathy among diabetes mellitus patients in Ethiopia.

2. Methods

2.1. Searching strategy and information sources

PubMed, Science Direct, Google Scholar and EMBASE were accessed. The core search terms and phrases were "Retinopathy", "Diabetes Mellitus", "Complications", and "Ethiopia". The following terms with MeSH (Medical Subject Headings) and Boolean operators were used to search PubMed: Prevalence OR Epidemiology AND Diabetic Retinopathy OR Retinopathy OR Diabetes Mellitus OR Complication AND Ethiopia.

2.2. Reporting

The results of this review were reported based on the Preferred Reporting Items for Systematic Review and Meta-Analysis statement (PRISMA) guideline [19] (Supplementary file-PRISMA checklist) and, it is not registered in the Prospero database.

2.3. Eligibility criteria

The inclusion criteria were: 1) All observational studies, which reported the prevalence of Diabetic retinopathy 2) studies conducted in Ethiopia 3) studies published in English, were considered. Articles excluded were: 1) unpublished articles 2) studies which were not fully accessed. An attempt was made to contact the corresponding author 3) Studies with methodological problems.

2.4. Study selection and extraction

Three independent reviewers screened the title and abstract. The disagreement was handled based on established article selection criteria. Three reviewers conducted the abstract and full-text review. Data were extracted using a standardized data extraction format prepared in Microsoft Excel by two independent authors. Two independent reviewers extracted data using a structured data extraction form. Any discrepancy during extraction was solved through discussion. The name of the first author, Publication year, prevalence, sample Size included, region, sampling design, and data collection method was extracted.

2.5. Quality assessment

Three independent authors appraised the quality of studies. The

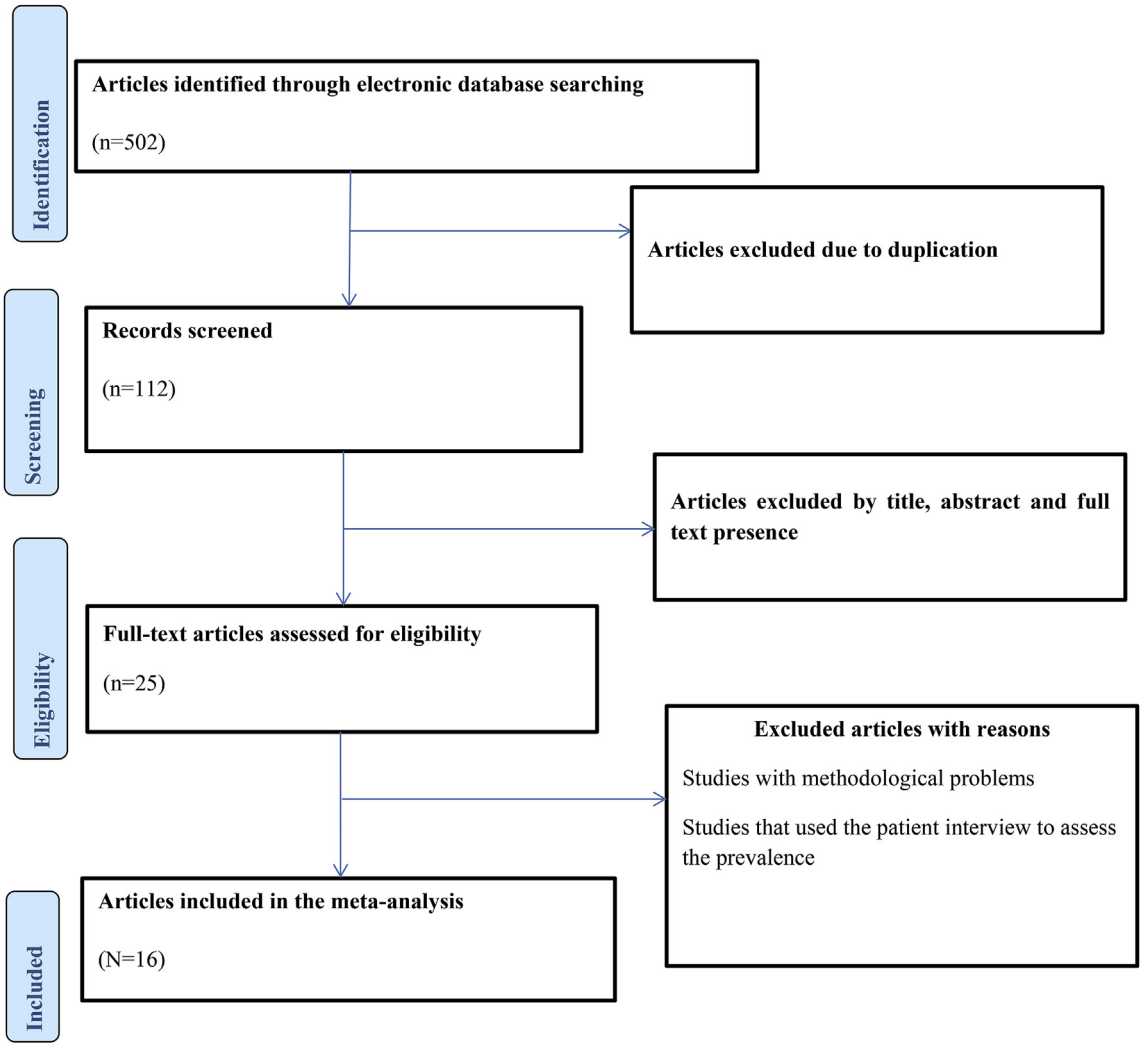

Fig. 1. Flow chart of study selection for systematic review and met-analysis of the prevalence of Diabetic Retinopathy in Ethiopia.

Joanna Briggs Institute (JBI) quality appraisal checklist was used [20]. The disagreement was resolved by the interference of third reviewer. The following items were used to appraise cross-sectional studies: [1] inclusion criteria [2], description of study subject and setting [3], valid and reliable measurement of exposure [4], objective and standard criteria used [5], identification of confounder [6], strategies to handle confounder [7], outcome measurement, and [8] appropriate statistical analysis. Studies were considered low risk when it scored 50% and above of the quality assessment indicators.

2.6. Statistical analysis

The data were extracted using Microsoft Excel and analyzed by using STATA version 11. Publication bias was checked by funnel plot and more objectively through Egger's regression test, with $P < 0.05$ considered to indicate potential publication bias [30]. Heterogeneity of studies was checked using the I^2 test. Pooled analysis was conducted using a weighted inverse variance random-effects mode [31]. Subgroup analysis was done by region. Sensitivity analysis was employed to see the effect of single study on the overall estimation. STATA version 11 statistical software was used for meta-analysis. The result was presented in a form of table and figures.

3. Results

3.1. Characteristics of included studies

Initially, 502 articles were retrieved. Of these articles, 390 were excluded due to duplication and 87 articles were exclude by title, abstract and full text presence. Therefore, 25 articles were fully accessed and assessed for eligibility. Ultimately, 16 articles met the eligibility criteria and were included in the final meta-analysis (Fig. 1).

Sixteen full text articles were included in this systematic review and meta-analysis. The studies had no considerable risk. Overall information regarding the prevalence was obtained from various areas in Ethiopia: 4 studies from Addis Ababa [21–24], 5 studies from Amahra [25–29], 5 studies from Oromia [30–34] and 2 studies from Southern Nations and Nationalities People region (SNNPR) [35,36]. The actual number of study participants ranges from 86 to 422. The highest prevalence of retinopathy (33.8%) was reported in a study from Oromia region and the lowest (4.7%) reported from a study conducted in Addis Ababa. The sampling method employed in four of the studies was systematic random sampling; two studies used simple random sampling (Table 1).

3.2. Publication bias

Egger's regression test p-value was 0.06, which indicated the absence of publication bias. A funnel plot showed a symmetrical distribution (Fig. 2).

3.3. Prevalence of retinopathy among diabetic mellitus patients

The estimated overall prevalence of retinopathy is presented in a forest plot (Figure). The overall prevalence of retinopathy was 19.48% (95% CI: 15.95, 23.01; $I^2 = 90.6\%$) (Fig. 3).

3.4. Sensitivity analysis

Ejigu A et al. and Shibeshi MS et al. had shown an impact on the overall estimation (Fig. 4).

Table 1
Descriptive summary of 16 studies included in the systematic review and meta-analysis of the prevalence of Diabetic Retinopathy in Ethiopia.

Authors	Publication year	Prevalence	Sample Size included	Region	Sampling	Design	Data collection Method
Chisha Y et al. [35]	2017	13	400	SNNPR	Consequetive	Hospital based Cross-sectional	Record
Kassahun T et al. [30]	2016	26.7	325	Oromia	Simple random sampling	Hospital based Cross-sectional	Record and interview
Azeze TK et al. [21]	2018	18.57	377	Addis Ababa	NR	Retrospective follow-up study	Record and Interview
Fasil A et al. [25]	2019	17.7	367	Amhara	NR	Hospital based Cross-sectional	Record, interview and physical examination
Shibeshi MS et al. [22]	2016	4.7	86	Addis Ababa,	NR	Hospital based Cross-sectional	Record, interview and physical examination
Gudina EK et al. [31]	2011	18.4	329	Oromia	NR	Hospital based Cross-sectional	Record and interview
Lebeta KR et al. [26]	2017	25.5	344	Amhara	Systematic Random Sampling	Institution Based Cross Sectional Study	Record and interview
Worku D et al. [32]	2010	33.8	305	Oromia	Systematic random sampling	Hospital based Cross-sectional	Record
Ejigu A [23]	2000	31.4	283	Addis Ababa	NR	Hospital based Cross-sectional	Record and physical examination
Tesfaye DJ et al. [36]	2014	11.7	247	SNNPR	Simple random sampling	Hospital based Cross-sectional	Record and physical examination
Walle B et al. [27]	2018	21	422	Amhara	Systematic random sampling	Hospital based Cross-sectional	Record and Interview
Ayele Y et al. [28]	2018	17.4	203	Amhara	Retrospective cross-sectional study	NR	Record
Wolde HF et al. [29]	2018	18.4	341	Amhara	Retrospective study	Simple random sampling	Record
Tilahun AN et al. [33]	2017	20.3	236	Oromia	Systematic random sampling	Hospital based Cross-sectional	Record, interview and physical examination
Abdella et al. [34]	2013	25.37	118	Oromia,	NR	Hospital based Cross-sectional	Record and interview
Gizaw M et al. [24]	2015	11	418	Addis Ababa	NR	Retrospective descriptive study	Record

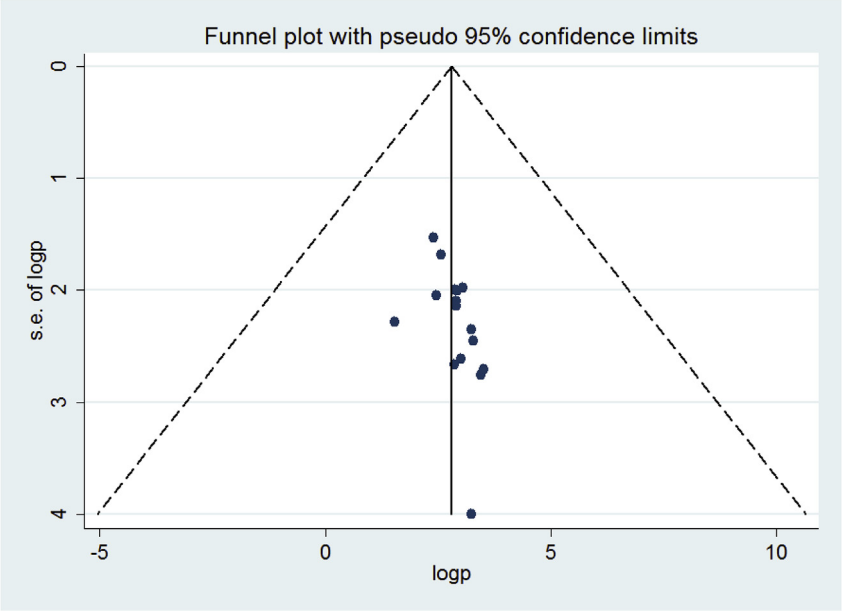

Fig. 2. Funnel plot of publication bias.

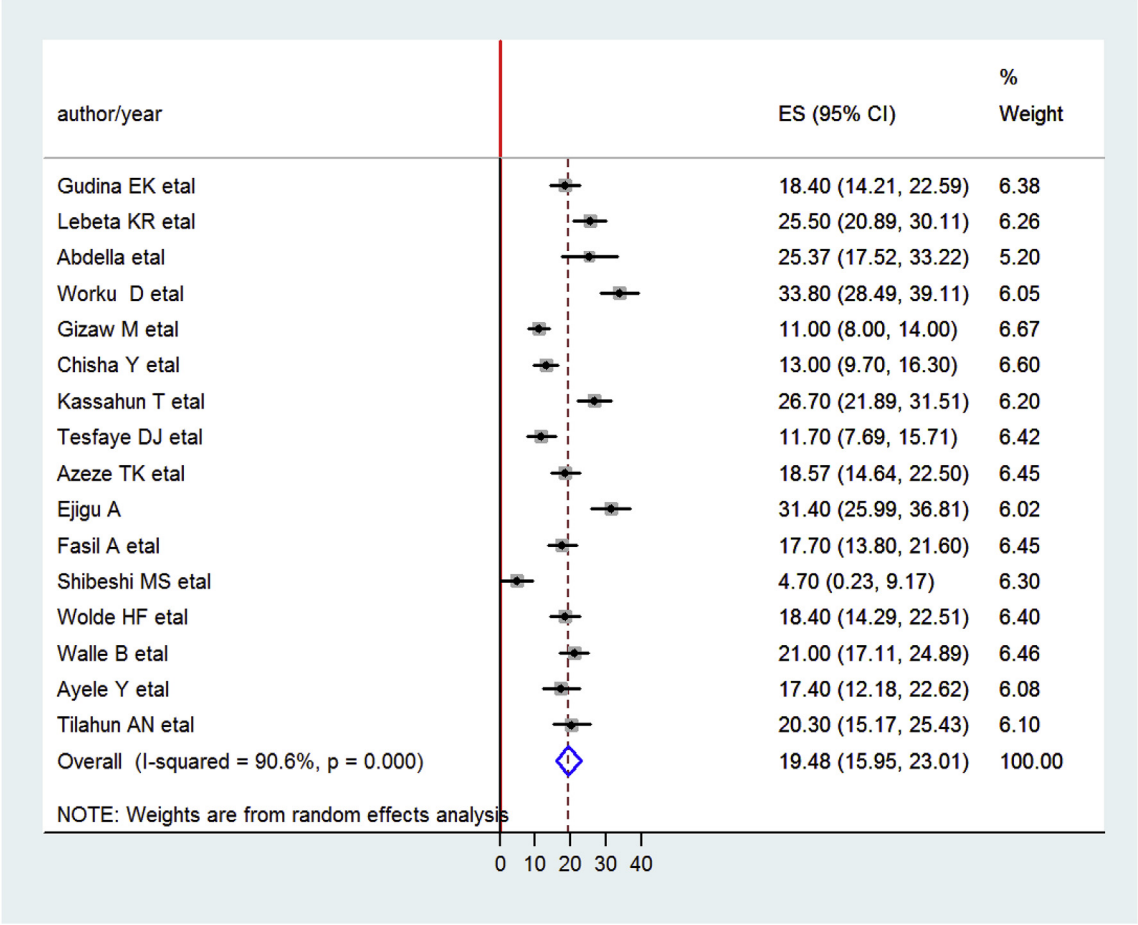

Fig. 3. Forest Plot of the prevalence of Diabetic Retinopathy with its 95% Confidence Interval.

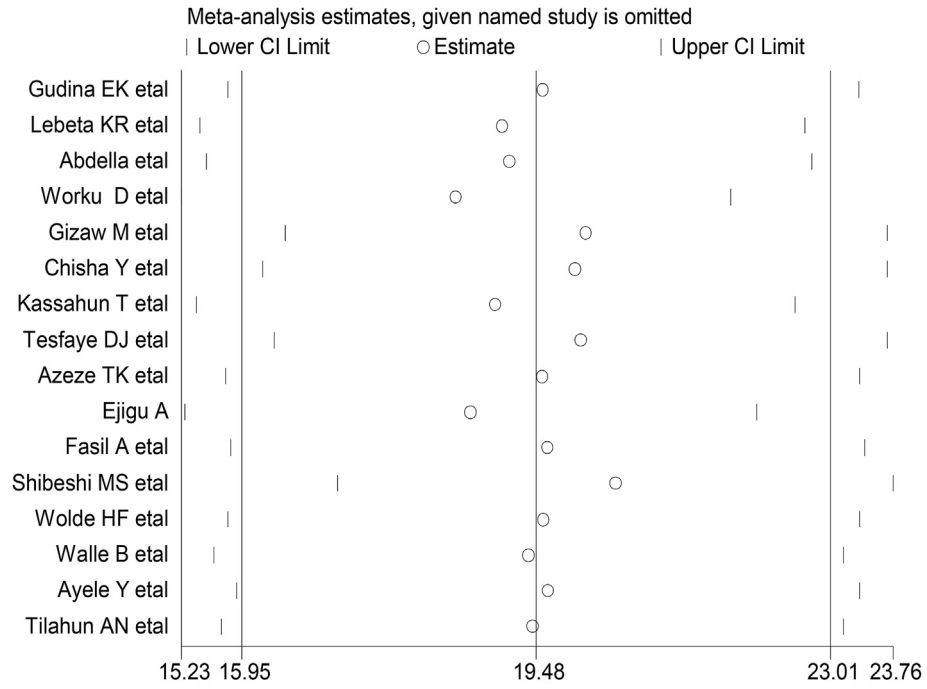

Fig. 4. The sensitivity analysis to estimate of the prevalence of Diabetic Retinopathy in Ethiopia.

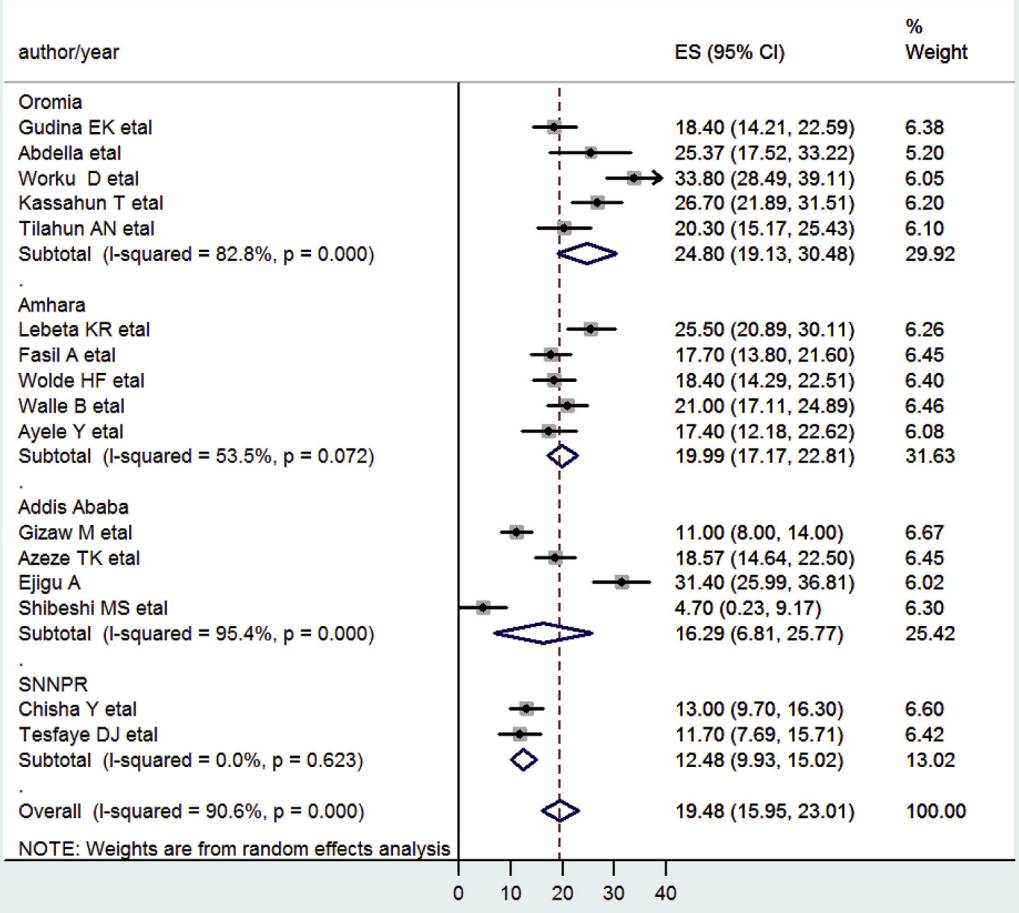

Fig. 5. Forest Plot of the prevalence of Diabetic Retinopathy based on the region where the studies conducted.

3.5. Subgroup analysis

The subgroup analysis based on the region was done. Accordingly, the prevalence of retinopathy is found to be 12.48% in SNNPR, 24.8% in Oromia, 19.99% in Amhara, 16.29% in Addis Ababa (Fig. 5).

4. Discussion

This study reviewed the evidence on the prevalence of diabetic retinopathy. Sixteen studies were included into the analysis, selected based on a series of inclusion criteria. To the best of our knowledge, this systematic review and meta-analysis provides a comprehensive estimation of the prevalence of diabetic retinopathy in Ethiopia.

In this systematic review and meta-analysis, the overall prevalence of retinopathy was 19.48%. This suggests that there is a high rate of retinopathy among diabetic patients, which indicates poor control of diabetes mellitus related complication. Intensive and multifactorial approach is required to combat the diabetic related complications, which focus on the treatment adherence, health education.

This finding is comparable with the finding from a systematic review and meta-analysis conducted in Arab countries, which reported that 19.48% of the patients with diabetic mellitus have developed retinopathy [37]. It is also consistent with a report from a systematic review and meta-analysis conducted in china that implies the diabetic retinopathy was 18.45%% [38]. On the other hand, the finding is lower than a report from a systematic review and in meta-analysis conducted in Iran, which showed that the prevalence of diabetic retinopathy was 41.9% [39] and a report from that reported 28% of the diabetic mellitus patients have developed diabetic retinopathy.

This study has an implication for health professional and patients. Early detection of poorly controlled diabetic mellitus and close monitoring of bad patient progress is essential to prevent the diabetic retinopathy. Therefore, we would like to recommend the conduct of national level study using Ophthalmoscope or fluorescein angiography diagnosis.

The strength of the systematic review and meta-analysis is the use of extensive search strategy to incorporate the studies. On the other hand, studies are reported from limited number of regions within the country that may create under representation.

5. Conclusion

In conclusion, this study revealed that the prevalence of Diabetic retinopathy was relatively high in Ethiopia. Besides, the prevalence of diabetic retinopathy differed by region. Close monitoring of the patient and appropriate prevention techniques is recommended.

Conflicts of interest

None declared.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.dsx.2019.04.016.

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