

MANUSCRIPT TITLE : Nutritional Education Strategies for Patients with
Chronic Liver Disease : A Narrative Review

AUTHORS NAME AND AFFILIATIONS :

1. **First name :** Manila
Last name : Sophasath
Title : RD
Affiliations :
Hepato-Neuro Laboratory, CRCHUM, Université de Montréal, 900 R. Saint-Denis street, R08.720, Montreal, QC, H2X 0A9
Département de nutrition, Faculté de médecine, Université de Montréal, 2405, Côte-Sainte-Catherine, Montreal, QC, H3T 1A8
514-890-8000, ext. 23607
E-mail address : manila.sophasath@umontreal.ca

2. **First name :** Alexandre
Last name : Brisset
Affiliations :
Hepato-Neuro Laboratory, CRCHUM, Université de Montréal, 900 R. Saint-Denis street, R08.720, Montreal, QC, H2X 0A9
581-990-2304
E-mail address : alexandre_brisset@hotmail.com

3. **First name :** Christopher F.
Last name : Rose
Title : Ph.D.
Hepato-Neuro Laboratory, CRCHUM, University de Montréal, 900 R. Saint-Denis street, R08.720, Montreal, QC, H2X 0A9
Département de médecine, Faculté de médecine, Université de Montréal, 2405, Côte-Sainte-Catherine, Montreal, QC, H3T 1A8
514-890-8000, ext. 35739
E-mail address : christopher.rose@umontreal.ca

4. **First name :** Chantal
Last name : Béméur
Title : RD, Ph.D.
Hepato-Neuro Laboratory, CRCHUM, University de Montréal, 900 R. Saint-Denis street, R08.720, Montreal, QC, H2X 0A9
Département de nutrition, Faculté de médecine, Université de Montréal, 2405, Côte-Sainte-Catherine, Montreal, QC, H3T 1A8
514-890-8000, ext. 30847
E-mail address : chantal.bemEUR@umontreal.ca

CORRESPONDING AUTHOR (Chantal Bémeur) at :

Hepato-Neuro Laboratory, CRCHUM, University de Montréal, 900 R. Saint-Denis street, R08.480, Montreal, QC, H2X 0A9

Département de nutrition, Faculté de médecine, Université de Montréal, 2405, Côte-Sainte-Catherine, Montreal, QC, H3T 1A8

514-890-8000, ext. 30847

E-mail address : chantal.bemeur@umontreal.ca

PRESENT/PERMANENT ADDRESS : 900 R. Saint-Denis street, R08.480, Montreal, QC, H2X 0A9

1 **Keywords :** Chronic liver disease, Nutritional education strategies

2

3 **ABSTRACT**

4 **Background :**

5 Patients with chronic liver disease suffer from many complications, including
6 malnutrition, which must be managed promptly and effectively by the healthcare team.
7 Educating patients about their medical condition, the risk of malnutrition and other
8 complications of cirrhosis, could contribute to optimal nutritional status, quality of life
9 and general health.

10 **Objective :** This review provides an overview of the literature on a variety of nutritional
11 education strategies used with patients suffering from chronic liver disease. This review
12 also identifies barriers and facilitators which impact the adherence in using these
13 strategies.

14 **Patient involvement :** A patient-partner contributed to this review by providing insights
15 on different issues and concerns that patients with cirrhosis might ask themselves
16 regarding nutritional education strategies. The patient-partner was also involved in the
17 overall revision of the review.

18 **Methods :** Articles published between the years 2000-2023 focusing on nutritional
19 education strategies in patients living with cirrhosis were identified using Google_Scholar
20 and PubMed and were screened for inclusion in the study. All selected studies were
21 intervention studies. A quality assessment of the included studies was conducted using
22 the *Mixed Methods Appraisal Tool* (MMAT).

23 **Results :** Only a few nutritional education strategies in patients with cirrhosis were
24 documented in the literature. The strategies ranged from using traditional printed
25 materials to advanced technologies. These strategies may prove beneficial in
26 complementing routine interventions provided by health professionals, such as registered
27 dietitians, in their clinical practice.

28 **Discussion :** This narrative review clearly highlights the need for further research to
29 elaborate and evaluate nutrition education strategies for people living with chronic liver
30 disease.

31 **Practical value :** Elaborating and evaluating educational strategies in nutrition for
32 patients living with cirrhosis will be an adjuvant to health professionals and dietitians in
33 their clinical practice by providing them, and the patients, with targeted education
34 resources.

35

36 **1. INTRODUCTION**

37 Liver disease contributes to approximately 2 million deaths worldwide annually [1]. In
38 Canada, 1 in 4 individuals may be affected by liver disease [1], as compared to 1 in 10 in
39 the US [2]. Patients living with chronic liver disease, namely cirrhosis, are at risk of
40 developing several complications, including malnutrition, which can negatively impact
41 their medical outcome and quality of life. In fact, malnutrition is one of the most
42 prevalent complications of cirrhosis [3].

43
44 Interestingly, it has been suggested that patients suffering from cirrhosis display a
45 suboptimal level of health literacy (degree to which individuals have the capacity to
46 obtain, process, and undertake basic health information and services needed to make
47 appropriate health decisions) [4], probably due to the complexity of their condition,
48 which may accordingly affect their disease outcome [5]. Nonetheless, it is important to
49 emphasize that patients with cirrhosis are motivated to learn about their disease [6].

50
51 Optimal education strategies, specifically pertaining to nutrition, could potentially enable
52 patients to develop effective self-management skills [7,8], thus help improve their health
53 literacy, nutritional status and quality of life. Self-management is defined by acquisition
54 of tools and skills to actively participate in the management of the disease by increasing
55 knowledge, monitoring and managing symptoms, medication or modification of risky
56 behaviors [9]. Improvement of self-management by education means was demonstrated
57 to be beneficial for clinical outcomes in patients suffering from other chronic conditions
58 including arthritis and chronic asthma [10]. Importantly, implementing programs for

59 optimal self-management in patients with chronic diseases has demonstrated to be
60 beneficial in reducing length of hospitalization, thus contributing to diminished costs of
61 health care [11,12].

62

63 The main objective of this narrative review is to provide an overview of the various
64 educational strategies involving nutrition that are currently being used with patients
65 suffering from cirrhosis. Secondly, this review aims at identifying facilitators and barriers
66 for the implementation of and adherence to such strategies.

67

68 **2. PATIENT INVOLVMENT**

69 A patient-partner was involved in the review process by initially reflecting on the ways
70 he could be involved in his own care, specifically on the nutritional aspect. He asked
71 himself many questions, including ‘What would be the most optimal nutritional education
72 resources to help me, in an ideal world?’ To this last question, and prior to his
73 involvement in the review, he targeted strategies that he considered relevant based on his
74 personal experience as a patient : books/pamphlets/validated written references, access to
75 health professionals for educational purposes, mobile applications and technological
76 devices developed for monitoring purposes.

77

78 **3. METHODOLOGY**

79 ***3.1 Data retrieval***

80

81 A literature search was carried out using the search engines *Google Scholar* and *PubMed*.

82 The search terms mainly arose from studies approaching any nutrition educational

83 strategy used with patients with cirrhosis. The key words used in this research process
84 were : “Cirrhosis” or “Chronic liver disease”, “Nutrition education” or “Nutrition
85 counseling” or “Technology Nutrition Education”.

86

87 ***3.2 Eligibility Criteria***

88 In order to be included, studies needed to specifically include education strategies with a
89 nutritional component for patients suffering from cirrhosis. All included studies were
90 quantitative in nature. Studies were excluded if they involved any other chronic disease,
91 or if it was unclear whether the educational intervention included a nutrition component.
92 All studies which did not include any intervention(s), or were published before 2000 or
93 involved studies from the pediatric population were excluded. There were no exclusion
94 criteria based on language and geographic location of the studies.

95

96 ***3.3 Selection process***

97 A registered dietitian (Ph.D. candidate) identified studies using the key words previously
98 mentioned. Titles and abstracts were checked to ensure that the target population was
99 addressed and that they were indeed intervention(s). After full-text review and screening
100 the references of all articles, the publications of interest were included.

101

102 ***3.4 Study quality assessment***

103 The validated *Mixed Methods Appraisal Tool* (MMAT) was used to assess the
104 methodological quality of the included studies [13]. This rigorous and easy-to-use tool
105 was selected because it allows the simultaneous evaluation of studies of various research

106 designs. Each type of study design is evaluated based on five specific criteria. For
107 example, for randomized controlled trials, the quality assessment is based on how the
108 randomization was performed; if the groups are comparable at baseline, complete
109 outcome data are presented, outcome assessors blinded to the intervention and whether
110 the participants adhere to the assigned intervention. An overall score was estimated for
111 each study. This score ranges from 0% to 100%; 0% = very low quality, no criteria met;
112 20% = low quality, 1 criterion met; 40% = mid-low quality, 2 criteria met; 60% = mid-
113 high quality, 3 criteria met; 80% = high quality, 4 criteria met; 100% = very high quality,
114 all criteria met.

115

116 **4. RESULTS**

117 ***4.1 Study selection***

118 The flowchart illustrated in Figure 1 demonstrates the selection process. A total of 965
119 articles resulted in the initial search in the databases and were screened for inclusion by a
120 registered dietitian (Ph.D. candidate). After applying inclusion and exclusion criteria, a
121 total of 6 studies were included in the review (Table 1).

122

123 ***4.2 Study quality***

124 As shown in Table 1, all studies underwent the quality assessment based on the MMAT.
125 A first assessment was conducted by the registered dietitian (Ph.D. candidate), which was
126 then evaluated separately by the primary investigator in order to confirm the assessment
127 and minimize bias. The studies included in the review were mostly of mid-high to high
128 quality. Indeed, while only two of them received a score of 40% (associated with a lower

129 rating), two received a score of 60% and two others received a score of 80% (associated
130 with a higher rating).

131

132 ***4.3 Educational strategies in chronic liver disease***

133 The included studies which discussed nutritional education strategies were divided into
134 three main categories: printed material, nutritional counseling as well as contemporary
135 strategies such as phone calls and mobile applications. Main results are summarized in
136 Figure 2.

137

138 ***4.3.1 Printed materials***

139 Printed materials consisted of publications, guides, handouts, pamphlets, booklets or
140 documents including texts or graphics as a medium for communicating information.

141 Two studies involving a traditional education tool in the form of printed materials were
142 retrieved in the search. The first one was a pre-post intervention study involving a short
143 educational leaflet on cirrhosis in general, with some recommendations regarding sodium
144 intake as the nutrition component. This intervention assessed the impact of this leaflet on
145 patients' understanding of their disease through a telephone-based questionnaire [6].

146 Compared to baseline, improvement of disease understanding and knowledge were
147 observed in the 39 clinically stable patients with cirrhosis after two months whereas no
148 assessment on clinical outcomes was performed.

149 Secondly, a non-randomized pilot study evaluated the impact of a booklet (guide), as a
150 nutritional education tool, on cirrhosis [14]. This guide included five chapters regarding

151 the importance of nutrition and diet in this disease, dietary components and food groups,
152 healthy lifestyle recommendations, and meal planning for patients living with cirrhosis.
153 The results illustrated beneficial effects of the education intervention through clinical
154 visits and the booklet on the manifestation of complications (ascites and edema) after six
155 months, **and on the length of patients' hospital stay.** The educational guide also led to a
156 significant increase in patients' level of knowledge and quality of life after 6 months [14].

157 *4.3.2 Nutritional counseling*

158 Nutritional counseling, an ongoing process, is defined as the accompaniment and
159 education of a patient in terms of nutrition by carrying out meetings and informative
160 sessions as well as follow-ups in order to help the individual make and maintain the
161 needed dietary changes.

162

163 Three studies involving nutritional counseling were identified. Firstly, a randomized
164 controlled study, assessing the effect of an education program on quality of life of
165 patients with cirrhosis, was performed [15]. Four different educational programs,
166 including nutritional counseling as one of the themes, were designed based on patients'
167 level of education. All four programs had similar content but were adapted in complexity
168 level according to the level of education. The results show that the entire educational
169 program, all themes combined, significantly improved patients' quality of life after three
170 months, independently of the patients' level of education, in the intervention group (n=21
171 patients). In addition, patients in the control group (n=23) displayed a significantly
172 decreased quality of life during the intervention period.

173

174 Secondly, a study retrospectively evaluated the impact of nutritional counseling on the
175 survival of patients (n=133) living with chronic liver disease, compared to patients
176 (n=101) that did not receive counseling [16]. The counseling involved in-person meetings
177 with a registered dietitian in which patients were given recommendations following the
178 nutritional guidelines for cirrhosis described by the European Society of Parenteral
179 and Enteral Nutrition [17]. Survival rate was significantly higher in patients receiving the
180 nutritional counseling as compared to patients that did not. The difference was even more
181 significant in patients classified as Child-Pugh A (no difference when classified in Child-
182 Pugh B or C) and for male patients (no difference for female patients). The Child-Pugh
183 score is used to characterize the disease severity and is a simple prognostic measure for
184 patients with cirrhosis [18] , classifying patients as followed : A = good hepatic function,
185 B = moderately impaired hepatic function, and C = advanced hepatic dysfunction [19].
186 Therefore, the intervention had a beneficial effect on the survival of patients at an early
187 stage of disease.

188

189 Finally, Hayward et al. conducted a randomized controlled trial to evaluate an
190 educational program, involving lifestyle recommendations including nutritional
191 counseling in patients with decompensated cirrhosis [20]. Patients in the control group
192 received standard of care consisting in regular meetings and education by their
193 hepatologist. After a period of six months, patients in the intervention group had a
194 significantly higher nutritional knowledge compared to the control group. The patients in
195 the educational program group also had a significant improvement of their self-reported
196 quality of life, whereas the control patients did not display any significant changes.

197 However, it is important to mention that a pharmacist was involved in the nutritional
198 counseling whereas no registered dietitian intervened in this study. Also, the nutritional
199 counseling part of the educational program is not detailed.

200

201 *4.3.3 Phone calls*

202 Only one study involving phone calls was retrieved from the search. An eight-week
203 randomized controlled trial evaluated the impact of a series of phone calls to 8
204 malnourished patients awaiting liver transplantation [21]. The purpose of these calls was
205 to optimize nutritional education and to follow up by evaluating patients' nutritional
206 status using the *Subjective Global Assessment*. The results demonstrated no significant
207 effect on the improvement of the nutritional status of the patients, nor on the number of
208 hospitalizations. However, a trend in decreasing number of hospitalizations was noted.

209

210 *4.3.4 Mobile applications*

211 To this date, no study has been conducted to assess the impact of a nutritional educational
212 mobile application in patients with chronic liver disease. However, Tandon et al. (2022)
213 published a protocol for a feasibility study aiming to evaluate the acceptability of a
214 mobile application for lifestyle education (exercise and nutrition) for patients with
215 cirrhosis [22]. This 12 weeks protocol study aims to evaluate primarily participants'
216 retention and adherence and secondarily to evaluate aerobic capacity and resistance using
217 the 6 Minute Walk Test as well as patients' satisfaction. Results from this pilot study will
218 be the first step towards evaluating mobile application for education purposes in patients
219 living with cirrhosis.

220

221 ***4.4 Facilitators and barriers***

222 Several facilitators and barriers for each strategy are discussed in this review (Table 2).

223 Printed materials are tangible resources that have been produced by professional experts

224 in their fields. They allow a good popularization of the information presented. Printed

225 material is also a key resource for longer term information retention, through the

226 sustainability of this kind of educational resource. However, if not carefully planned,

227 patients could be overwhelmed by the important volume of information transmitted.

228

229 Nutritional counseling allows for face-to-face intervention between a specialized health

230 professional, such as a registered dietitian, and patients, possibly making patients more

231 open to receiving information. They are also reassured about the education process,

232 although counseling requires rigorous organization which may be time consuming. Other

233 barriers associated with nutritional counseling are desirability biases and longer attention

234 time required from the patients.

235

236 As for both the phone calls and mobile applications, the one main facilitator is the

237 proximity and speed of the transmission of messages. Phone calls are an interesting and

238 quick education strategy in telemedicine, although they may not be suitable for visual

239 learners. Finally, mobile applications require a better grasp of technology as well as

240 possession of electronic devices such as cell phone or electronic tablet.

241

242 **5. DISCUSSION AND CONCLUSION**

243 ***5.1 Discussion***

244 This review demonstrates that there are few studies evaluating nutritional education
245 strategies in the chronic liver disease population. It clearly highlights the need for further
246 investigations on this subject. Some strategies presented, although few, have proven to be
247 beneficial in different aspects. Studies including “traditional” printed materials as an
248 intervention have focused on educating patients with cirrhosis regarding their disease in
249 general. It was shown that printed material exerts a beneficial effect by improving
250 patients’ understanding of their disease and increasing their knowledge. Although these
251 strategies are deemed useful by patients and can be utilized quickly and repeatedly as
252 needed, there is a lack of literature focusing on nutritional education based on printed
253 materials. As suggested in a pilot study, patients want more information regarding diet
254 management in the context of cirrhosis [8]. Nutritional counseling also demonstrated
255 beneficial results regarding survival rate, nutrition knowledge as well as quality of life.
256 However, our review highlights that there is an important need for patients’ nutritional
257 counseling, whether it is asked directly from patients or strongly suggested by health
258 professionals; this has been reported in the literature by many clinical practice guidelines
259 [23]. Educating patients early-on after their diagnosis optimizes the care of patients
260 suffering from cirrhosis. In this regard, phone calls, a quick and easy method of teaching
261 and educating patients, have the potential to ensure retention of the concepts taught and
262 continuous sharing of information. Nonetheless, our review reports that no significant
263 positive effect was noted with phone calls, specifically on nutritional status. It should be
264 noted that the sample of patients included was relatively small (n=18), which may justify
265 the lack of statistical power in this study. This is the only study evaluating the impact of

266 educational telephone calls in this population. Long-term randomized controlled trials are
267 needed to assess the impact of phone follow-ups on nutritional status, including larger
268 cohorts.

269

270 In the literature, several articles have focused on the development or evaluation of
271 nutrition education strategies for different chronic disease populations. These strategies
272 are also of a wide variety, ranging from rather traditional strategies to some relating to the
273 use of technological platforms. Among the most innovative tools in the sphere of
274 technology, Maghrabi et al. looked at patient education through the use of video clips.
275 This study assessed the effect of videos created for patients undergoing bariatric surgery
276 [24]. The intervention consisted of a presentation, including a video, given by a registered
277 dietitian. There was a significant increase in patients' knowledge immediately after the
278 intervention. However, interestingly, the scores were not significantly different after 1
279 and 3 months, demonstrating lower retention of information over the medium term. As
280 shown in Table 2, retention of information could be facilitated using printed material.
281 Mixing different nutrition education strategies, for example printed material with a video
282 clip, could improve outcomes of the intervention. The use of an educational video was
283 also evaluated in a British study designed for the population living with cirrhosis [25]. In
284 this study, the video, containing general information on the disease (liver function,
285 development of cirrhosis and its complications), improved the patients' knowledge of
286 their disease, although no nutritional component was included. No other studies have
287 been conducted using educative video in patients living with cirrhosis, highlighting the
288 need for further research.

289

290 Furthermore, with the evolution of information technology, mobile devices and social
291 media platforms, such as Facebook, have grown in popularity. The National Institutes of
292 Health (NIH) defines mHealth as ‘‘the use of mobile and wireless devices (cell phones,
293 tablets, etc.) to improve health outcomes, health care services and health research’’ [26].
294 A group examined the role of social media platforms in providing education and support
295 around the diagnosis, management and progression of different chronic conditions
296 (cancer, depression and obesity), but did not include a nutritional component [27]. The
297 main platforms and web pages used were Facebook, blogs, YouTube, Wikipedia or Wikis
298 and Twitter. The impact, whether negative or positive, of social networks on different
299 chronic conditions, varies and seems difficult to assess. On one hand, negative impacts
300 concern mainly the sharing of information on the definition, treatments or management of
301 medical conditions, information which sometimes turns out to be inaccurate or
302 incomplete [28,29]. However, several studies showed a beneficial effect of platforms
303 generally used for training and joining patient support groups such as Facebook [30–35],
304 Twitter [36,37] or various blogs [38,39]. Together, the positive impacts of social media
305 platforms are mainly psychological and emotional, which support the fact that the use of
306 these platforms would be an interesting avenue for the support and care of patients with
307 chronic diseases. However, to date, no impact on patients’ education in general or
308 regarding the nutritional management of their diseases has been reported.

309

310 The use of education strategies involving mobile devices has been studied for the
311 management of chronic diseases, such as diabetes, obesity, cardiovascular diseases and

312 cancer [40]. In general, mobile applications linked to nutrition and diet have been shown
313 to exert a beneficial impact on behavioral changes [41]. Educational strategies in the
314 technological domain seem to be an interesting avenue to mainly optimize patient self-
315 management, as some studies have shown that the use of technologies is promising by
316 allowing patients to better manage their conditions [42–48].

317

318 There is also a potentially important role for care managers in the handling of patients'
319 conditions, specifically in their self-management. It has been shown that there is a
320 beneficial role of care managers (nurses in this case), acting as a bridge between
321 specialists and patients with chronic cardiovascular disease, particularly on health
322 knowledge and self-management skills [49]. When it comes to nutritional education,
323 several health professionals may be involved, such as dietitians, physicians, nurses and
324 others. Their involvement in patient education is crucial, but sometimes challenging for
325 several reasons, such as lack of time, lower education level of the patient, cultural
326 differences, and insufficient patient interest [50]. The development of intervention and
327 education plans, involving first line care managers, could prove to be promising, but
328 remains to be studied and validated in the population of patients with cirrhosis.

329

330 Moreover, many points mentioned by the patient-partner are in agreement with the
331 literature, including “ideal” educational strategies in the form of traditional strategies
332 such as printed materials and counseling with a health professional. Technological
333 strategies, such as mobile applications or technological devices, were also mentioned.

334 Hence, the strategies reported in the literature so far are relevant, from a patient's point of
335 view, but could also further explore the use of technological interventions.

336

337 ***5.2 Strengths and limitations***

338 This review has several strengths. To our knowledge, it is the first narrative review to
339 present an overview of the literature regarding nutritional education strategies specifically
340 for patients living with cirrhosis. Furthermore, the quality analysis of the studies was a
341 strength, as it demonstrated that the majority of the articles included were of mid-high to
342 high quality. Also, the involvement of a patient-partner was of great value in the review
343 process, as it allowed to illustrate a patients' perspective with regards to education
344 resources. As for limitations, the number of articles and the educational strategies
345 included in this review was small. However, this is representative of the current state of
346 the literature. The methodology of the articles included in the review was not always very
347 detailed, especially regarding the content of the educational interventions. Some articles
348 focused entirely on nutritional education, while others on one component of a larger
349 intervention program. Therefore, the effects noted in these studies may not necessarily be
350 attributed to education, specifically in nutrition.

351

352 ***5.3 Conclusion***

353 This narrative review provides an overview of studies focusing on nutritional education
354 strategies in patients living with cirrhosis. Considering the specificity of the topic of this
355 review, only a few studies were found. However, these studies still showed a variety of
356 strategies that revealed some beneficial effect. This highlights the importance of

357 providing nutritional education to this population, without however allowing a consensus
358 on the type of optimal educational strategy. It could be considered to develop an
359 educational program including different educational tools to ensure positive outcomes in
360 several respects with this population. The elaboration and validation of these strategies
361 could certainly benefit the health professionals in their practice but, most importantly, it
362 could significantly improve the quality of life of patients with cirrhosis as well as their
363 caregivers.

364

365 ***5.4 Practice implications***

366 In a context where health professionals are relatively limited in time to intervene with
367 patients, it is undoubtedly relevant to look at educational strategies with the potential to
368 maximize patients' knowledge and retention of information. The results presented in this
369 review demonstrate a range of nutritional education interventions that can be beneficial
370 for patients with cirrhosis. However, we must also emphasize that very few educational
371 strategies in nutrition were studied in this population. The different strategies included in
372 this review have specific strengths and weaknesses, but they overall **demonstrate**
373 beneficial effects, particularly on patients' level of knowledge and understanding of their
374 disease. Therefore, a mixed educational model combining the use of technology and
375 traditional components, such as counseling and printed materials, could be potentially
376 beneficial.

377

378 From a practical point of view, developing and validating nutritional education resources
379 for patients living with cirrhosis could provide health specialists with more resources that

380 could be helpful in their practice. Furthermore, the use of such education strategies could
381 be an asset in the clinical practice in several respects, whether to ensure the continuity of
382 their interventions with patients, strengthen their adherence to nutritional treatment plans
383 or increase their knowledge and self-empowerment.

384

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387 **REFERENCES**

- 388 [1] Canadian Liver Foundation. Maladies du foie. 2020.
- 389 [2] Cleveland Clinic. Liver disease. 2022.
- 390 [3] Shin S, Jun DW, Saeed WK, *et al.* A narrative review of malnutrition in chronic
391 liver disease. *Ann Transl Med* 2021;**9**:172–172. doi:10.21037/atm-20-4868
- 392 [4] Velardo S. The Nuances of Health Literacy, Nutrition Literacy, and Food Literacy.
393 *J Nutr Educ Behav* 2015;**47**:385-389.e1. doi:10.1016/j.jneb.2015.04.328
- 394 [5] Volk ML, Fisher N, Fontana RJ. Patient knowledge about disease self-
395 management in cirrhosis. *Am J Gastroenterol* 2013;**108**:302–5.
396 doi:10.1038/ajg.2012.214
- 397 [6] Beg S, Curtis S, Shariff M. Patient education and its effect on self-management in
398 cirrhosis: A pilot study. *Eur J Gastroenterol Hepatol* 2016;**28**:582–7.
399 doi:10.1097/MEG.0000000000000579
- 400 [7] Freundlich Grydgaard M, Bager P. Health literacy levels in outpatients with liver
401 cirrhosis. *Scand J Gastroenterol* 2018;**53**:1584–9.
402 doi:10.1080/00365521.2018.1545045
- 403 [8] Kelly L. Hayward, Leigh U. Horsfall, Brittany J. Ruffin, W. Neil Cottrell,
404 Veronique S. Chachay Katharine M. Irvine, Jennifer H. Martin , Elizabeth E.
405 Powell A, Valery PC. Optimising care of patients with chronic disease: patient-
406 oriented education may improve disease knowledge and self-management. *Intern*
407 *Med J* 2017;**47**:952–5. doi:doi:10.1111/imj.13505
- 408 [9] Jonkman NH, Schuurmans MJ, Jaarsma T, *et al.* Self-management interventions:
409 Proposal and validation of a new operational definition. *J Clin Epidemiol*

- 410 2016;**80**:34–42. doi:10.1016/j.jclinepi.2016.08.001
- 411 [10] Warsi A, Wang PS, LaValley MP, *et al.* Self-management Education Programs in
412 Chronic Disease. *Arch Intern Med* 2004;**164**:1641.
413 doi:10.1001/archinte.164.15.1641
- 414 [11] Bodenheimer T, Lorig K, Holman H, *et al.* Patient self-management of chronic
415 disease in primary care. *J Am Med Assoc* 2002;**288**:2469–75.
416 doi:10.1001/jama.288.19.2469
- 417 [12] Lorig KR, Sobel DS, Stewart AL, *et al.* Evidence suggesting that a chronic disease
418 self-management program can improve health status while reducing hospitalization
419 a randomized trial. *Med Care* 1999;**37**:5–14. doi:10.1097/00005650-199901000-
420 00003
- 421 [13] Pace R, Pluye P, Bartlett G, *et al.* Testing the reliability and efficiency of the pilot
422 Mixed Methods Appraisal Tool (MMAT) for systematic mixed studies review. *Int*
423 *J Nurs Stud* 2012;**49**:47–53. doi:10.1016/j.ijnurstu.2011.07.002
- 424 [14] P. A, E. H, B. D, *et al.* The effect of nutritional education and continuous
425 monitoring on clinical symptoms, knowledge, and quality of life in patients with
426 cirrhosis. *Gastroenterol Hepatol from Bed to Bench* 2019;**12**:17–
427 24.<http://www.embase.com/search/results?subaction=viewrecord&from=export&i>
428 [d=L626637783](http://www.embase.com/search/results?subaction=viewrecord&from=export&i)
- 429 [15] Zandi M, Adib-Hajbagheri M, Memarian R, *et al.* Effects of a self-care program
430 on quality of life of cirrhotic patients referring to Tehran Hepatitis Center. *Health*
431 *Qual Life Outcomes* 2005;**3**:1–8. doi:10.1186/1477-7525-3-35
- 432 [16] Iwasa M, Iwata K, Hara N, *et al.* Nutrition therapy using a multidisciplinary team

- 433 improves survival rates in patients with liver cirrhosis. *Nutrition* 2013;**29**:1418–21.
434 doi:10.1016/j.nut.2013.05.016
- 435 [17] Plauth M, Cabré E, Riggio O, *et al.* ESPEN Guidelines on Enteral Nutrition: Liver
436 disease. *Clin Nutr* 2006;**25**:285–94. doi:10.1016/j.clnu.2006.01.018
- 437 [18] Kim WR, Poterucha JJ, Wiesner RH, *et al.* The relative role of the Child-Pugh
438 classification and the Mayo natural history model in the assessment of survival in
439 patients with primary sclerosing cholangitis. *Hepatology* 1999;**29**:1643–8.
440 doi:10.1002/hep.510290607
- 441 [19] Tsoris, A., A. Marlar C. *Use Of The Child Pugh Score In Liver Disease*. StatPearls
442 Publishing online 2019.
- 443 [20] Hayward KL, Valery PC, Patel PJ, *et al.* Effectiveness of patient-oriented
444 education and medication management intervention in people with decompensated
445 cirrhosis. *Intern Med J* 2020;**50**:1142–6. doi:10.1111/imj.14986
- 446 [21] Chaney AJ, Heckman MG. The Benefit of Supplemental Nutrition Education for
447 Severely Malnourished Patients Awaiting Liver Transplant. *Prog Transplant*
448 2018;**28**:390–3. doi:10.1177/1526924818800052
- 449 [22] Tandon P. Feasibility of an App-based Nutrition & Exercise Program in Cirrhosis.
450 2022.
- 451 [23] Theodoridis X, Grammatikopoulou MG, Petalidou A, *et al.* A Systematic Review
452 of Medical Nutrition Therapy Guidelines for Liver Cirrhosis: Do We Agree? *Nutr*
453 *Clin Pract* 2020;**35**:98–107. doi:10.1002/ncp.10393
- 454 [24] Maghrabi AA, Abumunaser A, Dakhkhni B, *et al.* Nutritional Education for
455 Patients Undergoing Bariatric Surgery Improves Knowledge of Post-Bariatric

- 456 Dietary Recommendations. *Int J Med Res Heal Sci* 2019;**8**:82–8. www.ijmrhs.com
- 457 [25] Goldsworthy MA, Fateen W, Thygesen H, *et al.* Patient understanding of liver
458 cirrhosis and improvement using multimedia education. *Frontline Gastroenterol*
459 2017;**8**:214–9. doi:10.1136/flgastro-2016-100761
- 460 [26] Health NI of. Mobile Health: Technology and Outcomes in Low and Middle
461 Income Countries (mHealth). 2022.
- 462 [27] Patel R, Chang T, Greysen SR, *et al.* Social media use in chronic disease: A
463 systematic review and novel taxonomy. *Am J Med* 2015;**128**:1335–50.
464 doi:10.1016/j.amjmed.2015.06.015
- 465 [28] Hasty RT, Garbalosa RC, Barbato VA, *et al.* Wikipedia vs peer-reviewed medical
466 literature for information about the 10 most costly medical conditions. *J Am*
467 *Osteopath Assoc* 2014;**114**:368–73. doi:10.7556/jaoa.2014.035
- 468 [29] Steinberg PL, Wason S, Stern JM, *et al.* YouTube as Source of Prostate Cancer
469 Information. *Urology* 2010;**75**:619–22. doi:10.1016/j.urology.2008.07.059
- 470 [30] Herring SJ, Cruice JF, Bennett GG, *et al.* Using Technology to Promote
471 Postpartum Weight Loss in Urban, Low-Income Mothers: A Pilot Randomized
472 Controlled Trial. *J Nutr Educ Behav* 2014;**46**:610–5.
473 doi:10.1016/j.jneb.2014.06.002
- 474 [31] Kim C, Kang BS, Choi HJ, *et al.* Nationwide online social networking for
475 cardiovascular care in Korea using Facebook. *J Am Med Informatics Assoc*
476 2014;**21**:17–22. doi:10.1136/amiajnl-2012-001465
- 477 [32] Mota Pereira J. Facebook enhances antidepressant pharmacotherapy effects. *Sci*
478 *World J* 2014;**2014**. doi:10.1155/2014/892048

- 479 [33] Park S, Lee SW, Kwak J, *et al.* Activities on Facebook reveal the depressive state
480 of users. *J Med Internet Res* 2013;**15**. doi:10.2196/jmir.2718
- 481 [34] Valle CG, Tate DF, Mayer DK, *et al.* A randomized trial of a Facebook-based
482 physical activity intervention for young adult cancer survivors. *J Cancer Surviv*
483 2013;**7**:355–68. doi:10.1007/s11764-013-0279-5
- 484 [35] Wright KB, Rosenberg J, Egbert N, *et al.* Communication competence, social
485 support, and depression among college students: A model of facebook and face-to-
486 face support network influence. *J Health Commun* 2013;**18**:41–57.
487 doi:10.1080/10810730.2012.688250
- 488 [36] Pagoto SL, Schneider KL, Evans M, *et al.* Tweeting it off: Characteristics of adults
489 who tweet about a weight loss attempt. *J Am Med Informatics Assoc*
490 2014;**21**:1032–7. doi:10.1136/amiajnl-2014-002652
- 491 [37] Sugawara Y, Narimatsu H, Hozawa A, *et al.* Cancer patients on Twitter: a novel
492 patient community on social media. *BMC Res Notes* 2012;**5**:699.
493 doi:10.1186/1756-0500-5-699
- 494 [38] Andersson M, Gustafsson E, Hansson K, *et al.* External mirroring of inner chaos:
495 Blogging as experienced by the relatives of people with cancer. *Int J Palliat Nurs*
496 2013;**19**:16–23. doi:10.12968/ijpn.2013.19.1.16
- 497 [39] Hwang KO, Etchegaray JM, Sciamanna CN, *et al.* Structural social support
498 predicts functional social support in an online weight loss programme. *Heal Expect*
499 2014;**17**:345–52. doi:10.1111/j.1369-7625.2011.00759.x
- 500 [40] Fiordelli M, Diviani N, Schulz PJ. Mapping mhealth research: A decade of
501 evolution. *J Med Internet Res* 2013;**15**. doi:10.2196/jmir.2430

- 502 [41] West JH, Belvedere LM, Andreasen R, *et al.* Controlling your “app”etite: How
503 diet and nutrition-related mobile apps lead to behavior change. *JMIR mHealth*
504 *uHealth* 2017;**5**:1–10. doi:10.2196/mhealth.7410
- 505 [42] Chow CK, Redfern J, Hillis GS, *et al.* Effect of lifestyle-focused text messaging on
506 risk factor modification in patients with coronary heart disease: A randomized
507 clinical trial. *JAMA - J Am Med Assoc* 2015;**314**:1255–63.
508 doi:10.1001/jama.2015.10945
- 509 [43] de Jongh T, Gurol-Urganci I, Vodopivec-Jamsek V, *et al.* Mobile phone
510 messaging for facilitating self-management of long-term illnesses. *Cochrane*
511 *Database Syst Rev* 2012;**2017**. doi:10.1002/14651858.CD007459.pub2
- 512 [44] Foreman KF, Stockl KM, Le LB, *et al.* Impact of a Text Messaging Pilot Program
513 on Patient Medication Adherence. *Clin Ther* 2012;**34**:1084–91.
514 doi:10.1016/j.clinthera.2012.04.007
- 515 [45] Islam SMS, Chow CK, Redfern J, *et al.* Effect of text messaging on depression in
516 patients with coronary heart disease: A substudy analysis from the TEXT ME
517 randomised controlled trial. *BMJ Open* 2019;**9**:1–7. doi:10.1136/bmjopen-2018-
518 022637
- 519 [46] Maddison R, Cartledge S, Rogerson M, *et al.* Usefulness of wearable cameras as a
520 tool to enhance chronic disease self-management: Scoping review. *JMIR mHealth*
521 *uHealth* 2019;**7**:1–13. doi:10.2196/10371
- 522 [47] Park LG, Howie-Esquivel J, Chung ML, *et al.* A text messaging intervention to
523 promote medication adherence for patients with coronary heart disease: A
524 randomized controlled trial. *Patient Educ Couns* 2014;**94**:261–8.

525 doi:10.1016/j.pec.2013.10.027

526 [48] Quinn CC, Shardell MD, Terrin ML, *et al.* Cluster-randomized trial of a mobile
527 phone personalized behavioral intervention for blood glucose control. *Diabetes*
528 *Care* 2011;**34**:1934–42. doi:10.2337/dc11-0366

529 [49] Ciccone MM, Aquilino A, Cortese F, *et al.* Feasibility and effectiveness of a
530 disease and care management model in the primary health care system for patients
531 with heart failure and diabetes (Project Leonardo). *Vasc Health Risk Manag*
532 2010;**6**:297–305. doi:10.2147/vhrm.s9252

533 [50] Whitaker KM, Wilcox S, Liu J, *et al.* Patient and Provider Perceptions of Weight
534 Gain, Physical Activity, and Nutrition Counseling during Pregnancy: A Qualitative
535 Study. *Women's Heal Issues* 2016;**26**:116–22. doi:10.1016/j.whi.2015.10.007

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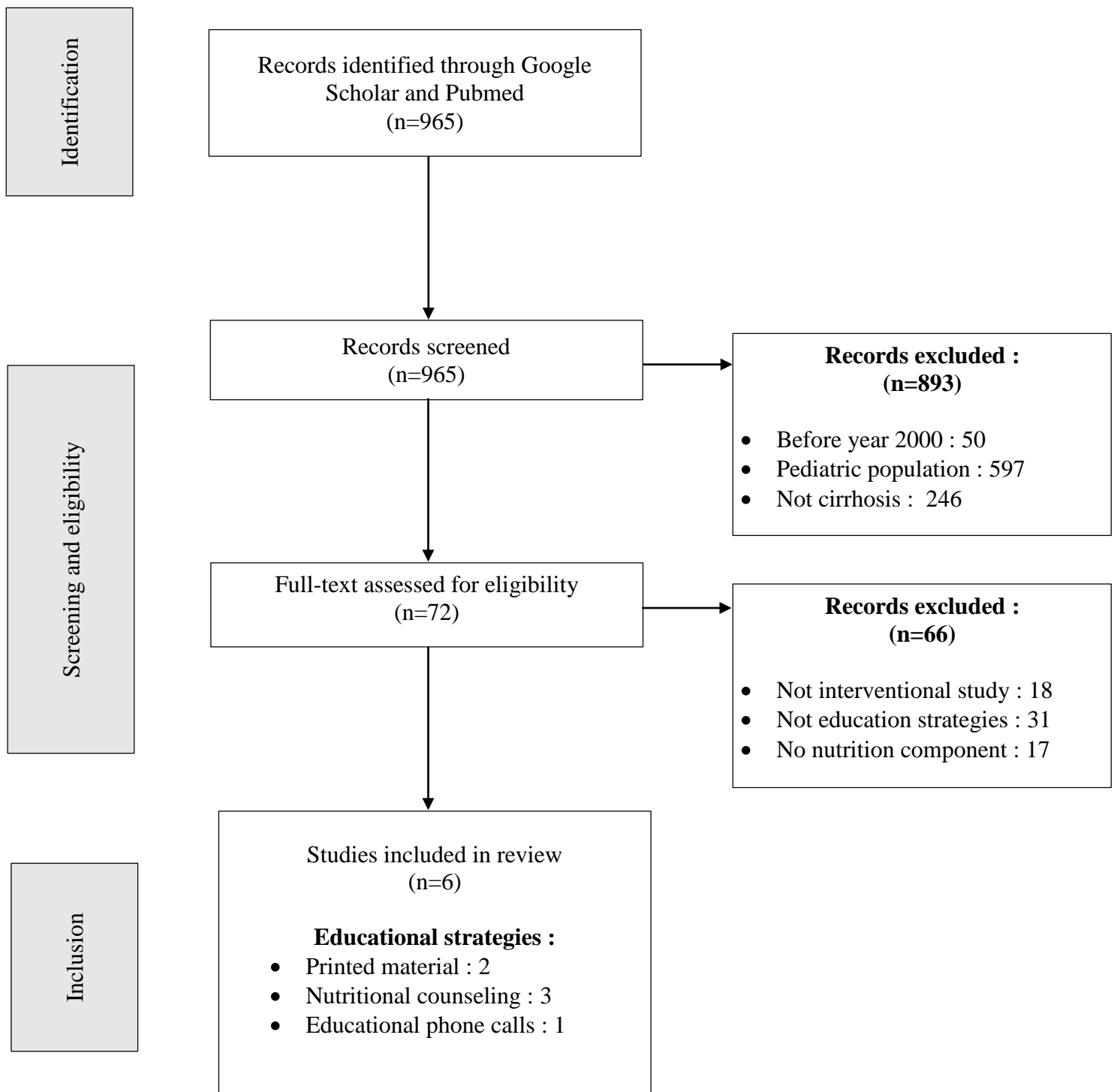


Figure 1. Flow diagram of study selection

Authors	Study Design	Population (n)	Intervention	Main Findings	Quality score (MMAT)
Printed material					
Beg et al. (2016)	Non-randomized study	Chronic liver disease patients (n=39)	Leaflet about general information on cirrhosis, including one nutrition component (sodium)	Significant increase of patients' understanding of their disease in general after two months. Patients reported wanting more information regarding nutrition.	40 % (mid-low quality)
Alavinejad et al. (2019)	Non-randomized study	Chronic liver disease patients (n=170)	Educational intervention and nutritional counseling via guide booklet	Quality of life and level of knowledge improved significantly after the intervention. No change in biochemical characteristics. Significant difference in days of hospitalization.	80% (high quality)
Nutritional counseling					
Zandi et al. (2005)	Randomized controlled study	Chronic liver disease patients (n=44)	Educational program divided in 4 sessions (1 session out of the 4 consisted of nutritional counseling), versus control)	Significant improvement of quality of life after three months as compared to worsening in control group.	60% (mid-high quality)
Iwasa et al. (2013)	Non-randomized controlled study	Chronic liver disease patients (n=234)	Nutritional counseling followed by nutritional assessment with a registered dietitian where they received general information and energy and protein recommendations, versus control (regular follow-up with physician)	Significantly higher survival rate in the group of patients who received nutritional counseling as compared to control group. Significantly higher difference in patients classified as Child A (no difference for Child B and C).	60 % (mid-high quality)
Hayward et al. (2020)	Randomized controlled study	Chronic liver disease patients (n=116)	Educational program, involving lifestyle recommendations including nutritional counseling, versus control (regular follow-up with physician)	Significantly higher overall and nutritional knowledge compared to the control group after approximately six months. Significant improvement of self-reported quality of life, whereas	80% (high quality)

				the control patients did not see any significant changes.	
Phone calls					
Chaney et Heckman (2018)	Non-randomized controlled study	Chronic liver disease patients awaiting liver transplant (n=18)	Follow-up phone calls (supplemental nutrition education) VS no phone call group	No significant effect of the intervention in the nutritional status or number or hospitalization.	40% (mid-low quality)

Table 1. Summary of studies included in the review, classified by education strategies

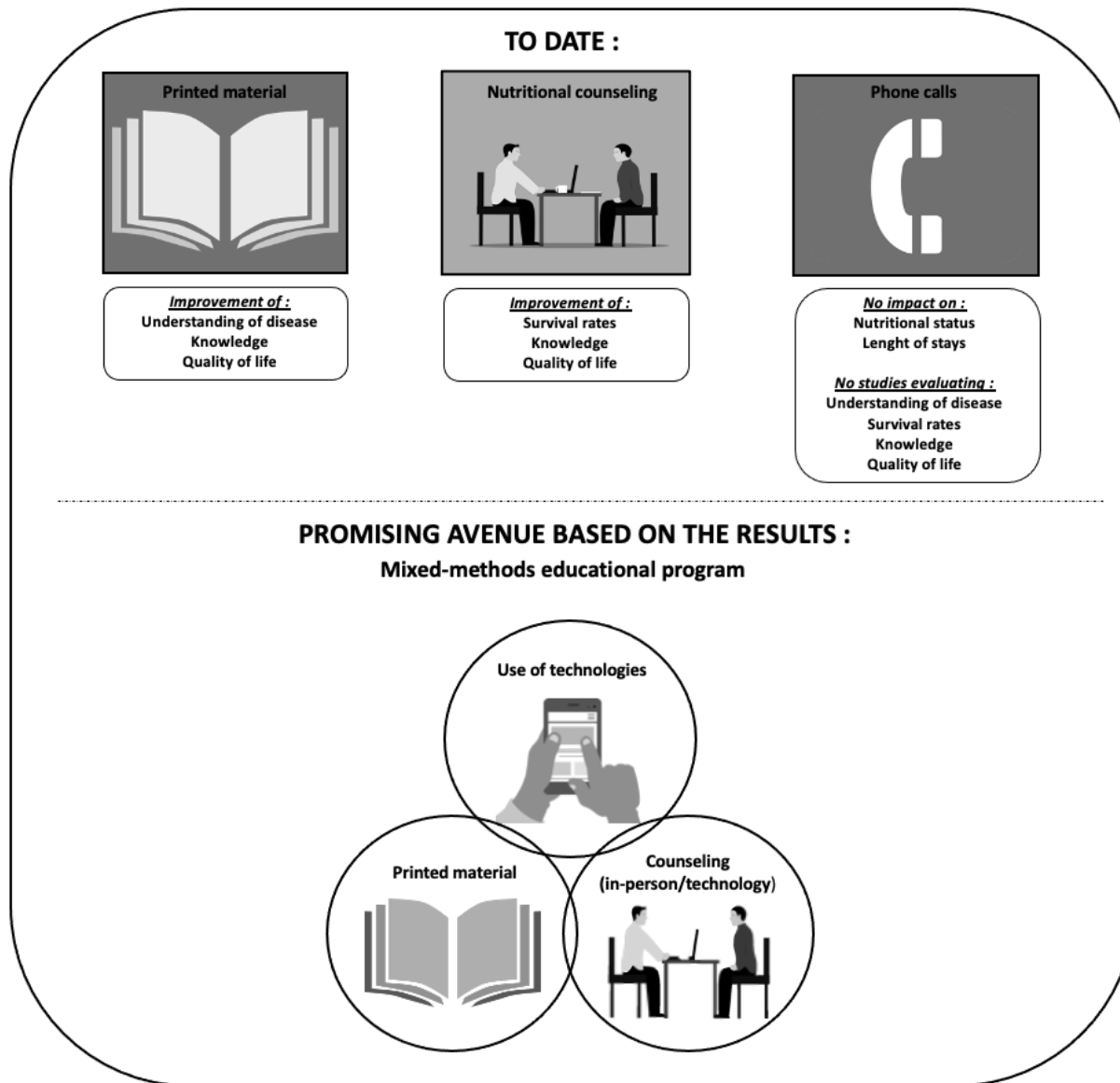


Figure 2. Representative figure of the results and promising avenue

Facilitators	Barriers
Printed material	
<ul style="list-style-type: none"> • Tangible information • Mainly developed by specialists • Sustainability of educational resource that may allow for longer term retention of information 	<ul style="list-style-type: none"> • Higher volume of information transmitted to patients, which may be overwhelming and discouraging
Nutritional counseling	
<ul style="list-style-type: none"> • Involvement of a health professional, preferably a registered dietitian • Face-to-face formula may increase patients' confidence and involvement in the educational process 	<ul style="list-style-type: none"> • Increased need for rigorous organization that may be time consuming • Increased desirability biases since talking directly to a specialist or a physician • Longer intervention where patients' attention may be difficult to maintain
Phone follow-ups	
<ul style="list-style-type: none"> • High speed of transmission of messages • Short interventions 	<ul style="list-style-type: none"> • Increased desirability biases since talking directly to a specialist or a physician • More visual patients may have more trouble understanding information transmitted by phone calls
Mobile applications	
<ul style="list-style-type: none"> • Easily accessible to the patients • High speed of transmission of messages 	<ul style="list-style-type: none"> • Require a good grasp of technology that can not necessarily be mastered by a non-initiated population • Require possession of a cellphone or electronic device

Table 2. Facilitators and barriers of nutritional education strategies

MANUSCRIPT TITLE : Nutritional Education Strategies for Patients with
Chronic Liver Disease : A Narrative Review

DECLARATION OF COMPETING INTERESTS

No competing interest to declare for all authors.

MANUSCRIPT TITLE : Nutritional Education Strategies for Patients with
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CREDIT AUTHOR STATEMENT :

Manila Sophasath : Conceptualization, Methodology, Validation, Formal Analysis,
Writing – Original Draft

Alexandre Brisset : Conceptualization, Writing – Review and Editing

Christopher F. Rose : Writing – Review and Editing

Chantal Bémeur : Conceptualization, Methodology, Validation, Writing – Review and
Editing, Supervision