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Bucher, Tamara; Rollo, Megan E.; Smith, Shamus P.; Dean, Moira; Brown, Hannah; Sun, Mingui; Collins, Clare "Position paper on the need for portion-size education and a standardised unit of measurement". Published in Health Promotion Journal of Australia (In Press)

Available from: <http://dx.doi.org/10.1071/HE15137>

Accessed from: <http://hdl.handle.net/1959.13/1344781>

Running Title: Portion size education and measurement

Manuscript Title:

Position paper on the need of portion size education and a standardized unit measure

Keywords: portion size education, serve size, standard serving size, food unit

Abstract (Aim)

Large portion sizes contribute to weight gain in western societies. Portion size interventions, aids and education can be effective in helping prevent weight gain, but consumers are unsure what adequate portions are and express confusion about existing guidelines. A lack of clarity about suggested serving size recommendations is one of the main barriers to appropriate food portion size control. Therefore, standardized measurement units and a clear terminology are required.

This position paper summarises the evidence regarding the impact and importance of portion size education and estimation, and outlines strategies for improving consumer understanding and application through the development of an international food measurement system and appropriate portion control tools.

In this position paper, the authors call for the standardisation of food volume measurement terminologies, units, implementation recommendations, as well as consumer education.

The target audience for this statement includes nutrition and behavioural researchers and policy makers, and stakeholders who potentially influence and implement changes in national food measurement systems, which in turn impact on consumer choice.

24 Introduction

25

26 ***Larger portion sizes contribute to weight gain***

27 Increased portion sizes ⁽¹⁾ and changes in eating patterns have been identified as important
28 contributors to the obesity epidemic in recent decades ^(2, 3). Several studies show that portion
29 sizes, especially of energy-dense, nutrient-poor foods and drinks, have increased significantly ⁽⁴⁻⁶⁾.
30 In the United States this development is commonly referred to as the “supersizing trend” ⁽⁶⁾. For
31 instance, French fries and soft drink portion sizes that are now two to five times larger than the
32 original size have replaced small portions ^(3, 7). Portion sizes of some foods and beverages have
33 also increased in European countries ⁽⁵⁾ and Australia ⁽⁸⁾. The rationale behind increasing portion
34 size is to meet consumer expectations for “value for money”, as it is more profitable for producers
35 to increase portion sizes than decrease prices ⁽⁹⁾.

36 The exposure to large portion sizes distorted consumption norms and perceptions of what is an
37 appropriate amount to eat ⁽¹⁰⁾. The impact of this is that larger portions increase consumption. This
38 finding is consistent across studies and has been demonstrated for a wide range of beverages and
39 foods ⁽¹¹⁻¹³⁾. The tendency to overeat in response to exposure of large food portions is ubiquitous
40 and occurs irrespective of demographic characteristics, such as age, body weight status, sex or
41 socioeconomic status ⁽¹⁴⁻¹⁷⁾.

42 However, although a direct causal link between portion size and obesity remains to be established,
43 advice to moderate portion sizes, especially of energy-dense foods, is presently the cornerstone of
44 most weight management advice ⁽¹⁴⁾.

45

46

47 ***Consumers focus more on the type of food rather than the amount***

48 Although for weight management the overall energy intake is relevant, people focus mainly on the
49 type of food, while portion sizes are often neglected completely ⁽¹⁸⁾. As an example, Rozin et al.
50 showed that many people believe that a tiny amount of chocolate contains more calories than a
51 large amount of bread ⁽¹⁹⁾. Similarly, a small amount of a healthy food or ingredient can bias energy
52 estimates of large portions of unhealthy foods ^{(20, 21) (22)}. It has for instance been shown that people
53 estimate the energy content of a burger with three celery sticks as being lower compared to the
54 energy content of the burger alone ⁽²⁰⁾.

55 Although certain foods are more filling than others, the amount of food consumed is just as
56 important as the type of food and choosing appropriate portion sizes is a critical skill. Consumers
57 therefore need to be educated to consider portion sizes when aiming to lose weight ⁽¹⁴⁾.

58

59 ***Variation in terminologies, measurement units and recommendations cause confusion***

60 Variability between dietary recommendations and inconsistency between measurement units exist.

61 A lack of clarity about suggested serving size guidance was found to be the main barrier to
62 appropriate food portion size control ⁽²³⁾. Recommended food intakes and their format do differ
63 between countries. However, even within a country, various terminologies for food portions are
64 confusing for the average consumer. For example, in the study by Spence et al. consumers
65 recalled inconsistent serving size information for particular foods and food groups, obtained from
66 the public, private and voluntary sectors (e.g. dietitians, weight loss communities or food labels)
67 ⁽²³⁾. Furthermore, consumers mentioned that household measurements were open to interpretation
68 and they poorly recognized the actual quantity of servings specified in metric (e.g. grams) or
69 imperial (e.g. ounces) measurements ⁽²³⁾.

70

71 The Australian Guide to Healthy Eating defines 'standard serve sizes' as set amounts of certain
72 foods, which are components of broad food groups and have recommendations relating to total
73 serves per day ⁽²⁴⁾, 30g breakfast cereal (1/2 cup).

74 These standard serve size amounts differ from 'portion sizes', which are the amounts of food that
75 are consumed within a meal and can be thought of as a factor of the standard serve size. For
76 example, a standard serve of breakfast cereal is 30g, but the usual portion of cereal consumed
77 may be equivalent to two standard serves or 60g cereal (one cup). In contrast, the standard serve
78 sizes are different again from the 'serving size' (or recommended serve size) indicated on a
79 product's Nutrition Information Panel. The recommended serving size a food label corresponds to
80 the amount the manufacturer suggests as being an appropriate amount for consumption in one
81 eating occasion ⁽²⁵⁾, e.g. 45g cereal.

82 The United Kingdom Guide for creating front of pack nutrition labels states that "Generally
83 accepted portion sizes should be used wherever possible. However, it is also recognised that
84 labelling on the basis of a consumption unit, for example a slice of bread in a loaf, is practicable for
85 some foods where a standard portion size varies according to the eating occasion" ⁽²⁶⁾. The issue
86 of variable manufacturer determined serve sizes is discussed elsewhere ⁽²⁷⁾.

87

88 Furthermore, food volume is measured in different units across different countries. In the United
89 States customary units are common to measure food and consumers think in terms of ounces
90 (liquid) and pounds (weight). Other countries such as Australia and most of Europe use the metric
91 system and measure liquids in litres and weight in kilograms. Although most countries use the
92 metric system, household measures such as cups and spoons are often used as food measures.
93 However, the volumes of these utensils again differ between countries. While 'one cup' is 250 ml in
94 Australia, New Zealand and Canada, it corresponds to 284 ml, which is half an imperial pint in the
95 UK and 237 ml, or half a US pint in the United States ⁽²⁸⁾.

96

97 Unsurprisingly, consumers are confused about portion sizes, standard serve sizes and
98 recommended serve sizes indicated by producers. A lack of clarity on aids and perceived

99 irrelevance of portion size advice for the general population has also been reported ^(14, 23), with the
100 lack of transparent and consistent messages undermining development of effective interventions
101 ⁽¹⁴⁾.
102

103 ***Consumers do not know what an adequate portion is***

104 Currently, it is not entirely clear what consumers perceive to be a normal portion size of various
105 foods and whether this is in agreement with dietary guidelines. In a recent study, Collins et. al.
106 invited parents and children to serve what they perceive to be a normal portion of various standard
107 food products ⁽²⁹⁾. The results indicate discrepancies between what consumers perceived to be
108 normal compared to current serving size guidelines ⁽²⁹⁾. A similar result was found recently in
109 young adults ⁽³⁰⁾. Portions of various foods the young adults perceived as adequate serving sizes
110 for one eating occasion were significantly larger than standard serving sizes defined in the
111 Australian Guide to Healthy Eating ⁽³⁰⁾.
112 Furthermore, from a study in which participants served themselves food from a lunch buffet, major
113 difficulties were found for portion size estimation, with consumers greatly overestimating self-
114 served vegetable and whole grain portion sizes ⁽³¹⁾.
115

116 ***Portion size interventions, aids and education can be effective***

117 To assist with efforts to counter the obesity epidemic, portion-size interventions are suggested as
118 potentially important strategies for addressing improvements in dietary habits and to reduce overall
119 energy intake at the population level.

120 Measures targeted at individuals comprise educational strategies to raise consumers' awareness,
121 teach behavioural strategies for portion-size control, and provision of feedback about chosen
122 portions ⁽¹²⁾. A systematic review of portion education/training interventions on dietary intake
123 concluded that training improved adults' ability to estimate portion sizes ⁽³²⁾. However, systematic
124 evidence on the effectiveness of portion size education in young children is still lacking.

125 There is increasing evidence that environmental interventions targeted at portion size are also
126 effective. For example, studies have shown that increasing variety can be used strategically to
127 increase the portion size of vegetables consumed by adults and children ^(33, 34). It has therefore
128 been recommended that portion-size interventions should be targeted at both the environmental
129 and individual level ⁽¹²⁾, however, environmental strategies are discussed elsewhere ^(12, 35, 36).
130

131 Research shows, that estimating food portions is difficult; in particular, consumers struggle with
132 volumes of amorphous foods and foods of irregular shapes ⁽³⁷⁾. Visual cues are an important
133 mediator of portion size ^(38, 39). Therefore, practical aids to assist consumers in eating more
134 appropriate portions, or at least being aware of the portion size consumed, are also required. The
135 ubiquity of technologies such as the Internet and smartphones, offer avenues for the delivery of
136 convenient and engaging portion size education and tools to aid selection. Poelman et. al. showed

137 that a dedicated online tool for portion size education increased portion size control behaviours ^{(40,}
138 ⁴¹⁾, and when used with other strategies, resulted in modest short-term weight loss ⁽⁴¹⁾. Further
139 research into the use and effect of these technologies, which provide practical aids to support long-
140 term portion control behaviours, is warranted.

141

142 **Conclusions**

143

144 ***Standardized measurement units and a clear terminology are required***

145 Standardised measurement units, practical education and visual tools might help to achieve better
146 portion control estimations and assist with efforts to counter the obesity epidemic. Specifically,
147 portion size measures based exclusively on the metric system and “SI” units, rather than cooking-
148 focused measures such as “cups”, could potentially be considered as a way to develop, test and
149 apply uniform measures accessible internationally. For example, among children, education on
150 standard serve sizes and recommended total number of daily serves could be taught within a
151 health education curriculum, home economics, or in after-school cooking classes. Further,
152 estimation of volumes of geometric shapes could be incorporated into the mathematics curriculum.
153 This might assist with better estimation of food volumes and in determining healthy portion sizes
154 later in life ⁽²⁷⁾.

155

156 Consumers need skills and tools that help them to accurately estimate portion sizes and to apply
157 information about standard serving sizes on nutrition information panels to choosing their own
158 portion sizes.

159 Furthermore, standardisation of the food volume measurement system might allow for improved
160 labelling regulation and environmental control of portion size by manufacturers and food service
161 operators in the long term.

162

163 ***Call for action for government agencies (e.g. departments managing education, health and***
164 ***food supply and regulation), non-government organisations (e.g. professional***
165 ***organisations, youth health services etc.) and industry (e.g. food manufacturers and***
166 ***distributors)***

167

- 168 ***1) Recommendations and terminologies relating to measurement of food portions need***
169 ***to be standardised to avoid consumer confusion.***
- 170 ***2) Rather than “cup” measures, new consumer focused methods related to standard***
171 ***food volume estimation using the International System (SI) of Units (e.g. cubic***
172 ***metres: m³) or the Centimetre-Gramm-Second (CGS) system (e.g. cubic centimetres:***
173 ***cm³) could be considered.***

174 ***International standardised aids for food volume measurement, which are based on SI units,***
175 ***may facilitate multi-national food portion measurement and surveillance, and the***
176 ***implementation of portion control strategies.***
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