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Prevalence of hematological malignancies in Africa: A systematic review and meta-analysis

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Hematological malignancies are a class of neoplasms that include a variety of diverse diseases that all develop from and change into lymphatic and bone marrow cells. Hematological malignancies significantly contribute to illness and mortality in African nations. The prevalence of these malignancies has not been evaluated in this continent. The purpose of this systematic review and meta-analysis was to assess the pooled prevalence of hematological malignancies in Africa. From October to November 2023, the electronic databases PubMed, Google Scholar, Web of Science, Research Gate, Embase, and Scopus were extensively searched to identify pertinent research. The Newcastle–Ottawa Quality Scale for cross-sectional studies was used to assess the quality of the included studies. The analysis tool used was STATA-14. To calculate the pooled prevalence of hematological malignancies, a random effects model was used. Heterogeneity was measured by using the I^2 value. Subgroup analysis was conducted for country, age of study subjects, population type, study design, and publication year. We evaluated publication bias through the implementation of a funnel plot and Egger's test and conducted a sensitivity analysis. A total of 34 published articles including 43,099 study participants were included. The pooled prevalence of hematological malignancies was 27.30%. There was high heterogeneity, with an I^2 value of 99.2%. Leukemia had the highest pooled prevalence (53.69%) among the hematological malignancy types, followed by lymphoma (38.36%). According to subgroup analysis conducted in African countries, Kenya had the highest pooled prevalence (44.69%). On the other hand, the lowest pooled prevalence reported in Nigeria (20.52%). Furthermore, the age-based subgroup analysis of the study participants revealed that children had a greater pooled prevalence of hematological malignancies than adults (60.92% vs. 17.02%), respectively. In African populations, the pooled prevalence of hematological malignancies was 27.30%. This suggests that there is a significant prevalence of hematological malignancy, necessitating regular monitoring and accurate diagnosis.

Trial registration **PROSPERO CRD42023427152.**

Keywords Hematological malignancy, Leukemia, Lymphoma, Prevalence, Systematic review, Africa

Abbreviations

ALL	Acute lymphocytic leukemia
AML	Acute myeloid leukemia
CLL	Chronic lymphocytic leukemia
CML	Chronic myeloid leukemia
HL	Hodgkin lymphoma
NHL	Non-Hodgkin lymphoma

Hematological malignancies, along with other forms of cancer, are emerging as a significant public health concern and a global priority due to their increasing impact on illness and death rates. These types of cancer

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now account for approximately one-fifth of the most commonly identified cancer types and rank as the second leading cause of cancer-related deaths[1–3].

A class of neoplasms known as hematological malignancies comprises a wide range of disorders that start with lymphatic and bone marrow cells and then transform into these cells. Malignancies, which are clonal diseases, induce independent cell division, lower normal hemopoietin levels, and invasion of organs and tissues[4,5].

The World Health Organization (WHO) divided hematologic malignancies into myeloid neoplasms, lymphoid neoplasms, mast cell disorders, and histiocytic neoplasms based on the role that cell lines play in neoplastic transformation[6,7]. Different neoplasms are described and characterized using a combination of biological features, immunophenotype, genetic, and clinical features of the patients[8]. There are several different types of hematological malignancies that can be classified, including leukemia, lymphoma, multiple myeloma, myelodysplastic syndrome, polycythemia vera (PV), myeloproliferative neoplasms (MPNs), and primary myelofibrosis[9,10]. Acute and chronic forms of leukemia can be distinguished by a variety of factors, including the type of cells involved, their differentiation, morphology, cytochemical characteristics, and immunephenotyping[11,12]. Acute leukemia includes acute myeloblastic leukemia (AML) and acute lymphoblastic leukemia (ALL), whereas chronic leukemia includes chronic lymphocytic leukemia (CLL) and chronic myeloid leukemia (CML)[5,13,14].

The most prevalent type of leukemia in children is ALL. However, only approximately 25% of adult ALL cases affect the T-cell phenotype, while in approximately 75% of cases, the remaining cases affect the B-cell phenotype[15].

Chronic leukemia is characterized by the unregulated proliferation and growth of mature, differentiated hematopoietic system cells in the bone marrow and peripheral circulation[9]. Myeloid hematopoietic cell lines, which include granulocytes, monocytes, erythrocytes, and megakaryocytes, are affected by a collection of heterogeneously associated disorders, is chronic myeloid leukemia[16]. However, chronic lymphocytic leukemia affects mature lymphoid cells with B and T-cell phenotypes[17].

Lymphoid malignancies, such as lymphoma can affect lymph nodes and/or other extramedullary locations. The two types of lymphomas are often categorized as Hodgkin lymphoma (HL) and non-Hodgkin lymphoma (NHL), and both are managed using quite different approaches. While the vast majority of NHLs have mature B, T, or natural killer cell phenotypes, up to 25% of childhood NHLs originate from precursor (immature) lymphoblasts. Extramedullary myeloid proliferation is uncommon and typically occurs in AML, in which case myeloid sarcomas (extramedullary accumulation of myeloid blasts) are present. With the exception of Langerhans cell histiocytosis, which is seen considerably more frequently, especially in children, and whose neoplastic character is debatable, histiocytic and dendritic cell neoplasms are typically rare[11,12].

The etiology of hematological malignancies is not fully understood. Numerous risk factors, including benzene, formaldehyde, organic solvents, agricultural pesticides and herbicides, smoking, prior chemotherapy and radiation therapy for cancer, immunological and genetic disorders, and infection with oncogenic retroviruses, have been linked to the development and increased risk of hematological malignancies in epidemiological studies[5,18].

According to a global cancer statistics report, it was estimated that there was a total of 437,000 new cases of leukemia and 309,000 deaths related to cancer from leukemia worldwide by 2018. There were nine cancer-related deaths[19]. Leukemia accounted for 3.4% of all new cancer cases and 3.8% of all cancer-related deaths worldwide in 2020[20]. The burden of hematological malignancy was also high in Africa reported by studies done in Africa. Hematological malignancies can affect anyone at any age, but children and elderly people are the most susceptible. Men have slightly higher prevalence rates of leukemia than women do for all types of the disease, and these disparities may be impacted by factors such as geography and ethnic origin like Africa region[18].

The impact of hematological malignancies in developing countries is high due to early death of children, loss of family, loss of productivity due to a disability, afflicted patients and their families psychologically, and high medical cost that affects the socioeconomic and health welfare of the population. The prevalence of these malignancies has been studied in different parts of the world, but little is known of their prevalence in the Africa. Also, the prevalence of hematological malignancies in Africa has not yet been reviewed by a formal national census or national health registry. In addition, there has been few meta-analysis reports globally[21,22]. However, these studies predominantly reported the pooled prevalence of hematological malignancy among specific study populations. Through our searching, this may be the first meta-analysis and systematic review of the pooled prevalence of hematological malignancies in Africa. Therefore, evaluating the pooled prevalence of hematological malignancies in the African population is the primary goal of this analysis.

Methods

Reporting and protocol registration

This systematic review and meta-analysis adhered to the guidelines set by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)[23]. The research protocol was registered in the International Prospective Register of Systematic Reviews (PROSPERO) under the registration number CRD42023427152.

Search strategy and study selection

All articles regarding hematological malignancies were retrieved through a systematic search of electronic databases such as PubMed/Central, Google Scholar, Web of Science, and Scopus from October to November 2023 and to ensure the presence of recently published additional articles, online data bases and grey literatures were rechecked again from February 3rd to 7th, 2025. Additionally, grey literatures were scrutinized from African Journal Online (AJOL), WHO IRIS, Hinary, university repositories and ResearchGate websites. To ensure comprehensiveness, a direct Google search was performed using the reference lists of the included studies to uncover additional pertinent studies that may have been overlooked during the electronic database searches. To

identify other pertinent studies that were missed during the electronic database searches, a snowball search was also carried out utilizing the bibliographies of the identified studies. An exhaustive search strategy was employed using the condition, context, population, and outcome of interest (CoCoPop) framework to formulate questions, and all eligible studies were accessed by employing Medical Subject Headings (MeSH) terms and combination keywords including prevalence, distribution and magnitude, "hematological malignancy", leukemia, lymphoma and cancer and Africa. Boolean operators ("OR" and "AND") were used as necessary in the advanced search databases for finding all relevant papers. Detailed article search strategies and search engines were indicated in (Supplementary file 1). Studies that overlapped and were found in several databases were excluded. Duplicate studies were excluded, and four separate reviewers independently screened the titles and abstracts of all possibly eligible studies. Then, the full texts of potentially eligible studies that reported the prevalence of hematological malignancies were added to the collections for extraction. Disagreements among the authors during data extraction were resolved by discussion.

The eligibility criteria

Original articles that reported the prevalence of hematological malignancies among the African population were included. In addition, the study diagnosis of hematological disease by clinical and laboratory methods (complete blood count and peripheral morphology and/or bone marrow and/or cytochemistry and/or cytogenetic and/or molecular and/or immunophenotyping) were included. Also, the studies classified hematological malignancy by FAB (French-American-British) or WHO classification criteria were included. Only studies reported in English were included. However, case reports, editorial letters, and review articles were not included.

Outcome variables

The outcome variable for this study is the pooled prevalence of hematological malignancies among African populations.

Data extraction

Four reviewers worked independently to extract data from the eligible studies into Microsoft Excel sheets. The information extracted from each study included the name of the first author, publication year, region, study subjects, study characteristics, study design, sample size, prevalence of hematological malignancies, prevalence of leukemia, prevalence of lymphoma, prevalence of multiple myeloma, prevalence of myeloproliferative and prevalence of different types of leukemia and lymphoma.

Risk of bias assessment

Three evaluators conducted a thorough assessment of the methodological and substantive quality of eligible studies was assessed using the Newcastle–Ottawa Quality Scale for cross-sectional studies. The critical appraisal checklist was applied during the assessment, considering studies with an average quality score of 50% or more (star 5–9) as being of high and moderate quality (low risk of bias) and consequently included in the analysis. However, the studies that had low quality scores were excluded from the analysis. The three reviewers (ZM, SA and HD) independently conducted quality assessments and meticulously verified their results. Any discrepancies were resolved through in-depth discussions and cross-verification of data. If consensus could not be reached, a senior reviewer (AG) provided the final decision.

Statistical analysis

A Microsoft Excel worksheet was used for the data extraction, and STATA version 14 with metan commands was used for the meta-analysis. The point estimate and 95% confidence interval of the prevalence of hematological malignancies for the included studies were calculated. Due to the high heterogeneity reported, the national pooled prevalence of hematological malignancies was calculated using a random-effects model. The DerSimonian–Laird method was used to estimate the between-study variance. Cochrane's Q test and I^2 statistics were used to estimate the percentage of variability in effect estimates due to heterogeneity rather than chance alone to assess heterogeneity[21]. Subgroup analysis was performed by country, publication year, age of the study subject, population type as general population (suspected hematological malignancy) and cancer case (diagnosed as cancer and suspected to cancer), and study design. Meta-regression was also performed for possible sources of heterogeneity for country, publication year, study population, age of the study subject as children (age < 18 years) and adult (age ≥ 18 years), and sample size. Furthermore, the presence of publication bias was evaluated by visually examining the symmetry of the funnel plot and analyzing the statistical outcomes of Egger's test[22,23]. A sensitivity analysis was conducted to evaluate the influence of an individual study on the overall combined effect size.

Results

Selection and identification of studies

A total of 1293 records were found after a systematic search of studies on the prevalence of hematological malignancies. After conducting a thorough screening for duplication and eligibility, a total of 34 studies met the inclusion criteria for this systematic review and meta-analysis. All phases of the procedure were conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA checklist 2020) indicated in (Supplementary file 2)[24] (Fig. 1).

Study characteristics

A total of 34 articles were included in this systematic review and meta-analysis a from various countries in the Africa, including 13 studies in Nigeria[24–36], 8 studies in Ethiopia[37–44], 6 studies in South Africa[45–50], 2 studies

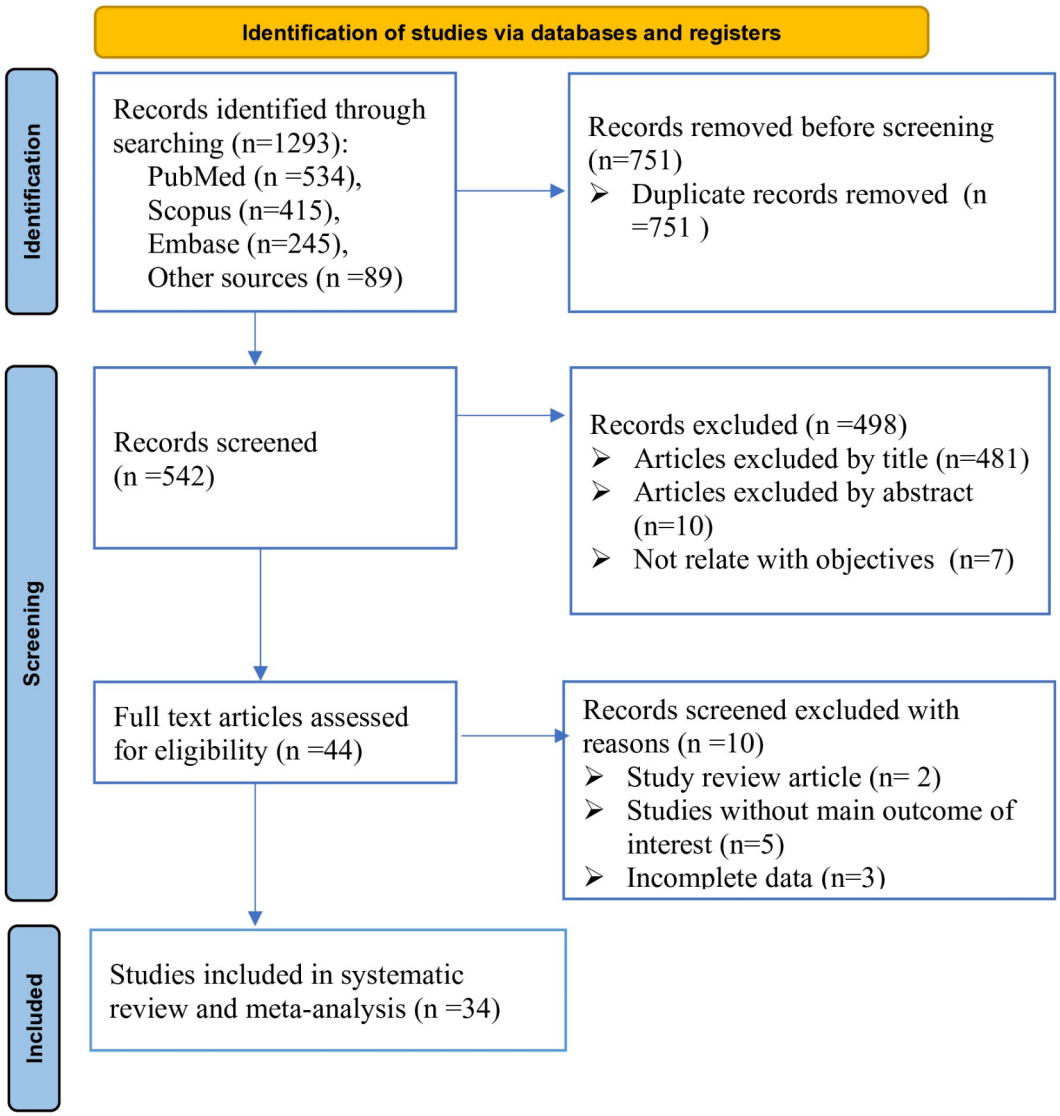

Fig. 1. Flow diagram of the included studies for the systematic review and meta-analysis.

in Kenya[51,52], 1 study in Tanzania[53], 1 study in Togo[54], 1 study in eastern Morocco[55], 1 study in Eritrean[56] and 1 study in Zimbabwe[57] (Fig. 2). The studies involved 43,099 study participants. The sample sizes of the studies ranged from 71[39] to 12,671[40]. All the included studies employed retrospective study designs, except for 3 studies. Out of the 34 studies that were included in this systematic review and meta-analysis, 20 studies included participants from all age groups, while 16 studies specifically focused on individuals diagnosed with cancer. Of the 34 studies included in this systematic review and meta-analysis, 25 reported the prevalence of hematological malignancies, while 31 articles reported the prevalence of leukemia with 5470 cases and 26 articles reported the prevalence of lymphoma that consists of 6740 cases. From the total, 10 studies diagnose hematological malignancy through bone marrow examination, 9 studies use basic lab tests (CBC and peripheral morphology) along with bone marrow examination, 3 studies additionally use immunohistochemistry, and 3 studies also incorporate imaging (X-ray and ultrasound) (Table 1). Every study that was included had a quality score higher than fifty percent or from star 5–8. The studies evaluated by Newcastle-Ottawa Quality Scale for cross-sectional studies the result showed that 22 studies had high qualities (7–8 stars) and 12 studies had moderate qualities (5–6 stars) (Supplementary file 3).

Prevalence of hematological malignancies

In this systematic review and meta-analysis, the pooled prevalence of hematological malignancies in Africa was 27.307% (95% CI 22.39–32.21%). Overall, the prevalence of hematological malignancies among the African population is variable, ranging from 7.0% reported in Nigeria (2022) to 71.88% reported in South Africa (2023). There was high heterogeneity, with an I^2 of 99.2% (Fig. 3).

Fig. 2. Geographical distribution of hematological malignancy. Map showing Africa countries for which data were included in the systematic review and meta-analysis created using https://www.mapchart.net/world-subdivisions.html. The different color shading indicates the prevalence of hematoloogical malignancy in each country.

The pooled prevalence of the type of hematological malignancy

In this review, when considering different types of hematological malignancies, leukemia had the highest pooled prevalence of 53.69%, followed by lymphoma with a prevalence of 38.36%. Multiple myeloma accounted for only 12.27% of the patients. Among the various subtypes of leukemia, chronic myeloid leukemia (CML) had the highest pooled prevalence at 27.47%, followed by chronic lymphocytic leukemia (CLL) at 27.25%. Conversely, acute myeloid leukemia (AML) had the lowest pooled prevalence among the subtypes of leukemia (19.74%). Among the lymphoma types, non-Hodgkin lymphoma (NHL) had the highest pooled prevalence, representing 66.01% of the cases (Table 2).

Author/year	Study period	Study area	Country	Age of participant	Study population	Sample size	No. of HM cases	Prevalence of HM	No. of leukemia	No. of lymphoma	No. of MM	No. of MP	No. of unspecifid HM	Reference
Getachew et al. (2001)	1988–1999	western Ethiopia	Ethiopia	All age	lymph case					83*				37
Babatunde et al. (2008)	1996–2005	Ilorin	Nigeria	All age	cancer case	2050	370	18.05	98	250	22			24
Akinbami et al. (2009)	2001–2008	Lagos	Nigeria	All age	hematology malignancy		81**		54	17	10			25
Okinda et al. (2010)	2003–2006	Khan	Kenya	All age	General population	356	97	27.25	68	20	9			51
N IA et al. (2010)	1999–2008	Benin	Nigeria	All age	cancer case	2368	412	17.40	164	198	34	16		26
Tadesse et al. (2013)		2008–2011	Gondar	Ethiopia	Adult	Hematology malignancy		67**		40	24	3		38
Stefan et al. (2014)	2003–2010	Namibia	South Africa	All age	cancer case	191	66	34.55	43	23				45
Mostert et al. (2015)	2006–2010	Western kenya	Kenya	Children	cancer case	398	246	61.81	81	165				52
Kueviakoe (2015)	1992–2013	Lome	Togo	All age	General population	1511	469	31.04	316		134		19	54
Yifru et al. (2015)	2010–2013	Gondar	Ethiopia	Children	cancer case	71	43	60.56	13	8			22	39
Tigeneh et al. (2015)	1988–2010	Tikur Anbesa	Ethiopia	All age	cancer case	12,671	1141	9.00						40
Babatunde et al. (2016)	2006–2015	Ilorin	Nigeria	All age	cancer case	2249	181	8.05	119	42	20			27
Errahhali et al. (2016)	2008–2012	Eastern morrocco	Eastern Morocco	All age	cancer case	6075	660	10.86	207	367	86			55
Chinembiri et al. (2017)	2004–2013	Zimbabwe	Zimbabwe	All age	leukemia case				601***					57
Egesie et al. (2017)	2000–2015	Jos	Nigeria	Adult	cancer case	1706	330	19.34	213	99	18			28
Inamasu et al. (2018)	2004–2013	Soweto	South Africa	Adult	hematology malignancy		1880**		487	1010	325	45	13	46
Oelofse et al. (2018)	2004–2013	Cape Province	South Africa	All age	hematology malignancy		3603**		1103	1801	465	234		47
Solomon et al. (2018)	At 2015	Addis Abeba	Ethiopia	Children	cancer case	3707	1841	49.66	1069	772				41
Belai et al. (2019)	2015–2017	National health Lab	Eritrean	All age	General population	207	52	25.12	50		2			56
Kingsley et al. (2019)	2009–2018	Cross river	Nigeria	Adult	cancer case	1314	138	10.50	65	54	17	2		29
Nwagu et al. (2019)	2011–2018	Delta State	Nigeria	Adult	cancer case	1431	169	11.81	70	69	27	3		30
Leak et al. (2020)	2016–2019	Kilimanjaro	Tanzania	Adult	hematology malignancy		209**		96	70	43			53
Kassahun et al. (2020)	Jan, 2019–April 30, 2019	Jimma	Ethiopia	All age	General population	332	31	9.34	30			1		42
Wilson et al. (2020)	2015–2019	KwaZulu-Natal	South Africa	Adult	General population	120	53	44.17	24	13	16			48
Babatunde et al. (2020)	2005–2018	Ilorin	Nigeria	All age	General population	496	323	65.12	187	60	57	19		31
Enawgaw et al. (2021)	2015–2019	Gondar and Bahirdar	Ethiopia	All age	hematology malignancy		1342**		95	1247				43
Abdullah et al. (2021)	2015–2018	Cape Town	South Africa	All age	HIV–patients	374	74	19.79	35	20		19		49
Dachi et al. (2021)	2018–2020	North eastern Nigeria	Nigeria	All age	cancer case	601	71	11.81	47	20	4			32
Out et al. (2021)	2005–2020	NorthCentral Nigeria	Nigeria	All age	cancer case	2655	328	12.35	184	88	32	24		33
Ugwu et al. (2021)		2012–2020	South-Eastern Nigeria	Nigeria	Adult	hematology malignancy		135**		65	49	10	11	34
Onoja et al. (2021)	2012–2019	Tertiary Health Facility	Nigeria	Adult	BM aspiration ordered	158	78	49.37	53	8	8	9		35
James et al. (2022)	2018–2020	Yola	Nigeria	All age	cancer case	1286	90	7.00	53	31	6			36
Ebrahim et al. (2022)	2020–2021	Dessie	Ethiopia	Adult	General population	228	26	11.40	22		4			44
Ndlovu et al. (2023)	1994–2014	Cape Town	South Africa	Children	cancer case	544	391	71.88	259	132				50

Table 1. Characteristics of the included studies. *HM* hematological malignancy, *MM* multiple myeloma, *MP* myeloproliferative agent, *BM* bone marrow. NB; *indicates only reported the prevalence of lymphoma types, **indicates not reported the prevalence of hematological malignancies, ***indicates only reported the prevalence of leukemia types.

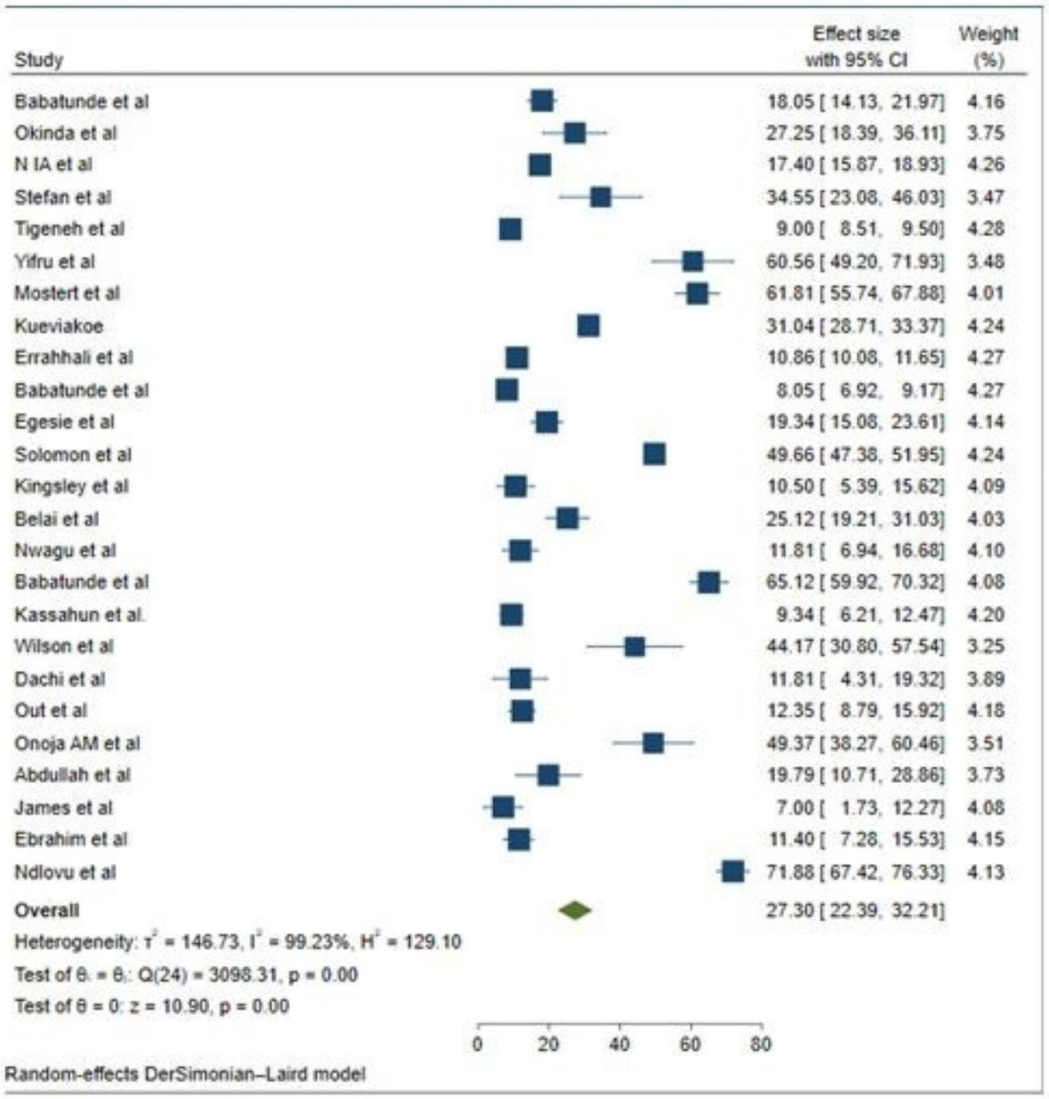

Fig. 3. Forest plot of hematological malignancies in Africa.

Subgroup analysis

Subgroup analysis of various African countries revealed that the highest pooled prevalence of hematological malignancies, 44.69% (95% CI 10.82, 78.55), was observed in Kenya, followed by 42.76% (95% CI 14.31–71.21) in South Africa. On the other hand, Nigeria reported the lowest pooled prevalence of 20.52% (95% CI 13.56–27.48). Furthermore, when considering the publication year of the studies, the highest pooled prevalence of 39.05% (95% CI 20.80, 57.29) was reported in the period of 2011–2015, followed by 25.04% (95% CI 15.65–34.44) in 2016–2020. The lowest prevalence of 18.81% (95% CI 15.37–22.25) was reported in studies published prior to 2011. The pooled prevalence of hematological malignancies was 60.92% (95% CI 48.26–73.57) among children and 17.02% (95% CI 10.55, 23.49) among adults. Similarly, the pooled prevalence of hematological malignancies was 28.34% (95% CI 11.83–44.85) among the general population and 23.97% (95% CI 21.79–32.13) among specific groups. Based on diagnostic criteria, the highest pooled prevalence of hematological malignancy detected at diagnosis by bone marrow examination alone was 36.59% (95% CI 21.81–51.37), while the lowest prevalence, 12.81% (95% CI 9.02–16.59), was observed when immunohistochemistry was included. The presence of low heterogeneity (34.80%) was noted in studies diagnosing hematological malignancy through the incorporation of immunohistochemistry (Table 3).

Meta-regression

The meta-regression showed that the most significant source of heterogeneity was the age of the study subject ($p < 0.001$) (Table 4).

Types of HM	No. of studies	Pooled prevalence (95%CI)	I^2	*P* value
Leukemia				
Total	31	53.69 (45.02–62.35)	99.3%	< 0.001
AML	28	19.74 (14.86–24.63)	96.0%	< 0.0001
CML	28	27.47 (21.70–33.24)	95.6%	< 0.0001
ALL	28	23.52 (13.54–33.49)	99.0%	< 0.0001
CLL	28	27.25 (22.26–32.25)	97.2%	< 0.0001
Lymphoma				
Total	26	38.36 (28.12–48.59)	99.4%	< 0.0001
HL	24	27.90 (19.86–35.93)	90.6%	< 0.0001
NHL	24	66.01 (56.72–75.30)	92.2%	< 0.0001
Other	10	14.78 (7.18–22.38)	85.8%	< 0.0001
Multiple myeloma	23	12.27 (9.92–14.62)	90.3%	< 0.0001
MP neoplasm	12	5.53 (3.69–7.36)	89.5%	< 0.0001
Unspecified HM	3	8.55 (2.25–14.86)	96.5%	< 0.0001

Table 2. The pooled prevalence of the type of hematological malignancy in Africa. *HM* hematological malignancy, *AML* acute myeloid leukemia, *CML* chronic myeloid leukemia, *ALL* acute lymphocytic leukemia, *CLL* chronic lymphocytic leukemia, *HL* Hodgkin lymphoma, *NHL* non-Hodgkin lymphoma, *MP* myeloproliferate.

Publication bias

In this review, both the symmetry of the funnel plot and the results of Egger's test ($P = 0.003$) indicated the existence of publication bias (Fig. 4). So, nonparametric trim and fill analysis was performed.

Trim-and-fill analysis of the pooled prevalence of hematological malignancies in Africa

Due to the detection of publication bias, a non-parametric trim and fill analysis was conducted. When trimming and filling analysis was conducted using a random model, fourteen studies were imputed, and the total number of studies was thirty nine. Following the inclusion of those additional studies, the revised pooled prevalence of hematological malignancies in Africa was 10.90% (95% CI 1.42–20.39%) (Table 5) and (Fig. 5).

Heterogeneity exploration and sensitivity analysis

To assess the possible sources of heterogeneity, a Galbraith plot was computed and indicated that one study was found outside of the 95% CI or not found between 2 and − 2 (Fig. 6). But, according to the sensitivity analysis, the exclusion of individual studies did not significantly affect the overall pooled prevalence of hematological malignancies. The pooled effect size, when any single study was omitted, remained within the 95% confidence interval of the overall pooled effect size. This suggests that the absence of any particular study did not have a substantial impact on the overall pooled prevalence of hematological malignancies (Fig. 7).

Discussion

This meta-analysis and systematic review aimed to determine the total frequency of hematological malignancies in Africa. This thorough study revealed that the pooled prevalence of hematological malignancies in Africa was 27.30%. The results of this systematic review and meta-analysis were consistent with those of a study conducted in the UK, which reported a prevalence of 29% for hematological malignancies among COVID-19 patients[58]. In contrast, our analysis revealed a greater prevalence of hematological malignancies among patients in Iran[59]. Another systematic review reported a prevalence of 14% for hematological malignancies among patients with membranous nephropathy[21], and a review reported a prevalence of 16.5% for hematological malignancies among patients with SARS-CoV-2 infection[22]. On the other hand, the prevalence of hematological malignancies among COVID-19 patients was lower than the findings of a study that reported a pooled prevalence of 34.3%[60] and a study conducted in Pakistan where the prevalence was found to be 45.36%[61]. These variations in prevalence could be attributed to differences in sample size, study population, geographical location, sociodemographic factors, type of sample, and diagnostic methods.

In this systematic review and meta-analysis, we found that among the different types of hematological malignancies, leukemia had the highest pooled prevalence (53.69%), followed by lymphoma (38.36%). While this provides valuable epidemiological insights, further investigation of potential risk variables such as ethnicity, genetic susceptibility, history of viral infections (e.g., EBV and HTLV-1), and environmental exposures may improve the interpretation of our findings. Understanding these characteristics may aid in the development of more specific prevention efforts, early detection programs, and focused public health interventions to lower the burden of hematological malignancies. This finding aligns with a study conducted in Pakistan (2019) among adults[61] as well as studies conducted in Bangladesh (2014) among patients of all ages[62] and in India (2008)[63]. However, in contrast to our findings, a study conducted in Bangladesh (2020)[64] and Latin America (2019)[65] among adult patients, as well as a worldwide study[66], reported that lymphoma neoplasm was the most common hematological malignancy. The variation in these findings could be attributed to differences in sample size, study

Sub group	No. of studies	Pooled prevalence (95%CI)	*P* value	Heterogeneity test (I^2)	Heterogeneity b/n groups (*P* value)
Country					
Ethiopia	5	27.59 (8.38–46.80)	< 0.001*	99.7%	0.156
Nigeria	11	20.52 (13.56–27.48)	< 0.001*	98.2%	
Kenya	2	44.69 (10.82–78.55)	< 0.001*	97.5%	
South Africa	4	42.76 (14.31–71.21)	< 0.001*	97.6%	
Total pooled	22	27.29 (20.82–33.76)	< 0.001*	99.3%	
Region					
West African	12	21.47 (14.40–28.54)	< 0.001*	97.61	0.217
East African	8	31.53 (15.96–47.11)	< 0.001*	98.5	
South Africa	4	42.76 (14.31–71.21)	< 0.001*	99.54	
Total pooled		28.21 (22.12–34.29)	< 0.001*	99.25	
Publication year					
≤ 2010	3	18.81 (15.37–22.25)	0.098	56.9%	0.013*
2011–2015	5	39.05 (20.80–57.29)	< 0.001*	99.4%	
2016–2020	10	25.04 (15.65–34.44)	< 0.001*	99.4%	
Above 2020	7	26.16 (5.96–46.36)	< 0.001*	99.0	
Total pooled	25	27.30 (22.39–32.21)	< 0.001*	99.2%	
Study design					
Cross sectional	2	14.76 (8.25–21.27)	0.022*	80.9%	0.001*
Retrospective	23	28.46 (23.26–33.65)	< 0.001*	99.3%	
Total pooled	25	27.30 (22.39–32.21)	< 0.001*	99.2%	
Age of study subject					
All ages	15	19.76 (15.96–23.56)	< 0.001*	98.5%	< 0.001*
Adults	6	17.02 (10.55–23.49)	< 0.001*	86.5%	
Children	4	60.92 (48.26–73.570)	< 0.001*	96.3%	
Total pooled	25	26.13 (22.39–32.21)	< 0.001*	99.2%	
Population type					
General population	5	28.34 (11.83–44.85)	< 0.001*	99.0%	0.876
Specific group	20	26.97 (21.79–32.13)	< 0.001*	99.2%	
Total pooled	25	27.30 (22.39–32.21)	< 0.001*	99.2%	
Diagnostic criteria					
Basic and BM examination	9	27.76 (16.49–39.03)	< 0.001*	98.68%	< 0.001*
BM examination only	10	36.59 (21.81–51.37)	< 0.001*	99.51%	
Add Immunohistochemistry	3	12.81 (9.02–16.59)	0.216	34.80%	
Add Imaging	3	10.49 (8.00–12.98)	< 0.001*	91.39%	
Total pooled	25	27.30 (22.39–32.21)	< 0.001*	99.2%	
Quality of study					
High quality	17	24.77 (18.15–31.39)	< 0.001*	99.32%	0.305
Moderate quality	8	33.46 (18.23–48.69)	< 0.001*	99.07%	
Total pooled	25	27.30 (22.39–32.21)	< 0.001*	99.2%	

Table 3. Subgroup analysis of hematological malignancies. *BM* Bone marrow, *statistically significant.

Variables	Coefficient	Standard error	*p* value	95%CI
Study area	0.887	1.956	0.957	0.009–45.973
Publication year	1.488	1.546	0.732	0.159–13.190
Study population	0.003	0.001	0.154	0.001–63.368
Study design	1.30	1.28	0.365	0.029–6.229
Age of study subject	2.853	1.240	< 0.001*	1.373–6.692
Sample size	0.997	0.001	0.115	0.994–1.001

Table 4. Meta-regression analysis of hematological malignancies. *Statistically significant; *CI* confidence interval.

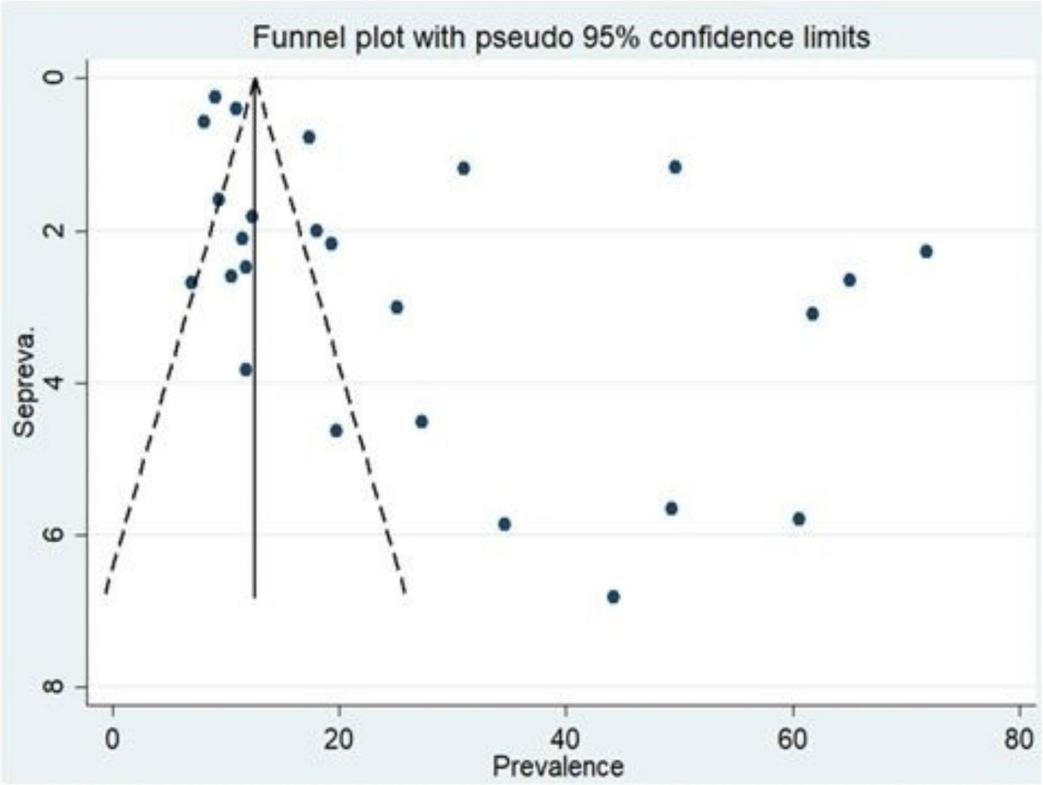

Fig. 4. Funnel plot of publication bias.

Studies	Pooled est	95% CI		No. of studies
		Lower	Upper	
Observed	27.30	22.39	32.21	25
Observed + Imputed	10.90	1.42	20.39	39

Table 5. Trim and fill analysis of the prevalence of hematological malignancies in Africa.

population, geographical location, sociodemographic factors, type of sample, age groups included in the study, and methods of diagnosis.

In this systematic review and meta-analysis, among the leukemia types, the most common was CML (27.47%), followed by CLL (27.25%). This review is similar to a study conducted in India (2016)[67]. However, the most prevalent type of leukemia was acute myeloid leukemia in studies conducted in Pakistan (2019) among adults[61], Bangladesh (2014)[62], Bangladesh (2010)[68] and India (2008)[63]. The possible justification for this variation might be the variations in sample size, study population, sociodemographic pattern, and age of the study subject.

According to the current systematic review and meta-analysis, among the lymphoma types, the most common was NHL (66.01%). These findings are similar to those of studies conducted in Bangladesh (2014)[62], worldwide[66], Korea (2012) and India (2012)[69]. Therefore, NHL was the most common type of lymphoma in this review and other studies.

Our result revealed significant heterogeneity in pooled prevalence, which might be attributed to various factors. As a result, we performed post hoc subgroup analysis according to many factors, including country, publication year, study design, age of the study subject and population type. Variations in the prevalence of hematological malignancies were observed in different African countries; the highest pooled prevalence of 44.69% was observed in Kenya, and the lowest pooled prevalence was reported in Nigeria (20.52%). This discrepancy might be ethnicity, target population, sample size, type of sample, participants' immunological status and method of diagnosis. Subgroup analysis by publication year revealed that the highest pooled prevalence was reported in 2011–2015 (30.67%), while the lowest prevalence was recorded in years after 2011 (18.81%). This variation it might be target population, sample size, and diagnostic criteria. Finally, the subgroup analysis by the age of the study subjects revealed that the highest pooled prevalence of hematological malignancies was among children (60.92%), and the lowest pooled prevalence was among adults (17.02%). This difference might be type of sample, participants' immunological status and method of diagnosis.

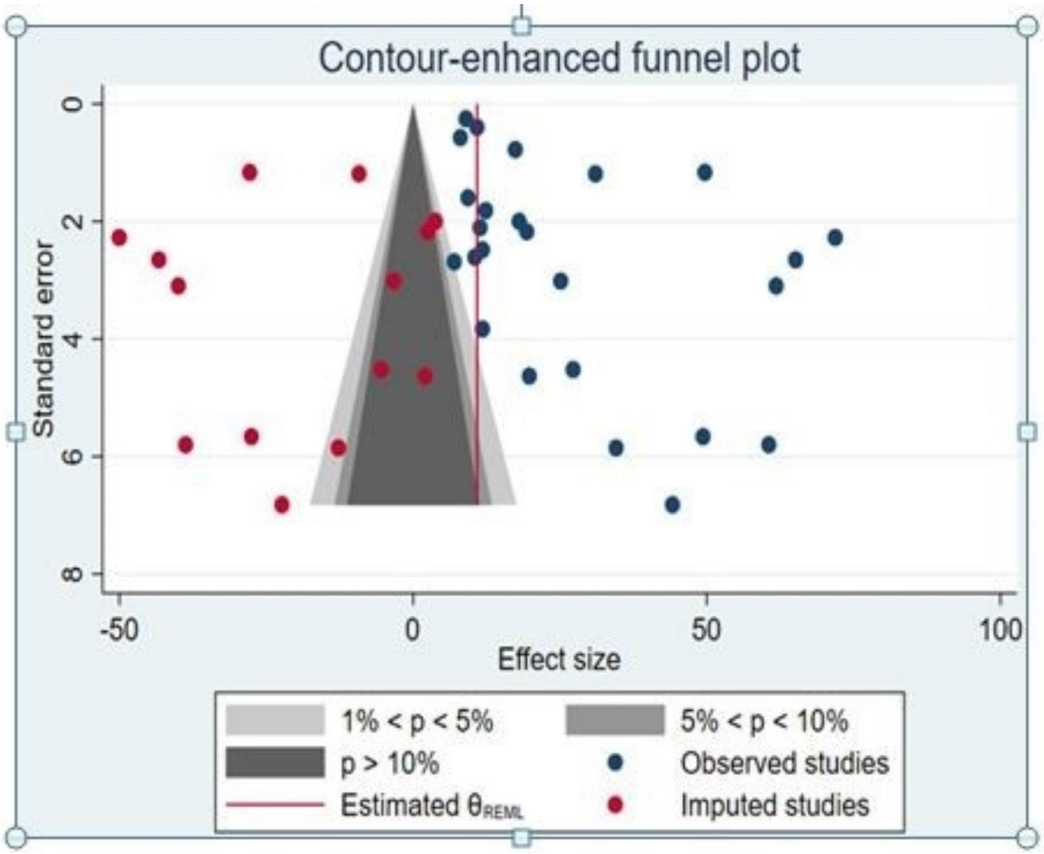

Fig. 5. Contour- enhanced Funnel plot of trim and fill analysis.

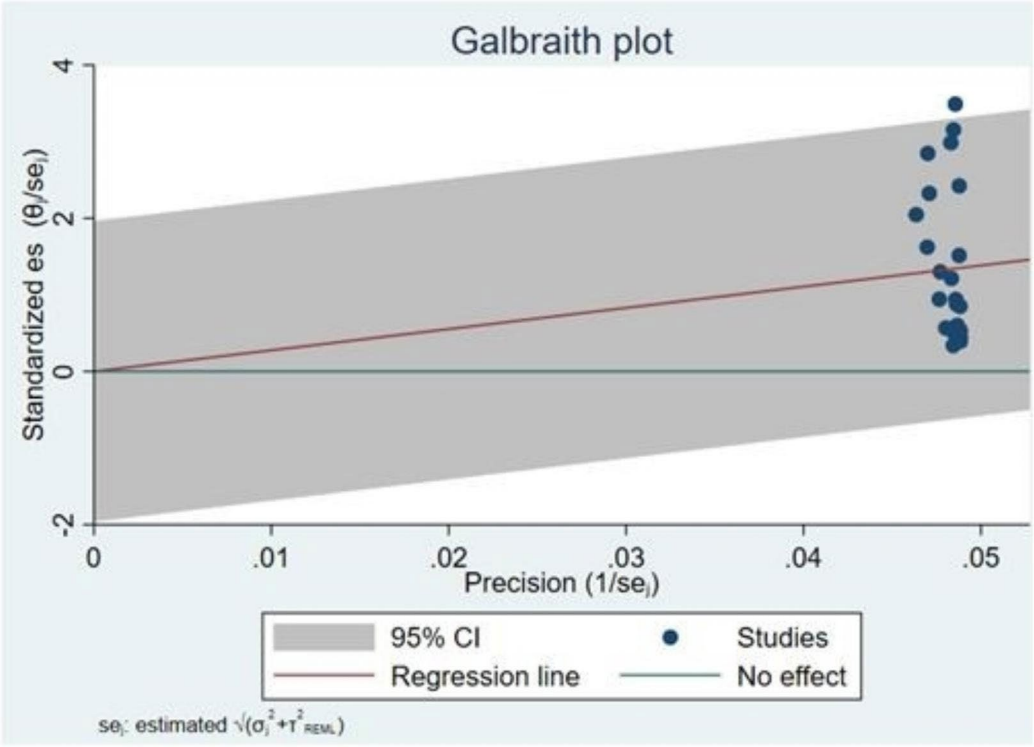

Fig. 6. Galbraith plot of hematological malignancies in Africa.

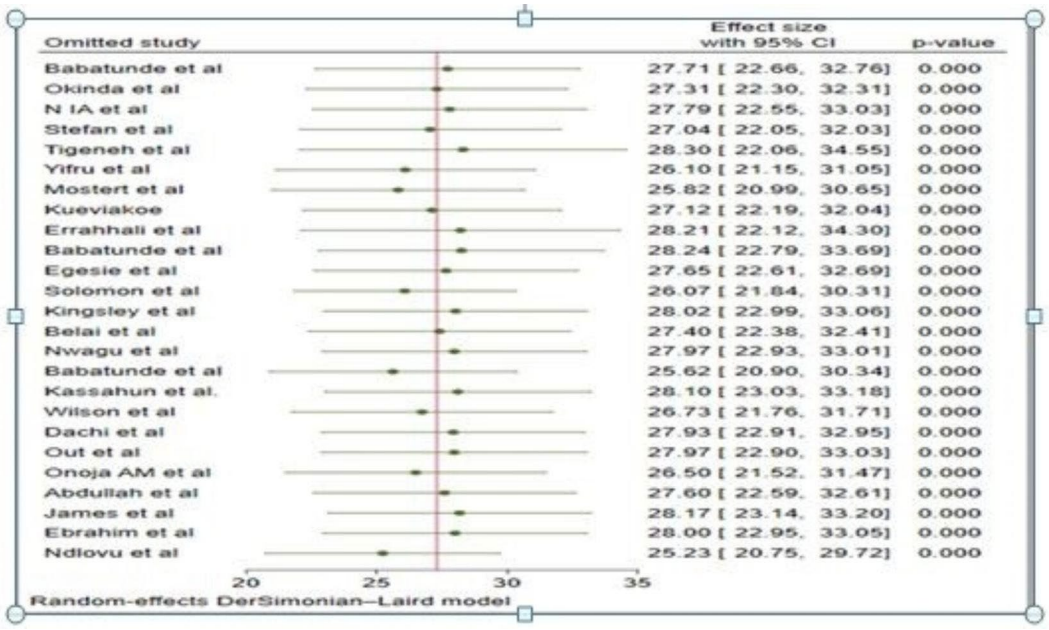

Fig. 7. Sensitivity analysis of hematological malignancies in Africa.

The subgroup analysis based on diagnostic criteria revealed that low heterogeneity (34.80%) was observed in studies diagnosing hematological malignancy through the incorporation of immunohistochemistry. Therefore, the variability in diagnostic criteria may be the cause of heterogeneity. The subgroup analyses based on publication year, country, study design, age of the study subject and population type may not fully elucidate all underlying factors contributing to heterogeneity in the pooled prevalence. Variations in study populations, including differences in demographic characteristics, ages, sex, participants' immunological status, and diagnostic criteria for hematological malignancy across different regions, could introduce heterogeneity. Furthermore, changes in assay methodologies, laboratory protocols, and equipment calibration may lead to heterogeneity in hematological malignancy diagnosis among studies, potentially altering the pooled prevalence. Unmeasured confounding variables, such as comorbidities, and lifestyle factors, could also influence study outcomes and contribute to heterogeneity in the pooled prevalence. The meta-regression also showed that the most significant source of heterogeneity was the age of the study subject.

The publication bias was identified in this systematic review and meta-analysis by the symmetry of the funnel plot and the Egger's test results. Hence, trim and fill analysis was computed. The pooled prevalence of hematological malignancy was 10.90% following a trim and fill analysis that included fourteen additional studies. The trim-and-fill analysis of the final model (Observed and imputed model) revealed a significant decline in pooled prevalence of hematological malignancies in Africa. This further suggests that evidences reporting lower estimates may be underrepresented in the literature. Thus, the current finding might overestimate the true prevalence of hematological malignancies in Africa. However, the findings of the sensitivity analysis showed that no single study had an impact on the pooled effect size. By eliminating each study in turn, the pooled prevalence of hematological malignancies was determined, and the resulting computed pooled prevalence was within 95% confidence intervals of the total pooled prevalence. Generally, the findings of the present study suggested that further large-scale studies are required and that there is a need for special concerns for high-risk groups to minimize the risk of hematological malignancies.

There are various limitations to this research. First, all the listed studies were conducted in Africa. To begin with, the publications included in this meta-analysis were primarily from a small number of countries, which may have introduced geographical bias. There was high heterogeneity amongst the studies, which may have influenced the results' interpretability. Despite doing subgroup analyses, the heterogeneity persisted except diagnostic criteria, implying that potential confounding factors impacting the pooled prevalence were not adequately examined in this meta-analysis. In addition, only research published in English were included, which may have resulted in language bias. These limitations may have an impact on the conclusions in this research for the overall prevalence of hematological malignancies in Africa. Another limitation is that most studies included in the meta-analysis were conducted using a retrospective study design. I recommend that researchers conduct prospective studies.

Conclusion

The pooled prevalence of hematological malignancies in Africa was 27.30%, according to this systematic study and meta-analysis. This encourages clinicians to consider hematological malignancies to request appropriate standard testing to confirm suspected hematological malignancies and treat those patients early. This study highlights the necessity of regular monitoring and accurate diagnosis of hematological malignancies in Africa.

Given the limited healthcare resources and diagnostic facilities in many regions, routine surveillance can help track disease prevalence, identify high-risk populations, and support early detection efforts. Accurate diagnosis is crucial for ensuring appropriate treatment, as misdiagnosis or delays can lead to poor clinical outcomes. Implementing advanced diagnostic techniques, such as immunophenotyping and molecular methods, alongside strengthening healthcare infrastructure, is essential for improving patient survival and informing effective public health strategies. Furthermore, it serves as a wake-up call to international, continental, and national health bureaus, as well as other stakeholders, to develop targeted prevention and control strategies for hematological malignancy disorders. This review also provides useful information for policymakers and other stakeholders. Furthermore, the data could be used for future complementary research and evidence-based decision-making. I recommend that researchers conduct prospective studies and diagnose hematological malignancies using advanced techniques such as cytogenetics, immunophenotyping, and molecular methods.

Data availability

Data is provided within the manuscript or supplementary information.

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Author contributions

Z.M. conceptualized , wrote the manuscript and assess quality. D.M.B., B.E., T.G., and M.T. search and extrac-

tion were carried out. S.A . and H.D. conducted the quality assessment of the included studies. E.A., D.M.B. and Y.K. performed statistical analysis and interpretation of the data. H.E., E.A., and A.G. prepared Fig. 1–6. All the authors read and approved the final manuscript.

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Declarations

Ethical approval and consent to participate
Ethical approval and consent to participate were not required because this was a systematic review and meta-analysis that did not involve human or animal experiments.

Competing interests
The authors declare no competing interests.

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