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Original Article

Understanding research gaps and priorities for tobacco harm reduction in low-income and middle-income countries

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ABSTRACT

Introduction: Tobacco use is among the leading preventable causes of premature death worldwide, with disproportionate effects in low-income and middle-income countries (LMICs). Global tobacco control efforts have shown inconsistent results, highlighting the need for innovative approaches, such as tobacco harm reduction (THR), to complement existing strategies. We aimed to identify gaps in THR research in the global and LMIC contexts.

Methods: We conducted a bibliometric review, using Scopus, to identify articles addressing THR published from January 2014 to August 2024. Research output was categorized by product type, geographical focus, volume of research output, and funding sources. A narrative synthesis was performed to outline research gaps and propose a strategic research agenda.

Results: THR research was dominated by e-cigarettes, primarily from high-income countries. Citations per 1 million smokers were highest in New Zealand (1,128.0), United Kingdom (634.3), United States (466.4), Australia (432.1), Switzerland (177.1), and South Korea (132.9). By contrast, rates were very low across Asia, Africa, and South America (range 1.8–53.5). Over the study period, research output increased only for e-cigarettes and heated tobacco products. Publicly funded research tended to focus on public health concerns, while private-sector research focused on product safety and efficacy.

Conclusions: THR research remains disproportionately concentrated in high-income countries and reflects a clear divergence between public and private research agendas. More research is needed to evaluate the long-term impacts, affordability, and real-world effectiveness of THR products using rigorous and standardized methodologies in diverse settings. Strengthening the evidence base in LMICs will be essential for developing affordable, accessible, and acceptable THR strategies tailored to local needs.

Introduction

Tobacco use is among the leading preventable causes of premature death worldwide, accounting for over 8 million deaths each year. More than 80% of the world's 1.3 billion tobacco users live in low-income and middle-income countries (LMICs) [1]. Prevalence of smoking is high in LMICs, particularly among men, which exacerbates health disparities and places immense pressure on already overburdened healthcare systems [2]. Despite global tobacco control initiatives [3], progress in reducing smoking rates in LMICs has been inconsistent and slower than anticipated. There is an urgent need for innovative approaches, such as tobacco harm reduction (THR), to complement existing tobacco control and cessation strategies by potentially mitigating the health impacts of smoking [4]. However, a critical challenge to advancing THR is the absence of clearly defined research priorities. Without a well-defined research agenda, the efforts of funders, academics, public health advocates, industry stakeholders, and governments may remain scattered and have reduced impact. This issue is particularly pressing since the WHO Framework Convention on Tobacco Control (FCTC) continues to evolve, and discussions at COP10 indicated that the Parties to the Convention continue to grapple with tobacco harm reduction [4].

The FCTC highlights the importance of research, surveillance, and

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capacity development as essential pillars of effective tobacco control [5]. Specifically, Article 4(3) of the FCTC emphasizes the need for international cooperation in research and information exchange to strengthen global tobacco control efforts. Article 20 advocates for the advancement of research to inform policy decisions, particularly through the systematic collection and dissemination of data on tobacco consumption and its associated health impacts. Moreover, Article 22 underlines the importance of capacity building, encouraging Parties to the Convention to support each other through technical assistance and resource sharing. Despite these clear directives, there remains no globally recognized priorities for tobacco control research and, more specifically, for THR research two decades after the FCTC's inception.

The absence of established research priorities for THR is particularly troubling given previous success in priority setting in tobacco control research. In the early 2000s, a global initiative by key stakeholders identified critical research areas that shaped a decade-long research agenda [6]. This initiative substantially advanced tobacco control efforts in LMICs, supported by funding from prominent organizations, such as the NIH's Fogarty International Center [7], Canada's International Development Research Centre (IDRC) Research for International Tobacco Control (RITC) program [8], and the UK-based Wellcome Trust [6]. These programs played a pivotal role in building scientific capacity for tobacco control in LMICs [9]. However, funding has dwindled except in some high-income countries.

Developing research priorities for THR is a logical extension of the FCTC's mandates and a necessary step to address the changing dynamics of tobacco use, especially in LMICs. In this study, we aimed to highlight research gaps that could be addressed by developing a set of research priorities for THR, with a particular focus on the unique challenges and needs of LMICs, where the tobacco burden is most severe.

Methods

Search strategies and search terms

To assess the landscape of THR research, we conducted a bibliometric review by searching for academic papers published from January 1, 2014, to August 9, 2024. The primary database used for this search was Scopus [10,11]. We did not perform a gray literature search, but to enhance the breadth of our findings, we incorporated reviews conducted by private research entities. We also referred to previous bibliometric reviews on the topic [12–15]. The search terms were intended to retrieve research related to THR products and practices. Initially, the list led to mismatches when searching for terms in titles, abstracts, and keyword lists sections using advanced search options. To address this, the search was refined to focus exclusively on titles containing THR-related terms: "tobacco harm reduction," "THR," "e-cigarettes," "electronic cigarettes," "heated tobacco," "HNB," "heat-not-burn," "smokeless tobacco," "nicotine pouches," "new nicotine," "vape," "non-combustible," "new tobacco," "nicotine replacement therapy," "NRT," "vaping," "nicotine," "smokeless," "nicotine products," "snus," and "reduced-risk products". This method maximized the likelihood that retrieved papers were specifically focused on THR. The search strategy details are provided in Table S1 (see supplementary materials associated with this article online). Only research published in English was considered.

The search terms were applied across various countries to provide a global perspective on THR research. We included papers from India, China, Indonesia, Bangladesh, Japan, Thailand, South Korea, and Russia to cover the Asian region; UK, France, Spain, and Switzerland, in Europe, North America (USA, Canada), Africa (South Africa, Nigeria), Oceania (Australia, New Zealand), and South America (Brazil). Search queries were tailored by supplementing the standard THR-related search terms with country-specific terms (e.g., for Nigeria the search string would be 'TITLE (("tobacco harm reduction" OR "thr" OR "e-cigarettes" OR "electronic cigarettes" OR "heated tobacco" OR "hnb" OR "heat-not-burn" OR "smokeless tobacco" OR "nicotine pouches" OR "new nicotine" OR "vape" OR "non-combustible" OR "new tobacco" OR "nicotine replacement therapy" OR "nrt" OR "vaping" OR "nicotine" OR "smokeless" OR "nicotine products" OR "snus" OR "reduced-risk products" OR "alternative nicotine products") AND ("Nigeria" OR "Nigerian" OR "in Nigeria" OR "Nigerian context" OR "in Nigerian population")) AND PUBYEAR > 2013 AND PUBYEAR < 2025'. We then systematically reported the number of THR studies found and the prominent research focus within each product category. These included e-cigarettes, heated tobacco products (HTPs), nicotine pouches, snus, and nicotine-replacement therapy (NRT). A global search without country restrictions was conducted to identify the top-cited papers across various THR domains: surveillance for THR products, biomarkers of exposure and outcomes, health conditions related to THR (cancer, mental health, chronic obstructive pulmonary disease [COPD], Parkinson's disease, and cardiovascular diseases), THR as a smoking cessation tool, youth use, product awareness, knowledge of THR, and socioeconomic aspects of THR. Perplexity AI (Collingwood, ON, Canada) was also utilized to scan the web, generating additional data to enhance our understanding of the THR research funding landscape. This was further manually verified for accuracy by two of the researchers and discrepancies were resolved.

For searches yielding 15 or more relevant papers, we further evaluated the top authors, affiliations, study designs, and journals, total citations of THR studies, total citations per million smokers (number of citations divided by the number of smokers in each country), and country-specific citations. The total citations per million smokers are suggestive of the influence of research relative to the smoking population.

Our inclusion criteria focused on articles that mentioned THR-related keywords in their titles and abstracts, which increased the likelihood that the studies were directly relevant to THR and human-focused. The identified studies were categorized by domain. We also extracted information on research output, study citations, and funding characteristics (predominantly private or public funding) where possible.

Data synthesis

We conducted a narrative synthesis based on the insights gathered from these reviews and developed research priorities to guide future THR research. The synthesis focused on identifying key gaps in the current literature and proposing a strategic research agenda that aligns with global tobacco control efforts and the specific needs of different regions.

Results

Research landscape

E-cigarettes dominate the THR research landscape, with a total of 14,720 published studies identified between 2014 and 2024, followed by NRT and heated tobacco products (Table 1). The number of papers published per year roughly tripled for e-cigarettes, from 576 in 2014 to 1,821 papers in 2023 (Figure S1; see supplementary materials associated with this article on line). Both HTPs and nicotine pouches had no publications in 2014. By contrast, numbers of publications for snus and NRT changed little or decreased. Citation rates up to 10,000 papers were highest for e-cigarettes, followed by NRT, HTPs, and snus, with the *h*-index values following the same pattern. The USA is the main source of THR research. Snus research is dominated by the Karolinska Institute in Sweden, while Osaka International Cancer Institute, Japan, contributes to HTP research. The National Institutes of Health (NIH) is the top public funder, while PMI, Swedish Match, and GlaxoSmithKline are the top industry funders.

The most cited papers per product category revealed significant insights into the focus and impact of research in this area. The leading e-

Table 1
Scopus tobacco harm reduction paper characteristics by products, as of 25 August 2024.

THR Product	Number of Published –Papers			Total Citations (up to 10,000 papers)	Total *h*-Index of Top 10,000 Papers	Top Country, Top Affiliation	Top Public and Top Industry Funder
	2014–2024	2014	2024				
E-cigarettes	14,720	576	1,821	284,190	181	United States, University of California	National Institutes of Health vs Philip Morris International
Heated Tobacco Products	1,143	0	214	15,041	56	Japan, Osaka International Cancer Institute	National Institutes of Health vs Philip Morris International
Nicotine Pouches	133	0	51	1,285	18	United States, University of California	National Institutes of Health vs Swedish Match
Snus	650	52	80	10,201	48	Sweden, Karolinska Institute	National Institutes of Health vs Swedish Match
Nicotine Replacement Therapy	4,780	537	399	77,405	108	United States, University of California	National Institutes of Health vs GlaxoSmithKline

cigarette paper, published in 2014, focused on toxicology, was funded by the US National Institute on Drug Abuse, and had received 1,310 citations. The most-cited NRT paper had 1,000 citations. It was used as a comparator for e-cigarettes in a randomized controlled trial published in 2019 and was publicly funded by the UK National Institute for Health Research and Cancer Research UK Prevention Trials Unit. For snus, the top paper had 198 citations, considered use of multiple tobacco products, was publicly funded by the New York State Department of Health, and was published in 2014. The HTP paper with the highest citation (n = 197) was published in 2018 and concerned second-hand exposure to vapor. It was publicly funded by the Horizon 2020 Framework Programme and Japan Society for the Promotion of Science. Studies of nicotine pouches have low citation rates, with the highest being only 21 for a paper assessing consumer use experience, which was publicly funded by Cancer Research UK.

Substantial disparities were found in the citation densities (citations per 1 million smokers) for THR research. The highest values were seen for New Zealand (1,128.0), the UK (634.3), the USA (466.4), Australia (432.1), Canada (374.2), Switzerland (177.1), and South Korea (132.9). By contrast, the citation densities in other countries were much lower, with India and China having citation densities of 4.4 and 2.6 respectively (Table S2; see supplementary materials associated with this article online). The highest *h*-index value was 62 in the USA, followed by 34 in the UK, 25 in Canada, 19 in South Korea, 18 in India, and 16 in Japan. The metrics were generally lower in Africa, Asia and South America (Table S2; see supplementary materials associated with this article on line).

The most-cited papers per area of THR research address smoking cessation (n = 995 citations), youth use (n = 722), awareness of THR (n = 433), surveillance of products (n = 597), biomarkers (n = 392), and cardiovascular diseases (n = 228; Table S3; see supplementary materials associated with this article on line). Very low numbers of citations were seen for COPD (n = 87), socioeconomic impact (n = 84), and Parkinson's disease (n = 17). Ten of the 11 top papers studied e-cigarettes and seven of them were published in the USA, underlining the dominance of this product and this country's contribution. The most cited randomized controlled trial was a 2019 study on e-cigarettes published in *New England Journal of Medicine*, with 1,000 citations. It was a publicly funded comparison of e-cigarettes with NRT, performed in the UK. Only NRT had close to this number of citations within the study period (731). This study was privately funded by Pfizer and GlaxoSmithKline in 2015. For snus, HTPs, and nicotine pouches, RCTs were cited only 30, 68, and 13 times, respectively. The snus paper was publicly funded in the USA in 2014, whereas the HTP and nicotine pouch papers were funded by the manufacturers and published in 2019 and 2021.

Funding landscape

Public funding for THR research throughout the study period was predominantly provided by public entities, with occasional contributions from charities, particularly in Europe (Table 2). The NIH was not only the most frequent funder but also provided support for THR research in the USA, India, China, South Korea, Canada, and Nigeria. The National Cancer Institute also plays a significant role, frequently funding research in the USA, India, Bangladesh, and China. However, most countries relied primarily on national funding sources for research.

Table 3 summarizes the aims of THR research by source of funding. Public funding is directed heavily towards chronic conditions, like cancer, cardiovascular, and respiratory disease, and the effectiveness of THR products as smoking cessation tools. Another key area of research that receives public funding is youth use. Privately funded research is focused on demonstrating the safety and efficacy of THR products, particularly as alternatives to traditional cigarettes, and on biomarker evidence of reduced harm to health.

Discussion

Our analysis of THR research revealed significant differences in research content and output between high-income countries and LMICs and in the focus of research funded publicly versus privately. The USA and UK dominate the THR research landscape in terms of volume of studies, citations, and influence (as reflected in *h*-Index values). By contrast, LMICs, where the tobacco burden is often greatest, perform little research, which suggests underfunding and under-prioritization. This finding is consistent with previous reviews of e-cigarette research [12–15] and many other areas of global health research.

Additionally, research focuses differ notably when funded publicly or privately. Publicly funded research is predominantly focused on possible harms caused by THR products, chronic illness, smoking cessation, and youth access and effects. Conversely, privately funded research mostly centers on product safety and efficacy and on harm reduction in adult populations. Both public and private research will be key for assessing the real-world impact and capturing the nuanced effects of THR products on health. Finally, THR research in the study period was heavily focused on e-cigarettes and NRT. The citation counts reflect the time that products have been on the market: snus and NRT are long established and much of the research was done before the study period; e-cigarettes entered the market from 2010, leading to a high number of studies in the period (with NRT as a comparator); and HTPs and nicotine pouches are newer products for which studies are emerging. Interest needs to be balanced well across all products, with research beginning as they become available.

We acknowledge that the quality of evidence used to develop THR policy must be methodologically sound. Polarization within tobacco and nicotine research poses a significant threat to the integrity of scientific studies in this field. Privately funded research has faced scrutiny due to concerns about potential bias, and restrictions have been placed on the publication and presentation of industry-funded research in certain journals and meetings, such as those within the BMJ group [16]. However, recent reviews of publicly funded epidemiological and toxicological research related to THR have raised fundamental concerns about methodological practices [17,18]. Common issues include vague

Table 2
Tobacco harm reduction research funding landscape, 2014 to 2024, as of 9th August 2024.

Continent and Country	Prevalent Funding Source	Top Funders (Number of Studies Funded)
Asia		
India	Public entities	National Cancer Institute (13) National Institutes of Health (12) Indian Council of Medical Research (7)
China	Public entities	National Natural Science Foundation of China (15), National Key Research and Development Program of China (5) and National Cancer Institute (5)
Indonesia	Public entities	Universitas Muhammadiyah Aceh, Institute of Research (4) and Development, Rajamangala University of Technology Thanyaburi (3) and Universitas Surabaya (2)
Bangladesh	Public entities	National Cancer Institute (6), International Development Research Centre (5) and Canadian Institutes of Health Research (5)
Japan	Public entities	Japan Society for the Promotion of Science (31), Ministry of Education, Culture, Sports, Science and Technology (14), Ontario Institute for Cancer Research (6), and Canadian Institutes of Health Research (6)
Thailand	Public entities	Thai Health Promotion Foundation (9), The Research Council (4) and Mahidol University (3)
South Korea	Public entities	Ministry of Health and Welfare (7), National Cancer Institute (7), Korea Centers for Disease Control and Prevention (6), and National Institutes of Health (6)
Russia (partly)	Public entities/ tobacco industry	Foundation for a Smoke-Free World (2), Auckland Medical Research Foundation (1) and British American Tobacco (1)
Europe		
United Kingdom	Public entities/ charities	Cancer Research UK (85), Medical Research Council (67) and Economic and Social Research Council (42)
France	Public entities/ charities	Institut National Du Cancer (6), Agence Nationale de la Recherche (3) and Ligue Contre le Cancer (2)
Spain	Public entities	European Regional Development Fund (4), Instituto de Salud Carlos III (3), U.S. Food and Drug Administration (2), National Cancer Institute (2) and European Commission (2)
Switzerland	Public entities	Schweizerischer Nationalfonds zur Förderung der Wissenschaftlichen Forschung (5), Schweizerische Akademie der Medizinischen Wissenschaften (3) and Swiss Cancer Research Foundation (2)
North America		
United States	Public entities	National Institutes of Health (171), National Cancer Institute (127) and National Institute on Drug Abuse (104)
Canada	Public entities	Canadian Institutes of Health Research (50), National Cancer Institute (23) and National Institutes of Health (23)
Africa		
South Africa	Public entities	African Capacity Building Foundation (6)
Nigeria	Public entities	Fogarty International Center (1), National Institutes of Health (1) and U.S. Department of Health and Human Services (1)
Oceania/Australia		
Australia	Public entities	National Health and Medical Research Council (42), University of Queensland (14) and Department of Health and Aged Care, Australian Government (13)
New Zealand	Public entities	Health Research Council of New Zealand (8), University of Otago (6) and Ministry of Health, New Zealand (4)
South America		
Brazil	Public entities	Conselho Nacional de Desenvolvimento Científico e Tecnológico (4), Fundação Carlos Chagas Filho de Amparo à Pesquisa do Estado do Rio de Janeiro (2), and Fundação de Amparo à Pesquisa do Estado de São Paulo (2)

Table 3
Narrative synthesis of privately funded versus publicly funded research by domain.

Research Topic	Public Funding Sources	Private Funding Sources
Surveillance for THR products	Primarily funded by public agencies like the NIH and CDC to monitor public health impact and usage trends.	Less common than public funding, but some industry-funded studies exist, focusing on market data.
Biomarkers study	NIH and other large health institutes fund research on biomarkers to understand health effects.	Tobacco companies often fund studies to demonstrate reduced harm.
Vaping and cancer	Public funding focuses on long-term cancer risk assessments.	Industry-funded studies generally aim to show lower risk compared to smoking.
THR and mental health	Increasing public interest, particularly in mental health outcomes related to cessation.	Limited funding from private sources, more focused on cessation benefits.
THR and COPD	Funded by public agencies looking at long-term respiratory outcomes.	Industry-funded research to highlight reduced risks relative to smoking.
THR and Parkinson's disease	Public funding in neurodegenerative disease studies, occasionally looking at nicotine.	Michael J Fox Foundation is a notable private funder; limited direct industry funding.
THR & cardiovascular diseases	Significant public funding due to widespread public health implications.	Industry-funded research aiming to minimize perceived risks.
THR as a cessation tool	Heavily funded by both public health bodies and private companies, particularly in the context of smoking cessation.	Tobacco companies fund studies to validate THR products as cessation aids.
Youth use and THR	Major focus of public health research, especially by NIH and CDC.	Industry-funded research tends to downplay youth appeal, focus on adult cessation.
Awareness related to THR	Public health campaigns are often funded by government grants.	Tobacco companies fund awareness studies to promote product safety.
Knowledge of THR	Publicly funded surveys and studies to gauge public understanding and misinformation.	Privately funded research often seeks to improve product image.
Socioeconomic aspect of THR	Public studies on cost-effectiveness and healthcare burden.	Some industry-funded research on economic benefits of THR adoption.

Table created by Perplexity AI (Collingwood, ON, Canada). Abbreviations: COPD, chronic obstructive pulmonary disease; THR, tobacco harm reduction.

hypotheses, use of inappropriate methods and lack of adaptation to emerging products (e.g., lack of standardization or specification of product exposure, use of conditions that do not reflect real-world use, and lack of adaptation to emerging technologies), unsupported claims and inferred conclusions, failure to control for confounding variables, use of non-representative study populations, and the omission of information on participants' prior use of combustible tobacco in analyses.

Some publicly funded studies have also been formally retracted [19], underlining the need for joint contributions from the public and private sectors to advance THR research. In the meantime, the THR debate is severely limited, inadequate science is being repeated, and misinformation is being disseminated, which could potentially mislead policymakers, health-care providers, and consumers.

Draft priorities for THR research

We have separated suggested research priorities into global and country/region specific (Fig. 1, Tables S4–S7; see supplementary materials associated with this article on line). This is because global priorities will not need to be addressed in every country but will be needed by all countries. By contrast, some research priorities will diverge owing to differences in culture, geography, national policies, and so on.

Global priorities

Global priorities should be approached with the same rigor as studies on vaccine or medication efficacy and effectiveness and overseen by international advisory boards to facilitate wide endorsement.

The first priority is long-term effects on health outcomes. Large-scale cohort studies that utilize validated biomarkers of exposure and harm should be performed in countries with differing patterns of THR use. Methodologies and standards should be agreed by private and public sector researchers. Industry and independent research will be crucial for regulatory approval of THR products while public research will advance knowledge for government policies and healthcare provider's behavior.

The second priority should be research into the health effects of nicotine as well as improving understanding of negative effects. This research would be best carried out by publicly funded researchers, although study design should be informed by the substantial research on this topic funded almost 50 years ago by tobacco companies and the UK Medical Research Council [20].

Third, the effectiveness of snus, HTPs, and nicotine pouches as smoking cessation aids need to be carefully reviewed to compliment the reviews already published on e-cigarettes. Definitions of smoking cessation vary across different organizations and complicate interpretation of results. Standardized criteria for cessation outcomes in THR research need to be agreed by the public and private sectors as well as national regulators and WHO. Industry should support such research, particularly if they wish to develop medically licensed products that physicians can feel comfortable to recommend to their patients who smoke.

Fourth, research focused on secondary prevention among high-risk tobacco users is urgently needed to better understand how the effectiveness of THR products can be maximized in high-risk populations. Such groups include smokers with early-stage COPD, cardiovascular diseases, peripheral vascular diseases, certain cancers, tuberculosis, and schizophrenia. In all these examples, 60–70% of patients smoke yet most never receive adequate support to quit or switch to THR products. In addition, heavy smokers (more than 20 cigarettes a day) are disproportionately affected by tobacco-related diseases and account for most lung-cancer and COPD deaths [21], highlighting a critical gap in public health interventions. Deeper understanding is needed of perceptions, preferences, and barriers to quitting smoking and how different age and demographic groups interact with THR products. The lack of targeted research in this area is concerning, as it leaves a significant portion of the smoking population underserved by existing THR strategies The public sector has a special responsibility to step up research in this area that leads to implementation at the interface between physicians and patients.

Finally, the quality of epidemiological and behavioral studies needs to be strengthened. Key areas on which to focus are harms and benefits, THR and public safety, potential differences between formulations and delivery mechanisms, and actionable knowledge for policymakers and health-care providers

Country and regional research priorities

Country-specific and region-specific priorities are needed to address diversity in product use, research capabilities, public health competence (includes illicit trade control, enforcement capacity for youth access and marketing laws), public health priorities, epidemiological realities, cultural attitudes, regulatory environments, and health-care infrastructures across different nations.

Data on tobacco prevalence must be routinely monitored to evaluate the effectiveness of control measures. Effects of poly-use (use of multiple nicotine or tobacco products) should be assessed using consumers self-reports and, where feasible, biomarkers of exposure. Stratification of these data by age, sex, amount, and type of nicotine product used will maximize their usefulness.

The role of health-care providers in the adoption of THR products cannot be overstated [22,23]. In 2022, Sermo (Cambridge, MA, USA) conducted online quantitative interviews with 15,335 physicians across 11 countries: China, Germany, Greece, India, Indonesia, Israel, Italy, Japan, South Africa, the UK, and the US [24]. The survey revealed that nearly 77% of doctors mistakenly believe nicotine causes lung cancer, and 78% believe it causes atherosclerosis. Although 87% of doctors consider smoking cessation a priority, the lack of training and nicotine knowledge adversely impacts their ability to provide effective quitting and harm reduction advice. These findings highlight the need for country-specific research to assess health-care providers' knowledge and attitudes towards THR products and the role of nicotine in smoking cessation and THR. Understanding the barriers to health-care providers' support for THR can help address misinformation and foster more widespread acceptance of these products as viable harm reduction tools.

One of the most contentious issues surrounding THR products is their potential to serve as a gateway to smoking, particularly among youth [24–27]. In many countries, stringent regulations have been put in place to prevent youth access to THR products, although the effectiveness of

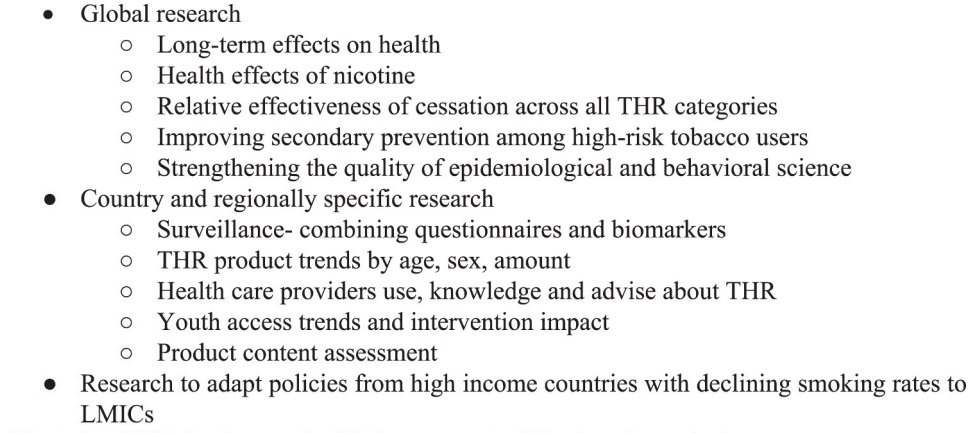

Fig. 1. Draft priorities for tobacco harm reduction research.

these measures remains unclear. Research should focus on the extent of youth access to THR products and the success of interventions.

LMICs

LMICs, particularly those in Africa and Asia, face unique THR challenges and opportunities [25], but the levels of research in LMICs are lower than those in high-income countries [12–15]. One of the most pressing research priorities is to comprehensively chart tobacco product use, including types consumed, demographic differences, cultural factors. These baseline data are essential for developing targeted, contextually appropriate, and effective THR interventions.

Tobacco control efforts in LMICs are primarily focused on reducing smoking prevalence through taxation, public awareness campaigns, and smoking cessation programs. Research is needed to assess the acceptability of THR products and how they may be incorporated in ways that complement tobacco control goals. Focuses must include evaluating the regulatory and economic implications where tobacco taxes and sales contribute significantly to government revenue. Additional important factors are THR affordability and accessibility; potential for misuse or unintended consequences; effective communication of the benefits; supply chain logistics; and the ability to scale up successful programs.

Policy research priorities

Policy research is a crucial yet often overlooked component in the successful implementation of THR strategies. Effective policies are grounded in solid, evidence-based research to ensure that the desired public health outcomes are achieved [26,27]. Furthermore, successful THR policy implementation depends on a deep understanding of the local context. Policy research must be culturally sensitive and adaptable to the unique challenges each nation faces. Local cultural attitudes towards smoking and nicotine products will need to be thoroughly understood through engagement with governments, health-care providers, public health organizations, and communities.

THR initiatives developed and implemented so far have been in high-income countries where smoking rates are declining, research infrastructures and public health frameworks are robust and are well funded. In countries like Sweden [28], New Zealand [29], Japan [30], the UK [31], and the USA [32], the introduction of THR products has notably accelerated the fall in smoking prevalence. Data have been assessed and leveraged to create nuanced policies that encourage the use of THR products while mitigating potential risks. However, the approaches might not be applicable to other countries and regions with different cultural, economic, and epidemiological contexts. Thus, there is a pressing need for tailored policy research that considers the unique circumstances of each country or region.

There are at least two distinct groups of countries that require different policy solutions. First includes those group like Ethiopia and Nigeria, where smoking prevalence remains low [33], and the primary public health priority should be to prevent increased tobacco use. Whether introducing THR products as a safer alternative to combustible tobacco products could reduce smoking rates and how to prevent an increase in nicotine addiction, particularly among previous non-smokers, need to be assessed in these countries. The second group comprises countries with high smoking prevalence, such as China, Indonesia, those in Eastern Europe and the Middle East, and small island states, where adult male smoking rates exceed 40%. Smoking remains deeply ingrained in the social fabric and is widely accepted. Policy research should focus on whether integrating THR products into broader tobacco control efforts can displace combustible tobacco use [25].

Conclusions and recommendation

This analysis highlights substantial research gaps and the critical need for a comprehensive and nuanced approach to THR research and policy development, particularly to address the unique challenges faced by LMICs. While some high-income countries have made significant strides in integrating THR products into their public health strategies, there remains a substantial gap in understanding of the long-term health impacts and the effectiveness of these products in different global contexts. In LMICs, where tobacco-related disease burdens are often higher, and health-care infrastructure is less robust, the potential benefits of THR products could be profound. Yet, these potential benefits are coupled with significant challenges, including varying levels of regulatory capacity, cultural attitudes towards tobacco use, and the need for affordable and accessible alternatives to traditional smoking cessation methods. Addressing these gaps through targeted research is essential to ensure that THR products can be safely and effectively integrated into public health strategies in these regions.

We recommend a multifaceted approach to advancing THR research and policy, with a strong focus on LMICs. First, global research priorities should include large-scale cohort studies that use validated biomarkers to assess long-term health outcomes, with specific attention paid to the epidemiological realities of LMICs. These studies should also explore the effectiveness of a broader range of THR products beyond e-cigarettes, including HTPs, nicotine pouches, and snus. They should aim to recruit participants from high-risk groups, such as heavy smokers and older adults. Second, country-specific research is essential to tailor THR strategies to local contexts, with an emphasis on surveillance, demographic trends, education of health-care providers, and prevention of youth uptake. In LMICs, this research must also consider the challenges of affordability, accessibility, and the cultural acceptability of THR products. Third, policy research should prioritize the development of culturally sensitive and sustainable THR policies that are informed by solid evidence and adaptable to the diverse needs of LMIC populations. Stakeholders, including policymakers, governments, health-care providers, and communities, need to work together to develop THR strategies. Additionally, there is a need for international collaboration to support LMICs in building the research capacity necessary to conduct high-quality studies and to implement effective THR policies.

By addressing these research and policy gaps, we can better harness the potential of THR products to reduce the global burden of tobacco-related diseases, particularly in LMICs, where the need for effective and accessible tobacco control strategies is most urgent.

CRediT authorship contribution statement

Yusuff Adebayo Adebisi conducted data extraction from Scopus, contributed to the study design and data interpretation, and wrote the first draft of the manuscript. Sahan Lungu, Adriana Curado, and Gabriel Oke contributed to the study design, data interpretation, and provided insights on the first draft. Derek Yach conceptualized the study, provided supervision and expert guidance on the study design and interpretation, and critically reviewed the manuscript. All authors contributed significantly to the intellectual content of the paper and approved the final draft for publication.

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Data availability

The data used in this research were sourced from Scopus, a subscription-based database. Access to this data is subject to Scopus licensing agreements. Additional data and information were obtained from other relevant sources, which have been cited throughout the manuscript.

Declaration of Competing Interest

Yusuff Adebayo Adebisi and Sahan Lungu previously received the

Kevin Molloy Scholarship for Tobacco Harm Reduction from Knowledge-Action-Change (KAC), a UK-based public health organization focused on promoting tobacco harm reduction. Adriana Curado and Gabriel Oke were also previously awarded Tobacco Harm Reduction Scholarships from KAC. Derek Yach was a former Executive Director of the World Health Organization's Department of Non-Communicable Diseases, where he played a key role in developing the WHO's Framework Convention on Tobacco Control (FCTC). From September 2017 to October 2021, he served as President and CEO of the Foundation for a Smoke-Free World, now known as Global Action to End Smoking, a non-profit organization funded by Philip Morris International with the mission to support scientific research and development in the global fight against smoking. This present research did not receive any funding and was conducted independently of any past or present funders or affiliations. The content, selection, and presentation of facts, as well as any opinions expressed in this document, are solely the responsibility of the authors and should not be interpreted as reflecting the views or positions of the authors' affiliated institutions.

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Appendix A. Supplementary material

Supplementary materials (Fig. S1 and Tables S1–S7) associated with this article can be found at http://www.scincedirect.com at doi; https://doi.org/10.1016/j.jemep.2025.101117.

Appendix B. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.jemep.2025.101117.

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