

Available online at www.sciencedirect.com

Public Health

journal homepage: www.elsevier.com/puhe

Original Research

Cardiovascular disease research in the Arab world: a scoping review from seven Arab countries (2000–2018)



R. Ghandour^a, A. Husseini^a, A.M. Sibai^{b,*}, N.M.E. Abu-Rmeileh^a

^a Epidemiology Unit, Institute of Community and Public Health, Said Khoury Building for Development Studies, Birzeit University, Birzeit, Palestine

^b Department of Epidemiology and Population Health, Faculty of Health Sciences, American University of Beirut (AUB), Riad El Solh, Beirut, Lebanon

ARTICLE INFO

Article history:

Received 24 May 2018

Received in revised form

9 April 2019

Accepted 12 June 2019

Keywords:

Cardiovascular disease

Research output

Scoping review

Arab countries

ABSTRACT

Objectives: The objective of this study is to map cardiovascular disease (CVD) research productivity in Arab countries and identify gaps and opportunities that would inform future research agenda.

Study design: This is a scoping review.

Methods: A review of research output between January 2000 and December 2018 in seven Arab countries, selected to represent various economies and epidemiological transitions, was conducted. Data on quantity and quality, study design, setting and focus were extracted and analysed for trends by time and place.

Results: Over the study period, a total of 794 articles were published, with an average of 7.3 publications per million population. While time trends showed a 6-fold increase in the number of publications over the study period, a decreasing trend in mean journal impact factor was noted (from 2.3 in 2000 to 1.5 in 2018). Most studies (71%) were observational, 56% were conducted in medical facilities (hospitals or clinics) and most of the experimental studies (10%) were based in laboratory settings. Behavioural risk factors were addressed in 52% of the studies, and there was a dearth of studies examining associations with diet, physical inactivity or family history.

Conclusions: Findings from this review indicate gaps in robust methods and pertinent themes in CVD research in the Arab region. Greater attention should be paid to high-quality evidence and implementation research. Also, there is a need for a more targeted CVD research agenda that is responsive to local and regional health burden and needs.

© 2019 The Royal Society for Public Health. Published by Elsevier Ltd. All rights reserved.

* Corresponding author. Department of Epidemiology and Population Health, Faculty of Health Sciences, American University of Beirut (AUB), PO Box: 11-0236, Riad el Solh, Beirut, 1107-2020, Lebanon. Tel.: +961 1 350000x4640; fax: +961 1 744470.

E-mail address: am00@aub.edu.lb (A.M. Sibai).

<https://doi.org/10.1016/j.puhe.2019.06.007>

0033-3506/© 2019 The Royal Society for Public Health. Published by Elsevier Ltd. All rights reserved.

Introduction

Cardiovascular diseases (CVDs) are the leading cause of death worldwide. In 2015, 17.7 million people died from these diseases, mainly coronary heart disease and stroke, with more than 70% occurring in low- and middle-income countries (LMICs).¹ In 2015, the proportionate mortality rate for CVDs in the Eastern Mediterranean region was 34.1%.² Most CVD deaths are premature and preventable by targeting behavioural risk factors, including physical inactivity, unhealthy diet, tobacco use and harmful use of alcohol.¹ Epidemiological data have shown an increasing trend in the burden of CVD risk factors in LMICs.³

Health research is a tool to improve population health and should be based on health burden and local needs.^{4,5} Although evidence is accumulating on the rising burden of non-communicable disease (NCD) in general and CVDs in particular in LMICs, CVD research is not given enough attention from research agencies or funding organisations. This might be due to the simplistic dichotomy between developed and developing nations and between non-communicable and communicable diseases and the perceived belief that NCDs are mainly diseases of the affluent populations.⁶ While much effort has been invested in improvement of health service delivery in NCDs, less effort has been directed to improving NCD health research. The World Health Organization notes that ‘there is no health without research’ and emphasises the importance of strategic, evidence-informed approaches to health research, particularly for LMICs.⁷ Investment in research should go in parallel with investment in health to be able to provide high-quality evidence for health interventions.⁴ In the Arab region, health research is in its infancy and remains largely underutilised, with little evidence that knowledge produced is translated into programmes and policies. Research expenditure in the Arab region does not exceed 0.3% of its average gross domestic product (GDP).⁸ Several United Nations reports and academic reviews note the low research funding and productivity in the Arab countries (if not the lowest)⁹ and point to the scarcity of evidence when it comes to implementation.¹⁰

From another global perspective, and in a series published in *The Lancet* reflecting on ‘research value and research waste’, Chalmers et al. highlight the high expenditure spent on health and biomedical research, which does not necessarily address the core health needs of users of research.¹¹ They also note that funders have primary responsibility for reducing waste by demanding that proposals be justified by systematic reviews of existing evidence and by so-called ‘research-on-research’.¹¹ Drawing out data from a large scoping review ‘Mapping of NCD Research in selected Arab Countries’ in the Arab region,¹² we take a closer look at CVD research output, assess strengths and gaps in methods used and themes addressed and examine whether the knowledge produced reflects disease burden and meets population needs. Findings from this study have implications on funding allocation and CVD research agenda in the region.

Methods

This study is one of a series of research articles that have been published or are being planned from a 4-year (2012–2016) large scoping review project on NCD research in the Arab region. Arab countries are 22 countries sharing a common language, culture and demographic characteristics but with a wide range of variations and diversity in terms of social characteristics, ethnicities, political contexts and economic resources. These variations are reflected in a number of demographic, social and health indicators and have been echoed in health research funding and output.¹³ The overall aim of the scoping review was to identify research gaps, overlaps and opportunities, explore trends and characteristics of the knowledge produced and propose avenues that would support coordinated approaches for NCD research production in the region. The review followed the five-step framework suggested by Arksey and O’Malley.¹⁴ Scoping reviews are emerging evidence-mapping tools that allow examination of research output to highlight areas of alarming gaps for in-depth analysis. Owing to the scale of data that could be generated and the limited resources, the study was restricted to knowledge produced from seven Arab countries selected to include three LMICs (Palestine, Morocco and Sudan), two upper-middle-income countries (UMICs) (Lebanon and Iraq) and two high-income countries (HICs) (Kuwait and Bahrain), based on the World Bank GDP classification. These countries additionally reflect different epidemiological and demographic transition profiles in the region. After setting a search strategy with proper inclusion and exclusion criteria (see [Appendix 1](#)), a literature search was conducted electronically using PubMed for studies published from January 2000 until December 2013. Independent reviewers (four teams of two members each) screened the titles and abstracts of the articles and checked them against the inclusion criteria. The latter included any published article on NCD or NCD risk factors, addressing human health or health systems and conducted in any of the selected countries. Discordances were resolved by discussion among team members, and in case of disagreement, a third reviewer was consulted (A.M.S.).

Data extraction and analyses

The original search from 2000 to 2013 yielded a total of 7950 unique articles. These were screened for eligibility: 3466 were excluded after title and abstract screening and 708 were excluded after full-text reading. This generated a data set of 3776 NCD-related articles; of which, we retained 497 articles that addressed CVDs as an outcome and main focus of the article. Further details on the search strategy and methods have been published elsewhere.^{12,15} For the objectives of the present study, the search was extended until 2018. We identified a total of 846 CVD unique articles; of which, 503 were excluded following title and abstract screening and 46 based on the full-text review, generating an additional 297 CVD articles for the years 2014–2018. Hence, the final number of records included in this analysis totalled 794.

Data were extracted and entered using predefined Excel forms containing information on the country and year of publication, type of study (case report, case series, correlational studies, cross-sectional studies, case–control, cohort, randomised controlled studies, systematic review, reviews, commentaries, qualitative studies, laboratory studies, book chapters and mixed methods studies), study setting (population-based, hospital or clinic setting, laboratory-based and others for letters to editors, commentaries, reviews) and the journal impact factor (JIF). It also included factors that were addressed as exposures/interventions in the article (tobacco, physical inactivity, alcohol and substance abuse, obesity, diet, diabetes, hypertension, lipids, metabolic syndrome, family history, genetics in addition to social determinants of health). Data were extracted by independent reviewers, and all discrepancies were resolved by discussion until consensus.

Data were transferred from Excel to SPSS version 24 for analysis. Trends were identified and summarised using relevant statistical summaries. To eliminate the effect of population size, publications per million population (PPMP) was calculated for each country and for each GDP group. The trend in JIF over time was assessed using the mean for all countries combined and for individual countries. Study designs were grouped into broader categories: observational studies, interventional studies (population- and laboratory-based) and reviews. The study setting was analysed as population based, medical facility based and laboratory based. In addition, the articles were characterised as having a public health focus or orientation (as opposed to clinical) when the study was conducted in the community rather than in a clinical setting, when it focused on primary prevention rather than treatment (in the case of implementation research) and/or included recommendations/messages in the abstract guiding public health policymaking.

Results

Table 1 summarises the number of publications for each country and PPMP and contrasts the findings with country-specific CVD death rate per 100,000 population and

proportional mortality ratios.^{2,16} Overall, CVD publication rate was 7.3 PPMP in the seven countries combined. Variations were observed between different countries in general as well as between different GDP country groups. Kuwait had the highest rate with around 61.4 PPMP, followed by Lebanon (58.8 PPMP) and Bahrain (41.2 PPMP). The remaining countries had much lower rates: Palestine 12.2 PPMP, Morocco 4.2 PPMP, Iraq 2.2 PPMP and Sudan with only 1.3 PPMP. Based on GDP country classification, a clear trend was observed in the number of publications, with considerable contrast in PPMP between HICs and LMICs (55.9 and 3.2 PPMP, respectively). No clear correlation was observed between country-specific CVD death rates or proportionate mortality ratios and research output. Iraq and Sudan had the lowest PPMP and highest CVD death rates, whereas Kuwait and Lebanon had the highest PPMP and lowest CVD death rates.

Fig. 1 presents time trends in publication output and mean JIF over the years of the study. Number of publications tended to increase from 13 in 2000 to 77 in 2018, around a six-fold increase over the 19-year period. Concurrently, an overall decreasing trend was observed in JIF. Overall, close to 38% of the articles were published in non-ranked journals and journals with lower than one IF, and only 16% appeared in journals with IF higher than 3 (data not shown). Variations in JIF were observed across countries, being highest for Lebanon and lowest for Iraq. When stratified by country-income groups, UMICs showed the highest mean JIF (2), followed by HICs (1.8) and LMICs (1.4), with no significant differences between the three groups.

Study design and setting

A high proportion of the study designs were observational (70.8%), comprising, in descending order, cross-sectional studies (26.7%), follow-up and panel designs (20.8%), case-reports/case series/correlational studies (14%) and case–control studies (10.7%). In addition, there were experimental studies (13.7%) and reviews (11.5%); of which, only 2.0% were systematic reviews (Fig. 2a). Most of the experimental study designs were laboratory based (80%). Variations were observed across different countries. While observational studies were dominant in most countries, Kuwait was

Table 1 – Cardiovascular disease (CVD) publications and burden in selected Arab countries (2000–2018).

Country	No. of publications (%)	Average population (thousands) (2000–2018)	PPMP	CVD death Rate per 100,000 population (2015)	CVD proportionate mortality ratio (%) (2015)
Low- and middle-income countries	228 (29)		3.2		
Palestine	49 (6)	4029.5	12.2	395	44
Morocco	134 (17)	32,231.6	4.2	268	34
Sudan	45 (6)	33,963.2	1.3	502	12
Upper-middle-income countries	337 (42)		9.6		
Lebanon	269 (34)	45,72.1	58.8	252	47
Iraq	68 (9)	30,626.3	2.2	604	33
High-income countries	229 (29)		55.9		
Kuwait	183 (23)	2979.5	61.4	210	41
Bahrain	46 (6)	1117.6	41.2	414	26
Total	794 (100)		7.3		

PPMP, publications per million population.

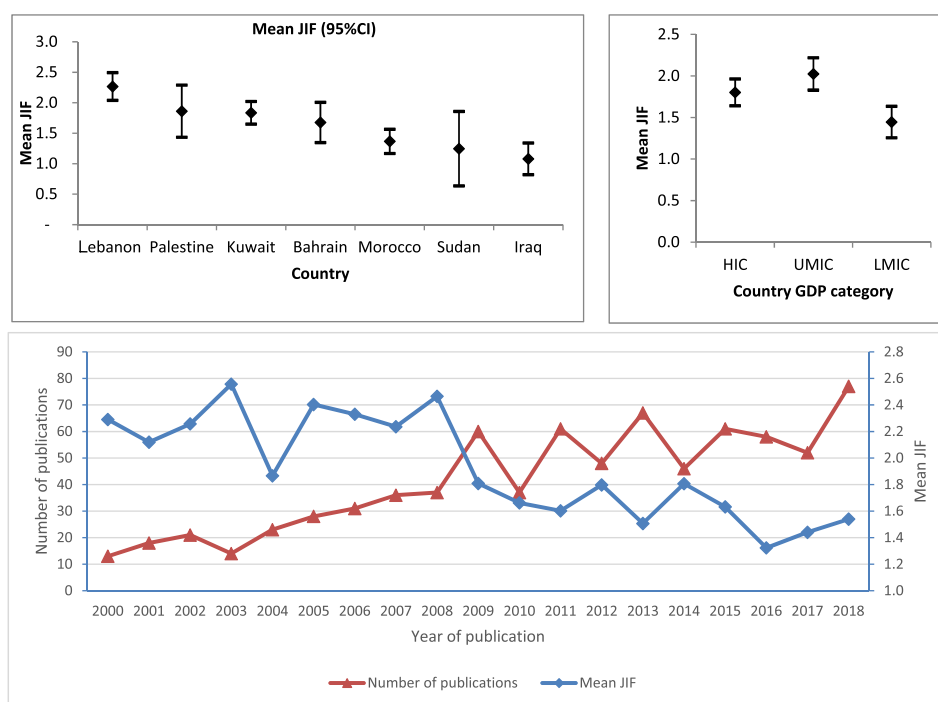


Fig. 1 – Trends in the annual number of cardiovascular disease publications and journal impact factor (JIF)^a by year in selected Arab countries (2000–2018). ^aCalculations excluded 3 articles of very high JIF, that were considered as outliers. CI, confidence interval; GDP, gross domestic product; HIC, high-income country; LMIC, low-to middle-income country; UMIC, upper middle-income country.

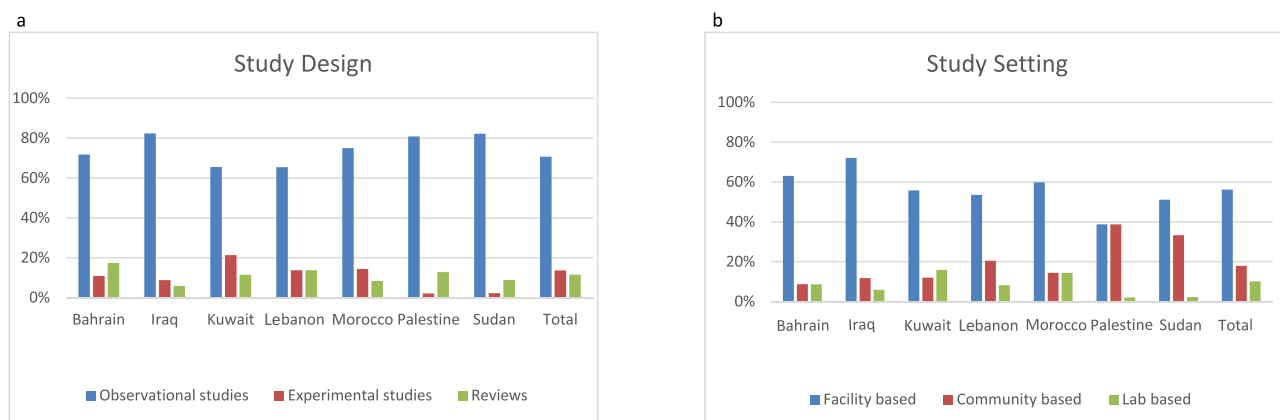


Fig. 2 – Distribution of cardiovascular disease publications by study design, study setting and country in selected Arab countries (2000–2018). ^aPercentages for each country do not add to 100% as the presentations excluded 'other' category (e.g. commentaries, letter to editor, book chapters).

characterised by a relatively high proportion of studies which are laboratory-based and Bahrain by studies which are systematic reviews, possibly owing, respectively, to the Kuwait Institute for Scientific Research (founded in 1967) and to the establishment of the Cochrane Center in Bahrain in 2005.¹⁷ The most common study setting was the hospital or the clinic (around 56.2%) across all countries. Community-based studies featured in 17.9% of the articles combined but appeared most in Palestine (38.8%) and least in Bahrain, Iraq, Kuwait and Morocco (range 8.7–14.4%).

Risk factors and public health orientation

Risk factors burden for CVDs is important to plan and design prevention interventions. In the publications identified in this review, 66% of the articles addressed metabolic risk factors including diabetes mellitus, hypertension, obesity and/or lipids with varying levels: 40%, 39%, 25% and 24%, respectively. With respect to the behavioural risk factors, publications were most likely to be examining tobacco use in relation to CVD (27%), with the negligible representation of

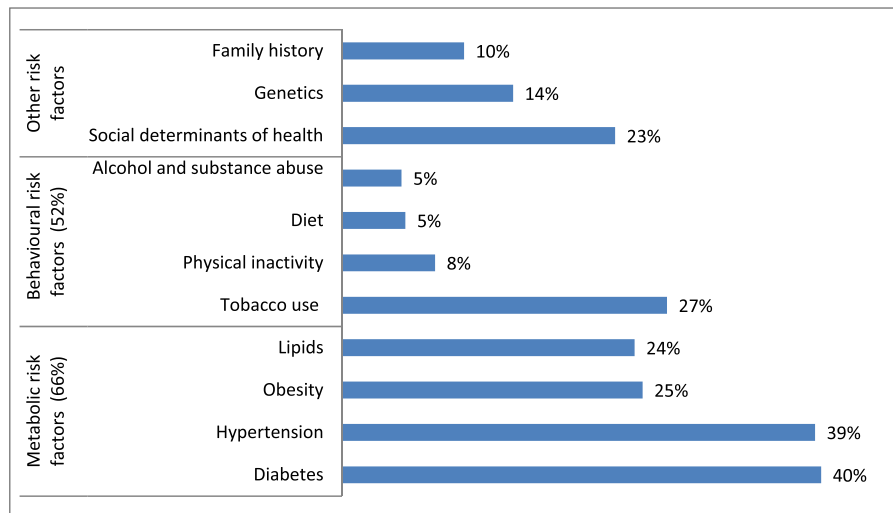


Fig. 3 – Risk factors addressed in cardiovascular disease publications in selected Arab countries (2000–2018).

physical inactivity, diet and substance abuse. Some studies examined social determinants of health (23%), genetics (14%) and several others associated findings with genetics and family history (10–14%) (Fig. 3). During further examination of the articles, we found that 34% included messages with a public health angle; however, there were wide variations across countries, the highest percentage being observed in Palestine (62%), followed by Sudan (40%), Kuwait (38%), Lebanon (37%), Iraq (27%), Bahrain (25%) and Morocco (20%) (data not shown).

Discussion

Although study findings revealed a relatively steady increase in CVD research output in Arab countries between 2000 and 2018, this remains modest and did not exceed 7.3 PPMP over the entire 19-year study period. This is important as these are countries where chronic diseases are emerging to constitute the leading causes of morbidity and mortality. In 2010, and according to the Global Burden of Disease Study, ischaemic heart disease and stroke were among the top five leading causes of death in Arab countries regardless of their income category.¹⁰ In a recent bibliometric analysis conducted in the Middle Eastern region (including Arab countries), Al-Kindi et al. underscored the scarcity of CVD research in comparison to disease burden, noting that over a 10-year period (2003–2012), Middle Eastern countries had contributed to only 3% of the global publication on CVDs.¹⁸ Furthermore, findings from this review identified gaps in analytic research addressing established risk factors for CVD. Despite their high prevalence in the region and the various genetic mix of the Arab population, physical inactivity, unhealthy dietary habits and family history and their association with CVD remain understudied areas.

The scarcity of evidence on CVDs and associated risk factors has been documented in other Arab countries. In their recent systematic review of the prevalence of CVDs and

associated factors in the Gulf Region, Aljefree and Ahmed¹⁹ note that, despite the high burden of CVD risk factors, well-designed population-based nationally representative surveys are largely lacking. Although evidence related to actions and control CVDs has been mounting globally, there is a dearth of locally driven evidence and high-quality research in Arab countries.¹³ Regional and local evidence aid governments in decision-making and in developing strategies to combat the rising burden of CVDs and CVD risk factors. Good quality research focussing on context-specific multifactorial roots of CVDs is essential to identify priority agenda for CVD prevention and control.

While the number of publications increased over time, intercountry variations were observed and were highly associated with the overall economic development of the country, corroborating findings from the global and western literature on CVD.^{4,20} Disparities in publication rates across countries might be linked to availability of institutional and individual resources as well as funding opportunities.^{4,18,20} Geopolitical factors may also play a role, with the ongoing conflicts in some study countries such as Iraq, Sudan and Palestine, limiting the conduct of research. Other reasons might be related to low interest in CVD research among local researchers and research centres, notably in low-income countries, such as Sudan, and other countries still struggling with the burden of communicable diseases. In addition, some research studies might be conducted at the local level or conducted by non-research agencies that primarily aim at improving services and hence are less likely to appear in scientific journals.⁶

Some challenges in producing high-quality research include presenting the appropriate research questions based on available evidence, selecting the proper study design, setting the right analytical strategy and conducting the research in settings that would make findings informative and useful for policy formulation and programme implementation. Rahim et al.¹⁰ argue that, in the Arab region, there is a dearth of implementation research that

evaluates knowledge tested in the West with the objective of improving health policies, programmes and quality of care in context-specific clinical and population-based localities. Community-based intervention studies are important in the planning and evaluation of public health intervention programmes, especially those related to lifestyle modification and prevention of behavioural risk factors.²¹ In this review, we found only a small proportion of studies that were population based (around 18%). One exception to this was in Palestine where community-based research approached 40%. This is likely to be linked to the developed community-based organisations that were historically important and established before the beginning of the 21st century and the relative scarcity of Palestinian research expertise in health facilities, which remain exclusively service oriented. Also, studies were mostly observational, with limited qualitative or mixed-methods designs that would bring out the strengths of both quantitative and qualitative methods, and provide a better understanding of the determinants and underlying factors of the burden of disease. Similar observations were made in a recent bibliometric analysis of CVDs research in Saudi Arabia. Saquib et al.²² note that, despite the overall increase in research productivity overtime, there remains a relative scarcity of high-level evidence output using hypothesis testing study designs, notably experimental study design, and studies with sufficient sample size that would allow better estimate precision and enhanced generalisability. Chalmers and Glasziou²³ note that around 85% of research funding is being wasted in various stages of the research process, starting with selecting the right research question, followed by methods and design, quality of evidence generated and reporting the evidence through publication. One of the tools to avoid waste is to conduct systematic reviews and identify gaps in the knowledge that would set the stage of the significance of new study proposals and avoid duplication.²³ The relative dearth of systematic reviews in our study raises concerns towards research waste in countries already burdened with limited resources.

Most of the CVD publications in this review were published in relatively low impact factor journals, with the lowest being noted in publications from LMICs, including Sudan and Iraq. The overall decreasing trend in JIF over the study period may reflect academic reward systems that incentivise quantity over quality and push researchers to prodigiously publish, with secondary consideration to academic rigour.²⁴ Alternatively, it may be due to unsuspecting academics falling into the trap of the worldwide trend of mushrooming low-quality and predatory journals. Notwithstanding the limitations of JIF,²⁵ further research is needed to better understand the reasons why variations exist in research quality across countries and whether this is driven by availability of governmental and institutional resources and policies (e.g. research and development spending, university promotion guidelines, library resources) or related to individual capacities of the researchers (e.g. country of higher education).

Findings from this study need to be interpreted considering certain limitations. This search was limited to PubMed, a publicly accessible database with free full-text

articles and good powerful citation analysis, and to articles where CVD is the focus. This is likely to underestimate research productivity in this area and to exclude reports published in regional journals and others that are not indexed in PubMed. Also, we surveyed reports in only 7 of the 22 countries in the Arab region. However, countries were selected to represent a range of geographic regions, GDPs and demographic and epidemiological transitions, thus providing a reasonable representation of the Arab region.¹² Also, our search was systematic and is reproducible, our results are internally consistent and our comparative assessments between countries and across time in this article remain valid to conclude.

Conclusion

This scoping review provides an overview of the research activity related to CVDs in seven Arab countries. Most of the evidence came from observational studies; mostly facility-based and published in low JIF journals. Some risk factors pertinent to the region were not sufficiently addressed, and intervention studies and health system and implementation research were scarce if any. While further review studies are needed covering a wider scope of databases and more countries from the region, ways to improve research output in quantity and quality are crucial. Funding bodies should consider research priorities and needs in specific areas and support studies that provide strong evidence to improve investments in health. This can be further improved by political will and support from policymakers. We need a research community integrated and connected to the available health system, to be able to provide timely evidence that can feed in the decision-making process and reflect the health needs of the community. A targeted and robust regional and country-specific research agenda is needed, taking into consideration local contexts and conditions.

Author statements

Acknowledgements

The authors acknowledge the foundational work of the NCD Scoping Review Working Group (2000–2013) at the Faculty of Health Sciences, American University of Beirut (AUB): Saw-san Abdulrahim, Samer Jabbour, Farah Naja, Shadi Saleh, Abla Mehio Sibai (PI) and Soha Yazbek. The authors thank the graduate students and research assistants who contributed to data extraction, noting in particular Anthony Rizk. The authors are also grateful for the voluntary work of Master in Public Health students, Jida Al-Mulki, Fatima Al Zahraa Chokor, Fatima Mouzahem and Ramy Warrak, in updating the review from 2014 until 2018. The authors thank the librarian staff at Saab Medical Library-AUB for assisting all through the data search, data identification and data access.

Ethical approval

Not applicable.

Funding

The original project was funded by the International Development Research Centre, Canada (grant reference number is 106981-00).

Competing interests

The authors declare that they have no competing interests.

Author contribution

R.G. conducted the analysis and wrote the first draft. A.M.S. contributed to the study design and search strategy, discussed the results and commented on different drafts. She additionally led the updates made to the review until 2018 and contributed substantially to the required revisions in the manuscript. A.H. and N.M.E.A.-R. contributed to the analysis plan, discussed the results and commented on different drafts. All authors read and approved the final manuscript.

Availability of data and material

Data will be available on e-mailing the corresponding author at: am00@aub.edu.lb.

REFERENCES

1. WHO. *Cardiovascular diseases (CVDs)* [fact sheet]. WHO; 2015 [updated January 2015; cited 2016 April, 17]; Available from: <http://www.who.int/mediacentre/factsheets/fs317/en/>.
2. Mokdad AH. Burden of cardiovascular diseases in the eastern mediterranean region, 1990–2015: findings from the global burden of disease 2015 study. *Int J Public Health* 2018;63(Suppl 1):137–49.
3. Uthman OA, Hartley L, Rees K, Taylor F, Ebrahim S, Clarke A. Multiple risk factor interventions for primary prevention of cardiovascular disease in LMIC: a Cochrane review. *Global Heart* 2017;12(3):199–208.
4. Huffman MD, Baldrige A, Bloomfield GS, Colantonio LD, Prabhakaran P, Ajay VS, et al. Global cardiovascular research output, citations, and collaborations: a time-trend, bibliometric analysis (1999–2008). *PLoS One* 2013;8:e83440.
5. Bloomfield GS, Baldrige A, Agarwal A, Huffman MD, Colantonio LD, Bahiru E, et al. Disparities in cardiovascular research output and citations from 52 African countries: a time-trend, bibliometric analysis (1999–2008). *J Am Heart Assoc* 2015;4.
6. Hofman K, Ryce A, Prudhomme W, Kotzin S. Reporting of non-communicable disease research in low- and middle-income countries: a pilot bibliometric analysis. *J Med Libr Assoc : JMLA*. 2006;94:415–20.
7. Editors PM. The world health report 2012 that wasn't. *PLoS Med* 2012;9:e1001317.
8. UNDP. *Arab knowledge Report 2009: towards productive intercommunication for knowledge*. Mohammed bin Rashid Al Maktoum Foundation and the United Nations Development Programme Dubai; 2009.
9. Sibai AM, Rizk A, Costanian C, Beard JR. Landscape of research on older adults' health in the Arab region: is it demography-driven or development-dependent? *J Gerontol B Psychol Sci Soc Sci* 2017;72(4):608–87.
10. Abdul Rahim HF, Sibai AM, Khader Y, Hwalla N, Fadhil I, Alsiyabi H, et al. Non-communicable diseases in the Arab world. *The Lancet* 2014;383:356–67.
11. Chalmers I, Bracken MB, Djulbegovic B, Garattini S, Grant J, Gülmezoglu AM, et al. How to increase value and reduce waste when research priorities are set. *The Lancet* 2014;383:156–65.
12. Sibai AM, Singh NV, Jabbour S, Saleh S, Abdulrahim S, Naja F, et al. Does published research on non-communicable disease (NCD) in Arab countries reflect NCD disease burden? *PLoS One* 2017;12:e0178401.
13. Jabbour S, Giacaman R, Khawaja M, Nuwayhid I, Yamout R, editors. *Public health in the Arab world*. 1st ed. New York: Cambridge University Press; 2012.
14. Arksey H, O'Malley L. Scoping studies: towards a methodological framework. *Int J Soc Res Methodol* 2005;8:19–32.
15. Jamaluddine Z, Sibai AM, Othman S, Yazbek S. Mapping genetic research in non-communicable disease publications in selected Arab countries: first step towards a guided research agenda. *Health Res Policy Syst* 2016;14:81.
16. WHO. *Country health profile*. 2015 [cited 2017 May 29]; Available from: <http://www.emro.who.int/entity/statistics/country-health-profiles.html>.
17. Fedorowicz Z, Al Hajeri A. Bahrain branch of Cochrane collaboration: six years of achievement. *Bahrain Med Bull* 2011;33:56–8.
18. Al-Kindi S, Al-Juhaishi T, Haddad F, Taheri S, Abi Khalil C. Cardiovascular disease research activity in the Middle East: a bibliometric analysis. *Ther Adv Cardiovasc Dis* 2015;9:70–6.
19. Aljefree N, Ahmed F. Prevalence of cardiovascular disease and associated risk factors among adult population in the Gulf region: a systematic review. *Adv Public Health* 2015;2015:23.
20. Jahangir E, Comandé D, Rubinstein A. Cardiovascular disease research in Latin America: a comparative bibliometric analysis. *World J Cardiol* 2011;3:383–7.
21. Rabiei K, Kelishadi R, Sarrafzadegan N, Abedi HA, Alavi M, Heidari K, et al. Process evaluation of a community-based program for prevention and control of non-communicable disease in a developing country: the Isfahan Healthy Heart Program, Iran. *BMC Public Health* 2009;9:57.
22. Saquib N, Zaghoul MS, Mazrou A, Saquib J. Cardiovascular disease research in Saudi Arabia: a bibliometric analysis. *Scientometrics* 2017;112:111–40.
23. Chalmers I, Glasziou P. Avoidable waste in the production and reporting of research evidence. *The Lancet* 2009;374:86–9.
24. Hanafi S, Arvanitis R. *The broken cycle: Universities, research and society in the Arab region- Proposals for change*. ESCWA, IRD and the Lebanese National Council for Scientific Research (LCNRS); 2014. Available from: http://horizon.documentation.ird.fr/exl-doc/pleins_textes/divers14-04/010061071.pdf.
25. Garfield E. The history and meaning of the journal impact factor. *J Am Med Assoc* 2006;295:90–3.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.puhe.2019.06.007>.