International Journal of Clinical and Health Psychology 26 (2026) 100732

Contents lists available at ScienceDirect

International Journal of Clinical and Health Psychology

journal homepage: www.elsevier.es/ijchp

Original article

Underrepresentation of low- and middle-income countries in suicidal ideation research and thematic trends in LMIC studies: a mixed-methods study using computational and qualitative analysis

Hayoung K. Donnelly [a,d,1], Michael B. Steinberg [a,1,*], Corbin J. Standley [b], Liang-Yun Cheng [c], Maria A. Oquendo [a], Gregory K. Brown [a,2], Danielle L. Mowery [d,e,2]

[a] Department of Psychiatry, University of Pennsylvania, Philadelphia, 3535 Market Street, 19104, PA, USA
[b] American Foundation for Suicide Prevention, New York, 199 Water Street 11th Floor, 10038, NY, USA
[c] School of Engineering and Applied Science, University of Pennsylvania, Philadelphia, 220 South 33rd Street, 19104, PA, USA
[d] Institute for Biomedical Informatics, Perelman School of Medicine, University of Pennsylvania , 3700 Hamilton Walk, Philadelphia, PA, 19104, USA
[e] Department of Biostatistics, Epidemiology, & Informatics, University of Pennsylvania, Philadelphia, 423 Guardian Drive, 19104, PA, USA

ARTICLE INFO

Keywords:
Global mental health equity
Suicidal ideation
Research synthesis method
Natural language processing
Unsupervised learning
Qualitative thematic analysis

ABSTRACT

Objective: This study leverages natural language processing (NLP) and qualitative analysis to assess the representation of low- and middle-income countries (LMICs) in suicide research relative to high-income countries (HICs), with a particular focus on suicidal ideation. This study also aims to summarize the body of SI research in LMICs by identifying its major themes and examining how these themes have evolved over time.
Methods: An analysis of 15,708 articles published between 1968 and 2022 was conducted, extracting country of focus using article titles and abstracts through NLP methods. Among the articles focusing on SI in LMICs, Latent Dirichlet Allocation (LDA) and manual qualitative theming were used to identify and examine thematic clusters.
Results: Among the papers that explicitly identified a target research country, only 26.6% (n = 1,314) focused on LMICs, whereas 70.5% focused on HICs and 2.9% on both. Five key themes emerged among the LMIC SI papers, including: developmental context; interpersonal and risk factors; clinical instruments and care; gender, sex, perinatal and discrimination; and suicide attempts and death. Analyses were also used to identify trends in how often these themes were discussed within LMIC research over time.
Conclusions: Findings highlight the need for increased SI research in LMICs in addition to improved research infrastructure and support. This study also demonstrates the utility of a mixed-methods approach, which combines computational natural language processing (NLP) with qualitative analysis, for large-scale research syntheses and provides promising directions for future global disparities research.

Abbreviations

HIC	high-income country
IPV	intimate partner violence
LDA	Latent Dirichlet Allocation
LMIC	low- and middle-income country
NLP	natural language processing
SI	suicidal ideation
STBs	suicidal thoughts and behaviors

Introduction

Suicide is a significant global health issue with over 720,000 deaths by suicide occurring annually (World Health Organization, 2025). Death by suicide ranks as the 17th highest cause of death globally, and it is an even more acute problem for people aged 15-29 where it is the 4th leading cause of death (Lovero et al., 2023). In multiple countries (e.g. United Kingdom, Japan, Canada), suicide death was the *leading* cause of death for those aged 15-34 (Ilic & Ilic, 2022).

* Corresponding author.
E-mail address: michael.steinberg32@gmail.com (M.B. Steinberg).
[1] Co-first authors.
[2] Co-last authors.

https://doi.org/10.1016/j.ijchp.2026.100732
Received 1 April 2026; Accepted 26 October 2026
1697-2600/© 2026 The Authors. Published by Elsevier B.V. This is an open access article under the CC BY license (http://creativecommons.org/licenses/by/4.0/).

Disparities in suicide and suicide research by country income level

Suicide research has been increasing significantly from 1990 to the present due to the creation of the internet in addition to increasing public interest in mental health research (Cai et al., 2020). Despite the proliferation of suicide research, significant disparities exist between the amount of suicide research focused on high-income countries (HICs) and low- and middle-income countries (LMICs) (Lovero et al., 2023). Even though 77% of suicide deaths occur in LMICs (Lovero et al., 2023), only 15% of research related to suicide comes from LMICs (Arafat et al., 2025). Additionally, only four of the top 20 most productive countries in suicide research are LMICs (Astraud et al., 2021). Understanding and reducing this disparity in research is important, because risk profiles for individuals with suicidal thoughts and behaviors (STBs) in LMICs may be qualitatively different from those in HICs across several domains. For example, one striking difference between these populations is that people who experience STBs as well as those who die by suicide in LMICs display significantly lower rates of psychiatric disorders compared to HICs (D. Knipe et al., 2019). Additionally, unique structural barriers hamper suicide research and intervention efforts across certain LMICs, such as the criminalization of suicide attempts across at least 35 different LMICs (Renaud et al., 2022). LMICs require additional suicide research, because HIC suicide research does not always translate to LMICs. Narrowing the research gap between HICs and LMICs may help uncover risk factors and interventions unique to LMICs, improving care for the majority of those at risk for suicide globally.

Study objectives

Our study aims to investigate disparities in SI research between LMICs and HICs using natural language processing (NLP) and qualitative analysis. Additionally, we plan to identify themes among SI research in LMICs and explore trends in the popularity of these themes within LMICs from the 1990s through the 2020s. By observing the frequency of different SI research themes across decades, we hope to identify how priorities in SI research have developed across LMICs.

This study offers several novel advancements to the field of suicide research. First, our study is unique given its use of NLP to extract themes in suicide research automatically from the abstract as opposed to manually evaluating articles. Second, to our knowledge, this is the first research synthesis study to thematically analyze LMIC-focused suicidal ideation research using a mixed-methods approach combining computational and qualitative analysis. Third, instead of using author country of origin to determine whether papers were focused on LMICs/HICs, our methods attempted to directly identify the country that was the subject of research. Lastly, this study identifies disparities in SI research between LMICs and HICs while most research has studied suicide more broadly.

Suicidal ideation–focused research synthesis

Most studies exploring global suicide research trends focused their searches on suicide more broadly (Arafat et al., 2025; Astraud et al., 2021; Cai et al., 2020; Pranckeviciene & Kasperiuniene, 2024) including suicidal ideation, planning, attempts, and deaths. This unintendedly introduces contamination to searches by including articles that study unrelated topics. For example, Pranckeviciene and Kasperiuniene (2024) use a broader approach that includes articles about suicide bombings in Afghanistan, which are not directly reflective of mental health symptoms. Some researchers manually read through the articles they extracted to remove irrelevant articles (Cai et al., 2020), but methods like these are time and resource intensive. Searching for suicidal ideation naturally excludes many of these irrelevant articles while maintaining articles with a broad level of risk (i.e. from low to high) including both clinical and non-clinical samples. Restricting the search to suicidal ideation may have excluded articles on other suicidal behaviors (e.g., suicide plans and attempts); however, this narrower scope enabled a more targeted discussion of SI research and prevention.

Limitations of existing approaches to synthesizing research

To date, most papers studying global suicide research trends have utilized scientometric and bibliometric approaches. These forms of analyses are quickly growing, because they allow researchers to study large swaths of scientific research faster using quantitative and statistic approaches (Haghani, 2023). To analyze disparities in suicide research between countries, these papers often rely on metadata such as country of origin or author affiliation for various authors to represent the country being studied for each article (Arafat et al., 2025; Astraud et al., 2021; Cai et al., 2020). This approach has been used often by previous researchers because it does not require manual review of unstructured text such as abstracts or full texts. However, when authors' affiliations do not match the country studied (e.g., researchers based in HICs conducting studies in LMICs), this approach may misidentify the study country. As a result, these reviews may overestimate or underestimate the volume of suicide research conducted in certain countries.

Additionally, other traditional research synthesis approaches (e.g., systematic or scoping reviews) often rely on manual qualitative review by researchers to capture details beyond metadata. To summarize themes and identify trends, researchers would need to invest substantial time manually reading hundreds or thousands of articles. As the volume of published research continues to grow, identifying and tracking emerging themes and trends through manual qualitative review alone will become increasingly difficult.

Integrating NLP and qualitative analysis for research synthesis

Natural language processing (NLP) offers several methodological advantages over conventional research synthesis methods. By automatically and computationally extracting key information and common themes from a large volume of publications, NLP enables a more efficient and systematic evaluation of research trends over time. In fact, previous studies have demonstrated the application of NLP as a cost-effective tool for synthesizing research and analyzing trends across publications (Ashcraft et al., 2026; Karabacak & Margetis, 2024; Zengul et al., 2021). NLP also allows researchers to determine an article's country of origin using full abstracts instead of relying on author information. Further, combining NLP with traditional qualitative techniques, such as thematic analysis, offers an innovative strategy to overcome a key limitation of computational methods, the lack of interpretability (Ashcraft et al., 2026; Donnelly, 2023). In this study, our focus was to build a foundational model for synthesizing global suicidal ideation research by combining NLP with qualitative analysis. We hypothesized that this approach could more accurately identify target country of study, automatically glean themes across suicide-related literature, and track global suicide research trends over time for LMICs.

Methods

Data

We compiled an extensive collection of PubMed research articles on SI published from 1968 to 2022 (N = 15,708 articles). We decided to use PubMed, because our focus is on clinical and biomedical science articles as opposed to the wider breadth of articles (e.g., philosophy) housed by Web of Science or Scopus which were less relevant to our aims (Falagas

et al., 2008). The publication abstracts were retrieved from the PubMed database using Python library metapub (version 0.5.5). Inclusion criteria encompassed articles that 1) incorporated search term (i.e., [suicide OR suicidal] AND [ideation OR thought OR thinking]) in their title or abstract, 2) were written in English, 3) included an available abstract, and 4) were classified as empirical research publications by PubMed article type filters (e.g. including clinical trials and excluding newspaper articles). Additionally, to assess the precision of our search strategy, we reviewed a 5% random sample of the retrieved records (n = 785) to determine whether each study focused on SI or measured it as one of its variables of interest. Of the 785 sampled articles, 740 were classified as relevant, yielding an estimated precision of 94.3% (95% CI: 92.6–95.9%). The remaining 45 records (5.7%) were classified as non-relevant. In these studies, SI was often mentioned only in the background or future study plan, typically as a potential outcome of the primary health condition under study (e.g., depression).

Analyses

All analyses except qualitative thematic analysis were conducted with Python jupyter notebook. To run the analyses, we pre-processed the unstructured abstract text data using the natural language toolkit (NLTK) and used Pandas libraries to convert it into a structured format. Then, we applied Named Entity Recognition (NER) by using a Python package spaCy (Honnibal et al., 2023) to recognize country names within the articles. We merged lists of country names obtained from the United Nations, World Health Organization, and World Bank and referenced the World Bank report from the 2023 fiscal year to determine whether an article focused on LMICs or HICs (The World Bank Group, 2023).

For the next step, we applied Latent Dirichlet Allocation (LDA) (Blei et al., 2003) topic modeling with the scikit-learn and Gensim Python package to the abstracts of the 1,458 articles that covered LMIC countries. LDA is a popular NLP technique that is used to discover hidden structure or themes, among a set of documents or corpus. This is an unsupervised learning technique where the algorithm uses probability distributions learned from the data to identify latent groupings among the documents. There are three main components of an LDA model: tokens, documents, and topics (Blei et al., 2003). The model makes two major assumptions: 1) documents are made up of topics, and 2) topics are made up of tokens (or words). The model computes the probability and outputs two matrices: probability of topics for each document and probability of tokens in each topic. These results can then be used to extract the dominant topic for each document and the top keywords for each topic which is then interpreted manually to extract semantic meanings. The major benefit of LDA is that instead of manually inspecting a large corpus (e.g., a structured set of words or phrases from unstructured texts) to identify common themes, we can set aside our presumptions and leverage the model to identify hidden patterns across words and documents by conducting exploratory text mining.

Number of latent theme clusters

This study used two performance metrics - CV coherence score and perplexity score - to decide the optimal number of latent clusters from LDA. Both metrics aim to evaluate the quality of topic and document clustering. The CV coherence score measures the co-occurrence and semantic relatedness of words within topics, with higher scores indicating better model quality (Syed & Spruit, 2017). The perplexity score focuses on examining prediction errors in document clustering, with lower scores indicating better models (Rüdiger et al., 2022). Grid search was applied to tune the hyperparameters of the LDA model (i.e., alpha, beta, learning decay, learning method, and topic numbers) to optimize its performance on the data. Alpha refers to how topics are spread across documents, and beta refers to how words are spread across topics (Blei & Lafferty, 2009). The parameters tuned included alpha and beta (set to 0.1), learning decay (tested at 0.5, 0.7, and 0.9), learning method (online versus batch), and topic numbers (from 2 to 15). LDA categorized each article into its most probable topic. We report the distribution of articles per topic cluster (furthermore described as theme clusters) and its latent themes and associated keywords.

Common & unique themes across the five theme clusters

Lastly, we conducted a qualitative thematic analysis (Braun & Clarke, 2006) to identify the underlying themes within the topic clusters generated by the LDA. Three researchers with experience in suicide research (two with doctoral degrees and one with a master's degree in psychology) independently conducted manual reviews of the keywords and representative publications for each cluster and assigned latent theme labels. The keywords and representative publications used in the qualitative review were selected based on those identified by the LDA model as most relevant and topically focused. Most discrepancies among the researchers reflected differences in terminology rather than meaning; for example, one coder used "military" and the others used "veteran" for the same topic area. These terminological differences were resolved through discussion either by adopting the majority label (i.e., the label independently proposed by at least two of the three researchers) or by harmonizing the terms (e.g., into "military and veterans"). The final label for each cluster was then determined through iterative review of the keywords and revision of the labels until all three researchers reached consensus. Two senior researchers, one with expertise in psychology and one in bioinformatics, additionally reviewed the final labels to ensure that they were consistent with terminology used in the scientific literature.

Results

Information on the country of the target population was available in 31.5% (N = 4,946) of the articles, and a total of 159 countries were identified from a total of 15,708 articles. Only 26.57% (N = 1,314) of the articles were focused on LMICs, 70.52% (N = 3,488) on HICs, and 2.91% (N = 144) on both LMIC and HIC countries. The top 10 countries with the highest volume of SI articles were as follows (see Fig. 1): U.S. (N = 1,847), China (N = 416), South Korea (N = 304), Australia (N = 183), Canada (N = 183), Japan (N = 143), United Kingdom (N = 127), India (N = 99), Taiwan (N = 92), and New Zealand (N = 91). Only two LMICs, China (Upper middle-income) and India (Lower middle-income), were identified in this list. We observed an upward trajectory of article counts from 1976 (the earliest publication with identified target country information) to 2017, experiencing a slight decline in 2018 followed by a subsequent rise, a consistent pattern for LMIC and HIC articles (see Fig. 2).

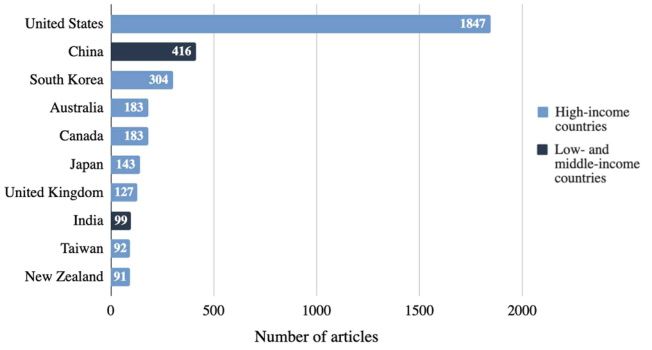


Fig. 1. Top 10 countries with the highest number of suicidal ideation articles.

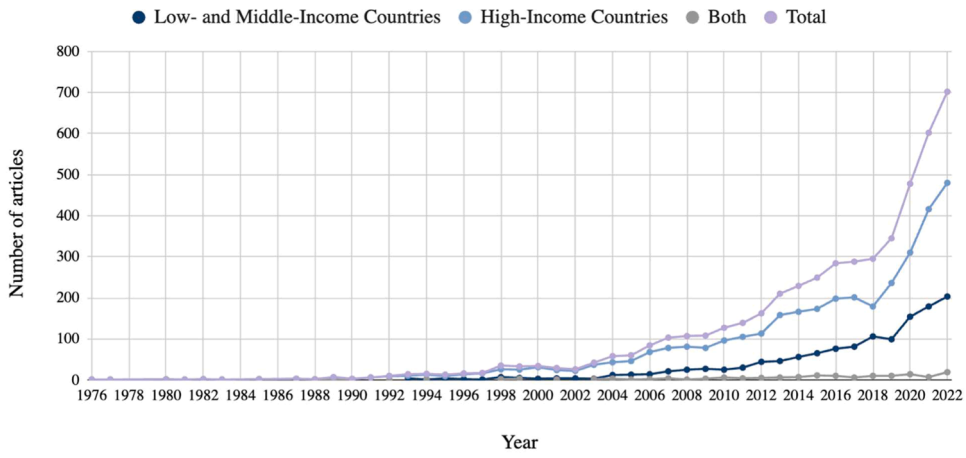


Fig. 2. Number of suicidal ideation research articles with identified target country information over the years.

Number of latent theme clusters

The performance metrics indicated the five-theme model performed the best classifying SI research articles based on the commonalities and differences in their word distributions (see Fig. 3). The CV coherence score for the five-theme model was higher than any other model, indicating that models with five theme clusters performed best. The perplexity score (lower scores indicating better fit) was lowest for the three-theme model followed by the five-theme model, indicating a great overall fit. An initial qualitative review by the researchers of the three-theme model suggested that it was somewhat simplistic, including mixed topics within single clusters. Moreover, given the low CV coherence score for the three-theme model, the five-theme model was considered the optimal model.

Common themes across the five theme clusters

Our qualitative thematic analysis enabled us to identify common keywords that appeared regularly across all five thematic clusters. These shared keywords reflected themes like behavioral and emotional health (e.g., *depression, anxiety, substance*), risk factors (e.g., *abuse, stress, disease*), and care (e.g., *intervention and treatment*). These shared themes were not limited to specific clusters, but were consistently observed across publications, regardless of their assigned unique theme clusters, since they are commonly addressed across the five unique themes.

Five unique themes

In terms of unique themes for each cluster, articles in the Theme 1

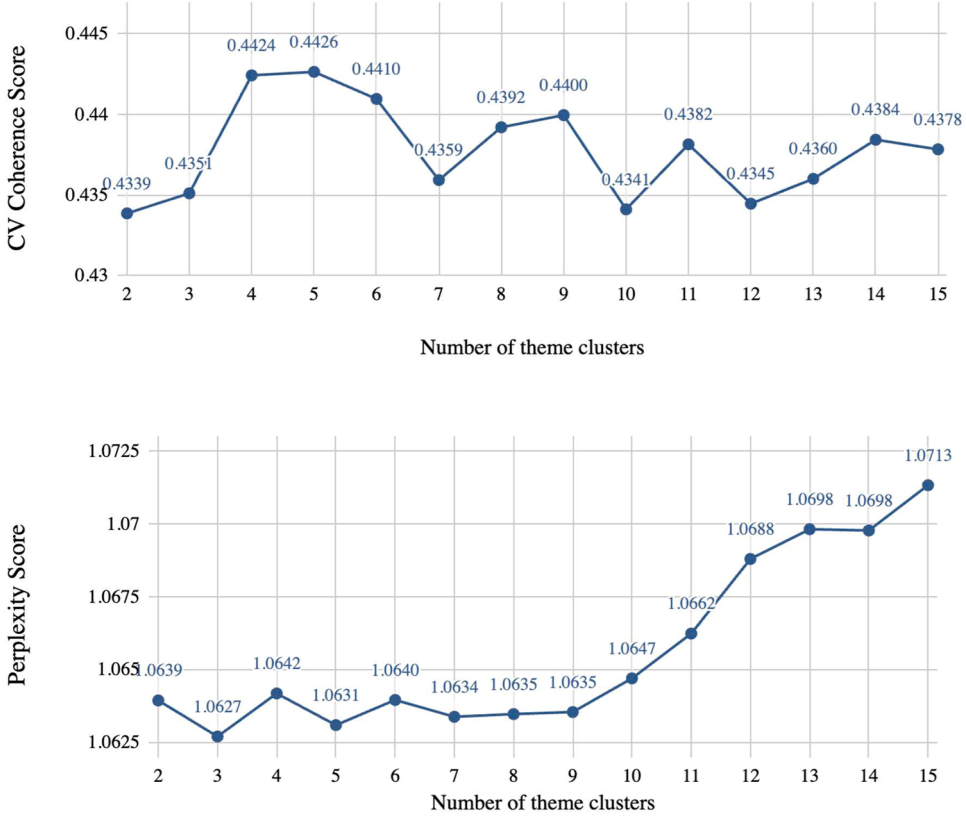


Fig. 3. LDA performance scores by the number of theme clusters derived from LMIC suicidal ideation research publications.

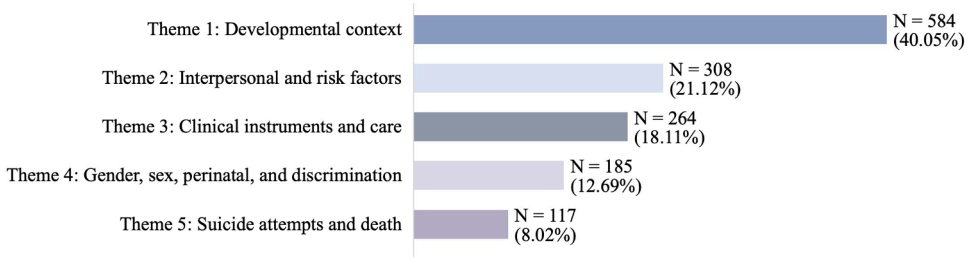


Fig. 4. Theme distributions across LMIC SI research publications.

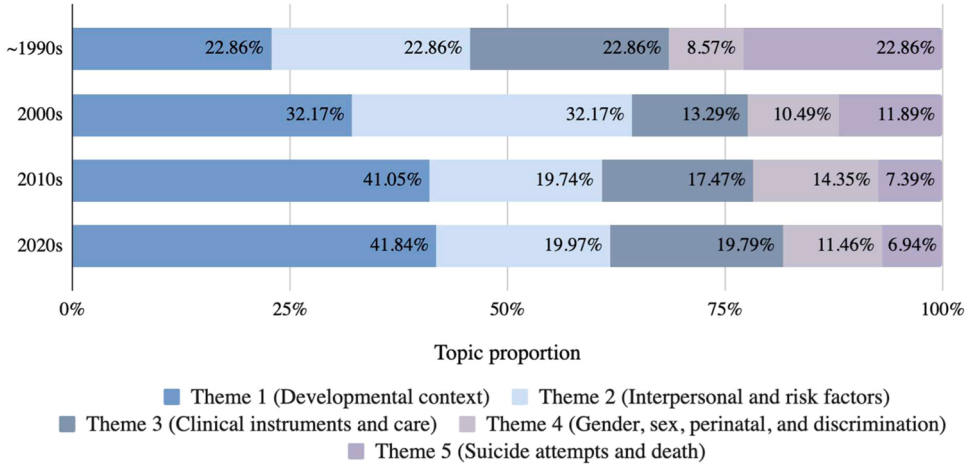


Fig. 5. Trends of LMIC SI publication themes.

cluster (n = 584, 40.05%) focused on developmental and lifespan contexts, represented by keywords such as *lifetime, childhood,* and *elderly*. The Theme 2 cluster (n = 308, 21.12%) was related to interpersonal (e.g., *parent, peer*) and risk factors (e.g., *alcohol, smoking, victimization)*. The Theme 3 cluster (n = 264, 18.11%) indicated themes of clinical instruments (e.g., *assessment, diagnosis, inventory, criterion)* and continuum of care (e.g., *hospital, nursing, medication*). The Theme 4 cluster (n = 185, 12.69%) showed themes of gender (e.g., *man, woman, msm [men who have sex with men]*), perinatal (e.g., *postpartum, pregnancy, mother*), sexual activity (e.g., *condom, [sexually transmitted] infection, sex-worker*), and discrimination and violence (e.g., *discrimination, violence, survivor, stigma, trauma*). The Theme 5 cluster (n = 117, 8.02%) centered around themes related to suicide attempts and death (e.g., *mortality, death, injury,* see Fig. 4).

In terms of theme trends, the distribution of themes changed over time (see Fig. 5). The proportion of articles in the Theme 1 cluster consistently increased from 22.86% in the 1990s to 41.84% in the 2020s. The proportion of articles in Theme 2 increased from 22.86% in the 1990s to 32.17% in the 2000s, then decreased to 19.74% in the 2010s, before slightly recovering to 19.97% in the 2020s. The proportion of articles in Theme 3 decreased from 22.86% in the 1990s to 13.29% in the 2000s, then steadily increased to 19.79% by the 2020s. The proportion of articles in Theme 4 gradually increased from 8.57% in the 1990s to 14.35% in the 2010s, before decreasing to 11.46% in the 2020s. The proportion in Theme 5 consistently decreased from 22.86% in the 1990s to 6.94% in the 2020s.

Discussion

Principal findings

The upward trajectory in the number of suicide-related articles over the years reflects ongoing global interest and increasing urgency in understanding and addressing suicide. Similar to previous studies, the majority of research on SI focused on HICs in this sample, despite most suicides occurring in LMICs. There are three common themes across LMIC SI literature (Behavioral and emotional health, Risk factors, and Care) and five unique themes (Developmental context, Interpersonal and risk factors, Clinical instruments and care, Gender, sex, perinatal, and discrimination, and Suicide attempts and death). Trends in publication numbers for each theme cluster vary over time.

Comparison with prior works

Several of our results differ from previous studies analyzing global suicide research trends which is understandable considering the differences between our approach and the methods employed by previous studies. Studies using scientometric and bibliometric methods were able to study larger pools of data, since they incorporated broader search terms to identify relevant articles and used metadata, like author affiliation and author country of origin, to identify countries being researched. Our more limited search produced fewer articles, and the NLP was unable to identify the country being studied in manuscripts that didn't mention a country in a paper's abstract. However, using direct and explicit search terms and indicators of the target country from the abstract rather than relying on broader metadata may have more accurately identified relevant articles as well as the countries being studied.

While several scientometric and bibliometric studies (Arafat et al., 2025; Astraud et al., 2021; Cai et al., 2020) found that the UK published the second most suicide-related articles, our results found that China was the subject of the second greatest number of research studies on SI. The UK was only the 7th most studied country according to our search. Additionally, our analyses produced a higher percentage of LMIC SI research compared to HICs than other analyses studying more general suicide research. Arafat et al., 2025 found that 85% of papers on

suicide-related themes were published in HICs, while our analyses showed that slightly over 70% of articles on SI were published about HICs .

Common themes of suicidal ideation research in LMICs

Common themes found across the five unique themes identified by LDA were consistent with ideas considered to be pervasive across suicide research. Themes related to behavioral and emotional health (e.g. depression) are highly related to suicide outcomes (D. Knipe et al., 2019). Given the strong connection between depression, anxiety, and SI in HIC literature (Bentley et al., 2016; Piscopo et al., n.d), it is not surprising these terms are commonly addressed in papers across themes even within LMIC research. Risk factors (e.g. abuse, stress, and disease) would similarly be expected to be prevalent across SI literature regardless of theme due to the strong connection between risk factors, like stress and abuse, with SI (Duprey et al., 2021). Lastly, the general care theme focuses on keywords like "intervention" and "treatment" which is relevant across themes as many studies likely focus their attention on potential interventions and treatments related to SI.

Unique themes of suicidal ideation research in LMICs

This study attempted to discern unique themes in SI research across LMICs and track trends in research across themes. Some studies have previously used keywords to analyze themes in suicide research (Pranckeviciene & Kasperiuniene, 2024). Other studies have manually reviewed abstracts to determine themes across literature; however, this is rare due to the manual labor needed for theme extraction. Even among the articles that manually reviewed abstracts or used keywords, we could not find any prior studies which examined themes in SI research solely among LMICs nor any studies that examined trends across those themes over time. Our goal was to understand the priorities for suicide research in LMICs and identify areas of research which have gotten less attention over time. We used LDA to identify articles that best represent each theme and will discuss a few of those representative articles as we delve into the various themes below. In this section, we focused on discussing each theme based on the articles clustered within it to ensure that the themes were explained by the data they actually included.

Theme 1: developmental context

The first theme we identified, "Developmental context," focused on concepts related to human development and suicide across the lifespan. LDA identified several articles which best represent this theme to provide a deeper insight into what this theme represents. Many of the articles chosen by LDA studied suicide across specific age groups, such as elderly populations in Thailand or youth populations in Mexico (Lara et al., 2018; Oon-arom et al., 2019). Understanding risk factors and statistics unique to various age groups is important, because there are significant differences in suicide behaviors and death by suicide across age groups (Uddin et al., 2019). For example, older adults have a higher risk of dying by suicide than other age groups (Conejero et al., 2018). They also display unique risk factors like social isolation (Conejero et al., 2018) or physical illness (Sadek et al., 2024) and exhibit high Male: Female ratios of death by suicide (Irías Escher et al., 2024) . The share of studies exploring how developmental contexts interact with SI has nearly doubled in LMICs since the 1990s, showing the greatest increase among all identified themes. This could reflect a general trend toward LMICs focusing suicide research on age-specific subgroups to tailor future screening, assessment, and intervention to targeted groups. It currently represents over 40% of the current research identified in this sample.

Theme 2: interpersonal and risk factors

The next identified theme grouped together research focused on "Interpersonal and risk factors" related to suicide. Interpersonal articles focus on how interpersonal interactions serve as protective and risk factors for STBs. For example, this theme examined the effects of supportive social networks on SI in El Salvador (Springer et al., 2006) and how parental involvement in certain child habits could affect SI in Ghanaian youth (Glozah et al., 2018). Other articles grouped under this theme focused on risk factors for STBs, such as substance use in ASEAN countries (Pengpid & Peltzer, 2019) or bullying in Latin American countries (Romo & Kelvin, 2016). Another study examined the impact of bullying on suicidal ideation among adolescents across 40 LMICs, providing evidence that bullying is not limited to a few countries but is a common risk factor for suicidal ideation across diverse LMICs (Fei et al., 2022). As mentioned previously, studying risk and protective factors in LMICs is important, because LMICs have unique risk and protective factors from HICs. This theme has stayed mostly stable from the 1990s to the present with a bump in articles in the 2000s before lowering back down to 20%.

Theme 3: clinical instruments and care

The theme of "Clinical instruments and care" covers themes related to the psychometrics of suicide-related instruments and surveys as well as interventions and other strategies to help reduce STBs. Many of the psychometric articles studied adaptations and translations for suicide measures. Especially in certain LMICs where stigma and laws criminalizing suicide hamper data collection (Renaud et al., 2022), having linguistic and cultural adaptations of suicide measures are crucial to improve understanding of a specific population's suicide risk (Ayub, 2008). For example, one article LDA identified to represent this theme was Kilincaslan and colleagues (2019) who adapted the Columbia-Suicide Severity Rating Scale to Turkish and evaluated its reliability and validity in this new context (Kilincaslan et al., 2019). A similar study by Ayub (2008) translated the Beck Scale for SI (BSSI) and tested its reliability and validity with Pakistani adolescents and young adults (Ayub, 2008). Ayub (2008) decided to adapt the BSSI to increase understanding of SI in Pakistan, a country with legal and religious stigma against suicide, and advance future suicide-related research in the country (Ayub, 2008). This theme also includes articles centered around actual interventions and campaigns to reduce STBs in LMICs. For example, Thakurta and colleagues (2012) explored the effects of ketamine on suicidal thoughts in an Indian population and Aldridge et al. (2020) studied the effects of integrated mental health care on SI in Nepal (Aldridge et al., 2020; Thakurta et al., 2012). LDA highlighted these articles in addition to several similar articles to represent this portion of the theme. The theme of "Clinical instruments and care" has stayed mostly stable over time from the 1990s to the present, despite a dip in the 2000s.

Theme 4: gender, sex, perinatal, and discrimination

The next theme, "Gender, sex, perinatal, and discrimination" focuses on a plethora of themes, though most articles focus on gender, sex, and sexuality. Many of the articles in this theme described suicide risk and outcomes for children and adults who are sex workers or victims of human trafficking. For example, the LDA identified Kiss and colleagues (2015) who looked at suicide risk in youth who were victims of human trafficking across several countries in the Greater Mekong Subregion (Kiss et al., 2015). Hong et al. (2010) examined suicide behaviors among female sex workers in China (Hong et al., 2010). Research on female sex workers in LMICs is important, because meta-analyses show that female sex workers display higher levels of mental health disorders, SI, and suicide attempts compared to the general population of LMICs (Beattie et al., 2020). Despite this increase in psychopathology and STBs, there are few interventions targeted toward female sex workers in LMICs (Beattie et al., 2020).

This theme also includes articles which examine suicidality among the LGBTQ+ community in LMICs, such as studies that explore SI in men who have sex with men (MSM) across several African countries (Stahlman et al., 2016) as well as studies that investigate suicidality

among transgender women in Brazil (Reis et al., 2021). Research surrounding youth sexual and gender minorities is increasing in upper middle-income countries, but the same trend is not seen in lower middle-income countries nor low-income countries (Pike et al., 2023). Overall, there is still insufficient research on youth identifying as sexual or gender minorities in LMICs (Frances et al., 2023). One reason for this lack of research could be explained by the criminalization of sexual and gender minorities among certain LMICs with some countries punishing these minorities with death sentences (Frances et al., 2023). As suicide risk is generally elevated for this population (Lovero et al., 2023), increasing research around sexual and gender minority youth in LMICs is crucial.

Lastly, there are many articles categorized under Theme 4 that focus on SI during pregnancy. While the LDA identified multiple articles that focus on SI during pregnancy more generally (Faisal-Cury et al., 2022), the theme seems to focus more on ideation in the context of intimate partner violence during pregnancy and postpartum (Islam et al., 2020; Shamu et al., 2016). STBs are more common during and post-pregnancy in low-income countries (Onah et al., 2017). One explanation for the increased rates of STBs in LMICs could be the increased rates of intimate partner violence (IPV) compared to HICs (Da Thi Tran et al., 2022). Shamu and colleagues (2016) showed that rates of IPV during pregnancy were as high as 65.4% of their Zimbabwe sample, and about 35% of those who experienced IPV demonstrated suicidal thoughts and/or behaviors post-partum (Shamu et al., 2016). Other research has demonstrated that violence during pregnancy led to 55% of all deaths by suicide among pregnant women (Musyimi et al., 2020). Certain LMICs have seen a 13.3% rate of suicide behavior among pregnant adolescents (Musyimi et al., 2020).

Theme 4, "Gender, sex, perinatal, and discrimination," started off as the least studied theme (of the five we examined) in the 1990s. It has remained the steadiest of the five themes, although it still remains the second least studied research theme of those generated.

Theme 5: suicide attempts and death

The final theme, "suicide attempts and death" contains articles focusing on suicide rates as well as some articles focused on lethal means. For example, Knipe and colleagues (2017) investigated suicide rates across multiple regions in Sri Lanka. Most articles the LDA identified followed similar lines of research, looking at suicide rates across LMICs. Other articles in the theme focused on lethal means. Demirci et al. (2009) discussed a growing trend in Turkey where people took measures to ensure they could not abort their suicide attempt by hanging and sought methods to make the attempt less painful (Demirci et al., 2009). Interestingly, this final theme contains the least number of articles written in the past decade even though it was one of the most popular themes in the 1990s. The reasons for the decline in articles on this theme are unclear; however, it could be due to the ambiguous nature of the theme or the limited scope of the theme. Suicide rates may lead to fewer new discoveries and advancements than other research questions in LMIC contexts.

Limitations

There were several limitations involved with this research. First, our search only focused on articles written in English. Given the large number of HICs and LMICs whose primary language is not English, this could mean we missed many relevant articles. Because not all publications explicitly named the country studied in their title or abstract, our findings, including the ratio of HIC to LMIC publications should be interpreted with caution. Likewise, the thematic trends among LMIC publications reported in this study reflect only articles that identified the target country in their title or abstract. Prior studies have found that psychology studies with U.S. and other Western, educated, industrialized, rich and democratic (WEIRD) samples are less likely to specify the study country in their titles than studies with non-WEIRD samples (Cheon et al., 2020; Kahalon et al., 2021). If this pattern also holds in SI research, HIC-focused studies may be underrepresented among the articles with identified country information in this study, and our estimate likely understates the disparity between HIC- and LMIC-focused research. Future studies could address this by combining our approach with traditional scientometric and bibliometric methods which typically identify countries based on author affiliations, allowing cross-validation and reducing the number of articles whose country information is missed. One additional limitation we observed was the NLP was unable to consistently distinguish between articles whose subject countries were LMIC versus HIC in cases where groups from HICs were being studied in LMIC settings. For example, the NLP categorized research studying US soldiers in Iraq as an LMIC paper even though the main focus was on US citizens (Maguen et al., 2011). For future directions, it would be interesting to merge NLP techniques with scientometric and bibliometric methods to improve approximations of LMIC and HIC research and better categorize themes emerging from LMIC SI research, an idea that's already being proposed in the field (Atanassova et al., 2019).

The primary goal of this study was to demonstrate how this method can be applied to suicide research in LMICs, going beyond traditional research synthesis approaches. However, ongoing monitoring of research trends is important to ensure timely and relevant discussion of current global suicide-related issues. Since we collected our data in 2023, additional studies on suicidal ideation have been published. For instance, using the same search strategy and inclusion criteria, we identified 713 eligible studies published between 2023 and 2025. The model proposed here can serve as a foundation for a long-term system that tracks global trends in suicidal ideation research. Applying the current approach to newly published studies would support continued discussion of whether research disparities between HICs and LMICs persist and what actions are needed to address them. In addition, recent studies have documented disparities in suicide research that extend beyond the volume of published studies. These include the underrepresentation of LMIC scholars on journal editorial boards (Arafat et al., 2024), lower rates of female lead authorship in LMICs (Arafat et al., 2026), and a lack of inclusive publication options to support LMIC scholars and research (Arafat & Lester, 2025). Therefore, future work should not only extend the time span of the publications analyzed but also examine disparities in suicide research at multiple levels, such as leadership representation and publication accessibility.

In this study, we classified countries as LMICs or HICs using the most recent World Bank income classification available at the time of data collection. However, the World Bank updates these classifications annually; for example, six countries moved to a higher or lower income group between the 2021 and 2022 releases. Future studies should take this into account by incorporating an analytic strategy that reflects changes in income classification over time when identifying LMIC-focused studies.

Regarding the identification of themes, there were a few additional limitations of our NLP methods. The five themes pooled by the NLP seemed to include multiple themes under one umbrella for several of the themes. For example, Theme 3, "Clinical instruments and care" pooled two distinct themes which were merged by the NLP: papers examining the psychometric properties of SI measures as well as studies about suicide prevention interventions. Even though metrics indicated the five-theme model was a strong choice for deciding the number of themes, it seems like there is room to improve the LDA by cross-validating with additional performance metrics or leveraging large language models to provide greater clarity and interpretability to the themes it derives. Our study used an article-level rather than a country-level analysis; therefore, the findings should be interpreted as reflecting the body of LMIC research as a whole rather than research trends within individual countries. For instance, the number of articles was disproportionately distributed across LMICs, with substantially more studies from China and India than from other countries. In addition, LMICs

comprise distinct income subgroups (i.e., upper-middle-income, lower-middle-income, and low-income countries). Given this uneven distribution of articles and the variation in income levels, the findings should be applied with caution when discussing individual countries. Future research could address this by conducting analyses by income subgroup or by country. We developed the five theme labels through open coding and a consensus-based approach rather than by applying a predefined codebook, and inter-rater reliability was not formally assessed. Future studies should evaluate the reliability of this labeling procedure more rigorously, for example by developing a codebook and calculating Cohen's or Fleiss' kappa on labels assigned by independent coders.

Conclusion

Despite the majority of suicide deaths occurring in LMICs, much of the extant SI research continues to focus on HICs. Using NLP and qualitative thematic analysis, our study examined which countries are being studied and which research themes are being pursued within LMICs. Our findings reveal a clear underrepresentation of LMICs in the suicidology literature and illustrate shifting thematic trends. Analyses show a growing emphasis on developmental and lifespan perspectives, along with decreased attention on suicide rates and lethal means. It also raises critical questions about which themes are being overlooked, particularly in contexts where suicide prevention infrastructure may be most limited.

Our approach demonstrates the value of combining computational methods with qualitative inquiry to deepen our understanding of the global research landscape in mental health. Building on this foundation, future work might integrate this study's methods with scientometric and bibliometric tools (Atanassova et al., 2019), expand to include non-English publications, incorporate broader data sources, and develop a more nuanced analysis of cultural and regional differences. Our findings may also help stimulate discussion of research priorities aimed at addressing the underrepresentation of LMICs. A larger body of scientific evidence on suicidal ideation from LMICs would better capture the lived experiences and environmental conditions of people in these settings. Closing the gap between where the burden of suicide falls and where knowledge is produced will require intentional investment in LMIC-focused research, in both volume and thematic breadth.

Declaration of generative AI and AI-assisted technologies in the manuscript preparation process

No AI tools, including generative AI, were used in the preparation of this research manuscript.

CRediT authorship contribution statement

Conceptualization: HD. Data curation: HD, LYC. Formal analysis: HD, LYC, MS, CS. Funding acquisition: MO, GB, DM. Investigation: All. Methodology: HD, MS, LYC, DM. Project administration: MS. Resources: MO, GB, DM. Software: HD, LYC, DM. Supervision: MO, GB, DM. Validation: All. Visualization: HD, MS, LYC. Writing - original draft: HD, MS, CS, LYC. Writing - review & editing: All.

Declaration of competing interest

Dr. Oquendo receives royalties from the Research Foundation for Mental Hygiene for the commercial use of the Columbia Suicide Severity Rating Scale. She serves as an advisor to Mind Medicine (pro bono), and Fundacion Jimenez Diaz. She reviews grants for Alkermes and her family formerly owned stock in Bristol Myers Squibb (sold March 2024).

There are no other conflicts of interest to disclose.

Acknowledgments

This study was supported by the National Institute of Mental Health P50 MH127511 (Drs. Brown and Oquendo, MPIs).

Data availability

The data are publicly available through PubMed. If requested with appropriate justification, the researchers may share the data from this study.

References

Aldridge, L. R., Garman, E. C., Luitel, N. P., & Jordans, M. J. D. (2020). Impact of a district mental health care plan on suicidality among patients with depression and alcohol use disorder in Nepal. *PLoS ONE, 15*(4), Article e0231158. https://doi.org/10.1371/journal.pone.0231158

Arafat, S. M. Y., & Lester, D. (2025). Suicidology needs a more inclusive approach for low and middle-income countries. *Health Science Reports, 8*(6), Article e70926. https://doi.org/10.1002/hsr2.70926

Arafat, S. M. Y., Kar, S. K., & Amin, R. (2024). Gender and geographical distribution of editorial board members of three leading suicide journals. *Crisis, 45*(2), 159–163. https://doi.org/10.1027/0227-5910/a000919

Arafat, S. M. Y., Singh, R., Singh, K., & Amin, R. (2025). Trend and geographical distribution of suicide research: A bibliometric analysis of three decades. *International Journal of Mental Health and Addiction, 23*, 2668–2677. https://doi.org/10.1007/s11469-024-01251-x

Arafat, S. Y., Lester, D., & Kar, S. K. (2026). Gender and geographic distribution of lead authors of three leading suicide journals in the last two decades (2005-24). *Geopsychiatry, 3*, Article 100041. https://doi.org/10.1016/j.geopsy.2025.100041

Ashcraft, L. E., Donnelly, H. K., Romano, J. D., Daniels, S. I., & Mowery, D. L. (2026). Data-driven implementation science synthesis: A topic modeling approach to understand implementation science in the biomedical literature. *Implementation Science Communications*. https://doi.org/10.1186/s43058-026-01110-x

Astraud, L.-P., Bridge, J. A., & Jollant, F. (2021). Thirty years of publications in suicidology: A bibliometric analysis. *Archives of Suicide Research: Official Journal of the International Academy for Suicide Research, 25*(4), 751–764. https://doi.org/10.1080/13811118.2020.1746944

Atanassova, I., Bertin, M., & Mayr, P. (2019). Mining scientific papers: NLP-enhanced bibliometrics. *Frontiers in Research Metrics and Analytics, 4*(2), 1–3. https://doi.org/10.3389/frma.2019.00002

Ayub, N. (2008). Validation of the Urdu translation of the Beck Scale for Suicide Ideation. *Assessment, 15*(3), 287–293. https://doi.org/10.1177/1073191107312240

Beattie, T. S., Smilenova, B., Krishnaratne, S., & Mazzuca, A. (2020). Mental health problems among female sex workers in low- and middle-income countries: A systematic review and meta-analysis. *PLoS Medicine, 17*(9), Article e1003297. https://doi.org/10.1371/journal.pmed.1003297

Bentley, K. H., Franklin, J. C., Ribeiro, J. D., Kleiman, E. M., Fox, K. R., & Nock, M. K. (2016). Anxiety and its disorders as risk factors for suicidal thoughts and behaviors: A meta-analytic review. *Clinical Psychology Review, 43*, 30–46. https://doi.org/10.1016/j.cpr.2015.11.008

Blei, D. M., & Lafferty, J. D. (2009). Topic models. *Text Mining*. Chapman and Hall/CRC.

Blei, D. M., Ng, A. Y., & Jordan, M. I. (2003). Latent dirichlet allocation. *Journal of Machine Learning Research, 3*(-), 993–1022.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Cai, Z., Chang, Q., & Yip, P. S. F. (2020). A scientometric analysis of suicide research: 1990–2018. *Journal of Affective Disorders, 266*, 356–365. https://doi.org/10.1016/j.jad.2020.01.121

Cheon, B. K., Melani, I., & Hong, Y.-y. (2020). How USA-Centric Is Psychology? An Archival Study of Implicit Assumptions of Generalizability of Findings to Human Nature Based on Origins of Study Samples. *Social Psychological and Personality Science, 11*(7), 928–937. https://doi.org/10.1177/1948550620927269. https://journals.sagepub.com/doi/10.1177/1948550620927269. (Accessed 23 June 2020)

Conejero, I., Olié, E., Courtet, P., & Calati, R. (2018). Suicide in older adults: Current perspectives. *Clinical Interventions in Aging, 13*, 691–699. https://doi.org/10.2147/CIA.S130670

Da Thi Tran, T., Murray, L., & Van Vo, T. (2022). Intimate partner violence during pregnancy and maternal and child health outcomes: A scoping review of the literature from low-and-middle income countries from 2016 - 2021. *BMC Pregnancy and Childbirth, 22*, Article 315. https://doi.org/10.1186/s12884-022-04604-3

Demirci, S., Dogan, K. H., Erkol, Z., & Deniz, I. (2009). Precautions taken to avoid abandoning the act of hanging and reducing pain in suicidal hanging cases. *The American Journal of Forensic Medicine and Pathology, 30*(1), 32–35. https://doi.org/10.1097/PAF.0b013e3181873f40

Donnelly, H. K. (2023). *Disclosure of suicidal drivers on social media: a natural language processing and thematic analysis approach*. Boston University.

Duprey, E. B., Handley, E. D., Manly, J. T., Cicchetti, D., & Toth, S. L. (2021). Child maltreatment, recent stressful life events, and suicide ideation: A test of the stress sensitivity hypothesis. *Child Abuse & Neglect, 113*, Article 104926. https://doi.org/10.1016/j.chiabu.2020.104926

Faisal-Cury, A., Oliveira Rodrigues, D. M., Matijasevich, A., Tarpinian, F., & Tabb, K. (2022). Prevalence and associated risk factors of suicidal ideation among brazilian pregnant women: A population-based study. *Frontiers in Psychiatry, 13*, Article 779518. https://doi.org/10.3389/fpsyt.2022.779518

Falagas, M. E., Pitsouni, E. I., Malietzis, G. A., & Pappas, G. (2008). Comparison of PubMed, Scopus, Web of Science, and Google Scholar: Strengths and weaknesses. *The FASEB Journal, 22*(2), 338–342. https://doi.org/10.1096/fj.07-9492LSF

Fei, W., Tian, S., Xiang, H., Geng, Y., Yu, J., Pan, C.-W., & Zhang, T. (2022). Associations of bullying victimisation in different frequencies and types with suicidal behaviours among school-going adolescents in low- and middle-income countries. *Epidemiology and Psychiatric Sciences, 31*, Article e58. https://doi.org/10.1017/s2045796022000440. https://www.cambridge.org/core/product/identifier/S2045796022000440/type/journal_article. (Accessed 11 August 2022)

Frances, C., Garnsey, C., & DeMulder, J. (2023). Neglected gaps in improving the health, wellbeing, and care for sexual and gender minority young people living in low- and lower-middle- income countries: A scoping review. *BMC Public Health, 23*(1), Article 1664. https://doi.org/10.1186/s12889-023-16443-8

Glozah, F. N., Asante, K. O., & Kugbey, N. (2018). Parental involvement could mitigate the effects of physical activity and dietary habits on mental distress in Ghanaian youth. *PLoS One, 13*(5), Article e0197551. https://doi.org/10.1371/journal.pone.0197551

Haghani, M. (2023). What makes an informative and publication-worthy scientometric analysis of literature: A guide for authors, reviewers and editors. *Transportation Research Interdisciplinary Perspectives, 22*, Article 100956. https://doi.org/10.1016/j.trip.2023.100956

Hong, Y., Fang, X., Li, X., Liu, Y., Li, M., & Tai-Seale, T. (2010). Self-perceived stigma, depressive symptoms, and suicidal behaviors among female sex workers in China. *Journal of Transcultural Nursing : Official Journal of the Transcultural Nursing Society, 21*(1), 29–34. https://doi.org/10.1177/1043659609349063

Honnibal, M., Montani, I., Boyd, A., & Van Landeghem, S. (2023). *spaCy: Industrial-strength Natural Language Processing in Python*. Zenodo. https://doi.org/10.5281/ZENODO.1212303 (Version v3.7.2) [Computer software].

Ilic, M., & Ilic, I. (2022). Worldwide suicide mortality trends (2000-2019): A joinpoint regression analysis. *World Journal of Psychiatry, 12*(8), 1044–1060. https://doi.org/10.5498/wjp.v12.i8.1044

Irías Escher, M. J., LC, V. J., & Yup de León, P. (2024). Suicide in older adults in Honduras: a retrospective analysis (2008-2022). *Frontiers in Psychiatry, 15*, Article 1489874. https://doi.org/10.3389/fpsyt.2024.1489874. https://www.frontiersin.org/articles/10.3389/fpsyt.2024.1489874/full. (Accessed 26 November 2024)

Islam, M. J., Broidy, L., Mazerolle, P., Baird, K., Mazumder, N., & Zobair, K. M. (2020). Do maternal depression and self-esteem moderate and mediate the association between intimate partner violence after childbirth and postpartum suicidal ideation? *Archives of Suicide Research, 24*(4), 609–632. https://doi.org/10.1080/13811118.2019.1655507

Kahalon, R., Klein, V., Ksenofontov, I., Ullrich, J., & Wright, S. C. (2021). Mentioning the Sample's Country in the Article's Title Leads to Bias in Research Evaluation. *Social Psychological and Personality Science, 13*(2), 352–361. https://doi.org/10.1177/19485506211024036. https://journals.sagepub.com/doi/10.1177/19485506211024036. (Accessed 8 July 2021)

Karabacak, M., & Margetis, K. (2024). Natural language processing reveals research trends and topics in the spine journal over two decades: A topic modeling study. *The Spine Journal: Official Journal of the North American Spine Society, 24*(3), 397–405. https://doi.org/10.1016/j.spinee.2023.09.024

Kilincaslan, A., Gunes, A., Eskin, M., & Madan, A. (2019). Linguistic adaptation and psychometric properties of the Columbia-suicide severity rating scale among a heterogeneous sample of adolescents in Turkey. *The International Journal of Psychiatry in Medicine, 54*(2), 115–132. https://doi.org/10.1177/0091217418791454

Kiss, L., Yun, K., Pocock, N., & Zimmerman, C. (2015). Exploitation, violence, and suicide risk among child and adolescent survivors of human trafficking in the greater Mekong subregion. *JAMA Pediatrics, 169*(9), Article e152278. https://doi.org/10.1001/jamapediatrics.2015.2278

Knipe, D. W., Padmanathan, P., Muthuwatta, L., Metcalfe, C., & Gunnell, D. (2017). Regional variation in suicide rates in Sri Lanka between 1955 and 2011: A spatial and temporal analysis. *BMC Public Health, 17*(1), Article 193. https://doi.org/10.1186/s12889-016-3961-5

Knipe, D., Williams, A. J., Hannam-Swain, S., Upton, S., Brown, K., Bandara, P., Chang, S.-S., & Kapur, N. (2019). Psychiatric morbidity and suicidal behaviour in low- and middle-income countries: A systematic review and meta-analysis. *PLoS Medicine, 16*(10), Article e1002905. https://doi.org/10.1371/journal.pmed.1002905

Lara, G. A. G., Zúñiga, J. O., Pérez, O. C., Solís, S. H., Jiménez, C. E. P., & Méndez, M. C. (2018). Predictors of suicidal ideation and depressive symptoms among adolescents in Chiapas, Mexico. *Ciencia & Saude Coletiva, 23*(4), 1089–1096. https://doi.org/10.1590/1413-81232018234.14492016

Lovero, K. L., Dos Santos, P. F., Come, A. X., Wainberg, M. L., & Oquendo, M. A. (2023). Suicide in global mental health. *Current Psychiatry Reports, 25*(6), 255–262. https://doi.org/10.1007/s11920-023-01423-x

Maguen, S., Luxton, D. D., Skopp, N. A., Gahm, G. A., Reger, M. A., Metzler, T. J., & Marmar, C. R. (2011). Killing in combat, mental health symptoms, and suicidal ideation in Iraq war veterans. *Journal of Anxiety Disorders, 25*(4), 563–567. https://doi.org/10.1016/j.janxdis.2011.01.003

Musyimi, C. W., Mutiso, V. N., Nyamai, D. N., Ebuenyi, I., & Ndetei, D. M. (2020). Suicidal behavior risks during adolescent pregnancy in a low-resource setting: A qualitative study. *PLoS One, 15*(7), Article e0236269. https://doi.org/10.1371/journal.pone.0236269

Onah, M. N., Field, S., Bantjes, J., & Honikman, S. (2017). Perinatal suicidal ideation and behaviour: Psychiatry and adversity. *Archives of Women's Mental Health, 20*(2), 321–331. https://doi.org/10.1007/s00737-016-0706-5

Oon-arom, A., Wongpakaran, T., Satthapisit, S., Saisavoey, N., Kuntawong, P., & Wongpakaran, N. (2019). Suicidality in the elderly: Role of adult attachment. *Asian Journal of Psychiatry, 44*, 8–12. https://doi.org/10.1016/j.ajp.2019.07.014

Pengpid, S., & Peltzer, K. (2019). Early substance use initiation and psychological distress among adolescents in five ASEAN countries: A cross-sectional study. *Psychology Research and Behavior Management, 12*, 1003–1008. https://doi.org/10.2147/PRBM.S223624

Pike, I., Kraus-Perrotta, C., & Ngo, T. D. (2023). A scoping review of survey research with gender minority adolescents and youth in low and middle-income countries. *PLoS One, 18*(1), Article e0279359. https://doi.org/10.1371/journal.pone.0279359

Piscopo, K., Lipari, R. N., Cooney, J., & Glasheen, C. (n.d.). *Suicidal thoughts and behavior among adults: Results from the 2015 National Survey on Drug Use and Health* (NSDUH Data Review, pp. 9, 1–15). NSDUH.

Pranckeviciene, E., & Kasperiuniene, J. (2024). Global suicide mortality rates (2000–2019): Clustering, themes, and causes analyzed through machine learning and bibliographic data. *International Journal of Environmental Research and Public Health, 21*(9), Article 1202. https://doi.org/10.3390/ijerph21091202

Rüdiger, M., Antons, D., Joshi, A. M., & Salge, T.-O. (2022). Topic modeling revisited: New evidence on algorithm performance and quality metrics. *PLoS One, 17*(4), Article e0266325. https://doi.org/10.1371/journal.pone.0266325

Reis, A., Sperandei, S., de Carvalho, P. G. C., Pinheiro, T. F., de Moura, F. D., Gomez, J. L., Porchat, P., Bastos, F. I., McFarland, W., Wilson, E. C., & Veras, M. A. (2021). A cross-sectional study of mental health and suicidality among trans women in São Paulo, Brazil. *BMC Psychiatry, 21*(1), Article 557. https://doi.org/10.1186/s12888-021-03557-9

Renaud, J., MacNeil, S. L., Vijayakumar, L., Spodenkiewicz, M., Daniels, S., Brent, D. A., & Turecki, G. (2022). Suicidal ideation and behavior in youth in low- and middle-income countries: A brief review of risk factors and implications for prevention. *Frontiers in Psychiatry, 13*, Article 1044354. https://doi.org/10.3389/fpsyt.2022.1044354

Romo, M. L., & Kelvin, E. A. (2016). Impact of bullying victimization on suicide and negative health behaviors among adolescents in Latin America. *Revista Panamericana De Salud Publica = Pan American Journal of Public Health, 40*(5), 347–355.

Sadek, J., Diaz-Piedra, B., Saleh, L., & MacDonald, L. (2024). A narrative review: Suicide and suicidal behaviour in older adults. *Frontiers in Psychiatry, 15*, Article 1395462. https://doi.org/10.3389/fpsyt.2024.1395462

Shamu, S., Zarowsky, C., Roelens, K., Temmerman, M., & Abrahams, N. (2016). High-frequency intimate partner violence during pregnancy, postnatal depression and suicidal tendencies in Harare, Zimbabwe. *General Hospital Psychiatry, 38*, 109–114. https://doi.org/10.1016/j.genhosppsych.2015.10.005

Springer, A., Parcel, G., Baumler, E., & Ross, M. (2006). Supportive social relationships and adolescent health risk behavior among secondary school students in El Salvador. *Social Science & Medicine, 62*(7), 1628–1640. https://doi.org/10.1016/j.socscimed.2005.08.018

Stahlman, S., Grosso, A., Ketende, S., Pitche, V., Kouanda, S., Ceesay, N., Ouedraogo, H. G., Ky-Zerbo, O., Lougue, M., Diouf, D., Anato, S., Tchalla, J., & Baral, S. (2016). Suicidal ideation among MSM in three West African countries: Associations with stigma and social capital. *The International Journal of Social Psychiatry, 62*(6), 522–531. https://doi.org/10.1177/0020764016663969

Syed, S., & Spruit, M. (2017). Full-text or abstract? Examining topic coherence scores using latent dirichlet allocation. In *IEEE International Conference on Data Science and Advanced Analytics (DSAA)* (pp. 165–174). https://doi.org/10.1109/DSAA.2017.61

Thakurta, R. G., Das, R., Bhattacharya, A. K., Saha, D., Sen, S., Singh, O. P., & Bisui, B. (2012). Rapid response with ketamine on suicidal cognition in resistant depression. *Indian Journal of Psychological Medicine, 34*(2), 170–175. https://doi.org/10.4103/0253-7176.101793

The World Bank Group. (2023). World Bank country and lending groups – World Bank data help desk. https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups.

Uddin, R., Burton, N. W., Maple, M., Khan, S. R., & Khan, A. (2019). Suicidal ideation, suicide planning, and suicide attempts among adolescents in 59 low-income and middle-income countries: a population-based study. *Lancet Child Adolesc Health, 3*(4), 223–233.

World Health Organization. (2025). Suicide worldwide in 2021: Global health estimates. https://www.who.int/publications/i/item/9789240110069.

Zengul, F. D., Oner, N., Byrd, J. D., & Savage, A. (2021). Revealing research themes and trends in 30 top-ranking accounting journals: A text-mining approach. *Abacus, 57*(3), 468–501. https://doi.org/10.1111/abac.12214