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Research priorities for cardiometabolic syndrome in humanitarian settings: A global consensus-based agenda

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ABSTRACT

Non-communicable diseases (NCDs) are a leading cause of global morbidity and mortality. The burden of NCDs largely falls on low- and middle- income countries, where the majority of humanitarian crises fall. Already fragile health care systems in acute and protracted crisis settings struggle to meet the increasing needs of people living with NCDs. Cardio-Metabolic Syndrome (CMS), in particular, is of growing concern, with little evidence on effectively managing cardiovascular disease care in emergency settings. A strategy that begins with identifying clear research priorities to inform a collective and integrated CMS care in humanitarian preparedness and response is needed. This study aimed to generate consensus-based research priorities for the humanitarian sector targeting CMS care. This was done by adopting an adapted approach of the Child Health and Nutrition Research Initiative (CHNRI). Our findings highlight the need to prioritize models of care, including processes and outcomes, for people living with CMS and NCDs in humanitarian settings. They also highlight the importance of adopting integrated, multidisciplinary approaches that address research, interventions, and policies involving local and international stakeholders. Sustainable approaches that facilitate continuity of care and ensure integration within existing health care systems are needed to adequately address the growing global burden of CMS and NCDs. The ranked priority questions from this research priority setting exercise serve as guidance for advocacy and the deployment of funds for future research, interventions, and policies.

Introduction

Global demographic transitions and socio-economic advances, with trends such as population ageing, increased life expectancy, changes in lifestyle, and air pollution have led to shifts in the burden of disease and the increasing prevalence of non-communicable diseases (NCDs) (Gohardehi et al., 2020; Murakami et al., 2018; World Health Organization, 2024). NCDs are now the leading cause of morbidity and mortality, accounting for 74 % (41 million) of global deaths, with cardiovascular diseases (CVDs) in particular being an ever-growing concern (Aebischer Perone et al., 2017; World Health Organization, 2024; World Health Organization, 2023, World Health Organization, 2024).

Almost three-quarters of these deaths occur in low- and middle-income countries (LMICs). In addition to being disproportionally burdened by NCDs, LMICs also carry the greatest burden of humanitarian crises, which are often protracted (Asgary et al., 2022; Bausch et al., 2021). In these settings, existing health conditions worsen, and new diseases emerge due to prolonged stress, disruptions in food security, and poor and interrupted access to care (De Rubeis et al., 2021). This is compounded by the destruction of health care facilities and the prioritization of acute conditions and trauma treatments, all preventing proper access to NCD care (Alawa et al., 2019; Crocker et al., 2021; Nickerson et al., 2015). Managing NCDs in crisis settings exacerbates the strain on already fragile health systems, which are often unable to adapt and meet the requirements of the increased burden of both acute and

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chronic illnesses in host and refugee communities (Aebischer Perone et al., 2017; Bausch et al., 2021).

The United Nations Office of the High Commissioner for Refugees (UNHCR) reports that 108.4 million people have been forcibly displaced worldwide, including refugees, asylum seekers, people in need of international protection and internally displaced people with the majority (76 %) of refugees being hosted in LMICs in protracted displacement situations (UNHCR, 2024). In addition, the International Organization for Migration (IOM) reports 281 million migrants some of whom follow the same route as refugees and other displaced persons thus requiring humanitarian assistance (International Organization of Migration, 2024). There is increasing evidence of an exacerbated CVD burden as a result of exposure to armed conflict in humanitarian settings and refugee populations (Hayman et al., 2015; Jawad et al., 2019). Disaster exposure and forced displacement may lead to a surge in adverse CVD risk factors and outcomes, including hypertension, diabetes and dyslipidemia (De Rubeis et al., 2021; Hayman et al., 2015; Jawad et al., 2019; Nieto--Martínez et al., 2023; Ohira et al., 2017; Rosenthal et al., 2022). Yet, evidence guiding interventions on effectively managing CVD care in emergency settings remains limited (Sibai et al., 2020; Slama et al., 2017). Furthermore, while CVDs share common metabolic risk factors (hypertension, diabetes, obesity, and hyperlipidemia), studies and research questions in humanitarian settings have routinely focused on one risk factor at a time, mainly hypertension and diabetes (Hayman et al., 2015; Song and Lee, 2021). The clustering of cardiometabolic disorders and risk factors (American Heart Association, 2023; James et al., 2018) , known as cardiometabolic syndrome (CMS), has long been noted, and multidisciplinary integrated CVD care is advocated in a number of protocols and guidelines by humanitarian agencies (Jobanputra, 2018; United Nations Interagency Task force (UNITF) on the Prevention and Control of Non-Communicable Diseases 2016) and academic reviews (Aebischer Perone et al., 2017; Jobanputra et al., 2016) alike. Hence, a strategy that begins with identifying clear research priorities to inform a collective and integrated CMS care in humanitarian response is needed.

While there is no widely agreed-upon definition of CMS (American Heart Association, 2023; International Diabetes Federation, 2006; Kelli et al., 2015), most definitions are comparable. According to the International Diabetes Federation's new definition, CMS is characterized by central obesity (waist circumference with ethnicity-specific values), in addition to at least two of the following factors: high triglycerides, reduced HDL cholesterol, high blood pressure, and high fasting plasma glucose (International Diabetes Federation, 2006). This definition may create challenges in contexts where operationalized definitions of waist circumference across diverse geographies and population groups vary in defining a threshold for central obesity.

This study aimed to generate consensus-based research priorities for the humanitarian sector targeting CMS care. To achieve this, a collaborative consortium comprising researchers from the Faculty of Health Sciences at the American University of Beirut (AUB) and the International Rescue Committee (IRC) was established, and a Cardio Metabolic Syndrome (CMS) research priority setting (RPS) exercise was commissioned by Elrha for Health in Humanitarian Settings. In this paper, we provide a detailed description of the methods used, the research questions compiled, and our findings on the critical key research questions and research agenda necessary to advance and inspire quality research needed to inform and guide humanitarian response.

Material and methods

This RPS exercise took place from April 2022 to December 2023, utilizing an adapted approach of the Child Health and Nutrition Research Initiative (CHNRI) (Rudan et al., 2008). We describe below the methods for each of the eight steps presented in Box 1. One major adaptation of the original CHNRI approach is the engagement of a wider range of stakeholders (as detailed under steps 4 and 6) rather than a limited group of technical experts throughout these steps, in line with more recent priority setting exercises employing this approach (Frison et al., 2020; Rollins et al., 2014; Tomlinson et al., 2019).

This work was undertaken with the engagement of the Informal Inter Agency Working Group (IIAWG) on NCD members and the World Health Organization (WHO) NCD management unit to ensure uptake and utilization of these RPS findings.

Box 1
The CHNRI process entailed 8 steps

1: Selection of process managers
2: Selection of most relevant criteria
3: Specification of context in space, impact of interest and context in time
4: Sourcing of priority research questions (PRQs) by deploying a survey guided by evidence maps
5: Consolidation of PRQs into one overall list
6: Scoring of PRQs according to pre-selected criteria
7: Calculation of scores and ranking of PRQs
8: Feedback and revisions

Step 1: Selection of process managers

The co-authors were the process managers. A Steering Committee (SC) provided guidance on all steps of the NCD-CMS research prioritization exercise (NCD-CMS RPS), as well as advice on engagement and facilitating access to various groups of stakeholders. A Technical Subcommittee (TSC) was formed to provide methodological and technical expert guidance on the scope, context and predefined criteria of the exercise, and the adapted CHNRI approach. The team established diversity criteria to ensure a SC and TSC that is reflective of the community of people working on NCDs within humanitarian settings based on gender, country of origin, and role in humanitarian response such as global and national policy makers, people with lived experience of NCDs, academics and staff from local NGOs. The SC diversity metrics were: 1) At least 50 % of the members are female, 2) At least 70 % of the members are from LMICs, 3) At least 30 % of the members are working for organizations that implement programs for people living with NCDs within humanitarian settings. TSC were members of the Steering Committee who are highly technical on service delivery for NCDs in humanitarian settings, working on only NCDs.

Step 2: Selection of the most relevant criteria for the topic of interest

TSC members were invited to select the top three criteria deemed most relevant for scoring the list of PRQs and potential questions addressing each of the criteria and to make recommendations on the weighing of selected criteria. The process managers compiled a list of criteria and their definitions using the guidelines for the implementation of the CHNRI approach (Rudan 2008 et al.) which provide a list of examples of the possible criteria which can be used for setting priorities in health research investments and their description. They also searched the literature for other priority setting exercises that have used the CHNRI approach and retrieved the criteria that were used and their definitions.

Criteria that were most frequently identified by the TSC members were selected, and questions were subsequently developed on that basis, which were given equal weight (Box 2). The final list of criteria and respective questions on NCDs were shared with the IIAWG for further validation.

Box 2
Criteria to score the PRQs

Impact: Would the research lead to interventions and solutions that provide the maximum potential impact on CMS burden and severity in humanitarian settings by 2030? (e.g. morbidity, mortality, economic or social impact)
Effectiveness: Would the research lead to interventions and solutions that are effective for preventing or managing CMS in humanitarian settings?
Feasibility: Would the research lead to interventions and solutions that are feasible in humanitarian settings? Reflecting on resources (e.g., funding, time, skilled staff) and security considerations.
Deliverability: Would the research lead to interventions and solutions that are deliverable in humanitarian settings? Reflecting on 1) The health system environment: the health workforce, the socio-political governance for health in your setting, access to medicine and diagnostics, information systems and health financing, and 2) Users of the interventions (e.g., need for change of attitudes or beliefs, supervision, existing demand).

Step 3: Specification of context in space, impact of interest and context in time

With input from the TSC, we agreed on the following scope of research:

- Target populations – all countries and communities affected by or at risk of humanitarian crises (conflict, displacement, complex emergencies, natural disasters, acute/protracted emergencies, migrant populations)
- Geographical scope – global, regional, country and local levels
- Time scale – 2023 to 2033
- Outcomes of interest – any outcome of interest

Step 4: Sourcing of priority research questions by deploying a survey guided by evidence maps

We deployed a first survey guided by evidence maps to source PRQs between April and June 2023. Evidence maps served as background information to support participants in identifying relevant questions and research priorities for the next decade. The maps were developed using the results of the WHO-commissioned systematic review of research evidence on NCDs in humanitarian emergency settings (Ansbro et al., 2024). The evidence maps aimed to summarize current research evidence and guidance on NCDs in humanitarian emergency settings, including research on epidemiological burden, targeted interventions, and integration of NCDs into emergency preparedness and response globally. We included information on types of humanitarian settings where NCDs were studied, total number of published systematic reviews per NCD, types of affected populations, hosting countries, number of systematic reviews per year of publication and outcomes assessed. Guidance on how to develop and frame research questions was also added to the survey to facilitate the process for participants. Informed by the CHNRI approach and previously funded Elrha priority setting exercises, participants were asked to provide information about their profession(s), region(s) and/or country(ies) of work, and to include up to 5 research questions they consider to be a priority. Responses revealed a broad geographical representation of countries, so we regrouped them by region of work using the WHO regional classification as follows: African Region (AFR), Region of the Americas (AMR), South-East Asian Region (SEAR), European Region (EUR), Eastern Mediterranean Region (EMR), Western Pacific Region (WPR). The survey was pilot tested with the SC members.

A strong dissemination strategy was adopted for both surveys, using various forms of media, and the survey was made available in four languages (English, French, Spanish, and Arabic). The survey targeted various types of stakeholders conducting, supporting, or implementing programs or conducting research on NCDs in humanitarian settings. These included frontline health care workers, researchers in academic or non-academic settings, representatives of health professional bodies, donor/funding organizations, focal persons from Ministries of Health or other government-related health agencies, NCD patient representatives, health program managers and technical experts. The invitation emails to the surveys contained screening criteria on professional experience on NCDs specifically in humanitarian settings to which if targeted participants answered "Yes" they would proceed to the survey and for "No" responses they would be exited.

Step 5: Consolidation of PRQs into one overall list

We then reviewed the generated list of PRQs and excluded questions that were either not relevant to CMS or to humanitarian settings or were not actual questions. Those remaining were categorized according to a preliminary theme and the '4Ds framework' (description, delivery, development, and discovery) specified in the CHNRI approach (Gohardehi et al., 2020). Under the framework, 'description' research includes research questions that assess the burden of CMS and understand its determinants; 'delivery' research includes questions that allow the evaluation of already available interventions to optimize health status; 'development' research focuses on questions aiming at improving existing interventions to be more feasible, sustainable, effective, etc.; and 'discovery' research includes research questions that may lead to

innovation, and thus the development of entirely new interventions.

The sourced research questions were further consolidated in an iterative process of thematic analysis, where they were grouped according to recurrent themes and subthemes: burden and risk factors, outcomes of care (prevention and control, and treatment), processes of care (integrated care, continuity of care, task shifting/sharing, patient-centered approaches/client responsiveness, access to care), monitoring and evaluation/digital health, financing, diagnostic/tools, innovations, health systems structure (Supplementary Table A.1).

The categorization of research questions and their further consolidation using thematic analysis involved five team members. For every entry, two team members completed the task independently and in case of disagreement, the remaining team members were engaged in a discussion until agreement was reached.

The consolidation process led to a narrower list of research questions, which were further shared with the TSC for specific input on the formulation of questions, whether questions could be further consolidated, and to ensure none of the questions had already been answered before in humanitarian settings.

Step 6: Scoring of research questions according to pre-selected criteria

In line with the CHNRI approach and previously funded Elrha priority setting exercises, An online survey was deployed for six weeks between October and November 2023 to score the final list of research questions against the four pre-selected criteria. The same types of stakeholders conducting, supporting, implementing programs, or doing research on NCDs in a humanitarian setting were targeted.

Data on the country and region of work, profession, area of work focus, and gender were collected from each participant. This exercise did not involve any personal or otherwise sensitive data. All findings were anonymized, and individual responses to the questions were not presented. The survey was pilot tested with the TSC members.

Step 7: Calculation of scores and ranking of PRQs

As part of survey 2, each participant was invited to score all shortlisted 43 PRQs (consolidated from 694 initial responses) against the four pre-selected criteria by answering with "Yes" (1 point), "No" (0 points), "Undecided" (0.5 points), and "Don't know/Insufficiently informed" (no input). Specific questions were provided to help assess the likelihood that the proposed research options would satisfy each of the selected criteria. The answer to each criterion for all questions was made mandatory to ensure the scoring of all questions by all participants.

The results of the survey were exported into Excel for data cleaning. The results were analyzed using Statistical Package for the Social Sciences (SPSS), and a research priority score (RPSC) was computed for each criterion for every PRQ ranging from 0–100 %. From this, an overall RPSC was computed for each PRQ and calculated as the average of the scores of the four criteria. The RPSC was calculated for all responses, and then stratified by region of work, profession, and area of work focus. All criteria were equally weighted when calculating the overall score per question.

Calculation of average expert agreement (AEA)

The level of agreement or controversy between participants' answers for each research area was assessed by calculating the average expert agreement (AEA). The AEA is the proportion of scorers who gave the most common score (mode) for a question, divided by the total number of scorers who scored that question. The AEA method was chosen as the preferred approach in this study based on our review of previously published articles related to the CHNRI approach. AEA consistently emerged as the most logical and clearly articulated option. Its explanations were straightforward, and the results it produced were both comprehensible and easy to interpret, making it a practical choice for our analysis.

AEA is computed as follows:

$$\text{AEA} = \frac{1}{4} \text{ x } \sum_{q=1}^{4} \frac{\text{N (scorers who provided most frequent response)}}{\text{N (scorers who provided any response}} \text{ x } 100$$

where q is a criterion question that experts are asked to evaluate each PRQ area against.

The AEA is unaffected by 'undecided' responses and variances in the number of scorers for each survey question. In AEA computation all four possible responses are treated as valid, including 'don't know/insufficiently informed' to reflect all responses at the level of overall agreement.

Step 8: Feedback and revisions

As the scores were calculated and process managers reflected on the results, a validation meeting was held with the SC and TSC to disseminate the results of the RPS as well as get members' feedback on the interpretation of the results vis a vis their knowledge and experience implementing NCD programs and research in humanitarian settings. SC/TSC members' input on the results (Acknowledgements) is integrated in this manuscript.

Ethical approval

This research was approved by the American University of Beirut Institutional Review Board (SBS-2022-0245). Ethical approval was sought for both online surveys. Survey responses were anonymous, as no personal identifiers were required from participants. However, participants were asked at the end of survey 1 whether they were interested in taking part in the next survey and if so, they provided their email addresses, which were used to contact them during the second survey. Answers were de-linked from their email addresses. Given the anonymity of respondents, we were unable to link identifiers between surveys 1 and 2.

Results

Participants' characteristics

A total of 186 entries were received for survey 1. Four entries were removed as the participants declined to participate in the survey, thus 182 participants contributed data. There were 75 participants in total for survey 2. All surveys were completed in full as questions could not be skipped and participants were able to select more than one answer per category, and hence percentages do not add up to 100 %. Participants represented 58 and 33 different countries for surveys 1 and 2, respectively, revealing a broad geographical representation. Figs. 1 and 2 outline the characteristics of both survey participants by region of work using the WHO regional classifications, and profession. For surveys 1 and 2, more than half the participants worked in the AFR (61.0 % and 54.7 % respectively), followed by EMR (30.8 % and 46.7 % respectively). For both surveys, the largest percentage of participants were health care workers (47.8 % and 38.7 % respectively) followed by health programme managers/coordinators and researchers, followed by smaller percentages of technical experts and representatives of various bodies. For survey 2, 84 % of participants worked in health, 38.7 % in nutrition and food security, 32 % in education, WASH, protection, disability, shelter, early recovery and other areas, 18.7 % in mental health and psychosocial support and only 9.3 % in government leadership (data not shown). For survey 2, half of the sample were males, a third females, 14.7 % preferred not to say and 1.3 % identified of other gender (data not shown).

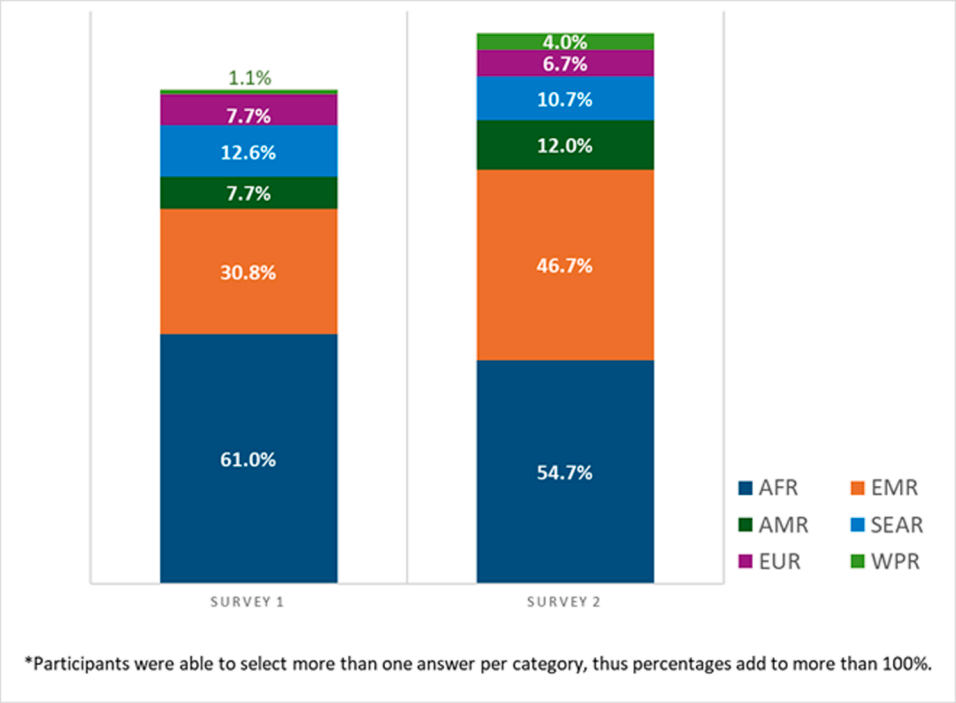

Fig. 1. Distribution of participants in prioritization exercise surveys 1 and 2 by region of work (as per WHO regions).

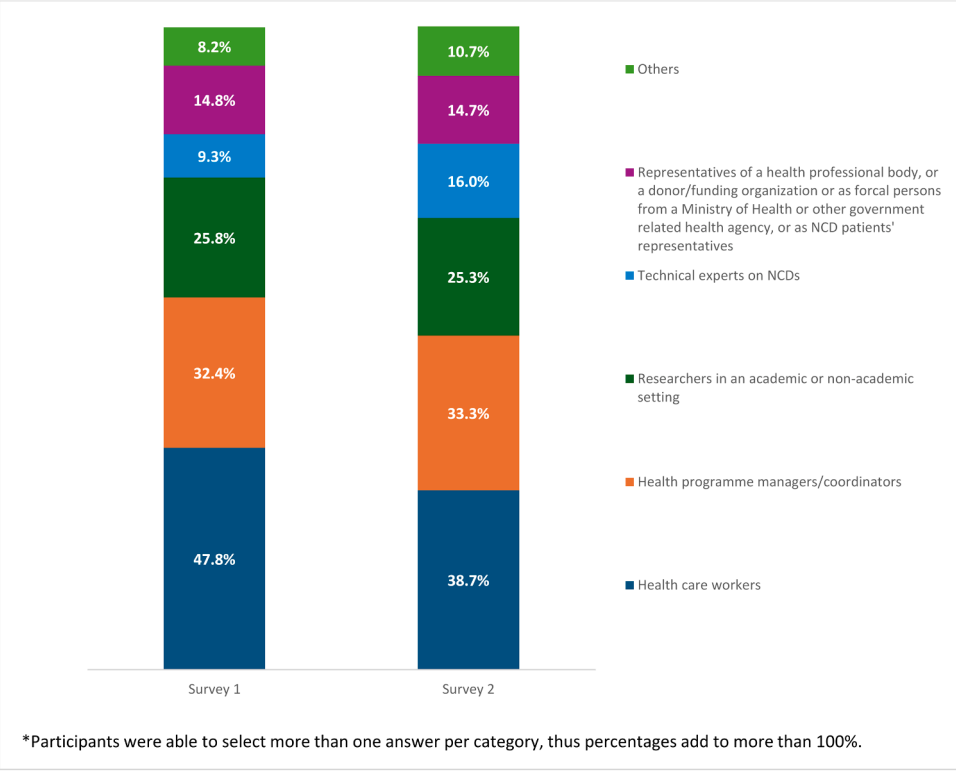

Fig. 2. Distribution of participants in prioritization exercise surveys 1 and 2 by profession.

Research priority questions scores

The 182 survey participants provided a list of 694 PRQs. We excluded 338 PRQs as they were not relevant to CMS (4.4 %) or to humanitarian settings (56.8 %) or were not actual questions (38.7 %). The remaining 356 relevant PRQs were further consolidated into a final list of 43 PRQs (Supplementary Fig. A.1).

Table 1 presents the frequency of distribution of PRQs by research theme.

Table 2 presents the number and percentage of priority research questions under each element of the 4D framework. While PRQs categorized under description represent around 35 % of questions, almost

Table 1
Frequency distribution of priority research questions per research theme/subtheme.

Research themes (and subthemes if applicable)	N
1. Burden and risk factors	**5**
2. Outcomes of care	**9**
2.1. Prevention and control	*3*
2.2. Treatment	*6*
3. Processes of care	**15**
3.1. Integrated care	*5*
3.2. Continuity of care	*2*
3.3. Task shifting/sharing	*3*
3.4. Patient-centered approaches/client responsiveness	*4*
3.5. Access to care	*1*
4. Monitoring & Evaluation / Digital Health	**3**
5. Financing	**3**
6. Diagnostics/tools	**3**
7. Innovations	**1**
8. Health system structure	**4**

Table 2
Number and percent of priority research questions by the 4Ds framework.

	Number of PRQ	Percent of total PRQ
Description	15	34.9
Delivery	20	46.5
Development	7	16.3
Discovery	1	2.3

half the PRQs fell under the delivery category and another 16 % under the development one.

Table 3 presents the list of 43 PRQs for the proposed CMS research agenda for 2021–2030, ranked according to the average criteria scores. The average score ranged from 92.88 % to 73.13 %. The AEA ranged between 81.67 % and 53.33 %, with an AEA range between 75 % and 81.67 % for the ten highest ranking questions, indicating a high-level of agreement between experts on the top priorities.

3. Further analysis by profession, region and area of work

The results of this RPS exercise are available in an online interactive data visualization tool hosted on Elrha's website (https://www.elrha.org/ncd). This tool enables users to interact with the data by average score and per criterion, as well as per region of work (as per WHO), profession, gender, and area of work. These stratifications might help interested stakeholders in identifying the highest priorities identified based on variables of interest.

Discussion

To our knowledge, this RPS exercise is the first of its kind as it studies CMS as a cluster of cardiometabolic disturbances (rather than each individual condition), and sheds light on CMS needs in crisis settings – an area of public health that has been previously underrecognized in global research and intervention. Given the lack of prioritization of NCDs within humanitarian contexts, this exercise makes the case for positioning them as a central concern moving forward, especially given the long-term implications of NCDs on global health. By identifying research gaps and collating stakeholder opinions on research priorities, this exercise has strong potential to influence research for future interventions in these contexts. It serves as a call to action for the implementation and funding of priority areas in addressing and managing CMS. To prevent any further unnecessary deaths and comorbidities, context-specific research and interventions must be prioritized in the global humanitarian agenda.

The top ten ranked questions focused on outcomes and processes of care. This could be explained by the high response rate to the survey by health care professionals, making this an important thematic area for them due to their proximity to patient care. The results have called for prioritization of implementation and intervention research, or identifying what works for patient care within humanitarian contexts. The top-ranking questions also reflect the critical need for a minimum service package (MSP) for NCDs in crisis situations. This indicates the need for implementation research that would be additive to the adoption of the WHO best buys, which outline evidence-based, cost-effective public health interventions to guide policy decisions on the prevention and control of NCDs (World Health Organization Eastern Mediterranean Regional Office, 2018).

Understanding Community Health Workers (CHWs) interventions, their modalities of work and training in addressing CMS in humanitarian settings was the top prioritized question. The value of CHWs cannot be understated in settings with disrupted or recovering health systems addressing CMS, particularly considering their role in supporting continuity of care, access to services, prevention and management of NCDs, vulnerability reduction, and health education and counseling on NCDs (International Rescue Committee, 2020; UNHCR, 2020). However, there is a need for existing guidelines to be contextualized to varied humanitarian settings for ease of uptake at the policy and implementation levels.

Further understanding on effective, efficient approaches of integrating CMS into primary health care (Leon and Xu, 2023), individual and population interventions, as well as self-care interventions (World Health Organization, 2022) for patient-centered prevention, diagnosis, and management efforts for CMS in crisis settings also ranked high. More research is needed on how the delivery of interventions varies in different settings influenced by limited resources, governance structures, social norms, culture, and gender disparity.

Specific interventions for preventing or mitigating disruptions to ensure continuity of care were also prioritized, particularly crisis-resilient service delivery models adopted for complex emergencies where multiple concurrent factors lead to disruption of services, compounded by context-specific constraints on management and high mobility of affected populations (Bausch et al., 2021). Research on context-specific task-shifting models for prevention and care for CMS in crisis settings was also prioritized with the realization that these settings have frequent/chronic healthcare worker shortages.

People living with CMS are at risk of mental health challenges, coupled by the challenges of living in crisis settings. Participants prioritized the determination of effective mental health and psychosocial support approaches and the impact of access to psychosocial support for people living with CMS.

This RPS suggests a shift in research interests and priorities from burden and risk factors to the delivery and improvement of interventions – including feasibility, scalability, accessibility, and other aspects that aim to optimize delivery of care within humanitarian settings. It further highlights the need for context-specific evidence on what interventions have the most potential, and how they can be adapted most effectively.

Questions related to financing were among those that ranked the lowest. NCD financing is not typically part of the day-to-day engagement of most health workers, who made up the majority of survey participants. Humanitarian funding also does not break down specific subareas of health; financing for NCDs is lumped within overall health funding, which is only able to sustain NCD services if it is sufficient (ECHO, 2014; UNHCR, 2021; USAID BHA, 2022).

Furthermore, the fundamental questions around implementation for NCDs in humanitarian settings have not yet been answered. The lack of existing evidence-based answers to the identified questions could further explain why financing ranked lower on the scale of prioritization relative to other questions.

Although research on NCD financing seems to have been deprioritized, questions related to cost efficiency of treatment, care, and prevention of CMS scored highly. Cost-effectiveness analysis is critical to support decision-making on the prioritization of scarce resources to

Table 3
List of 43 questions by overall ranking.

Overall rank	Question	4D framework				Research theme/subtheme	Average score	AEA
		Des	Del	Dev	Dis			
1	What are the most effective community health workers driven interventions for cardio-metabolic syndrome management, monitoring and prevention in humanitarian settings and what work modalities/training of community health workers is needed for this?		x			3. Processes of care: 3.3. Task shifting/sharing	92.88	81.67%
2	At the primary care level, what are the most effective/cost-effective interventions that can be effectively implemented to provide quality prevention, management and improve treatment outcomes for cardiometabolic syndrome in humanitarian settings?		x			3. Processes of care: 3.1. Integrated care	90.87	81%
3	What are the most effective/cost-effective interventions at the individual and population levels that provide quality diagnosis and management for cardiometabolic syndrome in humanitarian and low resource settings? How can they be adapted to meet the needs of varied populations?		x			2. Outcomes of care: 2.2. Treatment	89.11	74.00%
4	What self-care interventions are effective among people at risk or living with cardio-metabolic syndrome in humanitarian settings? How do they work, for whom, and under what conditions?		x			3. Processes of care: 3.4. Patient-centered approaches/client responsiveness	88.97	76.00%
5	What are the knowledge, attitudes and practices (KAP) regarding cardio-metabolic syndrome, its risk factors, care seeking practices, in [specific humanitarian context] from the perspective of service providers as well as recipients (e.g. refugees, displaced persons and host communities)?	x				1. Burden and risk factors	88.92	79.33%
6	What are the effective mental health and psychosocial support approaches and the impact of access to psychosocial support on the management of cardio-metabolic syndrome and treatment outcomes in humanitarian settings?		x			2. Outcomes of care: 2.2. Treatment	88.20	73.33%
7	What is the (cost-)effectiveness of adopting an integrated, primary care-centric approach to providing cardiometabolic syndrome care in humanitarian settings?		x			3. Processes of care: 3.1. Integrated care	88.15	76.33%
8	What are effective models of task shifting for cardio-metabolic syndrome prevention and care for different levels of health care providers (at health facility and community level), communities, and families in humanitarian settings?		x			3. Processes of care: 3.3. Task shifting/sharing	87.42	73.33%
9	What are the most feasible, effective/cost-effective interventions at the individual and population levels to prevent cardiometabolic syndrome and its risk factors in humanitarian and low resource settings? How can they be adapted to meet the needs of varied populations?		x			2. Outcomes of care: 2.1. Prevention and Control	87.40	75.00%
10	What interventions are effective at preventing or mitigating disruptions/ensuring continuity of care in cardiometabolic syndrome care in humanitarian settings, how do they work, for whom, and in what emergencies?		x			3. Processes of care: 3.2. Continuity of care	87.10	75.00%
11	What are the key factors (enabling/impeding factors) that influence prevention, diagnosis and management of cardiometabolic syndrome in humanitarian settings?	x				1. Burden and risk factors	86.88	76.67%
12	How can people living with cardiometabolic syndrome related conditions be effectively enrolled into care and followed up in humanitarian settings?		x			3. Processes of care: 3.2. Continuity of care	86.84	75.67%
13	Which NCD indicators at the community, health facility and health systems levels are the most useful for monitoring cardiometabolic syndrome in humanitarian settings?		x			4- Monitoring & Evaluation / Digital Health	86.66	75.00%
14	What is the burden of cardiometabolic syndrome in [specific humanitarian context]? Are there any notable disparities by age, urban/rural settings, genders, ethnicities, and physical abilities?	x				1. Burden and risk factors	86.45	73.67%

(*continued on next page*)

Table 3 (*continued*)

15	What are the key factors (enabling/impeding factors) that influence access to care and support for cardiometabolic syndrome in humanitarian settings?	x				3. Processes of care: 3.5. Access to care	86.33	78%
16	How do we sustainably implement proven effective interventions for prevention and control of cardio-metabolic syndrome in crisis-affected settings?		x			2. Outcomes of care: 2.1. Prevention and Control	85.65	70.33%
17	What are the research priorities from the perspective of people living with cardio-metabolic syndrome in humanitarian settings?	x				3. Processes of care: 3.4. Patient-centered approaches/client responsiveness	85.29	68.00%
18	What are the most effective interventions (e.g. simple electronic medical record systems/ patient held records)/best practices to improve the monitoring and surveillance of cardiometabolic syndrome care in humanitarian settings (e.g. monitoring indicators, medication control and prescription)?			x		4- Monitoring & Evaluation / Digital Health	85.12	76.67%
19	What are the best approaches to provide holistic care and improve treatment outcomes for persons with cardiometabolic syndrome in humanitarian settings? (Holistic care defined as the provision of care to patients that are based on a mutual understanding of their physical, psychological, emotional, and spiritual dimensions. In addition, holistic care emphasizes the partnership between nurse and patient and the negotiation of healthcare needs that lead to recovery.)		x			3. Processes of care: 3.1. Integrated care	84.89	70.00%
20	What are the most effective, acceptable and feasible pharmacological therapeutic strategies for effectively controlling the cardiometabolic syndrome and its complications in specific humanitarian contexts?		x			2. Outcomes of care: 2.2. Treatment	84.41	73.00%
21	What are effective mechanisms of including perspectives of people with lived experience of cardiometabolic syndrome, when it comes to program design and planning in humanitarian settings?		x			3. Processes of care: 3.4. Patient-centered approaches/client responsiveness	84.21	68.00%
22	What are the underlying individual, community, environmental factors that contribute to the development and progression of cardiometabolic syndrome, and how do these vary across axes of vulnerability/disadvantage in humanitarian crises? (food insecurity/income/wealth/educational attainment...)	x				1. Burden and risk factors	83.82	72.00%
23	What are effective/cost-effective innovations to improve prevention, diagnosis and management of cardiometabolic syndrome in humanitarian settings?				x	7- Innovations	83.70	72.00%
24	What strategies/approaches (including human rights-based approaches) can humanitarian actors (incl. donors) use to design and negotiate for a healthy food environment, provide and promote a healthy diet to prevent and manage cardiometabolic diseases in the humanitarian settings?		x			2. Outcomes of care: 2.2. Treatment	83.20	68.33%
25	How can early detection and risk prediction models for cardiometabolic syndrome be improved to enhance prevention efforts in high risk, vulnerable populations and those with co-morbidities in humanitarian settings?			x		6 - Diagnostics/tools	83.15	69.67%
26	How can technology and digital health interventions be leveraged to prevent, improve treatment outcomes and reduce healthcare costs in individuals with cardiometabolic syndrome in humanitarian settings?			x		4- Monitoring & Evaluation / Digital Health	83.10	65.67%
27	How can interventions aiming at improving the acceptability and accessibility of community-based care for cardio-metabolic syndrome effectively be delivered at scale and in a sustainable manner in humanitarian settings?			x		3. Processes of care: 3.3. Task shifting/sharing	83.05	68.00%
28	How can healthcare systems and policies be optimized to effectively prevent, detect, and manage cardio-metabolic syndrome at both the individual and population levels at all levels of crises (preparedness, response, recovery)?			x		8 - Health system structure	82.77	68.33%

(*continued on next page*)

Table 3 (*continued*)

29	What are the most effective, acceptable and feasible non-pharmacological lifestyle interventions (including dietary modifications, physical activity, and behavioral changes) for preventing and managing cardio-metabolic syndrome in humanitarian settings?		x			2. Outcomes of care: 2.1. Prevention and Control	82.30	71.67%
30	What is the impact of crises (armed conflicts, displacement, natural disasters, disease outbreaks, etc.) on the epidemiology, detection, and management of cardiometabolic syndrome?	x				1. Burden and risk factors	82.30	71.33%
31	What is the economic benefit/return on investment of ensuring prevention and access to care for cardio-metabolic syndrome in humanitarian settings (acute and protracted)?	x				5. Financing	81.85	66.00%
32	What are the mechanisms behind effective integrated care for long-term care of cardiometabolic syndrome in humanitarian settings?	x				3. Processes of care: 3.1. Integrated care	81.52	64.33%
33	What is the impact of interventions aimed at prevention and management of cardiometabolic syndrome on quality of life and burden of disease (QALYs/DALYs) in humanitarian settings?	x				2. Outcomes of care: 2.2. Treatment	81.08	67.00%
34	What are the behavioral modifications tools/models that can reduce incidence of cardiometabolic diseases among children in humanitarian settings?	x				6 - Diagnostics/tools	81.03	67.67%
35	Which approaches are effective in encouraging humanitarian health care workers/ service providers to focus on cardiometabolic syndrome among conflict affected communities?		x			8 - Health system structure	80.96	67.00%
36	How can operationalization of guidance and interventions for cardiometabolic syndrome in humanitarian settings be affected, particularly when funding is limited? What are the operational and capacity barriers and how can these be overcome?		x			8 - Health system structure	80.92	69.33%
37	What are the roles of the informal sector (drug stores, traditional healers) in addressing cardio-metabolic syndrome in humanitarian settings?	x				8 - Health system structure	78.65	65.00%
38	What are the socio-economic costs (including healthcare costs, loss of productivity, etc.) associated with cardio-metabolic syndrome on individuals and families in humanitarian settings, and how can they be mitigated?	x				5. Financing	78.59	62.33%
39	To what extent are cardiometabolic syndrome focused services inclusive of people living with disabilities in humanitarian settings?		x			3. Processes of care: 3.4. Patient-centered approaches/client responsiveness	78.03	58.67%
40	Among people with cardiometabolic syndrome, what are the implications of current models of care employed in humanitarian settings on long-term health outcomes (e.g., disease control, prevalence of complications, progression towards NCD, etc.)?	x				2. Outcomes of care: 2.2. Treatment	77.49	57.67%
41	To what extent do relevant entities (e.g. donors, funding agencies, governmental agencies) prioritize the financing, programming and resource allocation for cardio-metabolic syndrome prevention and control in humanitarian settings? What are effective strategies to prioritize these?	x				5. Financing	76.68	64.67%
42	How can we enhance prognostic models and individualized management techniques for healthier lives for people living with cardiometabolic syndrome in humanitarian settings?			x		3. Processes of care: 3.1. Integrated care	73.40	53.33%
43	What new biomarkers, simple diagnostic techniques and tools can properly identify people who are at risk of developing cardiometabolic syndrome in humanitarian settings in a timely manner?			x		6 - Diagnostics/tools	73.13	59.00%

ensure vital access to CMS services at a primary care level (Rokhman et al., 2023; Vlasenko and Davtian, 2023). However, more research on cost effectiveness is still needed (Kehlenbrink et al., 2019), calling for global, regional and national prioritization of funding for the prevention and management of NCDs, in line with global development goals (World Health Organization, 2024).

Another set of lower-ranking questions was related to innovation and the development of new biomarkers, simple diagnostic techniques and tools to identify people who are at risk of developing CMS. Identifying accurate biomarkers for CMS is crucial for its prevention, diagnosis, and management. However, many biomarkers are still under study such as high-density lipoprotein cholesterol, low-density lipoprotein cholesterol, triglycerides, fasting plasma glucose, and lipoprotein-A; as such, these may currently be unknown to frontline health care providers. Innovative simple diagnostic tools for CMS and NCDs are critical to enhance health system resilience by enabling early detection, accurate diagnosis, timely management and efficient allocation of scarce resources. Many providers in humanitarian settings focus on using existing basic tools or utilize syndromic approaches for diagnosis, while innovative tools may not be widely disseminated, or perceived as costly or unsustainable, which may explain the low scoring in this exercise despite their importance (Khan et al., 2023).

4.1. Strengths and limitations

An adapted CHNRI approach was utilized, a powerful tool that can help identify new research questions and maximize input on prioritization of these questions from a variety of different stakeholders. Since the CHNRI process is easily adaptable, it allowed for implementation in a web-based survey, as well as a wider scope, further enhancing representativeness. However, scoring might have been influenced by ongoing research or projects in which self-selected participants have relevant interests. This approach is limited to those who are reachable and able to respond, but efforts were made to limit any selection and response biases, such as having a robust dissemination strategy that ensured participation of a diverse group of experts. Both surveys were conducted in four languages (English, Arabic, French, and Spanish).

The majority of participants were health professionals working in the field in the AFR and EMR regions, where most humanitarian programs providing NCD care are located. This could potentially explain the scores of certain research questions. Most NCD work in humanitarian settings currently happens in these regions (Aebischer Perone et al., 2017), with increasing work in SEAR. The skewing of these results may not be a limitation as such, but is illustrative of the interest and involvement of those working on the ground in crisis contexts.

It was mandatory for participants to fully complete the survey to prevent partially-filled responses. While this enhanced the quality of the exercise, the time-consuming nature of the survey may have impacted the response rate. The non-randomized structure of the questions may have also resulted in scorer fatigue.

Additional areas of research may have emerged if a larger sample participated in the first survey. A sample size of 75 for the second survey may have led to an over- or under- estimation of some of the results, and could explain the variability in some of the question rankings. However, the CHNRI methodology attempts to mitigate this based on the wisdom of crowds theory "that suggests that approximately 24 scorers are needed in order to cancel out personal biases and judgements and to arrive at the collective wisdom of the group" (Tomlinson et al., 2019). As our survey had 75 participants, this potential bias was likely mitigated, though a larger sample in future studies would help provide more robust findings.

Among the 356 research questions that addressed CMS, only 19 reported specific contexts (emergency/stable/unstable). While context-specific questions that apply to only acute or protracted crises settings may be more nuanced, the objective was to capture all potential humanitarian contexts and obtain a broad perspective that could apply to various situations globally.

Finally, the impact of the ongoing crises in Gaza and in Ukraine may have limited or skewed the response rate from EMR and EUR.

Conclusions

Our findings highlight the need to prioritize models of care that ensure integration within existing health care systems and the delivery of quality, effective, integrated primary care for NCDs in humanitarian settings. There is a need to task shift care to CHWs in humanitarian settings using patient-centered and sustainable approaches. It is also important to adopt integrated, multidisciplinary approaches that address research, interventions, and policies involving local and international stakeholders.

There remain gaps around financing and analyses around cost-effectiveness of research and interventions in humanitarian settings. Further research efforts are needed to understand more effective ways of systematically addressing this burden. The list of ranked research priorities from this exercise could serve as guidance for advocacy, and the deployment of funds for future research, interventions, and policies.

CRediT authorship contribution statement

Chaza Akik: Writing – original draft, Visualization, Supervision, Project administration, Methodology, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Lilian Kiapi:** Writing – original draft, Supervision, Project administration, Methodology, Funding acquisition, Conceptualization. **Abla M. Sibai:** Writing – original draft, Supervision, Methodology, Funding acquisition, Conceptualization. **Stella Njagi:** Writing – original draft, Project administration, Methodology, Conceptualization. **Nancy Zaitouny:** Formal analysis, Data curation, Writing – original draft, Visualization. **Fouad Fouad:** Writing – review & editing, Conceptualization. **Mouna Mayoufi:** Supervision, Project administration, Writing – review & editing. **Mesfin Teklu Tessema:** Writing – review & editing, Funding acquisition, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Fouad Fouad is Associate Editor for Journal of Migration and Health and was not involved in the editorial review or the decision to publish this article.

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Supplementary materials

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