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Posted Date: 15 July 2025

doi: 10.20944/preprints202507.1045.v1

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 doi:10.20944/preprints202507.1045.v1

Review

Over 30 Years of HIV Interventions in Indonesia: A Bibliometric Analysis and Scoping Review

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Abstract

Globally, approximately 39.9 million individuals are currently living with HIV, with over one million new cases reported each year. In Indonesia, the incidence of new HIV infections has risen significantly by more than 400% in just over a decade. Various interventions have been implemented to prevent and reduce HIV transmission and address the associated impacts of HIV. However, there exists a significant gap in the literature, as no comprehensive studies have synthesised the available evidence to elucidate the current status and future trajectory of HIV interventions within the country. This study aims to fill this gap by exploring publication trends on HIV interventions, the types of interventions, targeted population groups, and the settings in which these interventions were implemented. A bibliometric analysis and a scoping review were conducted. The bibliometric analysis facilitated the identification of publication trends, key authors and collaborators, citation metrics, influential journals, trending topics in HIV interventions, and the co-occurrence of relevant keywords. The scoping review enabled the categorisation of various types of HIV interventions, the identification of targeted groups, and intervention settings. Databases including Scopus, Embase, PubMed, Web of Science, Google Scholar, Cochrane Library, CINAHL, Psychology and Behavioural Sciences Collection, Garuda, and Google were used. The bibliometric analysis encompassed 84 articles from a total of 847 retrieved from the Scopus and Web of Science databases, showing a steady increase in annual publication post-2008. These articles were published across 65 distinct journals and authored by 400 authors. The average citation rate per document was 8.48%. Key trending topics and co-occurring keywords identified included human immunodeficiency virus, HIV infections, acquired immune deficiency syndrome or anti-retrovirus, people who inject drugs, and adherence. The scoping review, which included 90 articles selected from a total of 2,224 retrieved, identified four types of HIV interventions, with HIV treatment, and prevention and education being the most common types. The interventions targeted 14 different population groups and were implemented across seven distinct settings in 19 districts/municipalities across 14 provinces. The findings underscore the pressing need for an expansion of HIV interventions that not only focus on prevention and treatment but also consider the social, cultural, and religious factors influencing both HIV transmission and its impact. Furthermore, the results highlight the necessity of targeting specific high-risk and underserved populations, such as men who have sex with men, transgender women, female sex workers and their male clients, pregnant women, individuals who use or inject drugs, prisoners, children, adolescents, and young people. Moreover, there is a critical need to extend the geographical coverage of these interventions into rural districts, often referred to as underdeveloped or disadvantaged areas within Indonesia.

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 doi:10.20944/preprints202507.1045.v1

Introduction

HIV is a public health problem which has infected tens of millions of people throughout the world, with 39.9 million people currently living with the infection [1]. Despite the sign of a declining trend, there are still over a million people newly diagnosed with the infection, and hundreds of thousands of people dying from AIDS every year globally [1,2]. Following Eastern and Southern Africa, Asia and the Pacific region is in the second leading position in terms of the number of HIV infections and AIDS-related deaths [1,2]. Meanwhile, with regard to HIV treatment coverage, the 2023 UNAIDS report showed that Asia and the Pacific is at the third bottom of regions with the lowest coverage [1,2].

Indonesia is one of the countries in Asia and the Pacific region with the second highest number of HIV infections and AIDS-related deaths [2,3]. The national AIDS data have reported that the country has been experiencing a 400% increase in new HIV infections over the last decade, from 98,390 in 2012 to 515,455 in 2023 [4]. The country's low performance in the UNAIDS triple 95 goals, aiming for 95% of people living with HIV (PLHIV) to get tested, 95% of those living with HIV to receive antiretroviral therapy (ART), and 95% of those on ART to have their viral load suppressed [5], is a plausible explanation for such a significant increase. Of an estimated 515,455 PLHIV in the country, only 77% knew their HIV status, only 45% who knew their status were on ART, and only 50% of those on ART had their viral load suppressed [4]. Moreover, the performance of the UNAIDS triple 95 goals [5] in the country has been reported lower among the key population groups, such as transgender people, men who have sex with men (MSM), and female sex workers (FSWs) and their male clients, who represent a significant portion of HIV infection in the country [4,6]. Poor health outcomes among PLHIV have been linked to delayed diagnosis, poor linkage to HIV care and inconsistent adherence to ART [5,7].

HIV interventions, whether it is for HIV prevention, education, testing, care, or treatment, play a critical role in global health efforts to reduce the transmission and impact of HIV [8–12]. Therefore, a wide range and coverage of interventions is vital for and can contribute to better prevention of new infections, and improvement of HIV care, treatment, and the quality of life for PLHIV. In the context of Indonesia, various interventions and strategies have been initiated and implemented in different settings and districts in response to HIV and its impacts on individuals living with HIV. These include interventions, such as HIV treatment and medication adherence [13,14] and the management of opportunistic infections [15,16]. HIV prevention and education interventions [17,18] and behavioural interventions [19,20] have also been implemented to increase and improve knowledge and awareness of HIV, and prevent HIV transmission. Similarly, HIV testing and counselling to improve access, identification, and treatment of HIV have also been implemented in various places in the country [21]. Digital and mobile health interventions are also some other types of HIV interventions aiming at improving knowledge of HIV and access to services within communities in Indonesia [22,23].

Despite the determined and long efforts and investment over the years to tackle HIV in Indonesia, there has not been synthesised evidence that provides a comprehensive overview of the types of HIV interventions that have been implemented in the country over the last 30 years, the targeted population groups, and the settings/locations of those interventions. Similarly, there have not been studies undertaken to provide evidence on the trend of publications on HIV interventions in Indonesia, key authors, publication citations, and trending topics and co-occurrence keywords used in those interventional studies. In addition, to our knowledge, no bibliometric analysis and scoping review of literature on various HIV interventions in Indonesia have been conducted. Therefore, firstly, using a bibliometric analysis, we aim to identify the trend of publications on HIV interventions in Indonesia, key authors and collaborators with number of publications and citations, the sources (journals) that published these articles, the trending topics of HIV interventions, and the co-occurrence of keywords used in HIV interventions in Indonesia. Secondly, we also conducted a scoping review to synthesise evidence on the types of HIV interventions implemented in Indonesia, the target population groups in those HIV interventions, and the settings or locations where those interventions were implemented. This study presents a novel approach by integrating two

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techniques: bibliometric analysis and scoping review, which have not been previously applied to the examination of HIV interventions in Indonesia or other settings. The findings provide a comprehensive overview of the landscape of HIV interventions within Indonesia, facilitating the identification of priority areas and offering guidance for future initiatives. Specifically, the findings highlight at-risk population groups that warrant targeted interventions and settings that should be prioritised for HIV-related interventions in Indonesia. Consequently, these insights hold significant relevance for HIV policy formulation, as they can be utilised by the Indonesian government, non-governmental organisations, and researchers to inform the development of future HIV policies, interventions, and practices tailored to the Indonesian context and other similar settings.

Methodology

Study design

Bibliometrics is a method that is systematic and organised, and is employed by a variety of academic disciplines to compile and summarise publications on a particular topic [24]. Bibliometrics supports the advancement and improvement of knowledge in the concept under investigation. The methodology of bibliometric studies is similar to that of other literature review forms, consisting of four stages: the formulation of search strategies, the aggregation of research outcomes and the construction of the dataset, the summarisation of the findings, and the analysis of the findings [25].

A scoping review was also conducted to provide additional and more in-depth information regarding the HIV interventions implemented in Indonesia. Scoping review is a method that systematically identifies and examines key concepts and literature within a specific field of study to provide a comprehensive understanding of the breadth and characteristics of existing research. An initial set of five phases was implemented in this investigation. The procedures were as follows: (a) formulating the research question; (b) identifying relevant articles; (c) selecting the eligible articles; (d) organising and documenting the collected data; and (e) synthesising, summarising, and presenting the resulting conclusions [26]. The reporting followed the PRISMA-ScR (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) statement for a Scoping Review (Supplementary 1) [27] and the reporting standard for bibliometric reviews of the biomedical literature is the BIBLIO checklist (Supplementary 2) [28].

Database and search strategy

Scopus and Web of Science databases were used to retrieve HIV intervention studies in Indonesia for bibliometric analysis. Both are multidisciplinary databases and the most extensive abstract and citation databases for peer-reviewed literature, covering publications in a range of areas, including arts and humanities, social sciences, medical, and health sciences [29]. For bibliometric analysis, the search was conducted from 25 to 30 March 2025 and rerun on 15 June 2025. For the scoping review, databases searched to retrieve articles were Scopus, PubMed, Embase, Web of Science, Google Scholar, Cochrane Library, CINAHL, and Psychology and Behavioural Sciences Collection. The search was conducted from 25 to 30 March 2025. A search of articles on Google was also performed. The Indonesian database, Garuda, was also searched to retrieve articles published in Indonesian journals.

The search technique was designed based on the primary concepts of "HIV", “intervention”, and "Indonesia". Following the completion of a preliminary search, we implemented a search strategy that involved a combination of keywords and Boolean operators. Publication dates were not restricted, and the sources were limited to both English and Indonesian literature. Detailed search strategies were provided in Supplementary 3.

Article selection process

The bibliometric analysis was conducted utilising Excel for the filtering process. Simultaneously, the sifting of all publications for the scoping review was performed by two researchers employing Covidence. This scoping review focused on studies on HIV interventions conducted in Indonesia. The inclusion criteria of an article to be included in this review were (1) an empirical study design in any form of design: qualitative, quantitative, or mixed methods, (2) related to HIV intervention

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studies, and (3) conducted in Indonesia. Articles were excluded according to the criteria: (1) unrelated topic, (2) non-HIV intervention studies, (3) studies in the form of reviews, and abstracts (with no full texts), (4) studies not conducted in Indonesia, and (5) non-English and non-Indonesian publications. The reviewers conducted the selection process based on title & abstract, following the criteria of population (people living with HIV), concept (interventions), and context (Indonesia). The screening, exclusion, and inclusion process is described under the "Description of the included study" section.

Data analysis

For the bibliometric analysis, the data were analysed using R Base version 4.2.2 with R Studio version 4.2.2 (Posit, Massachusetts, USA) [30]. The R programming environment utilised the open-source packages Bibliometrix and Biblioshiny. The Biblioshiny package is a shiny application that provides a web interface for the Bibliometrix program to obtain essential bibliometric indicators [30,31]. These indicators encompass a comprehensive summary of information, annual scientific output, identification of the most prolific authors, journals with the highest volume of publications, the most frequently cited documents, an analysis of keywords, and an examination of trends in thematic developments. This package is used across various scientific disciplines for bibliometric analysis.

The data acquired from the literature were systematically presented in a tabular format, following the objectives of the scoping review. Firstly, the included articles were read, and the texts (lines or data extracts) were coded, facilitating the interpretation of the data and the identification of key concepts and themes based on the review objectives. Next, descriptive themes were developed by organising similar concepts into overarching themes. Following the previous step, a critical review of the themes and a discussion regarding the potential addition or modification of these themes were carried out regularly among the reviewers [32]. Ultimately, the themes concerning the types of HIV interventions in Indonesia, the target groups and settings/locations of the interventions were identified and presented in the Results section [26]. Moreover, we created a forest plot to visually summarise the direction and magnitude of intervention or effects of exposures across various HIV-related outcomes, using adjusted odds ratios (AORs) with their corresponding 95% confidence intervals (CIs) extracted from studies that reported effect estimates or provided sufficient data to calculate them.

Results

Bibliometric analysis

In total, 847 articles were identified through a search of the Scopus and Web of Science databases. By employing the R software, 88 articles were identified as duplicates and subsequently excluded from further analysis. The population, concept, and context frameworks were all integrated into the screening process. Ultimately, 84 articles were screened and subsequently incorporated into the bibliometric study. The initial output of Biblioshiny is the summary information, which comprises the fundamental statistics regarding the literature dataset that was analysed. The retrieved articles were published in 65 distinct journals between 1993 and 2025 and authored by 400 authors, with 0.5% of them being single-author articles. The average number of citations per document was 8.48% (See Table 1). Articles accounted for over 91.67% of the documents, while others included reviews, brief surveys, and other forms of publication. The substantial discrepancy between the count of articles and the count of other literature categories is indicative of the high scholarly value of the literature in the field of HIV interventions in Indonesia.

Table 1. Summary information.

Item	Results
Main information	
Timespan	1993-2025
Sources (Journals, Books, etc) (n)	65

 doi:10.20944/preprints202507.1045.v1

Documents (n)	84
Document average age (mean)	7.45
Average citation per document (mean)	8.48
Authors	
Authors	400
Authors of single-authored docs	2
International co-authorship (%)	51.19
Co-author per document	7.17
Content	
Keywords Plus	549
Author's Keywords	220
Document types	
Article	77
Short survey	1
Review	3
Others	3

Before 2009, the field recorded no publications or only one publication each year; however, the general trend post-2008 demonstrates a steady increase (Figure 1(A)). The years with the highest number of publications were 2019, 2021, and 2023, with a total of 10 articles for each year. The peak of citations was reached in 1996, averaging 59 (Figure 1(B)). Overall, the average citation per document was 8.48 citations annually (Table 1).

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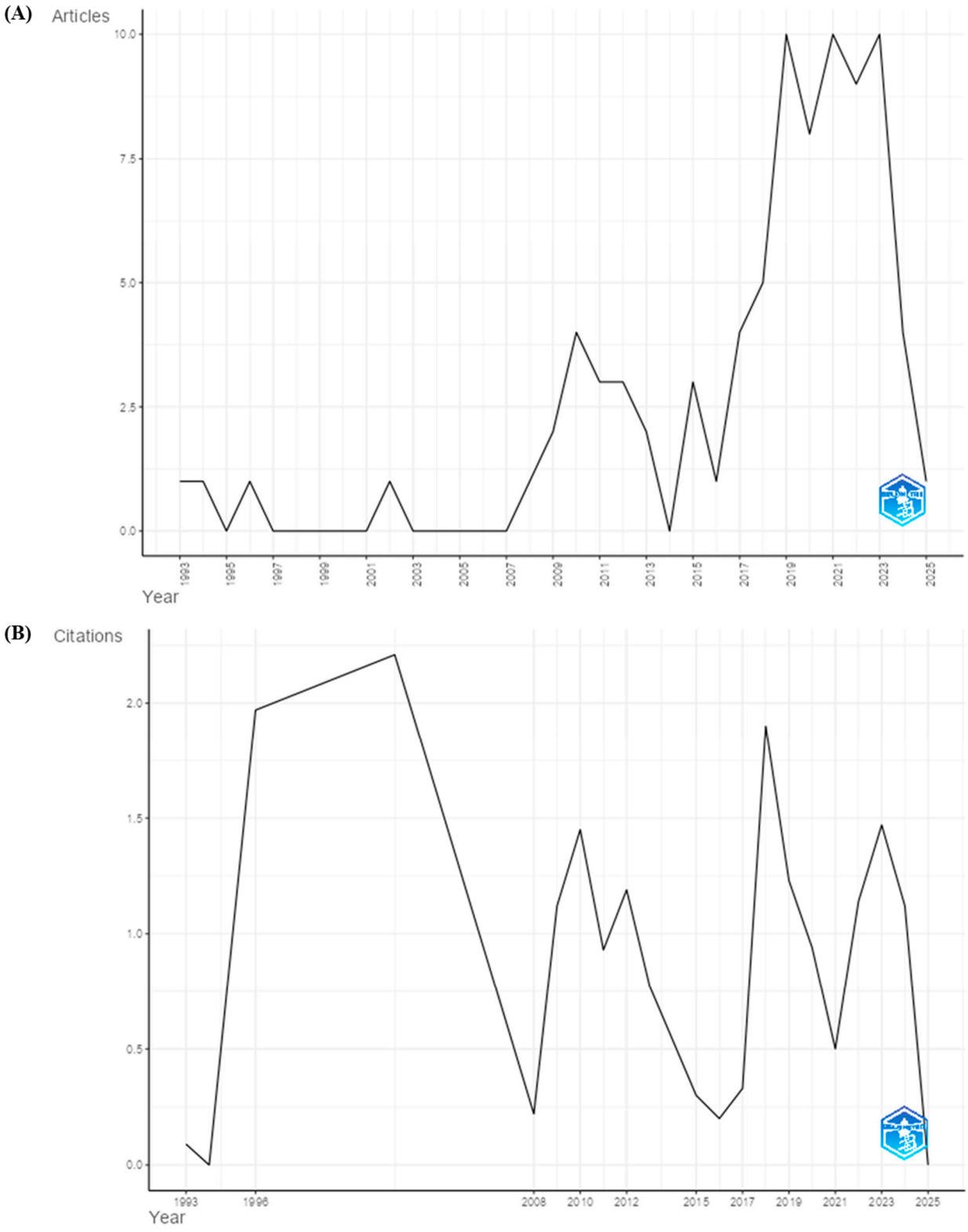

Figure 1. (A) Annual publications. (B) Average citations.

A variety of metrics were employed to assess the scientific productivity and impact of authors, including the volume of published papers, citation counts, the h-index, the g-index, and the extent of article fractionalisation. This bibliometric also assessed the citation measure, defined as the total number of citations a document has garnered since its release (Figure 2(A)). Among all the authors, the article by Miller, Hoffman [33] received the highest number of 68 citations, followed by Ford, Wirawan [20] with 59 citations and Ford, Wirawan [34] with 53 citations. The objective of the study by Miller, Hoffman [33] was to evaluate the feasibility of a future controlled trial by examining the

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incidence of HIV, enrolment, retention, and adoption of the intervention, as well as the efficacy of an integrated and flexible intervention on antiretroviral therapy (ART) use, viral suppression, and medication-assisted treatment (MAT) use. Additionally, articles on HIV interventions in Indonesia have been published in various journals. Acta Medica Indonesiana, AIDS, HIV and AIDS Review, PlosOne, Sexual Health, and Tropical Medicine & International Health have all published three articles, respectively (Figure 2(B).

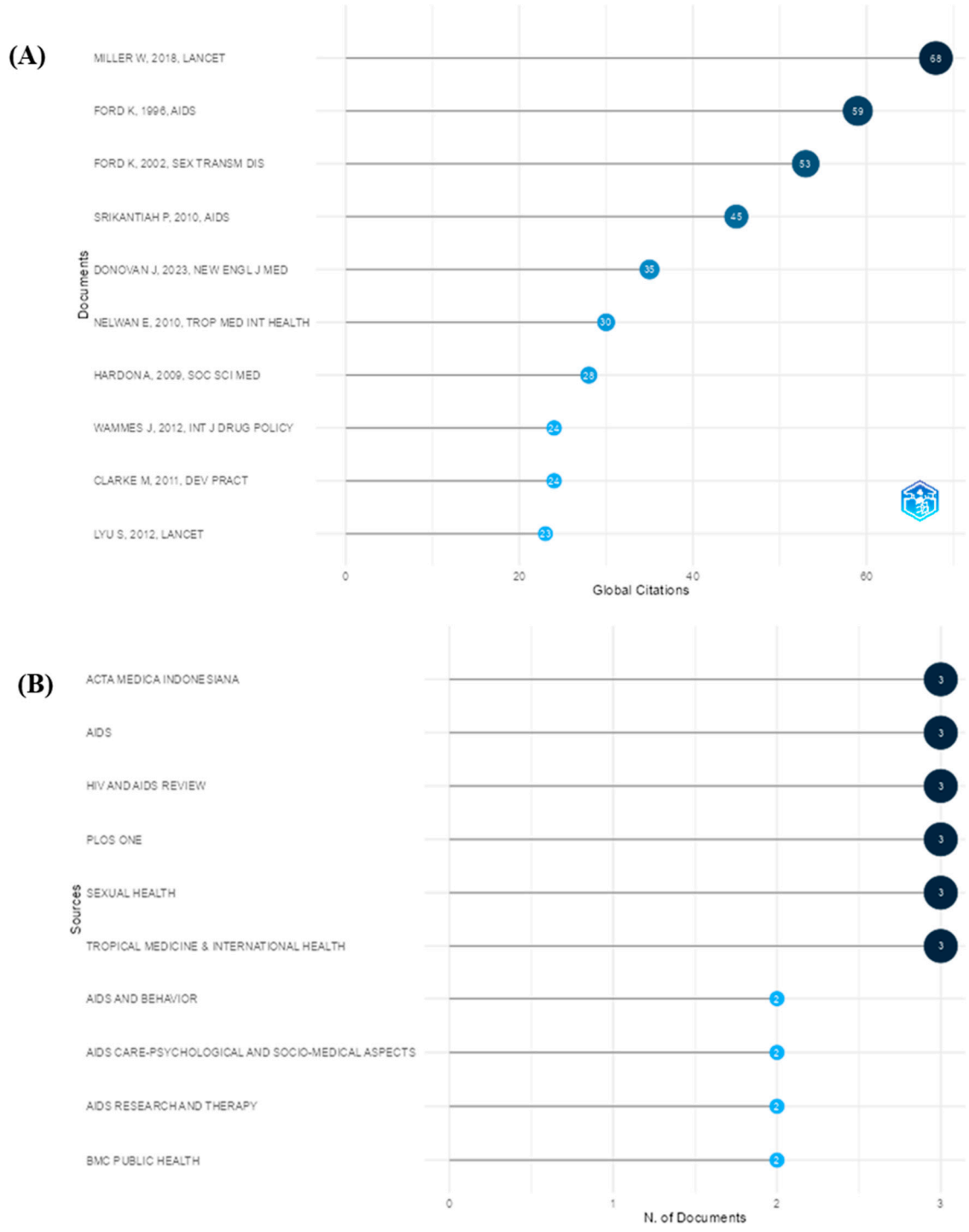

Figure 2. (A) The most cited documents. (B) The most relevant sources.

In terms of country collaboration network, most authors in Indonesia collaborated with authors from the US (14 articles), Australia (13 articles), and the Netherlands (11 articles) (Figure 3).

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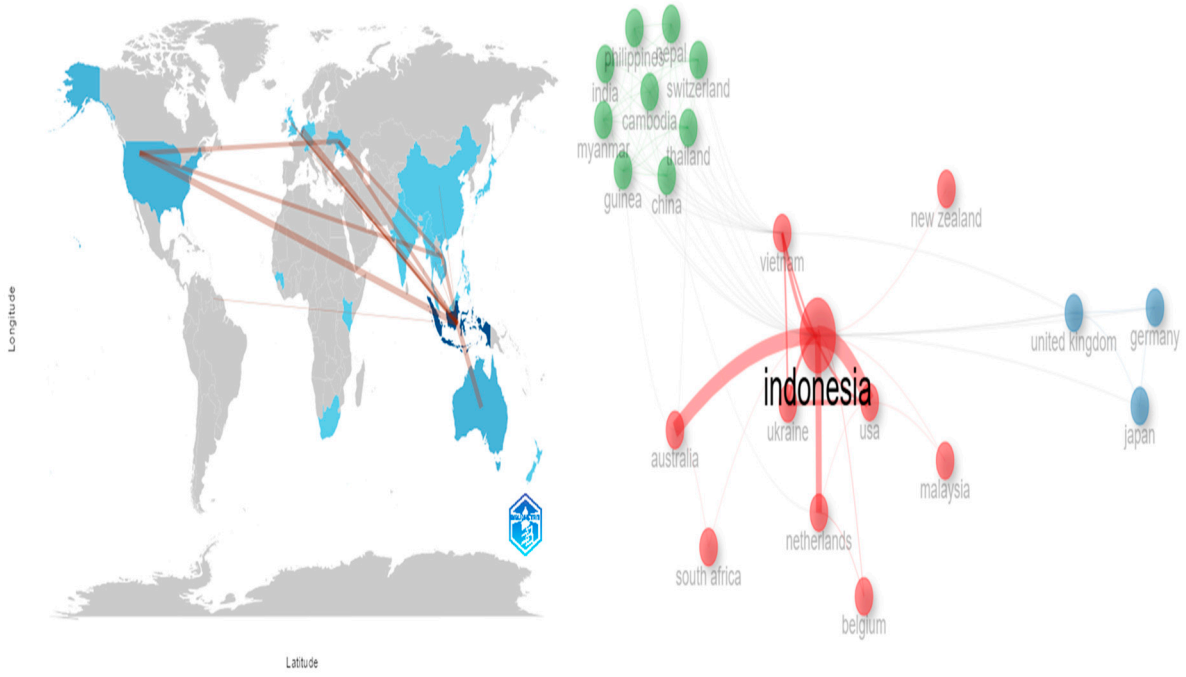

Figure 3. Country collaboration network.

The topics addressed in the publications are particularly relevant to this investigation, as the objective of this bibliometric study was to determine the publication trend on HIV intervention studies in Indonesia. Consequently, it is imperative to analyse the content of the literature items in accordance with the abstracts and keywords of the authors. The examination of these abstracts offers valuable insights into research trends and identifies deficiencies in the HIV intervention studies in Indonesia. In order to evaluate the feasibility of conducting future intervention studies in this discipline, it is essential to have a thorough understanding of the trend subjects.

Key trending topics and co-occurring keywords identified, which reflected the focus of the HIV interventions implemented in Indonesia over the last 30 years (1994-2024) included immunodeficiency virus or HIV infections, acquired immune deficiency syndrome, antiretroviral therapy or anti-retrovirus, people who inject drugs, and adherence. Consequently, the subsequent steps should entail completing a scoping review to incorporate additional databases and more detailed and in-depth information about the characteristics of the interventions.

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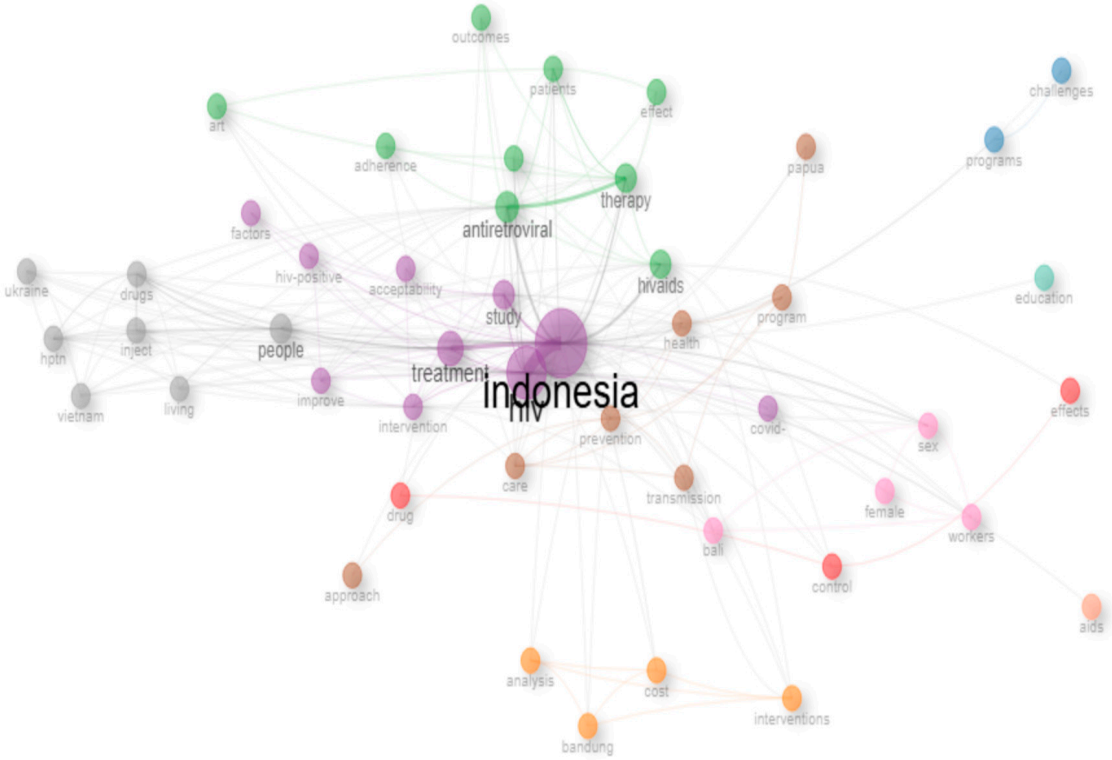

Figure 4. Co-occurrence network Scoping review.

Descriptions of the included studies

The screening procedure was conducted by two reviewers using Covidence, and 2,224 articles were retrieved from the six databases. To identify as many articles as possible about HIV interventions in Indonesia, we broadened the search by conducting a manual search and screening of Google and Garuda (an Indonesian database), which resulted in the identification of 26 additional articles. Following the removal of 282 duplicates, the articles were screened based on the titles and abstracts, leading to further removal of 1,793 ineligible articles. The full text of 149 articles was evaluated, which led to further exclusion of 59 ineligible articles. The screening process was resolved through discussions between the two reviewers and consultation with the third reviewer in the event of any disagreements. Ultimately, 90 articles were processed for the scoping review (Supplementary 4). The detailed characteristics of the included studies, including the authors' names, study aim, methodology (e.g., interventions, study designs, study participants, and study locations), and outcomes of the interventions, are presented in Supplementary 5.

The Special Capital Region (Jakarta) was the site 41% of the studies or interventions, followed by West Java (26%), and Bali (24%) (Supplementary 5). Approximately 16% of the studies or interventions were carried out in more than one city [18,22,23,35–45] and two studies (2%) did not specify the setting [46,47]. The number of participants was not specified in all of the studies; however, approximately 24,702 individuals were involved in these studies. Most participants were individuals living with HIV/AIDS (21%), followed by men who have sex with men (17%) and female sex workers (11%), as indicated by the target population of the studies.

In terms of the study design, the majority of the studies were conducted as interventional studies, with a randomised controlled trial (21%) or quasi-experiment (15%). Other studies that were included in the analysis employed an observational approach, primarily with a cohort design (28%), either using retrospective or prospective methodologies. The cost-analysis design was employed in approximately 11% of the included studies, while the remaining studies employed qualitative (13%) or mixed-methods designs (10%).

HIV interventions in Indonesia

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The initial studies of HIV interventions in Indonesia were published in 1993 [47], 1994 [48], 1996 [20], which were six to nine years after the first HIV infection was diagnosed in the country. Over the last three decades, various HIV interventions in Indonesia have been documented in 90 scientific publications across various journals worldwide. These HIV interventions address a range of aspects related to HIV, whether among PLHIV or the general population, to prevent HIV transmission and address the impacts of HIV faced by various population groups and improve their health outcomes. The various HIV interventions have shown some promising results and can be categorised into four types or groups, as presented below.

Antiretroviral and alternative therapy interventions

One of the HIV interventions that has been frequently implemented in response to the HIV issue in Indonesia is the HIV treatment using ART as a standalone or in combination with other medical treatment or herbal medicines, which is reported in 36 studies. Eleven studies reported on ART initiation or treatment interventions, suggesting that the interventions led to better outcomes in terms of virological suppression and immunological recovery among HIV patients and increased CD4 counts [49–60]. However, it was reported that those who experienced HIV drug resistance were less likely to achieve viral suppression [61]. Four other studies report several interventions, such as the Strategic Use of ART (SUFA) initiative, implemented by the national government in several cities in Indonesia, the implementation of Highly Active Antiretroviral Therapy (HAART) through a program known as Universal Test and Treat (UTT), Simple ART Initiation, and the modified alarm medicine box intervention [40,42,62,63]. These studies suggest that these interventions have resulted in significantly increased coverage of HAART, increased proportion of ART initiation, a higher number of HIV tests and detected HIV cases, a decrease in loss to follow-up during treatment, and enhanced medication (ART) adherence among PLHIV [40,42,62,63]. Three studies focusing on evaluating the acceptability, feasibility of home delivery of ART program and ART switch to support the continuation of ART in Indonesia during COVID-19 pandemic and a culturally adapted medication adherence intervention, indicate that these interventions were both feasible and acceptable to health service providers, clients, and other stakeholders, and also within the Indonesian prison setting, and could maintain patients' adherence to ART [13,64,65]. Other studies reported a decrease in levels of inflammatory biomarkers and Cytomegalovirus (CMV) antibodies in patients with HIV who were undergoing ART [66,67]. One study [68] reported a protocol for an intervention aimed at evaluating the effect of atorvastatin in statin-naive, virally suppressed HIV-infected patients with stable ART and CMV seropositivity, although details regarding the actual intervention are not yet available. In addition, three studies report on barriers to ART uptake suggesting that access procedures, poor financial conditions, ART side effects, lack of information about HIV testing and ART enrollment, lack of motivation to take up ART, and stigma are barriers to ART [69–71].

Furthermore, several other studies have also reported on HIV interventions that combine ART with other medical treatments. A study by Maemun and colleagues [14] highlighted the combination of ART and tuberculosis (TB) treatment for patients with HIV/TB co-infections. The findings show that early initiation of ART in patients already undergoing TB treatment resulted in higher survival rates compared to those who commenced ART at a later stage. Several other studies have reported on Methadone Maintenance Treatment (MMT) interventions for PLHIV, indicating that the integration of HIV treatment (ART) with MMT can be highly effective in preventing HIV infection [72–74]. For example, a study by Wammes et al. [74], which evaluated MMT as a method of HIV prevention, estimated that expanding MMT coverage from 5% to 40% by 2019 could potentially avert approximately 2,400 HIV infections. Similarly, another study examined the efficacy and practicality of substitution therapy for opioid dependency in the context of HIV prevention, treatment, and care for opioid-dependent injectors, reporting high retention rates in MMT, significant reductions in illicit drug (opioid) use, and improvements in emotional control and sleep disorders among clients [35]. Several other studies assessed the effects of the combination of ART and other medication-assisted treatments (MAT) or drugs and reported various benefits experienced by patients with HIV,

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including improved linkage to care, increased ART uptake, and other social and general benefits, such as enhancements related to employment, finances, relationships, and reduced stigma [75–77].

In addition to medical therapies involving antiretroviral medicines and methadone for HIV treatment or prevention, other studies have also reported on the use of alternative medicines or therapies, either as standalone treatments or in combination with ART. A study by Amanah and others [46] investigated an intervention using Mangosteen Peel Extract (MPE) for HIV patients on ART, suggesting a significant increase in the number of CD4+ T cells and a notable decrease in CD38 expression among the patients. Meanwhile, another study reported on an HIV intervention that utilised sago caterpillar oil extract, indicating an increase in CD4 cell count among participants and significant differences in leukocyte levels before and after the intervention [78]. However, this study did not specify whether the HIV patients receiving this alternative therapy were also on ART.

HIV counselling and testing interventions

HIV counselling and testing interventions in various forms have been initiated and implemented in several regions or cities across Indonesia, as reported in 12 studies. Two studies evaluating the outcomes of voluntary counselling and testing (VCT) service delivery intervention in urban Indonesia and community screening for HIV testing reported that these interventions resulted in a high number of HIV tests and facilitated early HIV diagnosis [45,79]. Another study focused on a prison-based assisted partner notification (APN) model aimed at assessing its effectiveness in enhancing partner notification and HIV testing reported that the intervention led to an increase in partner notifications regarding HIV exposure, and HIV testing uptake and diagnoses [21]. Other studies evaluating HIV self-testing interventions and their acceptability among groups of men who have sex with men (MSM) and men who purchase sex (MWPS) suggest that these interventions achieved high levels of acceptability, which in turn led to increased HIV testing uptake and early detection of HIV infection [80]. Moreover, some of the aforementioned studies reported that the HIV counselling and testing interventions ultimately resulted in enrolment in HIV treatment or ART, adherence to medication, and viral load suppression [77,79,81,82]. Finally, four additional studies concentrated on evaluating the costs associated with HIV testing interventions, including community-based oral HIV testing and APN [21,36,38,83].

Behavioural interventions

Behavioural interventions targeting various groups, such as adolescents, FSWs, PWID, and PLHIV in general, have been reported in eight interventional studies in Indonesia. Four studies reported on Motivational Interviewing (MI) interventions (behavioural approach) designed to enhance HIV prevention among adolescents, PWID, and PLHIV [19,20,41,84]. These studies suggest that behavioural interventions have resulted in a significant effect on awareness and behaviour regarding HIV prevention among adolescents, increased knowledge of sexually transmitted infections (STIs)/HIV and condom use, and reduced transmission rates of STIs/HIV [19,20,41,84]. Similarly, behavioural interventions for the prevention of risky behaviours reported that the interventions improved the resilience of adolescents to avoid unprotected sex and illicit drug use and supported women in helping their male partners change HIV risky behaviours [47,85]. Behavioural interventions not only positively affect the prevention of HIV transmission through improved knowledge of HIV/STIs and increased condom use but also contribute to early ART initiation, improved treatment outcomes or viral suppression, and enhanced self-reported adherence to ART among PLHIV, such as PWID and women [41,86]. In addition, another behavioural intervention focusing on self-management has been reported to improve the quality of life (QOL) of PLHIV in terms of their physical, psychological, and environmental dimensions [87].

Prevention and educational interventions

HIV interventions aimed at providing HIV education and prevention for population groups, which are reported in 34 studies, have been implemented using a range of strategies and methods. Several studies have reported on HIV interventions that utilised audio-visual media to educate adolescents or high school students [88–90]. These studies show that such interventions enhanced the knowledge and awareness of adolescents regarding HIV and its impacts [88–90]. Similarly, HIV

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education interventions employing social media platforms like WhatsApp and the internet have been deemed feasible, acceptable, and capable of improving access to HIV testing and treatment or ART [37,91,92]. The use of online applications such as Mobile Health Applications, My Therapy Application, and Integrated E-Health Services has also been reported in various studies, demonstrating an increase in knowledge about HIV and access to HIV services or ART [22,23,93,94]. Other educational interventions for young people and adolescents have also been reported effective in increasing their knowledge, attitudes and behaviours related to HIV transmission [44,95].

An art-based program or intervention has also been implemented to disseminate HIV education, promote prevention, testing, and treatment, particularly in low-resource areas, and has been reported to enhance awareness about HIV [96]. Peer education is another method employed in HIV education interventions, which has been shown to increase knowledge about STIs/HIV and promote the use of female condoms among FSWs [17,97,98]. Other HIV prevention and education interventions, such as male circumcision, the promotion of condom sales programs for vendors, and HIV training for medical doctors, have also been reported as acceptable and effective in increasing HIV knowledge and the number of vendors involved in condom sales [43,48,99]. Two studies specifically reported on HIV prevention interventions for men (male in IDUs and prisoners), such as HIV education, VCT, condom supply, prevention of rape and sexual violence, and reported effective in reducing risky sexual and injecting drug use behaviours [96,100]. Four studies reported on mother-to-child transmission (PMTCT) interventions which resulted in improved acceptability of and access to PMTCT services, such as HIV counselling and testing [18,101–103]. Other HIV education interventions or programs, such as peer outreach worker programs and group education initiatives focused on information disclosure and efforts to prevent HIV transmission among at-risk groups, have also reported positive outcomes [104,105]. These include increased community involvement in HIV programs, enhanced disclosure of HIV-related information, and improved prevention of transmission after the intervention.

Furthermore, five studies reported various HIV interventions, such as pre-exposure prophylaxis (PrEP), the HIV prevention trial network, condom distribution, mobile VCT, and STI services for different population groups, but primarily focusing on assessing the costs or financial implications of these interventions [39,106–109]. Meanwhile, two studies highlighted interventions aimed at integrating relevant social values to establish local priorities concerning HIV treatment and developing competent human resources and skills through individual and collective learning or research in order to be able to develop, pilot, implement, and evaluate evidence-based HIV prevention and treatment interventions [110,111]. Finally, one study reported on the effect of a brief educational intervention in informing oral health and HIV teaching in dental schools in Indonesia [112]. Moreover, figure 5 depicts AOR for various HIV-related interventions. Several interventions (e.g., peer facilitator support, female condom use) demonstrated strong positive associations with improved service utilisation (e.g., PMTCT uptake, reduced mortality) or behavioural outcomes, while others showed insufficient statistical evidence to support their effectiveness.

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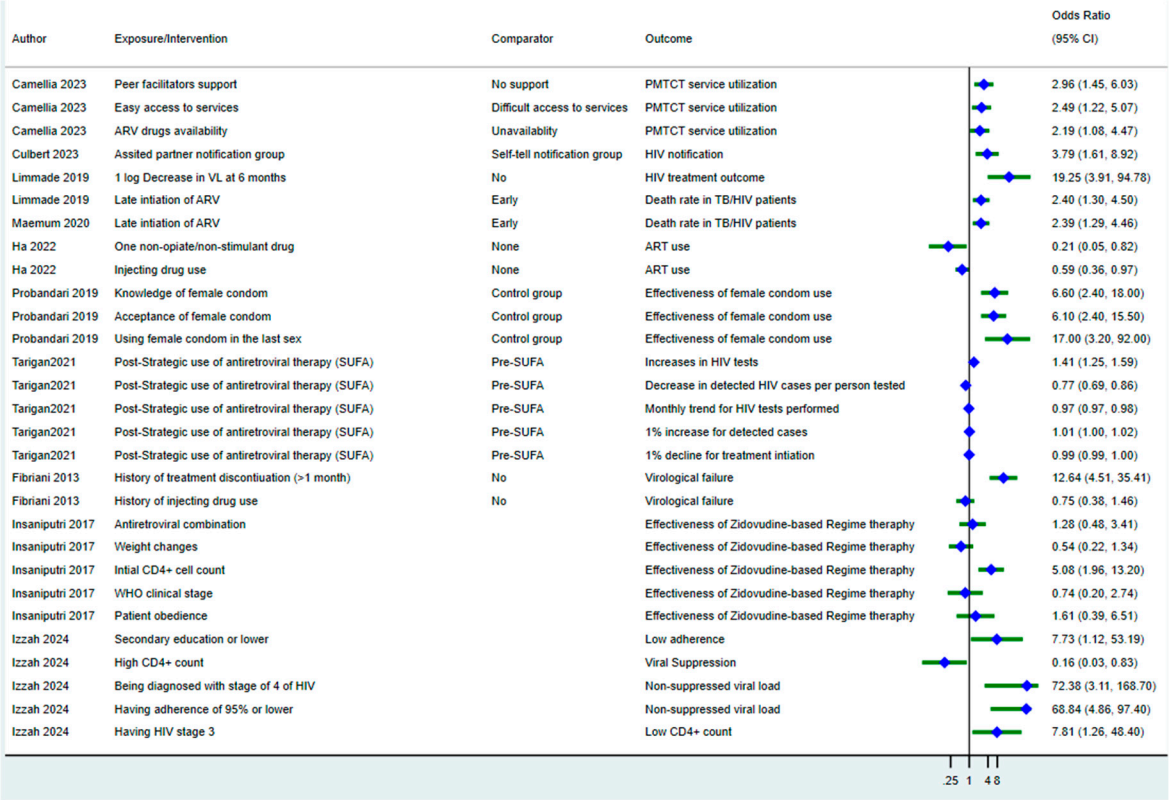

Figure 5. Forest plot of adjusted odds ratios (95% CI) showing the effects of HIV-related interventions in Indonesia across studies.

Population groups targeted in HIV interventions in Indonesia

The population groups targeted by HIV interventions in Indonesia are diverse and include individuals living with HIV, children and adolescents (including high school students), men and women in general, people who use drugs (PWUD) or inject drug users (IDUs), FSWs, MSM, transgender women, healthcare workers and HIV counsellors, incarcerated individuals, mothers, stakeholders, clients of FSWs, university students, and employees in the private sector. A total of thirty-five studies reported targeting PLHIV both men and women in general [14,23,41,46,47,49–54,56,57,59,60,62–64,66–68,78,82,84,86,92,93,107,111], while nine studies reported HIV interventions for the general population of men and women who are not living with HIV [36,39,42,43,65,74,79,108,113]. Twelve studies reported HIV interventions targeting children and adolescents or high school students [19,43,44,53,63,65,85,88–91,95]. Ten studies specifically examined interventions involving healthcare workers, HIV counsellors, staff at infectious disease unit, dental school deans, and NGO staff [23,69,70,82,84,99,102,104,106,112], and one study reported on an HIV intervention that involved stakeholders from governmental and non-governmental organisations [110].

In terms of the coverage of populations at heightened risk for HIV infections and their associated impacts, fifteen studies reported interventions targeting IDUs and individuals who use illicit drugs [22,35,40,58,61,69–73,75–77,100,105]. Other high-risk groups, such as MSM [22,37,38,40,45,81,104,105,109], FSWs [17,20,38,40,97,98,114], and transgender women [22,37,40,109], were addressed in nine, seven, and four studies, respectively. Conversely, incarcerated individuals [13,21,83,96], mothers and pregnant women [18,101,103], and men who purchase sex or clients of FSWs [80], also recognised as high-risk groups for HIV transmission and its impacts, appear to have received comparatively less focus within HIV interventions in Indonesia.

Settings of HIV interventions in Indonesia

The studies reported that HIV interventions were implemented across a variety of settings in numerous districts and provinces within Indonesia. A total of 37 studies documented HIV

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interventions carried out in healthcare facilities or settings, which encompassed hospitals, public health centres, clinics, and health laboratories [14,23,35,36,39,40,42,49–53,55,57,59,62,64,66–69,72,73,78,79,81,82,86,87,89,99,102,107,108,111]. The predominant focus of these interventions was to facilitate HIV testing, counselling, and treatment. Sixteen and eight studies respectively highlighted interventions conducted within community settings [41,43,45,58,61,70,71,75–77,85,92,103–105,113] and in educational institutions such as schools and universities [19,44,88,90,91,94,95,112]. Six reported interventions carried out in brothel settings [17,20,80,97,98,114] and five studies reported interventions executed within organisational or institutional settings [60,63,93,101,106]. Four interventional studies were conducted in jails or prisons [13,21,83,96] and one study was implemented in a home environment [65].

Geographically, the HIV interventions spanned 19 distinct districts or municipalities across 14 provinces. Notably, a few municipalities accounted for the majority of these interventions: Jakarta municipalities, with 37 interventions [13,14,18,21–23,35–38,40–42,45,49,54,56,58,59,61,63,65–71,75–77,86,87,100,102–104], Bandung, with 19 interventions [19,36,37,39–42,55,62,72,73,79,83,84,95,96,108,109,111]; Denpasar, with 18 interventions [20,35,36,39,40,42,45,48,60,64,80–82,97,98,112,114]; Yogyakarta, with 7 interventions [36,37,40,45,50,53,113]; and Surabaya, with 5 interventions [37,39,42,51,93]. Other districts, such as Makasar [39,42,88,106], Surakarta [17,42], Medan [37,42], Malang [42,105], Bekasi [23,101], and Jayapura [42,78], reported the implementation of either two or three HIV interventions. In contrast, several municipalities, including Gowa [115], Wakatobi [91], Padang [23], Gianyar [85], Ogan Komering Ulu Timor [89], Manado [42], Sorong [42], Jayawijaya [42], and Bandar Lampung [90], each recorded only a single HIV intervention over the past three decades. The provinces that exhibited the highest concentration of HIV interventions included the Special Capital Region of Jakarta, West Java, Bali, the Special Region of Yogyakarta, and East Java.

Discussion

Despite a significant reduction in new HIV infections, declining by 39% since 2010 and by 60% since 1995, HIV remains a major public health problem in many countries. According to the UNAIDS report, an estimated 39.9 million people are currently living with HIV, with 1.3 million new diagnoses and 630,000 deaths attributed to AIDS-related illnesses globally in 2023 [1], reflecting the persistent threat of HIV over the last 40 years. In contrast to the global downward trend, Indonesia has witnessed a dramatic surge in new HIV infections, exceeding 400% from 2012 to 2023 [4]. This study aims to provide a thorough overview of HIV interventions that address the HIV epidemic in Indonesia and outline future directions for HIV interventions.

The first HIV case in Indonesia was diagnosed in September 1987 in a foreign male tourist in Bali [116]; however, HIV interventions in response to this emerging health threat appeared to be initiated years later. This is evidenced by the results of our bibliometric analysis, which suggest that initial publications on HIV intervention were recorded in 1993 [47], 1994 [48], and 1996 [20], which were six to nine years after the first HIV infection. The analysis further reveals a steady increase in annual publications starting post-2008, while there was only one publication per year or no publication at all before 2009. Despite this modest growth, there was a significant absence of publications on HIV interventions for 11 years, from 1997 to 2008. This gap may suggest that the issue of HIV was not being addressed with the requisite seriousness at the early stage of the epidemic, as the government tended to deny initial HIV cases to avoid worry and panic among Indonesians [117], nor had it emerged as a principal concern for governmental and non-governmental organisations in Indonesia. Moreover, one plausible explanation for the protracted absence of HIV interventions over more than a decade could be attributed to the severe monetary crisis in Indonesia that began in early July 1997 [118]. This crisis had far-reaching adverse effects on Indonesia's economy, including instability within the banking sector, the closure of numerous enterprises, and a consequent surge in unemployment [119,120]. Additionally, various development programs, including those on health, were significantly neglected [120,121]. This precarious situation was further intensified by the major

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civil unrest in May 1998, which ultimately led to the resignation of President Suharto and a subsequent deterioration of Indonesia's economic conditions for many years [122].

The bibliometric analysis also reveals that a total of 400 authors from various institutions in different countries (mostly from the US, Australia, and the Netherlands) have contributed to publications concerning HIV interventions in Indonesia. The average citation rate per document stands at 8.48%, and the article by Miller, Hoffman [33] received the highest number of 68 citations, followed by Ford, Wirawan [20] with 59 citations and Ford, Wirawan [34] with 53 citations. The identification of these key authors, along with the citation metrics, provides valuable insights for potential collaborations and the establishment of networks for future research and programs related to HIV interventions in Indonesia. Furthermore, our analysis highlights several trending topics and co-occurring keywords within the literature on HIV interventions in Indonesia, including "human immunodeficiency virus", "HIV infections", "acquired immune deficiency syndrome", "antiretroviral therapy", or “anti-retrovirus”, “people who inject drugs”, and “adherence”. These indicate a notable absence in HIV interventions specifically targeting children and adolescents living with HIV (CALHIV) in Indonesia. This gap underscores the urgent need for tailored interventions aimed at reducing and preventing HIV transmission among this demographic, improving ART and their health outcomes, as well as addressing the unique challenges they face [123–125]. The importance of such interventions is further emphasised by the alarming rise in new HIV infections among CALHIV, as evidenced by the 57,299 new diagnoses reported in 2023, of which 7.7% occurred in children and adolescents aged 4 to 19 years, and 18.1% in young individuals aged 20 to 24 years [4].

Our scoping review reveals that HIV interventions in Indonesia remain constrained in terms of the diversity of intervention types, the demographic groups they targeted, and the settings in which they were implemented. The review encompasses HIV interventions identified from 90 publications, which are categorised into four distinct groups. Notably, the findings indicate that the predominant focus of HIV interventions in Indonesia was on four key areas: HIV treatment, which included both biomedical and alternative therapies [13,14,42,51–53,62,63,65,72], HIV prevention and education [17,18,37,39,88–92,96,97,108,109,113,115], counselling and testing [21,36,38,40,61,79–81], and behaviour change [19,20,41,84,86,87]. The findings underscore a significant gap in interventions that address the social, cultural, and religious factors influencing both HIV transmission and impacts on individuals living with HIV and their families [126–129]. This gap highlights the need for future HIV interventions in Indonesia to consider these critical elements.

The findings from the scoping review have also highlighted that despite the initiation and implementation of HIV interventions in Indonesia over the past three decades, the coverage of PLHIV from high-risk groups, such as MSM, transgender women, and FSWs [40,64,98,114], PWUD or IDUs [72,75–77,83], prisoners [13,21], and pregnant women [18,103], remains markedly inadequate. The national AIDS report from Indonesia shows a concerning trend, with HIV infections within these high-risk groups steadily increasing over the years [4]. Notably, the prevalence of new HIV infections among MSM and transgender women surged from 2% in 2010 to 20% in 2019 [4]. In 2023, of the total 57,299 reported HIV infections, 31% were identified within these population groups [4]. Previous Indonesia-based studies have indicated that MSM and transgender women not only represent a high-risk demographic for HIV transmission but may also act as vectors for further transmission, both within their communities and to the general population, particularly given the prevalence of transactional sex involving both MSM/transgender women and heterosexual men [130–134]. Furthermore, pregnant women, who have not been adequately targeted by HIV interventions, accounted for 4% of new HIV infections in 2023, and mothers in general represented the highest proportion of AIDS cases compared to other groups in Indonesia [4]. These demographics are particularly vulnerable, facing not only the risk of infection but also a range of adverse effects associated with HIV, including physical and mental health challenges, as well as significant social and economic repercussions [117,135,136]. Therefore, our findings underscore the critical need for future HIV interventions that specifically target these high-risk groups to mitigate the risk of ongoing HIV transmission, mother-to-child transmission and to address the associated negative impacts on

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their health and overall wellbeing. Mother-to-child transmission prevention programs in many other settings globally have been shown to significantly mitigate the risk of HIV transmission from mothers to their newborns [137,138].

Our findings also highlight the limitations in the geographical coverage of HIV interventions, which have only reached 19 districts/municipalities, accounting for just 4% of the total 514 districts/municipalities in Indonesia [139]. Moreover, of these 19 districts/municipalities, the majority of the interventions were concentrated in major cities, such as Jakarta, Bandung, Denpasar, Yogyakarta, and Surabaya. These findings underscore the necessity of expanding the geographical coverage of future HIV interventions for PLHIV and the general population across many other districts in Indonesia. This is crucial if the country aims to successfully reduce or prevent HIV transmission, address the impacts on PLHIV and the affected families, and support their needs. This is particularly important as previous studies in Indonesia have suggested that PLHIV in rural districts, referred to as underdeveloped or disadvantaged areas, face significant challenges due to various factors, including a lack of HIV care services, the absence of HIV clinics, a shortage of HIV-trained healthcare professionals, limited availability of medications or ART, poor transportation systems that negatively affect access to services, and financial and economic difficulties [140,141].

Limitations and strengths of the study

The present study is subject to several limitations that must be acknowledged when interpreting the results. Firstly, the search for the bibliometric analysis was limited to articles that were indexed in the Scopus and Web of Science databases. Although both are multidisciplinary databases that are comprehensive and widely used, it is evident that relevant studies available in other databases, such as PubMed, Web of Science, CINAHL, Embase, Cochrane Library, Psychology and Behavioural Sciences Collection or Google Scholar, were overlooked. Additionally, it should be acknowledged that there may have been HIV programs or interventions initiated and implemented by the government of Indonesia at district or provincial levels, which have not been studied or reported in accessible documents, thus, information regarding those interventions was not included in this review. Notwithstanding these limitations, this study possesses notable strengths; it represents the first comprehensive review of HIV interventions, the demographic groups targeted, and the settings/locations in which these interventions were implemented in Indonesia over the past three decades. Furthermore, it is the first study to offer evidence-based directions for future HIV interventions in Indonesia, comprehensively identify high-risk population groups that should be targeted, and highlight underexplored settings/locations that warrant attention. Future studies using a quantitative approach are recommended to evaluate or measure the effectiveness of HIV interventions, as their findings could serve as a foundation for the scale-up of the already implemented or existing interventions or the development of new interventions in this field.

Conclusion

This study presents a comprehensive overview of HIV interventions implemented and studied in Indonesia over the past three decades. It presents a steady upward trend in publications on HIV interventions in Indonesia post-2008 and their citation rate, and identifies key authors and journals that disseminate these articles. It also presents trending topics and co-occurring keywords within the literature on HIV interventions, which indicate the possibility of exploring other topics that have not been investigated. Furthermore, the study also highlights the various types of HIV interventions implemented in Indonesia, identifies the targeted population groups in interventions, and outlines the settings in which these interventions were carried out. Ultimately, this research provides robust, evidence-based recommendations and strategic directions for future HIV interventions in Indonesia, highlighting high-risk populations that require attention and settings that merit further interventions. The findings are intended to serve as a substantial resource for healthcare systems, governmental agencies, non-governmental organisations, and researchers, thereby informing their future HIV policies, interventions and studies within the Indonesian context and other similar settings.

 doi:10.20944/preprints202507.1045.v1

Acknowledgments: The findings and conclusions in this document are those of the authors, who are responsible for its contents.

Funding Statement: The authors did not receive any specific grant or financial support from funding agencies in the public, commercial, or not-for-profit sectors for the research, authorship, and/or publication of this article.

Ethical Approval Statement: Not required.

Patient Consent for Publication Statement: Not required.

Conflicts of Interest Statement: The authors have declared no potential conflicts of interest.

Data Availability: As this study is a review of previous data, no new data were generated in support of this research.

Table:

Table 1. Summary information

Figures:

Figure 1. (A) Annual publications. (B) Average citations

Figure 2. (A) The most cited documents. (B) The most relevant sources

Figure 3. Country collaboration network

Figure 4. Co-occurrence network

Figure 5. Forest plot of adjusted odds ratios (95% CI) showing the effects of HIV-related interventions in Indonesia across studies.

Supplementary Information: The following supporting information can be downloaded at the website of this paper posted on Preprints.org, **Supplementary 1**. Author guidelines for scoping review. **Supplementary 2**. Author guidelines for bibliometric analysis**. Supplementary 3**. Search strategies**. Supplementary 4**. PRISMA. **Supplementary 5**. Characteristics of the included studies.

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