

1 **Title: Using the COM-B model to identify barriers and facilitators towards adoption of a**
2 **diet associated with cognitive decline (MIND diet).**

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11 **Short title:** Barriers and facilitators to the MIND diet

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20 ES analysed the data. ES & JMcC supervised the project.

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22 down in the Declaration of Helsinki and all procedures involving research study participants
23 were approved by the School of Psychology Staff and Postgraduate Ethics Filter Committee.
24 Written informed consent was obtained from all subjects/patients.

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ABSTRACT

Objectives: The aim of the study was to identify components of the COM-B (capability, opportunity, motivation and behaviour) model, that influence behaviour to modify dietary patterns in 40-55-year olds living in the UK, in order to influence the risk of cognitive decline in later life.

Design: This is a qualitative study using the COM-B model and theoretical domains framework (TDF) to explore beliefs to adopting the Mediterranean Intervention for Neurodegenerative delay (MIND) diet.

Participants: Twenty-five participants were recruited onto the study, to take part in either a focus group or an interview. Participants were men and women aged between 40-55 years. Participants were recruited via e-mail, Facebook and face to face.

Setting: Northern Ireland

Results: Content analysis revealed that the main perceived barriers to the adoption of the MIND diet were; time, work environment, taste preference and convenience. The main perceived facilitators reported were; improved health, memory, planning and organisation, and access to good quality food.

Conclusion: This study provides insight into the personal, social and environmental factors that participants report as barriers and facilitators to adoption of the MIND diet among middle aged adults living in UK. More barriers to healthy dietary change were found than facilitators. Future interventions that increase capability, opportunity and motivation may be beneficial. The results from this study will be used to design a behaviour change intervention using the subsequent steps from the Behaviour Change Wheel.

Keywords: MIND diet, COM-B model, dementia, adherence, brain health

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INTRODUCTION

Maintaining healthy dietary behaviours is crucial for population health and the prevention of non-communicable disease. The most recent statistics show that there are around 850,000 people in the UK with dementia.¹ The number of people with dementia is increasing because people are living longer with estimations showing that by 2025, the number of people with dementia in the UK will have increased to around 1 million.¹ It is estimated that by 2025, 20% of the population will be over 65 years and, with this increased longevity, there is a need to identify potential variables such as diet to promote healthy ageing.

Many of the epidemiological studies of dietary patterns have investigated the impact of the Mediterranean Diet and the DASH diet (Dietary Approaches to Stop Hypertension)² on cognitive function.³ Research found that higher adherence to the respective diets were significantly associated with less cognitive decline in midlife over a 4-month period⁴ and also in older adults over a 4-year period.⁵

The MIND diet (Mediterranean-DASH Intervention for Neurodegenerative Delay)⁶ is a hybrid of the Mediterranean diet⁷ and DASH diet. Findings from research on the Mediterranean and DASH diets, showed that protective effects on cardiovascular conditions that may adversely affect brain health. However, the dietary components of both individual diets may not capture the levels and types of foods shown to optimize brain health.⁶ Therefore, the MIND diet was designed to emphasize the dietary components and servings linked to neuroprotection and dementia prevention.⁶ The MIND diet consists of 10 healthy foods (leafy greens, other vegetables, nuts, berries, fish, poultry, olive oil, beans, whole grains, red wine) and 5 other foods which are to be limited (red meat, butter, cheese, pastries and sweets, fried foods).

There has been limited research investigating the MIND diet, however, recent research with older adults found that the MIND diet can slow cognitive decline over an average of 4.7 years.⁸ This study found that the MIND diet score was more predictive of cognitive decline than either the Mediterranean Diet or DASH diet. Research found a 53% lower risk for Alzheimer's Disease with high adherence to the MIND diet.⁸ Furthermore, a 35% lower risk of Alzheimer's Disease was shown for a moderate adherence to the MIND diet,⁸ whereas no significant association with Alzheimer's Disease was shown for the Mediterranean or DASH diet.⁹ Further support for a lower risk of cognitive decline with both moderate and high adherence to the MIND diet was shown in Adjibade et al. (2019). This study showed that 72%

93 of the large sample (6011) adhered at least moderately to the MIND diet¹⁰. Interestingly, recent
94 research found that the MIND diet and not the Mediterranean Diet, protected against 12 year
95 incidence of mild cognitive impairment and dementia in older adults.¹¹ A longitudinal study
96 with older adults found higher adherence to the MIND diet was associated with less cognitive
97 decline after a 6 year follow up,¹² and that greater long-term adherence to the MIND diet was
98 associated with better verbal memory over 6 years in older adults.¹³

99 Little is known about the social, environmental and cultural perspectives of adopting
100 the MIND diet in the UK. However, research has found that adopting a Mediterranean style
101 diet has social, cultural and environmental barriers. Research found that participants reported
102 British culture to be non-conducive to a Mediterranean dietary pattern¹⁴ and that factors such
103 as time, work and convenience were barriers to consuming a Mediterranean style diet.^{15,16} The
104 cost of food is suggested to play a role in peoples food choices,¹⁷ and that a healthy diet may
105 be costlier than a less healthy diet.^{18,19} Therefore, budget could be a barrier to eating a
106 Mediterranean style diet, especially for those of low socio-economic status. However, previous
107 research has found, that while consuming a healthier diet such as increasing fruit and
108 vegetables, may be more expensive, this cost could be offset with the reduction in meat product
109 cost.²⁰

110 This study seeks to explore the perceived barriers and facilitators to adopting the MIND
111 diet at midlife (40-55 years) in this non-Mediterranean country. This research could also add
112 support to the dementia strategy research by exploring modifiable risk factors in the prevention
113 of dementia, which could be applied globally.

114 ***Theoretical Framework***

115 The Behaviour change wheel is a framework for designing and evaluating
116 interventions. At the Behaviour Change Wheel core, is a model of behaviour known as COM-
117 B model, which stands for Capability (C), Opportunity (O), Motivation (M) and Behaviour (B)
118 and posits that all 3 components influence behaviour, which accounts for all the factors outside
119 the person that make the behaviour possible. The model also posits that both Capability and
120 Opportunity influence Motivation making it the central mediator of the model, therefore,
121 Capability and Opportunity affect behaviour both directly and indirectly. According to the
122 COM-B model, in order to change behaviour, one or more of the COM-B components need to
123 change, relating to either the behaviour or behaviours that support or compete with it.²¹ In this
124 study the COM-B model is used to explore perceived barriers and facilitators to identify
125 potential levers for change for adoption of the MIND diet to occur. A “behavioural analysis”

126 of the determinants of MIND diet behaviour will help define what needs to change in order for
127 adoption of MIND diet to occur. This will be a new behaviour to many, as this diet is very new
128 and hasn't been investigated in this way before. The COM-B model can be further elaborated
129 by the Theoretical Domains Framework (TDF)²² (see Figure 1). Although the TDF is
130 descriptive and fails to postulate the link between domains,²³ it consists of 14 domains
131 covering the spectrum of behavioural determinants and can be mapped directly onto the COM-
132 B components,²² which specifies the relationship between domains in regards to a person's
133 capability, motivation and opportunity to enact a behaviour²¹ and includes constructs aligned
134 with other behaviour change theories such as the theory of planned behaviour.²⁴ Each domain
135 of the TDF is further elaborated by a number of core components such as; belief about
136 capabilities which include, self-efficacy, control of behaviour and confidence.²² The
137 comprehensive coverage of the TDF allows researchers to analyse the most important domains
138 specific to their target behaviour, allowing a crucial step in predicting, and ultimately changing
139 dietary behaviour. By providing a wider range of behavioural determinants, researchers gain a
140 deeper understanding of factors influencing behaviour which can be addressed fully in
141 intervention design.

142 Several qualitative studies have used the COM-B model and TDF to explore barriers
143 and facilitators to dietary behaviour change.^{25,26,27} These studies found that the COM-B model
144 and TDF provided a comprehensive framework for describing barriers and facilitators to
145 reducing sugar intake in young adults,²⁵ delivery of a healthy kids check to pre-schoolers,²⁶
146 and to athlete nutritional adherence from the sports nutritionist perspective in 26-52 year olds.²⁷
147 These studies found the COM-B and TDF useful to inform an intervention to promote
148 behaviour. Furthermore, studies have designed dietary interventions based on the COM-B
149 model to promote the Mediterranean Diet in adults at risk of cardiovascular disease,²⁸ an app
150 to improve eating habits of adolescents and young adults,²⁹ and a text messaging service
151 targeting healthy eating for children in a family intervention.³⁰

152 This study investigates the perceived barriers and facilitators to adopting the MIND diet
153 in midlife (40-55 years). As we are looking to promote healthy ageing, we are investigating
154 modifiable risk factors in the prevention of cognitive decline. Research has found that a good
155 quality diet at midlife seems to be strongly linked to better health and well-being in older life.³¹
156 Previous research found that adherence to a healthy dietary pattern in midlife was positively
157 associated with cognitive functioning.³²

158 There is currently no study investigating adoption of the Mediterranean-DASH
159 Intervention for Neurodegenerative Delay (MIND) diet in midlife. This study addresses this
160 gap in the literature and highlights the perceived barriers and facilitators to adopting a diet that
161 may promote brain health at midlife and will be used to inform an intervention design.

162 The aim of this study was to explore perceived capability, opportunity, and motivation
163 to adopting the MIND diet among middle-aged (40-55 years) adults. The resulting
164 information will be used to inform the design of an intervention to promote the MIND diet in
165 middle-aged adults in the UK.

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METHOD

Design

168 A mixed methods qualitative design was used to elicit beliefs surrounding Capability,
169 Opportunity, Motivation and Behaviour (COM-B) with adopting the “MIND” diet. Capability,
170 motivation and opportunity were further elaborated into 14 domains, using a more detailed tool
171 to understand behaviour, the Theoretical Domains Framework. (TDF). Interviews and focus
172 groups generate different information from participants. Research shows that while focus
173 groups generate a wider range of ideas and views than that of interviews,³³ one to one
174 interviews capture more detail than focus groups and offer more insight into participants
175 personal thoughts and experiences.³⁴ In accordance with the COM-B framework, collecting
176 information to understand the target behaviour, data should be collected from different sources
177 as the most accurate picture will be informed by multiple perspectives, therefore, both focus
178 groups and interviews were conducted²¹, and lasting between 30-60 minutes each (see Table
179 1). The interview and focus group questions were based on guidance using the COM-B²¹ model
180 and TDF²² (Table 1). The model and framework were used both in developing the interview
181 schedule and informing the content analyses used. A topic guide was developed using the
182 TDF.²² The TDF consists of a comprehensive set of 14 domains into which all determinants of
183 adherence to implementation of a behaviour can be organised (see Table 1). The TDF can be
184 mapped onto the overarching COM-B model,²¹ which posits that three key components are
185 necessary for any behaviour—capability, opportunity and motivation.

Participants

188 According to similar behaviour change theories, the ideal sample size for elicitation
189 studies is 25.²³ Also, similar to other qualitative studies using the COM-B and TDF,^{25,26} twenty-
190 five participants were recruited onto the study, to take part in either a focus group or an
191 interview. Participants were selected for interview or focus group based on their convenience

192 to attend, which took place either in their local community hall, library, workplace or home.
193 Participants were both Caucasian men and women aged between 40-55 years. Participants were
194 recruited via e-mail, Facebook and face to face, which took place in a supermarket. Interested
195 participants were emailed a participant information sheet (PIS), consent form and a “MIND
196 DIET” booklet, explaining the elements of the MIND diet. Participants approached face to face
197 were given the booklet explaining the MIND diet and asked to contact the researcher if
198 interested in taking part, at which time, were emailed the PIS and consent form. All interested
199 participants were asked to contact the researcher by email. Dates, times and venue were
200 arranged for focus groups and interviews.

201 Inclusion criteria: Male or female aged between 40-55 years old living in Northern Ireland,
202 who have no food allergies or intolerances.

203 Exclusion Criteria: Participants following specific diets that excluded food groups, such as
204 veganism, vegetarian, Atkins were excluded from the study as these diets exclude foods such
205 as fish, poultry and wholegrains, which are specific to the MIND diet. Participants with food
206 allergies and/or intolerances were also excluded from the study.

207 *Procedure and Materials*

208 Participants were contacted by e-mail, Facebook and face to face. All participants were
209 asked to complete a personal information form which further asked if they followed a specific
210 diet and sign the consent form before the interview/focus group began. Before interview/focus
211 group began, there was an in-depth discussion on the MIND diet and its components between
212 participant and researcher to ensure participants understood what the diet entailed. Participants
213 were informed of what foods to eat, how often to eat foods and portion sizes required. There
214 was also discussion on dementia risk factors and prevalence in the UK. The questions tapped
215 into the components of the COM-B and TDF, that of Capability, Opportunity, Motivation and
216 Behaviour towards consuming a healthy diet. Interviews/focus groups were approached the
217 same in terms of discussion and questions asked, and were audio recorded using a hand-held
218 recorder.

219 Participants were informed that the study was voluntary and that they were free to
220 withdraw at any time. They were assured of confidentiality regarding any personal information
221 they supplied to the researcher.

222 **Data Analyses**

223 The data was transcribed verbatim and analysed using thematic analyses.³⁵ Both
224 researchers have extensive experience and training in thematic/content analysis employed
225 within theory of behaviour change frameworks and to inform intervention design. Researchers

226 attended specific workshops on the COM-B framework. LS is a Health Psychologist and DT a
227 trainee Health Psychologist, with an array of skills and experience in qualitative research
228 analysis and the use of behaviour change theories. Two researchers independently read through
229 the entire dataset and coded the data from each transcript and assigned initial “code names”.
230 Researchers kept a reflective diary to ensure a clear overview of the material. Each code was
231 noted as either “barrier” or “facilitator”, depending on the context in which the code occurred.
232 There was an initial 95% agreement of codes, which demonstrates an acceptable level of
233 agreement.³⁶ Discussion between researchers resolved any differences within the coding
234 process. After agreement on codes had been made, an additional step in analysis was taken by
235 applying summative content analysis,³⁷ which involved both researchers searching the text for
236 occurrences of codes and frequency counts for each identified code was calculated. Using a
237 common approach,^{38,39} TDF domains were judged based on the frequency count of coding for
238 each TDF domain, which had been aggregated from all the factors and behaviour-specific
239 belief statements within that domain. TDF domains were then rank ordered according to the
240 frequency coding to identify which components and domains of the theoretical models were
241 the main barriers and facilitators to adoption of the MIND diet (see Table 3).

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RESULTS

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246 A total of 25 participants took part in the study. A total of 15 individual interviews and
247 two focus groups. One focus group included six participants and the second focus group
248 included four participants. Participants were both male (40%) and female (60%) aged between
249 40-55 years old with an average age of 45 years. Forty percent of participants were of low
250 socio-economic status. Forty four percent of participants had children living at home and fifty
251 six percent of participants lived rurally compared to forty four percent living in an urban area
252 (see Table 2 for participants characteristics).

Theoretical Framework

254 The transcripts provided data from all the 14 domains of the TDF and all the
255 components of the COM-B model. All the perceived facilitators and barriers could be fitted
256 into one of the TDF domains and mapped onto the COM-B model, with 65% of all mentions
257 reported as barriers to adopting the MIND diet, compared to 35% of mentions reported as
258 facilitators. The most commonly reported domains were, belief about consequences, belief

259 about capabilities and environmental context/resources, and the least commonly reported
260 domains were, goals and optimism (see Table 4 and 5 for quotes).

261 **Capability**

262 According to the COM-B model, for behaviour to occur, there must be the capability
263 to do it. Capability can be either psychological (knowledge, psychological skills or stamina) to
264 perform the behaviour, or “physical” (having the physical skills, strength or stamina) to
265 perform the behaviour.

266 **Psychological Capability.** Psychological capability was a COM-B component identified as a
267 barrier to participants adoption of the MIND diet. Twenty nine percent of barriers to adopting
268 the MIND diet fell into the psychological capability component of the COM-B model. These
269 barriers also fell into 3 of the 14 TDF domains, knowledge, memory, attention and decision
270 processes, and behavioural regulation.

271 **Knowledge.** All participants reported that they had never heard of the MIND diet prior to the
272 current study.

273 Most participants reported that they didn’t know that certain foods were associated with brain
274 health.

275 **Memory, attention and decision processes.** The current study defined memory,
276 attention and decision processes as the role of memory and attention to ensure adoption of the
277 MIND diet, and “life distractions”, such as alcohol and tiredness, which may limit attention
278 control with respect to eating foods that promote brain health. Several of the participants
279 reported that alcohol is a barrier to eating brain healthy foods.

280 Another “distraction” reported by participants was being tired. This was mainly due to
281 participants being at work all day or having a long day with the children and too tired to cook
282 when they came home. One participant reported eating sugary foods because of tiredness, to
283 keep him going throughout the day.

284 **Behaviour regulation.** In terms of dietary patterns, behaviour regulations are the steps
285 taken to ensure that food intake is remembered and conducted, and steps taken to break
286 unhealthy habits. In this study, most of the participants did not monitor their food intake.
287 However, most of the participant’s viewed monitoring of food, with weight management
288 programs.

289 However, several participants stated that while they didn’t record their food intake, they were
290 aware of what they ate.

291 **Physical Capability: Skills.** Physical skills are defined as the level of self-efficacy in
292 cooking/eating with MIND diet foods. Six percent of the barriers to adoption of the MIND diet

293 fell into the TDF skills domain and mapped onto the physical capability component of the
294 COM-B model.

295 Cooking skills were reported to be a barrier to adoption of the MIND diet. Those
296 participants who reported cooking skills as a barrier, tend to be married men. However, most
297 of the participants that reported lack of cooking skills, were particular to a food in the MIND
298 diet that they usually didn't eat.

299 Skills was also reported to be a facilitator in this study, with 12% of all facilitators
300 falling into the TDF skills domain. Most participants felt confident with cooking with the
301 MIND diet foods.

302 Also, many participants reported that if they didn't know how to cook something, they were
303 confident that they could follow a recipe.

304 ***Opportunity***

305 The COM-B model states that for behaviour to occur, there must be the opportunity for
306 the behaviour to occur in terms of a conducive physical and social environment.

307 ***Physical Opportunity.*** Barriers relating to physical opportunity was the most commonly
308 reported barrier in this study, with 29% of all barriers falling into this component. Physical
309 opportunity is defined in terms of what the environment facilitates in terms of time, resources,
310 location, physical barriers etc. The TDF domain related to this component is environmental
311 context and resources.

312 ***Environmental context and resources.*** This domain is defined as any circumstance of
313 a person's situation or environment that discourages or encourages the development of skills
314 and abilities, independence, social competence and adaptive behaviour, environmental
315 stressors, resource's, salient events and person x environmental interaction. For example; cost
316 of foods, lack of time, doesn't do the shopping or cooking, accessibility of cheap fresh foods.
317 Several participants reported that their work environment was a barrier to eating MIND diet
318 foods. In particular, their facilities to cook at work and the canteen at work.

319 Time was another major barrier, most participants, especially those who were in
320 employment. Participants reported that having worked all day, they didn't have the time to
321 cook fresh food all the time. Also, those participants who have children, reported time to be a
322 barrier. Participants reported that getting children ready for school or after school, homework
323 and activities, took the time away from cooking healthy meals.

324 Having treats in the house and in the workplace is reported to be a major barrier in
325 eating MIND diet foods. All participants with children reported having treats in for the kids
326 but would eat the treats themselves. Also, all those participants that were employed, reported

327 that treats at work was a barrier to eating MIND diet foods. Budget was reported to be a barrier
328 to buying some of the MIND diet foods, such as berries and nuts, as these foods are reported
329 as expensive. This was the view of those participants who were either not working or in low
330 paid jobs.

331 Environmental context and resources domain was also reported as being a facilitator to
332 adoption of the MIND diet. Participants reported that, having access to cheap fresh/frozen
333 foods would be a facilitator. Some participants reported that, with stores like Lidl and markets
334 where there are cheaper foods, that there is really no “excuse” to not eat healthy.

335 Participants also reported that, a lot of food can be bought frozen, such as fruit,
336 vegetables, chicken and fish and that it is cheaper and a good way of preparing meals for the
337 week ahead. Participants also reported that a facilitator to adopt the MIND diet under this
338 domain was, to bring lunch to work. Participants felt that, in order to consume the MIND diet
339 foods at work, they would need to bring lunch with them, to avoid eating out or from a canteen.
340 **Social Opportunity.** Social opportunity was reported as a key facilitator in this study, with 13%
341 of all facilitators falling into this component. The TDF domain related to this component is,
342 social influence.

343 *Social influence:*

344 Participants reported, family support/influence as a key facilitator to adoption of the
345 MIND diet. Participants reported that they felt that family would support them if they were to
346 adopt the diet. Participants also reported that family influence would facilitate them in
347 consuming the MIND diet.

348 **Motivation.**

349 Motivation is a component of the COM-B model and there must be strong motivation
350 for the behaviour to occur. Motivation can be divided into “reflective” or “automated”.

351 **Reflective Motivation.** Reflective motivation involved self-conscious planning and
352 evaluations. (Beliefs about what is good or bad). Participants reported reflective motivation to
353 be a barrier to the adoption of the MIND diet and 15% of barriers fell into this component of
354 the COM-B model.

355 **Belief about capabilities.** Acceptance of the truth/reality about or validity of an ability,
356 talent or facility that a person can put to constructive use: Self-confidence, perceived
357 competence, perceived behavioural control, self-efficacy: The extent to which the individual
358 believes they are able to adopt the MIND diet.

359 Participants reported that convenience was a barrier to adoption of the MIND diet. Those
360 participants with children reported that, their children didn’t like healthy food or wouldn’t eat

361 the MIND diet foods, and rather than making two meals, they ate what the children wanted out
362 of convenience.

363 Taste preference was also a key barrier to the adoption of the diet under this domain.
364 Some participants reported not liking some of the MIND diet foods, such as leafy greens, nuts,
365 or fish. Others were not willing to try different foods or try a different way of cooking those
366 foods. Mindset was another key barrier reported to adoption of the diet within this domain.
367 Participants reported that to change their diet and consume the MIND diet, they would have to
368 be in the right frame of mind. They would need to want to change their diet for a reason and be
369 determined to do so.

370 There were more facilitators than barriers that fell into the motivation component of the
371 COM-B model. Forty two percent of the facilitators in this study fell into the motivation
372 component of the COM-B model. Seventeen percent of facilitators fell into the TDF belief
373 about consequences, 16% of facilitators fell into belief about capabilities and 9% of facilitators
374 fell into TDF emotion.

375 ***Belief about consequences.*** This domain is defined as the, *anticipated outcomes of not*
376 *eating brain healthy foods, anticipated or experienced outcomes of eating brain healthy foods.*
377 *(positive or negative).*

378 Participants reported that, if they were to consume the MIND diet, they felt that this would
379 make them feel better generally and improve memory. Some participants also reported that
380 with the better quality of food in the MIND diet, and the reduction of fat and sugar, they felt,
381 their psychological health would improve.

382 ***Belief about capabilities.*** It was reported that in order to facilitate participants adopting
383 the MIND diet, they would need to be, prepared, organised and plan. Participants reported
384 leading busy lives, with work and children and while time and convenience were a barrier to
385 consuming the diet, if they were to have the MIND diet foods in the house, organise and prepare
386 meals in advance or at least have an idea of what to cook, this would help facilitate adoption
387 of the MIND diet.

388 ***Automatic Motivation.*** Automatic motivation was reported as a facilitator to adoption of the
389 MIND diet, with 9% of facilitators falling into the TDF emotion domain.

390 Automatic motivation involves wants and needs, desires, impulse and reflex responses.

391 ***Emotion.*** Most participants reported feeling positive when asked how they feel about
392 the prospect of adopting the MIND diet. However, this didn't necessarily coincide with their
393 intention to do so.

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DISCUSSION

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399 This study sought to elicit factors influencing adoption of the MIND diet in midlife in
400 the UK. This is the first theory-based qualitative study to explore participants' barriers and
401 facilitators to adopting the MIND diet. Results found that, 80% of barriers and facilitators fell
402 into 6 of the TDF domains, with the main barriers reported as; environmental context and
403 resources, belief about capabilities, knowledge, memory, attention and decision making,
404 behaviour regulation and physical skills, and the main facilitators reported as; belief about
405 consequences, belief about capabilities, environmental context and resources, social
406 influences, skills and emotion. Results confirmed earlier findings regarding common barriers
407 and facilitators to adopting or adherence to dietary change, including budget,⁴⁰ time and taste
408 preference,⁴¹ and convenience and cooking skills.⁴²

409 Participants reported having no knowledge of the MIND diet prior to the study and
410 lacked knowledge in brain healthy foods. Lacking cooking skills was also reported as a barrier,
411 highlighting that "capability" was a key barrier to adopting the MIND diet. Previous research
412 found that a major barrier to meeting dietary recommendations, was lack of knowledge
413 regarding dietary recommendations and health benefits,⁴³ and lack of information on healthy
414 foods.⁴⁴ Previous research found that not knowing what to eat or how to eat or cook healthily
415 was a barrier to healthy eating.⁴⁵ Many participants reported not eating beans and lentils, which
416 are part of the MIND diet. This was mainly due to lack of knowledge on how to prepare beans
417 and how to make them tasty. This finding is similar to previous research that found lack of
418 knowledge on how to prepare pulses, a barrier to their consumption.^{46,47} Beans may not be a
419 common staple in the Northern Irish population, and, therefore, may explain why families
420 report similar barriers regardless of income or where they live.

421 Participants reported a lack of monitoring their food intake which also highlights
422 "capability" as a key barrier to adoption of the MIND diet. Research found that behaviour
423 regulation was associated with changes in dietary outcomes,⁴⁸ and that self-monitoring
424 specifically showed a positive change in diet.⁴⁹ Maas et al. (2013), found that self-monitoring
425 reduced snack eating but not alcohol consumption. However, this finding is in line with other
426 research that suggests self-monitoring of alcohol consumptions to be weak⁵⁰ or absent^{51,52}

427 Opportunity was highlighted as a barrier and facilitator to the adoption of the MIND
428 diet, with physical opportunity reported as the main barrier. A major theme to emerge was

429 environmental context and resources, with “budget” being a significant factor, mainly due to
430 the expense of the healthy components of the MIND diet, such as fruit, nuts and fish. Budget
431 was only reported as a barrier by those participants who were of low socioeconomic status.
432 These findings are in line with previous research, that found food cost to play an important role
433 in determining people’s food choice and consumption,¹⁷ and that it is the healthy component
434 of a whole dietary pattern such as, fruit and nuts of the Mediterranean diet, that is associated
435 with higher cost.⁵³ This finding is supported in the literature in a recent meta-analysis,¹⁸ that
436 found healthy foods such as fruit, vegetables and nuts to be more expensive than processed
437 foods, refined grains and meat. Therefore, this suggests that budget could be a main barrier to
438 adopting a healthy dietary pattern amongst those of low socio-economic status.

439 However, previous research compared the actual cost for a four-member family with
440 the cost of the same family following a Mediterranean Diet and found that the monthly
441 expenditure was slightly higher on the Mediterranean Diet in the overall budget.⁵⁴ However,
442 after increasing the budget for fruit and vegetables, and reduced budget for processed meat and
443 sweets, the overall budget for both diets were similar and therefore, it was concluded that lower
444 adherence to the Mediterranean Diet was not related to budget, but rather, a substantial
445 difference in allocating budget to the different food groups, for example, less money on fruit
446 and vegetables. Similar findings were found in other research.^{20,55,56}

447 Physical opportunity was also reported to be a facilitator in this study, with
448 environmental context and resources also emerging as a theme. Access to fresh cheap produce
449 was reported as a barrier and facilitator in the current study. The results found that those living
450 in rural areas to be a barrier more than those living in a city, where there may be more access
451 to markets and bigger stores within reach. Research found that stores with more nutritious food
452 is a longer distance away from rural areas.^{57,58} However, those who could grow their own food
453 or had access to farmers’ markets, was a facilitator to healthy eating.⁵⁹ Participants who
454 received nutrition education and access to a garden to eat fruit and vegetables, reported to eat
455 the recommended daily fruit and vegetables.⁶⁰

456 Social influence was reported as a key facilitator in this study with social influence
457 emerging as a theme. Participants reported that family support and influence was a factor that
458 would help them adopt the MIND diet. This finding is consistent with previous research that
459 found family influence as a facilitator in nutritional knowledge and healthy habit.⁶¹ Other
460 research found that those who perceived family support were more likely to eat more fruit and
461 vegetables, wholegrains and consume less meat and fats.^{62,63} However, family has been found
462 to be a barrier to healthy eating.⁴⁵ It was reported that women were pressurised to eat more and

463 that they were not supported if they were trying to eat a healthy diet.⁴⁵ However, the sample in
464 this study was with African American women, and they may feel pressure to eat more, as food
465 and the context of eating their traditional food is important to their cultural identity. The women
466 in this study reported that larger curvaceous bodies are the ideal body type for African
467 American women and that food was a big part of their customs.⁴⁵

468 Motivation was also highlighted as a barrier and facilitator to the adoption of the MIND
469 diet. Belief about capabilities was a major theme to emerge as a barrier. Participants reported
470 convenience to be a factor associated with their ability to adopt the MIND diet. Previous
471 research also found convenience to be a barrier to healthy food choices,⁴¹ and that fast food
472 and unhealthy snacks were more convenient.⁵⁹

473 The results from this investigation has created a “behavioural diagnosis” of what needs
474 to change from the COM-B analysis in order for dietary behaviour change to occur. The COM-
475 B model and TDF are used as a starting point to understand behaviour in the context in which
476 it occurs. This behavioural diagnosis has identified that all 3 components of the COM-B model
477 can be targeted as potential levers of change. Linking the COM-B model to the BCW allows
478 for a systematic approach in subsequent intervention development and evaluation.²¹ While
479 there has been a wide range of behavioural models developed, such as the theory of planned
480 behaviour,²⁴ they only help to understand or predict behaviour⁶⁴ and do not help to understand
481 behaviour change⁶⁵ or design interventions. The Behaviour Change Wheel guides this
482 transition and, in designing the intervention, the COM-B components to be targeted will be
483 mapped onto intervention functions and policy categories suggested by Michie et al. (2014)²¹
484 that are expected to be effective in bringing about change, such as education, persuasion, and
485 coercion. Following the identification of intervention function and policy categories, the
486 content of the intervention will be identified in terms of which behaviour change techniques
487 and mode of delivery are best to promote behaviour change.

488 ***Limitations***

489 This study was undertaken in a small sample of men and women, although in line with
490 other COM-B studies⁶⁶ and dietary studies.⁶⁷ Furthermore, while we were able to include
491 participants with different sociodemographic backgrounds, this study was conducted only with
492 a white Irish sample. However, 98% of the population in Northern Ireland are white, with 88%
493 born in Northern Ireland,⁶⁸ therefore, the current studies sample reflects the majority of the NI
494 population. Further research to collect data from a more ethnically diverse population is
495 needed. Moreover, our findings may be context based and, therefore, not generalisable to the
496 whole population. However, our study did not aim to find generalisability, rather to find a

497 deeper understanding of the people's attitudes in midlife towards the adoption of the MIND
498 diet that might need addressing in future interventions. Researcher subjectivity may be a
499 limitation to our study; however, codes and themes were identified by a second researcher
500 which suggest that the themes drawn have credence beyond interpretation of the lead
501 researcher. Focus groups run the risk of introducing bias,⁶⁹ resulting from an individual's desire
502 to conform to social acceptability.⁷⁰ However, in this study, focus group participants were
503 acquaintances, and therefore, may reduce the risk of social acceptability. Barriers and
504 facilitators reported in this study are "perceived" and, therefore, may have limited value in
505 predicting uptake of the MIND diet. While there was a discussion on prevalence rates of
506 dementia in the UK with participants, their perceived risk of dementia was not addressed in
507 this study. Nevertheless, participants felt their knowledge of dementia increased, as had their
508 knowledge of brain healthy foods. Further research should address perceived risk of dementia
509 and its association with intention to eat a brain healthy diet.

510 *Strengths*

511 The COM-B model is an established method for understanding behaviour and used
512 extensively in behaviour change interventions, including dietary studies.^{71,30} To our
513 knowledge, this study is the first study to explore barriers and facilitators to adopting the MIND
514 diet, and the first study to use the behaviour change wheel to investigate the MIND diet. This
515 was the first study to apply the TDF to explore peoples understanding and perceptions of a
516 whole dietary pattern. Moreover, this study used the COM-B model as an additional step in the
517 thematic analysis, which increased the study's efficiency and showed that the entire framework
518 was adequate for purpose.

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520 CONCLUSION

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522 Findings from this study provide insight into the personal, social and environmental
523 factors that participants report as barriers and facilitators to adoption of the MIND diet among
524 middle aged adults living in the UK. Using the TDF and COM-B model is a starting point for
525 understanding behaviour in specific contexts and is able to make a 'behavioural diagnosis' of
526 what needs to change, to modify behaviour. The TDF and COM-B model has allowed us to
527 gain deep understanding and increased awareness of the current situation and has clarified
528 which barriers and facilitators can be targeted to improve adherence to the MIND diet. The
529 results presented above suggest that there is potential to optimise all three components of the
530 COM-B model to increase adherence to the MIND diet, highlighting the importance of

531 addressing these factors when designing behaviour change interventions. Furthermore,
 532 understanding barriers and facilitators to the adoption of the MIND diet may help health
 533 professionals working with individuals/communities to help prevent or reduce the risk of
 534 cognitive decline. The Behaviour Change Wheel will be used to systematically design and
 535 develop an intervention to increase adherence to the MIND diet.

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753 **Figure 1(a):** TDF domains and corresponding mapping onto the COM-B component

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772 **Table 1:** Interview/focus group questions asked to participants in accordance with the TDF

773 and COM-B model.

COM-B	TDF	QUESTION
Psychological Capability	Knowledge.	What is your understanding of the MIND diet?
Psychological Capability	Memory, attention and decision processes.	To what extent is eating a diet to promote brain health something you normally do? ➤ Prompt: Do you eat foods that promote brain health each day
Psychological Capability	Behaviour regulation	To what extent do you monitor whether you are eating foods that promote brain health?
Physical Capability	Skills	To what extent are you confident in cooking/eating a diet that promotes brain health?
Social Opportunity	Social influences	To what extent do/would your family or friends help or hinder you eating a diet that promote brain health? ➤ Prompt: Does/would your family support you in eating a diet that promotes brain health?
Physical Opportunity	Environmental context and resources.	Discuss anything in your work or/and home environment that might help or hinder you eating foods that promote brain health? E.g budget, time
Reflective Motivation	Social/Professional role and identity	To what extent would eating a diet that promotes brain health be accepted by your friends and family? ➤ Prompt: Do you think your family/friends influences what you eat?
Reflective Motivation	Belief about capabilities	How difficult/easy would it be for you to eat a diet that promotes brain health? ➤ Prompt: What are the barriers to consuming a diet that promotes brain health? ➤ Prompt: What are the facilitators to consuming a diet that promotes brain health?
Reflective Motivation	Optimism	To what extent are you confident that any barriers you may have to eating a diet that promotes brain health can be solved?
Reflective Motivation	Intention	To what extent do you intend to follow the MIND diet to promote brain health?
Reflective Motivation	Goals	To what extent would you like to follow the MIND diet?
Reflective Motivation	Belief about consequences	What do you think will happen if you eat a diet to promote brain health? ➤ Prompt: Discuss any benefits to eating a diet that promotes brain health?
Automatic Motivation	Reinforcement	To what extent are there any incentives for you to eat a diet that promotes brain health?

Automatic Motivation	Emotion	Discuss how you think eating a diet to promote brain health would make you feel? ➤ Prompt: Would you feel happy
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774 COM-B: Capability (C): Psychological or physical ability to enact behaviour; Opportunity (O): Physical and social environment that enables
775 behaviour. Motivation (M): Reflective or automatic mechanisms that activate or inhibit behaviour; Behaviour (B). TDF: Theoretical Domains
776 Framework.

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778 **Table 2: Summary Characteristics of Interview/Focus Group Participants(n=25)**

Characteristic	Percentage of sample (N=25)
Age	
40-44	60(15)
45-49	16(4)
50-55	24(6)
Gender	
Male	40(10)
Female	60(15)
Ethnicity	White Irish
	100(25)
Occupation	
Professional	44(11)
Skilled	16(4)
Unskilled	40(10)
Education	
Higher education	36(9)
Further education	28(7)
No formal qualifications	36(9)
Marital status	
Married	44(11)
Co-habiting	4(2)
Separated	4(2)
Single	32(8)
Widowed	4(2)
Living	
Urban	44(11)
Rural	56(14)
Children in household	
Yes	44(11)
No	56(14)

779 Education: Level of education obtained within a discipline or profession. Higher education= undergraduate/postgraduate degree: Further
780 education= any study after secondary school that does not include higher education, such as higher national diploma, higher national certificate,
781 apprentices for industry such as hairdressing, plumbing. N=25

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798 **Table 3:** Barriers and facilitators in rank order of mentions in relation to MIND diet in 40-
799 55-year olds: COM-B and TDF domains

COM-B	TDF	Rank order	Frequency of mentions relating to codes	%mentions
Facilitators				
Reflective motivation	Belief about consequences	1	28	17
Reflective motivation	Belief about capabilities	2	27	16
Physical opportunity	Environment context and Resources	3	22	13
Social opportunity	Social influences	4	21	13
Physical Capability	Skills	5	20	12
Automatic motivation	Emotion	6	15	9
	Reinforcement	7	10	6
	Intention	8	6	4
	Behaviour regulation	9	4	2
	Optimism	10	4	2
	Social/Professional and identity.	11	3	2
	Knowledge	12	3	2
	Memory	13	1	1
	Goals	14	0	0
	TOTAL		164	100

800 Information above the thick black line represents the top 6 reported domains of the TDF and corresponding COM-B components. Eighty
801 percent of the data fell into the top 6 TDF domains:

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COM-B	TDF	Rank order	Frequency of mentions	%mentions
Barriers				
Physical opportunity	Environment context and Resources	1	90	29
Reflective motivation	Belief about capabilities	2	46	15
Psychological capability	Knowledge	3	37	12
Psychological capability	Memory, attention, decision process	4	30	10
Psychological capability	Behaviour regulation	5	24	7
Physical capability	Physical skills	6	17	6
	Social	7	15	5
	Belief about consequences	8	12	4
	Social/professional and identity	9	12	4
	Intention	10	9	3
	Optimism	11	6	2
	Goals	12	5	2
	Emotion	13	3	1
	Reinforcement	14	1	0
	TOTAL		307	100

803 Information above the thick black line represents the top 6 reported domains of the TDF and corresponding COM-B components. Eighty
804 percent of the data fell into the top 6 TDF domains; COM-B: Capability (C): Psychological or physical ability to enact behaviour; Opportunity

805 (O): Physical and social environment that enables behaviour. Motivation (M): Reflective or automatic mechanisms that activate or inhibit
806 behaviour; Behaviour (B). TDF: Theoretical Domains Framework.
807 Mentions: Spoken word/words in relation to codes/themes/subthemes emerging from questions asked regarding MIND diet.
808 n=25

809 **Table 4:** Key facilitators, themes and quotes

COM-B	TDF	SUB-THEME	QUOTE
Reflective motivation	Belief about consequences	<ol style="list-style-type: none"> 1. Feel better generally 2. Improve psychological health 3. Improve memory 	<p>“I think the diet would just help you feel better generally” (male 41, low education, I: P12)</p> <p>“And even help your head, less stress and worry” (male 55, low education, I: P21)</p> <p>“Well if it helps with dementia and we are heading for that” (female 40, higher education, I:14)</p>
Reflective motivation	Belief about capabilities	<ol style="list-style-type: none"> 1. Planning/ preparation/ organisation 	<p>“Organisation and preparation the night before, so having your berries and salad ready for work” (female 48, low education, I: P20)</p> <p>“I buy frozen cabbage, spinach, the things that I eat and just throw them in at the end and that is that” (female, 49, higher education, FG2: P8)</p> <p>“Preparation is a massive thing, because if you know what you are going to be eating, you can prepare for that. And you know what you are going to have for a snack or lunch”. (female 41, higher education, FG1: P4).</p>
Physical opportunity	Environment context	<ol style="list-style-type: none"> 1. Accessibility fresh/frozen food 2. Bring lunch to work 	<p>“I would go to Lidl, because it is cheaper and better quality” (female 40, higher education, FG1: P3)</p> <p>“In my work, you need to be prepared and bring lunch with you” (female 42, higher education, FG1: P5)</p>
Social opportunity	Social influence	<ol style="list-style-type: none"> 1. Family support/influence 	<p>“My mum is always cutting out articles showing me research on good and bad foods for your health (male 51, low education, I: P13)</p> <p>“I think my family would support me if I wanted to do it yes”. (male 48, low education, I: P15).</p>
Physical capability	Skills	<ol style="list-style-type: none"> 1. Confident cook 	<p>“I am pretty confident cooking these foods” (female 41, higher education, FG1: P6)</p> <p>“Well I am a confident cook, but not always the best cook, but if I see recipe, I will have a try”. (female 43, low education, I: P22)</p> <p>“You can google what ingredients you have and google will give you a recipe”. (female 42, higher education, FG1: P5).</p>
Automatic motivation	Emotion	<ol style="list-style-type: none"> 1. Positive 	<p>“I would be positive about it, I get excited trying new things” (female 50, higher education, FG2: P9)</p> <p>“I feel positive about it, I do intend to follow it, but not religiously, there is no point telling a lie, I am not a robot, a walking talking machine”. (male 40, low education, I: P12)</p>

810 COM-B= Capability, Opportunity, Motivation, Behaviour TDF= Theoretical Domains Framework n=25 FG1=focus group 1, FG2= focus group 2 I=interview P=participant

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812 **Table 5:** Key barriers, themes and quotes

COM-B	TDF	SUB-THEME	QUOTE
Physical opportunity	Environmental context	<ol style="list-style-type: none"> 1. Time 2. Food environment at work/canteen 3. Budget 4. Treats in for kids. 	<p>“For me it is time, by the time you get home from work, and maybe have done overtime, you couldn’t be bothered” (male 40, further education, FG1: P1)</p> <p>“There is nothing healthy in a canteen” (male 50, higher education, FG2: P10)</p> <p>“I am on my own here with 4 kids, so budget is definitely a factor.” (female 40, low education, I: P18)</p> <p>“There are always buns, biscuits in the cupboards, for visitors and kids.” (female 48, further education, I: P20)</p>
Reflective motivation	Belief about capabilities	<ol style="list-style-type: none"> 1. Convenience 2. Taste preference 3. Mindset 	<p>“Kids don’t want healthy stuff, so sometimes I have convenience stuff to make it easier for me” (female 40, low education, I: P17)</p> <p>“I think if I was going to change my diet, I would have to be in the right frame of mind” (male 51, low education, I: P13)</p> <p>“There is stuff there I won’t eat and that is that” (male 51, further education, FG2:P7)</p>
Psychological capability	Knowledge	<ol style="list-style-type: none"> 1. Lack knowledge of MIND diet and foods 	<p>“If you don’t know what is healthy for your brain, you won’t eat that way” (male 40, further education, FG1: P2)</p> <p>“Well probably mainly cos I didn’t know it would have any benefit on my brain”. (Female 45, low education, I: P23)</p>
Psychological capability	Memory, attention and decision process	<ol style="list-style-type: none"> 1. Alcohol 2. Tired 3. Holidays 	<p>“If I had a drank alcohol at the weekend, it would take Tuesday or Wednesday to get over it, and I wouldn’t want to eat this food” (female 40, higher education, FG1: P3)</p> <p>“Well ye know, if I have been out all day with the kids and I am tired, and I haven’t the slow cooker on, there’ll be a fast food takeaway then, and that’s the reality of it”. (female 40, higher education, I: P17)</p> <p>“And like holidays like Christmas, you just eat for the sake of it.” (female 41, higher education, FG1: P4)</p>
Psychological capability	Behaviour regulation	<ol style="list-style-type: none"> 1. Lack monitoring of food consumption 	<p>“No, I don’t, and sure, when I go to weight watchers, I don’t even do it” (female 41, low education, I: P16)</p> <p>“No, but trying to be very aware of it, you know, but not recording it”. (female 40, low education, I: P14)</p>
Physical capability	Skills	<ol style="list-style-type: none"> 1. Lack cooking skills 	<p>“I couldn’t cook that, if you handed me all the ingredients, I would be like, what am I doing with it” (male 51, further education, FG2: P7)</p> <p>“No, I wouldn’t be confident, I can cook basic meals, but I am not very versatile with those foods on that diet”. (male 55, low education, I: P21).</p>

813 COM-B= Capability, Opportunity, Motivation, Behaviour TDF= Theoretical Domains Framework n=25 FG1=focus group 1, FG2= focus group 2, I=interview, P=participant

814 Figure 1

