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Metabolic Dysfunction-Associated Steatotic Liver Disease in the MENA Region: Setting a Research and Action Priority Agenda

Mohamed El-Kassas[1,2,3] | Marcela Villota-Rivas[4] | Khalid A. Alswat[2,3,5] | Khalid M. AlNaamani[2,3,6] | Yusuf Yilmaz[2,3,7] | Asma Labidi[2,8] | Faisal M. Sanai[2,9] | Abeer Awad[10] | Maisam W. I. Akroush[2,11] | Saleh A. Alqahtani[3,12] | Mohamed Elbadry[1,2] | Nermeen Abdeen[13] | Linda Henry[3,14] | Zobair M. Younossi[3,14] | Jeffrey V. Lazarus[4,15,16] | Abdel-Naser Elzouki[2,17] | on behalf of the Steatotic Liver Disease Study Foundation in Middle East and North Africa (SLMENA) Collaborators

[1]Endemic Medicine Department, Faculty of Medicine, Helwan University, Cairo, Egypt | [2]Steatotic Liver Disease Study Foundation in Middle East and North Africa (SLMENA), Cairo, Egypt | [3]The Global NASH/MASH Council, Washington, DC, USA | [4]Barcelona Institute for Global Health (ISGlobal), Barcelona, Spain | [5]Liver Disease Research Center, Department of Medicine, College of Medicine, King Saud University, Riyadh, Saudi Arabia | [6]Division of Gastroenterology and Hepatology, Department of Medicine, The Medical City for Military and Security Services, Muscat, Oman | [7]Department of Gastroenterology, School of Medicine, Recep Tayyip Erdoğan University, Rize, Turkey | [8]Department of Gastroenterology "A", Rabta Hospital, Tunis, Tunisia | [9]Department of Medicine, Gastroenterology Section, King Abdulaziz Medical City, King Abdullah International Medical Research Center, Ministry of National Guard–Health Affairs, Jeddah, Saudi Arabia | [10]Internal Medicine Department, Faculty of Medicine, Cairo University, Cairo, Egypt | [11]Digestive and Liver Disease Clinic, Private Sector, Faculty of Medicine, Jordan University, Amman, Jordan | [12]Liver, Digestive, and Lifestyle Health Research Section, and Organ Transplant Center of Excellence, King Faisal Specialist Hospital and Research Center, Riyadh, Saudi Arabia | [13]Tropical Medicine Department, Faculty of Medicine, Alexandria University, Alexandria, Egypt | [14]Beatty Liver and Obesity Research Program, Inova Health System, Falls Church, Virginia, USA | [15]City University of New York Graduate School of Public Health and Health Policy (CUNY SPH), New York, New York, USA | [16]Facultat de Medicina i Ciències de la Salut, Universitat de Barcelona (UB), Barcelona, Spain | [17]Department of Medicine, Hamad Medical Corporation and College of Medicine, Qatar University, Doha, Qatar

Correspondence: Mohamed El-Kassas (m_elkassas@hq.helwan.edu.eg)

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ABSTRACT

Background & Aims: Metabolic dysfunction-associated steatotic liver disease (MASLD) is a growing health challenge, particularly in Middle East and North Africa (MENA) countries. This study aimed to establish a consensus-driven research and action agenda to address MASLD within the MENA region.

Methods: Following a global MASLD research and action agenda setting study, over two Delphi rounds (Rs), MENA region experts (R1 $n = 112$, R2 $n = 104$) indicated their level of agreement with and provided feedback on MASLD research and action priorities via Qualtrics XM. In R2, panellists also ranked the priorities, which were categorised across six domains: (1) the human

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The full list of Steatotic Liver Disease Study Foundation in Middle East and North Africa (SLMENA) Collaborators (i.e., the full authorship list) can be found in Appendix A.

and economic burden; (2) defining and implementing care models; (3) disease management; (4) education and awareness; (5) patient and community perspectives; and (6) leadership and policies for the MASLD public health agenda.

Results: The consensus-built MASLD research and action priority agenda for the MENA region comprises 52 priorities. Combined agreement (i.e., 'agree' + 'somewhat agree') increased from 97.6% and 98.1% in R1 to 98.2% and 98.5% in R2 with the research ($n = 30$) and action ($n = 22$) priorities, respectively. The highest ranked research priorities included developing regional MASLD databases and validating non-invasive diagnostic tools. The highest ranked action priorities included taking steps to enhance the adoption of lifestyle interventions among people living with MASLD and improving disease knowledge among healthcare providers.

Conclusions: This region-specific agenda can help to guide research and optimise clinical practice, thereby improving the understanding, prevention, and management of MASLD, enhancing health outcomes and reducing its burden within the MENA region.

1 | Introduction

Metabolic dysfunction-associated steatotic liver disease (MASLD), formerly known as non-alcoholic fatty liver disease, is the most common liver disease globally. Its estimated prevalence is rising, affecting 38% of adults and 13% of children [1–3]. MASLD can progress to metabolic dysfunction-associated steatohepatitis (MASH), formerly known as non-alcoholic steatohepatitis, and can significantly impact quality of life [4]. MASH is a leading contributor to the risk of developing hepatocellular carcinoma, the second leading cause of years of life lost among all cancers. Consequently, MASLD poses substantial health and economic challenges worldwide [5–7].

Global regional estimates have identified the Middle East and North Africa (MENA) as a high MASLD prevalence region at 37%, with this rate being surpassed by only Latin America, at 44% [2]. Within the MENA region, MASLD prevalence rates vary and reach as high as 56% in Egypt [2, 8]. Unsurprisingly, the prevalence of MASLD risk factors within the MENA region is alarmingly high, with obesity prevalence estimates in countries such as Kuwait being as high as 55% and 30% among women and men, respectively [9], in contrast to the global averages of 19% among women and 14% among men [10]. Moreover, the MENA region has the highest estimated global age-standardised diabetes prevalence at 12%, compared to the global average of 8% [11]. Sedentarism is also highly prevalent within the MENA region, with a study indicating a 33% rate, exceeding the 28% average across the 168 countries studied [12]. The MENA region has also experienced accelerated growth in MASLD-related complications, with annual percent change rates per 100 000 of 3.45 for incident liver complications, 1.76 for deaths, and 1.71 for disability-adjusted life years, surpassing the global rates of 1.75, 1.54, and 1.14, respectively [13].

Despite global efforts, substantial gaps remain in our understanding of MASLD progression, pathogenesis, and optimal care strategies [14–18]. These gaps are particularly pronounced within the MENA region, where data on steatotic liver disease (SLD, formerly known as fatty liver disease)—a broader category encompassing various causes of hepatic steatosis [1]—are notably scarce [14, 19]. There is an urgent need to increase awareness and education, develop comprehensive guidelines, enhance diagnostic methods, and provide access to affordable risk stratification tools for effective patient identification, monitoring, and management within the MENA region [20–23]. As such, stakeholders involved in addressing MASLD within the MENA region must establish a clear path forward to mitigate the growing disease burden and gaps.

Building on past global efforts [20, 22, 23], this study aimed to establish a consensus-driven research and action priority agenda for MASLD within the MENA region by leveraging the expertise of a regional multidisciplinary panel. The proposed agenda is intended to inform and guide research, clinical practice, and policy making, considering the specific context within the region, to effectively address the challenges posed by MASLD and improve health outcomes across the region.

2 | Methods

2.1 | Expert Delphi Panel

This study utilised a Delphi methodology, which has been used in various previous studies, to achieve consensus on MASLD research and action priorities tailored to the MENA region [1, 20, 22]. Six co-chairs employed an iterative approach involving purposive and targeted sampling to establish a core group ($n = 16$) of experts in clinical care, public health, policy, and advocacy (Table S1) and a Delphi panel ($n = 132$), respectively (Figure 1). The Delphi panel comprised members of the Steatotic Liver Disease Study Foundation in the Middle East and North Africa (SLMENA) and of MENA scientific societies. SLMENA is a regional non-profit organisation working on harnessing resources and expertise across the MENA region to study different aspects of and local challenges regarding SLD. The Delphi panel included experts in hepatology, gastroenterology, endocrinology, nutrition, and epidemiology.

2.2 | Delphi Priority Domains

The development of MASLD research and action priorities for the MENA region was informed by recently published global SLD research and action priorities [20, 22]. Using the global priorities as a foundation, the co-chairs drafted region-specific priorities across six domains: (1) the human and economic burden, (2) defining and implementing care models, (3) disease management, (4) education and awareness, (5) patient and community perspectives, and (6) leadership and policies for the MASLD public health agenda. The remaining core group members refined these priorities before the first Delphi round, conducted from 23 February to 26 March 2024.

2.3 | Delphi Data Collection and Analysis

Two Delphi rounds (R1 and R2), developed and distributed via Qualtrics XM, were conducted to achieve consensus on

Summary

- Metabolic dysfunction-associated steatotic liver disease (MASLD) is a pressing health challenge, particularly in Middle East and North Africa (MENA) countries.
- This study aimed to establish a consensus-driven research and action agenda to address MASLD within the MENA region. Over two Delphi rounds, MENA region experts indicated their level of agreement with, ranked, and provided feedback on MASLD research and action priorities categorised across six domains, via Qualtrics XM.
- The consensus-built MASLD research and action priority agenda for the MENA region, comprising 52 priorities, can help to guide research and optimise clinical practice, thereby improving the understanding, prevention, and management of MASLD, enhancing health outcomes and reducing its burden within the region.

the MENA MASLD research and action priorities. Panellists indicated their level of agreement with each priority using a four-point Likert scale: 'agree', 'somewhat agree', 'somewhat disagree', and 'disagree'. An additional 'not qualified to respond' option was included to accommodate for the diverse expertise of the panellists.

In R1, demographic data were collected and panellists who agreed with a priority had the option to provide feedback, while those who disagreed were required to provide feedback to inform revisions for R2. The co-chairs reviewed R1 data, which included 300 feedback comments, and revised the priorities accordingly. The remaining core group members reviewed these revisions before finalising them for R2. During R2 (13 May to 5 June 2024), panellists reassessed the revised priorities and were provided with summaries of the amendments made. Panellists also ranked at least half of the priorities within each domain, and all of them within domains with three or fewer priorities. Panellists had the option to provide feedback at the end of each domain in R2 and upon finishing each round. All feedback was considered in the writing of this manuscript.

Quantitative analysis of each round involved calculating frequencies and proportions for each response category. Final R2 priorities were graded based on their combined agreement (i.e., 'agree' + 'somewhat agree'), with 'U' indicating unanimous (100%) agreement and 'A' indicating 90%–99% agreement. The proportion of panellists that selected 'not qualified to respond' was excluded from the denominator when calculating agreement levels. Rankings were calculated and normalised using

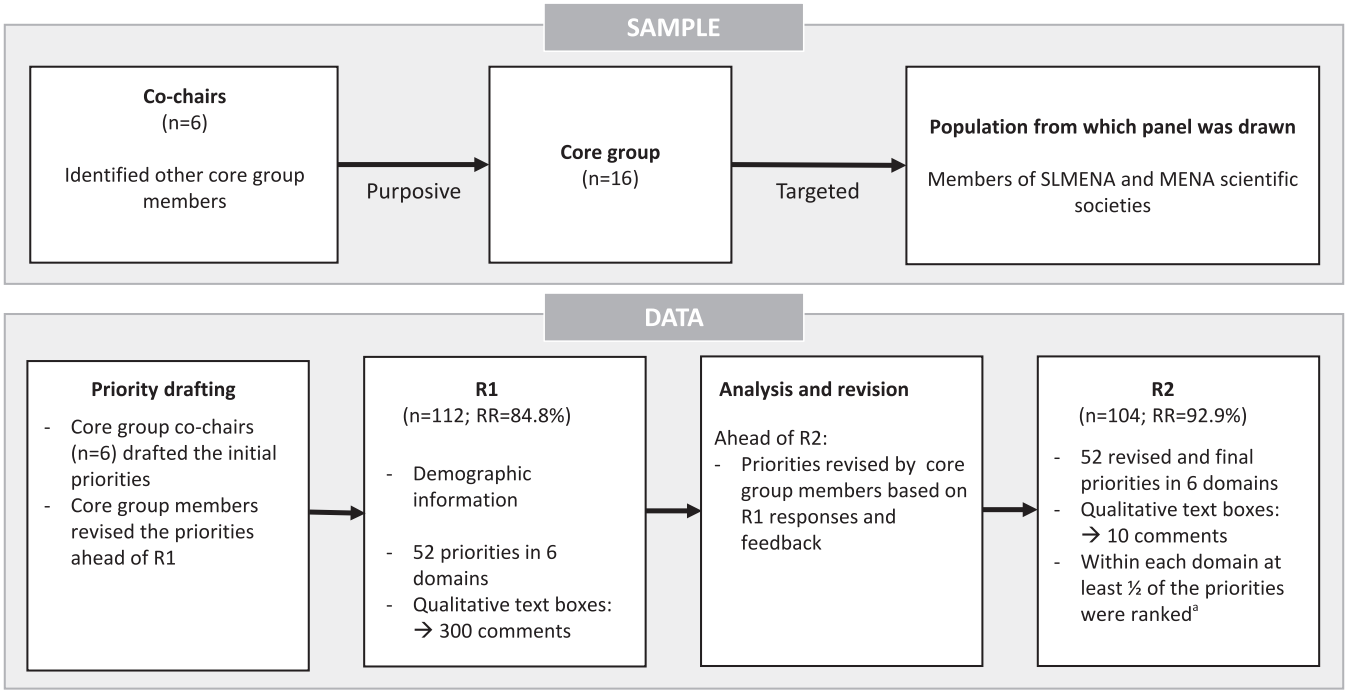

FIGURE 1 | Delphi process methodology. Abbreviations: MENA, Middle East and North Africa; SLMENA, Steatotic Liver Study Foundation in Middle East and North Africa; R, round; RR, response rate. Top: Iterative sampling approach used to generate a large and diverse Delphi panel (R1 $n = 112$, R2 $n = 104$)–six co-chairs identified an additional 10 experts in clinical care, public health, policy, and advocacy, and collectively they formed the core group ($n = 16$); members of SLMENA and MENA scientific societies were invited to participate in the Delphi process. Bottom: iterative data-handling process–priorities were drafted (by the co-chairs) and revised (by other core group members); R1 was carried out with these priorities; an analysis of R1 data was undertaken and priorities were subsequently revised by core group members; R2 was carried out with these final priorities; R1 allowed for feedback about individual priorities; R2 allowed for feedback about each domain; both rounds allowed for feedback at the end; in R2, panellists were asked to rank at least ½ of the priorities within each of the domains. [a]For domains with ≤ 3 priorities, panellists were asked to rank them all.

TABLE 1 | Delphi panel characteristics ($n = 112$).

Characteristic	*n* (%)
Gender	
Woman	42 (37.8)
Man	69 (62.2)
Prefer not to say	1 (0.9)
Age, mean [SD]	
All	50.3 [10.7]
Income level[a] of country of birth (n=20)	
Low or middle	83 (74.1)
High	29 (25.9)
Region[b] of birth	
Africa	1 (0.9)
Europe and Central Asia[c]	25 (22.3)
Middle East and North Africa	84 (75.0)
North America	1 (0.9)
South Asia	1 (0.9)
Income level[a] of country of work (n=15)	
Low or middle	78 (69.6)
High	34 (30.4)
Region[b] of work	
Europe and Central Asia[d]	24 (21.4)
Middle East and North Africa	88 (78.6)
Employment status	
Employed	108 (96.4)
Unemployed	3 (2.7)
Retired	1 (0.9)
Sectors worked in[e]	
Academia	95 (84.8)
Public	52 (46.4)
Private	30 (26.8)
Civil society	11 (9.8)
Sector primarily worked in	
Academia	78 (69.6)
Public	26 (23.2)
Private	7 (6.3)
Civil society	1 (0.9)
Fields worked in[e]	
Clinician/medical doctor	107 (95.5)
Allied health professional	7 (6.3)
Healthcare administration	12 (10.7)
Clinical research	58 (51.8)
Non-clinical research	9 (8.0)
Patient advocacy	4 (3.6)
Policy	6 (5.4)
Education/pedagogy	31 (27.7)
Other	2 (1.8)
Field primarily worked in	
Clinician/medical doctor	98 (87.5)
Allied health professional	2 (1.8)
Healthcare administration	1 (0.9)
Clinical research	8 (7.1)
Education/pedagogy	3 (2.7)
Years working in MASLD field	
1 to 11	60 (53.6)
12 to 22	37 (33.0)
23 to 33	14 (12.5)
> 33	1 (0.9)
Publications authored focused on MASLD	
< 5	73 (65.2)
5 to 10	22 (19.6)
11 to 19	10 (8.9)
20 to 29	3 (2.7)
≥ 30	4 (3.6)
Liver association membership[e,f]	
AASLD	28 (25.0)
APASL	7 (6.3)
EASL	37 (33.0)
No membership	70 (62.5)
Liver association primarily associated with (n=42)[f,g]	
AASLD	19 (45.2)
APASL	3 (7.1)
EASL	20 (47.6)
Professional association/society/foundation membership[e]	
African Middle East Association of Gastroenterology (AMAGE)	1 (0.9)
Algerian Society of Hepato-Gastro-Enterology and Endoscopy (SAHGEED)	4 (3.6)

(Continues)

TABLE 1 | (Continued)

Characteristic	*n* (%)
American Association of Clinical Endocrinology (AACE)	1 (0.9)
American College of Gastroenterology (ACG)	1 (0.9)
American College of Physicians (ACP)	2 (1.8)
American Diabetes Association (ADA)	1 (0.9)
American Gastroenterological Association (AGA)	1 (0.9)
American Society for Gastrointestinal Endoscopy (ASGE)	1 (0.9)
Arabic Association for the Study of Diabetes and Metabolism (AASD)	6 (5.4)
Bahrain Diabetes Society (BDS)	1 (0.9)
Canal Association for Care of Liver Disease	1 (0.9)
Diabetes in Asia Study Group (DASG)	1 (0.9)
Egyptian Association for Research and Training in Hepato-Gastroenterology (EARTH)	5 (4.5)
Egyptian Association for the Study of Liver and Gastrointestinal Diseases (EASLGD)	7 (6.3)
Egyptian Association of Endocrinology, Diabetes, and Atherosclerosis (EAEDA)	1 (0.9)
Egyptian Foundation for Integrated Medicine in Pulmonology and Gastroenterology (PulmoGUT)	3 (2.7)
Egyptian Functional Medicine Association (EFMA)	1 (0.9)
Egyptian Group For Updates in Hepatology and Gastroenterology	1 (0.9)
Egyptian Medical Association for the Study of Obesity (EMASO)	1 (0.9)
Egyptian Nutrition and Health Coaching Association (ENHCA)	1 (0.9)
Egyptian Society of Liver Cancer (ESLC)	1 (0.9)
Egyptian Society of NAFLD/NASH and Its Complications	1 (0.9)
Egyptian Society of Paediatric Gastroenterology, Hepatology and Nutrition (EGSPGHAN)	2 (1.8)
Emirates Gastroenterology and Hepatology Society (EGHS)	3 (2.7)
European Association for the Study of Diabetes (EASD)	1 (0.9)
European Society for Paediatric Gastroenterology, Hepatology and Nutrition (ESPGHAN)	2 (1.8)

(Continues)

TABLE 1 | (Continued)

Characteristic	*n* (%)
German Society for Gastroenterology, Digestive and Metabolic Diseases (DGVS)	1 (0.9)
Gulf Association of Endocrinology and Diabetes (GAED)	1 (0.9)
International Society of Tropical Paediatrics (ISTP)	1 (0.9)
Jordan Paediatric Society (JPS)	1 (0.9)
Jordanian Society of Gastroenterology and Hepatology (JSGH)	5 (4.5)
Kuwait Gastroenterology Association (KGA)	2 (1.8)
Lebanese Society of Gastroenterology (LSGE)	3 (2.7)
Libyan Society for Gastroenterology and Hepatology	2 (1.8)
Mediterranean Association for the Study of Liver Disease	3 (2.7)
Moroccan Society of Digestive Endoscopy (SMED)	3 (2.7)
Moroccan Society of Gastroenterology	2 (1.8)
Moroccan Society of Hepatogastroenterology	2 (1.8)
Oman Gastroenterology Society (OGS)	2 (1.8)
Oman Society for Lipid and Atherosclerosis (OSLA)	1 (0.9)
Pan Arab Association of Gastroenterology	4 (3.6)
Pan Arab Liver Transplant Society (PALTS)	10 (8.9)
Pan Arab Society for Paediatric Gastroenterolgy, Hepatology and Nutrition (PASPGHAN)	1 (0.9)
Pan Arab Women Physicians Association	1 (0.9)
Royal College of Physicians (RCP)	3 (2.7)
Royal College of Physicians and Surgeons of Canada (RCPSC)	1 (0.9)
Saudi Association for the Study of Liver Diseases and Transplantation (SASLT)	19 (17.0)
Saudi Society for the Study of Liver Disease and Transplantation	1 (0.9)
Saudi Society of Paediatric Gastroenterology, Hepatology and Nutrition (SASPGHAN)	2 (1.8)
Sharkia Endocrinology & Diabetes Association (SHEDA)	1 (0.9)
Society on Liver Disease in Africa (SOLDA)	1 (0.9)
Tunisian Association of Nutrition Sciences (ATSN)	1 (0.9)
Tunisian Society of Gastroenterology (STGE)	9 (8.0)

(Continues)

TABLE 1 | (Continued)

Characteristic	*n* (%)
Turkish Association for the Study of the Liver (TASL)	18 (16.1)
Turkish Gastroenterology Association (TGD)	1 (0.9)
Turkish Society for Paediatric Gastroenterology, Hepatology and Nutrition (TCGHBD)	1 (0.9)
Turkish Society of Clinical Enteral and Parenteral Nutrition (KEPAN)	3 (2.7)
Turkish Society of Endocrinology and Metabolism (SEMT)	4 (3.6)
United European Gastroenterology (UEG)	1 (0.9)
Yemen Diabetes Association (YDA)	1 (0.9)
No membership	7 (6.3)
Professional association/society/foundation primarily associated with (n=105)[h]	
SAHGEED	4 (3.8)
ACP	1 (1.0)
AGA	1 (1.0)
AASD	4 (3.8)
BDS	1 (1.0)
EARTH	4 (3.8)
EASLGD	7 (6.7)
EAEDA	1 (1.0)
EFMA	1 (1.0)
ESLC	1 (1.0)
EGSPGHAN	2 (1.9)
EGHS	3 (2.9)
ESPGHAN	2 (1.9)
ISTP	1 (1.0)
JPS	1 (1.0)
JSGH	4 (3.8)
KGA	2 (1.9)
LSGE	3 (2.9)
Libyan Society for Gastroenterology and Hepatology	2 (1.9)
SMED	1 (1.0)
Moroccan Society of Gastroenterology	1 (1.0)
Moroccan Society of Hepatogastroenterology	1 (1.0)
OGS	2 (1.9)
PALTS	1 (1.0)
RCP	1 (1.0)
SASLT	17 (16.2)
Saudi Society for the Study of Liver Disease and Transplantation	1 (1.0)
SASPGHAN	1 (1.0)
SHEDA	1 (1.0)
ATSN	1 (1.0)
STGE	9 (8.6)
TASL	17 (16.2)
KEPAN	1 (1.0)
SEMT	4 (3.8)
YDA	1 (1.0)

Note: Percentages may add up to more than 100 due to rounding.
Abbreviations: AASLD, American Association for the Study of Liver Diseases; ALEH, Asociación Latinoamericana para el Estudio del Hígado (Latin American Association for the Study of the Liver); APASL, Asian Pacific Association for the Study of the Liver; EASL, European Association for the Study of the Liver; MASLD, metabolic dysfunction-associated steatotic liver disease.
[a]Based on World Bank data.
[b]Based on World Bank regions.
[c]$n = 24$ participants were born in Turkey.
[d]$n = 24$ participants worked in Turkey.
[e]Sum may exceed sample size as participants could choose more than 1 response.
[f]Nobody reported being a member of ALEH.
[g]*n* only includes respondents who are members of any of the liver associations listed.
[h]*n* only includes respondents who are members of any of the associations/societies/foundations listed.

Microsoft Excel (version 16.86) to compare within each domain. Demographic data were descriptively analysed, including frequencies and proportions. As responses were required for all parts of each round, except for the optional feedback sections, there were no instances of missing data.

3 | Results

In R1, 132 experts were invited to participate, of whom 112 (84.4%) completed the survey. These 112 panellists were subsequently invited to participate in R2, of whom 104 (92.9%) completed the survey. Table 1 provides a comprehensive demographic profile of all panellists, among whom the mean age was 50.3 years (standard deviation: 10.7) and most were male (62.2%). Moreover, the majority worked in low- or middle-income countries (69.6%), have been primarily employed in the academic sector (69.6%), and have worked as clinicians/medical doctors (95.5%). The panel encompassed a diverse geographical representation, with 20 and 15 countries represented in terms of panellist country of birth and work, respectively.

In R1 the panel evaluated 52 draft priorities, comprising 30 research priorities and 22 action priorities. These were subsequently revised based on panellist feedback and presented in R2. The level of combined agreement increased from R1 to R2,

rising from 97.6% to 98.2% for the research priorities and from 98.1% to 98.5% for the action priorities.

Tables 2 and 3 delineate the final research and action priorities, respectively, along with their associated combined agreement grades and rankings. Unanimous combined agreement was reached with six of the research priorities (Figure 2), while the remaining 24 garnered a 90%–99% combined agreement. For 15 of the research priorities less than 80% of panellists selected 'agree', leading to a higher reliance on 'somewhat agree' to reach a high combined agreement (Table S2). Over half of the research priorities in the *defining and implementing care models, disease management, and leadership and policies for the MASLD public health agenda* domains received less than 80% 'agree' responses.

Unanimous combined agreement was reached with seven of the action priorities (Figure 3), with the remaining 15 achieving 90%–99% combined agreement. For 11 of the action priorities less than 80% of panellists chose 'agree', leading to a higher reliance on 'somewhat agree' to achieve a high level of combined agreement (Table S3). More than half of the action priorities in the *human and economic burden*, *defining and implementing care models*, and *disease management* domains received less than 80% 'agree' responses. The discussion section explores the priority rankings and provides a summary of the current evidence within each area.

4 | Discussion

Given the growing global burden of MASLD, particularly in regions such as MENA [2, 3, 13], it is crucial to establish comprehensive research and action priority agendas at global and regional levels to address this public health challenge effectively. As such, through an expert panel and Delphi process, 52 MENA-specific MASLD research and action priorities were established [20–22]. These priorities were selected considering the sociocultural, economic, and healthcare circumstances within the MENA region, and categorised into six domains. Although all domains and their respective priorities are of high importance, it is not reasonable to expect successful implementation of all of these at once. Therefore, we chose to focus our attention on a few of them.

We focused on *the human and economic burden* domain because MASLD has a profound global impact but remains underrecognised, resulting in fragmented and insufficient responses. The complexity and variability of the disease further complicate the development of effective prevention and management strategies [20, 22, 23]. Additionally, despite ongoing efforts to understand the burden of MASLD, substantial gaps persist, particularly regarding its prevalence and effects on quality of life, among the general population and high-risk groups within the MENA region [8, 23–27]. As such, the panel unanimously endorsed the creation of national and regional MASLD registries, to enhance the understanding of the determinants and burden of the disease (research priority 1.1; ranked as first in its domain) and prioritised investigating the epidemiology of the disease and its risk factors (e.g., obesity, type 2 diabetes, viral hepatitis), whose prevalence is high within the MENA region (research priority 1.2; ranked as second in its domain) [9–11]. The panel also elected to standardise data collection and reporting on the human and economic burden of MASLD, to allow for region-wide comparisons (action priority 1.1; ranked as first in its domain). Assessing the economic burden of the disease within the region (research priority 1.6), which the panel unanimously emphasised, will also provide essential data to quantify its strain on healthcare systems, including costs associated with medical treatment, hospitalisations, and long-term care. This information will be vital for policymakers, as it enables evidence-based decision-making regarding resource allocation, prioritisation of healthcare spending, and the development of cost-effective prevention and management strategies. Moreover, understanding the economic toll of MASLD can support advocacy efforts to secure funding for research and public health programmes tailored to the unique needs of the MENA region.

We also focused on the *defining and implementing care models* domain, in which panellists called for the collaboration between liver specialists and primary care experts to determine which non-invasive tests (NITs) are best to use in assesing fibrosis risk within primary care settings in the region (action priority 2.1; ranked as first in its domain). After decades of research on MASLD, it has become apparent that early diagnosis of MASLD, and especially identification of those at highest risk for disease progression (i.e., MASLD with fibrosis stage 2 or greater), is the most efficient and effective way to delay and/or prevent severe complications, including development of advanced liver disease, thereby reducing associated morbidity and mortality. Consequently, identifying appropriate NITs for screening and staging of liver fibrosis and defining priority populations for this are critical objectives [20, 28]. Moreover, although there are a number of NITs available, it has been challenging to determine which ones are the most effective and easiest to implement by busy clinicians treating individuals with high-risk MASLD within the MENA region [27]. Therefore, the panel unanimously recognised the critical importance of validating non-invasive methods, such as imaging and blood biomarkers, among cohorts from the region, for the diagnosis, risk stratification, and monitoring of MASLD progression (research priority 2.1; ranked as first in its domain), which will be difficult given the heterogeneity of the MENA population. Nontheless, having valid and reliable risk stratification NITs will ensure their applicability and accuracy, reducing the likelihood of misclassification and enabling accurate identification of high-risk individuals.

Within the same domain, the panel stressed the significance of assessing the availability and impact of various MASLD care models within the MENA region, including those targeting different subpopulations, such as paediatric patients (research priority 2.3; ranked as third in its domain). This emphasis on such subgroups reflects an understanding of the differences in disease progression and management across age groups. Research could help to identify gaps in services and ensure that vulnerable groups receive equitable and effective care. These efforts will require collaboration between liver specialists and primary care physicians (PCPs), with the latter often being the first point of contact for patients and thus holding an important role in the early identification and management of MASLD. The development of context- and resource-specific multidisciplinary care models to optimise MASLD

TABLE 2 | MASLD research priorities within the MENA region.

Priorities		Grade	Rank	A (%)	SA (%)	A + SA (%)	SD (%)	D (%)	NQ (%)	*N*
Domain 1: The human and economic burden										
1.1	Develop national and regional MASLD databases/registries to elucidate the disease determinants and burden within the MENA region	U	1	94.2	5.8	100.0	0.0	0.0	1.0	103
1.2	Investigate the epidemiology of MASLD within the MENA region, with an emphasis on risk factor variation across the region	A	2	92.2	6.8	99.0	1.0	0.0	1.0	103
1.3	Conduct cohort studies within the MENA region to prospectively monitor health outcomes in people living with defined liver disease phenotypes (e.g., MASH, MASH with fibrosis, cirrhosis, hepatocellular carcinoma)	A	2	92.2	6.8	99.0	0.0	1.0	1.0	103
1.4	Explore the impact of environmental, genetic, and lifestyle factors on MASLD development and progression among the MENA population	A	3	87.5	11.5	99.0	1.0	0.0	0.0	104
1.5	Integrate measures of environmental sustainability into MASLD research within the MENA region, in alignment with environmental health-related SDGs (e.g., SDG 6: Clean Water and Sanitation)	A		54.5	41.6	96.0	2.0	2.0	2.9	101
1.6	Investigate the economic burden of MASLD within the MENA region countries, capturing direct and indirect costs	U		87.3	12.7	100.0	0.0	0.0	1.9	102
Domain 2: Defining and implementing care models										
2.1	Validate non-invasive methods (imaging and blood biomarkers) among cohorts from the MENA region for diagnosis, risk stratification, and monitoring of MASLD progression	U	1	94.2	5.8	100.0	0.0	0.0	0.0	104
2.2	Evaluate how MASLD risk prediction models perform among different populations across the MENA region	U	2	75.0	25.0	100.0	0.0	0.0	0.0	104
2.3	Assess the availability and impact of different MASLD care models within the MENA region, including among different subpopulations (e.g., paediatrics)	A	3	59.6	35.6	95.2	3.8	1.0	0.0	104
2.4	Evaluate the cost-effectiveness of different MASLD care models within the MENA region, including those directed at different subpopulations	A		60.6	35.6	96.2	2.9	1.0	0.0	104
2.5	Examine MASLD health outcome disparities among the MENA population, considering cultural and socioeconomic factors	A		66.0	31.1	97.1	2.9	0.0	1.0	103
Domain 3: Disease management										
3.1	Evaluate the role of bariatric interventions (medical, surgical, and endoscopic) in MASLD management within the MENA region	A	3	78.8	15.4	94.2	3.8	1.9	0.0	104

(Continues)

TABLE 2 | (Continued)

Priorities		Grade	Rank	A (%)	SA (%)	A + SA (%)	SD (%)	D (%)	NQ (%)	*N*
3.2	Evaluate the role of dietary patterns and interventions in MASLD prevention and development within the MENA region	U	1	96.2	3.8	100.0	0.0	0.0	0.0	104
3.3	Investigate culturally sensitive interventions for MASLD prevention and management within the MENA region and assess their effectiveness	A		52.4	44.7	97.1	1.0	1.9	1.0	103
3.4	Evaluate the impact of the optimal management of MASLD related comorbidities (e.g., diabetes, obesity) on hepatic outcomes, within the MENA region	U	2	95.2	4.8	100.0	0.0	0.0	0.0	104
3.5	Evaluate the cost-effectiveness of the optimal management of MASLD related comorbidities (e.g., diabetes, obesity) on hepatic outcomes, within the MENA region	A	4	80.6	18.4	99.0	1.0	0.0	1.0	103
3.6	Evaluate the efficacy of multi-faceted strategies (addressing environmental, biological, and behavioural health risks and/or commercial and social determinants of health) in preventing MASLD-related complications, within the MENA region	A		68.0	30.1	98.1	1.0	1.0	1.0	103
3.7	Assess the cost-effectiveness of multi-faceted strategies (addressing environmental, biological, and behavioural health risks and/or commercial and social determinants of health) in preventing MASLD-related complications, within the MENA region	A		61.2	36.9	98.1	1.0	1.0	1.0	103
Domain 4: Education and awareness										
4.1	Investigate the educational needs of different healthcare providers (e.g., primary care, diabetes/endocrinology, obesity medicine, cardiology) about MASLD, within the MENA region	A	1	89.3	8.7	98.1	1.0	1.0	1.0	103
4.2	Study strategies to impact MASLD knowledge, attitudes, beliefs, and practices among relevant healthcare professionals (e.g., primary care, diabetes/endocrinology, obesity medicine, cardiology) within the MENA region	A	2	84.5	13.6	98.1	1.0	1.0	1.0	103
4.3	Conduct comparative population-based surveys to understand MASLD knowledge among the general population and high-risk groups within the MENA region, to inform the development of strategies to improve MASLD health literacy and other public health initiatives	A	3	73.1	26.0	99.0	1.0	0.0	0.0	104
Domain 5: Patient and community perspectives										
5.1	Evaluate if MASLD patient guidelines are available within the MENA region and increase the understanding of and adherence to management recommendations	A	1	87.5	10.6	98.1	1.0	1.0	0.0	104
5.2	Study the impact of MASLD management on quality of life, including functional status (physical, psychological, social), among people living with MASLD within the MENA region	A	2	82.7	16.3	99.0	1.0	0.0	0.0	104

(Continues)

TABLE 2 | (Continued)

Priorities		Grade	Rank	A (%)	SA (%)	A + SA (%)	SD (%)	D (%)	NQ (%)	*N*
5.3	Assess the experiences and needs of people living with MASLD and at-risk communities within the MENA region, including stigma and mental health	A		61.2	35.9	97.1	0.0	2.9	1.0	103
5.4	Assess the effectiveness of strategies for community engagement and education on MASLD, considering the cultural and linguistic diversity of the MENA region	A		61.5	35.6	97.1	2.9	0.0	0.0	104
5.5	Explore how socioeconomic factors, cultural practices, and religious behaviour (e.g., Ramadan fasting) could influence MASLD prevalence, diagnosis, and management within the MENA region	A	3	81.7	14.4	96.2	2.9	1.0	0.0	104
Domain 6: Leadership and policies for the MASLD public health agenda										
6.1	Conduct regular cross-sectional studies on national and regional policies and guidelines for MASLD prevention and management, to identify gaps, document trends, and assess implementation within the MENA region	A	1	86.4	11.7	98.1	0.0	1.9	1.0	103
6.2	Analyse non-communicable disease policy successes and failures to enhance MASLD management strategies within the MENA region	A	2	69.6	29.4	99.0	1.0	0.0	1.9	102
6.3	Study the impact of scientific and community stakeholder collaborations on MASLD knowledge and practices within the MENA region (in line with SDG 17: Partnerships for the Goals)	A		67.6	31.4	99.0	0.0	1.0	1.9	102
6.4	Investigate the role of MASLD management in achieving different SDGs (e.g., SDG 3: Good Health and Well-Being) within the MENA region	A		65.7	33.3	99.0	1.0	0.0	1.9	102
Mean % agreement				76.9	21.3	98.2				

Note: Percentages may add up to more than 100 due to rounding. Grades are based on the percentage of combined agreement (i.e., 'agree' + 'somewhat agree'). U, unanimous (100%) agreement; A, 90%–99% agreement. Responses to each priority are presented as percentages of the total responses.

Abbreviations: A, agree; D, disagree; MASH, metabolic dysfunction-associated steatohepatitis; MASLD, metabolic dysfunction-associated steatotic liver disease; MENA, Middle East and North Africa; *N*, total number of responses; NQ, not qualified to respond; SA, somewhat agree; SD, somewhat disagree; SDG, Sustainable Development Goal.

TABLE 3 | MASLD action priorities within the MENA region.

Priorities		Grade	Rank	A (%)	SA (%)	A + SA (%)	SD (%)	D (%)	NQ (%)	*N*
Domain 1: The human and economic burden										
1.1	Promote the standardisation of data collection and reporting on the human and economic burden of MASLD, to enable comparisons across different populations and settings within the MENA region	A	1	78.8	20.2	99.0	1.0	0.0	0.0	104
1.2	Develop national and regional investment cases, by modelling the direct and indirect costs and cost of inaction, to inform evidence-based action and advocacy on MASLD within the MENA region	A	2	57.8	41.2	99.0	1.0	0.0	1.9	102
Domain 2: Defining and implementing care models										
2.1	Liver specialists and primary care experts should collaborate to determine which non-invasive tests are most appropriate for assessing fibrosis risk within primary care settings, within the MENA region	A	1	87.5	9.6	97.1	2.9	0.0	0.0	104
2.2	Advocate for policies and guidelines that promote the timely referral and comprehensive care of people living with MASLD within well-defined care pathways, within the MENA region	A	2	85.6	13.5	99.0	1.0	0.0	0.0	104
2.3	Standardise key metrics for assessing MASLD care models within each country of the MENA region	A	3	70.2	26.9	97.1	1.0	1.9	0.0	104
2.4	Develop a range of context- and resource-specific MASLD multidisciplinary care models, to promote evidence-based knowledge sharing and optimum care for people living with MASLD within the MENA region	A		72.8	26.2	99.0	1.0	0.0	1.0	103
2.5	Develop and implement community-tailored MASLD care models for prevention and management, within the MENA region	A		74.0	25.0	99.0	1.0	0.0	0.0	104
Domain 3: Disease management										
3.1	Increase the use of patient-reported outcomes (e.g., patients' symptom, quality of life, and functional status description) as primary study outcomes in clinical and research settings, alongside clinical outcomes, within the MENA region	A	2	68.3	26.9	95.2	3.8	1.0	0.0	104
3.2	Develop tools to encourage and support the adoption of lifestyle interventions (e.g., dietary adjustments, physical activity modifications) to improve health outcomes in people living with MASLD within the MENA region	U	1	94.2	5.8	100.0	0.0	0.0	0.0	104
3.3	Consider the social determinants of health when developing management strategies for people living with MASLD within the MENA region	A	3	69.2	29.8	99.0	1.0	0.0	0.0	104
Domain 4: Education and awareness										

(Continues)

TABLE 3 | (Continued)

Priorities		Grade	Rank	A (%)	SA (%)	A + SA (%)	SD (%)	D (%)	NQ (%)	*N*
4.1	Invest in healthcare infrastructure and professional capacity to improve MASLD management within the MENA region	A	2	77.5	19.6	97.1	2.0	1.0	1.9	102
4.2	Enhance the knowledge of relevant healthcare providers, such as primary care physicians, diabetes and obesity specialists, and paediatric hepatologists, on the latest advancements and challenges in MASLD management, within the MENA region	U	1	94.2	5.8	100.0	0.0	0.0	0.0	104
4.3	Develop culturally relevant MASLD educational campaigns for the diverse communities found within the MENA region	A		79.8	18.3	98.1	1.0	1.0	0.0	104
4.4	Enhance coordinated efforts to raise public awareness about MASLD within the MENA region, emphasising prevention, early detection, and healthy lifestyle choices	U		91.3	8.7	100.0	0.0	0.0	0.0	104
Domain 5: Patient and community perspectives										
5.1	In line with SDG 5 on gender equality, consider potential gender-specific impacts of cultural factors on MASLD management, within the MENA region	A	2	49.0	41.2	90.2	8.8	1.0	1.9	102
5.2	Support the development of and access to community services for promoting healthy lifestyles among people living with MASLD, within MENA region	U	1	80.4	19.6	100.0	0.0	0.0	1.9	102
Domain 6: Leadership and policies for the MASLD public health agenda										
6.1	Encourage interdisciplinary experts to consider the recommended MASLD research and action priorities for adoption at national and sub-national levels, within the MENA region	A	1	86.4	12.6	99.0	1.0	0.0	1.0	103
6.2	Advocate for the incorporation of MASLD into relevant non-communicable disease strategies and guidelines, including those published by national and regional scientific societies within the MENA region	U	3	85.6	14.4	100.0	0.0	0.0	0.0	104
6.3	Implement strategies to limit the advertisement and accessibility of unhealthy food and drinks within the MENA region	A	2	88.5	10.6	99.0	1.0	0.0	0.0	104
6.4	Consider and address the commercial determinants of MASLD within the MENA region	A		72.8	26.2	99.0	1.0	0.0	1.0	103
6.5	Establish a collaborative interdisciplinary (e.g., researchers, clinicians, community representatives, policymakers) MASLD network within the MENA region to comprehensively advance disease understanding and management	U		90.4	9.6	100.0	0.0	0.0	0.0	104

(Continues)

TABLE 3 | (Continued)

Priorities		Grade	Rank	A (%)	SA (%)	A + SA (%)	SD (%)	D (%)	NQ (%)	N
6.6	Collaborate with global initiatives and international organisations and institutions to leverage expertise, resources, and support for addressing MASLD within the MENA region and worldwide	U		90.2	9.8	100.0	0.0	0.0	1.9	102
Mean % agreement				79.3	19.2	98.5				

Note: Percentages may add up to more than 100 due to rounding. Grades are based on the percentage of combined agreement (i.e., 'agree' + 'somewhat agree'). U, unanimous (100%) agreement; A, 90%–99% agreement. Responses to each priority are presented as percentages of the total responses.
Abbreviations: A, agree; D, disagree; MASLD, metabolic dysfunction-associated steatotic liver disease; MENA, Middle East and North Africa; *N*, total number of responses; NQ, not qualified to respond; SA, somewhat agree; SD, somewhat disagree; SDG, Sustainable Development Goal.

management, was also recognised as a priority (action priority 2.4). The integration of specialised knowledge into PCP and liver specialist workflows requires a patient-centred, system-wide approach to MASLD management that could enhance patient outcomes and quality of care in an economically feasible manner [29, 30].

As for the *disease management* domain, the panel unanimously endorsed the development of tools that can be used to promote healthy lifestyles (action priority 3.2; ranked as first in its domain). This priority stems from the lack of universally accepted guidelines for the prevention and management of MASLD via pharmacological and/or non-pharmacological interventions. This lack of standardised therapeutic approaches poses significant challenges [31]. Within the MENA region, dietary habits often include high consumption of refined carbohydrates, saturated fats, and sugars, which are associated with an increased risk of MASLD [19, 28]. By investigating the role of dietary patterns and interventions on MASLD prevention and development, which panellists unanimously prioritised (research priority 3.2; ranked as first in its domain), disease management could be tailored to regional food availability, cultural practices, and eating habits and effective prevention strategies could be developed.

Within the same domain, the panel highlighted the importance of incorporating patient-reported outcomes (PROs), such as symptoms, quality of life, and functional status, as primary outcomes in clinical and research settings, within the region (action priority 3.1; ranked as second in its domain). Focusing solely on clinical outcomes, such as liver function tests or fibrosis stage, provides an incomplete picture of how MASLD affects individuals. PROs offer critical insights into how the disease impacts patients' daily lives, including their mental and physical well-being, productivity, and overall satisfaction with care [4]. In the MENA region, where there may be variations in healthcare access, social support, and cultural perceptions around illness, incorporating PROs into research and clinical practice would provide a more comprehensive understanding of patients' needs and preferences [32].

Despite being the most prevalent liver disease worldwide, MASLD remains relatively obscure outside the realms of hepatology and gastroenterology. Thus, the panel unanimously prioritised increasing MASLD awareness among PCPs, within the *education and awareness* domain (action priority 4.2; ranked as first in its domain), which is notably limited [22]. Moreover, as MASLD pathogenesis involves complex interactions among different body systems, identifying distinct subphenotypes within MASLD is crucial for tailoring precise treatment strategies and improving patient outcomes [20, 33]. Therefore, the panel emphasised investigating the educational needs of healthcare providers (HCPs), such as PCPs, endocrinologists, obesity medicine experts, and cardiologists, within the region (research priority 4.1; ranked as first in its domain). These specialists must be aware of the interactions between their areas of expertise and MASLD to provide comprehensive, integrated care. Such educational initiatives can also promote the use of non-invasive diagnostic tools, early interventions, and evidence-based treatment guidelines, ensuring that patients receive consistent and high-quality care, with the ultimate goal of reducing the burden of the disease

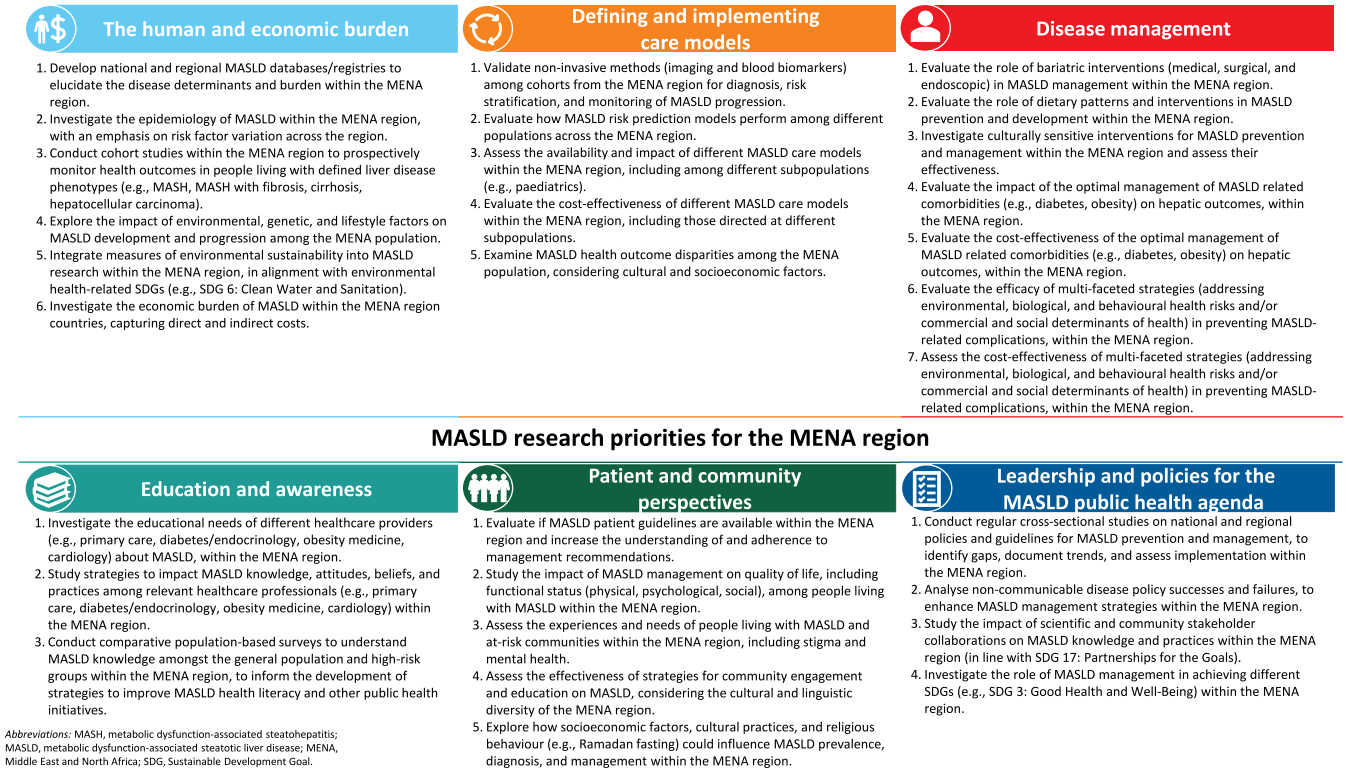

FIGURE 2 | MASLD research priorities for the MENA region.

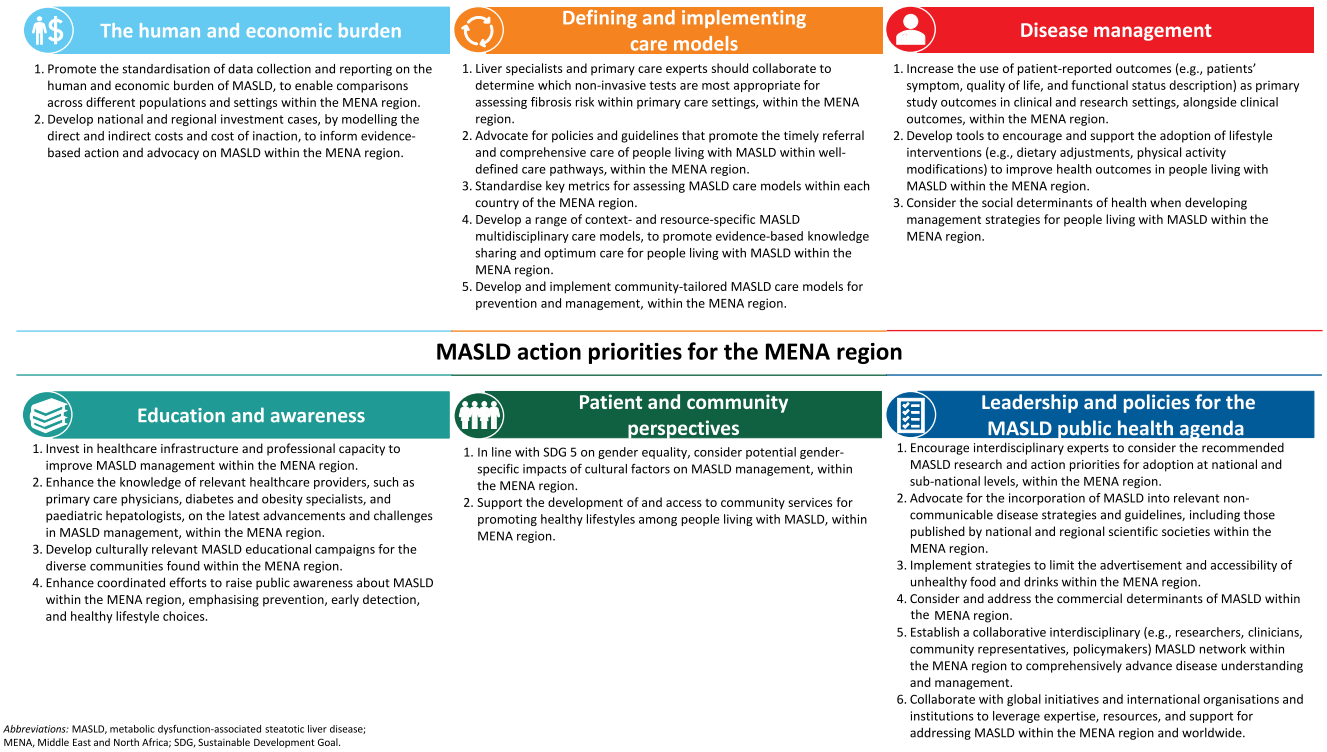

FIGURE 3 | MASLD action priorities for the MENA region.

and improving public health outcomes. Furthermore, studying strategies to impact the MASLD-related attitudes, beliefs, and practices of HCPs are needed to enhance disease management, a priority which panellists highlighted (research priority 4.2; ranked as second in its domain). Research on MASLD knowledge among the public to improve disease-related health literacy is also pivotal, as emphasised by the panel (research priority 4.3; ranked as third in its domain) and is needed before broad, comprehensive MASLD educational initiatives can be undertaken.

In terms of the *patient and community perspectives* domain, the panel prioritised enhancing the comprehension and adherence to MASLD management recommendations among patients within the MENA region (research priority 5.1; ranked as first in its domain). This priority addresses the major gap between evidence-based recommendations and real-world practice, which is essential for improving patient outcomes and mitigating the growing burden of MASLD in the region. This gap may be further addressed through the development of a multidisciplinary care models, the collection of PROs that include health related quality of life, and education strategies, as described above [34, 35].

In order for all of the above priorities to be implemented, the priorities in the last domain, *leadership and policies for the MASLD public health agenda*, need to be considered. For instance, the call for conducting regular cross-sectional studies on national and regional policies and guidelines for MASLD prevention and management to identify gaps, document trends, and assess implementation (research priority 6.1; ranked as first in its domain) is critical in optimising disease management strategies. Policies often lag behind advancements in scientific understanding and clinical practices, leading to inefficiencies in addressing health conditions. By systematically documenting trends, assessing the alignment of existing policies with evidence-based practices, and identifying implementation barriers, stakeholders can refine strategies to enhance MASLD outcomes. This approach ensures that policies evolve in response to emerging challenges and opportunities, ultimately fostering more effective prevention and management programmes. The panellists also supported analysing the successes and failures of non-communicable disease (NCD) policies to enhance MASLD management strategies within the MENA region (priority 6.2; ranked as second in its domain). The analysis of NCD policy frameworks can reveal best practices that can be adapted for MASLD and enabling learning from unsuccessful approaches. Moreover, collaboration among researchers, HCPs, policymakers, and community organisations can help to bridge the gap between knowledge and practice, resulting in more effective and sustainable interventions, a priority that the panel unanimously endorsed (action priority 6.5). The panel also emphasised the importance of encouraging interdisciplinary experts to consider the recommended MASLD research and action priorities for adoption at national and sub-national levels within the MENA region (action priority 6.1; ranked as first in its domain). By engaging diverse stakeholders and integrating MASLD priorities into public health agendas, the region can ensure that strategies are aligned, contextually relevant, and broadly impactful. For example, widespread implementation of policies to limit the advertisement and accessibility of unhealthy foods and beverages in the region (action priority 6.3; ranked as second in its domain) could help to curb obesity and related diseases, like MASLD, given the increasing prevalence of metabolic disorders in the MENA region [2, 8, 9, 11]. As such, the panel prioritised addressing the commercial determinants of MASLD within the region (action priority 6.4). Related strategies could include lobbying for better regulation around food production, improving labelling standards, and creating economic incentives for the production and consumption of healthier food. Finally, panellists unanimously endorsed regional collaboration with global initiatives and international organisations to leverage expertise, resources, and support for addressing MASLD within the region and globally (action priority 6.6). Such partnerships are pivotal as fragmented efforts are unsustainable and only by cooperating across disciplines, sectors, and nations will we be able to tackle NCDs like MASLD.

This study is the first to propose a comprehensive research and action priority agenda for MASLD within the MENA region, via a rigorous Delphi methodology. The high combined agreement among panellists across all priorities highlights the significance of this effort and marks a crucial achievement for the MENA region and the MASLD field. These priorities not only emphasise the interconnectedness of MASLD with wider health, economic, and societal factors, but also provide a framework with broad scoping initiatives to address this multi-faceted disease. A limitation of this study is the relatively small number of panellists included. However, the work accomplished provides a base from which to begin working in a strategic manner to address the impact of MASLD within the MENA region and, ultimately, worldwide.

5 | Conclusion

This study established consensus-built research and action priorities to effectively advance the MASLD agenda, from evidence-base building to clinical practice and policy, within the MENA region. Addressing MASLD comprehensively region-wide will require a significant shift in approach, including expanding the community of practice and emphasising collaboration across different fields of practice. By prioritising these strategies, stakeholders can enhance the understanding, prevention, and management of MASLD, ultimately improving health outcomes within the region.

Author Contributions

This study was led by a core group of 16 authors. M.E.-K. led the core group. J.V.L. and Y.Z. led the conceptualisation. M.V.-R. led the methodology. Collaborators participated in two Delphi rounds. K.A.A., K.M.A., Y.Y., F.M.S., M.E., N.A., and A.-N.E. reviewed the comments submitted as part of the two Delphi rounds. A.L., M.W.I.A., and S.A.A. were responsible for the communication pertaining to and coordination of distribution of the surveys. M.V.-R., M.E.-K., and A.A. wrote the first draft of the manuscript, which was reviewed and edited further by L.H. and J.V.L. All authors revised and approved the final version of the manuscript. Those fulfilling authorship criteria are named.

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Ethics Statement

This study received ethical review exemption in 2024 from the Hospital Clínic of Barcelona, Spain, as it did not involve patients, patient data, or biological samples. Panellists consented to participate, and measures were taken to ensure data protection and confidentiality, with all data being de-identified for analysis.

Conflicts of Interest

M.E.-K. is an investigator/speaker/advisory board member for AstraZeneca, Roche, MSD, AbbVie, Eva, Mash Premier, Takeda, Organon, AUG, Inspire, HSO, Gilead, Janssen, Intercept, Rameda, FPI, Ipsen, Onxeo, Sanofi, Sandoz, Al Andalus Pharma, MinaPharm, Inspire, Pharco, Zeta, Alfa Cure, Bayer, Oncoustics, PDC, Acino, and Spimaco, outside of this work. Y.Y. is a consultant for Novo Nordisk, Zydus, Cymabay, Akero, and Echosens, outside of this work. Z.Y. is a consultant for Madrigal, Intercept, Novo Nordisk, Boehringer Ingelheim, GSK, Ipsen, Abbott, Siemens, and Akero, outside of this work. J.V.L. acknowledges grants to ISGlobal from AbbVie, Boehringer Ingelheim, Echosens, Gilead Sciences, Madrigal Pharmaceuticals, Moderna, MSD, Novo Nordisk, Pfizer, and Roche Diagnostics, consulting fees from Echosens, GSK, Novavax, Novo Nordisk, Pfizer, and Prosciento, and payment or honouraria for lectures from AbbVie, Echosens, Gilead Sciences, Janssen, Moderna, MSD, Novo Nordisk, and Pfizer, outside of this work. M.V.-R., K.A.A., K.M.A., A.L., F.M.S., A.A., M.W.I.A., S.A.A., M.E., N.A., L.H., and A.-N.E. have no conflicts of interest to declare.

Data Availability Statement

De-identified source data for all analyses will be made available for fair use by contacting the corresponding author (m_elkassas@hq.helwan.edu.eg), with appropriate ethical approval.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section.

Appendix A

Authorship list: Steatotic Liver Disease Study Foundation in Middle East and North Africa (SLMENA) Collaborators

Mohamed El-Kassas[1,2,3], Marcela Villota-Rivas[4], Khalid A. Alswat[2,3,5], Khalid M. AlNaamani[2,3,6], Yusuf Yilmaz[2,3,7], Asma Labidi[2,8], Faisal M. Sanai[2,9], Abeer Awad[10], Maisam W.I. Akroush[2,11], Saleh A. Alqahtani[3,12], Mohamed Elbadry[1,2], Nermeen Abdeen[13], Linda Henry[3,14], Zobair M Younossi[3,14], Jeffrey V. Lazarus[4,15,16], Abdel-Naser Elzouki[2,17], Faisal A. Abaalkhail[18], Haifa Abdesselem[19], Maheeba A. Abdulla[20], Meral Akdogan Kayhan[21], Fatma E. Akin[22], Said A. Al-Busafi[23], Waleed K. Al-hamoudi[24], Abdulrahman A. Al-Hussaini[25], Ahmad Al-Rifai[26], Khaldon K. Al-Sarihin[27], Ali A. Alali[28], Assaad Aldafter[29], Saad M. Aldosari[30], Assim A. Alfadda[31], Abdullah S. Alghamdi[32], Mohammed Y. Alghamdi[33], Ala K. Ali[34], Mohammed Aljawad[35], Abdulrahman A. Aljumah[36], Nasser M. ALMasri[37], Maen AlMattooq[38], Dalal Alromaihi[39], Ashraf F. Alsahafi[40], Ibrahim H. Altraif[41], Nourdin Aqodad[42], Derya Ari[43], Cigdem Arikan[44], Zayed A. Atef[45], Fehmi Ates[46], Ugur Avci[47], Mohamed M. Awad[48], Myriam Ayari[49], Mohamed A. Babatin[50], İbrahim H. Bahçecioğlu[51], Yasemin H. Balaban[52], Mustapha Benazzouz[53], Olfa Berriche[54], Sultan A. Bin Tarif[55], Mona Boudabbous[56], Arif Mansur Cosar[57], Nabil Debzi[58], Coskun O. Demirtas[59], Dinc Dincer[60], Suhail A. Doi[61], Iman EL Sherif[62], Hanaa M. El-Karaksy[63], Mortada H.F. El-Shabrawi[63], Nour Elleuch[64], Medhat H. Elsahhar[65], Nehal Hamdy Elsaid Awad[66], Aisha Elsharkawy[67], Reda Elwakil[68], Rym Ennaifer[69], Askin Erdogan[70], Gamal Esmat[71], Mamdouh A. Gabr[72], Genco Gencdal[73], Lina J. Haddad[74], Bilal H. Hotayt[75], Mona H. Ismail[76], Zahi Ismaili[77], Hani A. Jawa[78], Saibe Merve Kazdal[79], Ayse Kefeli[80], Murat Kekilli[81], Caglayan Keklikkiran[82], Ashraf T. Mahmoud[83], Mohammad Mawardi[84], Mohammed A. Medhat[85], Engy A. Mogahed[86], Mohsen S. Mohamad[87], Heba Omar[88], Ashraf O. Osman[89], Radia Osmane[90], Ozen Oz Gul[91], Tugce Ozlu Karahan[92], Yaser M. Rayyan[93], Khadidja Saidani[94], İlker Şen[95], Abdelhamid A. Serwah[96], Ala I. Sharara[97], Mrabet Soumaya[98], Raja Tlili[99], Damla Tüfekçi[100], Ali Tumi[101], İnci Türkoğlu[102], Melin M. Uygur[103], Imam Waked[104], Haythem Yacoub[105], Cesar G. Yaghi[106], Suna Yapali[107], Yosra Zaimi[108], Doaa Z. Zaky[68], Shahrazed Zemmouchi[109].

[1]Endemic Medicine Department, Faculty of Medicine, Helwan University, Cairo, Egypt; [2]Steatotic Liver Disease Study Foundation in Middle East and North Africa (SLMENA), Cairo, Egypt; [3]The Global NASH/MASH Council, Washington DC, USA; [4]Barcelona Institute for Global Health (ISGlobal), Barcelona, Spain; [5]Liver Disease Research Center, Department of Medicine, College of Medicine, King Saud University, Riyadh, Saudi Arabia; [6]Division of Gastroenterology and Hepatology, Department of Medicine, The Medical City for Military and Security Services, Muscat, Oman; [7]Department of Gastroenterology, School of Medicine, Recep Tayyip Erdoğan University, Rize, Turkey; [8]Department of Gastroenterology "A", Rabta Hospital, Tunis, Tunisia; [9]Department of Medicine, Gastroenterology Section, King Abdulaziz Medical City, King Abdullah International Medical Research Center, Ministry of National Guard—Health Affairs, Jeddah, Saudi Arabia; [10]Internal Medicine Department, Faculty of Medicine, Cairo University, Cairo, Egypt; [11]Digestive and Liver Disease Clinic, Private Sector, Faculty of Medicine, Jordan University, Amman, Jordan; [12]Liver, Digestive, and Lifestyle Health Research Section, and Organ Transplant Center of Excellence, King Faisal Specialist Hospital and Research Center, Riyadh, Saudi Arabia; [13]Tropical Medicine Department, Faculty of Medicine, Alexandria University, Alexandria, Egypt; [14]Beatty Liver and Obesity Research Program, Inova Health System, Falls Church, Virginia, USA; [15]City University of New York Graduate School of Public Health and Health Policy (CUNY SPH), New York, New York, USA; [16]Facultat de Medicina i Ciències de la Salut, Universitat de Barcelona (UB), Barcelona, Spain; [17]Department of Medicine, Hamad Medical Corporation and College of Medicine, Qatar University, Doha, Qatar; [18]Department of Medicine, King Faisal Specialist Hospital, Riyadh, Saudi Arabia; [19]Department of Nutritional Diseases D, National Institute of Nutrition, Tunis, Tunisia; [20]Department of Medicine, Ibn AlNafees Hospital, Manama, Bahrain; [21]Department of Gastroenterology, Health Science University, Bilkent City Hospital, Ankara, Turkey; [22]Gastroenterology Department, Ankara Yildirim Beyazit University Medical School, Bilkent City Hospital, Ankara, Turkey; [23]Department of Medicine, College of Medicine and Health Sciences, Sultan Qaboos University, Muscat, Oman; [24]Liver Disease Research Center, King Saud University, Riyadh, Saudi Arabia; [25]Division of Paediatric Gastroenterology and Hepatology, Children's Specialized Hospital, King Fahad Medical City, Riyadh, Saudi Arabia; [26]Department of Gastroenterology and Hepatology, Sheikh Shakhbout Medical City, Abu Dhabi, United Arab Emirates; [27]Endocrine Division, King Hussein Medical Center, Amman, Jordan; [28]Department of Medicine, Faculty of Medicine, Kuwait University, Jabriya, Kuwait; [29]Department of Internal Medicine, Noor Specialist Hospital, Manama, Bahrain; [30]Department of Medicine, King Abdulaziz Medical City, Jeddah, Saudi Arabia; [31]Obesity Research Center and the Department of Medicine, College of Medicine, King Saud University, Riyadh, Saudi Arabia; [32]Gastroenterology Unit, Department of Medicine, King Fahad Hospital, Jeddah, Saudi Arabia; [33]Department of Medicine, KFMMC, Dhahran, Saudi Arabia; [34]Abdali Hospital, Amman, Jordan; [35]Department of Medicine, Johns Hopkins Aramco Health Care, Dhahran, Saudi Arabia; [36]College of Medicine, Dar Al Uloom University, Riyadh, Saudi Arabia; [37]Gastroenterology & Hepatology Department, PSMMC, Riyadh, Saudi Arabia; [38]Department of Gastroenterology, Kuwait City, Kuwait; [39]Department of Medicine, Royal College of Surgeons in Ireland—Medical University of Bahrain, Awali Hospital, Awali, Bahrain; [40]Department of Paediatrics, King Abdullah Specialized Children Hospital, Ministry of National Guard, Riyadh, Saudi Arabia; [41]Department of Medicine, Dr. S Fakeeh Hospital, Riyadh, Saudi Arabia; [42]Gastroenterology Department, Sousse Massa Hospital University, Agadir, Morocco; [43]Department of Gastroenterology, Ankara Bilkent City Hospital, Ankara, Turkey; [44]Paediatric Gastroenterology, Hepatology and Nutrition, School of Medicine, Koç University, Istanbul, Turkey; [45]Department of Medicine, Sana'a University, Sana'a, Yemen; [46]Department of Gastroenterology, Mersin University Hospital, Mersin, Turkey; [47]Recep Tayyip Erdogan University, Faculty of Medicine, Rize, Turkey; [48]Department of Medicine, Diabetes and Endocrine Division, Zagazig University, Zagazig, Egypt; [49]Department of Hepato-Gastroenterology, Internal Security Forces Hospital La Marsa, Tunis, Tunisia; [50]Department of Medicine, King Fahad Hospital, Ministry of Health, Jeddah, Saudi Arabia; [51]Department of Gastroenterology, Firat University, Elazig, Turkey; [52]Department of Internal Medicine/ Gastroenterology, Hacettepe University, Ankara, Turkey; [53]Department of Gastroenterology and Hepatology, International University of Rabat, Rabat, Morocco; [54]Department of A, Institute of Nutrition and Food Technology, Tunis, Tunisia; [55]Private Sector, Amman, Jordan; [56]Department of Gastroenterology, Hédi Chaker Hospitalier, Sfax, Tunisia; [57]Department of Gastroenterology, Karadeniz Technical University, Trabzon, Turkey; [58]Hepatology Department, Mustapha Bacha University Hospital, Algiers, Algeria; [59]Division of Gastroenterology and Hepatology, Marmara University School of Medicine, Istanbul, Turkey; [60]Department of Gastroenterology, Akdeniz University Hospital, Antalya, Turkey; [61]Department of Population Medicine, Qatar University, Doha, Qatar; [62]Department of Internal Medicine, Suez Canal University, Ismailia, Egypt; [63]Department of Paediatrics, Cairo University, Cairo, Egypt; [64]Department of Gastroenterology, Sahloul Hospital, Sousse, Tunisia; [65]Department of Hepatology & Gastroenterology, Police Authority Hospitals, Cairo, Egypt; [66]Department of Internal Medicine, Faculty of Medicine, Cairo University, Cairo, Egypt; [67]Endemic Medicine and Hepatogastroenterology Department, Cairo University, Cairo, Egypt; [68]Tropical Medicine Department, Ain Shams University, Cairo, Egypt; [69]Department of Hepato-Gastro-Enterology, Mongi Slim University Hospital, Tunis, Tunisia; [70]Department of Internal Medicine, Alanya Alaaddin Keykubat University, Antalya, Turkey; [71]Endemic Medicine Department, Cairo University, Cairo, Egypt; [72]Internal Medicine Department, Tanta University, Tanta, Egypt; [73]Department of Gastroenterology, Koc University, Istanbul, Turkey; [74]Amman, Jordan; [75]Department of Gastroenterology, Belle Vue Medical Center, Beirut, Lebanon; [76]Division of Gastroenterology, Department of Internal Medicine, King Fahd Hospital of the University-Al-Khobar, Al Khobar, Saudi Arabia; [77]Department of Hepato-Gastroenterology, Mohammed

VI University Hospital, Oujda University, Oujda, Morocco; [78]Department of Medicine, King Abdulaziz University, Jeddah, Saudi Arabia; [79]RTEU Training and Research Hospital, Rize, Turkey; [80]Department of Gastroenterology, Gaziosmanpasa University, Tokat, Turkey; [81]Department of Gastroenterology, Gazi University Hospital, Ankara, Turkey; [82]Department of Gastroenterology, Recep Tayyip Erdogan University, Rize, Turkey; [83]Internal Medicine Department, Damietta University Hospitals, Damietta, Egypt; [84]Department of Internal Medicine, King Faisal Specialist Hospital and Research Center, Jeddah, Saudi Arabia; [85]Tropical Medicine and Gastroenterology Department, Assiut University, Assiut, Egypt; [86]Department of Paediatrics, Cairo University, Giza, Egypt; [87]Clinical Hepatology Department, National Liver Institute, Shebeen El Koum, Egypt; [88]Department of Endemic Medicine and Hepatology, Faculty of Medicine, Cairo University, Cairo, Egypt; [89]Department of Endemic Medicine and Hepatology, Cairo University Hospital, Cairo, Egypt; [90]Department of Medicine, Faculty of Algiers, Algiers, Algeria; [91]Department of Endocrinology, Uludag University Medical School, Bursa, Turkey; [92]Department of Nutrition and Dietetics, Health Sciences Faculty, Istanbul Bilgi University, Istanbul, Turkey; [93]Department of Medicine, School of Medicine, The University of Jordan, Amman, Jordan; [94]Department of Medicine, Central Army Hospital, Algiers, Algeria; [95]Department of Gastroenterology, Sisli Etfal Education and Training Hospital, Istanbul, Turkey; [96]Department of Medicine, Suex Canal University, Ismailia, Egypt; [97]Department of Medicine, American University of Beirut Medical Center, Beirut, Lebanon; [98]Department of Gastroenterology, Farhat Hached University Hospital, Sousse, Tunisia; [99]Department of Gastroenterology, Hospital Mahmoud Matri, Ariana, Tunisia; [100]Department of Endocrinology and Metabolism, Recep Tayyip Erdogan University, Rize, Turkey; [101]Department of Internal Medicine, Central Hospital, Tripoli, Libya; [102]Department of Nutrition and Dietetics, Hacettepe University, Ankara, Turkey; [103]Department of Endocrinology and Metabolism Disease, School of Medicine, Recep Tayyip Erdoğan University, Rize, Turkey; [104]Hepatology Department, National Liver Institute, Cairo, Egypt; [105]Department of Gastroenterology B, La Rabta Hospital, Tunis, Tunisia; [106]Hotel-Dieu de France University Hospital, Department of Gastroenterology and Hepatology, Beirut, Lebanon; [107]Division of Gastroenterology, Acibadem University, Istanbul, Turkey; [108]Department of Gastroenterology, Charles Nicolle Hospital, Tunis, Tunisia; [109]Department of Medicine, Bologhine University Hospital, Algiers, Algeria.