



# Strengthening research capacity: a systematic review of manuscript writing and publishing interventions for researchers in low-income and middle-income countries

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**To cite:** Busse CE, Anderson EW, Endale T, *et al*. Strengthening research capacity: a systematic review of manuscript writing and publishing interventions for researchers in low-income and middle-income countries. *BMJ Global Health* 2022;**7**:e008059. doi:10.1136/bmjgh-2021-008059

**Handling editor** Seye Abimbola

► Additional supplemental material is published online only. To view, please visit the journal online (<http://dx.doi.org/10.1136/bmjgh-2021-008059>).

Received 20 November 2021  
Accepted 4 January 2022



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## ABSTRACT

**Introduction** Health researchers from low-income and middle-income countries (LMICs) are under-represented in the academic literature. Scientific writing and publishing interventions may help researchers publish their findings; however, we lack evidence about the prevalence and effectiveness of such interventions. This review describes interventions for researchers in LMICs aimed at strengthening capacity for writing and publishing academic journal articles.

**Methods** We followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines to report literature searches in PubMed, Embase, Global Health, Scopus and ERIC. Our keywords included LMICs, low-income and middle-income countries, health research and writing/publication support interventions, with no restrictions on publication date. Our screening process consisted of title screening, abstract review and full-text review. We collected information about the content, implementation and evaluation of each intervention, if included.

**Results** We identified 20 interventions designed to strengthen capacity for scientific writing and publishing. We summarised information from the 14 interventions that reported submitted or published papers as outcomes separately, reasoning that because they provide quantifiable metrics of success, they may offer particular insights into intervention components leading to publication. The writing and publishing components in this ‘Publications Reported’ group were an average length of 5.4 days compared with 2.5 days in the other group we refer to as ‘Other Interventions.’ Whereas all 14 Publications Reported interventions incorporated mentors, only two of five in the Other Interventions group incorporated mentors. Across interventions, leaders expressed the importance of a high ratio of mentors to participants, the need to accommodate time demands of busy researchers, and the necessity of a budget for open access fees and high-quality internet connectivity.

**Conclusion** Writing and publishing interventions in LMICs are an underutilised opportunity for capacity strengthening. To facilitate the implementation of high-quality interventions, future writing and publishing

## Summary box

### What is already known?

- Health researchers from low-income and middle-income countries (LMICs) are under-represented in the scientific peer-reviewed literature.
- Limited evidence exists about the effectiveness of writing and publishing interventions in LMICs; for example, it is unclear what approaches best support the publication of research findings in academic journals.

### What are the new findings?

- Of the 20 writing and publishing interventions in our sample, we summarised information from the 14 interventions that reported submitted or published papers as outcomes separately, reasoning that because they provide quantifiable metrics of success, they may offer particular insights into intervention components leading to publication. Interventions in this ‘Publications Reported’ group were mostly part of larger research capacity interventions and the writing and publishing component was an average length of 5.4 days compared with an average of 2.5 days in the other group we refer to as ‘Other Interventions.’
- All 14 Publications Reported interventions incorporated mentors to support writing and publishing and the majority offered this support after the main intervention ended; two of five ‘Other Interventions’ incorporated mentors.
- Across interventions, leadership expressed the importance of a high ratio of mentors to participants, the need to accommodate time demands of busy researchers and the necessity of a budget to support open access fees and high-quality internet connectivity.

interventions should share their experiences by publishing detailed information about the approach and effectiveness of the interventions.

## Summary box

### What do the new findings imply?

- ▶ Moving forward, those who implement writing and publishing interventions should write a detailed account of how they carried out the intervention in a scientific manuscript. Helpful details might include whether a needs assessment was conducted, prior research training that participants received, the length of the writing and publishing intervention, topics covered, whether one-on-one writing mentorship was provided, attendance, and outcome measures.
- ▶ Gaps in this literature that require additional study include whether one comprehensive training can make a lasting impact and how to best support individuals' overall scientific productivity (eg, publications, grants, professional promotions). The impact of a 'train-the-trainers' writing and publishing intervention should also be investigated.

## INTRODUCTION

Researchers from low-income and middle-income countries (LMICs) are under-represented in the academic literature compared with their counterparts in high-income countries (HICs). This trend has been demonstrated across fields, including maternal health,<sup>1</sup> community health,<sup>2</sup> surgery,<sup>3</sup> infectious disease<sup>4</sup> and psychiatry.<sup>5</sup> Though progress has been made, disparities in output between researchers from LMICs and HICs persist. A bibliometric analysis of research publications led by African authors found that the absolute number of publications more than tripled from 2000 to 2014, yet publications led by African authors made up just 1.3% of research publications worldwide in 2014.<sup>6</sup> Moreover, in studies where authors from LMICs and HICs collaborate, authors from LMICs are less likely to be represented in the first and last author positions, which reflect leadership and decision-making power.<sup>2 4 7 8</sup>

Schneider and Maleka aptly assert that trends in research publications and the distribution of authorship are a 'barometer of research capacity and local ownership.'<sup>2</sup> Ultimately, these disparities in publication and authorship are a symptom of structural power imbalances in which the global health research agenda is determined and funded by HICs. Health research investments in LMICs continue to make up a woefully small percentage of global health research investments.<sup>9-11</sup>

Research by outside investigators is thus over-represented, and may lack meaningful context and interpretation.<sup>12</sup> In contrast, findings published by resident researchers in LMICs will often define research priorities appropriate to that region, develop contextualised responses to local health problems, and connect research to policy and practice.<sup>12-14</sup> Increasing research output from LMICs is a sound strategy for improving global health.<sup>12</sup>

Publishing in academic journals is critical to health researchers' success, including career advancement and the attainment of grant funding. Unfortunately, many structural barriers prevent researchers in LMICs from publishing their work. Research writing instruction and

support are not available in many low-resource settings, leading to poor manuscript preparation. In addition, academic journals lack the staff and budgets to offer extensive writing support to authors who submit promising, but poorly prepared, manuscripts. Tacit conventions in scientific publishing, like the importance of writing a cover letter to accompany a journal submission and the need to consult a journal's author guidelines throughout the writing and formatting process, present further challenges to researchers who may not have scientific mentors to help them navigate the publication process.

But what types of research writing and publishing interventions warrant investment? To efficiently steward resources, it is critical to identify the characteristics of scientific writing and publishing interventions for researchers in LMICs that result in the most meaningful gains in technical writing skills and publications. To our knowledge, no such investigation of the literature exists. This study seeks to fill that gap by: (1) summarising the approach, structure and outcomes of scientific manuscript writing and/or manuscript publishing interventions in LMICs and (2) identifying gaps in this literature to support further capacity strengthening in academic writing and publishing.

## METHODS

### Search strategy

Following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses recommendations,<sup>15</sup> an experienced health sciences librarian (CS) performed literature searches in the following databases: PubMed (National Library of Medicine), Embase (Embase.com), Global Health (EBSCOhost) and ERIC (ProQuest). We used cited reference searching to evaluate eight sentinel articles in Scopus (Elsevier). All searches were completed by 30 January 2020. The main search strategy, created in PubMed and translated to other databases, was constructed by combining selected keywords and controlled vocabulary for LMICs (defined by the World Bank classification from 2020<sup>16</sup>) health research, and writing and/or publication interventions. No search restrictions were placed on publication date or language. This review was not registered, but the search strategy is included in online supplemental appendix. Citations were imported into Mendeley reference manager (Mendeley), then uploaded into Covidence software (Melbourne, Australia) for the study selection process.

### Screening process

We reviewed articles in three stages: title screening, abstract review and full-text review. Two independent reviewers (CEB and MK) evaluated articles at each stage. Disagreements were resolved by a third independent reviewer (ETA).

### Title screening and abstract review

In the title screening stage, articles were excluded if they were obviously irrelevant. In the abstract review stage,

articles were excluded if they met any of the following criteria: (1) the writing or publication intervention described in the article was not implemented in an LMIC; (2) the paper did not examine an actual intervention (eg, reviews, editorials, frameworks); (3) the intervention described in the article focused on healthcare delivery or a clinical intervention. Articles focusing on healthcare delivery or clinical interventions were specifically excluded during the abstract review stage because reviewers were confident that such articles did not include interventions pertaining to writing or publishing. Articles on other topics sometimes included information about writing or publishing in the body of the paper but not in the abstract, so they were evaluated during full-text review to minimise the risk of improper exclusion. If the reviewer was unsure of whether the intervention included information about scientific writing or publishing, they voted to include it in the full-text screening stage.

### Full-text review

In the full-text review stage, an article was excluded if it met any of the following criteria: (1) it met any of the exclusion criteria from the abstract review stage; (2) the article described an intervention that did not provide instruction specific to scientific writing or publishing; (3) the article described a research capacity strengthening intervention but it did not describe a writing intervention component (citing publications as a desired or measured outcome alone was not considered a writing intervention); (4) the article described an individual mentoring programme (rather than a group programme) or (5) the article described a writing and/or publication intervention embedded within a degree granting programme. Writing retreats were included if they offered a structured writing or publishing intervention that met all inclusion criteria. Individual mentoring programmes that connect researchers with mentors without a structured intervention protocol were excluded; however, interventions that met our inclusion criteria that included a one-on-one mentorship component were included. Interventions embedded within degree granting programmes were excluded because they are not broadly accessible to researchers.

During full-text screening, we determined that articles describing 41 interventions provided insufficient detail to enable further analysis. For example, several articles simply stated that manuscript workshops were held, without describing the content of the intervention or its evaluation.

During data abstraction and analysis, the intervention was considered the unit of analysis. In some cases, more than one paper was published about a particular intervention. When this occurred, we included all of the relevant papers identified through our search in our analytical sample and information from each article was synthesised to describe that single intervention. The six papers describing Structured Operational Research Training Initiative (SORT-IT) interventions were a

notable exception to this rule. Though the overall intervention was similar among the six papers, we considered each paper to be a separate intervention because each described an intervention implemented in a distinct setting and context.

This systematic review process identified 64 articles for inclusion. The final analytical sample contained 23 articles describing 20 interventions (figure 1). If a paper in our main sample cited an additional reference that described details about the intervention, pertinent details from that article were included in our analysis, but the article was not formally added to our analytical sample. Such additional references are cited in our tables and labelled ‘supporting papers.’

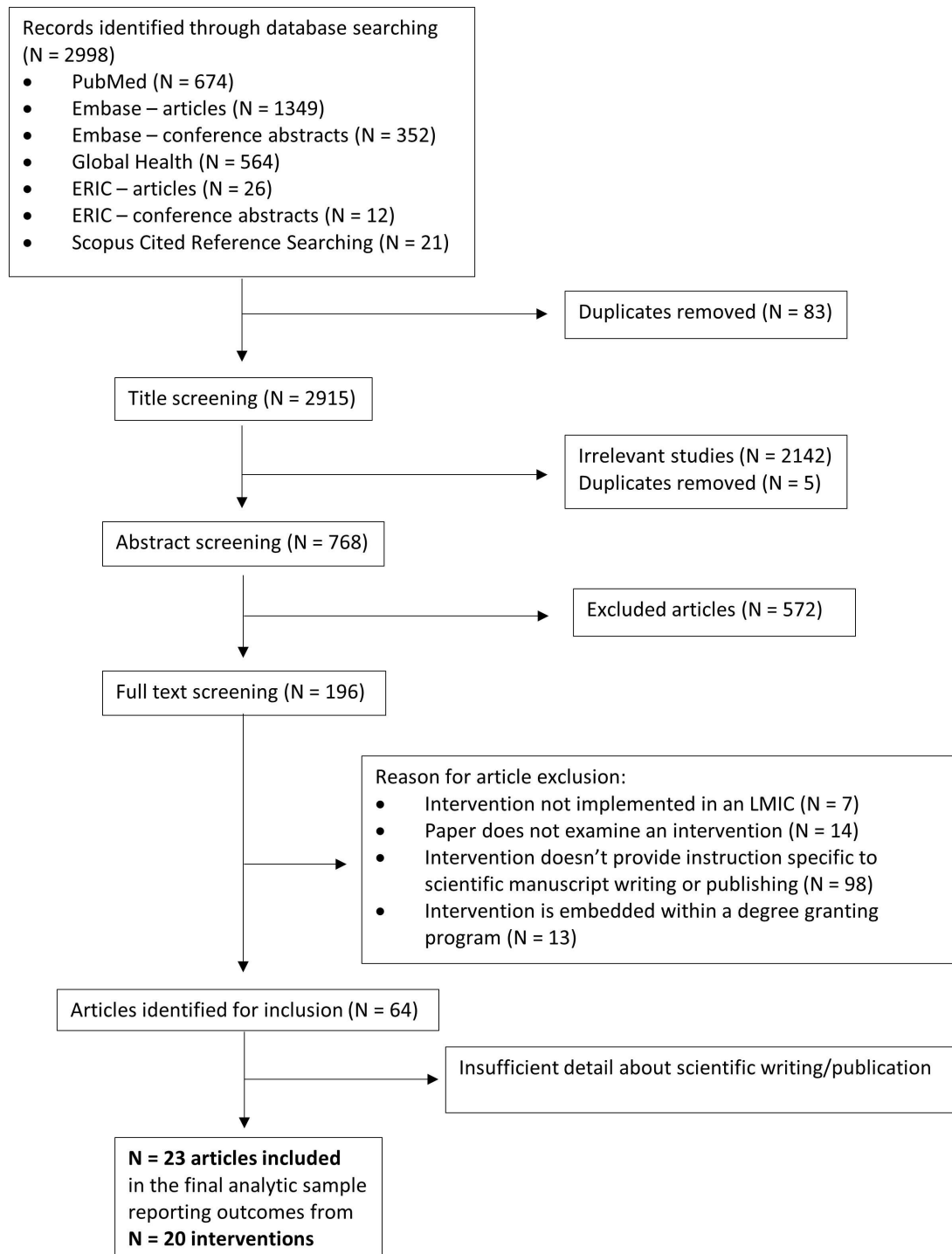
### Data abstraction

We abstracted details about each writing and publishing intervention, including the location of activities, whether a needs assessment was conducted, whether the writing and publishing programme was part of a larger initiative, the intervention’s content area(s), participant characteristics, the format, frequency and duration of the intervention. We summarised the instructor characteristics and country affiliation, the writing and publishing skills and topics covered, whether participants had data for their manuscript at the training event, and the type of one-on-one support provided for writing, submission and response to reviewers. Additionally, we highlighted programme attendance, evaluation methods, outcome measures, and results. We also identified whether a comparison group was included in the evaluation of the intervention. Finally, we summarised challenges and lessons learnt from each intervention as explained by the authors of the manuscript(s) describing the intervention. The specific elements identified above were determined after surveying articles and identifying emergent themes.

### Presentation of results

In pursuit of our first aim, to identify approaches for strengthening capacity for writing and publishing research in academic journals, we organised our results to highlight the approaches of interventions that reported the number of submissions and/or publications. We refer to these interventions as the “Publications Reported” group. We reasoned that because they provide quantifiable metrics of success, they may offer particular insights into intervention components leading to publication.

We present information on the following variables by group (Publications Reported vs Other Interventions): needs assessments, intervention structure and delivery, the topics covered in the intervention, the support provided in follow-up period (eg, one-on-one mentorship for completing a manuscript). Also compared between the two groups are the evaluation method and outcome measures, including whether comparison groups were used, whether participant feedback on programme quality was gathered, attendance data and the cost of the writing and publishing intervention. We reasoned



**Figure 1** Process for identifying articles for inclusion in systematic review of writing and publishing interventions.

that this information may be different by those interventions that did and did not report publications and thus, identified the information separately by group. We aggregated intervention information from the total sample when reporting instructor characteristics, challenges and lessons learnt.

**RESULTS**

Through our three-stage systematic review process, we identified 20 scientific writing and publishing

interventions that provided sufficient detail for analysis. These interventions were designed to strengthen capacity for scientific writing and publishing among researchers in LMICs. Eighteen were part of broader capacity strengthening interventions that provided training for research skills beyond writing and publishing.<sup>17-34</sup>

The majority of interventions in our main sample were focused on specific content areas (table 1): five advanced operational research, three supported psychiatry and mental health, three addressed tuberculosis and two

**Table 1** Summaries of the location, participant characteristics, broader programme (if present), format, frequency, duration and programme content area of the 20 writing and publishing interventions in the analytical sample

Citation and/or intervention name	Location of activities	Participant characteristics and number	Was the writing and/or publishing intervention part of a broader programme or was it stand alone? if not, description of main programme	Format, frequency, duration and activities of writing and publishing intervention	Programme content area
<b>PUBLICATIONS REPORTED INTERVENTIONS (Interventions that Reported Submissions and/or Publications)</b>					
Thakurdesai <i>et al</i> , 2018 <sup>17</sup> (eJCI/India; Electronic Journal Club India)	India	426 members at time of publication (ongoing programme), primarily in India, mostly students and faculty. Varied age, gender, areas of interest, and geographical location.	Part of a larger programme; journal club activities help critical evaluation and writing.	Ongoing online journal club; mentored writing support; small group writing e-workshop; peer review.	Psychiatry
Klinkenberg <i>et al</i> , 2014 <sup>18</sup> (Ethiopian Operational Research Initiative)	Ethiopia	52 participants completed programme in first 2 years (2012–2014); TB programme and university staff across Ethiopia.	Part of a larger programme; main programme expanded capacity for TB research and control.	4–6 day writing component in 15 month programme; train-the-trainer; mentored writing and editing support; peer review, individual writing practice <sup>†</sup> ; post course, ongoing, mentored writing support.	TB
Kramer <i>et al</i> 2016, <sup>35</sup> Kramer, 2018 <sup>27</sup>	Faculty of Health Sciences, University of Witwatersrand, Johannesburg, South Africa	Attendance varied from 7 to 25 participants; mainly graduate students and researchers.	Part of a larger programme; main university-wide multi-year programme included over 70 courses, incentives <sup>†</sup> and other activities (eg, writing retreats, funding opportunities, forums, workshops).	3-day writing retreats: small group writing workshop; mentored writing and editing support; individual writing practice <sup>†</sup> ; incentives <sup>†</sup>	Multiple topic areas
Ganju <i>et al</i> , 2018 <sup>36</sup> (Knowledge Network)	India	70 participants; early-stage researchers without publishing experience plus 40 data analysts.	Stand alone.	Two 5-day writing workshops; first workshop: structured sequenced programme; didactic lecture <sup>†</sup> ; peer-editing practice; small group writing workshop; presentation; peer review; postcourse ongoing mentored writing support; second workshop: 5-day mentored writing and editing training; total of 32 weeks of support provided.	HIV prevention programmes
Memiah <i>et al</i> , 2018 <sup>28</sup>	Kenya and Tanzania	5 cohorts of participants (n=98) included clinicians working for NGOs in Kenya and Tanzania; 83% of participants were female.	Part of a larger programme; main programme trained clinicians to design, conduct, and publish scientific research.	3 sequential writing workshops over 12 days (7 days total on manuscript writing/ publishing); didactic lecture <sup>†</sup> ; participatory; small group writing workshop; peer review; presentations; post course ongoing mentored writing support.	HIV/AIDS
Mathai <i>et al</i> , 2019 <sup>29</sup>	Kenya (University of Nairobi)	45 trainees, 15 faculty, 9 nonacademic health workers participated over 3-year project.	Part of a larger programme; main programme strengthened mental health research capacity in Kenya.	1.5-day writing component in 2-week programme: didactic lecture <sup>†</sup> , mentored writing and editing support; small group writing workshop; post course, presentations; 3 years ongoing mentored writing support.	Mental health
Kempker <i>et al</i> , 2018 <sup>30</sup>	Georgia, the country	20 long-term trainees between 2004 and 2015; median age 29 years; majority (65%) were female, most (60%) employed at National Centre for Tuberculosis and Lung Diseases; most (n=18) had medical degrees.	Part of a larger programme; main programme provided didactic <sup>†</sup> and mentored TB-related research training; participants obtained MPH or MSCR at Emory University in Georgia in USA then transitioned to distance and in-country learning.	Length of writing component not reported; didactic lecture <sup>†</sup> ; postcourse ongoing mentored writing support; leadership practice.	TB

Continued

**Table 1** Continued

Citation and/or intervention name	Location of activities	Participant characteristics and number	Was the writing and /or publishing intervention part of a broader programme or was it stand alone? if not, description of main programme	Format, frequency, duration and activities of writing and publishing intervention	Programme content area
da Silva <i>et al</i> , 2019 <sup>31</sup> ; Gureje <i>et al</i> , 2019 <sup>32</sup> ; (PAM-D); Partnership for Mental Health Development in Africa); Supporting papers: Schneider <i>et al</i> , 2016 <sup>33</sup> ; Pilowsky <i>et al</i> , 2016 <sup>34</sup> ;	The hub spans Nigeria, Ghana, Kenya, Liberia, and S. Africa.	35 early-career and mid-career researchers.	Part of a larger programme; main programme a regional hub to increase resources and infrastructure, including research training, for mental health interventions in LMICs.	4-day writing component: didactic lecture; one-on-one mentored writing and editing support; incentives.†	Mental health
Fatima <i>et al</i> , 2019 <sup>32</sup> (SORT-IT); Structured Operational Research Training Initiative in Pakistan); Supporting paper: Ramsay <i>et al</i> , 2014 <sup>45</sup>	3 courses in Pakistan, 1 in South Asia, 1 in Paris	34 selectively enrolled health professionals in government, research, NGOs and academia. Some women.	Part of a larger programme; Main programme supports development of operational research skills; three modules (5–7 days each) conducted over 9 months; first and second modules focused on research skills; third module focuses on scientific writing and publication. Milestone achievements required at specific timepoints; if not met participants were terminated from programme.	5-day writing component: didactic lectures; small group writing workshops; mentored writing and editing support; presentation and feedback sessions; incentives; post-programme mentored writing and submission support.	Operational research
Guillerm <i>et al</i> , 2014 <sup>33</sup> ; (SORT-IT); Structured Operational Research Training Initiative); Supporting paper: Bissell <i>et al</i> , 2012 <sup>37</sup>	8 courses were held in Paris, Hyderabad, Luxembourg, Fiji, Kathmandu, and Nairobi between 2012–13.	83 of 93 enrollees from LMICs completed one of 8 SORT-IT programmes; of 76 survey respondents, 43% worked in government health sector, 37% worked in NGOs, 20% were university based; over half were medical doctors and others were health staff and practitioners; male and female participants (numbers not reported).	Part of a larger programme; main programme supports development of operational research skills; three modules (5–7 days each) over 9 months; first and second modules focus on research skills; third module focuses on scientific writing and publication. Milestone achievements required at specific timepoints; if these not met participants terminated from programme.	5-day writing component: didactic lectures; small group writing workshops; mentored writing and editing support; presentation and feedback sessions; incentives; post-programme mentored writing and submission support.	Operational research
Zachariah <i>et al</i> , 2016 <sup>34</sup> ; (SORT-IT); Structured Operational Research Training Initiative in 64 LMICs); Supporting paper: Ramsay <i>et al</i> , 2014 <sup>45</sup>	8 courses held in Europe, 6 in Asia, 3 in Africa, and three in Fiji between 2009 and 2014.	236 participants from across Africa, Asia, Europe, South Pacific and South America (64 LMICs); most participants were clinicians; nearly half worked for ministry of health/public health programmes, 32% worked at NGOs; 41% were female.	Part of a larger programme; main programme supports development of operational research skills; three modules (5–7 days each) over 9 months; first and second modules focus on research skills; third module focuses on scientific writing and publication. Milestone achievements required at specific timepoints; if these not met participants terminated from programme.	5–7 days writing component: didactic lectures; small group writing workshops; presentations; mentored writing and editing support; incentives; post-programme mentored writing support.	Operational research
Goel <i>et al</i> , 2018 <sup>19</sup> (SORT-IT); Structured Operational Research Training Initiative adapted for Tobacco Control)	India (participants from across country).	6 female and 5 male post graduate students and junior faculty in public health and medicine from India and Nepal.	Part of a larger programme; main aim of programme build capacity of public health professionals operational research with focus on tobacco control using standard data set, with goal of submission within 4 weeks of the course; adapted to use fewer resources than standard SORT-IT intervention.	5.5-day course integrating writing and data analysis; precourse work with matched mentors; didactic lectures; small group writing workshop; presentations; individual writing practice; one-on-one mentored writing and editing support.	Tobacco control

Continued

Table 1 Continued

Citation and/or intervention name	Location of activities	Participant characteristics and number	Was the writing and/or publishing intervention part of a broader programme or was it stand alone? if not, description of main programme	Format, frequency, duration and activities of writing and publishing intervention	Programme content area
Kumar <i>et al</i> , 2013 <sup>20</sup> (Union/MSF Operational Research Training\$ adapted for Nepal); Supporting paper: Bissell <i>et al</i> , 2012 <sup>37</sup>	Nepal	12 male and female participants; primarily health professionals (physicians, programme managers, paramedical workers, data analysts) from India, Nepal, Bhutan, Bangladesh, Pakistan, Sri Lanka, Indonesia, Timor Leste and Cambodia.	Part of a larger programme; main programme supports development of operational research skills; 3 modules (5 days each) over 9 months; first and second modules focus on research skills; third module focuses on scientific writing and publication; goal was manuscript submission to peer-reviewed journal within 4 weeks of completing third module.	5-day paper writing module; adapted Union/MSF intervention to include organising and managing references and peer writing support; small group writing workshops; matched new with experienced facilitators; lecture; peer mentoring; mentored writing and editing support.	Operational research in multiple topic areas.
Odhiambo <i>et al</i> , 2017 <sup>21</sup> (IORT (Intermediate Operational Research Training Programme; adapted from SORT-IT for Rwanda)	Rwanda	9 participants (1 female, 8 males); 6 were ministry clinical staff and three were programme staff all working in health service delivery in rural districts.	Part of a larger programme; Seven 2-day sessions every 4–6 weeks over 8 months.	2-day writing component; small group writing workshop; mentored writing and editing support; presentation and feedback sessions; individual writing practice*; post programme mentored writing support.	Operational research.
<b>OTHER INTERVENTIONS</b> (Interventions that Did Not Report Submissions and/or Publications)					
Merritt <i>et al</i> , 2019 <sup>22</sup> (ACES; Academic Competencies Series)	Blantyre, Malawi	Postdocs and Master of Philosophy fellows in Ethiopia, Malawi, South Africa and Zimbabwe; 12 participated in writing workshop.	Part of a larger programme; main programme focused on career development skills.	5-day writing component, residential; didactic lecture†, text book; peer editing practice, individual writing practice, mentored writing and editing support.	Multiple topic areas
Usher <i>et al</i> , 2015 <sup>23</sup> (APEDNN; Asia Pacific Emergency and Disaster Nursing Network)	Cairns, Australia	23 nurses (faculty, consultants, staff at ministries of health) involved in disaster management from Asia-Pacific region; some women.	Part of a larger programme; main programme enhanced technical and research skills to support management and research of disasters in Asia-Pacific region.	Length of writing component not reported; part of 3-week course; didactic lecture; peer editing practice; matched mentors; post course, ongoing mentored writing support.	Nursing disaster management
Atindehou <i>et al</i> , 2019 <sup>24</sup> (MooSciTIC; A shot of science)	Trainings were hosted in Benin	20 lecturers and research scientists from seven academic institutions in Benin, Burkina Faso, Burundi, Cameroon, DRC, Ivory Coast, Niger, Senegal, and Togo; 56% female.	Part of a larger programme; main programme strengthened capacity by 'training the trainers' on scientific writing, communication and integrity.	Length of writing component not reported; train-the-trainer; didactic lecture†; small group writing workshop.	Multiple topic areas
Varadaraj <i>et al</i> , 2019 <sup>25</sup> ; Varadaraj <i>et al</i> , 2016 <sup>55</sup>	India and Nepal	Participants from India (n=65) and Nepal (n=30); mostly 20–39 years of age; most affiliated with medical or dental departments at universities; 70%–80% female.	Part of a larger programme; main programme used expertise of diaspora health providers and researchers to improve research interest and output in LMICs.	½ day on writing of 2-day research seminar; reading material; didactic lecture†; small group writing workshop; presentations.	Biomedical research
Harries <i>et al</i> , 2003 <sup>26</sup>	Malawi	25 TB officers, varying educational backgrounds (some without degrees).	Part of a larger programme; main programme increased capacity for operational research on TB.	½-day writing component of 1 day workshop; didactic lecture; incentives†; individual writing practice*.	TB control
Mbuagbaw <i>et al</i> , 2011 <sup>38</sup>	Cameroon	15 Cameroonian university lecturers and researchers in health institutions, 12 were clinicians.	Stand alone.	4-day writing workshop; small group writing workshop.	Clinical medicine or health systems research

\*Individual writing practice refers to protected writing time.  
 †Incentives include small grants, graded, stipend, awards.  
 ‡Didactic lectures refer to courses, trainings, lectures and sessions.  
 \$Union/MSF is the pre-cursor to the SORT-IT intervention.  
 DRC, Democratic Republic of the Congo; LMICs, low-income and middle-income countries; MSF, Médecins Sans Frontières; NGO, Non-governmental organisation; TB, tuberculosis.

promoted research in HIV. The other seven focused on other topics or were not limited to a specific content area.

### Participants

Participants in the interventions in our sample came from 65 countries and included clinicians, research and professional staff and academic faculty and students (table 1). Eight interventions (8/20) did not report the gender of attendees. Twelve interventions (12/20) mentioned having women participants, and in five (5/12), women made up the majority of participants.

### Comparison of Publications Reported interventions to Other Interventions

The next several subsections highlight intervention approaches of the 14 interventions that reported the number of manuscript submissions or publications ('Publications Reported' interventions).

#### Needs assessments

Three interventions<sup>28 29 31</sup> (3/13) in the Publications Reported group reported conducting a needs assessment prior to the intervention (we did not include the ongoing journal club<sup>17</sup> in the denominator). Five<sup>22-26</sup> of the six interventions in the Other Interventions group reported conducting a needs assessment; four<sup>22-24 26</sup> completed them prior to the intervention, and one intervention<sup>25</sup> was a pilot programme intended, in part, to serve as a needs assessment.

#### Structure and delivery

Two writing/publishing interventions were standalone and the rest were part of larger research capacity programmes (table 1). The average length of the writing/publishing components in the Publications Reported group was 5.4 days (one Publications Reported intervention did not report length, and one other is the ongoing journal club, not included in the average). In contrast, the average length of the writing component in the Other Interventions group was 2.5 days (two did not specify length).

There were a wide range of programme formats, including structured workshops, training modules, courses, retreats and an online journal club (table 1). Twelve (12/14) interventions in the Publications Reported group and 5 (5/6) in the Other Interventions group specifically mentioned a small group interactive writing component, peer editing or peer review activities. However, four (4/14) in the Publications Reported group and just two (2/6) in the Other Interventions group provided protected time for writing or individual writing practice during the main programme.

Support for developing and submitting manuscripts and responding to reviewers was provided in some cases (one-on-one or one facilitator or mentor working with a small team) during the intervention or for some period afterward (table 2). All of the 14 interventions in the Publications Reported group incorporated mentors to support less experienced researchers. In the Other

Interventions group two reported providing mentors (2/5; the train-the-trainers intervention was not included in the denominator).

#### Scientific writing and publishing topics covered and data for manuscripts

In general, interventions in the Publications Reported group delivered or presented a greater breadth of content and topics in the intervention trainings. Aside from writing the basic sections of a paper, the most common topics mentioned in the didactic component of the Publications Reported interventions were responding to reviewers and revision (7/14), referencing skills and/or software (4/14), and authorship (3/14) (table 2). In the Other Interventions group, the most frequently mentioned topics were referencing skills and/or software (4/6) and English language skills (2/6).

Participants had data for their manuscript at the training event in all 14 of the Publications Reported interventions, and participants had data for their manuscript in two of the six Other Interventions training events.

#### Support provided in follow-up period

We define the 'follow-up period' as time beyond the main intervention to provide additional support or mentorship to participants. Among the Publications Reported group, intervention follow-up support lasted between 6.5 months and 3 years. Only one intervention in the Other Interventions group provided post-programme support and this was 12 months long.<sup>23</sup>

Among the follow-up support described were email feedback on manuscripts, remote editing and assistance responding to reviewers. Eleven interventions in the Publications Reported group reported providing mentoring during the follow-up period (11/13) and one (1/6) intervention in the Other Interventions group provided follow-up mentorship (table 2). eJCIIndia<sup>17</sup> was an ongoing journal club and is not included in the Publications Reported denominator above, and the train-the-trainers intervention<sup>24</sup> was not included in the denominator for the Other Interventions group.

#### Evaluation method and outcome measures

None of the studies in our sample reported using a closely matched comparison group such as a within-person pre/post comparison or other similar comparison group to track participant success in publishing articles, though many provided some evaluation (table 3). One university-wide multi-component intervention in South Africa<sup>27 35</sup> in the Publications Reported group reported a large increase in publications over the 9 years after their intervention, though it was unclear which didactic components were most effective and whether any increase in publications may have been due to an increase in faculty or other university-level policies or programmes during that time period. One intervention<sup>25</sup> in our Other Interventions group included two pre/post survey questions related to the importance of manuscript



**Table 2** Description of instructor characteristics, topics, skills and/or learning activities covered, whether participants had data at training event, and type of mentoring support for the 20 interventions in the analytical sample

Intervention name	Instructor/ facilitator/mentor characteristics and country affiliation	Topics, skills and/or learning activities	Participants had data for their manuscript at training event	Type and timing of mentor support
<b>PUBLICATIONS REPORTED INTERVENTIONS</b> (Interventions that Reported Submissions and/or Publications)				
Thakurdesai <i>et al</i> , 2018 <sup>17</sup> (eJIndia; Electronic Journal Club India)	Indian researchers in field of psychiatry	Activities include posts (questions or materials sent to group to improve knowledge and skills); reviewer training (members who are journal editors recruit small teams to participate in confidential manuscript review); journal article discussions, critiques and group commentaries.	Yes	Mentored journal club subgroups collaboratively wrote and published critiques of published articles.
Klinkenberg <i>et al</i> , 2014 <sup>18</sup> (Ethiopian Operational Research Initiative)	Ethiopian and international collaborators	Writing journal articles	Yes	Ongoing support by mentors to submit manuscript to a peer-reviewed international journal
Kramer and Libhaber, 2016, <sup>35</sup> Kramer and Libhaber, 2018 <sup>27</sup>	Writing retreat facilitators were academics with PhDs and expertise in scientific writing; facilitator affiliation not reported.	Writing and publishing journal articles, literature reviews, theses, critiques of articles.	Yes	Writing retreats: less experienced researchers received feedback and ongoing support on manuscript drafts from mentors.
Ganju <i>et al</i> , 2018 <sup>36</sup> (Knowledge Network)	Not reported	Writing and publishing journal articles; authorship; publication ethics; addressing reviewer feedback; literature searching; reference manager software; problem conceptualisation; data presentation; preparing abstract; barriers to publishing (time constraints; understanding writing conventions; mentorship; and writing confidence).	Yes	Over 10 weeks following first writing workshop: writing support by mentors, access to published literature; subsequent workshop provided time and mentor guidance, enabling participants to revise manuscripts and prepare submissions to peer-reviewed journals.
Memiah <i>et al</i> , 2018 <sup>28</sup>	Faculty and instructors from University of West Florida, University of British Columbia and Kenya Medical Research Institute developed curriculum.	Writing a scientific journal article; organisation; references; writing an abstract	Yes	During workshop: participants wrote manuscript drafts and revised based on mentor feedback; following workshop: participants continued to work with mentor monthly.
Mathai <i>et al</i> , 2019 <sup>29</sup>	University of Washington faculty taught workshop sessions at beginning; responsibility shifted to University of Nairobi faculty by year 3.	Research methods workshop: writing journal articles, literature reviews, literature searching tools; 'thesis-to-publication' workshops.	Yes	Trainees worked closely with mentors throughout and after programme for writing support; faculty mentors from both institutions collaboratively edited trainee manuscripts.
Kempker <i>et al</i> , 2018 <sup>30</sup>	In first year, students travelled to Emory or other programmes in USA to earn MPH or MS Clinical Research degrees; in second cycle, focus shifted to Georgia the country.	Writing journal articles; written and spoken English language training provided as needed.	Yes	Every trainee had mentor in Georgia the country and USA; mentors provided ongoing support for preparing and editing manuscripts.

Continued

**Table 2** Continued

Intervention name	Instructor/ facilitator/mentor characteristics and country affiliation	Topics, skills and/or learning activities	Participants had data for their manuscript at training event	Type and timing of mentor support
da Silva <i>et al</i> , 2019 <sup>31</sup> ; Gureje <i>et al</i> , 2019 <sup>52</sup> ; (PAM-D; Partnership for Mental Health Development in Africa); Supporting papers: Schneider <i>et al</i> , 2016 <sup>53</sup> ; Pillowsky <i>et al</i> , 2016 <sup>54</sup>	Instructors from hub countries as well as other collaborating countries (eg, the UK).	First workshop: phrasing research question; identifying suitable journal; abstract writing, introduction and discussion sections; second writing workshop: one-on-one sessions with facilitators; additionally, three participants trained in systematic reviews.	Yes	Support provided via one-on-one sessions in writing workshop and through additional mentoring throughout programme.
Fatima <i>et al</i> , 2019 <sup>32</sup> (SORT-IT; Structured Operational Research Training Initiative in Pakistan); Supporting paper: Ramsay <i>et al</i> , 2014 <sup>45</sup>	First course: international and national facilitators and mentors; subsequent courses, national faculty, many trained from previous SORT-IT courses.	Writing journal articles; how to submit paper to journal; navigating peer review process including responding to reviewers (standard SORT-IT protocol).	Yes	One-on-one mentoring provided during training modules and over email between modules and afterwards until paper was published (standard SORT-IT protocol).
Guillerm <i>et al</i> , 2014 <sup>33</sup> ; (SORT-IT; Structured Operational Research Training Initiative); Supporting paper: Bissell <i>et al</i> , 2012 <sup>37</sup>	Not reported	Writing journal articles; how to submit paper to journal; navigating peer review process including responding to reviewers (standard SORT-IT protocol).	Yes	One-on-one mentoring provided during training modules and over email between modules and afterwards until paper was published (standard SORT-IT protocol).
Zachariah <i>et al</i> , 2016 <sup>34</sup> ; (SORT-IT; Structured Operational Research Training Initiative in 64 LMICs); Supporting paper: Ramsay <i>et al</i> , 2014 <sup>45</sup>	Senior facilitators were NGO staff; 88% of facilitators were from LMICs, most were medical doctors or public health practitioners; 37% were female.	Writing journal articles; how to submit paper to journal; navigating peer review process including responding to reviewers (standard SORT-IT protocol).	Yes	One-on-one mentoring provided during training modules, over email between modules and afterwards until paper was published (standard SORT-IT protocol).
Goel <i>et al</i> , 2018 <sup>19</sup> (SORT-IT; Structured Operational Research Training Initiative adapted for Tobacco Control)	Nine facilitators who had conducted operational research or had taught operational research courses.	Scientific English writing; writing results; writing an abstract; creating tables and figures, references, choosing a journal, electronic submission, peer review, revision, research questions, conflicts of interest, and authorship.	Yes	Facilitators mentored trainees before and during the programme. Follow-up support was not reported.
Kumar <i>et al</i> , 2013 <sup>20</sup> (Union/MSF Operational Research Training* adapted for Nepal); Supporting paper: Bissell <i>et al</i> , 2012 <sup>37</sup>	Facilitators were participants in previous courses.	Writing journal articles, online submission, peer review, and manuscript revision.	Yes	Two facilitators mentored groups of three trainees during the 5-day workshop. Follow-up support was not reported.

Continued

Table 2 Continued

Intervention name	Instructor/ facilitator/mentor characteristics and country affiliation	Topics, skills and/or learning activities	Participants had data for their manuscript at training event	Type and timing of mentor support
Odiambo <i>et al</i> , 2017 <sup>21</sup> (IORT (Intermediate Operational Research Training Programme; adapted from SORT-IT for Rwanda))	Two primary facilitators/mentors were a PhD-level biostatistician and an MPH-level trainer with research and public health programme experience.	Writing journal articles, creating an outline, managing references; choosing a journal, authorship, acknowledgements, and the paper development process from submission to publication.	Yes	On average, mentors provided 2 hours of mentorship per week per team for 25 weeks and fellows provided 4 hours of mentorship per week per team for 15 weeks, for a total of 110 hours of mentorship for each research project during practicum and through publication.
<b>OTHER INTERVENTIONS</b> (interventions that Did Not Report Submissions and /or Publications)				
Merritt <i>et al</i> , 2019 <sup>22</sup> (ACES; Academic Competencies Series)	US-based clinical academics with extensive publication experience	Writing journal articles; cover letters; grammar, organisation, syntax, publication skills	Yes	Participants worked on manuscript draft during workshop including one-on-one mentored writing support
Usher <i>et al</i> , 2015 <sup>23</sup> (APEDNN; Asia Pacific Emergency and Disaster Nursing Network)	Led by members of James Cook University's WHO Organisation Collaborating Centre Staff, including a research intern.	Library tutorials, referencing software, English expression and editing	No	Follow-up mentorship provided after in-person component ended
Atindehou <i>et al</i> , 2019 <sup>24</sup> (MooSciTIC: A shot of science!)	Not reported	Literature mining, reference database management, journal guidelines, strategies for efficient writing, the peer review process; writing journal articles.	No	This was a 'train-the-trainers' intervention, so not applicable
Varadaraj <i>et al</i> , 2019 <sup>25</sup> ; Varadaraj <i>et al</i> , 2016 <sup>55</sup>	Diaspora physicians from India (n=2) or Nepal (n=1), alumni of Johns Hopkins Bloomberg School of Public Health	Literature review, using databases, creating libraries, using reference managers, writing journal articles; referencing, citations, publishing	No	Not reported
Harries <i>et al</i> , 2003 <sup>26</sup>	Local personnel from Malawi National Tuberculosis Control Programme	Writing journal articles	Yes	Authors reported that support was not feasible
Mbuabaw <i>et al</i> , 2011 <sup>38</sup>	Facilitators were from diverse locations and had expertise in systematic reviews and meta-analyses as well as content expertise.	Systematic reviews and meta-analysis; asking answerable questions, searching and selecting studies, data extraction, the Cochrane collaboration and library, interpretation of systematic reviews, searching for reviews, overview of systematic reviews on health systems and organisation of care, finalising a review, publishing challenges and tips.	No	Not reported

\*Union/MSF is the precursor to the SORT-IT intervention. LMICs, low-income and middle-income countries; MPH, Master of Public Health; MS, Master of Science; MSF, Médecins Sans Frontières; NGO, Non-governmental organisation.

**Table 3** Information about attendance, evaluation method and outcome measures, and results for the 20 writing and publishing interventions in the analytical sample

Intervention name	Attendance and completion of programme	Evaluation method and outcome measures for writing and publishing components (including length of follow-up, if available)	Results (writing and publishing components only)
<b>PUBLICATIONS REPORTED INTERVENTIONS</b> (Interventions that Reported Submissions and/or Publications)			
Thakurdesai <i>et al</i> , 2018 <sup>17</sup> (eJChIndia; Electronic Journal Club India)	Not tracked	# e-conversations; # published papers and paper critiques; ongoing	Approximately 20 papers published by group members on journal club critiques; 3193 conversations (for example, journal club discussions) recorded as of April 2018.
Klinkenberg <i>et al</i> , 2014 <sup>18</sup> (Ethiopian Operational Research Initiative)	Not reported	# published papers within first 2 years	6 published papers
Kramer and Libhaber, 2016, <sup>35</sup> Kramer and Libhaber, 2018 <sup>27</sup>	Writing retreats in 2010 and 2011 attended by 8–10 participants; In 2012, 18 retreats held, 14 retreats held in 2013, and 12 retreats held in 2014.	Follow-up period not reported: # published papers pre/post; cost of writing a published paper; participant feedback on programme quality.	Publications in Witwatersrand Faculty of Health Sciences more than doubled from approximately 400/year in 2008 to 1026/year in 2016; eight papers submitted after each retreat in 2010 and 2011; after 2012 retreat, 186 papers from 18 groups submitted; 92 papers submitted from 14 groups who attended 2013 retreats; in 2014, 12 retreat groups produced 38 articles; positive assessment of writing courses including feeling inspired, having 'good direction,' gaining more confidence.
Ganju <i>et al</i> , 2018 <sup>36</sup> (Knowledge Network)	110 participants trained in 6 workshops from 2010 to 2015; no drop-outs reported for 3 workshops in 2010–2013.	10 years follow-up: # manuscripts and publications; relevance and impact of publications; post-programme participant self-assessment survey (quantitative and qualitative measures).	67 papers coauthored by mentees (publication status not specified); two-thirds of 95 published papers coauthored by programme-supported mentees; participants reported improvements in writing and publication skills and knowledge of research and scientific publication process.
Memiah <i>et al</i> , 2018 <sup>28</sup>	Not reported	Follow-up at 3 months: participant feedback on programme quality; # publications.	4 manuscripts published; evaluation data from writing portion not presented
Mathai <i>et al</i> , 2019 <sup>29</sup>	Not reported	3 years follow-up: # submissions; # publications; participant feedback on programme quality.	16 trainees submitted 18 manuscripts for publication in peer-reviewed journals, 13 were accepted for publication; participants described greater facility with literature search process as result of programme.
Kempker <i>et al</i> , 2018 <sup>30</sup>	Of 20 'long-term' trainees, 19 (95%) completed at least 2 years of formal research training.	One-year follow-up: # publications; # and % of participants that published; author position; career development metrics.	65 peer-reviewed publications by trainees since entering Fogarty training; among 20 trainees, 15 (75%) authored or coauthored at least one peer-reviewed publication after starting programme; median number of peer-reviewed publications per trainee was six (IQR 2–14); among 15 trainees with a publication, this was 13 (IQR 4–15).
da Silva <i>et al</i> , 2019 <sup>31</sup> ; Gureje <i>et al</i> , 2019 <sup>32</sup> ; (PAM-D; Partnership for Mental Health Development in Africa); Supporting papers: Schneider <i>et al</i> , 2016 <sup>53</sup> ; Pilowsky <i>et al</i> , 2016 <sup>54</sup>	11 (85%) of 13 completed 4-day writing workshop, 14 participated in biostatistics and writing workshop (attendance not reported).	2-year follow-up: # publications and # submissions; authorship position; participant feedback on programme quality.	At end of capacity strengthening activities at 5 Hubs, 60 articles published; trainees were first authors on 21 of 60 papers.
Fatima <i>et al</i> , 2019 <sup>32</sup> (SORT-IT; Structured Operational Research Training Initiative in Pakistan); Supporting paper: Ramsay <i>et al</i> 2014 <sup>45</sup>	18/34 (78%) completed course	Tracked papers submitted and published	As of June 2018 (2 years after programme began), 18 papers submitted, 15 papers published

Continued



**Table 3** Continued

Intervention name	Attendance and completion of programme	Evaluation method and outcome measures for writing and publishing components (including length of follow-up, if available)	Results (writing and publishing components only)
Guillerm <i>et al.</i> , 2014 <sup>33</sup> ; (SORT-IT; Structured Operational Research Training Initiative); Supporting paper: Bissell <i>et al.</i> , 2012 <sup>37</sup>	83/93 (89%) of participants completed 7 days course.	13-month follow-up questionnaire (76 of 93 respondents completed); % participants completing research projects; % published papers; % peer reviewers; % mentoring OR courses; % received new funding for operational research projects.	After median follow-up time of 13 months, 62% of participants completed further research projects and 50% published papers beyond course; nearly 40% were peer-reviewers for journals; 1/3 obtained new funding for operational research.
Zachariah <i>et al.</i> , 2016 <sup>34</sup> ; (SORT-IT; Structured Operational Research Training Initiative in 64 LMICs); Supporting paper: Ramsay <i>et al.</i> , 2014 <sup>45</sup>	90% of participants completed programme (including submitting publication to peer-reviewed journal).	13 months follow-up: # publications; # manuscripts; % of participants who became facilitators.	197 papers published or in press within 13 months of the start of the programme. Of 213 participants who achieved successful course completion, 41 (19%) became new facilitators of subsequent courses.
Goel <i>et al.</i> , 2018 <sup>19</sup> (SORT-IT; Structured Operational Research Training Initiative adapted for Tobacco Control)	14 of 14 attended entire 5.5 day programme	1-year follow-up: # publications; # submissions; # manuscripts; participant feedback on programme quality; cost of writing intervention.	One year after course, participants submitted four papers to peer-reviewed journal, one was published and two in press; participants reviewed course favourably
Kumar <i>et al.</i> , 2013 <sup>30</sup> (Union/MSF Operational Research Training* adapted for Nepal); Supporting paper: Bissell <i>et al.</i> , 2012 <sup>37</sup>	11/12 (92%) of participants completed 5 day programme	# submissions within 3 weeks of programme	Each participant submitted at least one manuscript to peer-reviewed journal
Odhiambo <i>et al.</i> , 2017 <sup>21</sup> (IORT (Intermediate Operational Research Training Programme; adapted from SORT-IT for Rwanda)	9/10 participants completed the course attending all sessions.	# publications per funded project assessed after 3 years (2013–2016)	5 papers published (one for each project funded)
<b>OTHER INTERVENTIONS</b> (Interventions that Did Not Report Submissions and /or Publications)			
Merritt <i>et al.</i> , 2019 <sup>22</sup> (ACES; Academic Competencies Series)	12 of 16 (75%) eligible people attended 5 days writing workshop.	Not reported	Not reported
Usher <i>et al.</i> , 2015 <sup>23</sup> (APEDNN; Asia Pacific Emergency and Disaster Nursing Network)	All participants travelled to the 3-week workshop.	Post course quantitative and qualitative survey; participant feedback on programme quality.	None specifically related to writing intervention; some evaluation comments discussed issues related to writing publications, such as conducting literature reviews and searching databases.
Atindehou <i>et al.</i> , 2019 <sup>24</sup> (MooSciTIC: A shot of science!)	Year 1: 18/25 (72%) participants attended; year 2 16/28 (57%), and year 3 23/27 (85%); completion not reported.	Participant feedback and 1 year delayed feedback on programme quality; year three self-assessment survey of programme impact: (efficiency and quality in research publication; improved student supervision; reuse of teaching materials).	Overall, participants rated intervention well; participants especially liked scientific communication and bibliography topics; 70% reported increased efficiency and quality in research publication, 60% reported improved student supervision, 40% reused teaching materials to train students and/or fellow scientists.
Varadaraj <i>et al.</i> , 2019 <sup>25</sup> ; Varadaraj <i>et al.</i> , 2016 <sup>55</sup>	Not reported	Pre and 2-month follow-up post-programme participant survey; participant feedback on programme quality; % understood how to write a literature review; % understood how to write a research paper; participant self-assessment; % feel that mentor is important.	86% of participants agreed or strongly agreed that they understood how to conduct a literature review and over 90% agreed or strongly agreed that they understood how to write a research paper. 91% believed mentor is important.
Harries <i>et al.</i> , 2003 <sup>26</sup>	25 began training and 17 (68%) attended 1-day workshop (½ day on writing); 11 (65%) turned in paper within 2 months of workshop.	2-month follow-up: # papers turned in; assessment of participant manuscripts by national TB programme facilitators.	Of 11 papers turned in to course organisers, article reported that five were well written.

Continued

**Table 3** Continued

Intervention name	Attendance and completion of programme	Evaluation method and outcome measures for writing and publishing components (including length of follow-up, if available)	Results (writing and publishing components only)
Mbuagbaw <i>et al</i> , 2011 <sup>36</sup>	Not reported	Follow-up period not reported; participant feedback on programme quality	Quality of lectures: all indicated good or excellent; quality of examples: all rated good or excellent; quality of reading material: all rated good or excellent; pace of course: 1/12 indicated satisfactory, 7/12 indicated good and 4/12 indicated excellent; amount of material covered: all rated good or excellent.

\*Union/MSF is the pre-cursor to the SORT-IT intervention. LMICs, low-income and middle-income countries; MSF, Médecins Sans Frontières; TB, tuberculosis.

writing and the importance of having a mentor, but did not include any questions tracking participant success with publishing articles.

Papers describing five interventions (5/14) in the Publications Reported group and four (4/6) in the Other Interventions group mentioned gathering participant feedback on the quality of the programme.

Ten of the 13 interventions in our Publications Reported group provided attendance and/or completion data for their programme, while 4 of the 6 Other Interventions reported attendance and/or completion data.

Two of the 14 Publications Reported interventions (and none of the Other Interventions group) reported the cost of the writing and publishing intervention. The Health Sciences Research Office of the University of Witwatersrand, Johannesburg, South Africa reported the cost of generating one publication via a writing retreat to be US\$255, compared with the institutional subsidy of US\$11 000 per publication that the University receives.<sup>27</sup>

The adapted 5.5-day Union-MSF (Médecins Sans Frontières) Operational Research Course provided to India's National Tobacco Control Programme yielded publications and reported a cost of US\$140 per participant.<sup>19</sup>

**Overall sample: instructor characteristics**

Of those who reported instructor information, seven (7/16) were led by a blend of instructors and facilitators/mentors from LMICs and HICs (table 2), three of which started with international instructors and shifted to local experts. Seven (7/16) interventions drew exclusively on local instructors, two (2/16) interventions were taught by HIC instructors only, and four (4/20) did not specify instructor affiliations.

**Overall sample: challenges**

The most frequently cited challenges related to mentoring (9/20). Specific challenges included recruiting enough qualified mentors<sup>19 20 21 30 31 34 36</sup>, and cost and communication barriers<sup>21 23 26 27 30 31</sup> (technology, infrastructure, and language across cultures and nationalities). The slow pace of developing a pipeline of mentors (eventually from programme participants) was also mentioned.<sup>34</sup> Poor long-distance communication and spotty connectivity for remote learning were major concerns<sup>18 22 26 29 31 33 34 37 38</sup> (8/20) as well. Additionally, the cost of open access publishing and accessing literature was a concern<sup>20 21 32 33 34 37</sup> (5/20). Time was a frequently cited challenge (4/20)<sup>21 22 24 29</sup>; concerns about cost kept programmes short, yet participants and organizers cited a scarcity of time as an impact on logistics and the quality of the learning experience. Authors stated the need for paid protected time for participants and mentors.<sup>19 25 30 33 34 37</sup> An important related challenge involved recruiting and retaining women due to the amount and frequency of time away<sup>20 24 32 34</sup> (4/20). Some interventions involving HIC partnerships mentioned that unanticipated cultural factors were challenging<sup>25 31</sup> (2/20).

### Overall sample: lessons learnt

Many lessons were shared from these interventions. Writing and publishing interventions benefited when they had a large number of facilitators with a high ratio of mentors to participants for writing and publishing. Articles described several strategies to overcome the challenge of having too few qualified mentors and facilitators, especially those who are women. These strategies included pairing senior and junior facilitators, pairing faculty from HIC and LMICs, drawing on faculty in a country's diaspora, paying facilitators, and creating thematic groups of mentors and mentees. Train-the-trainer interventions, which develop and strengthen the skills of local intervention leaders, may also be helpful.

Planning and needs assessment can help to address time issues in writing interventions, which most importantly require ample protected (paid) time for writing and manuscript preparation. Other lessons learnt included the need to schedule time for people to work together and network, schedule workshop phases closer together to allow people to attend as they develop their draft paper, to arrange sessions to be cost effective for travellers and avoid wasted time by having staff onsite. Recommendations also included investing effort in the evaluation, using clearly defined measures with standard follow-up periods, and tracking outcomes.

The majority of these interventions were partnerships and collaborations. Many attributed their success to clear communication, respect for cultural differences, clearly defined roles, and a distribution of leadership.

### DISCUSSION

We conducted this systematic review to describe scientific writing and publishing interventions in LMICs and identify gaps in this literature to support capacity strengthening efforts. Research publications serve many critical purposes: they can inform health policy and health interventions, they are the currency for advancement in research careers, and they can enhance a country's credibility and influence.<sup>12 39</sup> Further, by publishing their scientific research, researchers in LMICs may advance professionally and thereby gain the funding and platform needed to set research priorities for their own country and region.<sup>12 40 41</sup> Without publications, what is often a substantial financial investment in the research may be wasted.<sup>42–45</sup>

We identified only 20 writing and publishing interventions in LMICs that described their activities, evaluations and outcome measures in enough detail to enable analysis. Among these, we highlighted the approaches of interventions that reported the number of submissions and/or publications as outcomes because they offered quantifiable metrics of success. Notable approaches implemented by this subset of 14 interventions included an intervention length of approximately 5 days and the provision of one-on-one mentorship during and after the main intervention to support writing and publication.

A study of mentorship at Makerere University College of Health Sciences in Uganda found that both mentors and mentees reported that lack of formal structure was a barrier to effective mentoring.<sup>46</sup> The formal structure of writing and publishing interventions may be an ideal setting for focused, mutually beneficial mentoring relationships between experienced faculty and junior researchers or trainees.

The mentorship component of these interventions overcomes writing and publishing barriers reported in the literature, including poor access to scientific writing instruction, inadequate writing skills, a lack of dedicated time and opportunity for scientific writing, and lack of support from more experienced researchers.<sup>41 44</sup> Several papers in our sample emphasised that their interventions benefited from a large number of facilitators with a high ratio of mentors to participants for writing and publishing.

The context in which interventions are implemented differs across settings, and writing and publishing interventions should be tailored to the preferences and needs of their intended participants. Needs assessments, which can help achieve this goal,<sup>47</sup> were conducted in nearly half of interventions across our sample, and it is possible in some cases that they were performed but not reported. Papers in this analysis reported learning key information from needs assessments including why participants were motivated to publish and participate in the intervention; the experience and skill level of participants; and specific barriers to writing and publishing that participants faced. It is also valuable to learn about the resources available to participants, like budget, technology and library access.<sup>44 48</sup> Needs assessments were reported less frequently in the Publications Reported group compared with the Other Interventions group; it is possible that reporting publications is related to conducting a needs assessment, but the mechanism by which these might be related is not clear. One of the Publications Reported interventions that did not report a needs assessment is the ongoing 'eJCIIndia' journal club in India.<sup>17</sup> A needs assessment may not be relevant for an ongoing journal club because the intervention can be modified as needs are identified across time, and because the group and their needs also likely change across time. Regardless, several papers identified the importance of conducting a needs assessment as part of the intervention planning process.

Our sample offered a rich collection of lessons learnt and suggestions for future interventions. Three lessons stood out: (1) the importance of keeping interventions short to allow researchers to balance work and family demands, (2) the value of a high ratio of mentors to mentees and (3) the need for plenty of time from senior researchers to provide detailed feedback on participants' writing. Another recurring theme was the need for a budget to support open access fees and for accessing articles behind a paywall, as well as the need for high-quality internet connectivity. Limited time, lack of mentorship,

and lack of a budget for open access fees, article access and technology infrastructure have been cited throughout the literature as barriers to publication.<sup>44 48</sup>

Though 64 articles were identified for inclusion in the analytical sample, 41 lacked sufficient detail about the content, structure and delivery of the intervention to allow for analysis. Future papers describing writing and publishing interventions should include details that will allow readers to understand and replicate an intervention. Key details include whether a needs assessment of scientific writing and publishing was conducted and how the findings informed programme design, length of the writing and publishing intervention, topics covered, whether one-on-one writing mentorship was provided, attendance and outcome measures. Articles should also include information about the residential affiliation of intervention leadership so that readers know whether leaders were local, from high-income countries, or if leadership transitioned from high-income countries to local leaders.

Careful evaluation that is contextualised to a group's goals and particular setting will help shape scientific understanding of the power of writing and publishing interventions to strengthen capacity. Ideally, such research will offer a range of strategies to support efforts across different regions.<sup>49</sup> In addition to providing details about the intervention's approach and evaluation, tracking quantifiable metrics such as number of submissions and/or publications post intervention may offer insight into whether and which components of an intervention may have been most effective. Further, allocating enough follow-up time (eg, 2–3 years after an intervention) to track publications will allow greater capture of this key outcome.

Questions that will help inform future writing and publishing interventions include whether one comprehensive training can make a lasting impact in supporting individuals in greater overall productivity, including number of publications, grant applications and professional promotions.

Additionally, it would be helpful to understand whether training local senior researchers to lead, facilitate and otherwise participate in author trainings additionally supports their own professional productivity and advancement and local capacity.<sup>50</sup> Finally, every intervention has a budget and reporting the cost of training a group of researchers can be helpful to others planning similar activities.

Writing and publishing a research paper occur in the later stages of the research process, building on a wide range of skills required to carry out research. These skills include the ability to search and understand the scientific literature in a given topic area, and to conceptualise and investigate a research question with an appropriate methodological approach. A research publication will not be successful unless these foundational skills are in place. Papers describing standalone writing and publishing interventions should describe the amount

of prior research training participants had entering the programme and interventions that are part of a broader research capacity programme should describe the research training that the programme provided.

### Limitations

Several limitations should be noted when interpreting our results. The analytical sample included five SORT-IT interventions<sup>19 21 32–34</sup> and one precursor to SORT-IT (Union/MSF operational research training<sup>20</sup>); this core programme was repeated across time and in various settings. We considered these as separate interventions with the assumption that if they were published as original research, they were distinct. There was, however, overlap.

We did not capture every writing and publishing intervention conducted in LMICs, only those that were indexed in the five databases we searched and also provided sufficient detail to qualify for inclusion in our sample. Additionally, we did not capture interventions that were conducted but not published.

Our classification of interventions as Publications Reported or Other was based on whether they reported as outcomes submitted and/or published papers. It is possible that participants in interventions that did not report submissions and/or publications published papers on their own, and this was not captured in our classification. Additionally, publication can easily take 2 years or more and papers published after an intervention's follow-up period were not included in our results.

Finally, our paper selection and data extraction process were subject to errors; for example, overlooking key details during data extraction. To minimise the risk of such errors, two authors independently reviewed papers at each stage, and a third author resolved any discrepancies.

### CONCLUSION

Writing and publishing interventions in LMICs are an underused opportunity for capacity strengthening and merit greater consideration in the health literature.<sup>51</sup> We offer this systematic review of existing scientific writing and publishing interventions with the hope that it provides a valuable resource for evidence-based and more integrative programme development, implementation and evaluation. We hope that this review stimulates the continued development of evidence-based writing and publication interventions to strengthen health research capacity in LMICs.

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**Contributors** ETA conceived the study and acts as the guarantor. CEB, ETA and CS developed the study methodology. EWA, ETA, CEB, MK, and CS collected and analysed study data. ETA, CEB, and EWA drafted the original text. All authors critically reviewed the approach and results and edited the manuscript text. All authors have read and agreed to the published version of the manuscript.

**Funding** Funding was provided by the Center for International Reproductive Health Training. We thank Joseph C. Kolars, MD, at the University of Michigan for his insightful feedback on our manuscript.

**Competing interests** ETA is the founder and editor-in-chief of the non-profit organisation PREPSS (Pre-Publication Support Service). PREPSS's work involves writing and publishing interventions in low-income and middle-income countries, which is the topic of this systematic review paper. Former and current employees of PREPSS include ETA, EWA, CEB and MK. YRS and TE are the principal investigator and managing director of CIRHT (Center for International Reproductive Health Training), respectively. CIRHT is a client of PREPSS. CIRHT and PREPSS's work and publications are not referred to or included in the manuscript.

**Patient consent for publication** Not applicable.

**Ethics approval** This study does not involve human participants.

**Provenance and peer review** Not commissioned; externally peer reviewed.

**Data availability statement** Data sharing not applicable as no datasets generated and/or analysed for this study.

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## Appendix

### Search Strategies

All searches were run from inception of the database to January 27 – 30, as noted. The filters used are identified for each database. The original PubMed search strategy translated and adapted to other databases using <http://sr-accelerator.com/#/polyglot> and the searcher's discretion.

#### Databases

- PubMed (PubMed.gov)
- Embase.com
- Global Health (EBSCOhost)
- Scopus (Elsevier)
- ERIC (ProQuest)

The final strategy used for each database is detailed below.

#### PubMed (27 January 2020)

(developing countries[mh] OR low- and middle-income countries[tiab] OR LMIC\*[tiab] OR Sub-Saharan Africa[tiab] OR Africa[mh] OR South Africa[tiab] OR Rwanda[tiab] OR Kenya[tiab] OR Nigeria[tiab] OR Asia[mh] OR South America[mh] OR Central America[mh]) AND (early career researchers[tiab] OR biomedical research[mh] OR health services research[mh] OR public health research[tiab] OR writing[mh] OR writing[tiab] OR publishing[mh] OR publishing[tiab]) AND (capacity building[mh] OR capacity building[tiab] OR training support[mh] OR training support[tiab]) N = 675

#### Embase (27 January 2020)

1. 'Africa'/exp OR 'Asia'/exp OR 'South America'/exp OR 'Central America'/exp OR 'Mexico'/exp OR 'Pacific Islands'/exp OR 'Sub-Saharan Africa':ab,ti OR 'South Africa'/exp OR 'lmic':ab,ti OR 'low- and middle-income countries':ab,ti OR 'lowest income group'/exp
2. 'medical education'/exp OR 'medical research' OR 'postgraduate education':ab,ti OR 'health sciences academics':ab,ti OR 'university hospital'/exp OR 'health program'/exp
3. 'capacity building'/exp OR 'intersectoral collaboration'/exp OR 'capacity building':ab,ti OR 'cooperation'/exp OR 'research capacity':ab,ti OR 'workload':ab,ti
4. #1 AND #2 AND #3
5. #4 AND ([article]/lim OR [article in press]/lim) N = 1481

#### Global Health (EBSCOhost) (30 January 2020)

1. (SU Africa OR Asia OR South America OR Central America OR Mexico OR TI ( Africa OR Asia OR South America OR Central America OR Mexico OR "Sub-Saharan Africa" OR Rwanda OR Kenya OR Nigeria OR "South Africa" OR "low- and middle-income countries" OR LMIC\* ) OR AB ( Africa OR Asia OR South America OR Central America OR Mexico OR "Sub-Saharan Africa" OR Rwanda OR Kenya OR Nigeria OR "South Africa" OR "low and middle-income countries" OR LMIC\* ))

2. ((medical research OR health services research ) OR TI ( "biomedical research" OR "health services research" OR "public health research" OR "research infrastructure") OR AB ( "biomedical research" OR "health services research" OR "public health research" OR "research infrastructure" ))
3. ((SU ( writing OR training ) OR TI ( "writing skills" OR "training support" OR "capacity building" OR "research capacity" OR "research support") OR AB ("writing skills" OR "training support" OR "capacity building" OR "research capacity" OR "research support"))
4. #1 AND #2 AND #3
5. #4 limited to Academic Journals N = 647

ERIC (ProQuest) (30 January 2020)

(su(developing countries OR global approach) OR ab("developing countries" OR "global approach" OR "low-and middle-income countries" OR LMIC\* OR Africa OR Asia OR "South America" OR "Central America" OR Mexico) OR ti("developing countries" OR "global approach" OR "low-and middle-income countries" OR LMIC\* OR Africa OR Asia OR "South America" OR "Central America" OR Mexico)) AND (su(public health OR medical research) OR ab("public health" OR "health services research" OR "medical research" OR "health care system") OR ti("public health" OR "health services research" OR "medical research" OR "health care system")) AND (su(capacity building OR institutional cooperation) OR ab("research capacity" OR "research capacity building" OR writing OR training) OR ti("research capacity" OR "research capacity building" OR writing OR training)) Limited by: Peer reviewed; Narrowed by: Source type: Scholarly Journals N = 27

Scopus Cited Reference Searching (30 January 2020)

PMIDs: 26055974, 27091342, 27102019, 30064479, 31391948 N = 34