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Smoking among people living with HIV/AIDS: a bibliometric analysis ($GAP_{RESEARCH}$)

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Abstract

Tobacco smoking undermines the effectiveness of antiretroviral therapy (ART) among people living with HIV/AIDS (PLWHA) and potentially associates with other health problems. This study aimed to analyze the growth and content of research on smoking among PLWHA on Web of Science Database. Co-occurrence analysis and Jaccard's' similarity index calculation were performed to identify and visualize networks of countries collaboration, keywords co-occurrence, and research topics. Exploratory factor analysis was applied to the abstracts' contents to uncover research domains and landscapes. The number of publications increased by 14.55% annually in the period of 1991-2017, with 74% of total papers published within 2007-2017. A wide range of topics have been covered, notably co-morbidities, interventions on smoking abstinence and cessation, and the enforcing relationship of smoking cessation with antiretroviral treatment adherence. A shortage of studies on smoking among PLWHA in low- and middle-income countries, limited collaborations between countries outside of close geographical proximity and a lack of discussion on local contexts and psychosocial factors were found. Smoking among PLWHA has been being studied more extensively in recent years, enhancing our knowledge and awareness of the significant and specific effects smoking have on PLWHA, which, in turn, assisting the proposals and implementations of suitable solutions. However, more efforts should be made to examine and understand contextualized aspects, including culture and beliefs specific to each nation or smaller sub-population within a country, especially those currently under-researched, as well as psycho-behavioral factors to implement more effective interventions to reduce smoking among PLWHA.

Keywords

Scientometrics. HIV. AIDS. Smoking. Mapping.

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Introduction

Since the 2000s, the accelerated advancement of HIV interventions, in particular, scale-up implementation of antiretroviral treatment (ART) services, has brought about substantial improvements in health status as well as the quality of life of HIV-positive individuals1. By receiving ART, people living with HIV/AIDS (PLWHA) are now able to live longer, yet many suffer from the increasing burden of non-communicable diseases (NCD), mainly due to lifestyles or behavioral habits that are harmful to health[1]. Challenges to the efficiency of HIV/AIDS care and treatment programs have been found to not only be in maintaining the optimal adherence of PLWHA but also in preventing their health risk behaviors, including smoking[2].

Empirical studies and systematic reviews have revealed that PLWHA are more likely to smoke cigarettes than the general population[2-6]. For example, in a large drug-using population in Vietnam, 36.1% and 9.5% of PLWHA were current and former smokers, respectively. Smoking associated with poor adherence to HIV treatment, increased risk, and mortality of cancer, heart diseases, tuberculosis, and lung diseases[3,6-10]. Moreover, motivation to quit smoking and coverage's of NCD screening program among this population was found to be limited[7,11].

The previous studies have focused on examining the impact of smoking on HIV care and treatment outcomes and identified models for smoking-cessation interventions[2,4,8-10]. A meta-analysis by Uthman et al. showed that in the short term, m-health interventions resulted in higher cessation rates than face-to-face interventions[12]. A trial conducted by O'Cleirigh et al. also indicated that the integration of smoking cessation with mental health improvement brought about better cessation rates in both short term and long term. Other trials have examined the effectiveness of different approaches to smoking across sub-groups of ethnicities, locations, health states, and facilities[3,9,10,12-16]. Although the wealth of literature on smoking cession trials among general populations may provide a good reference for the potential implementation with PLWHA, individual barriers, including dependence on nicotine, craving, using smoking to reduce stress, and environmental barriers, such as lack of social support for quitting smoking and the existence of social network of smokers, remain[17-22]. Addressing these barriers requires a better understanding of contextual factors and characteristics of HIV epidemics in specific settings. A thorough analysis of existing literature on smoking among PLWHA thus would be helpful in determining the current coverage and emerging trend of research regarding the topic, in particular, whether contextualized aspects have been sufficiently considered, and whether there has been any research gap. Findings of such analysis would assist the academic community and policymakers in setting appropriate research priorities, which would, in turn, enhance the effectiveness of HIV programs.

To the best of our knowledge, there has not been a study that explores the issue of smoking among PLWHA on a comprehensive, global scale. This study aims to do that by employing a combination of conventional bibliometric approach and a number of statistical analysis to (1) quantify the growth in publications volume and determining the extent of research collaborations between countries, (2) uncover the development of major research domains and research landscapes within smoking among PLWHA, and (3) identify factors associated with smoking and interventions as well as emerging research and interventions.

Methods

Search strategy

In the middle of 2018, we searched and retrieved all papers published between 1983 and 2017 related to HIV/AIDS and smoking on the Web of Science, which is an online database covering the largest proportion of the peer-reviewed literature in this field. The search query included two stages:

1. Searching for HIV/AIDS: using the combination of words: "HIV"; "AIDS" within the title, abstract, author keywords, and keywords plus of the article's records. This study only included original research papers and reviews in English. Papers published later than the end of December 2017 were also not included (since the search was conducted in July 2018, only a 1/2-year worth of publications can be retrieved for 2018, which the authors believe would undermine the representative of data for the year).
2. Searching for "Smoking": by applying the keywords of "smoker(s)" or "smoking" or "tobacco" or "cigarette(s)" or "nicotine".

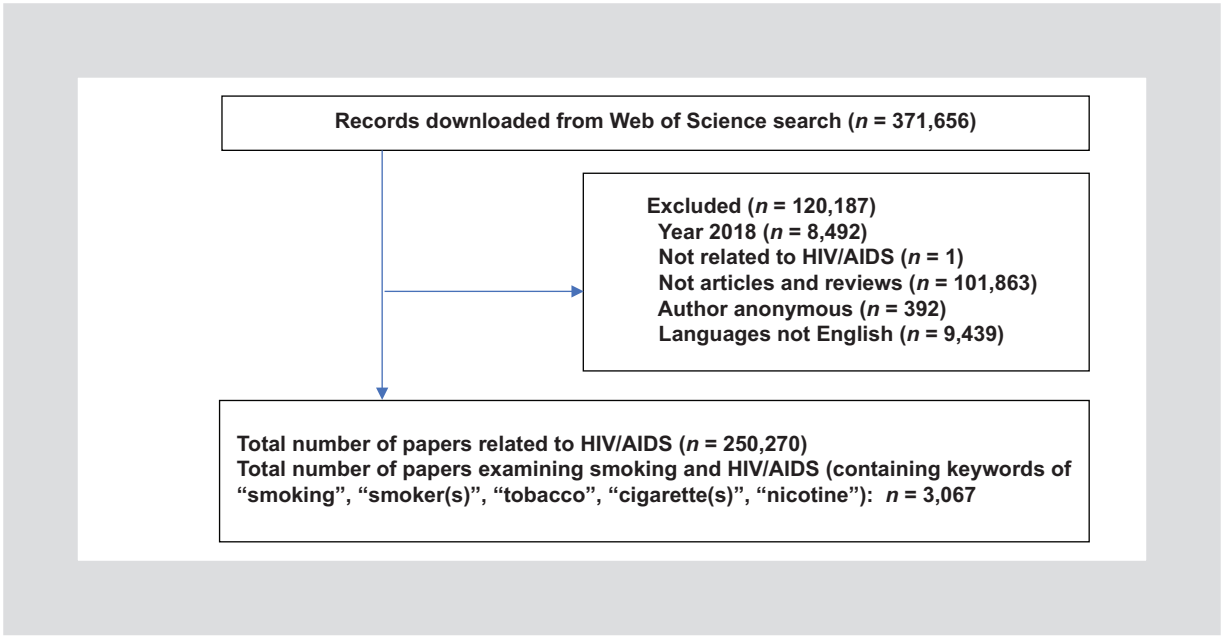

Figure 1. *Paper selection process.*

Data extraction

We downloaded all data found in the first stage of above Search Strategy from the Web of Sciences database in txt format, including all papers' information such as authors' names and institutional affiliations, papers' titles, journals' names, keywords, the total number of citation, research areas, and abstracts. All of these data were converted from txt. format to xls. file (Microsoft Excel). Two researchers (H.L.T.N and C.L.H) read the title of all records to identify paper unrelated to HIV or AIDS. Then, we refined the data by removing publications which were: (1) not original research papers and reviews, (2) not related to HIV/AIDS, and (3) not in English. Any conflict was solved by discussion (Fig. 1).

We then used STATA (Version 15, StataCorp) to extract from the finalized HIV/AIDS dataset records related to smoking by searching from Title and Abstract of those records the keywords detailed in (2) of Search Strategy. A total of 3607 records of smoking among PLWHA were obtained at the end of this process, which then will be carried forward for further analysis in Stata[23].

Data analysis

Simple descriptive statistics were reported for the basic component of publication (total number of authors, publication years, citations, and number of time downloaded [usages]). Citations by country and inter-country collaboration were also calculated. Network graphs illustrating the association among countries with shared co-authors and author keyword co-occurrence were created using VOSviewer (Center for Science and Technology, Leiden University, the Netherlands) software. Exploratory factor analysis was applied (with loadings of 0.4) on abstracts' content to identify research domains[24]. To find out research topics and terms that have co-occurred most frequently, we deployed Jaccard's similarity index[25].

Results

Number of items published from 1991 to 2017

Fig. 1 shows the paper selection process. A total of 3067 papers related to "smoking" among PLWHA were obtained.

Table 1 shows that the United States of America was mentioned the most in the study settings (abstracts) (27.2%), followed by South Africa (6.9%) and Ireland (5.6%). Meanwhile, in low-income and middle-income settings such as Vietnam, Ghana, Cambodia, or Zambia where the prevalence of tobacco use in PLWHA was high (27.1% of HIV-positive men), the number of papers was smaller compared with high-income countries[26]. The total proportion of low- and middle-income countries as study settings appeared in publications was roughly 21.5%

Table 1. Number of papers by countries as study settings

Rank	Country settings	No of papers	%	Rank	Country settings	No of papers	%
1	United States	351	27.2	23	Kenya	14	1.1
2	South Africa	89	6.9	24	Italy	12	0.9
3	Ireland	72	5.6	25	Malawi	10	0.8
4	Brazil	64	5.0	26	Taiwan	9	0.7
5	Canada	53	4.1	27	Zambia	9	0.7
6	India	44	3.4	28	Cameroon	8	0.6
7	Australia	39	3.0	29	Germany	7	0.5
8	China	36	2.8	30	Malaysia	7	0.5
9	United Kingdom	29	2.2	31	Rwanda	6	0.5
10	Uganda	25	1.9	32	Cambodia	5	0.4
11	Ethiopia	23	1.8	33	Denmark	5	0.4
12	Spain	21	1.6	34	Ghana	5	0.4
13	Viet Nam	21	1.6	35	Hong Kong	5	0.4
14	Iran	20	1.6	36	Israel	5	0.4
15	Tanzania	19	1.5	37	Colombia	4	0.3
16	Thailand	17	1.3	38	Croatia	4	0.3
17	France	16	1.2	39	Mali	4	0.3
18	Mexico	16	1.2	40	Namibia	4	0.3
19	Niger	15	1.2	41	Pakistan	4	0.3
20	Nigeria	15	1.2	42	Switzerland	4	0.3
21	Puerto Rico	15	1.2	43	Ukraine	4	0.3
22	Japan	14	1.1	44	Others	51	3.4

(including other countries which consist of those with the frequency of appearance of under 4 times each).

Table 2 shows some characteristics of the analyzed publications. The number of papers examining smoking among PLWHA has been increasing over time (on average by 14.55% annually for the period from 1991 to 2017). Papers published within the 10 years from 2007 to 2017 accounted for 74% of the total number of papers, indicating a more significant growth of publication in recent years. A total number of citations peaked for papers published in 2006 then exhibiting the downward trend for papers published from 2006 forward. Similar patterns were found for total and mean usage in the past 5 years. Papers published in 2017 have significantly higher usage in the past 6 months (3 times higher than that of those published in 2016), perhaps signaling a renewed interest of readers in the topic of smoking among PLWHA.

International co-authorship

Fig. 2 displays the global networks among 78 countries sharing co-authors. Overall, as can be seen, the

Table 2. General characteristics of the included publications

Year published	Total number of papers published per year	Total citations up to 2017 (cumulative)	Mean cite rate per year*	Total usage† last 6 months	Total usage last 5 years	Mean use rate last 6 months¶	Mean use rate last 5 years§
1991	13	776	2.21	1	11	0.08	0.17
1992	14	515	1.41	0	19	0.00	0.27
1993	19	1,093	2.30	0	34	0.00	0.36
1994	36	2,320	2.69	5	95	0.14	0.53
1995	34	2,284	2.92	2	78	0.06	0.46
1996	42	1,874	2.03	11	96	0.26	0.46
1997	49	6,304	6.13	73	975	1.49	3.98
1998	46	1,885	2.05	9	161	0.20	0.70
1999	53	4,617	4.58	42	716	0.79	2.70
2000	45	3,215	3.97	10	228	0.22	1.01
2001	60	3,505	3.44	21	329	0.35	1.10
2002	62	3,091	3.12	22	265	0.35	0.85
2003	65	5,713	5.86	26	491	0.40	1.51
2004	64	2,935	3.28	13	322	0.20	1.01
2005	83	6,391	5.92	89	1,069	1.07	2.58
2006	111	11,395	8.55	123	2,210	1.11	3.98
2007	108	5,168	4.35	37	607	0.34	1.12
2008	144	5,333	3.70	39	773	0.27	1.07
2009	128	3,870	3.36	38	771	0.30	1.20
2010	135	3,763	3.48	29	634	0.21	0.94
2011	188	4,817	3.66	36	1,201	0.19	1.28
2012	198	4,702	3.96	74	1,763	0.37	1.78
2013	265	5,582	4.21	149	2,925	0.56	2.21
2014	255	4,034	3.95	115	2,048	0.45	1.61
2015	275	2,468	2.99	119	1,979	0.43	1.44
2016	274	1,593	2.91	199	1,736	0.73	1.27
2017	291	479	1.65	360	1,132	1.24	0.78

Mean cite rate per year = total citations/(total citations [2018-that year]).
†Total usages: total downloads.
¶Mean use rate last 6 months = total usage last 6 months/total number of papers.
§Mean use rate last 5 years = total usage last 5 years/total number of papers*5.

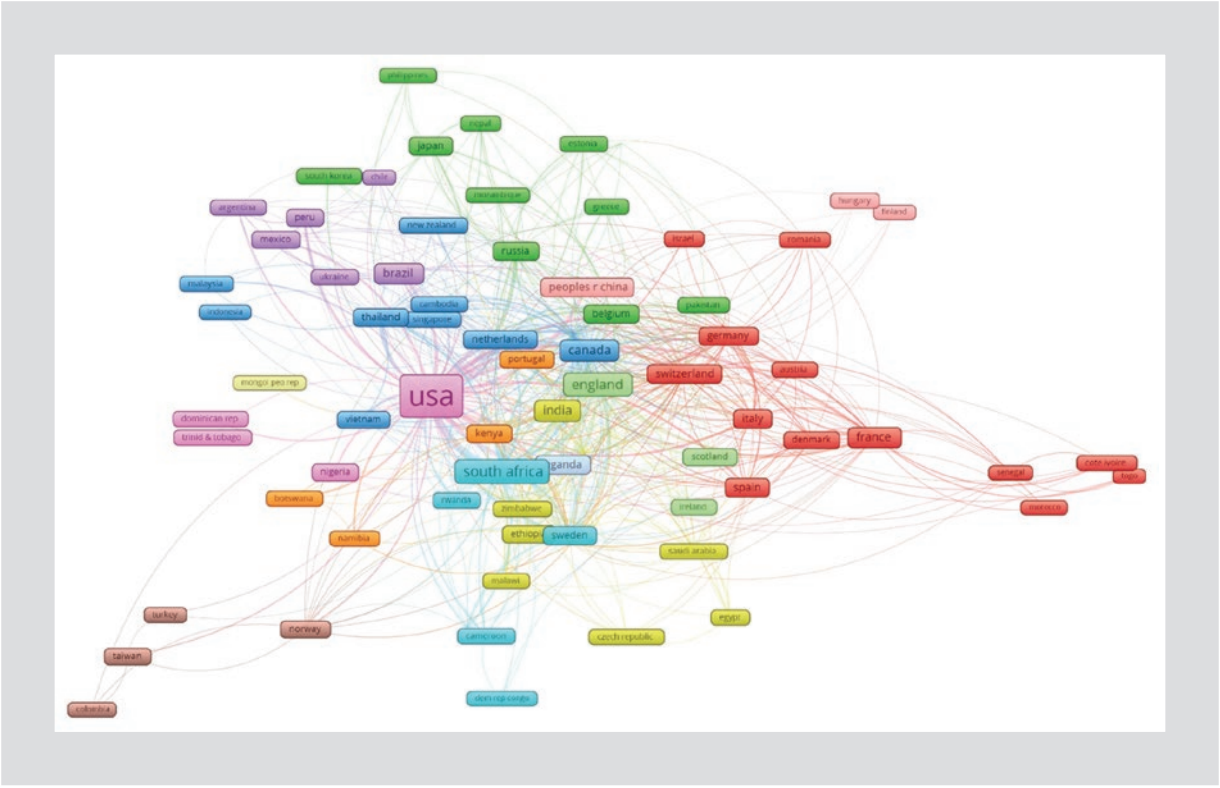

Figure 2. *Countries having co-authorships (n = 78). The size of the node shows the number of papers that contributed by a country and the length of the lines indicated the strength (short line) or weakness (long line) relationship between two countries.*

international collaborations of research on smoking among PLWHA based on the similar geographic location and cultural proximity. For example, collaborations are clustered into groups of (1) the America region with the contribution of the U.S, Brazil, Peru, or Mexico (pink and purple), (2) the Western European region including Germany, Switzerland, or (3) French-speaking nations with France with French-speaking countries in Africa (red). Interestingly, Southeast Asia countries had a strong collaboration with the Netherlands and Canada, while Northeast Asia countries such as Japan and South Korea cooperated with Russia and Greece.

Most frequent keywords and research domains

Analyses of keywords and abstract's contents provide us with a better understanding of the scopes of studies and development of research landscapes. Fig. 3 describes the principal components of the keywords structure with the most common terms. There were 16 main clusters arising from 322 most frequent keywords co-occurrence of at least 30 times. Some major clusters are: Cluster 1 (red) refers to harm reduction interventions. Cluster 2 (green) focuses on the implementation science of services in Africa. Cluster 3 (yellow) describes clinical features of antiretroviral therapies. Cluster 4 (blue) covers the socio-psychological aspects of living with HIV/AIDS.

As for the content analysis of abstracts, the top 50 research domains are listed in table S1. Smoking among PLWHA has been studied in various directions, including its associations with prevention and treatment of NCD (Cardiovascular, Cancer, Tuberculosis, and Metabolic Syndromes), communicable diseases (Hepatitis C Virus, and Hepatitis B Virus), multiple concurrent risk behaviors (illicit drug, alcohol use, sexual behaviors, family history, and income), and interventions on smoking abstinence and cessation.

Suppl. Figure 1 illustrates the classification of the co-occurrence of research domains into principal components. Primarily, we have the following major components: (1) HIV/AIDS treatment (red), (2) harm reduction (Violet), (3) TB-HIV (green), (4) lung diseases (blue), and (5) interventions (others).

Suppl. Figure 2 describes the most frequent terms co-occurring with "abstinence", and "cessation" terms

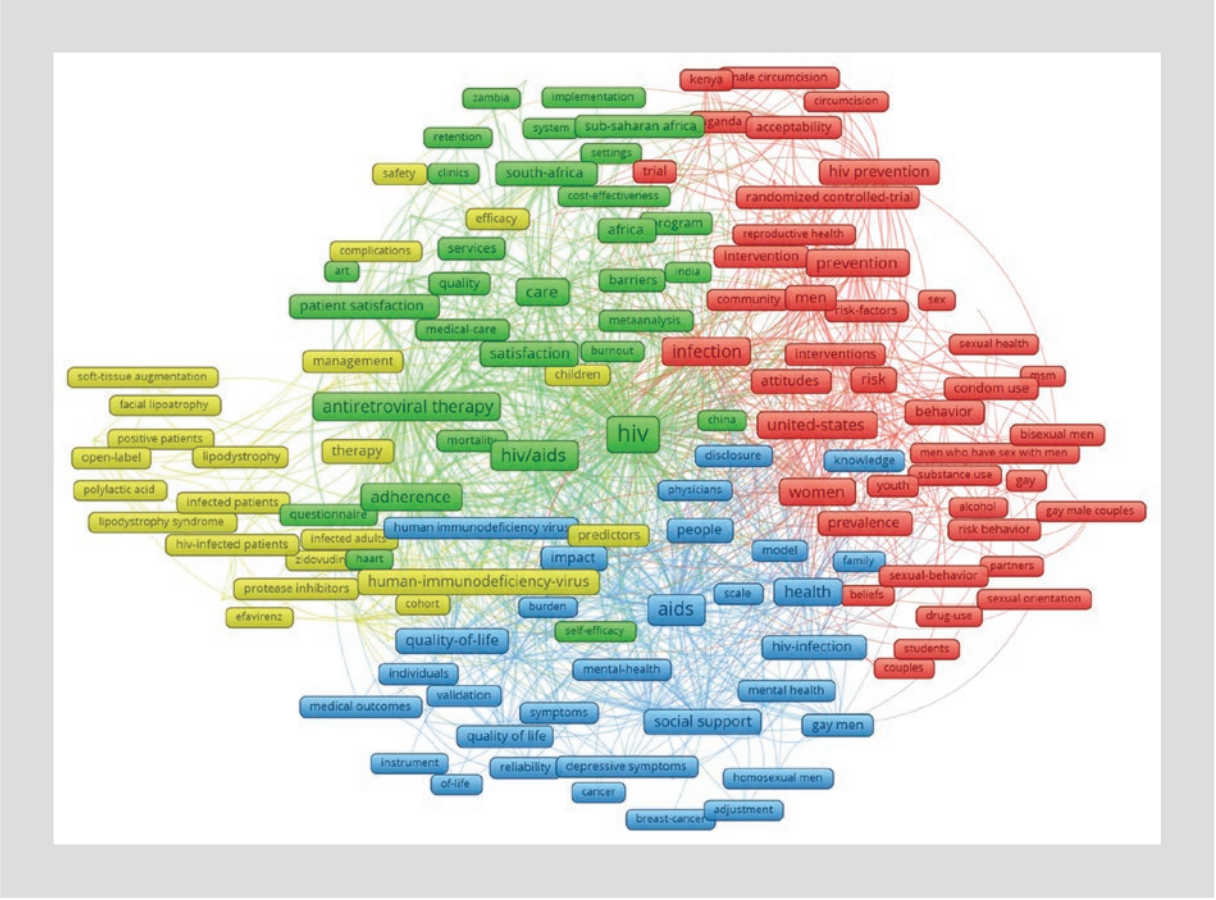

Figure 3. *Network of authors' keywords that co-occured most frequently (n = 322). The colors of the nodes indicate principle components of the data structure; the nodes size is proportional with the keywords' occurrences; the thicker the line is, the stronger the association between two keywords is.*

in the content analysis of all abstracts. Smoking "abstinence" and "cessation" have been identified in support of ART adherence and outcomes and related to increased risks of mortality and morbidity, such as cardiovascular, required screening and counseling, and in follow-up studies.

Top ten papers (excluding reviews) with the highest citation rate on smoking interventions in PLWHA are presented in table S2. Most of these papers were found to have been published in the recent 13 years. That shows that the concern of researchers has started recently although the prevalence of smoking among PLWHA was high and the effects of such phenomenon on health have been well-known early on[26]. These interventions usually address multiple concurrent risk behaviors, covering both physical and mental health causes and outcomes, involving strategies at increasing at individuals' awareness, or motivation, clinics, family, and community levels. They also focused on sub-populations of different ethnic groups, which have specific health problems, and mobile and electronic health interventions.

Discussion

This study captures an overview of research growth in the topic of smoking and HIV/AIDS. We found a rapid increase in both knowledge production and usage in recent years that highlight the importance and attraction of this topic in HIV research. However, there has evidently been a shortage of studies on smoking among PLWHA in low- and middle-income countries reportedly having a high prevalence of tobacco use in PLWHA. In addition, we advanced the application of bibliometric analysis by applying content analysis to all the selected abstracts, which uncovers groups of most frequently studied topics/keywords within smoking among PLWHA, notably co-morbidities (cardiovascular

disease or cancer), interventions on smoking abstinence and cessation and the enforcing relationship of smoking cessation with ART adherence. These findings suggest more efforts should be given to increase the research capacity of developing countries with a high prevalence of smoking among PLWHA, along with the adoption of appropriate behavioral interventions that aiming at reducing risky behaviors of PLWHA.

This study, among very few, attempted to add to existing literature knowledge on the growth of research on smoking in PLWHA by quantifying changes in the number of publications, citations, usages, and strengths of partnerships[27,28]. Comprehensive coverage of articles published globally and under a wide range of fields relating to smoking in PLWHA has been lacking in existing systematic reviews of the topic, due to the nature of the methodology of such reviews (i.e., focusing on specific aspects of an issue). In addition, our findings from an analysis of study settings and collaborations of countries showed that there appeared to be an imbalance in terms of the presence and potential impacts of smoking and HIV epidemics in each nation within collaboration networks. This can be said to be especially profound for Asian countries, as the limited presence of China or southeast Asian nations suhc as Vietnam, Thailand, or Cambodia as study settings and their lack of research collaboration with leading nations like the United States of America do not reflect their popularity as markets for tobacco industry[29,30] or their HIV prevalence[31,32]. Such lack of research production by these nations and by LMIC in general, as can be seen from our results, maybe due to the fact that these countries are usually on tight funding to combat a range of diseases alongside HIV while struggling with under-developed health system[30], such that funding for research activities remains insufficient. This emphasizes the necessity of producing localized and readily adoptable evidence-based programs across sub-populations.

Although there have been some bibliometric analyses conducted with the literature on HIV/AIDS[27,28], this study enriches previous ones by compiling more updated and comprehensive data, and by focusing on a specific behavior. Moreover, this study provides a number of valuable implications deriving from the quantification of qualitative contents of abstracts. First, we found that the smoking-related issues have been identified in various portfolios of HIV/AIDS policies, including harm reduction, treatment, prevention, and impact mitigation. Similar to other risk behaviors, smoking should be recognized not only as one of the measures but also as a target for prevention and treatment services and efficiency of the health system. The frequent co-occurrence of the terms "screening", "counseling" with "abstinence" and "cessation" found in our content analysis showed that attention and efforts have been given to incorporating early screening (early detection), counseling (continuous and additional support) into programs and initiatives targeting smoking reduction. However, we have also found a lack of terms relating to behavioral interventions, which perhaps can be considered a research and implementation gap. It has been indicated elsewhere that regular assessment of patients' behavioral and clinical responses to antiretroviral therapies as well as the incorporation of behavioral interventions into existing treatments are important to improve the cost-effectiveness of treatment services. In addition, the findings suggest that new behavioral interventions should concurrently address multiple behaviors and health problems, including NCD and mental issues, as co-morbidities and risky behaviors have been found to be commonly identified and discussed in papers on smoking among PLWHA. The use of e-health platform applications may be helpful at this stage, thanks to their initial success in addressing multiple issues. Finally, global HIV initiatives that bring international resources into countries experiencing hardest hit of HIV epidemics should also increase the research capacity of local researchers, strengthen research partnership and technological transfer, and accelerate the adaptation of contextualized strategies in controlling HIV-related comorbidities.

Findings of our study echo, although on a larger, more comprehensive scale, a number of systematic reviews on smoking among PLWHA. For instance, Pacek and Crum reviewed the increased risks of morbidity and mortality as well as diminished adherence and outcomes of ART among smokers living with HIV/AIDS[8]. They also highlighted effective interventions, such as counseling, Nicotine replacement therapy, and non-Nicotine replacement therapy, and discussed multi-level barriers to the implementations of these interventions. Meanwhile, Scott and Ledgerwood described the use of behavioral supports, pharmacotherapy, and the emergence of mobile-phone-based interventions[2,33]. Many similarities among the findings of reviews published in the last decade were also identified, especially in the impact of smoking on health status and HIV treatment outcomes, packages of current interventions, barriers, and facilitating factors[2,4,9,34]. Nonetheless, there has still been a lack of attention

given to exploring the context of smoking among PLWHA and its impacts, for instance, the culture and beliefs of smokers living with HIV/ AIDS who are from the South East Asian region. Thus, it is necessary to have a deeper understanding of the contexts and other psychosocial factors to effectively reduce smoking, as with other unhealthy behaviors.

Although a novel approach was introduced to synthesize and analyze the literature, there are limitations need acknowledging. The databases were limited to the Web of Sciences. First, even though the Web of Sciences covers a large body of the literature in the field of HIV/AIDS research, it might not be fully representative of the entire literature. Another limitation is that solely documents in English were selected for this study. Finally, the content analysis included only abstracts. Nonetheless, this modified bibliometric analysis provides a comprehensive overview of research trends and landscapes in Smoking and HIV/ AIDS.

Conclusions

A growing wealth of literature has been dedicated to exploring the topic of smoking among PLWHA, covering issues from co-morbidities and health problems relating to smoking while being HIV-positive, to the relationship between smoking cessation and HIV/AIDS treatment as well as potentially effective solutions that should be incorporated into smoking cessation programs. Nonetheless, the absence of discussion on contextual aspects of smoking among PLWHA, including culture, beliefs and lifestyle of these patients, suggested that more efforts should be made to examine the local contexts and socio-psycho-behavioral factors to implement more effective interventions.

Supplementary data

Supplementary data are available at AIDS Reviews online (10.24875/AIDSRev.19000098). These data are provided by the corresponding author and published online for the benefit of the reader. The contents of supplementary data are the sole responsibility of the authors.

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