Development and validation of an online portion size norm assessment tool

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Article

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Abstract

Background

Portion size norms (described as a typical perception of how much of a given food individuals choose to eat in one eating occasion) may have shifted towards larger sizes due to the high availability of large package and serving sizes. This is especially concerning for discretionary foods that are energy-dense and nutrient-poor. Currently, there is a lack of validated tools to assess portion size norms for common foods. Therefore, the aim of this study was to develop and validate an online image-based tool to examine the portion size norms of discretionary foods among Australian consumers.

Methods

Using a within-person crossover design, an online survey with image-series of 15 discretionary foods and drinks was validated against corresponding real foods. Participants selected their normal portion size using both methods and could choose from a scale ranging from 0 (do not eat this food) to 9 (greater than the largest option displayed). Agreement between methods was examined using cross-classification and intra-class correlation coefficient (ICC).

Results

A sample of 114 Australian adults were recruited (mean age 24.8 years). Cross classification indicated over 90% of selections (ranging from 86-96%) were matched in the same or adjacent portion size option. ICC was 0.85 across all foods, and 12 of the 15 foods demonstrated a good to excellent level of agreement (ICC >0.75).

Conclusion

This novel food images survey showed good agreement when compared with corresponding real foods. This survey may be a valuable tool to examine portion size norms for common discretionary foods among Australian adults in future studies.

Introduction

Portion size norms, described as a typical perception of how much of a given food individuals choose to eat in one eating occasion (1, 2), have a key role in food consumption and portion control behaviours (3, 4). This norm may have been distorted towards larger sizes due to the ubiquity of large serving and package sizes available in the food environment (5, 6). Recommended intakes from dietary guidelines may be considered “too small” as large servings are now perceived as the new “normal” (7). This is especially concerning for discretionary foods, described as foods and drinks that are high in saturated fats, added sugars, added salt and/or alcohol and should be consumed sometimes and in small amounts (8). Unconscious overconsumption of discretionary food can result in excessive energy intake, lower dietary quality, and the development of obesity and chronic diseases long term (9, 10). Reducing the upshifted portion size norm has therefore been highlighted as one potential strategy to tackle this trend and empower consumers to select
more appropriate portion sizes (5, 11). However, relatively few studies have examined the portion size norms of discretionary foods (10). A clear understanding of norm boundaries across commonly consumed discretionary foods has yet to be established (10).

Different assessment tasks have been used to investigate the portion size norm, including self-selected portion size tasks based on provided serving size options (12–14), normality judgement tasks using computer-based images (15), and an estimation of the number of portions contained in a package or container (16). Previous literature has shown that a range of portion sizes could be considered normal within a population, and multiple cognitive, social, and contextual factors may influence the decision-making process and accuracy of estimations (2, 3, 17, 18). For example, individuals might be guided by social norms of portion sizes (that is, beliefs about how much others expect them to eat) when dining out with a group, while personal norm of portion sizes (that is, beliefs about how much to eat according to oneself) may be more salient when eating alone in a home setting (1, 18). Unit bias and social desirability bias have also been consistently demonstrated (18, 19). Individuals tend to rely on the size of a single food unit when making portion size decisions and may consider the displayed serving size to be the socially expected portion size (18–20). To minimise the interaction between serving size exposure and potential bias, there needs to be careful consideration of food selection, presentation, as well as the number and range of options (17, 21). Previous research in this area shows a large degree of heterogeneity in terms of definitions of portion size norms, validation of portion size measures, and descriptions of eating context, with many studies only providing one single serving size option (2).

To ensure the accuracy of outcome measures, assessment tools specifically designed to examine the portion size norm are needed. A series of computer-based food images appears to be a promising alternative to using real foods in the estimation of portion size norms due to a lower respondent burden and more accessible to a larger population (17, 22). Therefore, the aim of current study was to develop and validate an online image-based tool to examine the portion size norm of discretionary foods among Australian consumers.

**Methodology**

**Study design**

An online survey was developed to investigate the portion size norm of commonly consumed discretionary foods in Australia. Online image-series for 15 discretionary foods were validated against corresponding real foods. Using a cross-sectional, within-person crossover design, participants reported their normal portion sizes for each test food twice, once based on food images and the other time based on real foods.

**Selection of test foods and portion sizes**

A variety of commonly consumed discretionary foods, familiar to Australian consumers (23), were included; sweet snacks (M&Ms, chocolate bars, chocolate blocks, and sweet biscuits), cakes (layered cake, caramel slices, muffins, and banana bread), savoury snacks (savoury biscuits and potato crisps), fast foods (pizza, nuggets, and hot chips), and sugary carbonated drinks (in glasses or cups, and in bottles or cans).
Eight portion sizes in increasing size were included for each food (except for drinks in bottles or cans where six options were included). This is based on literature that suggests presenting a range of serving size options may assist with portion size estimations (21) and an even number of options helps to avoid the temptation of choosing the centre image (21, 24). Detailed criteria used to develop the portion size options and the portion size weights are available in supplementary materials (Appendix 1).

Questionnaire design

The accompanying questionnaire was developed using Qualtrics (an online survey development software) and consisted of three sections: demographics, food images, and real foods. The demographic section collected information on participants’ gender, age, self-reported height and body weight, postcode of home address, usual physical activity level (PAL), and confidence in their cooking skills. PAL was estimated using the physical activity factor and classified as sedentary, lightly active, moderately active, very active and extra/vigorously active (25, 26). Confidence of cooking skills was assessed as a marker of food literacy/awareness of food quantity (27) using a validated Likert scale (28).

The food image section displayed the eight successive images corresponding to the sliding scale question, labelled from smallest ‘1’ to largest ‘8’ and additional selections of ‘0 – I do not eat this food’ and 9 – greater than the largest option displayed’ (Fig. 1a). Participants were instructed to move the marker to their corresponding portion size norm, which would become enlarged for easier viewing. A cover photo of a typical manufactured package was used as an example to orient the participant to each food. The JavaScript code was based on Embling et al.’s image carousel (22).

The real food section consisted of the questions and sliding scale identical to the image section (Fig. 1b) but without the food images. Participants answered each question by observing the labelled portion size options present at the food stations.

The presentation order of section and test foods within sections were both randomised using a built-in randomiser. The survey questionnaire was pilot tested in the target population (March 2022) and minor modifications were made to improve usability. Further details of study and questionnaire design are attached as supplementary material (Appendix 1).

Study procedure and participant recruitment

A convenience sample of university staff and students was recruited through online advertisements and the distribution of physical flyers. An online screener questionnaire excluded participants who did not meet the following criteria: living in Australia, aged between 18–65 years, fluent in English, no current or previous diagnosis of an eating disorder, and who were able to attend an in-person laboratory session. Participants attended the in-person session at a university campus in Sydney (April to May 2022) and were instructed to complete the questionnaire individually using a laptop. Participants were reminded of the definition of portion size as ‘the amount of food they eat at one sitting’. Researchers remained in the laboratory room in an unobstructive manner during the study process.
A small token was offered to compensate participants’ time. The study was approved by The University of Sydney Human Research Ethics Committee (ethics approval number 2022/147). Study protocol was registered in priori on the Open Science Framework (OSF registration DOI: osf.io/x3fm7).

Due to the preliminary nature of this study, a power analysis could not be calculated based on previous literature. Thus a sample size of 100 participants was used as recommended for preliminary validation in dietary assessment (29).

**Statistical analysis**

Data were analysed using IBM SPSS v28 (IBM, Armonk, NY, USA). Descriptive analyses on participants characteristics was conducted. For each food, data were excluded if participants reported that they do not consume the food. Reported normal portion sizes from two methods were compared using cross-classification and intra-class correlation coefficients (ICC, two-way mixed model, average measure). Data were classified as correct match (described as participants who selected the same image option as real foods), adjacent match (described as participants who selected a portion size image one option away from what they selected based on real foods), and gross mismatch (described as participants who selected a portion size image four or more options away from what they selected based on real foods) (30). ICC values < 0.5 were considered poor, 0.5–0.75 moderate, 0.75–0.9 good, and > 0.9 excellent (31). Proportion of over- and underestimation was tested based on real foods being the reference standard. The relationship between cooking confidence and the ability to match images with real foods (that is, the mean proportion of correct match across foods, per participant) was investigated using the non-parametric Chi-square test. The median energy (in kilojoules) of reported portion sizes were calculated based on the nutrition information panel on food packages.

**Results**

**Sample characteristics**

A total of 235 subjects passed the screener questionnaire and were invited to the study. A final sample of 114 subjects completed the laboratory session. The majority of participants were female (82.5%) with a mean age of 24.8 years and within the normal weight range (77.2%). Details of participant characteristics are presented in Table 1.

Depending on food type, 65 to 111 participants selected normal portion sizes based on food images and real foods, resulting in a total of 1442 comparisons being made (Table 2). Cross-classification analysis suggested that overall, 91% of comparisons were classified as a correct or adjacent match, ranging from 86% (crisps) to 97% (nuggets). An average of 53% of all comparisons (ranging from 39% for hot chips to 69% for cola in bottles/cans) achieved an exact match, whilst less than 1% of foods were grossly mismatched (>four categories apart). The ICC of reported normal portion sizes between images and corresponding real foods across all foods was good at 0.85 (31). Good to excellent levels of agreement (ICC above 0.75) were observed in 12 out of 15 test foods, whereas moderate agreement was observed for chocolate bars (ICC 0.71), muffins (ICC 0.69), and banana bread (ICC 0.72).
The median energy for reported portion size norms varied depending on food type (Figure 2), ranging from 405 kJ (sugary carbonated drinks in glass/cup) to 2337 kJ (pizza). The median energy reported was similar for 13 of 15 test foods, but variations in interquartile ranges were observed. For example, portion sizes for banana bread, nuggets and sugary carbonated drinks in glass/cup were overestimated, suggesting the tendency to select larger portion sizes from images than real foods.

The effect of cooking confidence on agreement was analysed using the percentage of correct matches (Table 3). Across all foods, significant difference between participants with low and high cooking confidence \((p=0.04)\) was observed. Participants with high cooking confidence achieved a significantly higher proportion of correct matches than those with low cooking confidence for four out of 15 foods, including chocolate blocks, chocolate bar, crisps, and hot chips \((p<0.05)\). No differences were found for the remaining 11 foods. Both under- and overestimations were observed in all test foods regardless of cooking confidence. No association between presentation order of image and real food sections and percentage of correct match was observed \((p>0.05)\).

**Discussion**

To explore the portion size norm of discretionary foods in Australian adults, an online survey of image-series for 15 common discretionary foods was developed and validated against corresponding real foods. Agreement between the methods was found to be high based on cross-classification analysis and ICC. Cross classification showed over 90% of selections were matched in the same or adjacent portion size option out of a series of nine options. Similarly, ICC results demonstrated good to excellent agreements for most foods, although three foods had moderate agreements. For potential moderators of the portion size norm, results suggested that cooking confidence was positively associated with level of agreement; participants who reported higher cooking confidence tended to achieve higher percentage of correct matches across foods.

These findings are in line with other validation studies using series of food images. The proportion of correct and adjacent matches varied between 80-98% across studies \((30, 33, 34)\). Variations in the accuracy of estimations might be explained by the complexity of the portion size decision process in dietary assessments \((35, 36)\). Individuals need to make visual perceptions (of volumes) of the displayed amount of food in real-life and relate it to the portion-size aid \((34, 35, 37)\). Previous research noted that misestimations were common with both over- and underestimations present \((30, 34, 38)\). It is unclear which factors or which food type lead to certain direction of estimation errors due to the high heterogeneity in study designs \((37)\). In addition, the effect of cooking habit on ability of portion size estimation has not been well examined, but one study observed that cooking experience contributed to a better ability in serving size quantification \((39, 40)\). More frequent exposure to grocery shopping and food preparation could result in an improved capacity to identify and quantify portion sizes, particularly for foods that are light but high in volume (for example, potato crisps and hot chips) \((39, 41)\). Future studies are needed to investigate the underlying mechanism of potential moderating effects such as cooking skills on portion size estimation, particularly for snacks that are usually consumed directly from original packages.

The normal portion size selected was based on using real foods as the ‘reference standard’. However, it remains uncertain whether this measure necessarily reflects the actual norm considering a norm is a
subjective concept about what constitutes usual behaviours (1, 11). The construction of a portion size norm seems to be heavily influenced by the external environment (18, 42). For example, displayed portion size options may act as a social expectation of how much people should consume, triggering restraint behaviour (18). Participants may tend to select a smaller normal portion size unconsciously, especially for discretionary foods that are generally considered as unhealthy (18). In the current study, special attention was paid to minimise potential social desirability bias; a wide range of portion size options were present simultaneously, and displayed options were piloted in the target population to ensure feasibility (17, 24). Although the validity of methodologies used to measure norms have not been well studied, the self-selected portion size task using real foods appears to be a well-recognised approach to reflect the actual food amount and most frequently used in previous research (2). Moreover, the preliminary nature of this study and differences in design with other studies should be acknowledged. Many previous studies of portion size estimations used matching tasks where food images and corresponding real foods were presented simultaneously (30, 33, 34, 38). In contrast, participants in the present study were required to mentally conceptualise their normal portion sizes, then select the closest match by using two different aids (real foods versus images). Higher cognitive ability and memory may be required to accurately recall how normal portion sizes were determined in their day-to-day life (37).

Despite the overall good level of agreement, images-series for a few foods including banana bread, muffin, and chocolate bar showed only moderate ICCs. For banana bread and muffin, one study noted similar results that the image-series for bread slice performed poorly (30). One possible explanation could be that serving sizes of cakes vary grossly across settings in Australia (for example, supermarkets and cafés) (43), and consumers have been exposed to a wide range of serving size options. This may add to estimation bias as participants may find generalisation of normal portion size more challenging, especially when using two-dimensional images that are not life-sized (30, 44). The image series of chocolate bars has not been tested in other validation studies but could potentially be due to small weight increments between the first three options (half fun-size bar 10 g, one fun-size bar 17 g, half standard-size bar 23 g) (30). Some food characteristics such as the fillings or layers in a chocolate bar may not be easily distinguished from the images (22).

Several strengths of the methodology used to validate this newly developed tool can be noted. This survey has a low respondent burden as it is easily accessible with any electronic device (22). The size of increments between portion size options were chosen based on package sizes available in Australian supermarkets and food outlets to reflect real food environments. Food images were prepared using a constant angle and lighting and were presented in an ‘animated’ way to mimic a real-world portion size selection process. A reference object and some typical package sizes were included to assist portion size estimation (17). A sufficiently large sample size recommended for validation studies was recruited (29), and pilot testing was conducted to ensure usability (17). Despite this, we acknowledge several limitations. The way test foods were presented on white plates may not reflect how consumers have snacks in real life. The convenience sample recruited around university was primarily females and young adults in their 20s, which may not be representative of the general population. The proportion of individuals within the normal weight range was higher in this study compared with the population average (45). However, previous research noted that although females tended to select smaller portion sizes as their ideal, gender and BMI are not significantly
associated with the ability to quantify food (46). Future studies should further explore the potential moderating effects of participant characteristics such as age, gender, and education level on the accuracy of portion size estimation.

**Conclusion**

This novel online image-based survey to estimate normal portion sizes of discretionary foods showed good agreement with real foods. This survey may be a valuable tool and has wider implications to investigate the portion size norms for common discretionary foods among more diverse samples of Australian adults. A better understanding of current portion size norms could inform the development of public health campaigns, food labelling and messaging to facilitate more appropriate portion size selection.

**Declarations**

**Author contributions**

Q.L. and A.R. conceptualised the study, Q.L. prepared food photos, Q.L., S.G. and A.R. designed the questionnaire, Q.L., L.W. and A.R. conducted the laboratory session, Q.L. drafted the manuscript. All authors edited and revised the manuscript.

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**Declaration of interests**

The authors declare no competing interests.

**References**


Tables

Table 1. Participants’ characteristics (n=114)

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong>, years, mean (SD)</td>
<td>24.8</td>
<td>(8.0)</td>
</tr>
<tr>
<td><strong>Gender</strong>, females, n (%)</td>
<td>94</td>
<td>(82.5)</td>
</tr>
<tr>
<td><strong>BMI</strong>&lt;sup&gt;a&lt;/sup&gt;, kg/m&lt;sup&gt;2&lt;/sup&gt;, mean (SD)</td>
<td>21.9</td>
<td>(3.3)</td>
</tr>
<tr>
<td>Within normal weight range, n (%)</td>
<td>88</td>
<td>(77.2)</td>
</tr>
<tr>
<td>Underweight, n (%)</td>
<td>13</td>
<td>(11.4)</td>
</tr>
<tr>
<td>Overweight, n (%)</td>
<td>10</td>
<td>(8.8)</td>
</tr>
<tr>
<td>Obese, n (%)</td>
<td>3</td>
<td>(2.6)</td>
</tr>
<tr>
<td><strong>Physical activity level (PAL)</strong>&lt;sup&gt;b&lt;/sup&gt;, n (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sedentary</td>
<td>17</td>
<td>(14.9)</td>
</tr>
<tr>
<td>Lightly to moderately active</td>
<td>89</td>
<td>(78.1)</td>
</tr>
<tr>
<td>Very to extremely active</td>
<td>8</td>
<td>(7.0)</td>
</tr>
<tr>
<td><strong>Cooking confidence</strong>&lt;sup&gt;c&lt;/sup&gt;, n (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>45</td>
<td>(39.5)</td>
</tr>
<tr>
<td>High</td>
<td>69</td>
<td>(60.5)</td>
</tr>
</tbody>
</table>

<sup>a</sup>BMI: body-mass-index, calculated using the formula . BMI (kg/m<sup>2</sup>) <18.5 is underweight, 18.5-24.9 within normal weight range, 25.0-29.9 overweight, >30.0 obese (32).
bPAL: estimated using the physical activity factor; classified into five categories as sedentary, lightly active, moderately active, very active and extra/vigorously active (25, 26).

cCooking confidence: measured using a validated 5-point Likert scale (can cook a nutritious meal; can cook a meal in a short amount of time; can cook spending a lot of money; can follow a recipe); classified as high if participants scored ≥16 out of 20 (very/extremely confident), otherwise as low (28).

Table 2. Agreement of reported normal portion sizes between the food images and corresponding real foods, by food type.
<table>
<thead>
<tr>
<th>Sweet snacks and cakes</th>
<th>No. of comparison</th>
<th>ICC (95% confidence interval)</th>
<th>Correct match&lt;sup&gt;b&lt;/sup&gt; %</th>
<th>Correct and adjacent match&lt;sup&gt;b&lt;/sup&gt; %</th>
<th>Gross mismatch&lt;sup&gt;b&lt;/sup&gt; %</th>
</tr>
</thead>
<tbody>
<tr>
<td>M&amp;Ms</td>
<td>111</td>
<td>0.87 (0.80-0.92)</td>
<td>51</td>
<td>94</td>
<td>0</td>
</tr>
<tr>
<td>Chocolate blocks</td>
<td>104</td>
<td>0.92 (0.88-0.94)</td>
<td>60</td>
<td>96</td>
<td>0</td>
</tr>
<tr>
<td>Chocolate bar</td>
<td>89</td>
<td>0.71 (0.51-0.82)</td>
<td>58</td>
<td>94</td>
<td>0</td>
</tr>
<tr>
<td>Sweet biscuits</td>
<td>98</td>
<td>0.83 (0.67-0.90)</td>
<td>59</td>
<td>92</td>
<td>0</td>
</tr>
<tr>
<td>Caramel slices</td>
<td>88</td>
<td>0.76 (0.63-0.84)</td>
<td>50</td>
<td>88</td>
<td>0</td>
</tr>
<tr>
<td>Layered cake</td>
<td>104</td>
<td>0.81 (0.72-0.87)</td>
<td>44</td>
<td>87</td>
<td>0</td>
</tr>
<tr>
<td>Muffin</td>
<td>95</td>
<td>0.72 (0.46-0.84)</td>
<td>55</td>
<td>92</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Banana bread</td>
<td>101</td>
<td>0.69 (0.48-0.80)</td>
<td>51</td>
<td>88</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Savoury snacks and fast foods</th>
<th>No. of comparison</th>
<th>ICC (95% confidence interval)</th>
<th>Correct match&lt;sup&gt;b&lt;/sup&gt; %</th>
<th>Correct and adjacent match&lt;sup&gt;b&lt;/sup&gt; %</th>
<th>Gross mismatch&lt;sup&gt;b&lt;/sup&gt; %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Savoury biscuits</td>
<td>97</td>
<td>0.83 (0.75-0.89)</td>
<td>48</td>
<td>88</td>
<td>0</td>
</tr>
<tr>
<td>Crisps</td>
<td>105</td>
<td>0.80 (0.71-0.86)</td>
<td>44</td>
<td>86</td>
<td>2</td>
</tr>
<tr>
<td>Pizza</td>
<td>110</td>
<td>0.93 (0.90-0.96)</td>
<td>57</td>
<td>93</td>
<td>0</td>
</tr>
<tr>
<td>Nuggets</td>
<td>97</td>
<td>0.87 (0.77-0.92)</td>
<td>61</td>
<td>97</td>
<td>0</td>
</tr>
<tr>
<td>Hot chips</td>
<td>109</td>
<td>0.79 (0.70-0.86)</td>
<td>39</td>
<td>89</td>
<td>0</td>
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<table>
<thead>
<tr>
<th>Sugary carbonated drinks</th>
<th>No. of comparison</th>
<th>ICC (95% confidence interval)</th>
<th>Correct match&lt;sup&gt;b&lt;/sup&gt; %</th>
<th>Correct and adjacent match&lt;sup&gt;b&lt;/sup&gt; %</th>
<th>Gross mismatch&lt;sup&gt;b&lt;/sup&gt; %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cola cup/glass</td>
<td>69</td>
<td>0.77 (0.53-0.88)</td>
<td>43</td>
<td>93</td>
<td>3</td>
</tr>
<tr>
<td>Cola bottle/can</td>
<td>65</td>
<td>0.90 (0.84-0.94)</td>
<td>69</td>
<td>88</td>
<td>0</td>
</tr>
</tbody>
</table>

| All                        | 1442             | 0.85 (0.83-0.87)             | 53                          | 91                               | <1                        |

<sup>a</sup>Intra-class correlation coefficient (ICC): ICC estimates and their 95% confidence interval were calculated based on average measures, absolute-agreement, 2-way mixed-effects model.

<sup>b</sup>Correct match described as participants who selected the same image option as real foods; adjacent match described as participants who selected a portion size image one option away from what they selected based
on real foods; gross mismatch described as participants who selected a portion size image four or more options away from what they selected based on real foods.

Table 3. Frequency of correct match, over-, and underestimation of the reported normal portion size between food images and corresponding real foods, by food type and cooking confidence.

<table>
<thead>
<tr>
<th>Food type</th>
<th>p value</th>
<th>Correct match %</th>
<th>Overestimation %</th>
<th>Underestimation %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Low cooking confidence</td>
<td>High cooking confidence</td>
<td>Low cooking confidence</td>
</tr>
<tr>
<td>Overall</td>
<td>0.04*</td>
<td>46</td>
<td>57</td>
<td>36</td>
</tr>
<tr>
<td>M&amp;Ms</td>
<td>0.83</td>
<td>49</td>
<td>53</td>
<td>27</td>
</tr>
<tr>
<td>Chocolate blocks</td>
<td>0.05*</td>
<td>48</td>
<td>68</td>
<td>29</td>
</tr>
<tr>
<td>Chocolate bar</td>
<td>0.03*</td>
<td>43</td>
<td>69</td>
<td>43</td>
</tr>
<tr>
<td>Sweet biscuits</td>
<td>0.53</td>
<td>54</td>
<td>62</td>
<td>43</td>
</tr>
<tr>
<td>Caramel slices</td>
<td>1.00</td>
<td>49</td>
<td>51</td>
<td>24</td>
</tr>
<tr>
<td>Layered cake</td>
<td>0.55</td>
<td>40</td>
<td>47</td>
<td>38</td>
</tr>
<tr>
<td>Muffin</td>
<td>0.21</td>
<td>63</td>
<td>49</td>
<td>32</td>
</tr>
<tr>
<td>Banana bread</td>
<td>0.84</td>
<td>50</td>
<td>53</td>
<td>40</td>
</tr>
<tr>
<td>Savoury biscuits</td>
<td>0.21</td>
<td>40</td>
<td>54</td>
<td>34</td>
</tr>
<tr>
<td>Crisps</td>
<td>0.02*</td>
<td>29</td>
<td>55</td>
<td>51</td>
</tr>
<tr>
<td>Pizza</td>
<td>0.85</td>
<td>56</td>
<td>58</td>
<td>31</td>
</tr>
<tr>
<td>Nugget</td>
<td>0.09</td>
<td>50</td>
<td>68</td>
<td>45</td>
</tr>
<tr>
<td>Hot chips</td>
<td>0.02*</td>
<td>25</td>
<td>49</td>
<td>30</td>
</tr>
<tr>
<td>SSB cup/glass</td>
<td>0.81</td>
<td>42</td>
<td>46</td>
<td>50</td>
</tr>
<tr>
<td>SSB bottle/can</td>
<td>0.41</td>
<td>62</td>
<td>74</td>
<td>23</td>
</tr>
</tbody>
</table>

*aDifference of % exact match between participants with low and high cooking confidence by Chi-square test.

Figures
What portion size of M&Ms or similar confectionery (as a snack) would you normally eat?

*Portion size is the amount of food you consume at one sitting

Figure 1

Example of survey questions in food image (1a) and real food (1b) sections.
Figure 2

The median energy of reported normal portion sizes, images vs real foods, in kJ\textsuperscript{a}

\textsuperscript{a}Blue box indicates reported portion sizes based on real foods; orange box indicates reported portion sizes based on images. Thick lines indicate median; upper and lower lines of the box indicate 25\textsuperscript{th} and 75\textsuperscript{th} percentiles, respectively; whiskers above and below the box indicate maximum and minimum values within 1.5 interquartile range above 75\textsuperscript{th} percentile or above 25\textsuperscript{th} percentile; values above 75\textsuperscript{th} percentile or below 25\textsuperscript{th} percentile greater than 1.5 interquartile range were counted as outliers and not shown on this figure.

Supplementary Files

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- PStoolvalidationsupplementaryfinalplaintxt.docx