SYSTEMATIC REVIEW

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Prolonged length of stay and associated factors among emergency department patients in Ethiopia: systematic review and meta-analysis

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Abstract

Background The duration between a patient's arrival at the Emergency Department (ED) and their actual departure, known as the Emergency Department Length of Stay (EDLOS), can have significant implications for a patient's health. In Ethiopia, various studies have investigated EDLOS, but a comprehensive nationwide pooled prevalence of prolonged EDLOS, which varies across different locations, is currently lacking. Therefore, the objective of this systematic review and meta-analysis is to provide nationally representative pooled prevalence of prolonged EDLOS and identify associated factors.

Methods In this study, we conducted a comprehensive systematic review and meta-analysis using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 checklist. We conducted a thorough search of numerous international databases, including PubMed/Medline, SCOPUS, Web of Science, and Google Scholar. The primary outcome was the prevalence of prolonged EDLOS. The secondary outcome was factors affecting the EDLOS. Random-effects model was used to since there was high heterogeneity. We also conducted subgroup analysis and meta-regression to investigate heterogeneity within the included studies. To assess publication bias, we used Egger's regression test and funnel plots. All statistical analyses were performed using STATA version 17.0 software to ensure accurate and reliable findings.

Result We have identified eight articles that met our inclusion criteria with a total sample size of 8,612 participants. The findings of this systematic review and meta-analysis indicate that the pooled estimate for the prevalence of prolonged EDLOS is 63.67% (95% CI = 45.18, 82.16, I^2 = 99.56%, P = 0.0001). The study identified several significant factors associated with prolonged EDLOS, including patients admitted to overcrowded emergency departments (OR = 5.25, 95% CI = 1.77, 15.58), delays in receiving laboratory findings (OR = 3.12, 95% CI = 2.16, 4.49), and delays in receiving radiological results (OR = 3.00, 95% CI = 2.16, 4.16).

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Conclusion In this review, the EDLOS was found to be very high. Overcrowding, delays in laboratory test findings, and delays in radiology test results make up the factors that have a statistically significant association with prolonged EDLOS. Given the high prevalence of prolonged EDLOS in this review, stakeholders should work to increase the timeliness of ED services in Ethiopia by proper disposition of non-emergency palliative patients to the appropriate destination, and implementing point-of-care testing and imaging.

Keywords Emergency Department, Length of Stay, Associated factors, Ethiopia

Introduction

The Emergency Department (ED) is a hospital unit that specializes in the treatment of acute, severe, or urgent illnesses and injuries [1]. It functions as a pivotal point of entry for numerous patients who may require further care in other units of the hospital. Emergency departments are grappling with an escalating number of challenges on a global scale due to a rise in patient load and the inability to adequately match their capacity to meet the demand [2].

The term "Emergency Department Length of Stay " (EDLOS) refers to the amount of time that passes between a patient's physical departure from the Emergency Department (ED) and their arrival [3]. It is widely recognized as one of the most significant performance indicators used in in numerous countries [4]. The duration of prolonged EDLOS cut-points varies from 4 to 48 h [3]. In Ethiopia, patients who stay for 24 h or more are considered to have prolonged EDLOS [5].

Patients may experience various health-related consequences as a result of prolonged EDLOS. Such consequences may be associated with issues in the intensive care unit (ICU), hospital-acquired infections, patient dissatisfaction and a decline in the overall quality care provided to ED patients [6–9]. A statewide study carried out in Korea revealed that 25.3% of adult patients admitted from the ED to the ICU experienced a prolonged EDLOS. This finding was associated with a significantly increased risk of in-hospital mortality [10]. Furthermore, a systematic review and meta-analysis study focused on patients admitted to the ICU found a statistically significant correlation between EDLOS exceeding 24 h and hospital mortality [8].

Various research has been carried out in Ethiopia to determine the duration of hospital stays and the factors associated with it in emergency departments. According to studies, the percentage of patients experiencing prolonged EDLOS in Ethiopian hospitals' emergency departments ranges from 38.4% to 91.5% [11, 12]. This demonstrates variations across multiple studies, highlighting the diverse factors that influence the duration of stay in EDs. These factors encompass the availability of admission beds, overcrowding, delays in obtaining laboratory test results, delays in obtaining radiology test results, time and date of arrival, duration of pain symptoms, triage category, patient residence, availability of prescribed medications, experience of shift changes, absence of insurance coverage, patients' communicative ability during presentation, delayed consultation, and diagnosed with medical conditions [11–15].

Despite the presence of several studies, there is currently no nationally representative pooled prevalence of prolonged EDLOS that accounts for variations among study locations in Ethiopia. The objective of this systematic review and meta-analysis was to determine the overall prevalence of prolonged EDLOS and its associated factors in Ethiopia.

The findings of this review have tremendous importance. The findings of this review strongly indicated the need to appropriate disposition of non-emergency palliative patients to appropriate care destination and the need for implementation of point-of-care testing and imaging to enhance the timeliness of ED care. In addition, the findings of this review broadly help local and national stakeholders adapt and implement interventions aligned with the goals of the African Federation for Emergency Medicine (AFEM) and the International Federation of Emergency Medicine (IFEM). The AFEM aims to strengthen emergency care across Africa, while the IFEM seeks to create a world where all people, in all countries, have access to high-quality emergency medical care [16, 17].

Methods

Study design and search strategy

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 checklist was followed for this systematic review and meta-analysis [18]. To find published articles, we conducted a thorough search of numerous international databases, including PubMed/Medline, SCOPUS, Embase, Hinari, and Web of Science. Additionally, in order to find unpublished studies and grey literature, we searched Google Scholar. Up until December 10, 2023, all published and gray literature was retrieved, critically evaluated, and assessed to be included in this study. The following search terms employed using "AND" and "OR" Boolean operators to retrieve articles: ('Length of stay' OR 'Stay Length' OR 'Stay Lengths' OR 'Hospital Stay' OR 'Hospital Stays' OR 'Stay, Hospital' OR 'Stays, Hospital') AND ('Associated Factors' OR Predictors) AND ('emergency department patients' OR 'emergency department patient' OR

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'emergency department clients' OR 'emergency department client') AND (Ethiopia OR 'Federal Democratic Republic of Ethiopia'). The **Co**, **Co**, **Pop** (Condition, Context, and Population) search strategy was used (Supplementary Table 1).

Inclusion criteria and exclusion criteria

This review includes all published and gray literatures reporting EDLOS or associated factors in English till December 10, 2023. Articles that did not provide full access and did not report on the outcome of the interest, on the other hand, were excluded. Initially, each publication was evaluated independently for inclusion based on its title and abstract. The full text was then used to screen research that passed the title and abstract review. In the event of duplicated data, the one with available full-text published article was kept and articles without the full-text were removed.

Outcome of interest

The primary outcome, represented as percentage and frequency in articles, was the prevalence of prolonged EDLOS. Using the PEO (*P*=Population, E=exposure, O=outcome) model, the secondary outcome was factors affecting the LOS of ED patients in Ethio-pia, which were represented in the form of odds ratios and or in cross-tabulation as cell values of number of exposed with the outcome, number of exposed without the outcome, number of non-exposed with the outcome and number of nonexposed without the outcome. As a result, the secondary outcome was provided as odds ratios estimated by meta-analysis of odds ratios from individual studies that reported the determinant variable or the cell values of the variable from cross-tabulated data. The variables used in this meta-analysis to estimate the secondary outcome were those that were deemed statistically significant in the primary studies.

Quality assessment and data extraction

The Hoy risk of bias tool was used to assess the risk of bias in the included studies [19]. The tool comprises nine parameters, each with a score of zero or one. When the total score for each parameter is 0–3, it shows low risk of bias (high quality), when it is 4–6, it indicates moderate risk of bias, and when it is 7–9, it indicates high risk of bias or poor quality. Using standardized data extraction checklist, the two reviewers (T.A. and M.A.M.) independently evaluated and extracted the articles for inclusion in the review and overall research quality. Primary author, study year, study region, study design, sample size, prevalence of prolonged EDLOS, and odds ratio of factors affecting EDLOS were all included in the data extraction format. Any disagreement amongst the

reviewers was settled by dialogue and the participation of other reviewers (A.T.T., M.G., and F.A.)

Data analysis

Microsoft Excel was used to extract the data, which were then exported to STATA version 17.0 for additional analysis. The I^2 test statistic with Hartung-Knapp adjustment, was used to evaluate the heterogeneity among the studies [20]. Since there is high heterogeneity, we estimated the pooled prevalence of prolonged EDLOS using a random-effects model. We used funnel plot [21] and Egger et al.'s [22] test to check for publication bias subjectively and objectively. Furthermore, we used meta-regression using publication year and sample size as covariates, sensitivity analysis and subgroup analysis by region, sample size of the included articles, type of ED, and cut-off points for prolonged EDLOS to figure out the source of heterogeneity. Meta-analysis was used to examine the effect of the selected predictor variables. The results of this meta-analysis were reported in the form of a forest plot and an odds ratio (OR) with a 95% confidence interval (CI).

Results

Article selection

Of the 393 articles retrieved, 390 were published, and 3 were grey literature. After screening the titles and abstracts, 258 articles and 23 duplicate records were removed from the list. The inclusion and exclusion criteria were used to determine the eligibility of the remaining 12 studies. Furthermore, four studies [23–26] were eliminated from the total of twelve since they didn't report the main outcome. Ultimately, this systematic review and meta-analysis included 8 articles (Fig. 1).

Characteristics of the included studies

The present review included eight cross-sectional studies with a total of 8,612 participants. Among the included studies, two were based on retrospective secondary data. One study was descriptive cross-sectional study [27] that reported on the outcomes of adult patients visiting the emergency department, while the other study was an analytical cross-sectional study [28] that focused on the outcomes and associated factors of pediatric patients visiting the emergency department.

The remaining six studies were analytical cross-sectional studies that directly use primary data from adult emergency departments. Among these, two studies were conducted in Southern Ethiopia [11, 15], two in Northern Ethiopia [14, 27], and four in the Central Ethiopia region [12, 13, 28, 29].

Five out of the eight included studies provided both the primary and secondary outcomes specifically the prevalence of prolonged EDLOS and associated factors [11, 12,
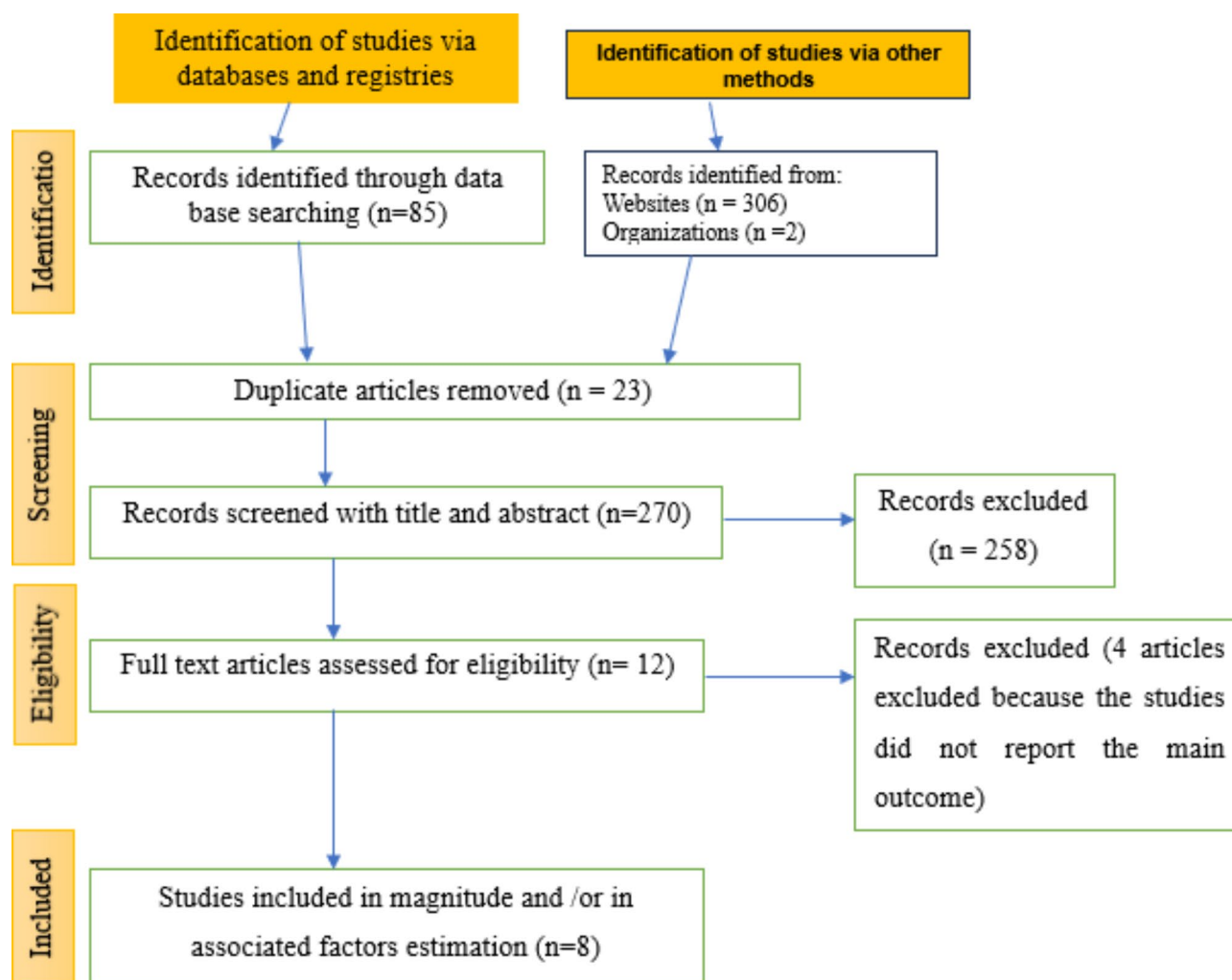
Fig. 1 PRISMA 2020 flow diagram showing the article selection process of the systematic review and meta analysis of prolonged EDLOS and associated factors in Ethiopia, 2023

14, 15, 25]. The remaining three studies only reported the primary outcome [27–29] (Table 1).

Prevalence of prolonged emergency department length of stay (EDLOS)

The pooled prevalence of prolonged EDLOS was found to be 63.67% [95% CI=45.18, 82.16] in this systematic review and meta-analysis. There was a significant heterogeneinity between the studies (I^2=99.56%, P=0.0001) (Fig. 2). As a result, sub-group analysis was performed to identify the source of heterogeneity by study region, sample size, and type of emergency department.

Subgroup analysis

The Southern subgroup (85.68% CI=74.12, 97.25) had the largest prevalence in the subgroup analysis by region (Supplementary Fig. 1). When analyzing subgroups analysis based on sample size of the each of the included articles (≤400 versus >400), studies with a sample size >400

had the highest prevalence (70.10%, CI=52.55, 87.64) (Supplementary Fig. 2). Sub-group analysis by emergency department (ED) type showed no significant variation in prevalence between pediatric and adult emergencies (Supplementary Fig. 3).

Sensitivity analysis

To determinewhether the individual studies influenced the pooled prevalence estimates, a sensitivity analysis was carried out. The outcome of the sensitivity analysis showed that no study influenced the total pooled prevalence in a random-effects model (Fig. 3).

Publication bias

The results of Egger's test indicated the existence of publication bias, with a p-value of (p=0.0009) and an asymmetric funnel plot. Therefore, a trim and fill analysis was performed and two hypothetical studies are estimated to be missing and are imputed. If these two studies were

Table 1 Characteristics of included studies for the systematic review and meta-analysis of prolonged EDLOS in Ethiopia, 2023

Author	Year	Region	Study design	Type of ED	Sample size of studied patients	Prevalence	Response rate	study period	hospitals involved
Alemu et al. [11]	2019	Southern Ethiopia	Cross sectional	Adult	422	91.5	94.5	2018	Hawassa University Comprehensive Specialized Hospital
Negasi et al. [15]	2022	Southern Ethiopia	Cross sectional	Pediatric	422	79.7	96.68	2021	Wolaita Sodo University Hospital
Fekadu et al. [13]	2022	Central Ethiopia	Cross sectional	Adult	400	42.25	97	2021	Hiwot Fana Comprehensive Specialized Hospital
Belayneh et al. [14]	2023	Northern Ethiopia	Cross sectional	Adult	512	46.5	96.7	2022	Amhara region comprehensive specialized hospitals
Ahmed et al. [12]	2020	Central Ethiopia	Cross sectional	Adult	422	38.4	100	2018	Jimma Medical Center
Tarkie et al. [27]	2023	Northern Ethiopia	Cross sectional	Adult	5232	79.1	100	2021	University of Gondar Comprehensive Specialized Hospital
Asinakew et al. [28]	2023	Central Ethiopia	Cross sectional	Pediatric	303	46.2	100	2022	Randomly selected hospitals in Addis Ababa
Getachew M. [29]	2023	Central Ethiopia	Cross sectional	Adult	899	85	100	2023	Hiwot Fana Comprehensive Specialized Hospital

Study	prevalence with 95% CI	Weight (%)
Alemu et al., 2019	91.50 [88.84, 94.16]	12.56
Negasi et al., 2022	79.70 [75.86, 83.54]	12.50
Fekadu et al., 2022	42.25 [37.41, 47.09]	12.45
Belayneh et al., 2023	46.50 [42.18, 50.82]	12.48
Ahmed et al., 2020	38.40 [33.76, 43.04]	12.46
Tarkie et al., 2023	79.10 [78.00, 80.20]	12.60
Asinakew et al., 2023	46.20 [40.59, 51.81]	12.39
Getachew M., 2023	85.00 [82.67, 87.33]	12.57
Overall	63.67 [45.18, 82.16]	

Heterogeneity: $\tau^2 = 485.03$, $I^2 = 99.56\%$, $H^2 = 228.71$

Test of $\theta_i = \theta_j$: Q(7) = 945.36, p = 0.00

Test of $\theta = 0$: t(7) = 8.14, p = 0.00

Random-effects REML model
Knapp–Hartung standard errors

Fig. 2 Pooled prevalence of prolonged EDLOS in Ethiopia, 2023. The vertical red line represents the pooled effect size (prevalence) of EDLOS

included in the meta-analysis, the funnel plot would be more symmetric. After imputing the studies, we obtain an updated estimate (based on the eight studies observed plus imputed) of the mean effect size of 71.410 with a 95% CI [55.62, 87.20] (supplementary Fig. 4).
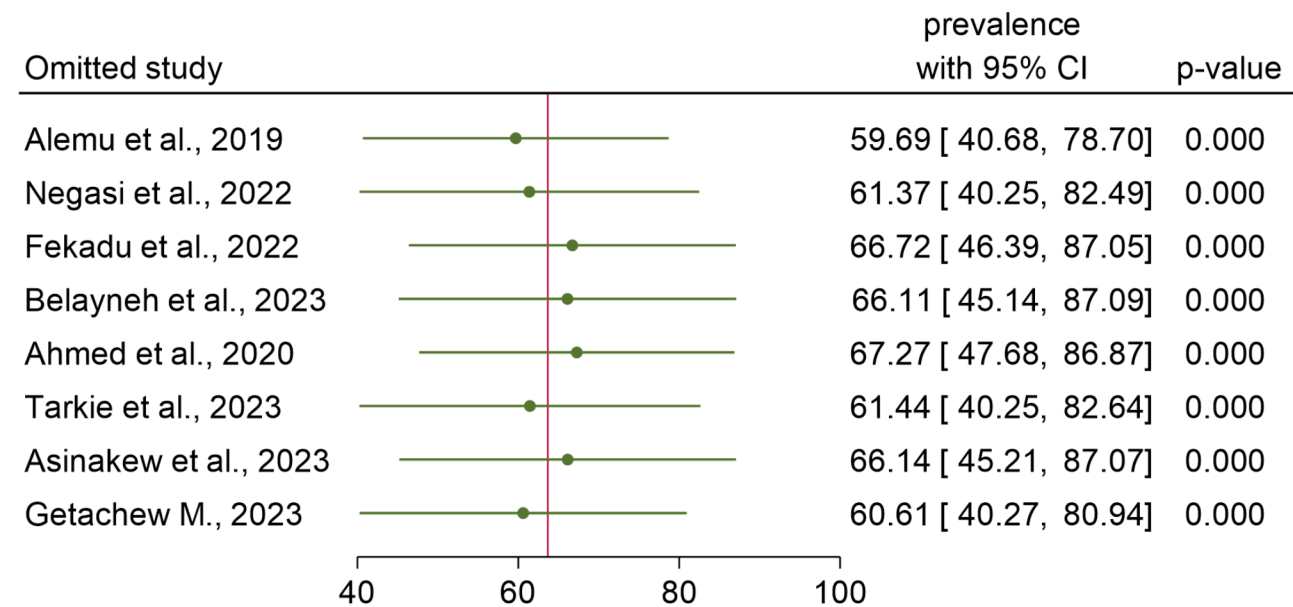
Meta-regression

The cause of heterogeneity was determined using meta-regression, with publication year and sample size as covariates. However, the results, revealed that neither sample size norpublication year were statistically significant factors contributing to the observedheterogeneity (Table 2).

Factors associated with prolonged EDLOS

This meta-analysis found different factors associated with prolonged EDLOS in Ethiopia. The factors found to be related to prolonged EDLOS were overcrowding, delays in laboratory results, and delays in radiology results. Patients treated in overcrwoded EDs were were found

Fig. 3 Sensitivity (leave-one-out) analysis result for pooled prevalence of prolonged EDLOS in Ethiopia, 2023. The red line represents the pooled effect size

Table 2 Meta-regression analysis of factors affecting between study heterogeneity

Hetroginity source	Coefficients	Standard error	p-value
Sample size	0.0053917	0.00563	0.382
Publication year	-3.730861	6.134817	0.570

to be 5.25 times more likely [OR=5.25, 95% CI=1.77, 15.58] to to experience a longer EDLOS compared to their counterparts. Similarly, patients with laboratory result delays were 3.12 times more likely [OR=3.12, 95% CI=2.16, 4.49] to have a longer EDLOS than their couterparts. Furthermore, patients who had radiology results delayed were 3.00 times more likely [OR=3.00, 95% CI=2.16, 4.16] to have a longer EDLOS than their counterparts (Fig. 4).

Discussion

Due to the negative patient outcomes associated with prolonged EDLOS, it is now being considered a critical performance indicator for quality improvement initiatives in hospital EDs [3, 10]. The specific thresholds defining prolonged EDLOS vary depending on the subgroup of ED patients and can range from 4 to 48 h [3]. In Ethiopia, the key indicators of ED care include triage within five minutes and dsposition of ED patients to suitable destinations within 24 h [30].
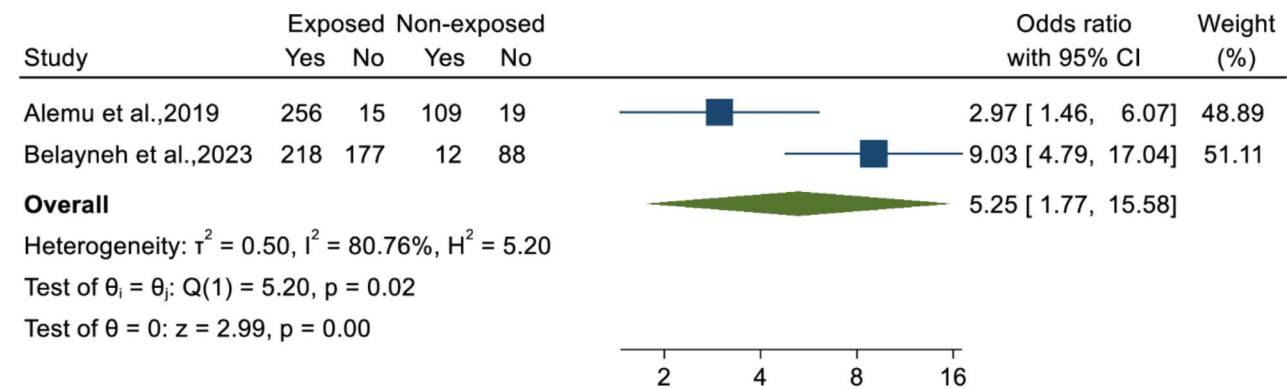
In this review, the pooled prevalence of prolonged EDLOS was found to be 63.67% [95% CI=48.35, 78.99]. This figure is higher than that reported by the American College of Surgeons' Trauma Quality Improvement Program (ACS-TQIP) centers in the United States (13.5%) [31], Canada (26.5%) [32], a nationwide analysis in Korea (25.3%) [10], Dutch tertiary care centre (20%) [33] and Iran (10.2%) [34]. The disparity between our review and these studies could be attributed to differences in advancements in emergency department (ED) treatment. In Ethiopia, emergency medical care is still in its early stages [35]. However, our review's finding is similar with a study conducted in Botswanan (72.5%) [36]. Despite using a higher cutoff point (24 h), the prevalence of prolonged EDLOS is still relatively high in Ethiopia.

The high proportion of extended EDLOS indicated by this review highlights the need for expedited delivery of Ethiopian emergency services. Timeliness is a crucial factor in assessing the effectiveness of emergency care. According to our definition, timely care entails that emergency departments (EDs) must consistently strive to "minimize waiting times and mitigate potentially detrimental delays for both patients and healthcare providers" [34, 37].

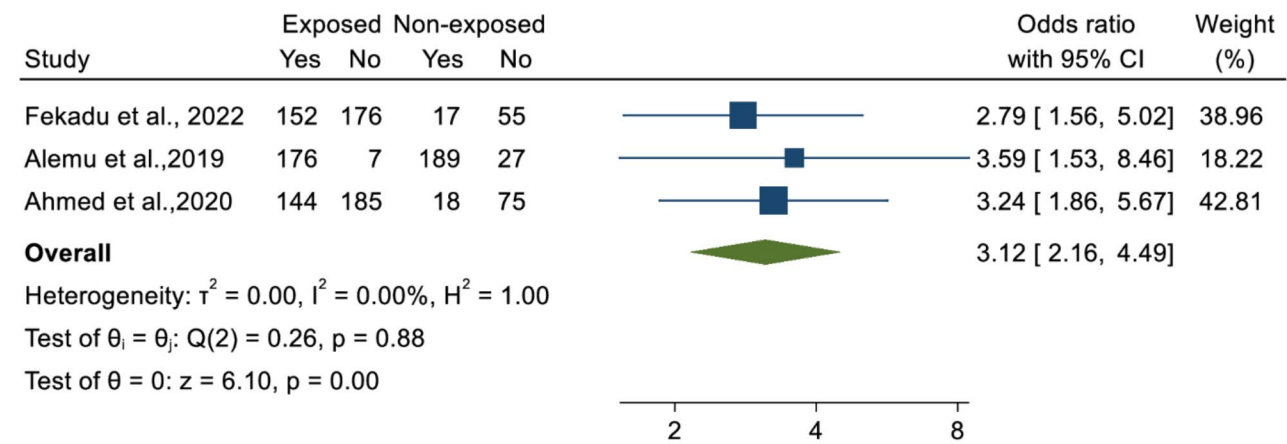Despite the fact that all of the included studies used acceptable techniques to estimate sample size, the highest prevalencewas observed in studies with sample sizes greater than400 (70.10%, CI=52.55, 87.64). As the sample size increases, the statistical power also increases, leading to more precise estimation [38].

The meta-analysis conducted in this review revealed that patients admitted to overcrowded emergency
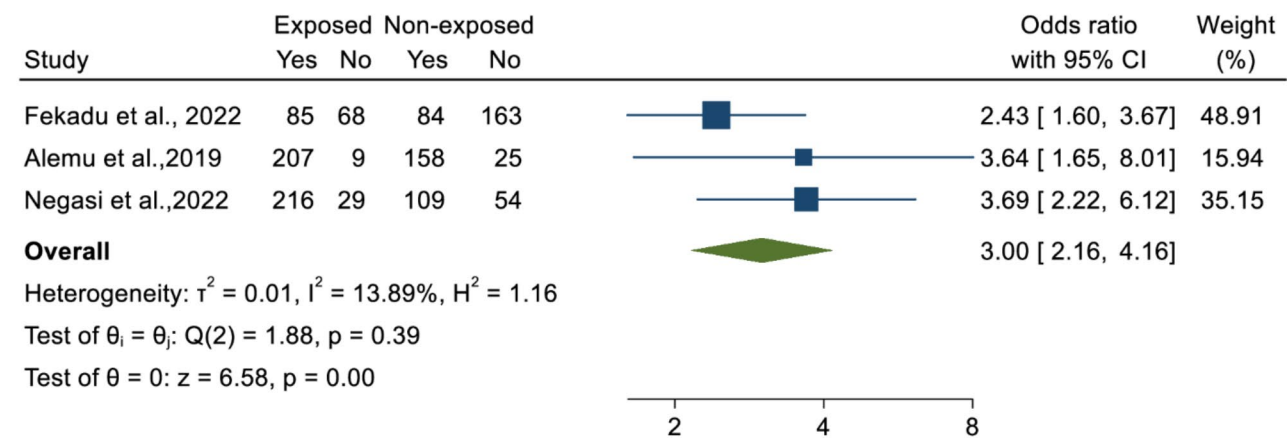
Study	Exposed Yes	No	Non-exposed Yes	No		Odds ratio with 95% CI	Weight (%)
Alemu et al.,2019	256	15	109	19		2.97 [1.46, 6.07]	48.89
Belayneh et al.,2023	218	177	12	88		9.03 [4.79, 17.04]	51.11
Overall						5.25 [1.77, 15.58]	

Heterogeneity: $\tau^2 = 0.50$, $I^2 = 80.76\%$, $H^2 = 5.20$

Test of $\theta_i = \theta_j$: Q(1) = 5.20, p = 0.02

Test of $\theta = 0$: z = 2.99, p = 0.00

Random-effects REML model

A

Study	Exposed Yes	No	Non-exposed Yes	No		Odds ratio with 95% CI	Weight (%)
Fekadu et al., 2022	152	176	17	55		2.79 [1.56, 5.02]	38.96
Alemu et al.,2019	176	7	189	27		3.59 [1.53, 8.46]	18.22
Ahmed et al.,2020	144	185	18	75		3.24 [1.86, 5.67]	42.81
Overall						3.12 [2.16, 4.49]	

Heterogeneity: $\tau^2 = 0.00$, $I^2 = 0.00\%$, $H^2 = 1.00$

Test of $\theta_i = \theta_j$: Q(2) = 0.26, p = 0.88

Test of $\theta = 0$: z = 6.10, p = 0.00

Random-effects REML model

B

Study	Exposed Yes	No	Non-exposed Yes	No		Odds ratio with 95% CI	Weight (%)
Fekadu et al., 2022	85	68	84	163		2.43 [1.60, 3.67]	48.91
Alemu et al.,2019	207	9	158	25		3.64 [1.65, 8.01]	15.94
Negasi et al.,2022	216	29	109	54		3.69 [2.22, 6.12]	35.15
Overall						3.00 [2.16, 4.16]	

Heterogeneity: $\tau^2 = 0.01$, $I^2 = 13.89\%$, $H^2 = 1.16$

Test of $\theta_i = \theta_j$: Q(2) = 1.88, p = 0.39

Test of $\theta = 0$: z = 6.58, p = 0.00

Random-effects REML model

C

Fig. 4 Shows the association between prolonged EDLOS overcrowded ED (**A**), delays in laboratory test results (**B**) and delays in radiologic imaging test results (**C**). **CI** represents confidence interval; when odds ratio (OR) < 1 it represents negative relationship, when OR = 1 then it indicates no association and when OR > 1 then it represents positive relationship

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departments (EDs) had a 5.25 times higher probability of experiencing longer EDLOS compared to their counterparts. This finding has been consistently supported by similar investigations [39–41]. This could be because overcrowded EDs can make it difficult for doctors and nurses to provide quick ED care [42–44]. According to research, there is a bidirectional synergistic relationship between ED overcrowding and prolonged EDLOS. Both crowding and delays in ED care have been identified as significant predictors of patient outcomes [34, 45]. As a result, this data implies that efforts should be made to address overcrowding the emergency departments of Ethiopian hospitals'.

Similarly, patients with delayed laboratory findings had a 3.12 times greater chance of having a prolonged EDLOS than their counterparts. This finding is supported by other similar investigations [33, 46, 47]. Timeliness in reviewing test results is dependent on the availability of laboratory test tools and timely processing of laboratory tests [47]. Therefore, decreasing the turnaround time for laboratory work and analyzing test results can help reduce EDLOS and ED crowding.

Additionally, compared to their counterparts, patients who experienced delays in radiology imaging results had a 3.00-fold higher likelihood of prolonged EDLOS. Similar researche studies have also supported this finding [24, 48]. A lack of radiological imaging capability may exacerbate delays in imaging for inpatients in the emergency department (ED) [33]. Therefore, increasing radiological imaging capacity has the potential to generate cost savings due to the rising demand for advanced imaging among inpatients. This, in turn, can help reduceturnaround times, lengths of stay, and hospital expenses [49].

The review highlights a significant association between prolonged EDLOS and delays in laboratory test results, as well as radiology imaging results. This finding strongly suggests the importance of implementing point-of-care testing and imaging to effectively address these issues [50–52]. A variety of diagnostic procedures required in EDs can be performed at the point of care, such as glucose, cardiac markers, urinanalysis, metabolic testing, and cardiac troponin assessment [53, 54]. Point -of -care ultrasonography (POCUS) is one type of point- of- care imaging technology. It is a widely used rapid diagnostic tool in various fields, with particular significance in emergency care [52].

Strength and limitation of the review

This systematic review and meta-analysis attempted to include all available evidence, including published and gray literatures, from Ethiopia to ensure comprehensiveness and representativeness of the findings. However, it is important to note that all the studies included in this review employed a cross-sectional study design, which can be considered as a limitation. Consequently, for a more accurate interpretation of the results, it would be beneficial to consider the limitations inherent in the original studies.

Conclusion

The review revealed high rate of prolonged EDLOS, with a pooled prevalence of 63.67%. The following variables showed a statistically significant association with prolonged EDLOS: overcrowding, delays in receiving lab test results, and delays in receiving imaging test results. Considering the high prevalence of prolonged EDLOS identified in this review, stakeholders should prioritize efforts to improve the timeliness of ED services in Ethiopia. Measures should be implemented to reduce ED rcrowding and minimise delays in obtaining results from laboratory and imaging tests such as proper disposition of nonemergency palliative patients to the appropriate destination, and implementation of point-of-care testing and imaging.

Abbreviations
CI   Confidence Interval
ED   Emergency Department
EDLOS   Emergency Department Length of Stay
ICU   Intensive Care Unit
OR   Odds Ratio

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12873-024-01131-6.

Supplementary Material 1

Data availability
No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate
Not applicable.

Consent for publication
Not Applicable.

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