Review Article

Suicidal behaviors and associated factors among medical students in Africa: A systematic review and meta-analysis

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ABSTRACT

Background: Suicide behaviors are common among medical students, and the prevalence rates might vary across various regions. Even though various systematic reviews have been conducted to assess suicidal behaviors among medical students in general, no review has ever assessed or carried out a sub-analysis to show the burden of suicidal behaviors among African medical students which was fulfilled in the present study.
Method: A systematic review and meta-analysis of prevalence studies among African medical students from *PubMed, Scopus, PsycINFO, African Journals Online,* and *Google Scholar* databases. A total of 204 publications were identified. The studies' selection, data extraction, and methodological evaluation were performed, and meta-analysis was performed based on the random effects model.
Results: Data were obtained from 14 eligible studies, including 8585 medical students in Africa. The pooled prevalence of lifetime suicidal behaviors was 18.7% for suicidal ideation (95% CI: 14.1%-23.3; $I2 = 94.37\%$; $p < 0.001$), 3.8% for suicidal plans (95% CI: 2.7%-4.8%; $I2 = 0.03\%$; $p < 0.001$), and 5.5% for suicide attempts (95% CI: 3.8%-7.2%; $I2 = 89.47\%$; $p < 0.001$). The factors associated with suicidal ideations were female gender, use of alcohol, depression, and use of khat. Only depression was associated with suicide attempts.
Limitations: The review involved few studies, and not all African regions were represented.
Conclusion: Suicidal behaviors, particularly suicide attempts, are high among medical students in Africa. However, very few studies are done in the region to clearly quantify the burden and its associated factors.

1. Introductions

Suicidal behavior is a complex term that includes suicidal ideation (thoughts of ending one's life), suicide plans (organizing or planning to die by suicide), and suicide attempts (self-injurious behaviors with a non-fatal outcome) (World Health Organisation 2014). Globally the rate of suicide has increased over the years, especially in low-and middle-income countries such as countries in Africa (World Health Organisation 2021; Yip et al., 2021). Over the period of 1990–2019, a 365% suicide death increase was reported in lower-middle-income countries, which resulted from population growth and population age structure

(World Health Organisation 2021; Yip et al., 2021).

Over the past 130 years, suicide rates of medical students have been reportedly higher than the general population, with some estimates up to many times higher (Blacker et al., 2019). For instance, suicide death per 100,000 people among male physicians is 40% higher than in the general public, whereas it is 130% higher among female physicians than in the general public (World Health Organisation 2021; Yip. 2021). Such increment can be because medical degrees are among the most stressful academic degrees; medical students are more likely to report having mental health problems than general students (MacLean et al., 2016; Faruk et al., 2021). In addition, previous meta-analyses have reported a

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high prevalence of suicidal behaviors among university students ranging from 9.0% to 9.7%, especially among medical students (Rotenstein et al., 2016; Tsegay et al., 2020; Crispim et al., 2021; Demenech et al., 2021; Satinsky et al., 2021).

The high prevalence of suicidal behaviors among medical students is replicated in practicing physicians since the behaviors are believed to have started in medical school (Dutheil et al., 2019; Duarte et al., 2020). The high prevalence in the medical students and health professionals is attributed to the high levels of stress and burnout as they go through during medical school and because they have a very demanding profession (Rukundo et al., 2019; Mamun et al., 2020; Kaggwa et al., 2021a; Kajjimu et al., 2021). Other factors that are responsible for increasing suicidal behavior risks among medical students include depression, sleeping difficulties, living away from home, substance abuse, fatigue, poor social support, anxiety, thoughts of dropping out, history of physical assault, history of sexual or physical abuse, parental neglect, academic difficulties, living alone, having demanding parents, cigarette smoking, family history of mental illness, family history of suicidal behaviors, experiencing difficulty with clerkship, financial burden, alcohol use, use of khat, and internet addiction (Alpaslan et al., 2015; Desalegn et al., 2020; Seo et al., 2021).

Even though various systematic reviews have been conducted to assess suicidal behaviors among medical students and university students in general, no review has ever assessed or carried out a sub-analysis to show the burden of suicidal behaviors among African medical students. Also, no meta-analysis for the factors associated with suicidal behaviors among African medical students has previously been conducted despite the various studies reporting on suicidal behaviors in Africa (Okasha et al., 1981; Ovuga et al., 2006; van Niekerk et al. 2008; Ahmed et al., 2016). Therefore, the present systematic review and meta-analysis were carried out to identify the prevalence of suicidal behaviors and its associated factors among African medical students.

2. Methods

2.1. Study design

The present systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Moher et al., 2009) and the Meta-analysis of Observational Studies in Epidemiology (MOOSE) guidelines for systematic review and meta-analysis of observational studies (Stroup et al., 2000). The review was registered in PROSPERO #CRD42022308622.

2.2. Review question

The review question was formed according to the Joanna Briggs Institute (JBI) mnemonic, the CoCoPop (Condition, Context and Population) (Munn et al., 2015). The *condition* was suicidal behavior (suicidal ideation, plan, attempt, and/or suicide), the *context* was Africa, and the *population* was medical students. Therefore, the review question was: "What is the prevalence of suicidal behaviors (suicidal ideation, plan, attempt, and/or suicide) among medical students in Africa?"

2.3. Search strategies

With the help of the university liberian at the Mbarara University of Science and Technology, relevant databases were used for the literature search, including *PubMed, Scopus, PsychInfo (Psychological Information), African Journals Online,* and *Google Scholar.* The review included papers from inception to January 2022. The following keywords were used in the literature search: (i) suicidal behaviors (suicide, attempted suicide, suicidal ideation, suicidal plan, suicidality, completed suicide, dying by suicide, and self-murder), (ii) medical students (medical students, pre-clinical students, student doctors, student physicians, undergraduate medics, clinical students, medical residents, medical trainee, and health

professional students), and (iii) the list of all countries in Africa (Worldometer 2022). In the review, the papers from *Google Scholar* were downloaded after inspection for paper eligibility from the first 100 pages. Supplementary Table 1, has the detailed search strategies from the different databases. Additional files were included from previous systematic reviews, including papers from Africa and citations of the included papers. The collection of papers in the databases took place in the month of January 2022.

2.4. Inclusion and exclusion criteria

The review included papers of all languages reporting the prevalence of suicidal behaviors among medical students in Africa. The papers in French were screened and entered by a member of the research team (AF) from a French-speaking country – Burundi. Papers in other languages (other than English and French) were translated using *Google Translate*. The review included cross-sectional studies, case series, case reports, and cohort studies. Papers concerning university students that did not specify the exact number of medical students with suicidal behaviors were excluded. Review papers, commentaries, and letters were also excluded.

2.5. Study selection procedure

All identified papers ($n = 204$) were entered into *Endnote 9* to ascertain duplicates. After removing duplicates ($n = 14$) and review papers or commentary or letters ($n = 7$), two independent members on the team selected papers for inclusion based on title, abstract, and reporting of suicidal behaviors. A total of 163 papers did not meet the inclusion criteria, while six papers were among healthcare students but did not specifically have results about suicidal behaviors among medical students and one study (Kaggwa et al., 2021b) reported completed suicides in an African country - Uganda. Consequently, only 14 papers remained for full paper review after a discussion between research team members. Among the 14 included papers, only 11 were downloadable. The full version of three papers (Ovuga et al., 1996; Vaz et al., 1998; Alem et al., 2005) could not be assessed. The papers were included for a quality check using the JBI checklist for prevalence studies (Joanna Briggs Institute 2017), as used in other systematic reviews (Kaggwa et al., 2021a). All 11 papers were included in the final synthesis. Additionally, three further papers (Ovuga et al., 2006; Meron 2017; Barrimi et al., 2021) were identified from citations of the included papers. For details, see PRISMA 2020 flowchart (Fig. 1).

2.6. Data management and extraction

A pre-designed *Google Forms* checklist collected the following information: first author, title, year of publication, abstract, study design (cross-sectional, cohort, and case-series), paper quality assessment questions based on JBI, countries, universities, type of students (pre-clinical, clinical, undergraduate, postgraduate, and interns), year of data collection, age of participants, number of male and female participants, number of students per class, number of students with suicidal behaviors (ideation, plans, and attempts), tools/questions used to assess for suicidality, factors for suicidal behaviors, reasons for suicide attempts, the severity of attempts, methods used for suicidal behaviors (plan, attempt, and suicide), location of suicide/suicide attempt, where to get weapon used for suicide, family history of suicide attempt/suicide, and family history of mental illness.

2.7. Risk of bias evaluation and quality assessment of the included papers

The JBI checklist was used to evaluate the risk of bias and quality of the included papers (Joanna Briggs Institute 2017). The JBI uses a four-point with the answers of "no", "yes", "unclear", and "not applicable", for the following questions (1) appropriateness of the sample frame; (2)
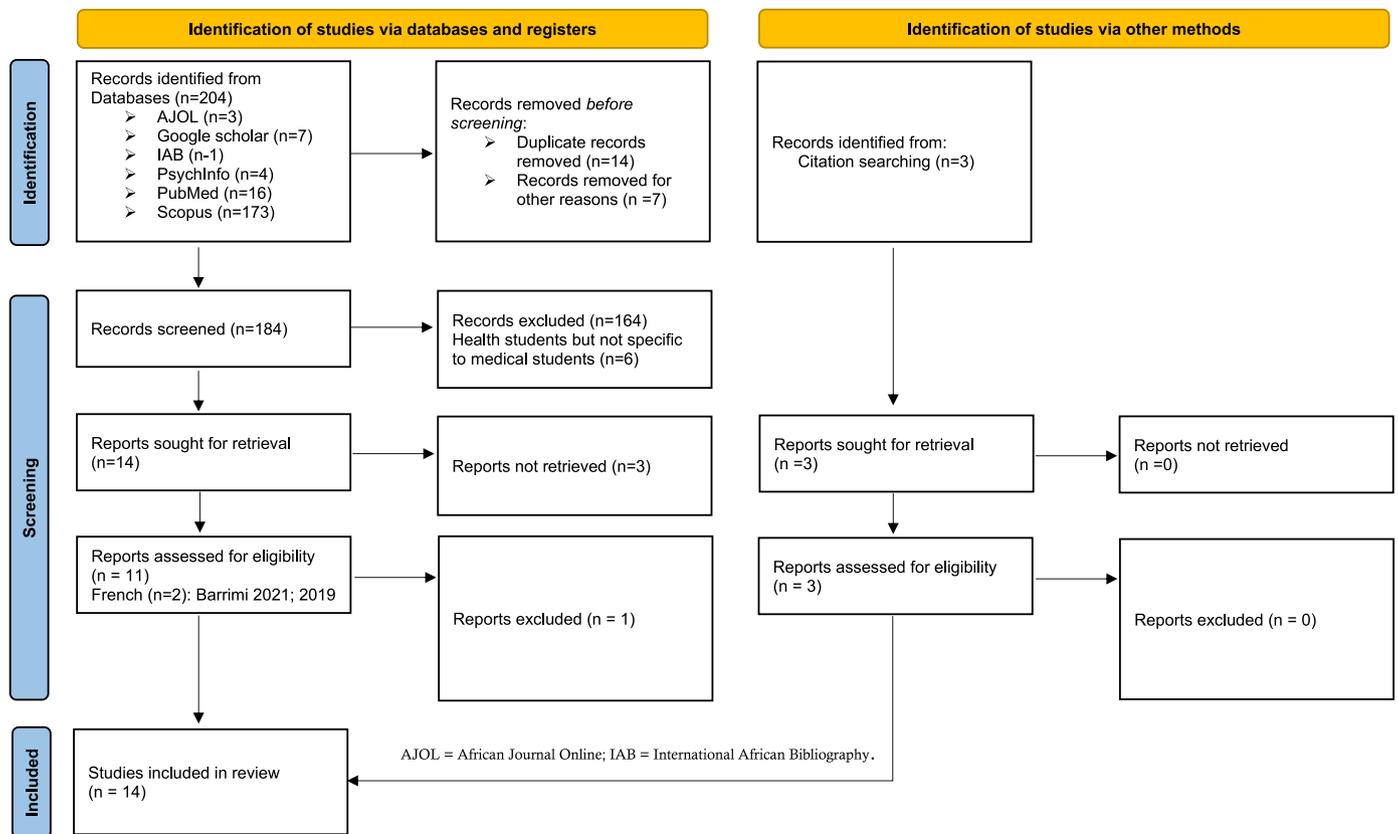
Fig. 1. PRISMA flowchart.

recruitment procedure; (3) adequacy of the sample size; (4) description of subjects and setting; (5) description of the identified sample; (6) validity of the methods used to screen for suicidal behaviors; (7) reliability of the methods used to screen for suicidal behaviors; (8) adequacy of statistical analyses; and (9) response rate. Papers were assigned one point per 'yes' response and the rest were assigned zero; therefore, the total score ranged between 0 and 9. Articles with a score of 4 and above will be considered good quality (Table 1).

2.8. Ethical aspects

Since the review used already published data involving human participants, ethical approval was not needed.

2.9. Data analysis

Microsoft Office 2016 (Microsoft Inc., Washington, USA) and STATA 16.0 software (StataCorp LLC, College Station, Texas, USA) were used for statistical analysis. Descriptive statistics and qualitative narrative analysis were used to present individual study characteristics and participant characteristics. Based on the number of students who had the different suicidal behaviors, a random effect meta-analysis was performed using STATA version 16.0 in built *meta* command to determine the pooled prevalence of suicidal behaviors. Random-effects model attempted to generalize findings beyond the included studies by assuming that the selected studies are random samples from a larger population (Cheung et al., 2012). The Cochran's Q statistic and I^2-statistic were used to evaluate between-study heterogeneity. An $I^2 > 75\%$ accounted for the heterogeneity among the studies. The results were presented on forest plots and funnel plots were generated to visually assess for publication bias. Subgroup analysis was performed for sub-Sahara vs. non-sub-Sahara African countries, country income status (low, lower-middle, and upper-middle-income countries), country,

regions of Africa (Eastern, Western, Central, Eastern, and Southern Africa), and COVID-19 pandemic period (pre-pandemic vs. during the pandemic). When at least two studies reported data on the factors associated with suicidal behaviors, a random effects meta-analysis was performed to estimate the overall effect of the identified factor using odds ratio (OR) and reported confidence intervals. The log odds ratio were analyzed and then back-transformed. The *p*-values were two-tailed, and were considered statistically significant if the *p*-value was <0.05. The factors associated with suicidal behaviors were tabulated.

3. Results

3.1. Characteristics of the studies and the participants

Of the 207 papers identified from the literature search, 14 studies involving a total of 8585 medical students in Africa were eligible for this review. The identified papers were published between 1981 and 2021 from seven African countries (Egypt, Ethiopia, Libya, Morocco, South Africa, Tunisia, and Uganda), and the country with the most studies was Ethiopia (*n* = 6 studies). Data used in these studies were collected between 1978 and 2020, with only two studies conducted during the COVID-19 pandemic. From the 14 studies that reported gender, a clear female predominance was noted (4845 female students vs. 3232 male students). The pooled mean age of the participants from eight studies that reported a mean age was 22.14 years (SD±3.30). Most of the medical students were from the fifth year (1395 students), and the total number of married medical students was 215. A total of 101 medical students were reported to have a history of suicide in the family, and 168 had a history of mental health illness in the family.

Table 1

Characteristics of the studies, study participants and prevalence of suicidal behaviors in the individual studies included in the review.

Study	Study design (JBI score)	Year of data collection	Country (university)	Sample size	Gender: M (F)	Age: mean (±SD)	Year of study	Married	Family history of suicide	Family history of mental illness	Lifetime suicidal ideation	Lifetime suicidal plan	Lifetime suicidal attempt	Screening instrument used
Okasha et al. (1981)	CS (6)	1978	Egypt (Ah-Shams Medical School)	516							64 (past 12 months=28)		3	
Ovuga et al. (2006)	CS (7)	2002	Uganda (Makerere university)	101	70 (31)	23.5 (± 5.0)	Year 1 = 101				9 (past week=1)			Response Inventory for Stressful Life Events – A 'yes' response to the two questions in the tool were considered for presence of suicide ideations
van Niekerk et al. (2008)	CS (9)	2007	South Africa (University of Pretoria)	416	152 (251)		Year 1 = 96; Year 4 = 149; Year 5 = 95; and Year 6 = 76	29			75 (serious severe ideation=34)		21	
Ahmed et al. (2016)	CS (9)	2016	Egypt (Ainshams University and Cairo University)	612	190 (442)	21.2 (±1.60)	Year 1 = 151; Preclinical students=223; and clinical students=238				78	22 (past 48 h = 17)		Beck Suicidal Ideation Scale (above 24)
Barrimi et al. (2020)*	CS (7)	2017	Morocco (Universite' Mohammed V – Souissi; Université Hassan II – Ain Chok; Université Cadi Ayyad; Universite' Sidi Mohamed Ben Abdellah; Université Mohamed Ier; Université Ibn Zohr; Université Abdelmalek Essaadi)	600	240 (360)	23 (±3.7); range-17–43	Year 1 = 78; Year 2 = 324; and Year 3 = 198				188		30	
Meron (2017)	CS (9)	2017	Ethiopia (Addis Ababa University)	291	166 (125)	<20=88; 21–25=190; >25=13	Year 1 = 58; Year 2 = 51; Year 3 = 39; Year 4 = 47; Year 5 = 43; and Interns = 43				42			
Tsegay et al. (2021)	CS (9)	2018	Ethiopia (Addis Ababa University)	390	232 (158)		Year 1 = 74; Year 2 = 80; Year 3 = 92; Year 4 = 73; and Year 5 = 71	5					32	

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Table 1 (*continued*)

Study	Study design (JBI score)	Year of data collection	Country (university)	Sample size	Gender: M (F)	Age: mean (±SD)	Year of study	Married	Family history of suicide	Family history of mental illness	Lifetime suicidal ideation	Lifetime suicidal plan	Lifetime suicidal attempt	Screening instrument used
Asfaw et al. (2021)	CS (9)	2019	Ethiopia (Haramaya University)	523	362 (161)	23.6 (±2.36)	Year 1 = 58; Year 2 = 78; Year 3 = 89; Year 4 = 84; Year 5 = 99; and Year 6 = 115	57			120		22	The Module of the World Mental Health Survey Initiative Version of the WHO and CIDI (Composite International Diagnostic Interview)
Asfaw et al. (2020)	CS (9)	2019	Ethiopia (Haramaya University)	710	489 (221)	22.71 (±2.62)	Year 1 = 85; Year 2 = 116; Year 3 = 118; Year 4 = 112; Year 5 = 121; and Year 6 = 158	52	52 (32 with history of completed suicide)	68	208 (past 12 months=168)	28	45 (past 12 months=28; Previously attempted once=28; Previously attempted twice=15; and previously attempted more than twice=2)	The Module of the World Mental Health Survey Initiative Version of the WHO and CIDI (Composite International Diagnostic Interview)
Barrimi and Bouyahyaoui (2021)*	CS (9)	2019	Morocco (Oujda; Rabat; Casablanca; Fez; Marrakech; Tangier; and Agadir)	608	194 (414)	21.8 (±2.6)	Year 1 = 40; Year 2 = 85; Year 3 = 79; Year 4 = 100; Year 5 = 152; Year 6 = 52; and Year 7 = 100	45					51 (Once=20; several times= 31)	
Barrimi et al. (2021)	CS (9)	2019	Morocco (undergraduate, graduate and postgraduate medical students from Moroccan medical faculties)	605	284 (321)	21.8 (±2.6), range=16–35yrs							51	
Desalegn et al. (2020)	CS (9)	2019	Ethiopia (UoG College of Medicine and Health Sciences)	393	241 (152)	22.16 (± 1.86)	Year 1 = 28; Year 2 = 73; Year 3 = 107; Year 4 = 106; and Year 5 = 79;	25	33	50	55		29	
Fekih-Romdhane et al. (2021)	CS (9)	2019	Tunisia (University of Tunis)	390	100 (290)	Median=22 (IQR=1), range=20–28	Year 1 = 132; Year 2 = 130; and Year 3 = 128	2	16	50	Median = 7 (IQR = 13)		11	Suicidal Ideation Questionnaire (a threshold value of 41)
Elhadi et al. (2020)	CS (9)	2020	Libya (15 medical schools in the towns of Tripoli, Al-Zawia,	2430	511 (1919)		Preparatory=71, Year 1 = 262; Year 2 = 258; Year 3 = 345;				552			PHQ-9 Item 9 (A score above 1)

Table 1 (*continued*)

Study	Study design (JBI score)	Year of data collection	Country (university)	Sample size	Gender: M (F)	Age: mean ($\pm SD$)	Year of study	Married	Family history of suicide	Family history of mental illness	Lifetime suicidal ideation	Lifetime suicidal plan	Lifetime suicidal attempt	Screening instrument used
			Misrata, Sebha, Gharyan, Albayda, Benghazi, Al-Khums, Tarhuna, Alzintan, Tobruk, and Sabratha				Year 4 = 540; Year 5 = 734; and interns=220							

CS= cross-sectional study, M=male, F=Female, SD=standard deviation.

3.2. Tools used for the assessment of suicidal behaviors

Less than half of the studies used tools/instruments to access suicidal behaviors that included the Response Inventory for Stressful Life Events (Ovuga et al., 2006), Beck Suicidal Ideation Scale Events (Ahmed et al., 2016), Suicidal Ideation Questionnaire (Fekih-Romdhane et al., 2021), Item 9 of the nine-item Patient Health Questionnaire (PHQ-9) (Elhadi et al., 2020), and a module of the World Mental Health Survey Initiative version of the WHO and CIDI (Composite International Diagnostic Interview) (Asfaw et al., 2020; Asfaw et al., 2021) Table 1.

3.3. Prevalence of suicidal behaviors

3.3.1. Suicidal ideations

A total of 1391 (out of 6202) medical students had lifetime suicidal ideation reported in ten studies and the pooled prevalence was 18.7% (95% CI: 14.1%–23.3%; I^2=94.37%; $p < 0.001$) (Fig. 2). There was publication bias based on visual inspection of the funnel plot and only two studies were within the funnel (Supplementary Fig. 1). The estimated slope from Egger's test was −1.16 (standard error [SE]=4.868; $p = 0.8122$), suggesting no publication bias publication due to small study effects. Based on fill and trim, no study needed to be imputed, suggesting no publication bias. In addition, no study had significant effect on the pooled prevalence based on leave one out meta-analysis (Fig. 3).

At subgroup analysis, there were statistically significant differences between the country where the study was conducted (Q difference [QD]=92.43, $p < 0.001$) and region of Africa (QD=13.61, $p < 0.001$). However, the prevalence of suicidal ideations among medical students in sub-Sahara African countries was lower than that of the non-sub-Sahara African countries (Table 2). Of the students who had suicidal ideations, one study reported ideations in the past week (one out of the nine students with lifetime suicidal ideation) (Ovuga et al., 2006), but the pooled prevalence of suicidal ideations from the past 12 months was 14.5% (95% CI: −3.4%–32.4%; I^2=98.68%; $p < 0.112$) from two studies (Okasha et al., 1981; Asfaw et al., 2020).

3.3.2. Suicide plans

Two studies reported data on suicide plans among medical students in Africa (Ahmed et al., 2016; Asfaw et al., 2020), and a total of 50 (out of 1322) students reported suicide plans. The pooled prevalence was 3.8% (95% CI: 2.7%–4.8%; I^2=0.03%; $p < 0.001$) (Fig. 4). Because of the small number of studies reporting suicide plans, a subgroup analysis was not performed. A total of 17 (out of 612) students had thought about a suicide plan within the past 48 h (Ahmed et al., 2016).

3.3.3. Suicide attempts

A total of ten studies reported suicide attempts among medical students in Africa, and a total of 295 (out of 5151) students had attempted suicide in their lifetime. The pooled lifetime prevalence was 5.5% (95% CI: 3.8%–7.2%; I^2=89.47%; $p < 0.01$) (Fig. 5). There was publication bias based on visual inspection of the funnel plot (Supplementary Fig. 2). The estimated slope from Egger's test was 7.43 (SE=0.65; $p < 0.001$), suggesting publication bias due to small study effects. A sensitivity meta-analysis was performed for all studies within the funnel (Barrimi et al., 2020; Asfaw et al., 2021; Fekih-Romdhane et al., 2021). In subgroup analysis, there was a statistical difference with the country where the study was conducted (QD=66.45, $p < 0.001$). The pooled lifetime prevalence of suicide attempts was lowest in lower-middle-income countries compared to other-income countries (Table 2).

A total of 28 (out of 710) students attempted suicide in the past 12 months (Asfaw et al., 2020). The pooled prevalence of students who had one previous attempt was 3.6% (95% CI: 2.6%–4.6%; I^2=0.09%; $p < 0.001$) while those with more than one suicide attempt was 3.7% (95% CI: 1.0%–6.3%; I^2=83.92%; $p < 0.007$).
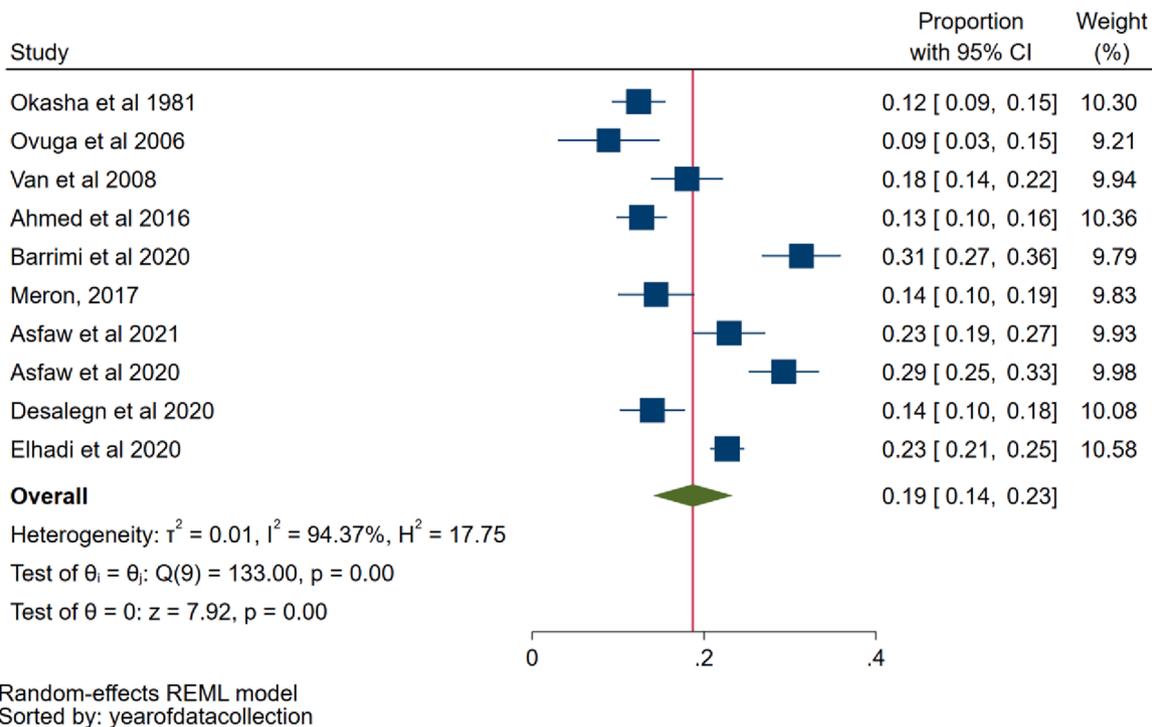
Fig. 2. Forest plot showing pooled prevalence of suicidal ideations among medical students in Africa.
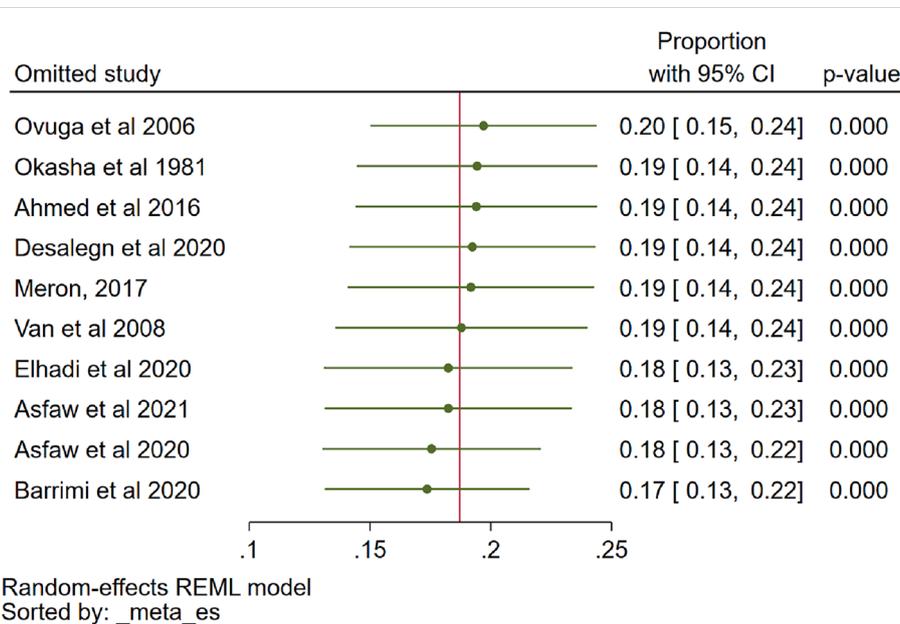

Fig. 3. Forest plot showing pooled prevalence of suicidal ideations among medical students in Africa following sensitivity analysis.

3.4. Reasons and severity of suicide attempts

A study by Asfaw et al. (2020) documented the reasons for suicide attempts among medical students as follows: death of family (16 students), family conflict (14 students), financial loss (10 students), physical illness (2 students), relationship problems (2 students), and mental illness (one student) (Asfaw et al., 2020). The same study reported 22 students experiencing serious suicide attempts, 21 students reported using ineffective methods, and two had to seek medical care due to their suicide attempt.

3.5. Methods used for considered for plan

The preferred methods for reported suicide plans in one study were overdosing on available medication ($n = 29$ students), shooting themselves with a gun ($n = 21$ students), cutting their wrists ($n = 20$ students), jumping from a high building ($n = 6$ students), and deliberately getting hit by a car ($n = 2$ students) (Ahmed et al., 2016).

3.6. Methods used for suicide attempt

The methods reported in two studies were: hanging ($n = 19$

Table 2

Subgroup analysis showing pooled prevalence of suicidal behaviors across different study characteristics.

Subgroup	Suicidal ideations				Suicide attempts			
	Number of studies	Prevalence (95% CI)	I^2 (p-value of Q)	Group difference: Q (p-value)	Number of studies	Prevalence (95% CI)	I^2 (p-value of Q)	Group difference: Q (p-value)
Country								
Egypt	2	12.6(10.5–14.7)	0(0.872)	92.43(<0.001)	1	0.6(−0.1–1.2)	N/A	66.45(<0.001)
Ethiopia	4	20.2(13.0–27.4)	92.21 (<0.001)		5	6.7(5.1–8.3)	62.10 (0.028)	
Libya	1	22.7(20.8–24.6)	N/A		0	–	–	
Morocco	1	31.3(26.9–35.8)	N/A		2	6.6(3.3–10.0)	81.07 (0.022)	
South Africa	1	18.0(13.9–22.1)	N/A		1	5.0(2.9–7.2)	N/A	
Tunisia	0	–	–		1	2.8(1.2–4.5)	NA	
Uganda	1	8.9(3.1–14.7)	N/A		0	–	–	
Region of Africa								
Northern	4	19.7(11.0–28.5)	97.34 (<0.001)	13.61(<0.001)	4	4.1(0.8–7.3)	94.87 (<0.001)	2.77(0.251)
South	1	18.0(13.9–22.1)	N/A		1	5.0(2.9–7.2)	N/A	
East	5	18.0(11.0–25.1)	92.62 (<0.001)		5	6.7(5.1–8.3)	62.10 (<0.001)	
Income status								
Low income	5	18.0(11.0–25.1)	92.62 (<0.001)	0.43(0.806)	5	6.7(5.1–8.3)	62.10 (0.028)	2.77(0.251)
Lower middle income	3	18.7(6.6–30.9)	97.45 (<0.001)		4	4.1(0.8–7.3)	94.87 (<0.001)	
Upper middle income	2	20.7(16.2–25.3)	76.02 (0.041)		1	5.0(2.9–7.2)	N/A	
Sub-Sahara region								
No	4	19.7(11.0–28.5)	97.34 (<0.001)	0.09(0.758)	4	4.1(0.8–7.3)	94.87 (<0.001)	1.65(0.198)
Yes	6	18.1(12.3–23.8)	90.88 (<0.001)		6	6.4(5.0–7.8)	58.78 (0.032)	
COVID-19 pandemic								
Pre-pandemic	9	18.2(13.1–23.4)	93.65 (<0.001)	2.59(0.108)	10	5.5(3.8–7.2)	89.47 (<0.001)	N/A
During the pandemic	1	22.7(20.8–24.6)	N/A		–	–	–	
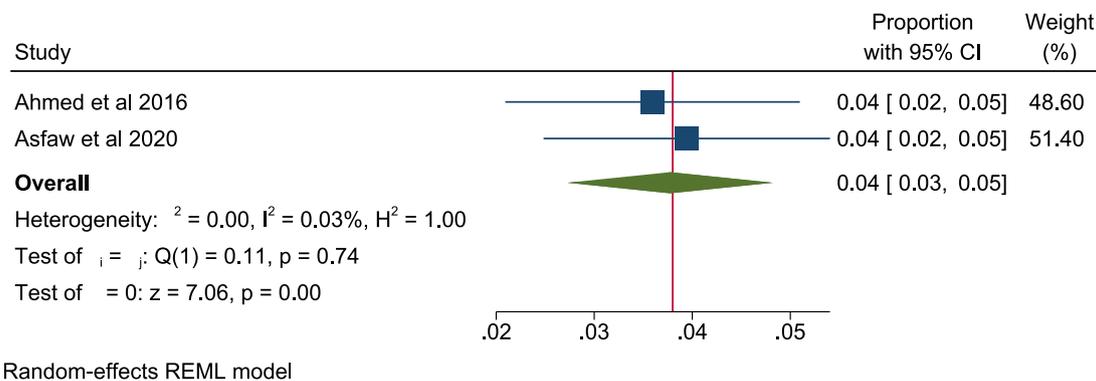
Fig. 4. Forest plot showing pooled prevalence of suicide plans among medical students in Africa.

students), poisoning (n = 22 students), use of a sharp tool (n = 2 students), drug overdose (n = 2 students), and an unspecified number of students who used self-strangulation and exsanguination (Asfaw et al., 2020; Fekih-Romdhane et al., 2021).

3.7. Factors associated with suicidal ideation and suicide attempts

3.7.1. Suicidal ideation

In many of the included studies, poor mental health, including depression and anxiety and use of addictive substances (especially alcohol and khat) were associated with suicidal ideation (Asfaw et al., 2020; Barrimi et al., 2020; Desalegn et al., 2020). Table 3. However, one study reported an association between female gender and suicidal ideation (Desalegn et al., 2020). Suicidal ideation decreased with a one-point increase in grade point average (Asfaw et al., 2020).

The meta-analysis showed that the female gender was significantly associated with suicidal ideation (odds ratio [OR]: 1.51, 95% CI: 1.09–1.92, I^2=19.72; Supplementary Fig. 3). Use of alcohol, depression, and use of khat were also significantly associated with having suicidal ideation (OR: 2.70, 95% CI: 1.78–3.62, I^2=29.24); (OR: 6.93, 95% CI: 4.81–9.15, I^2=<0.01); (OR: 2.40, 95% CI: 1.52–3.27, I^2=<0.01). However, a family history of mental illness was not associated with suicidal ideation (OR: 1.84, 95% CI: 0.93–2.74, I^2=4.41).

3.7.2. Suicide attempts

In most studies, poor mental health, including depression and anxiety, was associated with suicide attempts (Asfaw et al., 2020; Barrimi et al., 2020; Desalegn et al., 2020). Family history of mental illness and female gender were also associated with suicide attempts (Desalegn et al., 2020). The meta-analysis showed that depression was associated
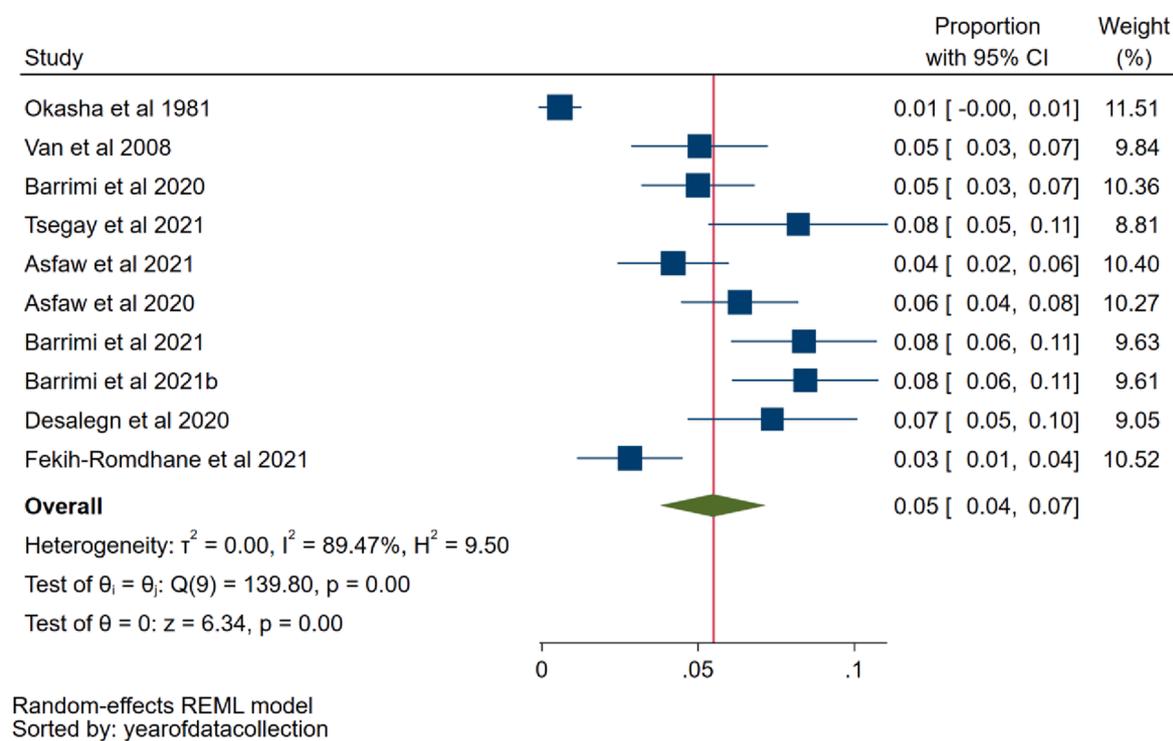
Fig. 5. Forest plot showing pooled prevalence of suicide attempts among medical students in Africa.

Table 3
Factors associated with suicidal behaviors from the included studies.

Study	Factors associated with suicidal ideation	Factors associated with suicide attempts
Asfaw et al. (2020)	Current use of alcohol, depression, anxiety, and poor social support. However, suicidal ideations decreased with one point increase of grade point average,	Depression, and anxiety
Desalegn et al. (2020)	Female gender, depression, Khat use	Female gender, depression, family history of mental illness
(Barrimi et al. (2020)	Poor mental health, and consumption of psychoactive drugs	Poor mental health

with suicide attempts (OR: 7.16, 95% CI: 2.39–11.94, I^2=<0.01). However, the female gender was not significantly associated with suicidal attempts (OR: 1.72, 95% CI: 0.75–2.69, I^2=29.24; Supplementary Fig. 5). Alcohol use (OR: 2.06, 95% CI: 0.79–3.34, I^2=<0.01) and khat use (OR: 2.17, 95% CI: 0.74–3.40, I^2=<0.01) were not associated with suicidal attempts.

4. Discussion

The present systematic review and meta-analysis indicated a modest (n = 14 studies), but growing body of research regarding suicidal behaviors among medical students in Africa. Also, culturally-related factors were associated with suicidal behaviors, such as the use of miraa/ khat [*Catha Edulis Forsk*] – plant leaves containing stimulants similar to amphetamine, commonly used in Africa, especially East Africa (Wabe 2011). However, research on factors associated with suicidal behaviors needs to expand because only three-quarters of the studies explored the factors associated with suicidal behaviors among medical students. In the present systematic review comprising 8586 medical students in Africa, the pooled prevalence of lifetime suicidal behaviors was 18.7% for suicidal ideation, 3.8% for suicide plans, and 5.5% for suicide attempts.

The lifetime pooled prevalence of suicidal ideation among medical students in Africa (i.e., 18.7%) is similar to that among physicians globally (i.e., 17%) (Dutheil et al., 2019). This suggests a continuum of mental health suffering from increasing suicidal ideation from medical school to practice, and it may be the contributor to the increasing suicide mortality rate among physicians (Dutheil et al., 2019; Duarte et al., 2020). Therefore, depleting the African health system with fewer individuals becoming physicians. The physician-patient ratio in the region is about 0.209 per 1000 individuals (The World Bank 2022). However, the lifetime prevalence of suicidal ideation (i.e., 18.7%) was much lower than for university students globally (27.1%) (Crispim et al., 2021). However, It was more than 9.1% among Brazilian undergraduate students (Demenech et al., 2021), and than systematic review and meta-analysis findings from PhD students ranging from 2% to 12% (Satinsky et al., 2021). This indicates the impact of the intense stressful life of students while in medical school on their mental health compared to other learners.

These high prevalence rates show the growing burden of suicide behaviors among university students. Despite the fact that the large difference with other types of students concerning lifetime prevalence of suicidal ideation, past-year suicidal ideation (i.e., 14.5%) was similar to the 14.1% among young university students (Crispim et al., 2021). The lifetime prevalence of suicide attempts among African medical students (5.5%) was higher than the global 2.19% estimate of suicide attempts among medical students (Tsegay et al., 2020) and university students (3.1%) more generally (Crispim et al., 2021).

The factors associated with suicidal ideation were female gender, depression, use of alcohol, and use of khat. However, only depression was associated with suicide attempts. Depression is prevalent among medical students, with over one quarter of them (i.e., 28.0%) suffering from depression (Puthran et al., 2016). The findings in the present study are similar to other systematic reviews among medical students where mental health symptoms/distress (depression, anxiety, burnout, stress, etc.), substance use, and female gender were associated with suicidal behaviors (Seo et al., 2021). Females in the medical profession appear to be at higher risk of suicidal behaviors (Duarte et al., 2020). This finding

has been consistent with other cohorts and populations. However, it is of special concern in the medical field since the number of female physicians, and female medical students are increasing (O'Sullivan et al., 2022), and if the rates of suicide continue to increase, health services will suffer. Therefore, preventative methods are needed to target this population for the betterment of the health system in Africa. Despite the prevalence of suicidal ideations among medical students in sub-Sahara African countries (0.1%) being lower than non-sub-Sahara African countries (0.8%), no statistical difference was obtained at sub-group analysis. Fewer studies were conducted in the sub-Sahara region than in the non-sub-Sahara region (five studies vs. eight studies). The difference may be attributed to attitudes towards suicidal behaviors in the two regions. More countries in the sub-Sahara region still consider suicidal behaviors to be illegal (Adinkrah 2016; Kaggwa et al., 2021c).

4.1. Limitations

When interpreting these results, the following limitations need to be considered. First, the findings in this study cannot be related to the general population or non-medical students because medical students tend to experience higher levels of stressful events during their demanding course, therefore making them more prone to experience suicidal behaviors. Secondly, all the included studies relied upon self-report data, which is prone to recall (and other) biases. However, publication bias was checked for in the present study, and relevant sensitivity analysis was performed. Thirdly, no cohort or prospective study was included in the meta-analysis. Therefore, causality relating to the factors cannot be determined. Future studies among medical students in Africa should consider prospective designs so that the causes of suicidal behaviors can be more clearly identified. Fourth, the studies identified were mainly from the northern part of Africa – and not representative of many regions. This calls for more studies among other regions such as Western, central, and southern Africa since there cultural differences and their effects on suicidal behaviors may not have been represented in the present review. Fifth, most of the included studies were done before the COVID-19 pandemic – a period when many young individuals' internet use increased due to online learning and social media use, putting them at higher risk of stressful situations and related consequences such as suicide (Jahan et al., 2021; Mamun et al., 2021). Therefore, the review here may not be representative of the current burden of suicidal behaviors in the region. Lastly, the present study had relatively few studies and some of these did not examine some variables such as suicide plans and attempts, which does not reflect the burden of suicide in the region. Future studies should include large multinational studies in the region involving all the suicide behavior variables to clearly determine the burden of suicide behavior in the region.

4.2. Future directions

Due to the potentially lethal nature of suicidal behaviors, future studies should use qualitative methods to understanding the root causes of suicidal behaviors among medical students so that strategic preventative techniques can be designed to help minimize students and future doctors dying by suicide. Since medical school can be extremely stressful and students experience high levels of burnout (Kaggwa et al., 2021a; Kajjimu et al., 2021), alternative methods such as meditation, yoga, and mindfulness can be used to reduce these stressors, as recommended by previous studies (Witt et al., 2019; Al Mamun et al. 2021; Kaggwa et al., 2021a). In addition, similar to most medical schools in developed countries, wellness programs can be instituted in these institutes to improve students' mental health and wellbeing and reduce the incidence of suicide behaviors. Restructuring medical school curricula and the stystem of student evaluations could be implemented, such as (i) the fostering of collaborative group learning through exchange programs so that students can change their environment, (ii) having rest time work-loaded into their timetables, and (iii) having a pass-fail grading

system rather than grade point average that create feelings of inadequacy even among students who have passed (Rotenstein et al., 2016). It is also proposed that universities with medical schools in Africa introduce routine screening for suicidal behaviors among their students so that some of the students can be helped before symptoms worsen. With about half (51%) of medical students in residence experiencing burnout (Low et al., 2019), the above suggested approaches may be employed by medical students during residence to combat burnout and reduce suicidal bahaviors.

In some African countries (e.g., Gambia, Ghana, Kenya, Malawi, Nigeria, Rwanda, Uganda, etc.), suicide is illegal (Adinkrah 2016; Kaggwa et al., 2021c; 2022 a, 2022b; Rukundo et al., 2022), which may result in socially desirable responses and lead to lower prevalence of suicidal behaviors. This may also lead to fewer studies assessing suicidal behaviors in these countries. Strategies to decriminalize suicide should be emphasized in these countries to help identify and treatment of individuals with suicidal behaviors.

5. Conclusion

-Based on meta-analytic findings, approximately onefifth of medical students in Africa have lifetime suicidal ideation, and approximately one in 20 suicidal behaviors experienced are suicide attempts (5.5%). However, very few studies are carried out in Africa to clearly quantify the burden and its associated factors. Future research is needed in most African countries because research on suicidal behaviors has only been carried out in seven out of 54 African countries.

Ethics statements

This study reviews secondary data, and therefore, no formal ethical approval is required.

Availability of data and materials

All data generated or analyzed during this study are included in this published paper.

Role of funding source

CRediT authorship contribution statement

Mark Mohan Kaggwa: Conceptualization, Visualization, Formal analysis, Data curation, Writing – original draft, Writing – review & editing. **Sarah Maria Najjuka:** Formal analysis, Data curation, Visualization, Writing – original draft, Writing – review & editing. **Alain Favina:** Visualization, Writing – original draft, Writing – review & editing. **Mark D. Griffiths:** Writing – original draft, Writing – review & editing. **Mohammed A. Mamun:** Visualization, Writing – original draft, Writing – review & editing.

Declaration of Competing Interest

The authors have no conflict of interest or financial and personal relationships with other individuals or organizations that could bias the findings.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jadr.2022.100456.

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