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Original Article

Co-designing Approaches to Sustainable Exercise Care for People with Metabolic Dysfunction-associated Steatotic Liver Disease

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Abstract

Background and Aims: Regular exercise is fundamental for people with metabolic dysfunction-associated steatotic liver disease (MASLD), yet exercise maintenance is generally poor. This generative co-design process aimed to embed the voices and opinions of people with lived experience of MASLD and their care stakeholders to (i) frame barriers and enablers to exercise maintenance and (ii) highlight priorities for exercise-focused research agendas in MASLD. ***Methods:*** A generative co-design framework was applied. Two virtual co-design sessions were undertaken: *Session 1 – Framing the issue*, where initial discovery was conducted with people with lived experience of MASLD; and *Session 2 – Generative design and sharing ideas* with lived experience partners and healthcare stakeholders. Sessions were audio-recorded and transcribed, and key determinants and considerations were discerned by two independent researchers. ***Results:*** Lived experience partners (n = 5, 53 ± 16 years, 40% male) ranked five equally important barriers to exercise maintenance: musculoskeletal and pain issues, lack of access to exercise equipment/facilities, cost, competing priorities, and low energy levels, which influenced core positive and negative determinants. Alongside lived experience partners, healthcare stakeholders (hepatologists [n = 3], exercise professionals [n = 3], 67% male) identified three core needs with eight considerations. Some disconnects in priorities were observed. Lived experience partners emphasized affordability, accessibility, and considerations for comorbidities, while healthcare partners advocated for research on natural history, prevention, behavior change, cost-effectiveness, and health system change. ***Conclusions:*** This co-design methodology highlights unique consumer-informed research questions. Exercise interventions and their associated implementation trials will benefit from being co-designed with both people with MASLD and care stakeholders.

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Introduction

Metabolic dysfunction-associated steatotic liver disease (MASLD) affects approximately one third of adults globally.[1] The increasing prevalence of MASLD is linked to the obesogenic environment (e.g., poor diet quality, food inequity and insecurity, physical inactivity) and is underpinned by metabolic dysregulation.[2,3] Healthy eating and physical activity, including its subdomain exercise, are central to the lifelong management of MASLD.[3] Despite the emergence of new drugs for MASLD treatment, these lifestyle-related factors remain fundamental components of care.[4] For example, in the United States, the newly approved thyroid hormone receptor-β agonist Resmetirom is indicated for use in combination with diet and exercise, and many payers require enrollment in a lifestyle intervention or an attempt at lifestyle change prior to prescription. The broad benefits of exercise training for

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MASLD management include reducing hepatic steatosis, inflammation, and hepatic stiffness, as well as improving body composition, cardiometabolic disease risk, and cardiorespiratory fitness.[5–7]

Reducing physical inactivity is considered a 'best buy' intervention to address the burden of steatotic liver disease.[8] International guidelines for physical activity and exercise for MASLD management were recently published, providing a framework for exercise assessment and prescription within the setting of patient-centred multidisciplinary care.[5,6] Despite compelling evidence for health benefits, only approximately 20% of people with MASLD meet recommended physical activity guidelines.[9–11] The literature base for exercise and MASLD is largely derived from short-term, supervised, laboratory-centred settings.[5] Only two trials have evaluated longer-term follow-up after supervised intervention, and these have found exercise maintenance to be poor.[12,13] This hinders the scaled translation of exercise programs for implementation in the MASLD community.

People living with MASLD experience higher levels of fatigue, decreased physical function, poor cardiorespiratory fitness, and exhibit higher perceived exertion rates at equal activity thresholds, which collectively may contribute to lower engagement in physical activity.[14–16] People with metabolic dysfunction-associated steatohepatitis (MASH) have reported that support from exercise specialists is a valued enabler of exercise uptake and maintenance, supporting session logistics, accountability, and a sense of safety.[12] However, there are no established models of exercise care for MASLD management globally. Moreover, qualitative evaluations of participant experiences and perceptions of exercise following supervised and self-directed (unsupervised) programs have indicated a disconnect between the clinical research primary and secondary outcomes and patient-important outcomes.[11,12] This disconnect may hinder patient motivation for exercise.

For interventions to be sustainable within the healthcare system, they also need to be delivered with fewer resources and at a lower cost. Suitable and sustainable options for exercise maintenance for people with MASLD need to be understood and explored. Recently, global action[17] and global research[18] agendas were developed in collaboration with a large international multidisciplinary panel to establish priorities for research and public health action for MASLD. A unified, standardized, and consumer-informed approach to exercise-related research, and community priorities that align with these global MASLD priorities, are needed to advance research and implement innovative exercise care solutions. Therefore, this generative co-design process aimed to (i) engage people living with MASLD who had previous experience initiating exercise to understand and document key barriers to sustained engagement with physical activity/exercise maintenance and (ii) co-design a research agenda including core research priorities, methodologies, and patient-important and stakeholder-important research outcomes related to sustainable exercise.

Methods

Study design

This study employed a generative co-design framework specific to healthcare innovation, as proposed by Bird and colleagues,[19] to comprehend and explain the perceptions and experiences of consumers and stakeholders across two sequential co-design focus groups (Fig. 1). *Co-Design Session 1 – framing the issue* (Step 3 of the framework) sought to undertake an initial discovery session with consumer partners with lived experience of MASLD who had at least one prior experience with exercise engagement. *Co-Design Session 2 – generative design and sharing ideas* (Step 4) aimed to build on the discovery session to co-develop research approaches with consumer partners and care stakeholders (clinicians and industry representatives). Prior to co-design, preparation and training of partners were undertaken (Step 2, Fig. 1). All procedures were conducted in accordance with the ethical standards of the 2024 Helsinki Declaration and its later amendments and were approved by The University of Queensland Human Research Ethics Committee (2016000010). Methods and outcomes have been reported according to the GRIPP 2 checklist for reporting patient and public involvement in research.[20]

Partners and recruitment

The overall sample size (n = 11 partners) was selected according to recommendations for traditional co-design practices[21] and partnership-focused, principles-driven online co-design.[22] A higher number of lived experience partners were selected to address potential power imbalances within that group.[22] All partners were purposively sampled from the research team's clinical and research networks. Lived experience (consumer) partners included people with MASLD who had previous experience with physical activity/exercise and varying levels of exercise maintenance (4/5 not meeting guideline-based amounts of physical activity). Stakeholder partners included clinicians (clinician-research hepatologists) and industry representatives (clinical exercise professionals accredited by the professional accrediting body, Exercise and Sports Science Australia (ESSA)). All partners received emails describing the project, and written informed consent was obtained from all partners before undertaking surveys and participating in the focus groups.

Data collection

Online survey: One week prior to each focus group, all partners (lived experience and stakeholders) were given access to an online participant survey to capture demographics, including age, gender, ethnicity, employment details, confidence to exercise, current level of engagement in physical activity, and amount of sedentary behavior. Additionally, lived experience partners were asked about their initial MASLD diagnosis (previously termed non-alcoholic fatty liver disease. Stakeholder (clinician and industry) partners were additionally asked about their years in their current clinical/industry roles and employment settings.

Focus groups: Semi-structured focus groups were conducted via video consultation (Zoom™) and facilitated by two researchers (SK, female, accredited exercise physiologist; IH, female, dietitian and implementation scientist) with experience in qualitative descriptive design methods. Sessions were audio recorded and auto-transcribed via the Zoom™ platform.

Co-Design Session 1 – framing the issue (90 min, lived experience partners only) focused on three topics: (i) developing an understanding of the issues regarding poor long-term exercise maintenance, (ii) a mutual understanding of lived experiences and challenges faced by partners, and (iii) initial ideation for research methods that can address arising issues. Throughout the session, four main questions regarding exercise maintenance were explored to facilitate discussion of barriers and facilitators to exercise among individuals with MASLD. To address topic (ii), the primary facilitator (SK) created an online poll to quantify the main barriers to exercise maintenance experienced by participants. The first poll con-

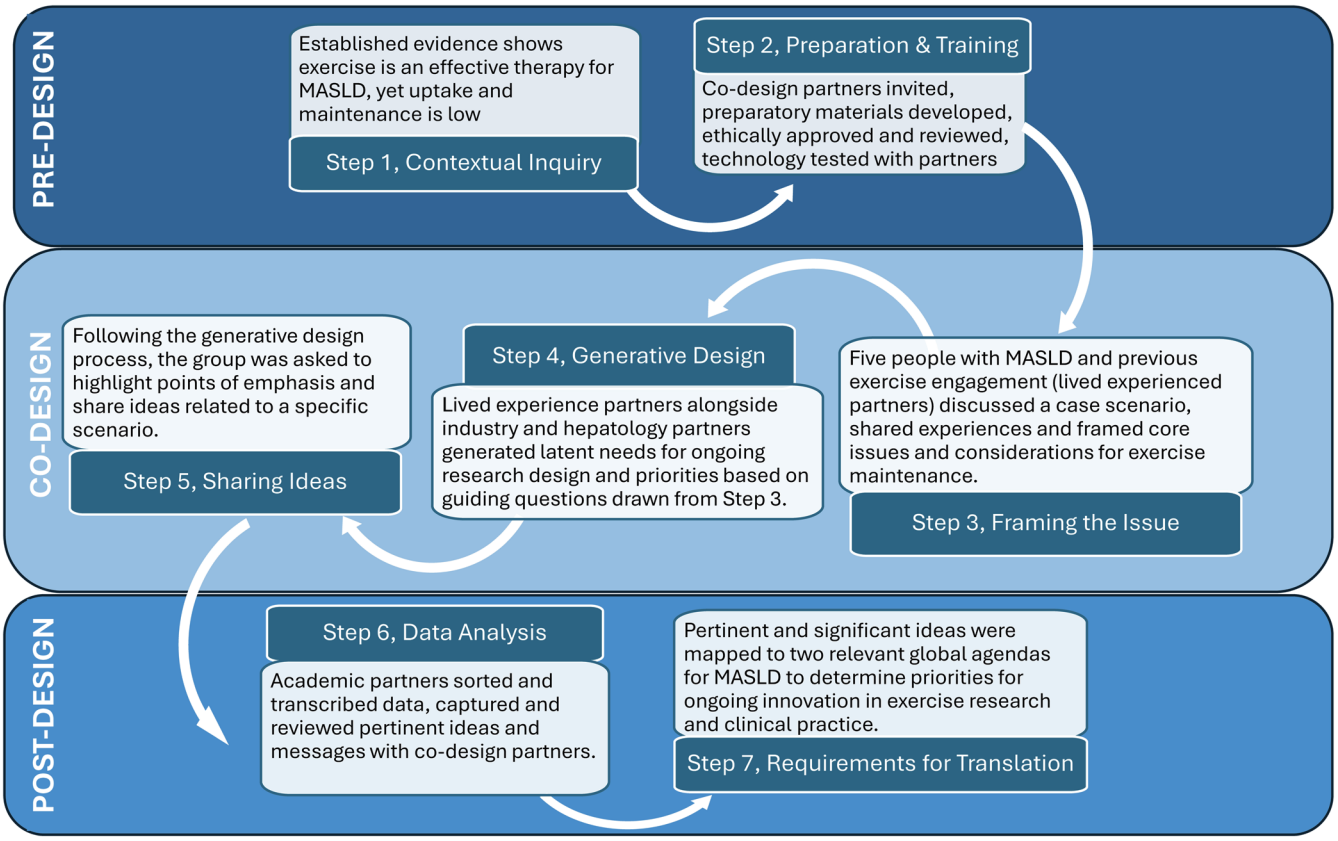

Fig. 1. Generative co-design process employed in the study. Adapted from Bird *et al.* 2021. MASLD, metabolic dysfunction-associated steatotic liver disease.

sisted of 16 possible barriers drawn from data derived from themes (i) and (ii) during 'framing the issue' and current evidence,[11,12,23] with multiple rounds employed until a 'top five' consensus was reached. Barriers selected by at least 3/5 partners (60%) progressed to the next round. In round 1, participants were instructed to select up to 10 barriers they experienced or to list their own. The anonymous vote results were viewed and discussed, and nine barriers were selected for round 2. In round 2, participants were asked to select their top five. The top seven were selected for the final round, where participants again selected their top five. The process was completed when a clear 'top five' barriers emerged.

Co-Design Session 2 – generative design and sharing ideas (90 min, consumer [lived experience], clinician, and industry partners) involved tailored questions applicable to each group's specific roles and experiences.

Data analysis

Responses to survey questions were summarized with descriptive statistics. Focus group transcripts were reviewed and corrected by two researchers (GC and JdB) to ensure accurate verbatim transcriptions. De-identified transcripts were independently reviewed for data familiarization, preliminary coding, and theming (GC, JdB, and SK) of determinants, barriers, and/or enablers for exercise maintenance, following the generative co-design framework.[19] Coding was managed in Microsoft Excel and examined independently (GC, JdB, and SK) for key barriers and enablers. To validate interpretations and ensure consistency, key concepts were cross-checked with relevant quotes tabulated in Microsoft Excel.

To address the 'Requirements Translation' (Step 7, Fig. 1) of the co-design framework, key determinants, needs, and considerations were mapped to the Global Research Priority Agenda (six domains, 28 priorities)[18] and the Global Action Agenda (six domains, 29 recommendations).[17]

Results

Five lived experience (consumer) partners participated in *Co-Design Session 1 – framing the issue*. Of these five lived experience partners, four had participated in a research study that included both supervised and self-directed exercise phases.[24] The other was recruited through a consumer-engagement conference via advertising. All lived experience partners reported sporadic engagement with exercise since the formal intervention, with only one partner sustaining at least 120 min per week for the last two weeks (Table 1). Lived experience partners rated their confidence to exercise as 3 ± 0.7 on a scale from 1 (no confidence) to 5 (high confidence). One partner was unable to attend the second session; therefore, four lived experience partners, three hepatologists, and three exercise physiologists participated in *Co-Design Session 2 – generative design and sharing ideas*. Socio-demographic characteristics of partners are presented in Table 1.

Co-Design Session 1- framing the issue

Determinants (positive and/or negative) of exercise: Four core determinants were identified by lived experience

Table 1. Participant characteristics

Characteristics	Lived experience partners (n = 5)	Healthcare stakeholders (clinician partners n = 3, industry partners n = 3)
Age, years	53 ± 16	NR
		Range, n (%):
		18–29, 1 (17)
		30–39, 3 (50)
		40–49, 1 (17)
		60–69, 1 (17)
Gender, male [n (%)]	2 (40)	4 (67)
Ethnicity [n (%)]		
Asian	1 (20)	1 (17)
Aboriginal or Torres Straight Islander	0 (0)	0 (0)
White	3 (60)	3 (50)
European	1 (20)	0 (0)
Other	0 (0)	2 (30)
Employed for wages, yes [n (%)]	2 (40)	
Flexibility in working hours [n (%)]		
None (set hours)	2 (40)	
A lot (have choices)	1 (20)	
Weekly paid hours [median (range)]	0 (0–15)	
Confidence to exercise (Scale 1–5)	3 (0.7)	4.8 (0.4)
Weekly exercise [n (%)]		
≤29 min/week	1 (20)	0 (0)
30–59 min/week	1 (20)	0 (0)
60–89 min/week	1 (20)	0 (0)
90–119 min/week	1 (20)	1 (17)
≥120 min/week	1 (20)	5 (83)
Daily sitting time [n (%)]		
5–7 h	1 (20)	0 (0)
8–9 h	1 (20)	0 (0)
10–11 h	0 (0)	0 (0)
12–13 h	0 (0)	1 (17)
≥13 h	3 (60)	5 (83)
MASLD diagnosis by: [n (%)]		
General practitioner	1 (20)	
Specialist (hepatologist, endocrinologist)	3 (60)	
Other		
Research study	1 (20)	
Employment organization		
Private clinic		2 (33)
Hospital service		4 (67)
Community health service		0 (0)
Years in current clinical/industry role [years as mean (SD)]		12.5 (89.2)

Data are mean (SD) unless otherwise stated. SD, standard deviation; MASLD, metabolic dysfunction-associated steatotic liver disease.

Table 2. Key determinants of exercise maintenance identified by people with MASLD during *Framing the Issue*

Determinant (positive [+] and/or negative [−]) of sustaining exercise	Description	Illustrative quote (with LE participant number noted in brackets)
Cost−	Four of the five LE participants, who had participated previously in a (free) supervised exercise clinical trial, reported that the cost of gyms and/or exercise professionals was a key reason for exercise cessation following the trial; Lack of suitable, accessible, and affordable physical activity/ exercise facilities (e.g., gyms, swimming pools, exercise machinery) impairs exercise maintenance; Adopting more affordable approaches to exercise resulted in sustained engagement in physical activity ; Partners suggested potential enablers to overcome cost, such as allocation of subsidized exercise resources (e.g., gym memberships, equipment) or government support to provide funding for programs and/ or to have costs subsidised by Medicare services (Australia's publicly funded universal health care insurance scheme).	*"Unfortunately, gym memberships tend to be very expensive when you limited income. You just can't afford them. It's funny. Cost has been the problem." (LE5). "I couldn't get to the gym. I reinvented by using households' things that would keep up my heart rate and try to do that as often as I could, which I still do now, so even grabbing a trolley at the shopping centre was part of my is part of my, you know routine now." (LE2).*
Personal Motivation+/−	*Knowledge of exercise on MASLD*: Partners reported having a sound understanding of the condition and acknowledged exercise as an important factor for management; Consensus that exercise has a positive impact on MASLD and their overall health; Positive health outcomes, including liver fat loss and improvement in liver function, as well as reductions in blood glucose, blood pressure, 'aches and pains', and overall improvements in sleep and quality of life; 'Visually seeing' results, for instance, reductions in weight or acute reductions in blood glucose levels following exercise, is a highly motivating factor; Exercise knowledge only sometimes translates into sustained behaviour.	*"Last appointment with [name removed] showed me that the weight loss had taken some fat off my liver, and… that my liver was starting to work again. So that was just good, really great news. So yeah, that's keeping me motivated." (LE2). "I do have a good understanding of the role of maintaining exercise; understanding it and performing it are two different things." (LE3).*
	Diagnosis and impact on exercise behaviour: Consensus that being diagnosed with MASLD did not interfere with the ability to maintain exercise long-term; Partners reported no symptoms of the disease nor issues preventing them from exercise beyond fatigue/low energy; Low energy levels were considered a barrier to initiating exercise and re-engaging with exercise following inactivity relapse (due to illness, holidays, and/or low motivation); Consensus that exercise increases energy levels, and this understanding increases engagement.	*"I'm unaware of there being any impact of the exercise with the fatty liver disease on my ability to do the exercise. I'm symptomless. Well, I had pain which initially led to all the testing which led to the diagnosis, but that pain is an intermittent thing, and it's not something that has been an issue in terms of exercise." (LE1). "It's just because we have low energy, and we do not want to start doing exercise. So that's the barrier." (LE3). "It's a bit ironic in that the more exercise you do, the more energy you have. So, getting going helps having the low energy is certainly a factor, but it would help to reinforce us. I guess, once you get going, it actually gives you more energy. Just more of an educational thing or a reminder." (LE3).*
	Competing priorities: Competing priorities were linked to both male and female partners and included working, social pressures, school drop-offs, and everyday normal schedules; Absence of normal everyday activities (e.g., on holiday) is reported to increase exercise maintenance when in the right environment; Despite awareness of the health benefits of exercise, some reported that exercise is not a priority and occasionally 'forgot to do it'.	*"It's not the actual disease itself that makes it hard to do the exercise. It's just the other social work. It's other social or employment pressures." (LE5). "I as well was doing my own sort of circuits that I worked out while we were on holidays at the beach. I was able to keep it up because I suppose I didn't have my normal activities, and I had an environment where you know you, you wanted to go out walking, and you wanted to go to the beach, and it was easier to do that." (LE1)/*

(continued)

Table 2. *(continued)*

Determinant (positive [+] and/or negative [−]) of sustaining exercise	Description	Illustrative quote (with LE participant number noted in brackets)
Co-morbidities^{-}	Partners reported physical discomfort and/or pain and medical comorbidities as key barriers to sustained exercise engagement; Physical discomfort was reported to cause difficulties in beginning exercise and, at times, limited exercise capacity (e.g., arthritis).	*"So, my hands and my feet swell often, and I can't do much exercise, so that prevents me from being active, and my health condition gets worse as well." (LE4).*
Accountability$^{+/-}$	*Professional exercise supervision*: Support of a qualified exercise professional had a considerable impact on exercise engagement in people with MASLD; Without exercise professional oversight, partners would lack the confidence and competence to self-direct exercise programming. Notably, to identify and undertake specific types of exercise safely and without triggering musculoskeletal pain or injury; Partners who identified that previous exercise support adequately prepared them for self-directed (unsupervised) activity, were able to more effectively translate supervised programs and sustain exercise; Partners suggested that a 'stepped down' and co-created home-based/self-directed program will enable better maintenance following supervised exercise training.	*"I decided to do some yoga at home, but I cannot, I'm not sure if my position, if my posture is right, and maybe it could do more harm to my body, so I stopped doing it." (LE4). "So, I worked out a schedule that I had done when we were still in the program and completed that circuit on the beach." (LE1). "You know it's 12 weeks, then 6 by yourself, and another 6 weeks, and then 3 yourself, and another 3 weeks, and then… you're on your own sort of thing that could help you to devise strategies and have it built into the program to be devising the strategies for…how do we replicate this at home? Umm and be doing some of that planning together." (LE1).*
	Monitoring: Self-monitoring of health-related measures and physical activity levels enhanced motivation, enhanced feelings of 'safety' and facilitated exercise maintenance. Specifically, technologies such as smartwatch devices were valued; Partners reported being well-monitored through supervised exercise programs but emphasised a lack of information, support, and follow-up thereafter; Follow-up calls were suggested as motivating to sustain behaviour for some; however, avoidance behaviour was also identified. A possibility of nudging phone check-in calls was raised, and a suggestion for text-messaging to provide behavioural nudges (rather than phone calls) was made.	*"My kids bought me an Apple Watch, so it keeps an eye on my heart rate and if I go into an irregular heartbeat, it lets me know, and umm counts my steps… It's really good to have these little watches, and if you do get into trouble, you press a button, and it goes through to your next kin or emergency contact." (LE2). "I reckon you know a phone call saying, how's it going? If that continues, you had some sense of 'I'm not just doing this by myself', that would have helped me. Even though you couldn't actually see what I was doing, I still would have felt some sense of responsibility to someone other than myself." (LE1). "The feeling that you're letting everyone down by not carrying on, I guess it's just putting pressure and guilt on myself. I would probably duck the calls." (LE3)*
	Social engagement: The role of social engagement in affecting accountability to exercise varied between partners, underscoring the need for personalised exercise tailored to individual preferences for exercise settings; One partner reported that their exercise behaviours are self-initiated and preferred to exercise alone while others preferred group-based exercise.	*"It is somehow awkward, if you, in a swimming pool, you just do your exercise by yourself instead of a group of people you know." (LE 4).*

LE, lived experience partner; MASLD, metabolic dysfunction-associated steatotic liver disease.

Table 3. Poll results for top barriers to exercise maintenance for people with MASLD

Round 1	%	Round 2	%	Round 3	%
Musculoskeletal issues- pain in muscles and bones/joints	80	Musculoskeletal issues- pain in muscles and bones/joints	80	Musculoskeletal issues- pain in muscles and bones/joints	80
No access to exercise equipment or facilities	80	No access to exercise equipment or facilities	80	No access to exercise equipment or facilities	80
Cost	80	Cost	80	Cost	80
Competing priorities (family/ work/caring/travel)	80	Competing priorities (family/ work/caring/travel)	80	Competing priorities (family/ work/caring/travel)	80
Low energy levels	80	Low energy levels	60	Low energy levels	80
Not being accountable to anyone for doing exercise	80	Not being accountable to anyone for doing exercise	60	Not being accountable to anyone for doing exercise	60
Fear of health event (e.g., low blood sugar, fainting, heart attack)	60	Fear of health event (e.g., low blood sugar, fainting, heart attack)	60	Fear of health event (e.g., low blood sugar, fainting, heart attack)	60
Lack of time	60	Lack of time	20		
Fear of injury (e.g., fall, muscle strain)	60	Fear of injury (e.g., fall, muscle strain)	20		
High fatigue/sleepiness	40				
All over body pain	40				
Low motivation	40				
Dislike exercise	20				
Not knowing what to do	20				
Transport	0				
Don't have the right clothing or shoes	0				

MASLD, metabolic dysfunction–associated steatotic liver disease.

partners, with illustrative quotes presented in Table 2 (participant numbers noted in brackets).

Key barriers to exercise maintenance: results from the poll: After three rounds of voting, five key barriers, each receiving an equal percentage of votes (80%), were identified. These were: musculoskeletal issues, access to equipment and facilities, cost, competing priorities, and low energy levels (Table 3).

Co-Design Session 2 - generative design and sharing ideas

Three core needs with eight considerations were generated, with illustrative quotes from lived experience partners, hepatologists, and industry partners (exercise physiologists) presented with participant numbers in brackets (Table 4).

Target outcomes

Patient-important outcome measures: Lived experience partners and health practitioners identified improvements in health-related quality of life (HRQoL), including mood and energy, and activities of daily living (ADLs) reflecting daily experiences, as priority outcome measures for exercise interventions to improve exercise maintenance. Assessing the ability to perform daily activities such as housework and gardening was highly valued. Specific ADLs to be assessed included strength, exercise capacity, and exercise tolerance or "limits". These outcomes should be tailored to individual circumstances based on participants' goals and expectations.

Physiological and natural history: Lived experience partners were interested in how exercise maintenance could influence basic physiological health markers, including blood pressure, heart rate, cholesterol, and body mass index. Individuals who had participated in exercise interventions valued monitoring these parameters during exercise, as it increased their confidence and motivation. Hepatology partners were particularly interested in outcomes demonstrating direct improvements in liver health. One hepatologist emphasized the importance of altering the natural history of the disease.

Strategies to enhance adherence

Habit forming: Hepatology partners expressed concern about exercise uptake and maintenance in people with MASLD and were interested in clinicodemographic factors that predict adherence. They sought to understand whether there is a minimal dose of exercise needed to create a sustainable habit. Given the high prevalence of comorbid illness in this population, hepatologists were also interested in ways to manage exercise during illness and, particularly, how to re-engage patients after forced breaks due to health deterioration.

Hepatologists also highlighted the importance of identifying factors influencing adherence. They were interested in differentiating intellectual from physical motivators and identifying the point at which exercise is performed out of personal motivation. Lived experience partners expressed feelings of guilt when failing to complete prescribed exercise, which led to poor outcomes. Industry partners were interested in supporting adherence from a behavior management or stage of change perspective. They suggested that people with MASLD need to be made aware of the behavior change model and that relapses often occur.

Table 4. Core needs and considerations with illustrative quotes from lived experience, clinicians, and industry partners during *generative design and sharing ideas*

Core needs and considerations (italicised)	Illustrative quote (with Lived Experience [LE], Hepatology [H], and Exercise Professional [EP] participant number noted in brackets)
Target Outcomes	
Patient-important outcome measures	*"Whether you have achieved your goals like losing weight or improving your diabetes or your high cholesterol or NAFLD [MASLD]. One of the main things you gain by stepping towards this is getting the quality of life."(H2). "…like being able to play with grandchildren, or undertake the housework or the gardening or something. So then you can assess the improvement against meeting those expectations."(H1).*
Physiological and natural history	*"I think those parameters that we measured. That parameter of measurement made me feel confident."(LE2). "Well, I suppose big picture would be you know, is it possible and as part of a package presumably but to change the natural history of the disease?"(H3).*
Strategies to enhance adherence	
Habit forming	*"I think sort of important questions are: trying to tease out if there are any clinicodemographic factors that are associated with people who can sustain exercise versus those that can't."(H1). "I'd be very interested in research into what is the minimum [that] needs to be done to develop the habit and to sustain it and what to do in those situations where unavoidably, there has to be a period of rest, because of a co-morbid illness or something, and how to re-engage effectively, because often that's when things fall apart, and it's very difficult to bring someone back after a break."(H1). "I think that there comes a point where I don't feel right, unless I do some exercise, and that's both in terms of my mental health and my physical well-being. I know that if I do some exercise, some of my aches and pains will get better, and particularly my mood will get better, and I'll sleep better. So that sort of becomes more of an internal locus of control for me, and more of a self-motivator for me. But that's taken me a long time to get to that kind of point where I recognise that, and it's trying to understand when that happens, and how that can happen so that it's something that you seek out from within rather than being told or feeling that you should… if you know what I mean?"(H2). "I do feel guilty, for me, the guilt just adds to the mental health accumulated effect, you know, like you feel bad about not doing it, because you feel bad to start with. And then, when you feel guilty, that just makes it worse."(LE1). "Educate…around the stages of change, like where are you in terms of this process, and it's okay to relapse, and helping them understand that so that they can identify: I'm doing well here, but I can't stay here."(EP1).*
Exercise professional support	*"So many people who walk in are so worried about my assessment because they think I'm going to stand there and make them lift the heaviest weights and run the longest marathon."(EP3). "The exercise is something that patients do worry about, because it is to some extent, easier to take a medication, perhaps, particularly if you're concerned about your ability to exercise or perhaps you've got issues with joints or previous injuries or other, you know, the time commitment is obviously bigger."(H2). "And so something that actually, you know, was concrete that allowed me to engage directly and was within a research program made it feel safe."(LE1).*
Factors influencing scaled implementation	*"I've definitely had for a very long time, you know, and so maybe I was not as asymptomatic as I thought I was, and finding that out earlier through education might solve issues as well."(LE3). "So that wasn't cost prohibitive, and that's something, if it costs a lot of money… well, I won't be going and there's probably a lot of people in my position who can't afford to go privately to these places."(LE2). "If research could show that there's a decreased strain on the system, i.e., with saving money by keeping people healthy, then a lot more people are going to invest in it."(EP1).*
Awareness of exercise benefits	
Benefits beyond weight loss	*"I mean, exercise is a key role in maintaining general body health, not just with fatty liver disease, but it's obviously crucial in the setting of metabolic risk factors."(H1).*

(continued)

Table 4. *(continued)*

Core needs and considerations (italicised)	**Illustrative quote (with Lived Experience [LE], Hepatology [H], and Exercise Professional [EP] participant number noted in brackets)**
Personalised doses	*"What we need to do is work out the dose, dosing schedule, and how long we need to keep the medication going for, in this case, exercise."(H2). "Like over what time range is it effective? Like as in, is it only effective while you keep doing it? Is there some improvement from doing anything at all?"(LE1). "Like what sort of exercise I can do, how long I need to do it for, you know, because I have other chronic health issues."(LE4).*
Clinicians as gatekeepers	*"I suspect that there is some sort of bias, that you would think a patient would be more physically able or seem more motivated...then for a drug study where you just have to swallow something or take an injection."(H3). "I don't think there has been a trial open that I am aware of recently that I could've enrolled."(H3). "And so the safest thing to do in that situation, if you're a clinician and you only like to do safe things, is not to tell them to exercise more, to keep it like that."(H2).*
Role of Professional Bodies	*"I think that the professional bodies have a role in advocacy and that's always an important one. Advocacy with the Government but also with the clinicians."(H2). "ESSA's [professional body] responsibility has to be getting to [Hepatologist 1], getting to hospitals to be like, if someone comes in, they need to go down this pathway, this is a pathway option that's available."(EP1). "We need the professional bodies to step in and create, obviously, an understanding among the community members that if you have NAFLD [MASLD], you can go on and see an exercise professional."(EP1). "I reckon most of the time a doctor, a GP, will be like, you need to change your lifestyle, you know... go out and find something. The clients like... I don't know what I'm looking for?... What do you want me to do here?... I need someone to direct me!"(EP1).*

NAFLD, non-alcoholic fatty liver disease; MASLD, metabolic dysfunction-associated steatotic liver disease; ESSA, Exercise and Sports Science Australia.

Exercise professional support: Industry partners and hepatologists expressed the importance of patients' perceptions toward exercise. Providers observed that patients who have not previously participated in exercise therapy commonly hold negative thoughts toward participation and assessments. Lived experience partners expressed that they highly valued supervision by a trained exercise professional, as this made them feel safe and provided motivation and support to continue. All lived experience partners who participated in exercise reported enjoying the experience and being impressed with the health outcomes.

Factors influencing scaled implementation: Lived experience partners had little to no knowledge of MASLD before diagnosis, with many believing they had lived with the disease long before diagnosis. Health literacy and understanding of exercise benefits for MASLD were viewed as low among MASLD partners. Cost of intervention was frequently mentioned by lived experience and industry partners, who indicated they were only willing to engage in exercise interventions if the cost was low. Industry partners emphasized the need for exercise interventions to demonstrate a positive monetary impact on the health system to support scaled implementation. This includes the need to transition patients into self-directed exercise. Gaining support from policymakers requires investment and active participation from many individuals who successfully engage with and adhere to the program.

Awareness of exercise benefits

Benefits beyond weight loss: Lived experience partners valued education targeting youth about the importance of exercise for physical fitness, rather than focusing solely on other health factors such as body weight. Hepatology partners were interested in disease prevention through education and early management, as well as the role of sustained exercise in improving hepatic outcomes. They emphasized that knowledge of exercise as a potential therapy to improve liver health needs to reach general practitioners and other referring health professionals.

Personalised doses: Lived experience individuals and hepatologists were interested in understanding effective exercise 'doses'. This included when to exercise, intensity, duration, and mode—commonly referred to as the 'FITT' principle: frequency, intensity, time, and type. One hepatologist compared this to pharmacological studies and advocated for applying similar outcome measures for exercise doses. Lived experience individuals were also interested in how to manage comorbid illnesses during exercise. Musculoskeletal comorbidities were frequently mentioned, along with other chronic health issues for which they required support.

Clinicians as gatekeepers: Hepatologists suggested that there may be a bias in exercise studies toward patients who are physically able and motivated, whereas drug studies do not require these qualities. Exercise was described as a therapy that requires time and effort, factors clinicians consider before referring patients to exercise studies. More effective provision of information regarding exercise-based clinical trials is required to improve recruitment. Hepatologists and industry partners believed that increased training in exercise is needed in medical schools, as misconceptions about the safety and efficacy of exercise may prevent referrals. One hepatologist noted that clinicians who have not upskilled in exercise therapy may not recommend exercise and instead only do the "safe things".

Role of professional bodies: ESSA, the accrediting body for exercise physiologists in Australia, was mentioned by hepatologists and industry partners as responsible for up-

skilling relevant clinicians. They described a central role for professional bodies in advocacy with government and clinicians to address the lack of training in exercise prescription for medical undergraduates and practicing clinicians. Industry partners highlighted that models of care are needed to increase awareness of Accredited Exercise Physiologists and to connect those with MASLD to Accredited Exercise Physiologists. The view was that professional bodies like ESSA should serve as the nexus between researchers, universities, doctors, clinicians, and hospitals for recruitment into exercise-related research studies. It was suggested that the professional body's website should provide clear and simple directions to clinical trials and exercise physiologists to help individuals make healthy behavioral choices. There were strong opinions that there is currently a lack of direction and effectiveness in referring individuals to exercise-related research studies, and that personal referrals are more effective than referrals through association bodies. Most partners indicated that primary healthcare providers play a significant role in motivating patients to engage in exercise. However, a need for skill development in exercise assessment and prescription was identified to better support primary healthcare providers in recommending, referring, and supporting exercise uptake and maintenance.

Standards mapping (Step 7 requirements for translation)

Determinants and needs were mapped across 11 statements from five domains of the Global Action Agenda and 12 statements across five domains of the Global Research Agenda (Table 5).

Discussion

In recent years, there have been several global calls to action to elevate the prioritisation of MASLD in global health and research agendas.[17,18] These consensus-driven, multidisciplinary agendas were co-developed by healthcare providers, clinical researchers, and policy experts to articulate coordinated strategies for global, national, and regional efforts to address MASLD. The principle "Nothing about us without us" is now widely adopted in clinical research, highlighting the importance of embedding the voices, needs, and opinions of people with lived experience in the design of effective care strategies.

Patient-centred research strategies in MASH have recently been advocated for and include principles of transparency, whole-person focus, patients as partners, family and caregiver awareness, and responsiveness to patient needs.[25] To research and translate innovative exercise care solutions for people with MASLD, it is necessary to adopt a cohesive strategy that addresses specific consumer-informed research questions, employs suitable research methods, and focuses on outcomes that are meaningful to both patients and stakeholders. Exercise guidelines for the management of MASLD have recently been published,[5,6] along with tools to enable clinicians to prioritise and facilitate regular physical activity for people with MASLD.[26,27] However, the uptake and maintenance of exercise remain a global challenge, with the majority of people with MASLD insufficiently physically active to achieve and sustain benefits.

This generative co-design process partnered lived experience experts and their care stakeholders to frame issues regarding barriers and enablers to exercise sustainability and to co-design priorities for exercise-focused research agendas in MASLD. The findings align with several recommendations and priorities outlined in the MASLD global action[17] and research priority[18] agendas, as well as the principles of patient-centred MASH research.[25] Our lived experience partners recognised core barriers to exercise maintenance and, alongside healthcare stakeholders, identified intervention targets and strategies to enhance long-term adherence. Increasing awareness of both MASLD and the benefits of exercise was viewed as crucial for ongoing research aimed at developing pragmatic and sustainable exercise solutions.

Through an iterative voting process, five key barriers to the maintenance of regular exercise were described and equally prioritised by lived experience experts (in alphabetical order): competing priorities, cost, lack of access to exercise equipment and facilities, low energy levels, and musculoskeletal and pain issues. These are consistent with broader literature exploring barriers to exercise adoption and maintenance in people with MASLD,[5,11,12,23,28–30] but this is the first study to illustrate a patient-led ranking of issues that require targeted strategies before or alongside further efforts to refine exercise prescriptions for liver and clinical outcomes. Embedding patient-led priority activities into established tools (e.g., those listed in Table 4) could be considered. Competing priorities, access to exercise equipment, and affordability of access to exercise facilities and professionals should be prominently addressed in future research design and clinical implementation.

Selecting patient-important outcomes to prioritise in exercise research and clinical prescription was identified as a critical factor by both lived experience and hepatology partners. This aligns with the consensus to "increase the use of patient-important outcomes in clinical and research settings and include these as primary study outcomes alongside clinical outcomes" (item 3.4 of[17]). Key HRQoL outcomes, specifically mood, energy, musculoskeletal issues and pain, and ADLs, were highlighted by both lived experience and clinician partners. These factors have been comparatively neglected in exercise training studies,[31] and there is currently no consensus on a standardised approach to the assessment of patient-reported outcome measures in MASLD. People with MASLD report lower HRQoL scores, particularly in physical activity and functional performance domains.[32] Emerging evidence shows that exercise can improve various aspects of HRQoL, with no evidence of worsening from such interventions.[24] In one study, lower pain interference and improved sleep (as assessed via the PROMIS tool) were reported by people with MASH after 20 weeks of moderate-intensity aerobic exercise.[33] This suggests that incorporating strategies into large-scale research that target HRQoL outcomes, such as musculoskeletal impairment, pain, and low energy, may enhance the maintenance of exercise behaviours. A strategic imperative is to standardise the tools used in clinical research to better understand the impact of exercise on HRQoL. Recently, patient-reported outcome measure tools promoted for MASLD have been evaluated.[32]

Elucidating 'personalised' exercise doses was also advocated for by both lived experience and hepatology partners. The 'minimal' dose required for habit formation was highlighted as a priority by hepatology partners. Evidence from general, apparently healthy populations suggests that exercising at least four times per week for six weeks is the minimum requirement to establish an exercise habit.[34] While the dose-response relationship for exercise in MASLD has been evaluated,[35] habit formation has not yet been investigated in this context.

Beyond these shared priorities, a disconnect was evident between lived experience, hepatology, and industry partners. Hepatology partners expressed the need to better understand the impact of exercise training on the natural history of

Table 5. Co-designed multidisciplinary research and implementation targets mapped to the global action and research agendas for MASLD

Theme	Subtheme	Domain	Global Action Agenda	Global Research Agenda	Recommendations
			Statement	Statement	
Target Outcomes	*Patient-important outcome measures*	1- The human and economic burden; 3- Treatment and care; 5- Patient and community perspectives.	1.2- Promote standardisation of data collection and reporting on the human and economic burden of fatty liver disease to enable comparisons across different groups, populations, and settings; 3.4- Increase the use of patient-important outcomes in clinical and research settings and include these as primary study outcomes alongside clinical outcomes.	3.3- Evaluate patient-centred decision making in relation to fatty liver disease treatment and care outcomes; 5.1- Conduct research to understand the needs and experiences of fatty liver disease patients and at-risk communities (e.g., perspectives around prevention, treatment, and care, including mental health); 5.2- Study the impact of treatment and care on overall quality of life, including functional status (physical, psychological, social) in fatty liver disease patients.	Assess and prioritise health-related quality of life (e.g., PROMIS tools, CLDQ-NAFLD/NASH, SF-36, EQ-5D-5L, NASH-CHECK) in exercise training interventions; Assess and prioritise rating of energy and fatigue (e.g., VAS-F, FSS, FIS) in exercise training interventions; Assess and prioritise exercise-related self-efficacy (e.g., Exercise Self-Efficacy Scale) in exercise training interventions; Assess and report exercise adherence data for all exercise training studies, including exercise session attendance, intensity adherence, and duration adherence. Adherence to lifestyle interventions in general can use the Exercise and Diet Adherence Scale (EDAS).
	Physiological and natural history	1- The human and economic burden.	1.2- Promote standardisation of data collection and reporting on the human and economic burden of fatty liver disease to enable comparisons across different groups, populations, and settings.		Include standardised non-invasive outcomes instead of liver histology in exercise-related research studies (e.g., MASH-RI, MRI-PDFF, liver fibro-inflammation via cT1).
Strategies to Enhance Adherence	*Habit forming*	2- Defining and implementing models of care; 3- Treatment and care; 5- Patient and community perspectives.	3.2- Develop tools to support the uptake of non-pharmacological interventions to improve outcomes in people with fatty liver disease.	2.6- Assess how digital health (e.g., applications, interventions, therapeutics) can support patients to achieve lifestyle behavioural change; 5.4- Evaluate the efficacy of patient-led self-care programmes in improving fatty liver disease outcomes; 5.5- Explore the potential of new technologies (e.g., digital health applications and therapeutics, mobile interventions) to foster patient engagement in treatment and care.	Implement and evaluate the use of digital technologies, including smartwatches, tailor-made websites, and mobile applications (e.g., EL-FIT, AQ) for enhancing exercise uptake and adherence, with varying degrees of support from exercise professionals.

(continued)

Table 5. *(continued)*

Theme	Subtheme	Domain	Global Action Agenda	Global Research Agenda	Recommendations
			Statement	**Statement**	
	Exercise professional support	2- Defining and implementing models of care.	2.1 Engage affected populations and people with lived experience in the design of patient-centered fatty liver disease models of care; 2.2 Implement community-tailored models of care for fatty liver disease diagnosis, prevention, and treatment; 2.4 Develop a range of context-specific and resource-specific fatty liver disease multidisciplinary models of care examples to promote evidence-based knowledge sharing of good practices.		Design and/or enhance referral processes and multidisciplinary linkage; Implement and evaluate the effectiveness and cost-effectiveness of local, national, and global models of exercise care that are embedded within the context of patient-centred and multidisciplinary care; Disseminate findings and implement recommendations from international guidelines on exercise for MASLD (e.g., ESSA, ACSM).
	Factors influencing scaled implementation	3- Treatment and care.	3.1- Account for the social and commercial determinants of health when developing treatment and care strategies for people with fatty liver disease.	3.3- Evaluate patient-centred decision making in relation to fatty liver disease treatment and care outcomes.	Embed measures of health literacy and social determinants of health in exercise intervention research; Evaluate the cost-effectiveness and cost-consequence of exercise training and exercise professional support for MASLD management. This should be linked to both the healthcare system and to the individual themselves (direct and indirect).
Awareness of exercise benefits	*Benefits beyond weight loss*	3- Treatment and care.		3.4- Evaluate the efficacy and cost-effectiveness of the optimal management of related diseases (e.g., diabetes, obesity) on fatty liver disease and other liver-related outcomes.	Advocacy of the collateral benefits of exercise outside of weight loss across the lifespan.
	Personalised doses	3- Treatment and care		3.4- Evaluate the efficacy and cost-effectiveness of the optimal management of related diseases (e.g., diabetes, obesity) on fatty liver disease and other liver-related outcomes.	Examine dose-response relationships across MASLD phenotypes, including minimal doses for health benefits; Disseminate findings and implement recommendations from international guidelines on exercise for MASLD (e.g., ESSA, ACSM) to educate clinicians on exercise dosing; Develop patient information tools regarding managing co-morbid illnesses and musculoskeletal issues with exercise training.

(continued)

Table 5. *(continued)*

Theme	Subtheme	Domain	Global Action Agenda	Global Research Agenda	Recommendations
			Statement	**Statement**	
	Clinicians as gatekeepers	2- Defining and implementing models of care; 5- Patient and community perspectives.	2.2 Implement community-tailored models of care for fatty liver disease diagnosis, prevention, and treatment; 5.6- Evaluate the effect of interventions to reduce stigma among patients, the public, and healthcare providers.	2.1 Determine the effectiveness of different models of care for fatty liver disease, including their impact on patient outcomes and their cost-effectiveness.	Develop an international registry of exercise-related clinical trials in MASLD to be shared with professional societies; Increase training in exercise-related care for medical practitioners involved in MASLD to better understand the safety, efficacy, and feasibility, and social and cultural determinants of exercise for MASLD management.
	Role of Professional Bodies	2- Defining and implementing models of care; 4- Education and awareness; 6- Leadership and policies for the fatty liver disease public health agenda.	2.1- Engage affected populations and people with lived experience in the design of patient-centred fatty liver disease models of care; 2.4- Develop a range of context-specific and resource-specific fatty liver disease multidisciplinary models of care examples to promote evidence-based knowledge sharing of good practices; 2.5- Clinical societies/ health authorities should develop clear guidance on care pathways that promote the timely referral of fatty liver disease patients within healthcare settings; 4.2- Expand the availability of educational courses and toolkits on fatty liver disease, including through formal medical curricula and continuing education, in collaboration with other disciplines; 4.3- Disseminate education resources on the implementation of non-invasive tests in different settings, including primary care, diabetes, and obesity clinics, tailoring content to the audience.	2.1 Determine the effectiveness of different models of care for fatty liver disease, including their impact on patient outcomes and their cost-effectiveness; 4.1- Conduct comparative population-based surveys to understand fatty liver disease knowledge amongst the general population and high-risk groups, specifically, to inform the development of awareness-raising approaches; 4.2- Conduct research to identify the educational needs of healthcare providers in key areas, such as primary care, diabetes/endocrinology, obesity medicine, and cardiology, about fatty liver disease; 4.3- Study the effectiveness of strategies to impact fatty liver disease knowledge, attitudes, beliefs, and practices (KABPs), prioritising KABPs among healthcare professionals and high-risk groups; 6.3 Monitor, study, and report mentions of fatty liver disease within patient groups and professional societies outside of the field of hepatology (e.g., at events, in publications).	Determine, implement, and evaluate a co-developed model of exercise care for all people at risk of and living with MASLD. This should include people living with MASLD and their support and healthcare networks, as well as professional bodies representing exercise professionals; Develop training in exercise care for clinicians involved in MASLD, and develop training in MASLD for exercise professionals; Establish mechanisms to keep medical and health care professionals (including exercise professionals) up-to-date with current and emerging evidence. Establish culturally responsive models of exercise care and educational resources, especially for First Nations peoples.

PROMIS, Patient-Reported Outcomes Measurement Information System; CLDQ-NAFLD/NASH, Chronic Liver Disease Questionnaire-Nonalcoholic Fatty Liver Disease/NASH; SF-36, Short Form 36; EQ-5D-5L, 5-level EuroQol-5 Dimension; VAS-F, visual analogue scale to evaluate fatigue severity; FSS, fatigue severity scale; FIS, fatigue impact scale; EDAS, Exercise and Diet Adherence Scale; MASH-RI, metabolic dysfunction-associated steatohepatitis resolution index; MRI-PDFF, magnetic resonance imaging proton density fat fraction; EL-FIT, Exercise and Liver FITness; AQ, activity quotient; MASLD, metabolic dysfunction-associated steatotic liver disease; ESSA, Exercise and Sports Science Australia; ACSM, American College of Sports Medicine.

MASLD, which has traditionally been constrained by the reliance on invasive liver biopsy to assess histological outcomes. Significant progress has been made in developing non-invasive measures, and emerging evidence suggests that exercise training improves histological features of MASLD, as informed by imaging and blood-based surrogates.[36,37] Ongoing research should prioritise both established and emerging surrogates for liver histology to better understand the impact of exercise on disease severity and long-term clinical endpoints, alongside what patients value. This is particularly relevant in the context of personalised medicine, as MASLD subtypes are increasingly identified and characterised.[38,39]

Hepatology and industry partners also expressed a need for clearer pathways and improved communication to facilitate referrals of individuals to exercise-related research studies. They further advocated for the integration of exercise therapy into medical school curricula. New tools and resources have been developed to support clinicians in prescribing exercise and understanding its role in MASLD management.[5,6,26,27] Professional bodies (e.g., ESSA, American College of Sports Medicine, British Association of Sport and Exercise Sciences) have a critical role in advocating for increased training in exercise for medical undergraduates and clinicians, bridging the gap between scientific knowledge and its clinical application. This is the intention of the global Exercise is Medicine initiative,[40] which aims to foster a culture in which healthcare providers routinely include exercise counselling and prescription as a standard part of patient care.

Exercise physiology partners recognized the importance of addressing exercise adherence through behavioral management strategies and an understanding of the stages of change. When designing interventions, it is crucial to incorporate educational components that support habit development beyond supervised sessions. Research examining how to manage interruptions during periods of illness or forced breaks, and identifying factors that contribute to or hinder adherence, is needed. For maintenance to be successful long-term, strategies that address relapse and assist re-engagement are required. Providing information about the stages of change and normalizing the concept of relapse may empower individuals and enhance their long-term adherence to exercise programs.

Lived experience partners emphasized the need for awareness and education regarding the benefits of exercise (notably beyond weight loss) and perceived that health literacy is generally low in people with MASLD. This is consistent with previous research showing that 70% of people with MASLD believed it was a hereditary condition, and only 2% recognized MASLD as preventable.[41] They also expressed the importance of targeting youth with education on healthy lifestyle choices. Indeed, there is a relative paucity of literature on youth compared to adult populations with MASLD.[42] Primary healthcare workers play a pivotal role in connecting patients to exercise interventions and promoting engagement in physical activity, as people are more likely to start exercise therapy when recommended by their doctor.[43] However, a leading barrier to exercise participation was a lack of resources and education from their treating medical providers.[11] Clear and concise messages about the safety and effectiveness of exercise to manage MASLD should be communicated by primary healthcare providers. Many primary healthcare professionals have reported a lack of knowledge about MASLD and consequently experience difficulties when communicating about the condition to patients.[44]

Identifying, evaluating, and implementing strategies to enhance exercise maintenance should be a priority for ongoing exercise research. This aligns with several priorities of the global agendas. Emerging evidence suggests that digital approaches, including smartphone applications[45–47] and telehealth,[48] are feasible and effective options to support self-directed exercise.[49] The support of an exercise professional was viewed as beneficial to adherence, increasing the capacity to individualize exercise prescriptions and enabling participants to feel safe, particularly those with significant musculoskeletal pain. However, innovative strategies to increase affordable access to specialists are needed. Regular 'check-ins' were also valued by people with MASLD as motivators to reinforce behavior. Digital technology may enable the continuation of exercise care beyond supervised settings but could also worsen disparities in care access.[50] Additionally, identifying predictors such as clinicodemographic factors associated with exercise adherence can help tailor appropriate support to specific subgroups.

These findings should be considered within the context of study limitations. Four of five lived experience experts were recruited through participation in previous exercise studies, which potentially biases the sample toward individuals interested in exercise. The guidance and education provided in those studies likely influenced their responses. Similarly, two of three hepatologists in the study were actively involved in lifestyle interventions for MASLD. Additionally, the pre-existing relationship between interviewers and participants may have influenced responses during interviews. However, participants were selected using non-probability sampling, taking a grounded theory approach. This sampling method is commonly used in similar research contexts, and the decision to utilize it was informed by academic and clinical partners. Although the interviewees represented a largely diverse group, the generalizability of results may be limited due to the small sample size.

Future co-design studies could promote broader stakeholder engagement through strategies such as embedding the activity within clinical settings with an opt-out (rather than opt-in) approach. Initial co-design findings could be shared with a broader group of stakeholders, including those less involved in exercise care, which may help validate and refine insights. Comprehensive stakeholder mapping should be undertaken to identify underrepresented voices, such as inactive people with MASLD, primary care clinicians with limited exposure or access to exercise interventions, or culturally diverse populations. These efforts should also include direct and indirect stakeholders such as community members, policy actors, and industry partners. Patient advocacy groups could facilitate this.

Conclusions

The disconnect between research priorities of hepatologists, exercise professionals, and people with MASLD highlights the critical importance of community and consumer involvement throughout all phases of research design and delivery. Key clinical recommendations include: (i) Patient-important outcomes should be assessed and prioritized in research concerning exercise and MASLD management. (ii) The benefits of exercise on patient-important outcomes should be highlighted in exercise conversations. (iii) Exercise research should include standardized non-invasive outcomes of liver histology and appropriately assess and report exercise adherence data to better inform dose-response relationships of exercise on histological outcomes. (iv) Research concerning exercise adherence-building strategies, which may include digital technologies, should be co-designed with lived experience partners. (v) Culturally responsive models of exercise care and point-of-care patient resources need to be defined,

evaluated, and implemented across local, national, and global settings. (vi) Training in exercise-related care should be embedded in the curricula and professional development of medical practitioners and clinicians involved in MASLD care.

There is a need to address the priorities of people with MASLD in ongoing research. Exercise and diet intervention studies are well placed for hybrid implementation-effectiveness trials, which have co-primary aims to investigate the effectiveness of type and dose of exercise along with implementation strategies to overcome non-liver barriers such as access, cost, and complex lives with competing priorities. Co-design at each stage of the research lifecycle is vital to advance the awareness and management of MASLD.

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Conflict of interest

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Author contributions

Conceptualization: SEK, AG, GAM, IJH; Data collection: SEK, IJH, GC; Data analysis and interpretation: SEK, JdB, GC, IJH; Manuscript Drafting: SEK, JdB, GC, IJH; Critical review of manuscript: JGS, GAM, EP, IJH. All authors have read and approved the final version and publication of the manuscript.

Ethical statement

All procedures were conducted in accordance with the ethical standards of the 2024 Helsinki Declaration and its later amendments and were approved by The University of Queensland Human Research Ethics Committee (2016000010). Methods and outcomes have been reported according to the GRIPP 2 checklist for reporting patient and public involvement in research. All partners provided written informed consent.

Data sharing statement

Sharing of de-identified coded data is available on reasonable request to s.keating@uq.edu.au.

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