

1 **Title**

2 Healthy snacks in hospitals: testing the potential effects of changes in availability

3

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24 **ABSTRACT**

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28 **Background:** Hospitals offer snacks for sale to patients, staff and visitors. **Aims:** As food
29 choice is heavily influenced by the options available, the present study: (1) audited snack
30 availability and purchase in NHS hospital sites across a large UK city, and (2) tested the
31 potential effects of changes to this availability in an online choice experiment. **Methods:** In
32 Study 1 (audit), single-serve snacks (n=376) available in 76 hospital food retail units were
33 audited. Purchasing data were obtained from 6 food retail units over 4 weeks (27,989 sales).
34 In Study 2 (online experiment), participants (n=159) chose snacks from pictured ranges
35 containing 25% (minority), 50% (equivalent) or 75% (majority) healthy options. **Results:**
36 Available single-serve snacks varied markedly in calorie (18-641kcal), fat (0-39g), sugar
37 (0.1g-76g) and salt (0g-2.9g). Only 30% of available snacks were healthy options and only
38 25% of the most commonly purchased snacks were healthy options. In Study 2, snack choice
39 was significantly associated with the availability of healthy options in the choice array (X^2
40 $(2) = 59.71, p < .01$). More participants made healthy choices when product ranges contained
41 75% healthy options compared to 50% ($p < .01$) and 50% healthy options compared with 25%
42 ($p < .01$). **Conclusion:** Healthy snacks are readily available in NHS sites but there is a greater
43 relative variety of unhealthy snack products. Many consumers continue to purchase unhealthy
44 items. Further increasing the availability and variety of healthy options may support
45 consumers to make healthier choices.

46

47 **Keywords:** snacking; hospital; food choice; availability; healthy choice

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50 INTRODUCTION

51

52 The UK's National Health Service (NHS) is one of the largest organisations in the world,
53 employing 1.7 million staff (Nuffield Trust, 2017) and dealing with more than a million
54 people every 36 hours (Department of Health, 2005). Consequently, NHS sites carry
55 significant potential as venues in which to promote healthy behaviours to a large and diverse
56 cross section of the general population. In addition, despite a clear NHS commitment to
57 improving the health of staff (NHS Strategy and Innovation 2018), many UK healthcare
58 workers live with overweight or obesity (Kyle et al, 2016; Kyle et al, 2017), and it has been
59 argued that more could be done to support staff to make healthy food choices on NHS
60 premises (Malhotra, 2013).

61 While there are a multitude of factors that influence food choice, two key drivers of
62 choice are innate preference and availability. People have strong taste preferences for high
63 fat/high sugar foods (Drewnowski and Almiron-Roig, 2010) and may select unhealthy
64 options with little or no conscious awareness if such options are readily available in the
65 surrounding environment (Marteau et al, 2012). In contrast to innate preference, the relative
66 availability of healthy and unhealthy products within a choice array is a modifiable feature of
67 the food environment and deliberate changes to the availability of different foods within a
68 particular setting can be used to influence the choice and purchasing behaviour of consumers
69 (Hollands et al, 2017). Where empirical studies have increased the availability of healthy
70 options in a given food environment, healthy options are typically selected more frequently.
71 For example, recent systematic reviews conclude that interventions which increase the
72 availability of healthy products relative to unhealthy products tend to be effective in
73 increasing the selection of healthy options (Hollands et al, 2019; Grech and Allman-Farinelli,

74 2015) and may successfully prompt healthier choices in healthcare settings (Al-Khudairy et
75 al, 2019).

76 In recent years, great progress has been made in the UK towards implementing
77 positive changes in the availability of healthy and unhealthy foods on hospital premises. For
78 example, in England, NHS organisations are incentivised to restrict the availability of
79 unhealthy foods within the healthcare environment (e.g. NHS England, 2017) and in
80 Scotland, mandatory nationwide standards ensure that at least 50% of available foods meet
81 enhanced nutritional standards (Healthcare Retail Standards; Scottish Government, 2016).

82 Of particular interest are the latter Scottish Healthcare Retail Standards, as they are
83 not optional (as in the rest of the UK) and guarantee that hospital patients, staff and visitors
84 will be able to make food choices from product selections where healthy and unhealthy
85 options are equivalently available. While this is clearly a positive health intervention, it may
86 not represent true equivalency of choice for two reasons.

87 Firstly, retailers may offer an equivalent number of healthy and unhealthy items for
88 sale overall, but there may be less variety / availability of healthy options within particular
89 product categories. For example, a retail unit selling 10 types of crisps and 10 types of
90 chocolate (20 product lines) could hypothetically meet the Healthcare Retail Standard by
91 selling 10 healthier types of crisps (50% of product lines) alongside the original selection of
92 chocolate. For a customer wishing to buy only chocolate, the relative availability and variety
93 of products that will be considered remains the same. Secondly, as people display strong
94 innate preferences for unhealthy foods (Drewnowski and Almiron-Roig, 2010) and require
95 cognitive resources and skills to resist them (Allan et al, 2016), it is possible that in situations
96 where healthy and unhealthy options are equally available (i.e. 50:50), or where only a
97 minority of options are healthy (i.e. 25:75), the relative pull of unhealthy items will be
98 stronger in the moment than if a clear majority of available options were healthy (e.g. 75:25).

99 At present, while the vast majority of hospital-based food retailers in Scotland (96%) comply
100 with the 50% healthy food standard, very few exceed this proportion (Shipton, 2019).

101

102 The present paper reports the results of two empirical studies which aim to extend the
103 evidence base in this area. Firstly, in a descriptive audit, the relative availability of healthy
104 options within one health-relevant food category– single serve snack foods - is
105 comprehensively assessed across all food retail units (shops, cafes and vending) in healthcare
106 sites across a large Scottish city. Secondly, in an online experiment, the potential benefits of
107 further increasing the relative availability of healthy options within this category are
108 investigated.

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110

111 **STUDY 1 - METHODS (SNACK FOOD AUDIT)**

112

113 **Design**

114 Descriptive audit which aimed to determine the relative availability and purchasing of healthy
115 and unhealthy single-serve snacks in all food retail units within NHS settings across one large
116 city in Scotland.

117

118 **Setting**

119 All food retail sites (n=76) comprising shops (n=2), cafes/canteens (n=11), cafes with
120 integrated shops (n=4) and vending machines (n=59) located in the 7 main, urban NHS
121 hospitals (comprising 1 acute/general; 1 maternity; 1 paediatric; 1 dental, 1 psychiatric and 2
122 community hospitals) and 1 NHS management building (regional headquarters) across one
123 city in Scotland were visited between January and May 2017 and had their snack range

124 recorded. The city under study provides acute care services for around 500,000 patients from
125 across the socioeconomic spectrum and employs approximately 7,000 healthcare staff.

126

127 **Materials and Procedure**

128 The audit aimed to collect data on the availability and purchasing of single serve snacks.

129 Such foods were the focus of the current study because they are typically supplementary to

130 the 'core' diet, are available across all hospital food retail sites (cafes, shops and vending),

131 vary markedly in nutritional quality (from e.g. fruit to chocolate bars) and are typically

132 consumed in their entirety, making it easier and more appropriate to infer likely consumption

133 following purchase. The products which fell into the single serve snack category included

134 confectionary, fruit, dried fruit, crisps, savoury snacks, cereal bars, and pre-portioned cakes

135 and traybakes. Data on two types of single serve products were not collected; chewing gum

136 (as it is not consumed) and products designed for customers with special dietary needs such

137 as diabetic sweet ranges (as customers purchasing these items often do not have a realistic

138 alternative).

139 To determine availability, data were collected on the type and nutritional content of

140 each unique variety of single-serve snack food available in the 76 retail sites. Where possible,

141 information was collected directly from the pack information. Where this was not possible

142 (e.g. for unpackaged baked goods and fruit), information was requested from suppliers or

143 taken from published nutritional information. To estimate purchasing, data on the numbers of

144 each product sold per week were sought from retailers. Detailed purchasing data on

145 individual products were not available from vending machines (where only spend was

146 recorded) or from many of the cafes/canteens included (where only broad category of

147 purchase was recorded). Consequently, the purchasing data reported reflects electronic

148 records of purchases (n=27,989) made in 6 of the largest sampled retail sites only (located in

149 the main acute/general hospital (n=2); the maternity hospital (n=1); the dental hospital (n=1);
150 the psychiatric hospital (n=1) and in one of the two community hospitals (n=1) covered by
151 the study). Purchasing was recorded over 4 weeks and the top selling items identified. As an
152 indicator of relative 'healthiness', each product (available or purchased) was coded according
153 to whether it met set criteria for a healthy option or not according to the Healthcare Retail
154 Standards (Scottish Government, 2016). This meant that to be coded as a 'healthy option',
155 products weighing $\leq 100\text{g}$ had to contain $< 17.5\text{g}$ fat per 100g; $< 5\text{g}$ saturated fat per 100g;
156 $< 22.5\text{g}$ sugar per 100g; and $< 1.5\text{g}$ salt per 100g). Data were descriptively summarised. No
157 pre-specified hypotheses were tested.

158

159

160 **STUDY 1 RESULTS (SNACK FOOD AUDIT)**

161

162 More than 500 different varieties of snack foods (n=533) were available for sale to hospital
163 staff, patients and visitors in NHS hospital sites across the target city, of which the majority
164 (n=407) were single-serve items, that is, not multi-packs or sharing packs. Nutritional
165 information was not available for 31 products (typically goods from local bakers). Data are
166 presented for all remaining single-serve snacks (n=376) on a per product basis.

167

168 **Nutritional characteristics of single-serve snacks**

169 Information about the average calorie, fat, sugar and salt content of different types of single
170 serve snacks is shown in Figure 1.

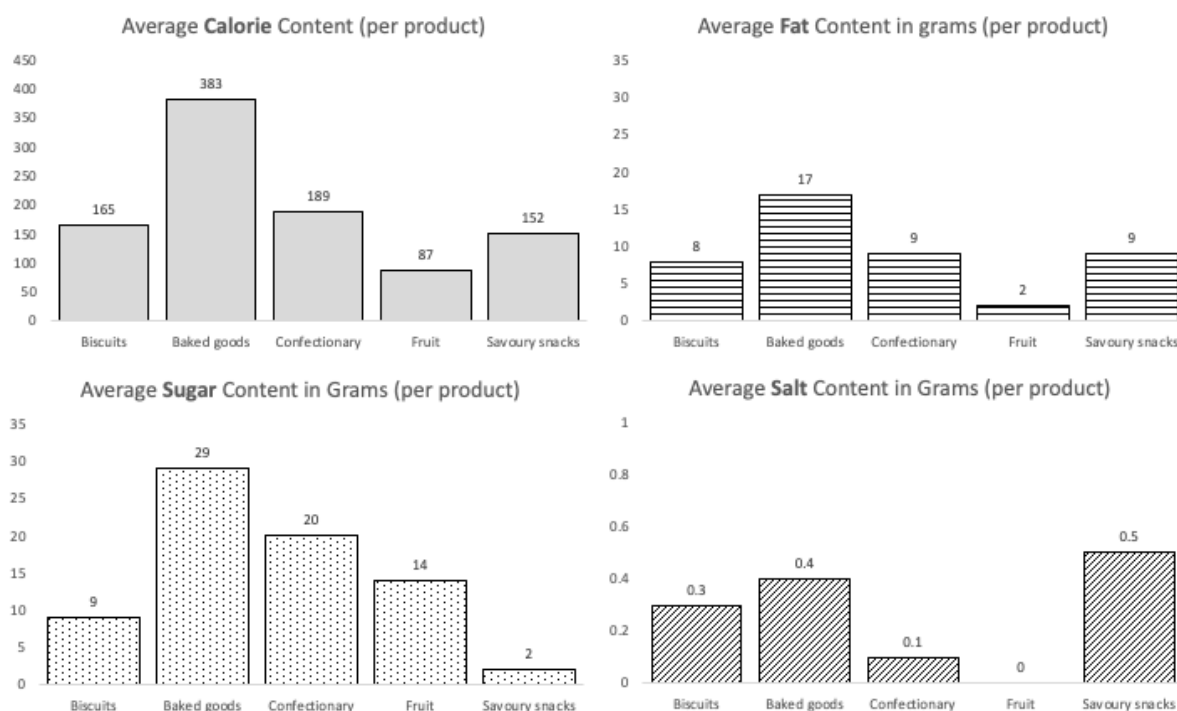
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174 *Figure 1: Average nutritional content of single-serve snack items by category*

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179

180 Across the whole available range, single-serve snacks (n=376) varied in; (a) calorie content
 181 from 18kcal per product (fresh passionfruit) to 641 kcal per product (slice of raspberry
 182 cake); (b) fat content from 0g (e.g. apple and grape bag) to 39g (chunky pork pie); (c) sugar
 183 content from 0.1g (e.g. ready salted crisps) to 76g (slice of raspberry cake); and (d) salt
 184 content from 0g (e.g. apple and grape bag) to 2.9 (cheese, pickle and crackers snack pack).

185

186 **Availability / variety of single serve snack foods**

187 While retailers ensured that 50% of all food products offered for sale in each site met the
 188 criteria for a healthy option (equal availability, in line with the Healthcare Retail Standards),
 189 within the category of single serve snacks foods, only 30% (112/376) of unique product lines
 190 in the present data set were healthier options.

191

192 **Purchasing of single-serve snack foods**

193 Purchasing data revealed that 27,989 snacks were purchased over 4 weeks in the 6 retail units
194 able to provide itemised purchasing data. The top 20 selling items accounted for 45% of total
195 snack sales (12,492 snacks). Of the 20 top selling single serve snacks, 7 were crisps/savoury
196 snacks (5,565 sales), 7 were confectionary (3,194 sales), 4 were baked goods (2,356 sales)
197 and 2 were fruit (1,377 sales). Only 5 of the 20 top selling snacks complied with healthy
198 option criteria (3 baked crisps within the savoury snack category and the 2 fruit options).

199

200

201 **STUDY 2 - METHODS (ONLINE CHOICE EXPERIMENT)**

202

203 In order to investigate the potential benefits of increasing the relative availability of healthy
204 options within single-serve snack ranges, an online experiment was conducted. It was
205 hypothesised that the proportion of healthy choices made would be higher when the relative
206 availability of healthy options within a pictured range was higher.

207

208 **Design**

209 Online, within participant experiment comparing choices made from selections of snacks
210 available in Study 1 manipulated to contain either (a) 25% (minority) healthy items; (b) 50%
211 (equivalent) healthy items; or (c) 75% (majority) healthy items.

212

213 **Participants**

214 Members of the public (n=173) were recruited via online adverts and a recruitment service
215 (Surveycircle).

216

217

218 **Materials and procedure**

219 Images of commonly available snack foods were selected from the Study 1 audit data and
220 used to create photo arrays of different snack ranges. In total, images depicting 15 different
221 ranges of 24 snack foods were created including a variety of fresh fruit, savoury snacks,
222 confectionary and baked goods. Of these 15 ranges; 5 were created to contain 25% (6/24)
223 products that met healthy option criteria (minority condition; broadly comparable to actual
224 availability in Study 1); 5 to contain 50% (12/24) products that met healthy option criteria
225 (true equivalence condition); and 5 to contain 75% (18/24) products that met healthy option
226 criteria (majority condition). As snack foods in hospitals are sold in shops, cafes and vending
227 machines, the ranges were pictured on both traditional shelves and in vending machines. The
228 spatial location of healthy and unhealthy snacks within each range was randomly varied in
229 each pictured range.

230 Participants made snack choices from 15 different pictured ranges, 5 from each
231 condition (25%; 50%; or 75% healthy). Within each condition, choices were coded as a
232 binary outcome variable indicating whether they were predominantly healthy options ($\geq 3/5$
233 choices met the criteria for a healthy option) or predominantly unhealthy options ($\geq 3/5$
234 choices did not meet the criteria for a healthy option).

235 Participants who responded to study adverts were directed to the online experiment
236 hosted on the PsyToolkit platform. After reading the study information and indicating
237 consent, participants were asked to complete some basic demographic information (age,
238 gender) before beginning the main food choice task. In the food choice task, participants were
239 presented with all 15 food ranges (in counterbalanced order) and were asked to pick the snack
240 from each that they would be most likely to purchase if confronted with this range in real life.
241 There was no limit on how long the participants could take to make their choice.

242 Both the study hypothesis and analysis plan were pre-specified. As the outcome
243 variable is binary (predominantly healthy vs unhealthy product choices), a Cochran's Q test
244 was used to test whether the proportion of people who made predominantly healthy choices
245 differed according to the relative availability of healthy options within each condition. All
246 analyses were carried out using IBM SPSS Statistics version 25.

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249 **STUDY 2 RESULTS (ONLINE CHOICE EXPERIMENT)**

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251 A sample size of $n=172$ was planned a priori to be able to detect a medium effect size in a chi
252 squared based analysis with 0.90 power at $\alpha=.05$. Of the participants who began the online
253 experiment ($n=173$), 14 failed to complete all trials, leaving complete data from 159
254 participants. The final sample size remained sufficient to meet the minimum assumption
255 required by the Cochran's Q test used in the analysis (Ramsey & Ramsey, 1981). Participants
256 in the final sample were predominantly female ($F=105$) and had an average age of 29.7 years
257 ($SD=11.1$ years; range =18-65 years).

258

259 Product choices were coded as predominantly healthy or unhealthy and the proportion of
260 each was calculated across the whole experiment and within the 3 different availability
261 conditions. On average, across the whole experiment, fewer participants made predominantly
262 healthy choices ($n=194$; 41%) than unhealthy choices ($n=283$; 59%). However, this
263 proportion varied significantly (Cochran's Q test; $X^2(2)= 59.71$, $p<.01$) from condition to
264 condition (37/159 in the 25% healthy condition; 65/159 in the 50% healthy condition; and
265 92/159 in the 75% health condition) as illustrated in Figure 2. Post hoc McNemar tests (with
266 manually applied Bonferroni corrections to allow for multiple comparisons) determined that

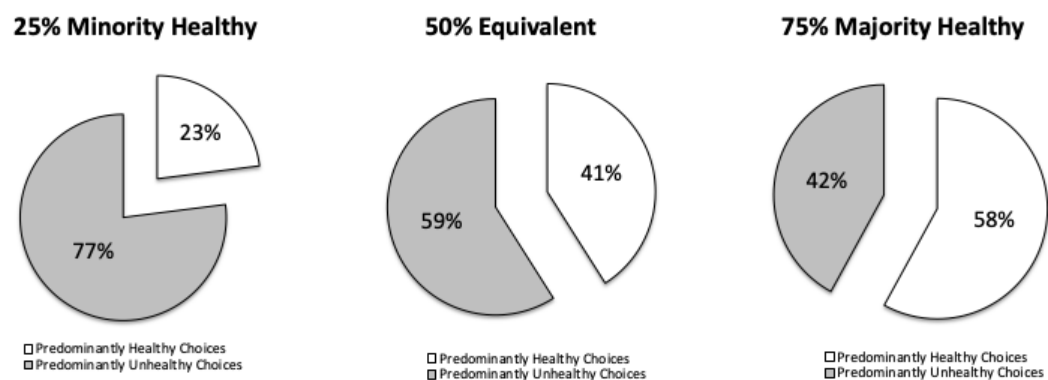
267 participants were more likely to make predominantly healthy choices when the ranges they
 268 were choosing from contained 75% healthy options compared to 50% ($p < .01$) or 25%
 269 ($p < .01$) and when ranges contained 50% healthy options compared with 25% ($p < .01$).

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271

272 *Figure 2: Proportion of healthy and unhealthy product choices from ranges with 25%, 50%*
 273 *or 75% healthy options*

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278 **DISCUSSION**

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280 While healthy foods in general are now readily available in Scottish hospitals, audit data
 281 collected in the present study show that only a minority (30%) of unique product lines within
 282 one identified health-relevant food category (single serve snacks) met healthy option criteria.
 283 Furthermore, in a sample of purchased snack items, the majority (15/20) of best-selling
 284 products were not healthy options. When pictures of single-serve snack ranges were
 285 experimentally manipulated to increase the relative availability of healthy options within the

286 range, a significantly higher proportion of products selected by participants were healthy
287 options.

288 The results of Study 1 indicated that while healthy options are now readily available
289 for purchase in hospital based shops, cafes and vending machines, around three quarters of
290 the most commonly purchased snack items do not meet Healthcare Retail Standard criteria
291 and cannot be considered healthy options. Across the product range assessed, there was
292 substantial variability in the nutritional characteristics of available products, with consumers
293 able to purchase single snacks which varied markedly in calorie, fat and sugar content.
294 Despite equivalence in the number of healthy and unhealthy (individual) products available
295 across each retail unit as a whole, within the single-serve snack category, only 30% of unique
296 product lines were healthy options. This indicates that consumers intending to purchase just a
297 snack are not presented with equivalent numbers of healthy and unhealthy options, rather
298 they must select from a range where there is a greater variety of unhealthy options. This
299 echoes the finding of Boelsen-Robinson et al (2017) who reported that even after the number
300 of healthy products in Australian hospital vending machines was increased to at least 50% of
301 the total number of available items, there was still less variety within the healthy than
302 unhealthy product range.

303 Variety is an important aspect of choice; consumers value variety as it increases the
304 likelihood that they will find an option that matches their own wants and needs (Johnson et
305 al, 2012). Experimental studies have demonstrated that increases in perceived variety lead to
306 increases in food selection and consumption (Kongsbak et al, 2016; Meengs et al, 2012;
307 Brondel et al, 2009), suggesting that the higher purchasing of unhealthy items observed in the
308 present study may partly reflect the larger relative variety of unhealthy products within the
309 available selection. While increasing the available variety of healthier products may go some
310 way towards addressing this, the impact of such a strategy needs to be investigated.

311 Increasing the variety of options available when products are unfamiliar (e.g. when
312 introducing new healthy products lines) may actually increase the cognitive demands of
313 choice (Johnson et al, 2012), making it more likely that consumers will default to more
314 familiar unhealthy choices.

315 Great strides have been made in recent years to restrict sales of unhealthy food in UK
316 hospitals (NHS England, 2017; Scottish Government, 2016). However, the present data
317 suggest that when looking for snack foods, many consumers continue to purchase unhealthy
318 items, even when healthy alternatives are also available. Consequently, further interventions
319 may be required to successfully tip the balance of consumer purchasing towards healthier
320 snacks as the norm. One viable strategy may be to introduce mandatory caps on the
321 maximum permissible calorie/fat/sugar/salt content per item on all items for sale (rather than
322 for just a set proportion). This would serve to remove the least healthy products from the
323 available range while retaining some choice for consumers. For example, a selection of baked
324 goods, confectionary and savoury snacks could be retained for sale but without the extreme
325 outliers within each range (e.g. removing the slices of cake with >600kcal). Alternatively,
326 hospital retailers could further modify the relative availability of healthy vs unhealthy options
327 within product categories until healthy options make up the majority of products for sale.

328 This latter possibility was tested in the present Study 2 using pictures of snack foods
329 commonly available for sale in the retail units included in Study 1. The results of this online
330 experiment demonstrated that participants were significantly more likely to choose a healthy
331 snack when the proportion of healthy options relative to unhealthy options was increased.
332 Specifically, the data indicated that when healthy and unhealthy options were equally
333 available, or where healthy options were in the minority within a range (as was the case in the
334 real retail data collected in Study 1), most people selected an unhealthy option. In contrast,
335 when the availability of healthy options was increased so that three quarters of items within

336 the array were healthy, the majority of people (58%) opted for a healthier item. These
337 findings echo those of studies showing that larger increases in the relative availability of
338 healthy options have a stronger impact on healthy food choice (Van Kleef et al, 2012).
339 Similarly, in a recent evaluation of the effects of a change in policy around hospital vending
340 machines in Victoria (Australia), Boelson-Robinson (2017) found that an increase in the
341 availability of healthy items to at least 50% of available items and a simultaneous reduction
342 in the availability of the most unhealthy items to below 20% of available items, led to
343 consumers purchasing around 55% fewer unhealthy items than would have been expected
344 from pre-policy sales patterns.

345 Other studies of availability in the healthcare context have investigated the effects of
346 manipulating perceived (rather than actual) availability. For example, Ryan et al (2020) and
347 Huse et al (2016) report the results of an intervention in a large hospital café where all of the
348 least healthy beverages were removed from view (although were still available on request).
349 While this intervention primarily targeted the visibility of unhealthy items, it also
350 functionally reduced the immediate (self-service) availability of unhealthy items resulting in
351 unhealthy drink purchases reducing from 33% of total sales prior to the change to 10%
352 immediately after and 7% 18 months later.

353 There are several possible reasons why increased availability may have led to a higher
354 proportion of healthy choices in the present study. Firstly, it may be that simply increasing
355 availability was sufficient to prompt healthier choices. Availability is one of six core features
356 of the environment empirically shown to change the behaviour of people within that
357 environment (Hollands et al, 2017). Simply put – people choose the products because they
358 are there. Secondly, as the increase in availability in Study 2 also increased the variety of
359 healthy options, this increased variety may have increased uptake. Participants in
360 experimental studies eat more when perceived variety is increased (Kongsbak et al, 2016;

361 Meengs et al, 2012; Brondel et al, 2009) and increasing the healthy range to contain a larger
362 selection of unique items may have made it more likely that the participants found a healthy
363 snack that was to their liking. Thirdly, choice may have been affected not by the increases in
364 the availability or variety of the healthy product range, but instead by decreases in the
365 availability and variety of the unhealthy product range. In situations where few unhealthy
366 products are available, it is possible that participants were less able to find an option that was
367 to their liking, or that the relative ‘pull’ of the unhealthy items was reduced, making it easier
368 to resist the temptation of an unhealthy snack. The latter possibility is supported by
369 experimental work demonstrating that changes in the availability of unhealthy options seem
370 to have a stronger effect on choice than comparable changes in the availability of healthy
371 options (Pechey and Marteau, 2018). Future studies should further investigate these
372 possibilities.

373 The present study is not without limitations. Data for the Study 1 audit were collected
374 between January and May 2017 during the period around the final deadline for compliance
375 with the Healthcare Retail Standards (31st March 2017). All sites included in the present food
376 audit had already fully implemented the HRS guidelines or were in the very final stages of
377 doing so but minor changes to the products on offer during the first 8 weeks of the study may
378 have occurred. In addition, purchasing data could only be collected from larger retail units
379 who recorded sales at the individual product level and so the reported pattern of purchasing
380 does not reflect purchasing across the full spectrum of retail outlets operating in hospitals.
381 However, the larger units sampled were located in a range of different acute, community,
382 general and specialised hospital settings and so were broadly representative of all hospital
383 settings in the city under study. The choice experiment conducted in Study 2 used a
384 convenience sample that was not stratified and so is unlikely to be representative of the
385 broader general population. Furthermore, this study was an online forced choice task and

386 asked participants only for their preference amongst a selected range of products. No
387 information was given on factors such as price that are highly likely to influence choice in
388 real life, and participants did not actually purchase and consume the chosen snacks, limiting
389 the ecological validity of the results.

390 In conclusion, while great progress has been made in supporting healthy choices in
391 hospitals in recent years, there is still scope to further increase the availability and variety of
392 healthy single-serve snack options in this setting. The present study revealed that when
393 making choices from ranges containing 75% healthy snacks, people selected significantly
394 more healthy options than when the ranges included 50% healthy snacks or 25% healthy
395 options. Further research on the relationships between availability, variety and choice is
396 required.

397

398

399 **ETHICAL STATEMENTS**

400

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407

408 **Availability of data:** Data is available from the authors on request, with the exception of the
409 retail sales data which we do not have permission to share.

410

411 **Authors' contributions:** JA conceived of study 1 and study 2 and drafted/revised the
412 manuscript. MH collected and descriptively summarised the data for study 1. SD collected
413 and analysed the data for study 2. FM, SW and MJ contributed to the design and execution of
414 study 1 and commented on drafts of the manuscript. All authors approved the final version of
415 the manuscript.

416

417 **Conflicts of interest:** The authors have no competing interests to declare.

418

419 **Consent for publication:** All authors consent to publication.

420

421 **Ethical approval:** Study 1 received ethical approval from the University of Aberdeen's
422 College of Life Sciences and Medicine Ethics Research Board (approval reference:
423 CERB/2017/1/1414). Study 2 received ethical approval from the University of Aberdeen's
424 College of Life Sciences and Medicine Ethics Research Board (CERB/2019/2/1713). All
425 participants gave informed consent before taking part.

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