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An evaluation of portion size estimation aids: Consumer perspectives on their effectiveness

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Title: An evaluation of portion size estimation aids: consumer perspectives on their effectiveness

Authors: Gemma P. Faulkner^{1,5}, M. Barbara E. Livingstone¹, L. Kirsty Pourshahidi¹, Michelle Spence², Moira Dean², Sinead O'Brien³, Eileen R. Gibney³, Julie M.W. Wallace¹, Tracy A. McCaffrey^{1,4} and Maeve A. Kerr^{1*}

Institutions:

¹ Northern Ireland Centre for Food and Health (NICHE), University of Ulster, Cromore Road, Coleraine, BT52 1SA.

² School of Biological Sciences, Queen's University Belfast, BT9 5AG, UK.

³ Institute of Food and Health, University College Dublin, Belfield, Dublin 4, Ireland.

⁴ Department of Nutrition and Dietetics, Monash University, Notting Hill, VIC 3168, Australia

⁵ Life and Health Sciences, School of Science, IT Sligo, Ash Lane, Co. Sligo, Ireland

***Corresponding author:** Dr Maeve A. Kerr

Address: Room W2030, School of Biomedical Sciences, University of Ulster, Coleraine campus, Cromore Road, Coleraine, Co. Londonderry, Northern Ireland, BT52 1SA.

Telephone: +44 28 70123515

Fax: +44 2870 123023

Email: ma.kerr@ulster.ac.uk

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Conflict of interest

None.

Authorship

G.P.F., M.B.E.L., M.A.K., T.A.M.C., J.M.W.W. and L.K.P. formulated the research questions and designed the study protocol. G.P.F. and L.K.P. carried out the study and analysed the data, G.P.F. wrote the manuscript; M.B.E.L., M.A.K, T.A.M.C., M.A.K, M.S., M.D, S.O.B. and E.R.G provided guidance on the analysis and write-up, and comment on drafts of the manuscript.

Ethics Statement

This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving human subjects were approved by the University of Ulster Research Ethics Filter Committee.

Title: An evaluation of portion size estimation aids: consumer perspectives on their effectiveness

Abstract

Objective: This qualitative study aimed to investigate consumer opinions on the usefulness of portion size estimation aids (PSEA); consumer preferences in terms of format and context for use; and the level of detail of guidance considered necessary for the effective application of PSEA.

Design: Six focus groups (three to eight participants per group) were conducted to elicit views on PSEA. The discussions were recorded, transcribed verbatim and analysed by two independent researchers using a template approach.

Setting: The focus groups were conducted in 2013 by an experienced moderator in various sites across the island of Ireland (three in the Republic of Ireland and three in Northern Ireland) including local leisure, community and resource centres; the home environment; and a university meeting room.

Participants: General population, males (n=17) and females (n=15) aged 18-64 years old. Participants were recruited from both urban and rural locations representing a range of socio-economic groups.

Results: The majority of participants deemed the coloured portion pots and disposable plastic cup (household measures) to be useful particularly for the estimation of amorphous cereal products (e.g. breakfast cereals). Preferences were evident for “visual” PSEA (reference objects, household measures and food packaging) rather than ‘quantities and measures’ such as weighing in grams or ounces. Participants stated that PS education should be concise, consistent, from a reputable source, initiated at school age and communicated innovatively e.g. mobile app or TV advertisement. Guidance in relation to gender, age and activity level was favoured over a “one size fits all” approach.

Conclusions: This study identified consumer preferences and acceptance of “visual” PSEA such as portion pots/ cups to estimate appropriate PS of amorphous grain foods such as breakfast cereals, pasta and rice. Concise information from a reputable source in relation to gender, age and activity level should accompany PSEA.

1 **Introduction**

2 An increase in the availability of larger food portion sizes (PS) is one of many factors promoting a
3 positive energy balance amongst consumers and contributing to the escalating rates of overweight
4 and obesity⁽¹⁻²⁾. Although this phenomenon initiated in the US⁽³⁾, similar trends have been observed
5 in the UK⁴ and Ireland⁽⁵⁾ in recent years. Larger PS are associated with higher energy intakes⁽⁶⁾, in
6 both acute⁽⁷⁻¹²⁾ and longer term studies of up to one month⁽¹⁾, conducted within and outside of the
7 home⁽¹³⁻¹⁴⁾. Larger PS outside of the home have become “consumption norms” for consumers⁽¹⁵⁾,
8 leading them to overestimate their PS in the home⁽¹³⁾. Furthermore, value deals (e.g. buy one get
9 one free) can lead consumers to purchase more than they need⁽¹⁶⁾, in turn contributing to their
10 distorted perceptions of appropriate PS.

11 The traditional reference to PS as “small, medium or large”, particularly outside of the home e.g. in
12 restaurants, fast food outlets and cinemas, may be too ambiguous and subjective for consumers⁽¹⁷⁻¹⁸⁾
13 and more specific guidance may be warranted. Although weighing scales and graduated measuring
14 apparatus (e.g. jugs) are generally considered the most accurate portion size estimation aids
15 (PSEA), they also tend to be the most burdensome and time consuming methods of measuring PS in
16 the home⁽¹⁸⁾. There are various other aids available from different sources ranging from two-
17 dimensional aids such as food photographs to common household items such as the cup.

18 In recent years, national dietary guidelines including those from the US⁽¹⁹⁾ and Canada⁽²⁰⁾ have
19 incorporated detailed serving size (SS) guidance accompanied by various PSEA into their
20 communications. In the Republic of Ireland, the Food Pyramid and Healthy Eating Guidelines
21 contain detailed guidance on appropriate SS for different sub-groups of the population⁽²¹⁾. In a
22 related survey, a sample of consumers indicated their preference for the 200ml plastic cup over the
23 dessertspoon for communicating SS of starchy foods, and the palm of the hand rather than the deck
24 of cards for SS of meat, fish and alternatives⁽²²⁾. Additional common household measures and
25 reference objects i.e. the teaspoon and matchbox are also used by this guide to illustrate the SS of
26 fats and oils, and cheese respectively. However, no evaluation of consumer opinions on the
27 usefulness and acceptability these aids have been conducted to date. In contrast to the
28 aforementioned countries, in the UK there is currently an absence of national quantitative guidance
29 apart from that which is available for the fruit and vegetable food group²³. ‘The Eatwell Plate’²⁴
30 depicts the importance of a balanced diet, leaving SS determination to the discretion of consumers
31 themselves. There are various SS guides available from non-governmental organisations (NGOs)
32 and the food industry which tend to communicate inconsistent and sometimes conflicting advice

33 which is confusing for consumers⁽²⁵⁾. As a result, it has been suggested that ‘The Eatwell Plate’
34 should be accompanied by additional resources on food SS⁽²⁶⁻²⁸⁾.

35 Overall, despite the wide availability of various PSEA, there are limited data to date on consumer
36 perceptions of the usefulness and their preferences for different types of PSEA which is of
37 importance to inform effective public health campaigns in relation to guidance on appropriate PS.
38 Therefore, the aims of the present study were to investigate consumer opinions on the usefulness of
39 PSEA; consumer preferences in terms of format and context for use; and the level of detail of
40 guidance considered necessary for the effective application of PSEA. A previous study evaluated
41 (in practice) the precision, ease of use and likelihood of future use of a range of PSEA for various
42 foods with diverse characteristics⁽²⁹⁾.

43 Note for the purposes of this study the term PS refers to the amount of food intended to be
44 consumed whereas SS refers to the amount of food recommended to be consumed e.g. in dietary
45 guidelines or food labelling. However, it was apparent that the aids selected for this study were
46 inconsistently used to either estimate PS or SS. Therefore, for the purposes of this study all aids
47 were referred to as PSEA.

48

49 **Methods**

50 This study was conducted according to the guidelines laid down in the Declaration of Helsinki and
51 all procedures involving human participants were approved by the University of Ulster Research
52 Ethics Filter Committee. Written informed consent was obtained from all participants before
53 commencing the study protocol.

54

55 *Portion size estimation aids*

56 A wide range of existing PSEA that could be used to aid the estimation of PS of a range of
57 commonly eaten foods of diverse visual and physical properties were selected. These included tools
58 utilised for amorphous (i.e. foods without a definite shape e.g. rice), liquid, solids, cooked, and
59 dried foods. An extensive search was conducted for any PSEA that were available to the public; this
60 included an online web search, review of household items and communication with dietitians,
61 nutritionists and public health agencies. The range of available PSEA were grouped into four

different categories: quantities and measures (e.g. SS in grams/ millilitres on food labels), reference objects (e.g. a small matchbox for a SS of cheese), household measures and utensils (e.g. 200ml disposable cup and coloured portion pots from Rosemary Conley™ which included a guide detailing the colour of pot that corresponded with certain foods), and indicators on food packets (e.g. SS demarcations on the packaging of a block of cheddar cheese). Only PSEA which were relevant and available to Irish and UK consumers were chosen, others such as the baseball, which originates from the US, were not included. A full list of the PSEA (and their corresponding foods which were used in a previous study⁽²⁹⁾) are presented in **Table 1**.

Focus group recruitment

Participants were recruited via a convenience sampling method using email distribution lists (sent to University staff and students) and social media advertisements. Recruitment opportunities were also sought in local community/volunteer groups and town centres between January and March 2013. Efforts were made to recruit from city, urban and rural locations, representing both males and females as well as a range of age groups, educational backgrounds and/or socio-economic groups, in order to capture a wide range of views. Inclusion criterion was that participants must be aged 18-64 years old. Participants with similar characteristics (such as age, gender, occupational status) were grouped together as it was felt this might facilitate interaction amongst them. Six focus groups (3 in Northern Ireland and 3 in the Republic of Ireland) with three to eight participants per focus group were formed with 32 participants in total (17 males; 15 females, aged 18-64 years) (**Table 2**). Characteristics of all participants are included in **Table 3**. The focus groups were conducted by an experienced moderator (G.P.F.) in informal confidential settings familiar to the participants including local leisure, community and resource centres; the home environment; and a university meeting room. Each focus group was audio recorded with the consent of participants and lasted approximately 60-90 minutes. Data on personal characteristics (self-reported weight and height; age category; special diets; occupational status, and household information) were collected using a brief self-administered questionnaire which also investigated participants' use of PSEA or intention to use PSEA pre and post focus group participation respectively. Recruitment ceased when data saturation was achieved such that no new themes were established in the data. A gift voucher to the value of £10/ €15 was given to each participant as disturbance allowance.

Focus group topics

93 A semi-structured discussion guide with open-ended topics was designed following a literature
94 review of consumer opinions on PSEA. Initially, consumer knowledge of PS/ SS and guidance to
95 help with portion size estimation was explored; progressing to the exploration of consumer opinions
96 on the usefulness and preferences for PSEA and related guidance. The specific issues explored were
97 as follows:

- 98 • Understanding of PS and SS
 - 99 • Current practice of PS control strategies (i.e. PSEA or other methods to control PS)
 - 100 • Perceived need for SS guidance/ aids
 - 101 • Perceived usefulness of PSEA (the PSEA were shown in the following order: quantities and
102 measures, reference objects, household measures and utensils, and indicators on food packets)
 - 103 • Preferences for PSEA: format i.e. specific PSEA from quantities and measures/ reference
104 objects/ household measures and utensils/ indicators on food packets, level of detail of guidance
105 accompanying the PSEA, context of use, preferred sources of information (e.g. government/
106 food industry) and specific foods/ food groups for consideration (additional materials were used
107 as prompts i.e. the Food Safety Authority of Ireland's healthy eating food guide which includes
108 the food pyramid and guides on SS specific to different age, gender and activity levels⁽³⁰⁾ and
109 the UK's 'Eatwell Plate' which guides on the proportion of foods from each food group⁽²⁴⁾).
- 110 The full discussion guide is available as Supplementary Online Material. The PSEA were used as
111 visual prompts to facilitate focussed discussion. The categories of PSEA were presented to
112 participants in a uniform order, however, within each category the order of the tools presented was
113 varied to eliminate order bias in the discussion. The moderator made every effort to seek opinions
114 from all participants and encouraged elaboration on all discussion points, using probes if necessary
115 to redirect or facilitate discussion. The semi-structured discussion guide was pilot tested in advance
116 of data collection to ensure clarity and comprehension and refined prior to implementation.

117

118 *Analysis*

119 The audio recordings for all six focus groups were professionally transcribed verbatim and
120 reviewed by the moderator for accuracy. The transcripts were uploaded to the qualitative data
121 analysis software package NVivo 9 (QSR International Pty Ltd., Doncaster, Victoria, Australia. A
122 template approach was used to analyse the transcripts⁽³¹⁾. Two independent researchers named
123 G.P.F. and L.K.P., defined and described the codes based on the research questions. Five broad
124 code categories formed the code template: understanding of PS/ SS; current practice of PS control

125 strategies; investigating the perceived usefulness of SS guidance/ aids; opinions on PSEA; and
126 overall views of PSEA. The transcripts were read repeatedly in order to achieve data immersion. To
127 determine the applicability of the individual codes to interview transcripts, the two researchers
128 independently applied the initial template of codes to two transcripts and compared the results,
129 wherein a decision was made to use the predetermined code template. The remaining transcripts
130 were coded in a similar manner, and, for corroboration purposes, the researchers discussed the
131 fundamental nature of each category code. Both reviewers agreed that data saturation had occurred
132 as no new themes emerged in the last two transcripts. Quotations from participants were extracted
133 to illustrate typical themes, individual participants were not identified on the transcripts therefore
134 the quotations were used to express the opinions of the minority and majority views within the
135 groups. IBM SPSS (version 20) was used to analyse quantitative data from the participant
136 characteristics questionnaire.

137

138 **Results**

139 *Participant characteristics*

140 Participants were mostly aged 26-45 years (47%); of healthy weight (BMI 18.5 – 24.9 kg/ m²)
141 (45%); employed full-time (28%), unemployed (22%) or students (22%); following no special diet
142 (78%); responsible for grocery shopping (44%) and preparing/ cooking meals in the household
143 (50%). A complete overview of subject characteristics is included in **Table 3** and a summary of
144 key results is also included in **Table 4**.

145

146 Note, any reference within the results to the ‘majority’ or ‘most’ of the participants means more
147 than 50% of participants; the ‘minority’ or ‘some’ means less than 50% of participants.

148

149 *Understanding of portion size and serving size*

150 It was evident across all groups that there was a lot of confusion in terms of the interpretation of a
151 PS versus a SS. Majority of participants were not able to correctly differentiate between the terms
152 PS and SS i.e. PS being the amount of food intended to be consumed by an individual whereas SS is
153 the amount of food that is recommended to be consumed by an individual⁽³²⁾. While some

154 participants reported that the terms had the same meaning, the majority reported that they were the
155 opposite to the Institute of Grocery Distribution definitions outlined above⁽³²⁾:

156 *“Serving size is the size of the plate in front of you. It could be anything. Portion means the*
157 *recommended intake of the meal for an individual”* (group 4, males aged 18-64 years).

158

159 *“Yeah, serving size is what you give yourself, portion size is what you probably should give*
160 *yourself”* (group 6, females aged 18-35 years).

161 Some participants also questioned whether a SS was the total amount to be eaten per day.
162 Nonetheless the majority were unanimous in thinking that SS was unrealistic and too small
163 particularly for breakfast cereals:

164 *“...on other brands of cereal it says 25 servings, and I would say you would get seven or eight out*
165 *of it”* (group 2, males aged 18-35 years).

166 *“Well sometimes, this is what amuses me, you know they say something is supposed to be a meal for*
167 *two, but you would eat it all yourself”* (group 1, females aged 36-64 years).

168

169 *Current practice of portion size control strategies*

170 Within this theme, the discussion explored the participants' use and awareness different portion
171 control strategies and selection methods. Majority of groups indicated that their PS is determined
172 by habit or judged by eye, so their PS selection was very much based on what they were familiar
173 with based on previous experiences. The PS of breakfast cereals in particular was determined by the
174 size of the bowl *“...you go by the look of the bowl”*, or for other foods the PS was one whole piece
175 e.g. one steak or chicken fillet.

176 *“...it's just what looks right in the pot”* (group 2, males aged 18-35 years);

177 Usually the amount that was cooked would be eaten. For those who were not usually involved in
178 cooking or preparing meals, their PS was determined by the server and they would generally *“clean*
179 *the plate”*:

180 *“...if the girlfriend is cooking for me, she puts it out there and I eat it all, without rhyme or reason.*
181 *Probably twice as much!”* (group 4, males aged 18-64 years).

182 *“I would eat until it was all gone. If there was too much meat I would just eat it until it was*
183 *finished because then I can wash the plate otherwise there’s a dirty plate...and that annoys me”*
184 *(group 6, females aged 18-35 years).*

185 Participants were previously aware of PS information from the media, food labels and slimming
186 groups, however, they their awareness off these aids did not always translate into their application
187 to help them with PS control and selection. Most participants were aware of the food pyramid and
188 either ‘The Eatwell Plate’²⁴ or a segmented diet plate. Only some participants had noticed SS on
189 food labels or the comparison of reference objects such as the matchbox and hand physiology to PS.
190 Participants were aware of other PSEA including the “spaghetti hole”, baking spoons, chopping
191 board with graduated ruler along the side, pre-portioned packaged foods and using handfuls or fists.
192 Some of them reported use of a pot or a cup for foods like rice and porridge to determine the correct
193 ratio of grain to liquid for cooking rather than portion control.

194

195 *Perceived need for serving size guidance/ aids*

196 Within this theme, the perceived need for SS guidance and PSEA was discussed as well as the
197 participants’ views on the importance of consideration for PS. Overall, most participants felt that PS
198 guidance was needed and that PSEA would be useful, particularly at the stage of food preparation.
199 In addition, there was a general consensus that PS was not considered to be important in certain
200 instances such as when feeling extremely hungry. However, some groups were of the opinion that
201 adhering to PS advice would be too regimented and that food type or a “*balanced diet*” was most
202 important rather than specific amounts:

203 *“Do you know, it’s just because you buy a bag of crisps it doesn’t mean to say you have to eat the*
204 *whole packet although sometimes you do. Or the same with chocolate bars as well, I think one here*
205 *and there doesn’t do anybody any harm, as long as you balance it” (group 6, females aged 18-35*
206 *years).*

207 On the other hand, there were some instances where participants felt that PS and PSEA were not of
208 significant importance to them individually i.e. if they were of normal weight and in the younger
209 age bracket. Specifically, participants were generally of the opinion that PS “should be important”
210 to them but that PS and PSEA were really only for the concern of “*dieters*” i.e. those following a
211 weight-loss diet:

212 *“I think it’s just in general like, I know some people are going to be more like people who are doing*
213 *specific diets like Weight Watchers or Slimming World or something like, going to be weighing all*
214 *the time, but it’s not going to apply like to everybody”* (group 2, males aged 18-35 years).

215 *“...they all seem to be intended for people who wish to limit their food and calculate calories*
216 *precisely; whereas that’s not something I ever wish to do, to count calories. It’s about just getting*
217 *an average meal every day”* (group 4, males aged 18-64 years).

218 The younger males and females indicated that PS was not a concern for them at present but perhaps
219 later in life. It was also indicated that the older age group should not be forgotten about when it
220 comes to PS as they are *“not as active”*:

221 *“I think maybe not at the moment but as you get older it might become more important”* (group 2,
222 males aged 18-35 years).

223 Lastly, a minority of participants mentioned ‘time’ as a factor that influenced their consideration for
224 PS, they indicated that they were too busy to take the time to use PSEA:

225 *“If you had time on your hands but a lot of people in this day and age are out working and they are*
226 *always on the go and don’t have time to do all that...if you’ve got two babies screaming at you...”*
227 (group 6, females aged 18-35 years).

228

229 *Perceived usefulness of portion size estimation aids*

230 The perceived usefulness of the PSEA was considered in relation to the groupings of PSEA i.e.
231 quantities and measures; reference objects; household measures; and indicators on food packets. By
232 in large, the majority of participants were in favour of the reference objects, household measures
233 and indicators on food packets but noted some refinements that may be necessary for their effective
234 application:

235 Quantities and measures – Measuring and weighing out foods were thought to be too laborious and
236 that it was only necessary when baking or following a recipe. However, the middle-aged females
237 (group 3, females aged 36-64 years) said they may use the weighing scales on one occasion then
238 subsequently judge the amount based on the initial measurement. It was also pointed out that older
239 people generally do not use the metric system, they still think in terms of pounds and ounces rather

240 than grams which have been more commonly used in recent years. They felt that SS on food labels
241 may be useful for interpreting nutritional information.

242 Reference objects – The groups were by majority in favour of the reference objects but some felt
243 that the size of them was too small and unrealistic compared to what they would eat. Some
244 participants were confused by the food photographs and thought that they suggested individual
245 foods were to be eaten in isolation and not as whole meals:

246 *“Not for me, because I’d never just serve those things by themselves”* (group 4, males aged 18-64
247 years).

248 *“... I’d never have just chips by itself, and curry without rice”* (group 4, males aged 18-64 years).

249 Household measures – In general, the groups liked the coloured portion pots and the disposable cup
250 measure, they thought they were easy to use, particularly for amorphous grains and flour. It would
251 help them cook the appropriate amounts and avoid food waste, however, some would be
252 discouraged by the extra washing up. There was concern noted among the younger females (group
253 6, females aged 18-35 years) that the coloured portion pots would go unused and that the disposable
254 cup was not very *“eye-catching”*. However, it was suggested to leave a disposable cup in food
255 packets of dried foods such as rice to use as a *“scoop”* when needed (group 4, males aged 18-64
256 years). Opinions tended to deviate with regards to the spoons, with some indicating they would use
257 one for condiments including jam and honey but others disagreed:

258 *“I would put honey or if I had a tablespoon full of jam or something like that. You know salad stuff*
259 *or...”* (group 1, females aged 36-64 years).

260 *“No, I don’t think so not for peanut butter or jam and marmalade, or honey, you’re not going to put*
261 *it in the spoon to take it back off again to put it on the bread or whatever”* (group 2, males aged 18-
262 35 years).

263 Indicators on food packets – The majority were not aware of indicators on food packaging before
264 but thought they could be useful for some foods particularly those that need to be sliced or poured
265 (e.g. cheese and rice respectively). It was highlighted that the markings on tinned foods were not a
266 good idea, as once opened these foods were not usually stored in the tin. The groups liked the idea
267 of the markings on the cheese block but were of the opinion that they may be inconvenient to use. It
268 was thought that markings on food packets could be a *“novelty”* for children. It was suggested that
269 printing circles on spaghetti and markings on pasta packaging may be useful indicators of SS. In

270 terms of SS as fractions of pie-shaped foods, participants liked the idea but emphasized that they
271 would generally eat a whole pizza to avoid wastage.

272

273 *Preferences for portion size estimation aids*

274 There was a clear preference for the “visual” PSEA particularly the portion pots, cups, reference
275 objects and indicators on food packaging (fractions and transparent demarcations) as it was said to
276 be “less hassle” and “quicker” as opposed to the “boring” quantities and measures. Participants also
277 liked using other common household items like scoops and bowls (for cereal):

278 “So definitely the visual, yeah rather than the grams and ounces” (group 3, females aged 36-64
279 years).

280 It was often mentioned that PSEA would be useful for everyday foods mainly the starchy foods
281 such as rice, pasta, cereals, porridge and potatoes, and foods that were difficult to control PS such as
282 cheese; rather than fruit and vegetables for which consumption would be encouraged. However,
283 views on PSEA for discretionary items or “junk” foods (i.e. snacks of high energy density such as
284 crisps and chocolate) and condiments (e.g. mayonnaise) were equivocal:

285 “That’s something I always struggle with, rice, never know, you end up just pouring, pouring, then
286 you could feed a family and then you end up dumping most of it” (group 2, males aged 18-35 years).

287 “It’s okay saying your cheese should be that size, but then you put it in the fridge and you go back
288 again and take another matchbox full out and eat it, you know, you can eat cheese all day. I love my
289 cheese” (group 1, females aged 36-64 years).

290 “Well it says for fruit that more is better, so it doesn’t make a difference really if you use that thing
291 [cup] or not” (group 2, males aged 18-35 years).

292 Unanimously participants felt the PSEA should be provided to the public free of charge and that
293 children in schools should be a prime target. SS guidance should be disseminated innovatively
294 through a TV advertisement, fridge magnet, on food labels or a mobile phone app:

295 “An app would be good, a portion size app, download this is the size of toast you are meant to have
296 in the morning or lasagne or this is the size of your cereal that we should have” (group 6, females
297 aged 18-35 years).

298 In terms of the format, there was some dislike for leaflets with the idea that they were “old” and
299 “boring” but the format and colour coding of the Irish Healthy Eating Guidelines³⁰ were well liked.
300 It was suggested to have a short guide for the general public and a more detailed guide for those on
301 special diets. Majority of participants felt it important to include a range of the number of daily SS.
302 The idea of guidance segregated into age, gender and activity levels was appealing to most
303 participants rather than a ‘one size fits all’ approach:

304 *“I think I quite like the way that goes up... a person that exercises to a person that doesn’t do much*
305 *exercise and things like that. I think it’s quite a good idea, going up in age groups and that as*
306 *well”* (group 6, females aged 18-35 years).

307 It was clear that all participants wanted the PSEA and guidance to come from one “reputable”
308 source i.e. either government or a recognised public health authority and this should be followed
309 consistently by all stakeholders particularly industry as there was some scepticism and distrust
310 towards the food industry and their motives:

311 *“...then the packaging would have to follow something that’s authorized... because if there isn’t*
312 *one baseline, you know, how do you interpret where information, X maybe on this, if they use one*
313 *source of authority or information being on another packet which uses another”* (group 1, females
314 aged 36-64 years).

315 *“...I don’t think I’d trust it as much if it came from the industry, because they really want you to eat*
316 *as much as you can... (group 4, males aged 18-64 years).*

317

318 **Discussion**

319 Larger food PS is a factor that has been linked with higher energy intakes⁽⁶⁾ contributing to the
320 current rates of overweight and obesity⁽¹⁻²⁾. Previous research suggests that reference to PS as
321 “small, medium or large”, may be unclear⁽¹⁷⁻¹⁸⁾. Despite consumers’ difficulty in controlling their
322 food PS, there has been little research to evaluate their perceived usefulness of PSEA and their
323 preferences for such PSEA. In Ireland, consumers preferred the idea of a cup over a dessertspoon
324 for SS of starchy foods, and the palm of the hand rather than the deck of cards for SS of meat, fish
325 and alternatives⁽²²⁾, although, no evaluation of the perceived usefulness and acceptability of these
326 PSEA has been conducted to date.

327 In the present study, focus groups and a brief questionnaire were used to explore consumer opinions
328 on the usefulness of PSEA; consumer preferences in terms of format and context for use; and the
329 level of detail of guidance which would be necessary for their utilisation. The qualitative data which
330 were collected conveyed a clear preference and acceptance (in theory) for “*visual*” PSEA (reference
331 objects, household measures and food packaging) rather than quantities and measures i.e. weighing
332 or measuring in grams/ millilitres/ ounces. In particular, amorphous grains including breakfast
333 cereals, pasta and rice; and cheese were highlighted as foods for which PSEA may be most useful.
334 The PSEA would most likely be used when preparing the main meal in the home. They were
335 deemed necessary mainly for those on a weight loss diet or for older adults. One general consensus
336 was that PS guidance should be concise, consistent, realistic, initiated at school age, from a
337 reputable source, and communicated innovatively e.g. mobile app or TV advertisement. Guidance
338 in relation to gender, age and activity level was favoured over a “one size fits all” approach.

339 In accordance with previous research, PSEA are viewed as being particularly useful for amorphous
340 grain foods such as breakfast cereals, pasta and rice³³, this previous study was conducted in the UK
341 using focus groups also. Participants indicated that they find it particularly difficult to estimate PS
342 of such foods. Similarly some participants expressed difficulty in controlling the amount of cheese
343 they consume, consequently, stating that a PSEA may be useful. This is in agreement with another
344 UK report that recommended the use of PSEA for foods high in saturated fat such as cheese²⁸. The
345 mixed opinions towards the need for PSEA for indulgent foods of high energy density e.g.
346 chocolate and mayonnaise, in the current study were also reflective of previous findings³³. The lack
347 of interest in PSEA for these high energy dense foods is an issue which needs further exploration in
348 future research. Researchers in the US who used a novel approach by inserting coloured potato
349 chips at regular intervals in a tube of potato chips, found that consumption decreased by over 50%
350 due to the segmentation cues which prompted a somewhat automatic subconscious response from
351 consumers³⁴. The latter study may provide further scope for the development and promotion of
352 indicators on food packets as participants were generally receptive to these as PSEA but reported
353 issues with their usability. Another option to be explored in future research are pre-portioned packs
354 of high energy dense foods, however, these tend to be more expensive than the larger value packs.
355 Therefore, a more proportionate pricing system may make pre-portioned foods more acceptable to
356 consumers. Nonetheless, the majority of PSEA considered in this study would generally evoke a
357 conscious response from the reflective system of the brain, it may be interesting to explore more
358 cues that could be subconsciously used by consumers such as the indicators on food packaging or
359 the segmentation cues within food packets in future research.

360 As current portion size selection tends to stem from both habit and tradition^(33,35), effectively
361 communicating the benefits of adhering to more appropriate PS could be instrumental to instigating
362 behavioural change³⁶. Participants indicated that they currently judge their PS either through habit,
363 by eye, using bowl size for items like breakfast cereals or in units for items like chicken breasts.
364 Participants were generally acquiescent to PSEA although in some instances deemed them only
365 necessary for those on a diet who wish to limit their intake of particular foods. There was a general
366 consensus that PSEA were unnecessary for fruit and vegetables; participants did not consider the
367 fact that PSEA could facilitate the ‘5-a-day’ recommendation. Some stated they would be too busy
368 to implement portion control while others said it would “*make you crazy*” using PSEA every day.
369 The present study has alluded to initiating PS education in schools to instil appropriate habits at an
370 early age. This may be a strategy to make PS education more amenable to children and younger
371 adults. This finding also implicates future policy with regards children’s nutrition as schools and
372 educators could be a key intervention point in terms of reducing children’s energy intake.

373 Further development is needed to incorporate PS guidance into more innovative communication
374 formats. For example, in the US a multimedia approach is adopted including the use of mobile
375 phone apps and a range of online resources and printed materials are provided^(19,37). Although there
376 has been research into the use of such methods for dietary assessment, there are limited data on their
377 use as PSEA pre consumption. A recent intervention conducted in the Netherlands evaluated a web
378 based portion size tool and found it to be effective in raising awareness of recommended SS and
379 overeating triggers from larger PS⁽³⁸⁾. In the current study, participants’ were receptive to using the
380 PSEA for food preparation in the home, suggesting that guidance on appropriate amounts of food to
381 purchase (e.g. meat) or cook (e.g. rice) may be most effective at helping consumers to serve out and
382 ultimately consume more appropriate PS. This implies that a key intervention point for policy
383 makers in terms of PSEA may be pre-consumption, therefore it may be worthwhile communicating
384 PSEA guidance in terms of raw/ pre-cooked amounts in future to encourage this practice. Perhaps
385 estimation of PS while purchasing and preparing food may help to eliminate the habit of “*cleaning*
386 *the plate*”. In any case, it is imperative that future research considers the incorporation of PS
387 guidance and PSEA into multi-media such as mobile phone apps, so that policy makers can
388 effectively integrate PSEA into such mediums in order to innovatively target a wide range of
389 consumers.

390 Age and gender differences were apparent with regards to preferences for PSEA. For example, the
391 middle aged females (group 1) were more accepting of the idea of using spoons to aid them with
392 portion control for condiments. On the other hand, the males of all ages indicated that they would

393 not be likely to use spoons, a reason for this is that it would result in more washing-up. Males also
394 indicated the unlikelihood of them using portion control for foods like cheese, this was illustrated in
395 group 4 “*I’d rather have it once a week and have a nice amount*”. This is a novel finding of the
396 current study as age and gender differences were not apparent in a previous study of similar
397 nature³³. Therefore, it is apparent that age and gender may need to be taken into consideration when
398 communicating portion control guidance in future.

399 This study has reiterated consumers’ distrust and lack of confidence in the food industry²⁵ owing to
400 the perception that they have ‘ulterior motives. This gives clear virtue to consumers’ desire for
401 consistent guidance from a reputable source such as government or a public health authority,
402 notwithstanding the fact that all advice should be non-prescriptive and serve to empower the
403 consumer to make their own informed choices³³. Successful public health initiatives such as the salt
404 reduction campaign, involve facilitating the food industry to commit to consistency, transparency
405 and standardisation for the benefit of the consumer. Adopting a similar approach with respect to
406 food PS may be warranted so that guidance from all stakeholders is uniform. This study has also
407 highlighted consumer confusion of the terms PS vs. SS, if ‘one size fits all’, and whether it’s a
408 “daily amount”²⁵. Therefore, clear and concise supplementary information should be made available
409 with the PSEA to clarify these issues.

410 A limitation of the present study is that drinks were not considered in relation to consumer
411 preferences for PSEA. This was partly due to the fact that a previous study alluded to the fact that
412 drinks were generally not considered by consumers in terms of PS estimation³³, and secondly
413 because there were limited PSEA available for drinks to consider as part of this research. Therefore,
414 there is an opportunity to develop novel PSEA for drinks and to investigate whether these would be
415 feasible for consumers to use.

416

417 **Conclusion**

418 This study has identified consumer preferences and acceptance for “*visual*” PSEA such as reference
419 objects, household measures and indicators on food packaging. In particular, these were deemed to
420 be most useful for amorphous grain foods such as breakfast cereals, pasta and rice. The following 4
421 key recommendations can be derived from this research.

- 422 1. PS education should be ingrained at a young age and disseminated through modern
423 technologies to engage with the wider public.

- 424 2. A concise, consistent, realistic and unified approach to PS guidance involving all
425 stakeholders is warranted in order to gain consumer trust.
- 426 3. The current findings should be considered in conjunction with further research which
427 examines the practical use and precision of such aids ⁽²⁹⁾.
- 428 4. The scope of the current research could be expanded to explore the feasibility of more
429 recently developed PSEA available electronically via mobile phone apps or online.

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513

514 **Table 1** Foods (consider in the previous study²⁹) and related portion size estimation aids

Food group	Foods	Amount displayed	Portion size estimation aids				
			Quantities and measures	Reference objects	Household measures and utensils		Indicators on food packets
Dairy	Cheddar cheese (grated)	250g bag	SS (food scales)	Small matchbox	Tablespoon	Portion pot	Demarcations
	Cheddar cheese (block)	250g block	SS (food scales)				
Grains	White rice (uncooked)	500g box	SS (food scales)		200ml disposable cup	Portion pot	Demarcations
	White penne pasta (cooked)	920g serving dish	SS (food scales)		200ml disposable cup		
Fruit and vegetables	Cornflakes	500g box	SS (food scales)		200ml disposable cup	Portion pot	
	Rice Krispies	510g box	SS (food scales)		200ml disposable cup	Portion pot	
	Carrots	240g dish	SS (food scales)		200ml disposable cup	Demarcations	
	Orange juice	1 litre carton	SS (measuring jug)		200ml disposable cup		
Meat dishes	Lasagne	1500g dish	SS (food scales)	Food photo			
	Chicken pieces (cooked)	520g dish	SS (food scales)	Palm of hand			
	Beef curry	1040g dish	SS (food scales)	Food photo			
High fat/sugar	Victoria sponge	228g cake	SS (food scales)	Food photo	Teaspoon	Average wine glass	Fraction
	Spread	500g tub	SS (food scales)	Portion pack			
	Crisps	150g share bag	SS (food scales)				
	White wine	750ml bottle	SS (food scales)		Portion pot	Measuring spoon	Tip of thumb
	Mayonnaise	400g jar	SS (food scales)		Tablespoon		

515 **Table 2** Demographics of focus group participants

Focus group number	<i>n</i>	Gender	Age range (y)	Location
1	5	F	36-64	NI – slimming group
2	5	M	18-35	ROI – community
3	7	F	36-64	ROI – community
4	8	M	18-64	ROI – university staff
5	4	M	18-64	NI – community
6	3	F	18-35	NI – community

516 NI, Northern Ireland; ROI, Republic of Ireland; F, female; M, male

517

518 **Table 3** Characteristics of the focus group participants (*n* 32)

	<i>n</i>	%
Gender		
Male	17	53
Female	15	47
Age (years)		
18-25	6	19
26-35	8	25
36-45	7	22
46-55	5	16
56-64	6	19
BMI (kg/m2)*		
Normal weight (18.5-24.9)	13	45
Overweight (25.0-29.9)	10	34
Obese (≥ 30.0)	6	21
Country of residence		
Northern Ireland	11	35
Republic of Ireland	20	65
Marital status		
Single	11	34
Living with partner	4	13
Married	14	44
Divorced/separated	2	6
Widowed	1	3
Highest level of education achieved		
Secondary (age 15/16 years)	2	6
Secondary (age 17/18 years)	4	13
Additional training (NVQ)	12	39
Undergraduate	6	19
Postgraduate	7	23
Occupational status		
Employed FT	9	28
Employed PT	5	16
FT home maker	7	22
Not employed	4	13
Student	7	22
Smoking status/history		
Current smoker	5	16
Ex smoker	8	25
Never smoked	19	59

Over the last year, have tried to:

lose weight	17	53
eat less fat	17	53
eat more fruit and vegetables	22	69
exercise more	23	72

Are you on a special diet?

No	25	78
Cholesterol lowering	1	3
Slimming (self/prescribed)	6	19

How many people (inc. you) live in your household?

Live alone	3	10
Two people	11	35
Three people	8	26
Four people	4	13
5+ people	5	16

Are you responsible for grocery shopping?

Yes – I do most	14	44
Yes – I am jointly responsible	11	34
No – someone else does it	7	22

Are you responsible for preparing/cooking meals?

Yes – I do most	16	50
Yes – I am jointly responsible	11	34
No – someone else does it	5	16

519 BMI, body mass index; FT, full time; PT, part time

520 *Calculated from self-reported weight (kg) and height (m)

521 **Table 4** Summary of key focus group results by discussion theme

Current understanding	<ul style="list-style-type: none"> • Confusion evident between different terminology used interchangeably/inconsistently (i.e. SS vs PS) • Majority of participant unanimously agreed that current SS were unrealistic and too small
Current PS/SS practices	<ul style="list-style-type: none"> • Current PS determined: <ul style="list-style-type: none"> ○ “by habit” ○ “judged by eye” ○ using the size of the plate/bowl ○ by the unit-size of foods, e.g. one steak or fillet ○ by the individual responsible for cooking/serving the meal • Awareness of PS information did not always translate into their use • Use of PS control strategies was more commonly employed when determining the amount to cook, particularly using household measures or reference objects, e.g. a handful
Perceived need for SS guidance/aids	<ul style="list-style-type: none"> • Most participants felt that PS guidance was needed particularly for when preparing food • This guidance should not override the importance of following a “balanced diet” • It was acknowledged that the importance of PS guidance would be different depending on individual circumstances, e.g. age, body weight, level of physical activity • May be most relevant for “dieters”
Perceived usefulness of PSEA	<ul style="list-style-type: none"> • Aids considered: <ul style="list-style-type: none"> ○ Quantities and measures ○ Reference objects ○ Household measures ○ Food packaging • All types of PSEA were generally well-received by the majority of participants, with the exception of the quantities and measures, which were viewed as being too laborious • Practical solutions and reference objects were perceived to be the most useful
Preferences for PSEA	<ul style="list-style-type: none"> • Clear preference for the “visual” PSEA • PSEA were particularly welcomes for starchy foods, and others that were difficult to control (e.g. cheese) rather than fruit/vegetables • Views on the need for PSEA for snacks, “junk food” and condiments were equivocal • Free dissemination of advice from a “reputable” Government body/public health authority, using innovative methods would be preferred • A one-size-fits-all approach should be avoided

522 PS, portion size; SS, serving size; PSEA, portion size estimation aids

523 **Supplementary Online Material**

524

- 525 1. Focus Group discussion guide (.pdf) uploaded separately.
- 526 2. Table 3 (full characteristics of all focus group participants) can be included as supplementary
- 527 online material at the discretion of the editor.