

Diet and physical activity after liver transplant: a qualitative study of barriers and facilitators to following advice

Short title

Diet and activity after liver transplant

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1 **Title**

2 Diet and physical activity after liver transplant: a qualitative study of barriers and facilitators to
3 following advice.

4 **Abstract**

5 **Background**

6 Liver transplant recipients are given diet and physical activity advice to aid recovery and promote
7 long-term health. This study aimed to explore patients' experiences of receiving and implementing
8 diet and physical activity advice after liver transplant and identify barriers and facilitators to
9 following recommendations.

10 **Methods**

11 A qualitative descriptive design included purposive sampling of thirteen liver transplant recipients.
12 Semi-structured audio-recorded interviews and inductive thematic analysis using a framework were
13 undertaken concurrently to enable recruitment until saturation of themes occurred.

14 **Results**

15 Overall experiences varied between participants and settings, and over time. Seven themes
16 emerged, all representing both barriers and facilitators to implementing advice. Poor capability and
17 loss of confidence were barriers which improved in hospital as healthcare professionals enabled
18 participants to set and achieve goals but remained key barriers after discharge from hospital. The
19 format and consistency of advice influenced participants' confidence in the healthcare team. Social
20 support helped participants to return to and implement advice, but social networks could also have a
21 negative influence. Advice and modelling of behaviour from other transplant recipients were
22 facilitators. Symptoms, side-effects, co-morbidities and the environment presented barriers and
23 facilitators. The desire to return to normal and coping strategies were drivers of behaviours, which
24 were also influenced by participants' beliefs and values.

25 **Conclusions**

26 The variation in experiences indicates a need for individually tailored advice that is consistent
27 across the multidisciplinary team. Interventions for behaviour change that merit further
28 investigation include goal setting, improving coping strategies, peer support and modifying the
29 hospital and home environment.

30 **Introduction**

31 Immediately following liver transplant, patients are advised to follow a diet that is energy-dense and
32 high in protein and to start mobilising to aid recovery^(1; 2). However, long-term changes in diet and
33 physical activity (henceforth referred to as activity) are recommended to reduce the risk of
34 cardiovascular disease, cancer and osteoporosis, which is elevated in this patient group^(3; 4). Despite
35 some transplant centres providing patients with dietary counselling, physical therapy and activity
36 advice, research indicates that many liver transplant recipients do not achieve the recommended
37 levels of activity^(5; 6) or dietary intake⁽⁷⁾, evidenced by excessive weight gain⁽⁸⁾ and metabolic
38 syndrome⁽⁹⁾ after transplant. Published studies which explore patients' experiences after liver
39 transplant have focused primarily on lived experience of transplantation⁽¹⁰⁾ or adherence to medical
40 care⁽¹¹⁾, with paucity of data about patients' experience of implementing diet and physical activity
41 advice.

42 The purpose of this study was to explore liver transplant recipients' experiences of receiving and
43 implementing diet and physical activity advice post-transplant and identify barriers and facilitators
44 to following diet and activity recommendations. This knowledge is important to enable healthcare
45 professionals to address barriers and better support recipients with these behaviours, and to inform
46 the content and theory of lifestyle interventions developed for this specific patient population⁽¹²⁾.

47 **Methods**

48 This qualitative descriptive research^(13; 14) used a constructivist research paradigm to inform the
49 research methods^(15; 16). Further details about the design and approach are reported in
50 supplementary information. This manuscript has been prepared using the standards for reporting
51 qualitative research⁽¹⁷⁾.

52 **Research participants**

53 Patients aged ≥ 18 years and fluent in English, who had undergone a liver transplant at the
54 Cambridge transplant centre 6 weeks or more prior to the study were eligible for inclusion. Patients
55 who were unable or unwilling to provide informed consent were excluded. All patients attending
56 the outpatient liver transplant clinic over a month were considered for inclusion (n=69). Purposeful
57 sampling was used to include participants at different times post-transplant (6 weeks, up to 12
58 months and more than 12 months post-transplant) and with different needs for nutrition and
59 physical therapy support. Recruitment and data collection continued until saturation of research
60 themes was reached, where additional data did not lead to any new themes⁽¹⁸⁾.

61 Fourteen patients were invited to participate. Thirteen agreed and were interviewed, including eight
62 (62%) women and five (38%) men. Median age was 60 years (range 20-70) and median time post-
63 transplant was 17 months (range 6 weeks – 14 years). Aetiology of liver disease included primary
64 biliary cholangitis (n=4), non-alcoholic fatty liver disease (n=3), alcohol-related liver disease (n=2),
65 primary sclerosing cholangitis (n=2), Budd-Chiari syndrome (n=1) and Wilson’s disease (n=1)
66 (Table 1).

67 **Data collection**

68 Data were collected over a three-month period via a semi-structured interview with each participant.
69 Data were collected and analysed concurrently. Participants chose a face-to-face or telephone
70 interview and the location. Interviews took place in a quiet private room in the hospital, a hotel
71 meeting room or in the participant’s own home. Each interview was undertaken by one of four
72 researchers who were clinical dietitians with experience in working with transplant recipients. Four
73 interviewers were required for ethical reasons so participants were interviewed by a dietitian with
74 no involvement in their clinical care. The format was informed by a topic guide (supplementary
75 information) which was developed by the researchers with patient and public involvement from
76 transplant recipients not participating in the study. The topic guide evolved as the study progressed
77 to ensure data were collected on new topics that emerged from interviews. Interviews lasted
78 between 40 and 120 minutes and were audio-recorded and transcribed verbatim by one of the
79 researchers (LS). Identifiable information was removed from the transcripts. To achieve consistency
80 between interviewers all were well acquainted with the topic guide, and the lead researcher (LS)
81 listened to all recordings and led reflexive meetings after each interview. There was no pattern in
82 interview length between interviewers.

83 **Data analysis**

84 NVivo 11⁽¹⁹⁾ was used to aid inductive thematic analysis using a framework for data management,
85 as described by Ritchie et al.⁽²⁰⁾. Two researchers (LS and AMC) undertook the analysis. The first
86 four interview transcripts were coded independently and used to develop a thematic framework. LS
87 and AMC then jointly indexed the remaining transcripts as they became available. For the
88 remaining transcripts, new codes were developed for data that did not fit into the framework and the
89 framework was adjusted. Previous transcripts were reviewed in order to apply these new codes.
90 When all transcripts had been indexed and displayed in charts, LS, AMC and AM reviewed the data
91 in each theme, mapped the range and diversity of views and experience, and developed further
92 themes to describe links and patterns within the data. Reflexive diaries and a record of analytical

93 thinking were maintained by the researchers throughout and were used to aid data collection,
94 analysis and interpretation of findings (see supplementary information).

95 **Results**

96 Overall, seven themes were identified that describe participants' experiences after the transplant in
97 hospital, whilst recovering at home and with long-term diet and activity behaviours. Findings are
98 illustrated with anonymised quotations. Further illustrative quotes can be found in supplementary
99 information.

100 **1. Beliefs and values**

101 ***1.1 Early after transplant***

102 In the first days following transplant, participants lost confidence in their abilities with diet and
103 physical activity. This led to some feeling incapable and fearful of eating and mobilising.

104 "You don't know anything because you're not a doctor or a, or a nutritionist... I felt
105 constantly inferior... you just seem to forget any contextual knowledge that you ever had"
106 (P7).

107 Encouragement, achieving goals and experiencing benefits of following advice improved self-
108 efficacy and motivated participants to continue implementing advice.

109 "You can see the weight going on, you know you, it's something tangible really if it does go
110 on because you think 'oh right this really works'" (P5).

111 ***1.2 After discharge from hospital***

112 Once home, participants were unsure of how to balance sufficient activity to progress, without
113 doing too much and risking injury. This led to fear, uncertainty, lack of confidence and feeling
114 "built up for a fall" (P13).

115 "I seem to have been just left to just fend for yourself and you don't know what [activity]
116 you can or should and shouldn't be doing... I've been scared... and it's frightening not to do
117 too much and then not to do enough" (P5).

118 In contrast, some participants felt capable of setting goals and progressing activity levels without
119 further support.

120 ***1.3 Beliefs about advice***

121 Participants who believed that implementing advice would be beneficial, or that current or past
122 behaviour may have a negative impact on health described following advice.

123 “You’ve got to do it [have a healthy lifestyle], you’re only killing yourself if you don’t do
124 it” (P2).

125 Conversely, those who viewed the advice as harmful or not beneficial described not changing their
126 behaviour. Recognising but not valuing the potential impact of behaviour on health, and not being
127 willing to accept the perceived costs or deprivation of behaviour change, such as less enjoyment
128 from food due to reduced fat intake, were also barriers.

129 “If I see a dietitian, that’s what she’s going to tell me isn’t she, ‘We don’t want you
130 growing overly large’, ha, if that happens it happens, I’m not bothered” (P6).

131 ***1.4 Beliefs about self***

132 “Self-determination” was described as a facilitator to implementing advice. Other participants
133 described being “lazy”, not “self-motivated” and “not particularly good at following peoples’
134 advice” as barriers.

135 **2. Healthcare professional support and advice**

136 ***2.1 Good support***

137 For inpatients, support from ward staff was an essential enabler, for example to access supplement
138 drinks and through encouragement to mobilise and eat. However, when support was lacking this
139 was a barrier.

140 “Quite frequently breakfast would be almost at lunch time because there was nobody to help
141 me feed... there were some times when they were very much on the ball and would get it
142 done and other times when they just couldn’t” (P3).

143 Support from dietitians and physiotherapists enabled participants to follow advice. Participants’
144 ability to implement advice was improved when advice was brief, tailored and regularly adapted as
145 their needs changed.

146 “It’s just reiterating, even though you tell us, I tend to forget” (P5).

147 “The fact that it wasn’t just a meal plan and then everybody gets the same one, it was very
148 much individually tailored” (P7).

149 Getting support at the right time when needed was important, for example when a problem was
150 encountered. However, participants could not always anticipate their support needs in advance.

151 “Being able to ask her [dietitian] about lifestyle stuff was helpful, especially once I had a
152 life again.... once you come across a problem, getting the answer to that is, is vital because
153 otherwise you can’t move on... Unless I encounter any problems, I don’t really know what
154 to say [to the dietitian]” (P7).

155 ***2.2 Insufficient support***

156 Some participants felt better support was needed: in hospital; to be more physically active after
157 discharge from hospital; for preventing unwanted weight gain; and with long-term healthy
158 behaviours.

159 “A little bit more help with and a bit more advice on diet and exercise would have been
160 useful” (P11).

161 Participants expressed desire for physical activity guidance and “benchmark” (P5) to know how
162 much they should be able to do and by when, particularly after discharge from hospital. “Vague”
163 advice that was not sufficiently tailored to the individual was difficult to implement.

164 “There was no real advice around exercise, you know, what would be safe to do” (P3).

165 ***2.3 Healthcare professional approach***

166 Participants were reluctant to engage with healthcare professionals who did not have an empathetic
167 approach, whereas those who were confident and knowledgeable with an empathetic and
168 encouraging approach had a positive impact on patients’ willingness to listen to and adopt advice.

169 “With the food and the exercise, it’s actually your life, you actually have to live it and I
170 think that the empathy that you get for that is really important. If it had been any other way I
171 don’t think I would have followed the advice frankly” (P7).

172 ***2.4 Consistent and clear advice***

173 Consistent messages about diet and activity across the healthcare team made participants feel more
174 confident about advice. Participants valued advice more when its importance was highlighted by
175 doctors and surgeons. Participants who experienced advice as conflicting found this confusing and
176 lost confidence in healthcare professionals.

177 “I was like well that’s not what [the other dietitian] said ...and I think it’s from then I just
178 thought, I’m not even listening to you” (P6).

179 **3. Social support and influence**

180 **3.1 Family and friends**

181 **3.1.1 Support and encouragement**

182 Support from family and friends was needed. For example, palatable nourishing food provided by
183 visitors during hospital admission was important for those who disliked the hospital food.

184 “It was a good job my sister bought me a big bag of goodies that I could dive into because
185 otherwise I think I would have starved to death” (P13).

186 Support to shop for and prepare food and with regaining mobility was needed at home as
187 participants were not physically capable of this when first discharged from hospital. Some described
188 their partners’ encouragement as the main driver of their activity and dietary intake.

189 “I was supposed to eat three meals a day and I used to try and push it off and my wife just
190 pushed it back on me...the only reason I did things was because of my wife really pushing
191 me. I’d rather sit down and do nothing really” (P4).

192 Some participants needed permission and support from their family to prevent too much physical
193 activity too soon. Participants’ family and friends being present when advice was given enabled
194 them to review this independent of healthcare professionals.

195 “I usually ask questions, and quite frequently with my family around because I just wasn’t
196 taking anything in at the time at all, so it was them [family] that kept pushing it, you know
197 and saying you can’t do this, you won’t be able to do that and, don’t worry about it as it
198 comes up we’ll deal with it.” (P3).

199 **3.1.2 Expertise**

200 Participants described receiving advice from family and friends who had knowledge and expertise
201 of diet and physical activity. In some cases, this was sought when support was lacking from
202 healthcare professionals, for example with physical activity.

203 “I also have a, a fitness instructor for a son...he had a booklet that had like exercises...so if
204 they’d given me something like that to come home with...I think that would be helpful”
205 (P13).

206

207 **3.1.3 Influence**

208 The behaviour of others influenced participants' ability to follow dietary advice in both positive and
209 negative ways, for example the pressure to eat unhealthy meals prepared by others and the positive
210 influence of health and wellbeing amongst friends and social media. When talking about diet and
211 activity for a healthy lifestyle, establishing healthy behaviours with other people was important.

212 "When I want to lose weight [my wife] helps me and, ur, then she went on a diet and I
213 joined her. We do it very much together" (P2).

214 **3.2 Other transplant recipients**

215 Participants had confidence in advice from other transplant recipients. Modelling of diet and
216 activity behaviours by other recipients encouraged participants to implement advice.

217 "I got a lot of confidence from [other recipient] because he had his transplant the year
218 before and then went to the transplant games...that's quite...inspiring. It made me think
219 actually if he can do it then I can do it" (P8).

220 **4. Symptoms, side effects and comorbidities**

221 **4.1 Symptoms and side effects**

222 Participants described symptoms related to medication, the transplant surgery and liver disease as a
223 barrier to implementing advice, for example, loss of appetite, taste changes, pain, fatigue, diarrhoea,
224 nausea and vomiting. These were most common in the early post-transplant phase and improved for
225 some as they recovered, however, for some ongoing or new symptoms continued to be a barrier for
226 years.

227 Dietary restrictions due to transplant side effects, such as chyle leaks and hyperglycaemia, posed a
228 challenge to finding suitable foods and meeting nutritional recommendations. In the early stages of
229 recovery poor attention span and retention of information prevented participants from grasping and
230 remembering advice.

231 "My brain was addled at the time ... I just wasn't taking anything in... I wasn't mentally
232 able to grasp it all in one go" (P3).

233 Being physically incapable of activity and eating due to loss of strength and stamina was a barrier
234 and contributed to low self-efficacy and negative emotions for some participants. However, being
235 malnourished and physically incapable could also motivate a desire to improve.

236 “I am probably more dedicated to doing it [exercise] because I want to get the muscle tone
237 back, you know, and I don’t want to be on my knees at the top of a flight of stairs because
238 my muscles are so fatigued” (P13).

239 When appetite returned, a strong and difficult-to-control hunger drive that required large volumes of
240 food to satisfy and a change in food preference were described by some participants.

241 **4.2 Co-morbidities**

242 A range of co-morbidities were barriers to following advice. Some participants needed to avoid
243 certain foods to manage their co-morbidities and some were not able to undertake the recommended
244 levels of activity.

245 “Vegetables and fruit don’t suit my ulcerative colitis” (P11).

246 “I don’t do a great deal of physical activity because of the [retracted comorbidity] so I’m
247 very limited” (P3).

248 For others, comorbidities, such as diabetes, encouraged the adoption of healthy behaviours to
249 manage the condition.

250 **5. Environmental influence**

251 **5.1 In hospital**

252 In hospital there were physical barriers such as being attached to drip-stands, poor access to
253 supplement drinks and a lack of opportunity for upper body exercise. However, the environment
254 was also used as an opportunity to aid physical activity via goal setting and tracking progress.

255 “My aim was to try and get right around the, there’s a little block you know where you go
256 all round the ward” (P5).

257 While some participants described good quality hospital food with a wide selection of options,
258 others reported their dislike of hospital food as a barrier to implementing dietary advice.

259 “The food was awful and I don’t think that encourages appetite” (P9).

260 **5.2 Recovery at home**

261 Having greater control over food and more opportunity for activity at home, compared to hospital,
262 were described as facilitators. Walking was an activity available to all and used to promote
263 recovery.

264 ***5.3 Being physically active after recovery***

265 Daily tasks of living that required physical exertion encouraged activity.

266 “[Physical activity] comes from things that need activity if you like, as opposed to looking
267 for it...mow the lawn, do some gardening, walk to the shop, just general activities” (P12).

268 The convenience of having a gym at work, the availability of interesting and accessible walks,
269 having a dog and good weather all facilitated activity. Bad weather and not having access to safe or
270 enjoyable walking routes were barriers.

271 “There's no pavements, just hedgerows, so it's difficult to sort of walk” (P12).

272 **6. Coping**

273 ***6.1 Threatened coping***

274 Not recovering as expected threatened participants' ability to cope, which was a barrier to
275 implementing advice.

276 “As time goes on you think when am I going to get better? When all this pain and effort,
277 when am I going to get pay back for that? ...you start to get depressed a little bit and that, of
278 course, affects your ability to eat” (P1).

279 ***6.2 Coping strategies***

280 Achieving diet and activity goals, experiencing benefits of implementing advice, making progress
281 towards 'normal' and sharing experiences with other transplant recipients helped participants to
282 cope.

283 “Once I'd done the walk I felt so much better, I really felt brilliant, you know mentally as
284 well as physically I think, because you think you've achieved something” (P5).

285 “You're starting to get back to doing normal things, eating normal things, walking normally,
286 you start to enjoy life again” (P1).

287 Participants felt responsible to “make the most of the second chance” (P11) which gave them a
288 purpose and motivation with behaviours. For some, adopting healthy behaviours was described as a

289 way of regaining control of health, reducing the risk of future ill-health, caring for the donated liver
290 and respecting the donor.

291 “We’ve been told that, you know, we’re high risk of diabetes, high risk of heart disease,
292 high risk of cancer so you just make sure you look after your health... because I don’t want
293 to be as ill as I was...I can control diet, exercise, you know, not all these other things
294 [medication side effects], so I should, I should try to.” (P8)

295 Others did not feel able to consider the impact of their behaviours on their future health as this
296 threatened their ability to cope.

297 “My coping mechanism has been one of this is my liver, I haven’t had a transplant, this is
298 my liver that’s been with me all my life so therefore to change anything dramatically, um,
299 and lose that mind-set is something that I didn’t want to do” (P12).

300 **7. Returning to ‘normal’**

301 *7.1 A desire to return to ‘normal’*

302 A desire to return to normal and the belief that diet and activity were important for this were
303 facilitators to implementing advice.

304 “I wanted to get on with life. I was walking around the block, and it was an effort but I made
305 the effort. I want to get back to something like normal as I used to be” (P1).

306 Some participants returned to their “usual” behaviours. Advice was easier to follow it was similar to
307 their “usual” behaviours.

308 “[Dietary advice] mostly chimed with what I was eating anyway... healthy sort of lifestyle
309 and healthy food” (P10).

310 “I have a grounding in, on the exercise side of it because it’s something that I’ve always
311 done” (P13).

312 Participants who found advice wasn’t “usual” for them reported it was more difficult to follow. For
313 example, participants who were used to following healthy eating guidance found it challenging to
314 introduce snacks to help manage diabetes or high energy foods to treat undernutrition.

315 “I never used to pick and stuff like that after, sort of, 7, 8 o’clock at night anyway. And
316 when you get asked to eat, have something to eat, you know, just before you go to bed [for
317 diabetes control], it just wasn’t me” (P4).

318 Others described introducing healthier foods or increasing physical activity as challenging.

319 “Throughout life I haven’t, but even, even pre transplant I wasn’t exactly over
320 active... If you’re not a particularly active person then, you know, you do what you
321 normally do, just live your life how you normally lived it” (P12).

322 *7.2 A transition to ‘normal’*

323 For some participants, transitioning from the diet required for their liver disease and recovery to a
324 “normal” way of eating was challenging as the special diet had become the norm and an important
325 part of managing their condition. Additionally for some participants, coming to terms with a normal
326 body weight after being underweight for a prolonged period was challenging and they were slow to
327 realise when weight may have increased too much as gaining weight was primarily perceived as
328 positive and resolving malnutrition.

329 “Being so thin...you just get used to it, you stop telling yourself that it’s so like alien and
330 now that I’m kind of normal sized it’s dysmorphic in my mind You know because I had
331 to think the way that I looked when I was ill was kind of acceptable because, you know you
332 have to, and now that I do look acceptable, I try and tell myself that this is actually normal”
333 (P7).

334 However, other participants described no change in their dietary intake or need to adapt to a new
335 weight.

336 **Discussion**

337 This study contributes new insight into the topic of diet and activity after liver transplant, providing
338 better understanding of both barriers and facilitators to receiving and implementing diet and activity
339 advice. Barriers included loss of confidence in abilities, fear, inadequate support and conflicting and
340 vague advice from healthcare professionals, negative social influence, low self-motivation, not
341 believing in advice, not being willing to accept perceived costs of behaviour change, poor health
342 and slow recovery, a difficult transition from a diet suitable for liver disease to a normal diet, and
343 being slow to realise that weight gain was greater than recommended.

344 Facilitators included good support, encouragement and empathy from healthcare professionals,
345 individualised timely advice that was consistent across the multidisciplinary team, being capable of
346 setting goals to progress, the belief that implementing advice would be beneficial, self-
347 determination, peer and social support and modelling, environmental opportunity, following advice
348 as a way to cope, and experiencing benefits of implementing advice.

349 The process of liver transplantation is medically and surgically complex and liver transplant
350 recipients follow diverse post-transplant recovery trajectories. Their wider health and social needs
351 are also complex and vary substantially between individuals. This diversity is reflected in the range
352 of responses received from participants. Results from this study highlight the potential for
353 individualising lifestyle advice. Facilitating recipients to set personalised goals might be a useful
354 method to tailor support for behaviour change. Goal setting is an effective intervention to increase
355 activity in a diverse range of populations, including patients with chronic conditions and recovering
356 from cancer, but there is no published evidence in transplant populations ⁽²¹⁾.

357 As described in Self-Regulation Theory, individuals need to compare their behaviour to a desired or
358 acceptable standard in order to judge its appropriateness, and believe they are capable of change ⁽²²⁾.
359 Our findings suggest inadequate support with, and guidance about, the type and timing of activity
360 that is safe after discharge from hospital is an important barrier that needs to be addressed to enable
361 self-regulation. Similarly, other qualitative research has found uncertainty about how to progress
362 activity due to participants' inability to assess the safety of exercise after liver transplant ⁽²³⁾. van
363 Adrichem *et al.* ⁽²⁴⁾ interviewed solid organ transplant recipients, including liver transplant, and
364 found incapability and fear of injury could be overcome with expertise and training from
365 physiotherapists.

366 Participants expressed desire for more support with preventing excessive weight gain after
367 transplant. Post-transplant weight gain results in high levels of overweight and obesity and
368 associated health problems, therefore, there is a need for evidence-based interventions ⁽⁸⁾. This study
369 has identified factors that could facilitate weight management, for example helping patients to
370 accept a 'normal' body weight after being underweight and support with timely transition to healthy
371 eating. Participants described an excessive appetite during their recovery which was difficult to
372 control. This may help to understand the association between uncontrolled eating and weight gain
373 after liver transplant ⁽²⁵⁾. The cause of increased appetite post-transplant is not understood.
374 Hypotheses include recovery of malnutrition, hunger driven by immunosuppressive drugs ⁽²⁵⁾, an
375 appetite disorder for example due to vagal nerve innervation due to the hepatectomy ⁽²⁶⁾, and/or due
376 to addiction transfer ⁽²⁷⁾.

377 Recipients require support with managing symptoms and side-effects of the transplant as these were
378 described as barriers to implementing advice. Some participants experienced resolution of their
379 symptoms and side effects, whereas others experienced ongoing or new issues years after their
380 transplant. Dudley *et al.* ⁽²⁸⁾ describes the liver transplant as "exchanging one health state for
381 another" (p.1301). Ongoing health problems left participants feeling out of control and threatened

382 their ability to cope with the transplant experience as their expectations of recovery had not been
383 met, and in turn influenced their behaviours ⁽²⁸⁾. In a study exploring lived experience of liver
384 transplant, recipients used activity to manage their symptoms ⁽²⁹⁾. Physical activity is associated
385 with better quality of life after liver transplant ⁽³⁰⁾ and improvement in fatigue is experienced with
386 activity ⁽³¹⁾. Therefore, facilitating behaviour change may be an effective way for healthcare
387 professionals to help patients adapt to or improve symptoms.

388 Participants' coping strategies influenced their behaviours. The desire to look after the transplanted
389 liver has also been identified as a source of motivation for healthy behaviours in other studies ^(10; 23).
390 However, we found that some participants did not feel able to consider the impact of their
391 behaviours on their health as this threatened their ability to cope. We found no quantitative research
392 with liver transplant recipients that investigates the influence of coping on health behaviours. In
393 research undertaken with other patient groups adaptive coping is associated with positive behaviour
394 change and maladaptive coping with negative behaviour change ⁽³²⁾. The influence of coping
395 strategies on health behaviours after liver transplant merits further investigation, such as studying
396 the effectiveness of an intervention that teaches adaptive coping skills.

397 Doctors and surgeons develop trusting relationships with transplant recipients over many years and
398 are influencers as patients hold their advice in high regard. Doctors coordinate overall treatment
399 plans and have an important role with diet and physical activity care including recognising when
400 specialist dietetic and physiotherapy support is required ⁽³³⁾. The role of dietitians and
401 physiotherapists is to translate the complex and nuanced nutrition and physical therapy science into
402 effective patient care to facilitate behaviour change. Our findings highlight the importance of this
403 multiprofessional involvement in nutrition and physical activity care as participants described need
404 for consistent messages across the team and the value of diet and physical activity highlighted by
405 doctors and surgeons.

406 The positive influence from other transplant recipients on behaviours found in our study suggests a
407 peer support system could be a useful intervention for diet and activity behaviour change and merits
408 further investigation. Hickman et al. also report confidence with activity increased with role
409 modelling from other recipients ⁽²³⁾. We identified no studies that have investigated the impact of
410 peer support on health behaviours in transplant populations.

411 Our findings suggest the support of relatives and friends influence behaviours, therefore including
412 them when providing diet and activity advice can be helpful. The provision of food by visitors was
413 described as a facilitator to nutritional intake during inpatient stay, particularly for those who did
414 not like the hospital food. Further investigation into how to optimise this support might be helpful,

415 for example the type of food provided by visitors and whether guidance should be provided so it
416 meets dietetic recommendations.

417 We found the physical environment could be both an enabler and barrier to following advice. The
418 importance of environment on behaviour is reflected in socioecological models of health promotion
419 ⁽³⁴⁾ with most research focusing on the macro-environment, such as the neighbourhood ⁽³⁵⁾. There is
420 limited evidence for the effectiveness of changes to the micro-environment, including the home and
421 hospital settings ⁽³⁶⁾. For patients with cancer, environmental opportunity for activity in the hospital
422 is associated with the time spent in intentional physical activity ⁽³⁷⁾. Equipment at home is correlated
423 with increased activity in patients with diabetes ⁽³⁸⁾. Healthcare professionals are well placed to
424 enable patients to set up environmental opportunities and problem-solve environmental barriers that
425 are relevant to their individual situation. The effectiveness of interventions that modify the home
426 and hospital setting to promote behaviour change for transplant recipients is an area requiring
427 research.

428 **Strengths and limitations**

429 The strengths of this research include the development of the topic guide with input from transplant
430 recipients and healthcare professionals with appropriate expertise to ensure all relevant topics were
431 covered. An inductive approach allowed the interview topics to evolve and the interviewers to
432 explore experience in greater depth and breadth. The purposive sampling method ensured
433 participants with a range of diet and activity support needs were included. The researchers kept
434 reflexive diaries throughout the research process and the influence of their experiences, thoughts
435 and preconceptions on the research were carefully considered to minimise bias.

436 Study limitations include undertaking the research at a single transplant centre where practice may
437 not be representative across all centres. It would be valuable to triangulate these findings with wider
438 research involving other transplant centres. All the researchers were dietitians and the participants
439 were aware they were being interviewed by a dietitian. This could have led to social desirability
440 bias in their responses ⁽³⁹⁾. To minimise this the interviewers were independent of the participants'
441 care team. Patients who did not speak fluent English were excluded from the study which
442 represented approximately 3% of the study site's liver transplant recipient population.

443 **Conclusions**

444 In conclusion, the barriers and facilitators to following diet and physical activity advice described
445 by liver transplant recipients varied between individuals and with their stage of recovery. The
446 variation expressed indicates a need for individually tailored advice that is delivered at a personally

447 relevant time, which could be years after transplant, and in a manner that the patient finds
 448 acceptable. Consistent diet and activity advice that is reinforced by different members of the
 449 multidisciplinary team, but especially by doctors and surgeons, is important. The influence of
 450 family, friends and other patients on behaviours should be considered when providing advice.
 451 Interventions that might facilitate behaviour change and merit further investigation include
 452 individualised goal setting, improving coping strategies, peer support and modifying the hospital
 453 and home environment.

454 **Conflict of interest statement**

455 No conflicts of interest.

456 **Transparency Declaration**

457 The lead author affirms that this manuscript is an honest, accurate, and transparent account of the
 458 study being reported. The reporting of this work is compliant with SRQR guidelines. The lead
 459 author affirms that no important aspects of the study have been omitted and that any discrepancies
 460 from the study as planned have been explained.

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