1   **TITLE PAGE**

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Effect of nutrition care provided by primary health professionals on adults' dietary behaviours: A systematic review.

Abstract

Background: 'Nutrition care' refers to any practice conducted by a health professional to support a patient to improve their dietary behaviours. Better understanding about the effectiveness of nutrition care is required to identify ways to enhance success of future interventions.

Objective: Systematically review literature that investigated the effect of nutrition care provided by primary health professionals on adult patients' dietary behaviours.

Methods: The systematic review included all studies published between January 2000 and January 2015 that involved nutrition care by one or more primary health professionals to adult patients, and incorporated at least one quantified food-related outcome measure (e.g. daily intake of vegetables in grams, weekly servings of lean meats). After data extraction, the methodological quality of each study was appraised using the Mixed Methods Appraisal Tool.

Results: Twenty one studies, totaling 12497 participants were included. The design, intensity, theoretical underpinning and follow-up period of interventions were diverse. Twelve studies found significant improvements in participants' dietary behaviours, such as increased daily consumption of fruit, vegetables, high-fibre bread and fish. However, seven studies did not identify any improvement in dietary behaviours; one observed equal improvements amongst participants in the intervention and control groups; and one found a reduction in participants' daily fruit and vegetable intake.

Conclusion: Interventions involving nutrition care provided by primary health professionals have the potential to improve patients' dietary behaviours. However, the consistency and

47   clinical significance of intervention outcomes are unclear. Further consideration of factors

48   that may influence the effectiveness of interventions, but not traditionally measured, are

49   required.

Introduction

Poor dietary behaviours contribute significantly to the prevalence of lifestyle-related chronic diseases (1, 2). Despite the existence of evidence-based guidelines for healthy eating (3), it is estimated that most (93%) adults have poor dietary behaviours (4). As a result, the promotion of healthy dietary behaviours is a priority for primary health care, and a key component of best-practice guidelines for primary health professionals (5, 6). Improvements in dietary behaviours based on foods and food groups (such as increased fresh fruit, vegetables, wholegrains and decreased meat) show more consistent and convincing associations with reduced risk of chronic disease, compared with improvements based on single nutrients (such as decreased saturated fat, cholesterol, or increased fibre) (7). Therefore, the promotion of healthy dietary behaviours by primary health professionals should focus on changes in dietary behaviours based on foods and food groups.

'Nutrition care' refers to any practice conducted by a health professional to support a patient to improve their dietary behaviours and subsequent biomarkers of chronic disease (8). Nutrition care may include any aspect of nutrition assessment, nutrition advice, nutrition counseling, as well as referral to other nutrition-focused health professionals and relevant services (8). Many primary health professionals (including General Practitioners (GPs), Nurses, Dietitians and Exercise Professionals) provide nutrition care to patients (9, 10). The delivery of nutrition care is diverse in terms of counseling style and content, and is generally considered to be less frequent than ideal (11). However, these professionals also report considerable challenges in providing nutrition care, such as lack of time, knowledge and low self-efficacy (12-14).

74 Numerous primary health chronic disease interventions have utilised nutrition care in order

75 to support patients to have healthy dietary behaviours. Generally, these interventions show

76 promising, but only modest outcomes on biomarkers such as weight, waist circumference,

77 and glycaemic control (15, 16). Some interventions report the actual change in dietary

78 behaviours of participants as a secondary outcome measure (17-19), but rarely is this

79 considered a possible reason for modest outcomes in biomarkers for chronic disease. As a

80 result, further investigation of the effectiveness of nutrition care provided by primary health

81 professionals is required to identify possible ways to enhance future intervention success.

82

83 Two systematic reviews have investigated the effectiveness of interventions aimed at

84 improving patients' dietary behaviours. In 2011, Greaves at al., identified intervention

85 components associated with improved dietary behaviours and/or physical activity in

86 individuals at risk of type 2 diabetes (20). Their review found that a wide range of health

87 professionals including GPs, Nurses, Dietitians, Nutritionists, and Exercise Professionals

88 could deliver effective interventions for improving dietary behaviours and/or physical

89 activity. However, the review was broad and did not describe or critically review individual

90 studies, limiting the ability to utilise the studies to inform future work. In 2013, Bhattarai et

91 al., reviewed the effectiveness of interventions conducted in the primary health care setting

92 at improving participants' dietary behaviours (21). Their review of ten studies found small

93 changes in dietary behaviours. However, the review was limited to Randomised Controlled

94 Trials (RCTs) with individuals who did not currently have a chronic disease, and it mostly

95 focused on patients' intake of nutrients (fat, fibre and cholesterol), rather than on foods

96 and/or food groups. Finally, not all studies involved the provision of nutrition care (e.g. the

97 review included postal newsletters and computer-generated interventions that did not involve

98 a health professional).

99

100   In order to advance understanding on the effectiveness of nutrition care by primary health

101   professionals, there is a need to better understand the expected food-related dietary outcomes

102   of relevant previous interventions. This understanding will help identify the nature of

103   interventions that have been previously conducted, the extent that the interventions have

104   resulted in improvements in patients' food-related dietary behaviours, and the potential

105   factors that contribute to positive outcomes in these interventions. The information can be

106   used to directly inform future interventions designed to promote effective nutrition care by

107   primary health professionals. Therefore, this study synthesised previous literature by

108   undertaking a systematic review of studies that aimed to improve adult patients' food-related

109   dietary behaviours through the provision of nutrition care by primary health professionals.

110

111   **Methods**

112   A systematic review was conducted to identify and critically review studies that aimed to

113   improve adult patients' food-related dietary behaviours through the provision of nutrition

114   care by primary health professionals. All applicable items from the PRISMA guidelines for

115   reporting of systematic reviews were included (22).

116

117   *Search Strategy*

118   A literature search was conducted in January 2015 using ScienceDirect, ProQuest Family

119   Health, Web of Science, Scopus, PubMed Central, MEDLINE®, CINAHL, and Cochrane

120   databases. All studies published from the year 2000 with at least one search term from the

121   following two categories in the title or abstract were included for consideration.

122   -   *For nutrition care*: Nutrition Care OR Nutrition Advice OR Nutrition Therapy (MeSH)

123   OR Diet (MeSH) OR Dietary Behaviours OR Diet Therapy (MeSH) Or Food Habits

124 (MeSH).

125 - *For primary health care:* Primary Care (MeSH) OR Primary Health Care (MeSH) OR

126 General Practice (MeSH) OR General Practitioners (MeSH) OR Family Practice (MeSH)

127 OR Primary Care Physicians OR Allied Health Personnel (MeSH)

128 No limit was applied to the intervention design or length of study. Cross-matching reference

129 lists and forward citation searching was conducted in order to identify additional studies for

130 consideration. A health-focused librarian provided support during the search process to

131 further enhance search quality.

132

133 *Study Selection*

134 The study selection process is illustrated in Figure 1. Interventions that involved the provision

135 of nutrition care exclusively by one or more primary health professionals in order to support

136 adult patients (aged ≥18 years) to improve their dietary behaviours were included in the

137 review. A primary health professional was defined as a health professional who usually

138 provided a first point of contact in a health care system, and included GPs, Nurses, Dietitians,

139 Nutritionists, Exercise Professionals and their assistants (23). Nutrition care was defined as

140 any practice conducted to support a patient to improve their dietary behaviours, and could

141 include components of nutrition assessment, nutrition advice, and nutrition counseling as well

142 as referral to other nutrition-focused health professionals and relevant services (8). Studies

143 that did not include at least one quantified food-related outcome measure (e.g. daily intake of

144 vegetables in grams, weekly servings of lean meats) and determine its change over time were

145 excluded.

146

147 *Data Extraction*

7

148 Articles for inclusion were selected independently by two researchers (LB & SC) using the

149 same search strategy. Differences in selections were discussed prior to reaching final

150 consensus. After careful review of each manuscript, information regarding study design,

151 recruitment, participants, intervention and its theoretical underpinning, health professional

152 training, relevant outcome measures and results were extracted by LB into two tables (Tables

153 1 and 2), and cross-checked by SC.

154

155 *Quality Assessment*

156 The methodological quality of each study was appraised by LB and SC using the Mixed

157 Methods Appraisal Tool (MMAT), and differences in scores were discussed prior to reaching

158 final consensus (24). The MMAT is designed for systematic reviews that include quantitative,

159 mixed methods and qualitative studies, and has proven content-validity and reliability (24).

160 The MMAT quality assessment process involves answering four questions that are

161 appropriate to the study design regarding recruitment, randomisation (if applicable),

162 appropriateness of outcome measures and attrition rate/completeness of data. Studies were

163 scored as: - (0% of quality criteria met); * (25% of quality criteria met); ** (50% of quality

164 criteria met); *** (75% of quality criteria met); or **** (100% of quality criteria met), and

165 are displayed in Table 2.

166

167 **Results**

168 The initial database search identified 3375 publications for consideration, of which 21 studies

169 (from 23 publications) were selected for inclusion (25-47). The reasons for excluding

170 publications fell within four criteria, as outlined in Figure 1. After excluding articles that did

171 not involve nutrition care provided by a primary health professional (such as mailed

172 pamphlets (48), nutrition care provided by student counsellors (49)), the most common

173　reason for excluding articles was that they did not include a quantified food-related outcome

174　measure. For example, some studies were excluded because they reported on the change in

175　proportion of patients following a healthy diet (50, 51), or the number of participants who

176　reported to be following a healthy diet (52, 53), but did not present a quantified outcome

177　measure (e.g. daily intake of vegetables in grams, weekly servings of lean meats). For one

178　study, two intervention arms met the inclusion criteria, and the third intervention arm did not

179　involve nutrition care provided by a primary health professional (27). Therefore, the two

180　applicable arms were included in the review.

181

182　The characteristics of the 21 studies included in the review are outlined in Table 1. Most

183　studies were conducted in UK/Europe (n=14, 67%) (25, 28, 30, 32, 35, 37-41, 43, 44, 46, 47),

184　with fewer from Australia/New Zealand (n=3, 14%) (31, 34, 36), USA (n=3, 14%) (27, 42,

185　45) and Asia (n=1, 5%) (26). Most studies were RCTs (n=13, 62%) (27, 28, 30, 32, 39-47),

186　with fewer Cluster-RCTs (n=5, 24%) (26, 30, 35, 37, 38), and longitudinal pretest-postest

187　studies (n=3, 14%) (25, 34, 36). A total of 12,497 (median n=326) individuals participated in

188　the studies, and were usually recruited by letters sent to participants on clinic records or via

189　verbal invitation when attending a clinic. Fourteen studies included both men and women

190　(25-28, 30-32, 35, 36, 39, 40, 43, 44, 47), five included women only (34, 37, 38, 42, 45), and

191　two included men only (41, 46). Nearly all studies recruited individuals with at least one risk

192　factor for chronic disease, but without diagnosis of a chronic disease such as Type 2 diabetes.

193

194　A description of the interventions tested is outlined in Table 2. Most interventions involved

195　multiple consultations (usually four or fewer) over the intervention period (n=18, 86%) (26-

196　28, 30-32, 34-38, 40, 42-47), although three (14%) involved a 'once-off' intervention within

197　a single consultation (25, 39, 41). Interventions were delivered by a range of primary health

198 professionals including multidisciplinary teams (n=6, 29%) (25, 28, 30-32, 36), Nurses (n=8,

199 38%) (34, 35, 37, 38, 40, 42-44), Dietitians (n=3, 14%) (26, 41, 46), GPs (n=2, 10%) (27,

200 39), or a Health Counsellor (n=1, 5%) (45). Nine studies (43%) used empirical guidelines to

201 inform the nutrition care such as best-practice guidelines or national dietary guidelines (26,

202 27, 30-32, 37-39, 47), nine (43%) were underpinning by theory, such as Motivational

203 Interviewing and behaviour change theories such as Stages of Change(28, 34-36, 42-45, 47),

204 whereas four (19%) did not report the use of any evidence to inform their intervention (25,

205 40, 41, 46).

206

207 All studies included a food outcome measure related to fruit and/or vegetable consumption,

208 with three also investigating fish intake, three also investigating breads/cereal and dairy

209 intake and one also investigating alcoholic beverage consumption. Eleven studies measured

210 food intake through a general questionnaire, eight utilised a food frequency questionnaire,

211 one utilised a food diary and one utilised a dietary recall. Approximately half of the studies

212 included a follow-up period of between three months and five years after the intervention

213 ceased (n=11, 53%) (25, 30, 31, 34-36, 39-41, 44-46), whereas half did not follow-up

214 participants after the intervention ceased (n=10, 47%) (26-28, 32, 35, 37, 38, 42, 43, 47).

215 None of the studies compared the food outcome measure to clinically meaningful changes,

216 such as minimum consumption associated with reduced chronic disease risk (2).

217

218 Twelve of the studies observed significant improvements in participants' dietary behaviours.

219 Examples of improvements include an increase in daily vegetable intake of 25.5g (26), an

220 increase in daily fruit and vegetable intake of 0.8 serves (37), an increase in proportion of

221 high-fibre bread consumed (38), and an increase in daily fish intake of 8.3g (41). However,

222 seven studies did not observe any improvement in dietary behaviours of participants (25, 27,

223 28, 30, 35, 36, 42) after the intervention, one study observed equal improvements in fruit and

224 vegetable intake amongst participants in the intervention and control groups (32) and one

225 study observed a reduction in participants' daily fruit and vegetable intake of 70g (40) after

226 the intervention.

227

228 The quality attributes of each study are displayed in Table 2. Two studies received a rating of

229 - (41, 42), two received a rating of * (30, 37), ten received a rating of ** (25, 27, 28, 32, 34,

230 38, 44-47), three received a rating of *** (35, 36, 43), and four received the highest possible

231 rating of **** (26, 31, 39, 40). For the longitudinal pretest-postest studies, the most common

232 reason for a lower methodological quality score was a considerable opportunity for selection

233 bias when recruiting participants. Similarly for randomised trials, the most common reason

234 for a lower methodological quality score was a lack of clear description of randomisation of

235 participants. Due to the nature of some interventions, it was not possible to conceal

236 participants' allocation from primary health professionals, which also reduced the

237 methodological quality score.

238

239 **Discussion**

240 This systematic review investigated the effectiveness of nutrition care provided by primary

241 health professionals at improving patients' dietary behaviours. Significant improvements in

242 dietary behaviours were observed in around half of the studies. The results suggest that there

243 is a potential to for primary health professionals to facilitate improvements in patients'

244 dietary behaviours. However, the inconsistency in findings suggests that the effectiveness of

245 interventions may be dependent on factors such as the theoretical underpinning, delivery,

246 intensity and content of nutrition care.

247

248   Significant improvements in patients' dietary behaviours were apparent in interventions with

249   diverse designs, intensity, theoretical underpinning and follow-up periods. This suggests that

250   it is possible to elicit positive improvements in patients' dietary behaviours with different

251   interventions. For example, improvements were seen in interventions with nutrition care

252   provided by a range of primary health professionals (mostly a combination of GPs (39),

253   Nurses (34, 37) and Dietitians (26, 31)), a range of intensities (mostly four or fewer

254   consultations (26, 43-46)), and a range of designs (including individual (44, 46), group (34,

255   47) and phone consultations (43, 45)). Notably, despite statistical improvements in measures

256   of dietary behaviour, the clinical significance of the improvements was not considered in any

257   study. Therefore, it is unclear whether the improvements in dietary behaviours were sufficient

258   to result in an improvement in health outcomes associated with chronic disease, and future

259   interventions are recommended to include measures of dietary behaviours as well as

260   biomarkers of chronic disease.

261

262   Interventions that are informed by theory are recognised as more likely to elicit positive

263   outcomes (54), including dietary behaviours (55). Four studies did not report the use of any

264   theory or other empirical evidence to inform their intervention (25, 40, 41, 46). Of these

265   studies, one observed an improvement in patients' dietary behaviours (46), two did not

266   observe any change in patients' dietary behaviours (25, 41), and one observed a reduction in

267   the quality of patients' dietary behaviours (40). It is possible that a lack of theory may

268   indicate a less rigorous approach to planning and development of the intervention, and may

269   explain the absence of consistent improvements in food-related outcome measures. Studies

270   that utilised theory to develop their intervention observed success with approaches such as

271   Stages of Change (56), Motivational Interviewing (57), and Social Learning Theory (58).

272   These theoretical underpinnings predominantly stem from counselling and psychological

273   disciplines to inform behaviour change techniques, and have been utilised in many primary

274   care interventions, with varying effectiveness (59). Importantly, other theories such as those

275   used for knowledge translation suggest that a wide range of approaches may facilitate

276   behaviour change (60), and warrant consideration in future interventions.

277

278   The studies with the largest sample sizes (>500 total participants) tended to utilise existing

279   patient databases to identify and invite potential participants (28, 42, 45), or expand the

280   recruitment over numerous general practice clinics (>30 clinics) (31, 39). This approach

281   appears more feasible than opportunistic recruitment through clinic attendance (37, 38), and

282   should be considered based on target sample sizes in future interventions. Similarly, the

283   studies with the highest retention rates (92% at 12 months after intervention) tended to

284   incorporate nutrition care as part of usual care and then measure the outcomes (31), and this

285   is likely to have a low burden on patients. However, other studies with interventions that

286   were independent to usual care were still able to observe high retention rates during follow-

287   up (>80%), showing that interventions with moderate intensity (four or fewer consultations)

288   are tolerated by patients (26, 43-46).

289

290   The methodological quality of the reviewed interventions requires consideration.

291   Interestingly, the only study to report a reduction in the quality of patients' dietary behaviours

292   achieved the maximum quality rating possible (40), and two studies with extremely low

293   methodological quality observed some improvements in patients' dietary behaviours (37, 41).

294   This suggests that although the methodological quality of future interventions could be

295   strengthened compared to existing studies, the success of interventions requires consideration

296   of factors beyond methodological quality. Some of these factors may include the delivery,

297   content and intensity of nutrition care.

298

299 Intervention components beyond the delivery, content and intensity of nutrition care have the

300 potential to influence the effectiveness of intervention outcomes. For example, nearly all of

301 the studies utilised an RCT or cluster-RCT design, which likely prevents the tailoring of

302 nutrition care to patients' needs or preferences. Furthermore, the authors of one study that did

303 not observe any difference in dietary behaviour change between participants in the

304 intervention and control groups suggested that the Nurses who provided nutrition care were

305 very eager, to the extent that the study may have been contaminated because there may not

306 have been considerable differences between the care provided to the two groups (35). In

307 addition, factors such as patients' satisfaction, expectations and broader perceptions of health

308 care experiences have been identified as having an influence on patients' self-efficacy,

309 lifestyle behaviours, and ultimately health outcomes (61, 62). Therefore, future interventions

310 should consider broader indicators of success, including positive health care experiences and

311 improved self-efficacy towards improved dietary behaviours.

312

313 A notable limitation to the reviewed studies is the variation in measures of dietary

314 behaviours. Over half of the studies utilised a general questionnaire to assess dietary

315 behaviours, with the remainder using a food frequency questionnaire, food diary, or dietary

316 recall. Importantly, there is no recognised gold-standard approach to assessing dietary

317 behaviours, and each approach used in the reviewed studies has inherent strengths and

318 limitations. One valid approach used within large population nutrition surveys is the

319 Automated Multiple-Pass Method for a 24-hour dietary recalls (63), which requires

320 significant time and equipment resources for data collection and analysis, and may not be

321 feasible for many studies. Furthermore, the most appropriate component of dietary behaviour

322 that relates to risk of chronic disease is not well recognised. Whilst associations between fruit

323 and vegetable intake and many conditions such as cardiovascular disease (64, 65), Type 2

324 Diabetes (66, 67) and overweight/obesity are strong (68-70); associations between other

325 foods and food groups such as cereals, meat and fish are less clear (69-71). This suggests that

326 while fruit and vegetables are appropriate indicators of dietary behaviour for risk of chronic

327 disease, other indicators are less clear and warrant caution prior to use.

328

329 This review suggests that nutrition care provided by primary health professionals has the

330 potential to improve patients' dietary behaviours. It appears that successful outcomes are

331 possible with a range of intervention approaches. However, the consistency and clinical

332 significance of outcomes are unclear, and further consideration of factors that may influence

333 the effectiveness of interventions are required. Researchers developing future interventions

334 are encouraged to utilise theory to inform the intervention, include a moderate intensity

335 intervention, consider the validity of the food-related outcome measure and feasibility of

336 recruitment approaches, and consider other factors that may influence outcomes such as

337 patients' perceptions of their health care experience.

338

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