

Portion control tools

Do they work in practice?



Portion control tools – do they work in practice?

Publication date: November 2022

Foreword

Eating large portions of certain foods has been linked with consuming too much energy and with weight gain. However, there is little awareness of what constitutes an appropriate portion size. Appropriate portion sizes for various foods and beverages for both consumers and manufacturers are referenced in the public health nutrition guidelines and obesity strategies in both Ireland and Northern Ireland. The Healthy Eating Guidelines in Ireland specify portion sizes for the foods in each of the food groups and the number of portions for different age, gender and physical activity levels. The Eatwell guide, which is the model used in Northern Ireland, shows the proportions of the main food groups that form a healthy, balanced diet and details portions for fruit and vegetables, fish and processed meat. A Healthy Weight for Ireland, the Obesity Policy and Action Plan for Ireland, includes an action to consider measures to introduce maximum portion sizes for relevant foods and drinks. A Fitter Future for All, the Framework for Preventing and Addressing Overweight and Obesity in Northern Ireland, includes actions to encourage manufacturers to provide smaller portion sizes of energy dense foods and regulation of portion sizes by caterers.

The estimation of appropriate portion sizes can be difficult in practical terms and has led to the development of a range of portion size guides by public and private sector to help consumers select appropriate portion sizes. Many of these guides provide information based on photographs and drawings. There are also practical utensils that contain visual marks of an appropriate portion, such as measuring cups and spoons, graduated bowls and glasses, and plates with sections for different food groups. Evidence on the acceptability of these tools is, however, very limited. This research was commissioned by **safefood** to test the acceptability of using a 200ml marked measuring cup in the family setting on the island of Ireland.

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Acknowledgements

safefood gratefully acknowledge the contributions of a range of organisations and individuals in the preparation of this report:

- The authors of the report: Dr Caomhan Logue, Dr Leanne Doherty, Dr Mary McCann, Dr Kirsty Pourshahidi, Dr Maeve Kerr, Ms Lena Acolatse, Mrs Laura Purdy, Dr Gemma McMonagle and Prof Barbara Livingstone, Ulster University
- Ms Rachael McAleenon, Nutrition Intern, Nutrition Innovation Centre for Food and Health (NICHE), Ulster University
- The community centres across the island of Ireland who graciously provided time and assistance in facilitating the recruitment and data collection processes
- All the participating households

Executive summary

Aim

This project aimed to investigate the acceptability and usability of a 200-ml portion cup within the family setting on the island of Ireland (IOI). The objectives were:

- To determine patterns of use of a 200-ml portion cup within the family setting
- To determine whether the introduction of the 200-ml portion cup to the household led to behavioural changes regarding portion size
- To gain an in-depth insight into participants' attitudes towards the usability and acceptability of the portion cup for long-term use within the family setting.

Methods

A mixed methods approach was employed to achieve the project objectives. Families from urban and rural settings from across the island of Ireland were recruited via Healthy Living Centres in Northern Ireland and community-based centres in Ireland between June and November 2019. Families participated in a 6-week intervention to test the acceptability and usability of the portion cup. Baseline demographic data was collected following recruitment, and a telephone survey was administered at week 3 and week 6 of the intervention. Four focus group sessions were subsequently conducted (2 in Ireland and 2 in Northern Ireland) between November 2019 and January 2020 to qualitatively explore attitudes towards use of the portion cup within the family setting.

Key findings

A total of 106 households were recruited from across the IOI and data was collected from 83 households at week 3 (78% retention rate) and 80 households at week 6 (75% retention rate).

Acceptability and usability

- 9 out of 10 households reported using the portion cup for measuring portions at week 3 (90% of households) and week 6 (94% of households).
- Around 9 out of 10 respondents (week 3, 86%; week 6, 91%) reported that the portion cup was 'very acceptable'.
- The portion cup was acceptable for use in the home setting, but most people stated that it would not be used outside the home.

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- Whilst most respondents reported that the portion cup was usable (week 3, 81%; week 6, 73%), some practical issues were raised by a small proportion of respondents including:
 - Recommended portion sizes were perceived to be too small
 - Markings being erased following repeated washing
 - Markings on the portion cup being too small to read

Patterns of use and behaviour change

- Consistent use of the portion cup was observed over the intervention period, and was used:
 - by around 8 out of 10 households at breakfast (week 3, 78%; week 6, 78%)
 - by around 1 out of 10 households at lunch (week 3, 8%; week 6, 10%)
 - by 9 out of 10 households (week 3, 95%; week 6, 94%) for amorphous foods such as cereal, rice or pasta.
 - for all members of the household (week 3, 89%; week 6, 86%).
- Feedback from the focus groups, however, suggested that use of the portion cup for all members of the household was transient and that it was only used for measuring children's portion sizes, initially.
- Engagement by males within the household was limited.
- Daily use of the portion cup diminished by the end of the intervention (week 3, 42%; week 6, 25%) with reported use 4-6 days per week becoming more common by week 6 (week 3, 39%; week 6, 48%).

Capacity building for behaviour change associated with portion sizes

- Most respondents reported that introduction of the portion cup into the household resulted in behavioural changes around portion size including:
 - An increased awareness of appropriate portion size
 - An improved ability to judge portion size and increased confidence in this regard
- These positive behavioural changes persisted for the duration of the intervention.

Recommendations

- The use of a portion cup within the family setting helped to highlight the importance of portion size, as well as increasing awareness of appropriate portion sizes. Consideration should be given to incorporating the portion cup into public health

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campaigns along with specific guidance on the recommended number of servings over the course of the day and the size of servings for different food groups.

- The provision of portion cups that are designed for specific stages of the lifecycle i.e. a portion cup for adults or a portion cup for children should be considered to maximise and optimise engagement across the whole family.
- Any portion tools need to be designed so that they are durable and easy to use.
- Consider novel approaches for promoting long-term use and engagement with all members of the household such as integrating the portion cup with existing technologies e.g. by adding a QR (quick response) code to the portion cup, which can sign-post consumers to accessible, detailed, and user-friendly portion size information via an app or website.

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1 Introduction

The prevalence of obesity on the island of Ireland (IOI) has doubled in the last 20 years, with around 60% of the population now living with overweight or obesity (1). Over consumption of food is an established risk factor for obesity and standard food portion sizes have been steadily increasing in parallel with obesity since the 1970's (2). Larger portions, particularly of energy-dense foods, may stimulate over-consumption of energy and as they are relatively cheap for the food industry to manufacture, they are often regarded as good value for money e.g. multi- or share-sized packs by consumers (3). Not only have food portion sizes increased significantly over time but the choice of portion sizes available to consumers has also increased substantially (4, 5). As a result, it has become more difficult for consumers to understand what constitutes as an appropriate portion size (4). Furthermore, large portion sizes outside of the home have become “consumption norms” for consumers leading to over-estimations inside the home (6).

It is generally accepted that there is a need for user-friendly, fit-for-purpose tools for helping consumers estimate portion size and, although weighing scales and graduated measuring apparatus e.g. jugs are considered the most accurate portion size estimation aids, they are also the most burdensome and time-consuming method of measuring portion size in the home in comparison to other portion size estimation aids such as cups and spoons and food photographs (7-10). Recent *safe food*-funded research, conducted by Ulster University, has identified a strong consumer preference for and acceptance of ‘visual’ portion size estimation aids to estimate appropriate portion sizes, especially for certain foods; specifically, in a qualitative study of 32 participants, household measures (coloured portion pots and disposable plastic cups) were deemed to be particularly useful for grain foods such as breakfast cereals, pasta and rice. Of particular importance, guidance in relation to age, gender and activity level was also favoured over a ‘one size fits all’ approach (10, 11).

In Ireland, the Healthy Eating Guidelines (12) contains detailed guidance on appropriate portion size for the population aged 5 years and older using a combination of household and quantitative measures with different numbers of servings recommended for sub-groups of the population depending on age, sex and physical activity levels. In Northern Ireland, the Eatwell Guide (13) provides recommendations about the types and proportions of each key food group to consume but only contains guidance on portion size for fish, processed meat and the fruit and vegetable group.

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Various portion size guides from non-governmental organisations (NGOs) and the food industry are available¹; however, these tend to communicate inconsistent and conflicting advice, leading to possible confusion among consumers (4).

Within the Obesity Policy and Action Plan 2016-2025 for Ireland (14), portion size control was reported as a cost effective intervention for tackling obesity with food industry regarded as a key partner in helping to deliver this, albeit on a voluntary basis initially. Within A Fitter Future for All, the Framework for Preventing and Addressing Overweight and Obesity in Northern Ireland 2012-2022 (15), identifies portion size as an environmental factor associated with obesity. Successful implementation of the plan clearly hinges on engaging consumers by providing evidence-based guidance on best practice for estimating appropriate food portion sizes.

This research was commissioned by **safe food** to provide insight into the practical implications of the use of a 200-ml disposable cup as a portion control tool in the family setting on the island of Ireland given that this is a measure referenced in the Healthy Eating Guidelines in Ireland.

Aim

This project aimed to investigate the acceptability and usability of a 200-ml portion cup within the family setting on the island of Ireland (IOI). The objectives were:

- To determine patterns of use of a 200-ml portion cup within the family setting
- To determine whether introduction of the 200-ml portion cup to the household led to behavioural changes regarding portion size
- To gain an in-depth insight into participants' attitudes towards the usability and acceptability of the portion cup for long-term use within the family setting

¹ Examples of materials include those from British Nutrition Foundation https://www.nutrition.org.uk/attachments/article/1193/Find%20your%20balance_%20full%20portion%20size%20list.pdf; European Food Information Council EUFIC - <https://www.eufic.org/en/healthy-living/article/how-to-measure-portion-sizes-with-your-hands-infographic>; and British Dietetic Association <https://www.bda.uk.com/resource/food-facts-portion-sizes.html>

2 Methods

Approach

This project employed a sequential mixed methods approach consisting of:

- A 6-week intervention investigating the acceptability and usability of a 200-ml portion cup within the family setting
- Focus group sessions qualitatively exploring attitudes towards the 200-ml portion cup

This combined approach enabled a comprehensive quantitative and qualitative evaluation of participants' experience with the portion cup within the family setting. In keeping with mixed methods research, both approaches were complementary in addressing the overall project aim as participants recruited for the focus groups has previously participated in the intervention. Furthermore, an integrated approach was adopted for data analysis and in the presentation of the results⁽¹⁶⁾.

Ethical approval to conduct the research was granted by the School of Biomedical Sciences Research Ethics Filter Committee, Ulster University, Coleraine (Study number: FCBMS 19-015).

Six-week intervention in the family setting

Recruitment procedures

The aim was to recruit at least 100 households (with a target sample size of 75 households) from both urban and rural settings across the island of Ireland. The research team worked in collaboration with healthy living centres (HLCs) in Northern Ireland and similar community-based centres in Ireland to promote recruitment to the study (Table 1). In total, 5 centres in Northern Ireland and 5 centres in Ireland, from a broad geographical area and from both urban and rural settings, were enlisted to promote recruitment to the study (Table 1). Recruitment sessions were held within each centre where the purpose of the study, along with the portion cup and its use, was explained to interested potential participants. The inclusion criteria were that participating households had to have at least one child aged 5 years or older within the household. Eligible participants were then invited to take part in the study and written informed consent was obtained from those willing to participate.

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Table 1 Recruitment strategy for the portion cup intervention

Ireland	
Location	Setting (Urban/Rural)
Dublin	Urban
Cork	Urban
Buncrana	Rural
Sligo	Rural
Monaghan	Rural
Northern Ireland	
Belfast	Urban
Derry	Urban
Cushendall	Rural
Craigavon	Urban
Irvinestown	Rural
Centres in Ireland : Dublin, Hill Street FRC; Cork, Le Chéile FRC; Buncrana, Buncrana Community Library; Sligo, Ballymote FRC ; Monaghan, The Peace Link. Centres in Northern Ireland: Belfast, New Lodge Duncairn Community Health Partnership; Derry, Bogside and Brandywell Health Forum; Cushendall, North Antrim Community Network; Craigavon, Verve HLC; Irvinestown, The Arc HLC.	

Intervention

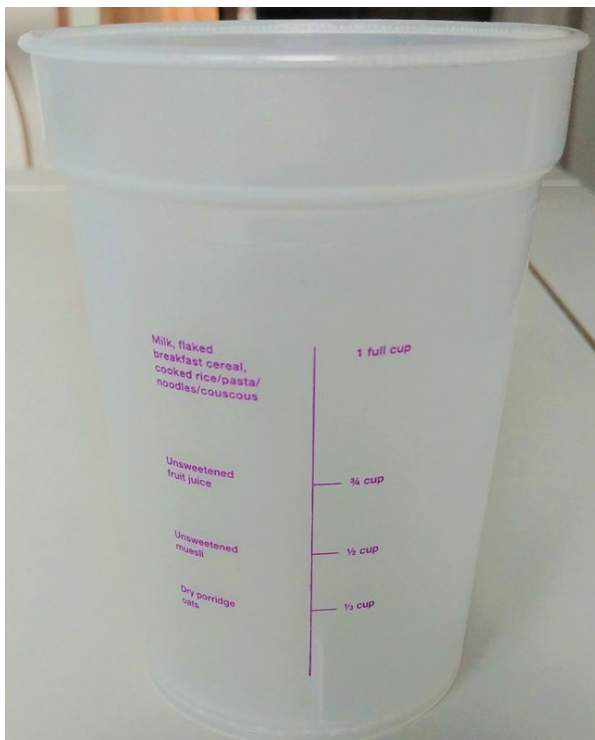
The intervention lasted for 6-weeks, which was sufficiently long to allow examination of behavioural change resulting from use of the portion cup in the family setting. Each participating household received an intervention pack and was asked to consider using the portion cup for the duration of the intervention. Participating households were also provided with portion control plates and measuring spoons to gauge their response to these measures during the intervention. The intervention pack included:

- A 200-ml portion cup – this was a prototype manufactured specifically for the purpose of the project based on the healthy eating guidelines in Ireland and marked with guidance on amorphous or free-flowing foods such as cereals, rice and pasta as well as fruit juice (Figure 1).
- An infographic with instructions on how to use the 200-ml portion cup and the public health nutrition guidance relevant in Ireland and Northern Ireland (Figure 2 and Figure 3)
- Adult and child portion control plate (Figure 4)

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- Six measuring spoons ranging in sizes from ½ teaspoon to 1 cup (240 ml) (Figure 4)

Figure 1 The 200-ml reusable portion cup front and back



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Figure 2: Infographic for participants in Ireland


Guide on how to use serving control tool/cup

The 200ml reusable cup is a tool that can be used to assist in measuring serving sizes for a range of foods.


HOW TO USE:
 Fill the cup with the amount of food noted for each of the foods for each person/serving.
 The cup can be used for foods such as milk, cooked rice/pasta/couscous, muesli, dry porridge oats, some fruits, and fruit juices.

How much? The amount recommended aligns with the Food Pyramid (see overleaf)


1 cup
Flaked cereals, cooked rice/pasta/noodles/ cous cous & milk




½ cup
Unsweetened muesli



1/3 cup
Dry porridge oats



¾ cup
Unsweetened fruit juice



Type of Food	Recommended number of servings per day
Starchy foods (such as cereals, rice, pasta and noodles)	3 - 5
Dairy (including milk)	3
Fruits & vegetables	At least 5*

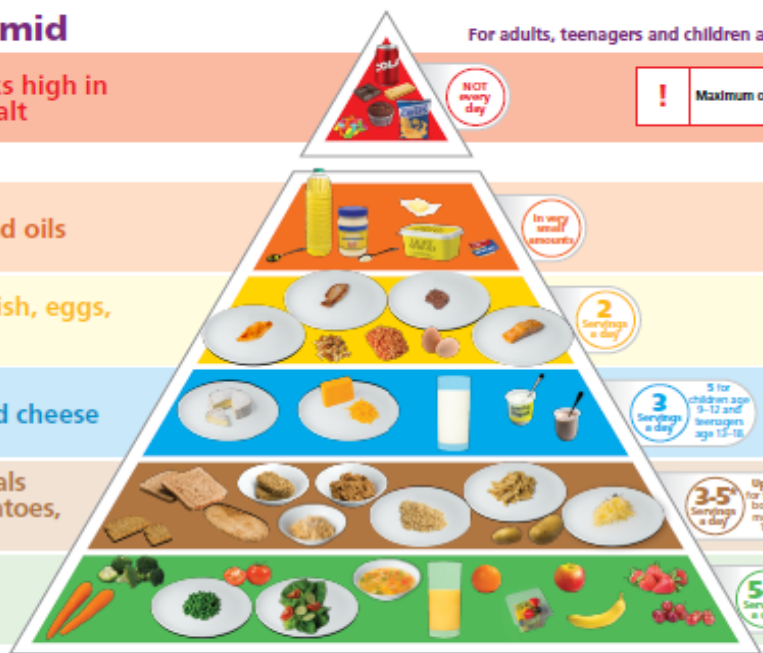
* Aim to have only 1 serving as fruit juice or a fruit smoothie.

Healthy Food for Life www.healthyireland.ie

The Food Pyramid

For adults, teenagers and children aged five and over

Not essential for good health.



! Maximum once or twice a week

Needed for good health - to enjoy a variety every day.

***Daily Servings Guide – wholemeal cereals and breads, potatoes, pasta and rice**

	Child (5-12)	Teenager (13-18)	Adult (19-50)	Adult (51+)		Teenager (13-18)	Adult (19-50)	Adult (51+)
Active	3-4	4	4-5	3-4	Inactive	3	3-4	3
Inactive	3-5	5-7	5-7	4-5	Inactive	4-5	4-6	4

There is no guideline for inactive children as it is essential that all children are active.

Drink at least 8 cups of fluid a day – water is best

Got Active!
To maintain a healthy weight adults need at least 30 minutes a day of moderate activity on 5 days a week (or 150 minutes a week); children need to be active at a moderate to vigorous level for at least 60 minutes every day.

Source: Department of Health, December 2014.

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Figure 3 Infographic for participants in Northern Ireland


Guide on how to use serving control tool/cup

The 200ml reusable cup is a tool which can be used to assist in measuring serving sizes for a range of foods.


HOW TO USE:
 Fill the cup with the amount of food noted for each of the foods for each person/serving.
 The cup can be used for foods such as milk, cooked rice/pasta/couscous, muesli, dry porridge oats, some fruits, and fruit juices.

How much? The amount recommended aligns with the Eatwell Guide (see overleaf)


1 cup
Flaked cereals, cooked rice/pasta/noodles/ cous cous & milk




½ cup
Unsweetened muesli



1/3 cup
Dry porridge oats



¾ cup
Unsweetened fruit juice



Type of Food	Recommended number of servings per day
Starchy foods (such as cereals, rice, pasta and noodles)	3 - 5
Dairy (including milk)	3 servings
Fruits & vegetables	At least 5*

* Aim to have only 1 serving as fruit juice or a fruit smoothie.

Eatwell Guide

Use the Eatwell Guide to help you get a balance of healthier and more sustainable food. It shows how much of what you eat overall should come from each food group.


Check the label on packaged foods

Each serving (150g) contains

Energy	240kcal	Tot	3.0g	Sat	1.3g	Chol	24mg	Salt	0.9g
Protein	4.0g	Carb	4.5g	Mon	7.7g	Fibre	2.0g	Sugars	1.0g

of an adult's reference intake
Typical values for food per 100g (800kcal 1600kcal)

Choose foods lower in fat, salt and sugars



Fruit and vegetables: Eat at least 5 portions of a variety of fruit and vegetables every day

Starchy carbohydrates: Choose wholegrain or higher fibre versions with less added fat, salt and refined sugars

Protein sources: Eat more beans and pulses, 2 portions of sustainably sourced fish per week, one of which is oily. Eat less red and processed meat

Dairy and alternatives: Choose lower fat and lower sugar options

Oils and spreads: Choose unsaturated oils and use in small amounts

6-8 a day

Water, lower fat milk, sugar-free drinks including tea and coffee all count.

Limit fruit juice and/or smoothies to a total of 150ml a day.

Per day 2000kcal 2500kcal = ALL FOOD + ALL DRINKS

Source: Public Health England in association with the Welsh Government, Food Standards Scotland and the Food Standards Agency in Northern Ireland. © Crown copyright 2018

Figure 4 Items provided with the portion control pack



Design and testing of the questionnaire

The questionnaire (Appendix 1) was designed in consultation with **safefood** and involved modifying an existing questionnaire (11) to address the objectives of the current study. To ensure its applicability, the questionnaire was piloted with a small number of individuals (n=7) not directly linked to the project prior to data collection. The 19-item questionnaire was designed to collect data on the following topics in the context of using the portion cup:

- Acceptability
- Ease of use
- Convenience
- Portion cup use across individual family members
- Most common foods for which the portion cup was used
- Meal-time use
- Perceived behaviour changes in the household in relation to portion size control

Data collection

At baseline, demographic information was obtained from participants. Data were collected on age, gender, marital status, ethnicity, education level, employment status and self-reported height and weight, from which body mass index (BMI) was calculated. Two telephone interviews were then conducted with the consenting adult to administer the questionnaire at agreed times at approximately the mid-point of the intervention (week 3) and post-intervention (week 6).

Data coding, analysis and quality assurance

Questionnaire data were double entered (entered by two researchers independently before merging the datasets as a quality assurance measure) into Microsoft Excel and cross checked for accuracy after which the data was transferred to IBM SPSS statistics package for Windows Version 25.0 (IBM Corp., Armonk, NY, USA).

Statistical analysis was carried out using IBM SPSS statistics package for Windows Version 25.0 (IBM Corp., Armonk, NY, USA), and statistical significance was set at $P < 0.05$. To overcome non-normal distributions, non-parametric testing was used, and data were presented as median (interquartile range). Participant characteristics were investigated using within-group Mann-Whitney U tests for BMI, gender, age, county and region. Wilcoxon signed-rank tests were used to compare level of concern regarding portion size. Preference for portion cup from week 3 to 6 was analysed by McNemar's test. Chi square for independence were used to compare weekly usage of the cup at week 3 compared to week 6

Focus groups

Approach and recruitment procedures

To achieve an in-depth insight into attitudes and opinions in relation to the usability of the portion cup in the family setting, as well as the likelihood for longer-term use, four targeted semi-structured focus group sessions (2 Ireland; 2 Northern Ireland) were undertaken within urban and rural settings across the island of Ireland. The focus group sessions were conducted within a local community centre that promoted good uptake within local communities for the six-week intervention in the family setting. To be eligible for the focus group session, participants were required to have fully completed the intervention and, at the time of consent, expressed an interest in participating in a focus group.

Participating households who completed the intervention (as indicated by complete telephone survey responses at week 3 and week 6) were recompensed with a £25 (Northern Ireland) or €25 (Ireland) one-for-all voucher. Participants of the focus group sessions were recompensed with a £20 (Northern Ireland) or €20 (Ireland) one-for-all voucher upon successful completion of the session. Child-care was provided to participants to ensure participation from a range of family backgrounds and dynamics.

Topic guide

Analysis on preliminary data from the six-week intervention in the family setting was conducted to help inform the development of the topic guide (Appendix 2) for focus group sessions. The topic areas, and details of the guidelines used by the researcher, were agreed and piloted

The following points provide a summary of discussion points within the topic guide:

- Reflections on behavioural changes during the trial period and influencing factors
- Factors that influenced the use of the portion cup for different members of the family
- Ease of use for different food groups
- Experiences of using the portion cup at different mealtimes
- Attitudes towards using the portion cup in other settings, such as out of home
- Attitudes, understanding and usefulness of the design of the portion cup
- An investigation of the likelihood of longer-term use of the portion cup within the family setting

Data collection

Each focus group was digitally recorded and then transcribed verbatim. Supplementary field notes were taken by a second researcher and used to document contextual data.

Data analysis

Transcripts were imported into NVivo 10 for data management and coding, and an inductive analysis of the data was undertaken using Braun and Clarke's 6 phases of thematic analysis (17). All transcripts were read and coded by two independent researchers (LA and LCD) and when a consensus could not be reached the opinion of a third researcher (KP) was sought.

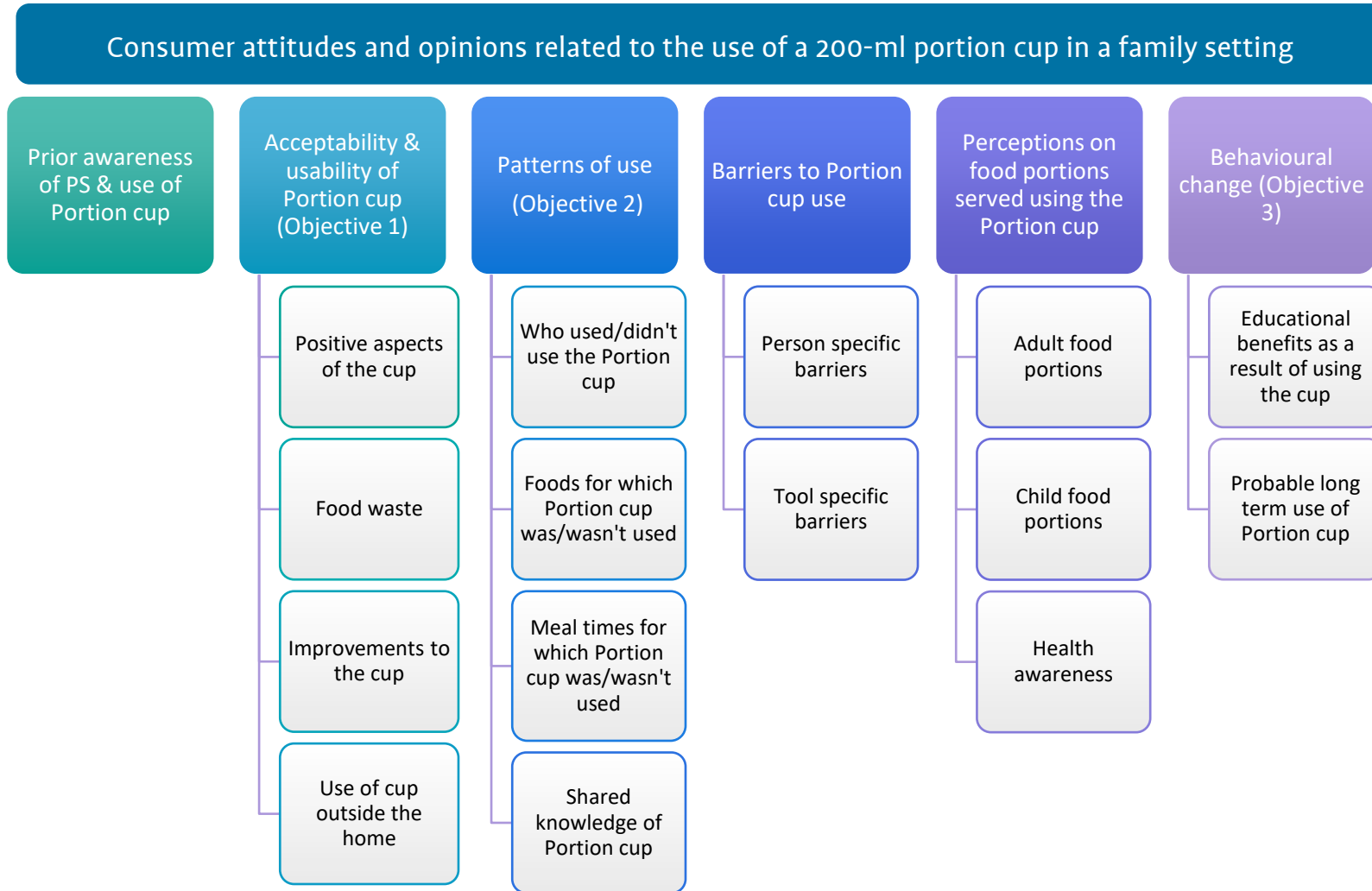
This approach was used to ensure rigour and trustworthiness. A framework was developed (LA) and used to identify emerging themes on one transcript which was verified by the second coder (LCD). The agreed themes were then used to code the remainder of the transcripts. Common themes were identified, a hierarchy of themes developed, and a conceptual map generated. The conceptual map was reviewed and refined by the research team (LA, LCD, CL, KP, MK and MMCC) to establish consensus. Verbatim quotes from the focus groups are presented to reinforce key findings.

3 Results

Results have been presented under subheadings that align with Objectives 1-3 and these results are supported, where appropriate, with additional complementary evidence that emerged from the qualitative analysis. This qualitative evidence of consumer attitudes and opinions about the use of a 200-ml portion cup identified six main themes that are supported by fifteen subthemes (Figure 5). The main themes were:

- Prior awareness of portion size and use of portion cup
- Acceptability and usability of the portion cup
- Patterns of use in the family setting
- Barriers to portion cup use
- Behavioural change
- Perceptions on food portions served using the portion cup

Figure 5 Conceptual map of the 6 main themes and fifteen subthemes identified



Demographics and family dynamics

A total of 106 households were recruited for this intervention and the characteristics of the study population are presented in Table 2. Data were collected from 83 participants at week 3 and 80 participants at week 6. Approximately equal numbers of households were recruited from Northern Ireland (47%) and Ireland (53%), with slightly more from the rural setting (58%) compared to the urban setting (43%). Most participants were female (92%), of white ethnicity (93%), married (63%), and either in full- or part-time employment (60%). The number of children in each household ranged from one to seven and child age ranged from 2–18 years (Table 3). In Northern Ireland, 42% (n=21) of households had two children and in Ireland 52% (n=29) of households were single child families.

Following completion of the portion cup intervention, four focus groups were undertaken and sample size within each ranged from four to six participants, with a total of twenty-one participants. All participants were female.

Prior awareness of portion size and use of portion control tools

Portion size behaviours and opinions

Some participants expressed a perceived lack of knowledge about appropriate portion size prior to commencing the intervention, particularly when serving amorphous grains such as cereal, pasta, and rice. When prompted, several participants said that the portions they had been serving were larger than the recommendations:

RESEARCHER: “WOULD PORTION SIZE BE SOMETHING YOU ALL WERE AWARE OF BEFORE THE STUDY?”

“NOT IN MY HOUSE EITHER, I WAS PROBABLY OVERFEEDING EVERYONE TO BE HONEST. I WAS FILLING THEIR PLATES SOMETHING SHOCKING.”

A smaller proportion of participants felt they served appropriate portion sizes in their home:

“IT’S A GREAT IDEA, BUT MY FAMILIES PORTION SIZES ARE SIMILAR TO CUP SO I DON’T SEE THE NEED TO CONTINUE USING.”

A summary of other portion size estimation aids used by participants in the family setting during the intervention is presented in Figure 2. At week 3 and week 6, 34% (n=28) and 27% (n=21) of participants respectively, reported using other portion size estimation aids to estimate portion size, with measuring scales being most frequently used, followed by common household items such as a measuring jug, spoons and cup (Figure 6).

Table 2 Characteristics of participants from households recruited to the 6-week intervention

Characteristics	All participants n 106	Northern Ireland n 50	Ireland n 56
Gender (female)	97 (92)	47 (94)	50 (89)
Age (years) [†]	38.5 (8.1)	39.1 (8.9)	38 (7.4)
Body Mass Index (kg/m ²) ^β	26.0 (22.9-29.1)	26.3 (24.2-30.3)	25.6 (22.4-28.7)
Underweight	1 (1)	-	1 (2)
Normal weight	39 (37)	15 (30)	24 (43)
Overweight	44 (41)	20 (40)	24 (43)
Obese	22 (21)	15 (30)	7 (12)
Ethnicity			
White	99 (93)	49 (98)	50 (89)
Mixed	2 (2)	1 (2)	1 (2)
Other	5 (5)	-	5 (9)
Geographical location			
Rural	61 (58)	26 (43)	35 (57)
Urban	45 (42)	24 (53)	21 (47)
Marital status			
Married/Common law/partner	76 (71)	34 (68)	42 (75)
Single	23 (22)	13 (26)	10 (18)
Divorced/Separated	6 (6)	3 (6)	3 (5)
Widowed	1 (1)	-	1 (2)
Highest education level attained			
Secondary (GCSE or equivalent)	31 (29)	19 (38)	12 (21)
Secondary (A-Level or equivalent)	12 (11)	6 (12)	6 (11)
Further (BTEC or equivalent)	24 (23)	10 (20)	14 (25)
Higher (undergraduate degree)	23 (22)	8 (16)	15 (27)
Higher (postgraduate degree)	11 (10)	3 (6)	8 (14)
None	5 (5)	4 (8)	1 (2)
Employment status			
Employed (Full-time)	33 (31)	14 (28)	19 (33.9)
Employed (Part-time)	31 (29)	15 (30)	16 (28.6)
Unemployed	35 (33)	19 (38)	16 (28.6)
Self-Employed	3 (3)	1 (2)	2 (3.6)
Student	2 (2)	-	2 (3.6)

Retired	2 (2)	1 (2)	1 (1.8)
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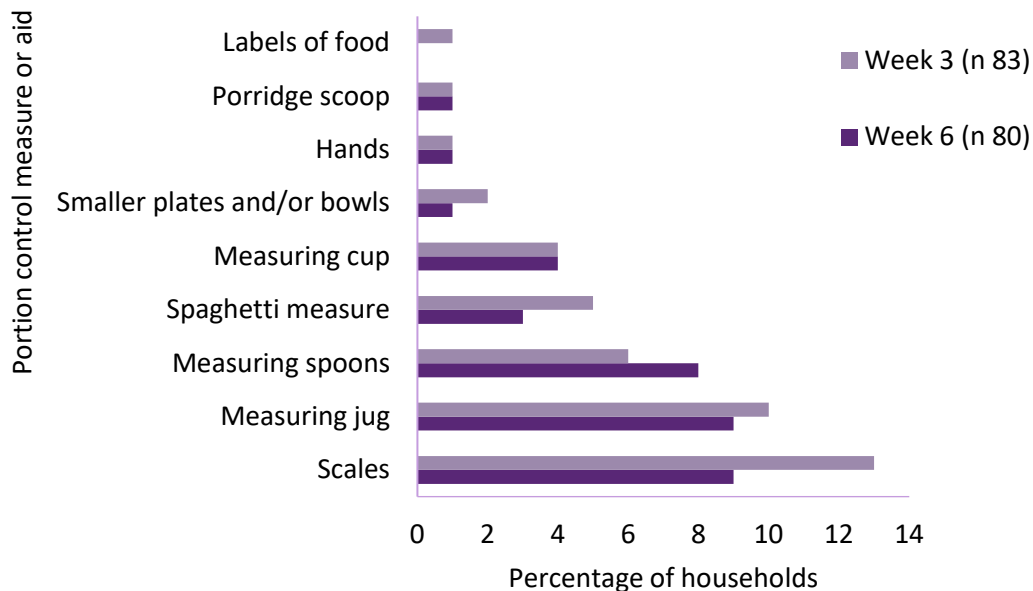
Data are presented as n (%) unless stated otherwise. †Data are presented as mean (standard deviation). ^β Body Mass Index (BMI) data are presented as median (inter-quartile range) and BMI calculated using self-reported height and weight obtained via telephone questionnaire.

Table 3 Percentage of households with one or more children

Number of children in household	Total n 106	Northern Ireland n 50	Ireland n 56
1	47 (44)	18 (36)	29 (52)
2	43 (41)	21 (42)	22 (39)
3	13 (12)	8 (16)	5 (9)
4+	3 (3)	3 (6)	

Data presented as n (%)

Figure 6: Percentage of households who indicated they used another portion control measure or aid during the 6-week portion control intervention



Level of concern regarding portion size

There was no difference in participants’ level of concern regarding portion size between week 3 and week 6. Most participants at week 3 (n = 50, 60%) and half of participants at week 6 (n =

48, 50%) reported they were neither ‘concerned’ or ‘not concerned’ about portion size (rating of 3).

There was no difference in the level of concern regarding portion size at either week 3 or week 6 in relation to BMI categories (BMI < 25 kg/m² versus BMI ≥25 kg/m²), sex or age (aged < 40 years versus ≥ 40 years). Level of concern regarding portion size was also not associated with jurisdiction (Ireland versus Northern Ireland) or setting (urban versus rural).

Concern with portion size at different eating occasions and locations

Participants were asked to indicate whether portion size was perceived as a problem ‘always’, ‘some of the time’ or ‘never’ for different eating occasions and locations (Table 4). Data were combined for those reporting portion size was sometimes or always a problem and the results are summarised below:

- Portion size was almost unanimously perceived as a problem on special occasions (week 3: n = 82, 99%; week 6: n = 78, 98%).
- > 80% of participants reported that portion size was a problem when eating outside of the home, snacking, when in stressful situations, eating with friends, eating at home, with a lack of time and eating while watching TV.
- To a lesser extent, participants reported portion size was a problem when eating late at night/after a night out (week 3: n = 56, 68%; week 6: n = 43, 96%) or when they were preparing a meal (week 3: n = 47, 56%; week 6: n = 36, 45%).
- Portion size when eating at work was perceived as ‘never’ a problem for most participants (week 3: n = 65, 78%; week 6: n = 60, 75%).

Table 4 The proportion of participants (%) who reported Portion Size was a problem always or some of the time for various eating occasions and locations

	Week 3	Week 6	P value
Special occasions	82 (99)	78 (98)	0.152
Eating outside the home	73 (88)	76 (95)	0.146
Snacking	78 (94)	73 (91)	0.629
Stressful situations	71 (85)	73 (91)	0.791
Eating with friends	73 (88)	72 (90)	0.227
Eating at home	71 (86)	60 (75)	0.556
Lack of time	69 (83)	62 (78)	1.000
Eating while watching TV	68 (82)	71 (76)	1.000
Eating late/ after a night out	56 (68)	43 (66)	0.424
Preparing a meal	47 (57)	36 (45)	0.189

	Week 3	Week 6	P value
Eating at work β	18 (27)	20 (30)	0.375

Data presented as n (%). Data assessed using McNemar's test. β Only those who reported being self-employed, in full-time or part-time employment (n = 67) included in the analysis.

The acceptability and usability of the portion control tool

Preferences for portion control tools

Participants' preference for each tool cup is presented in Table 5. Nearly all participants (week 3: n = 81, 98%; week 6: n = 79, 99%) reported using the 200-ml portion cup in the family setting; reasons for not using the portion cup included: resulting portion sizes were too small (n = 1), more confidence in using a similar 200-ml cup (n = 1) and forgetting to use it (n = 1). Preference was greatest for the 200-ml portion cup in contrast to the measuring spoon, which was the least preferred tool. Use of the portion control plates significantly decreased by week 6 and data from the qualitative analysis suggest that participants *"shared their knowledge"* of this portion tool by giving the plates to other family members to use in their household:

"I HAVE GIVEN IT TO MY SISTER... SHE'S CONCERNED ABOUT PORTION CONTROL FOR HER WEE ONES, SO I GAVE IT TO HER".

Table 5 Preference for portion control tools at week 3 and week 6

Portion control tool	Week 3 n 83	Week 6 n 80	P value
Cup	75 (90)	75 (94)	0.453
Child's plate	54 (65)	36 (45)	0.003
Adult's plate	41 (49)	24 (30)	0.005
Measuring spoon	9 (11)	6 (8)	Unable to compute

Data presented as n (%) and data were analysed by McNemar's test

Acceptability of the 200-ml portion cup

Acceptability of the 200-ml portion cup remained consistently high from week 3 to week 6, with the majority of participants stating it was 'very acceptable' (week 3: n = 71, 86%; week 6: n = 72, 90%), 'very easy to use' (week 3: n = 78, 94%; week 6: n = 78, 98%), 'very convenient' (week 3: n = 78, 94%; week 6: n = 73, 91%) and 'very effective' (week 3: n = 80, 96%; week 6: n = 77, 96%).

Qualitative data suggest that most participants had a positive experience when using the portion cup:

" MUCH EASIER FOR PORTION SIZES THAN JUST GUESSING".

“NOTHING COMPLICATED AT ALL”.

“IT’S REDUCED OUR FOOD WASTE A LOT AS WE ARE ONLY EATING OUR CORRECT PORTIONS”.

“I HOPE SO [TO CONTINUE USING THE CUP]- IF I GET INTO A HABIT AND REMEMBER TO USE IT”.

However, there were a small number of participants (n=7) who did not find the portion cup acceptable, especially for certain foods, and felt the portion size it provided was too small:

“NOT USEFUL FOR NORMAL FAMILY MEALS BUT MORE TAILORED TO THOSE ON A STRICTLY CONTROLLED DIET”.

Usability of the portion cup

At week 3 and week 6, 81% (n = 67) and 73% (n = 58) of participants respectively, reported no problems when using the portion cup ($P= 0.238$). However, some issues were reported regarding usability; these are summarised below:

- Markings were erased by washing (week 3 n=8, 10%; week 6 n=18, 23%)
- No markings on the portion cup for cooked pasta or rice (week 3 n=5, 6%; week 6 n=2, 3%). Note: there were markings for these foods on the cup but it seemed unclear to some participants that these foods were specified.
- Markings on the portion cup were too small (week 3 n=2, 2%; week 6 n=3, 4%)
- Less commonly reported problems included:
 - Portion size was too small (n=2)
 - No markings for fruit or vegetables (n=1)
 - No handle on the cup (n=1)

Participants made several suggestions on how to improve the design of the portion cup and these are summarised below:

- Include markings for uncooked pasta and rice; millilitres and grams; additional food items
- Add a handle and spout
- Change material e.g. glass or heat proof
- Add colour to the portion cup
- Larger writing

Qualitative data supports these findings:

*“A WEE [SMALL] MARK MAYBE FOR WHAT RICE YOU PUT IN DRY WOULD
MAYBE BE BETTER ON IT TOO BECAUSE I’M ALWAYS PUTTING TOO MUCH ON”
“IT IS TOO HARD WHEN HOT FOOD IS IN IT, WE USE HOT MILK, PASTA,
NOODLES”
“I’LL USE IT WHILE I CAN STILL SEE THE WRITING”*

Patterns of use of the portion cup within the home setting

The portion cup was used for estimating portion sizes for the entire family in most households (week 3: n = 74, 89%; week 6: n = 69, 86%), with some using it only for themselves (week 3 & 6: n = 3, 4%) or their children (week 3: n = 5, 6%; week 6: n = 6, 8%).

However, data from the focus groups suggest that the portion cup may have initially been used for the entire family, albeit in some cases it was used for the children only.

*“PROBABLY THE FIRST WEEK FOR EVERYBODY AND THEN IT WAS WITH THEM
[CHILDREN] REALLY, JUST SHOWING THEM THE PORTIONS...”
“WELL, I ONLY USED IT ON THE KIDS BECAUSE FOR MYSELF I JUST... IF I USED
THE CUP AND WANTED MORE, I’D TAKE IT”*

Some participants reported a lack of engagement with the portion cup by males within the household:

*“MY HUSBAND AND MY SON REFUSED TO ENGAGE WITH IT... IN ANY FORM AT
ALL. POINT BLANK THOUGHT IT WAS A RIDICULOUS NOTION AND YOU KNOW
JUST CONTINUED ON”*

Usage of the portion cup at various eating occasions is presented in Figure 7.

- Breakfast was the most common occasion for using the portion cup with 78% (week 3: n=65; week 6: n=62) of households reporting everyone used the portion cup at this meal.
- The portion cup was used least at lunch, with 90-92% of households not using the portion cup at this time (week 3: n=76, 92%; week 6: n=72, 90%).
- At week 3 and week 6, 46% (n=38) and 44% (n=35) of households reported everyone used the portion cup at dinner.
- The portion cup was used by everyone for snacks in 34% of households (week 3: n = 28; week 6: n=27).

Figure 7: Use of portion cup at breakfast (a) Lunch (b) Dinner (c) and Snacks (d)

Figure 7a (Breakfast)

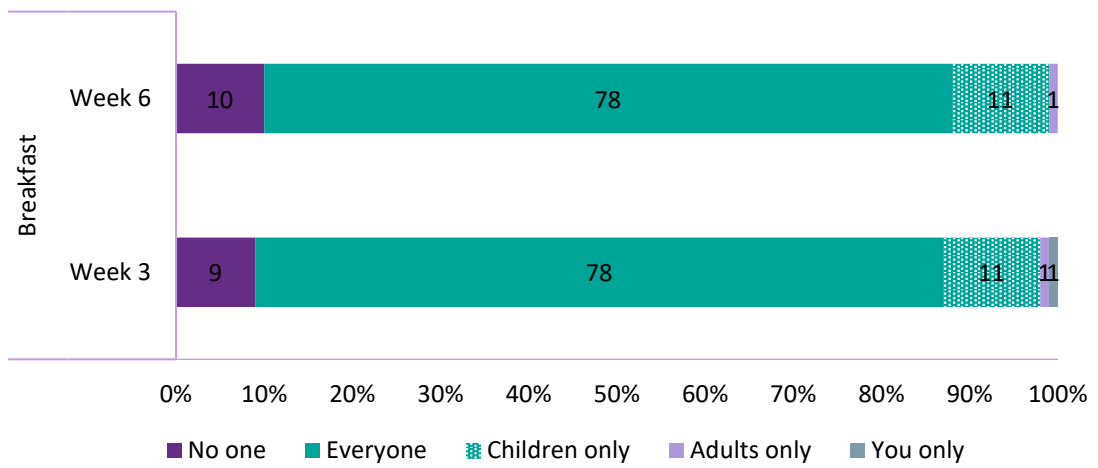


Figure 7b (Lunch)

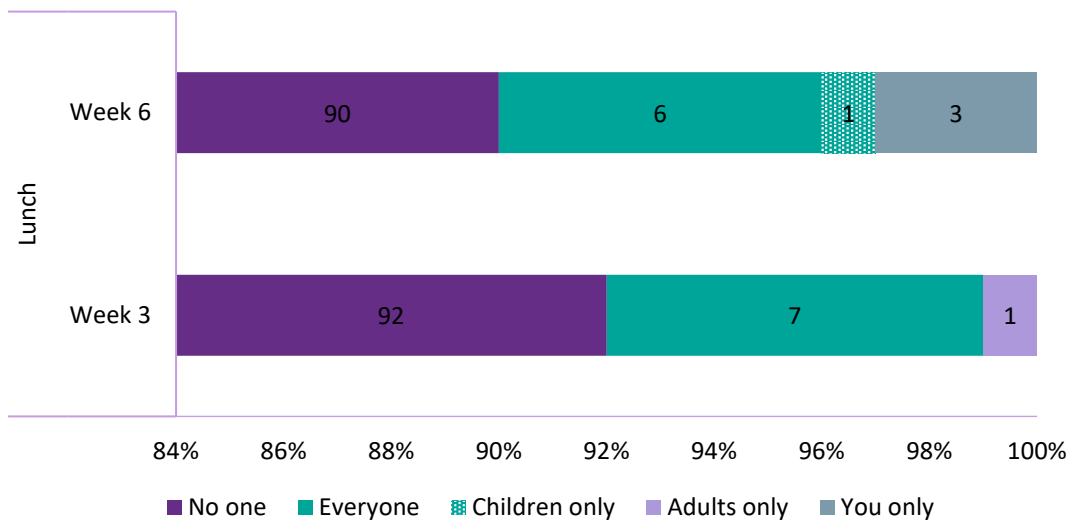


Figure 7c (Dinner)

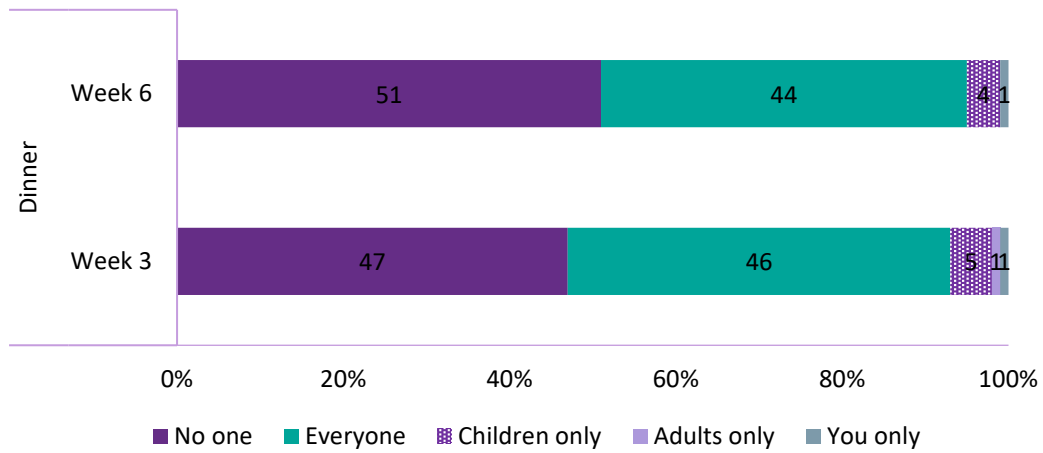
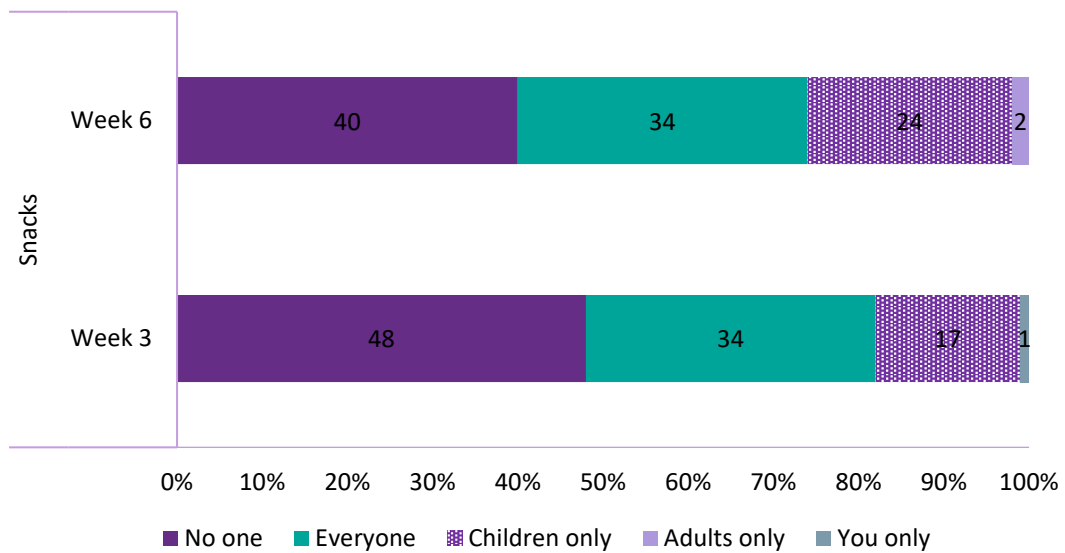


Figure 7d (Snacks)



These quantitative data are in line with the evidence that emerged during the focus group discussions and supported with the following quotes:

“YEAH, BREAKFAST. CEREALS”

“IT’S JUST THAT I TAKE IT OUT ALONG WITH THE CEREAL BOWL AND PROBABLY BEFORE THAT YOU WERE JUST FILLING UP THE BOWL”

“DIDN’T USE IT FOR LUNCH AT ALL. THEY AREN’T THERE FOR LUNCH, THEY’RE AT SCHOOL”

“I WOULD SAY DINNER. BREAKFAST AND DINNER”

Daily usage of the portion cup diminished between week 3 and week 6 ($P=0.035$) (Table 6) and data suggest that participants gained confidence in their ability to judge appropriate portion size without the use of the portion cup:

“IF YOU TRY SOMETHING NEW, YOU MIGHT USE IT JUST FOR THAT TO GET AN IDEA OF WHAT SIZE IT IS IN THE PLATE OR BOWL OR WHATEVER... BUT WOULD YOU USE IT FOR PORRIDGE EVERY SINGLE MORNING... PROBABLY NOT BECAUSE AFTER THE FIRST TWO WEEKS YOU KNOW EXACTLY WHAT’S MEANT TO BE IN THE BOWL”

The portion cup was used most often to measure amorphous grains such as cereal, rice or pasta (week 3: n = 79, 95%; week 6: n = 75, 94%) and milk was the most common beverage served using the portion cup in the home setting (week 3: n = 35, 42%; week 6: n = 27, 34%), followed by juice/fruit juice (week 3: n = 23, 28%; week 6: n = 23, 29%). These findings were consistent with the results from the focus groups:

“I HAVE USED IT [THE CUP] AND I THOUGHT IT WAS GOOD THAT YOU WERE SEEING WHAT... I THINK ESPECIALLY THE ORANGE JUICE. I HAVE A TENDENCY TO PUT MORE OUT THAN I SHOULD. BUT I USED IT FOR THE ORANGE JUICE AND SUPPOSE THE RICE THAT’S ALWAYS A HARD TASK- THERE’S ALWAYS TOO MUCH. YOU COULD BE FEEDING FOR 10 NEARLY WITHOUT IT. I FOUND IT USEFUL FOR THOSE SORTS OF THINGS”

Table 6 Percentage of household that used the portion cup during the 6-week intervention

	Week 3 (n 83) N (%)	Week 6 (n 80) N (%)
Cup usage at:		
Breakfast	75 (90)	72 (90)
Lunch	7 (8)	7 (9)
Dinner	42 (51)	40 (50)
Snacks	43 (52)	45 (56)
Weekly usage of the cup:		
Everyday	35 (42)	20 (25)
4-6 days	32 (39)	38 (48)
2-3 days	13 (16)	17 (21)
≤ 1 day	3 (3)	5 (6)
Usage by food group:		
Cereals/rice/pasta	79 (95)	75 (94)
Fruit/vegetables	2 (2)	1 (1)
Drinks	43 (52)	46 (58)

Data presented as n (%)

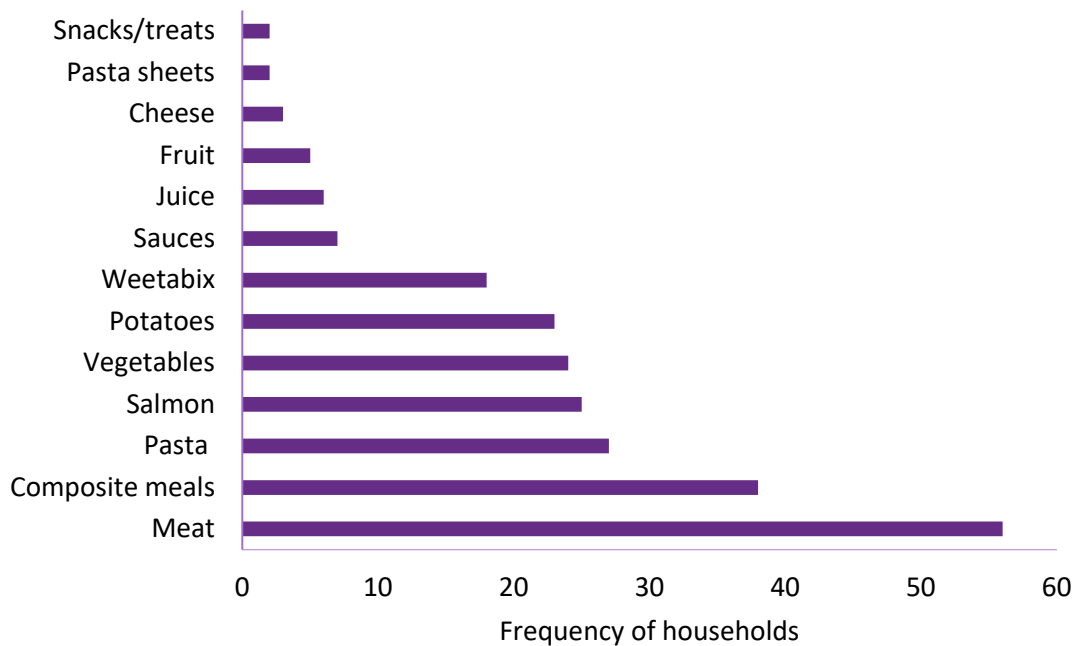
Foods for which the cup would be least useful

Participants’ responses when asked for what foods the portion cup would be least useful are presented in Figure 8. At week 3, 33% (n=27) of participants indicated that the portion cup would be least useful for pasta (did not specify cooked or uncooked), 8% (n=7) of participants specified it would be least useful for uncooked pasta/rice and 4% (n=3) said cooked

rice/pasta. Focus group evidence suggests that a small proportion of participants were confused as to whether the portion cup was to be used for cooked or uncooked rice/pasta:

“I THOUGHT THAT WAS IT JUST DRY... I DIDN’T REALISE COOKED, NOW THAT I SEE IT [LOOKING AT THE CUP]”

Figure 8: Foods for which the portion cup was perceived to be least useful for in the home setting



Eating outside the home

Participants unanimously agreed the 200-ml portion cup would **not** be useful when eating outside of the home setting (98-100%):

“YOU WANT TO BE RELAXED AND NOT WORRY ABOUT PORTION SIZE”
“LIKE, IF YOU WERE BUYING A MEAL OUT? OH GOD NO”
“BUT IF YOU GO OUT TO A RESTAURANT AND YOU’RE GOING TO MEASURE WHAT’S ON YOUR PLATE, IT WOULD BE AFTER IT IS SERVED TO YOU SO THE FOOD LEFT WOULD BE WASTED. YOU MAY AS WELL ENJOY THE TREAT AND EAT IT”

From using the portion cup, participants’ knowledge of portion size improved, and participants were more aware of portion size when eating outside the home:

“MADE ME SEE HOW BIG OF A DIFFERENCE THERE IS IN WHAT WE GET OUTSIDE OF HOME AND HOW EASY IT IS TO OVER EAT”

Barriers to using the portion cup

Barriers that would potentially influence how the 200-ml portion cup would be used in the family setting were categorised as person- and tool-specific.

Person-specific barriers

The most important factor influencing the likely non-use of the 200-ml portion cup was the perception that the resulting portion sizes were too small and not appropriate for their family:

“WE TRIED AND IT’S TOO SMALL”

“IT’S NOT GOOD FOR THE KIDS WHEN THEY ARE VERY HUNGRY”

Tool-specific barriers

A key finding was that the markings on the 200-ml portion cup were not clear, they were erased off with washing:

“HOW DURABLE WOULD THAT CUP BE IF YOU USED IT OVER SIX MONTHS TO TWELVE MONTHS?”

Perceived behavioural changes in portion size control in the context of the Transtheoretical Model of Behavioural Change

Qualitative analysis identified the main theme *“Behavioural change”* with two subthemes *“Educational benefits as a result of using the cup”* and *“Probable long-term use of portion cup”*, that are discussed under this objective.

Behavioural changes in portion size assessment

At week 3, 77 (93%) participants reported changing the portion size they served as a result of using the portion cup with 74 (93%) participants maintaining this behaviour at week 6.

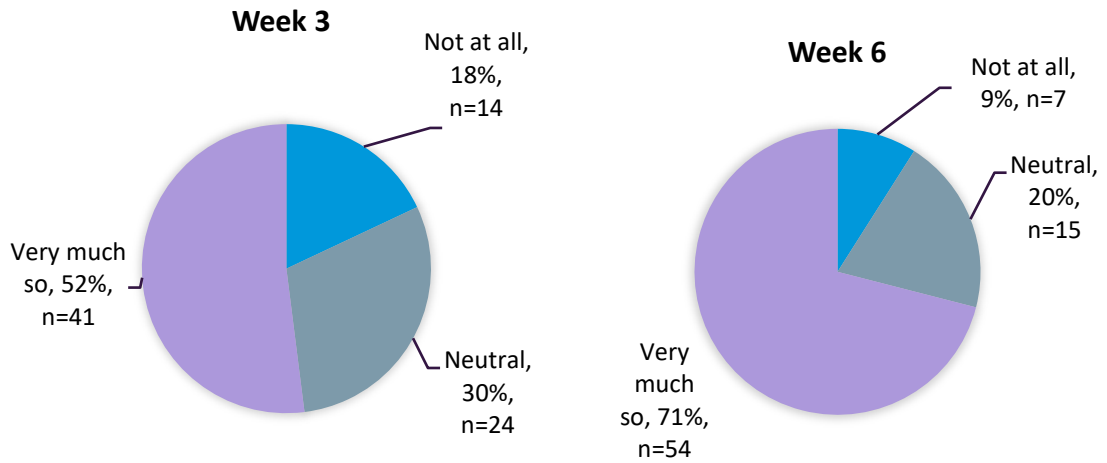
Participants were asked to evaluate statements regarding their readiness to change portion size behaviour and the results are summarised below:

- Participants unanimously said they were ‘very much so’ ‘considering making some changes to portion size’ at week 3 (n = 79, 100%) and week 6 (n = 75, 99%).
- Most participants (week 3: n = 76, 96%; week 6: n = 75, 99%) said they had ‘very much so’ ‘started to change portion size’.
- The proportion of participants who said they had ‘very much so’ ‘changed portion size and maintained these changes’, increased from 52% (n=41) at week 3 to 71% (n=54) at week 6 (Figure 9). The participants in the intervention were asked if they had changed portion size but were not asked if the change led to a bigger or smaller

portion size but the focus group participants indicated that the change in portion size was likely to be towards more appropriate portion size.

- The majority of participants (week 3: n=73, 93%; week 6: n=72, 95%) responded “not at all” when asked if they made some changes to portion size that they had not maintained, and the remainder of participants were neutral in their opinions.

Figure 9: Changes in portion size behaviour as a result of using the 200-ml portion cup



Perceptions on food portions served using the 200-ml portion cup

The consensus was that ‘one size does not fit all’ when serving food using the portion cup in the family setting and that the portion size was too small, particularly for adults:

“WELL, I’D EAT MORE CEREALS AND STUFF. I WOULDN’T EVEN USE THE CUP BECAUSE I KNOW I’D FILL MY BOWL UP! YEAH OR ELSE I’D BE GOING FOR TWO CUPS”

Participants acknowledged as a result of using the portion cup in the home setting, their awareness of appropriate portion sizes had increased, and they noticed how excessive portion sizes are when eating outside of the home:

“DIDN’T USE OUTSIDE BUT THERE WAS A DIFFERENCE IN MY PORTION SIZES COMPARED TO CUP SO RESTAURANTS WILL BE A BIGGER DIFFERENCE”

On whether a 5-year-old should have the same portion as an adult:

“THE ONLY THING THAT I WOULD SAY IS THAT, IT WAS OVER 5 YEARS OLD... SO I THOUGHT THAT THE PORTION FOR A 5-YEAR-OLD SHOULDN’T BE THE SAME AS A GROWN MAN”

In most households, the portion cup was used mainly to serve food for the children, but there were some opposing opinions across different groups:

“WELL, I ONLY USED IT ON THE KIDS”

“IT’S DEFINITELY THE RIGHT PORTION FOR THE TWO KIDS WHO ARE SIX AND EIGHT BUT IN SAYING THAT MY KIDS DO SOMETHING EXTRA NEARLY EVERY DAY LIKE THEY WOULD DO CIRCUS SCHOOL, PARKOUR, TRAMPOLINE, SO I FOUND THOSE PORTIONS PERFECT AND THE RIGHT SIZE FOR THEM, THEY WEREN’T SNACKING BETWEEN FOOD AND STUFF”

“MY WEE BOY WAS HUNGRY AFTER AND COULDN’T UNDERSTAND THAT THAT WAS ALL HE WAS ALLOWED”

Approximately half the participants (week 3: n = 40, 48%; week 6: n = 36, 45%) thought the portion cup would be more beneficial when restricting the diet to control weight:

“NOT USEFUL FOR NORMAL FAMILY MEALS BUT MORE TAILORED TO THOSE ON A STRICTLY CONTROLLED DIET”

Findings from the focus groups showed that the portion cup was useful for family members who wanted to monitor their portion sizes more closely for health reasons such as diabetes or when losing weight. The following quote was from a participant who shared the portion cup with a family member living with diabetes:

“MY MUMMY’S PARTNER... I WOULD NEVER HAVE DONE ANYTHING LIKE THAT BEFORE SO SHE WAS INTRIGUED SO I GAVE IT TO THEM...[NAME] IS DIABETIC AS WELL AND HE’S A MAN BY HIMSELF SO, OH GOD, HIS TUMMY IS BULK OF FAT SO HE HAS BEEN USING IT. HE’S COMPLETELY TRIED TO CHANGE STUFF AROUND”

Educational benefit of the 200-ml portion cup

Increased awareness of portion size as a result of using the 200-ml portion cup

A key finding within the project was that the majority of participants (week 3: n = 51, 61%; week 6: n = 48, 60%) reported the portion cup helped them become more aware of portion size in the home and 36% (week 3: n = 30; week 6 n = 29) said it helped them inside and outside of the home (i.e. restaurants, take-away or cafes):

“IT JUST MADE YOU MORE AWARE. I DON’T THINK YOU’LL EVER GO BACK TO WHERE IT WAS”

Independent ability to judge portion size

Some participants reported being more able to judge appropriate portion size without continued use:

“I THINK WE ARE MORE AWARE AND HAVE LESS NEED OF CUP”

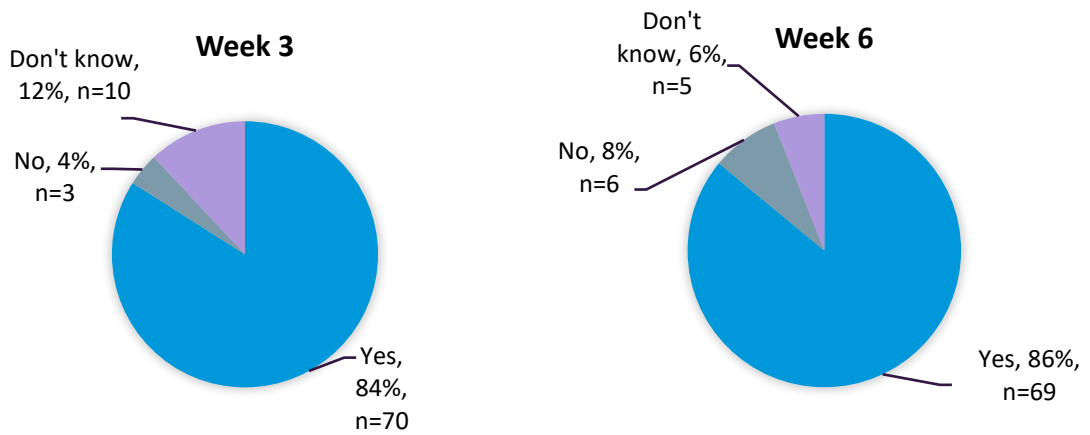
Others felt the portion cup would be most useful when serving a new food, they hadn’t routinely been serving with the portion cup:

“IF YOU TRY SOMETHING NEW, YOU MIGHT USE IT JUST FOR THAT TO GET AN IDEA OF WHAT SIZE IT IS IN THE PLATE OR BOWL OR WHATEVER... BUT WOULD YOU USE IT FOR PORRIDGE EVERY SINGLE MORNING... PROBABLY NOT BECAUSE AFTER THE FIRST TWO WEEKS YOU KNOW EXACTLY WHAT’S MEANT TO BE IN THE BOWL”

Probable long-term use of the 200-ml portion cup

Most participants reported in week 3 and week 6 that they were likely to continue using the portion cup in the future when serving food in the home (Figure 10).

Figure 10: Probable future use of the 200-ml portion cup



Qualitative data from the evaluation questionnaire suggest that whilst most participants intended to use the portion cup in the future they would have liked to receive this guidance when they were younger:

“I WISH I'D HAD THIS INFORMATION WHEN I WAS YOUNGER- IT IS EDUCATING MY CHILDREN”

There was a small number of participants who did not intend to use the portion cup owing to their perceived competence in estimating portion sizes without the use of the aid:

“IT'S A GREAT IDEA, BUT MY FAMILY'S PORTION SIZES ARE SIMILAR TO CUP SO I DON'T SEE THE NEED TO CONTINUE USING”

4 Discussion

Promoting appropriate portion size is accepted as an integral component of healthy eating advice and is advocated for the prevention and management of overweight and obesity. However, translating this advice into desired behaviour change is challenging. Previous *safefood*-funded research reported that visual portion size estimation aids such as cups or spoons are preferred by adults when estimating portion size (11). The present work has reinforced this observation by demonstrating that a reusable 200-ml portion cup is an acceptable and user-friendly tool for estimating portion sizes in the family context on the island of Ireland. Furthermore, our results suggest that the portion cup may increase awareness and emphasise the importance of portion size, as well as positively impacting on consumer's understanding of portion size. These findings complement ongoing healthy eating campaigns and will inform future campaigns specifically related to promoting appropriate portion size within the family setting.

The ever-evolving food environment, along with the lack of, or indeed conflicting, advice regarding portion size, is likely to be a cause of confusion amongst consumers (11). Whilst there is often a focus on foods and beverages high in fat, sugar and salt in the context of public health nutrition, interventions that consider staple food items also play a key role in maintaining or improving the health of the population. In the present work, most households (78%) reported using the portion cup for foods such as cereals, rice and pasta throughout the intervention. Therefore, integration of portion size estimation aids as a key strategy in public health campaigns, may be a potentially effective way of helping consumers manage portion sizes at home.

Although the overall acceptability and general engagement with the portion cup was maintained throughout the intervention, the pattern of use evolved over time; notably, once knowledge of an appropriate portion size for a certain food was established, use of the portion cup for that food tended to diminish. This familiarisation may partly explain the decrease in reported daily use of the portion cup between week 3 and week 6. Furthermore, some participants indicated that, although the portion cup was initially used for the whole family, it was mainly used only for children as the intervention progressed. A lack of engagement from males (adults and children) within the household was also observed, which merits further investigation. In addition, it is important to acknowledge that guidance on

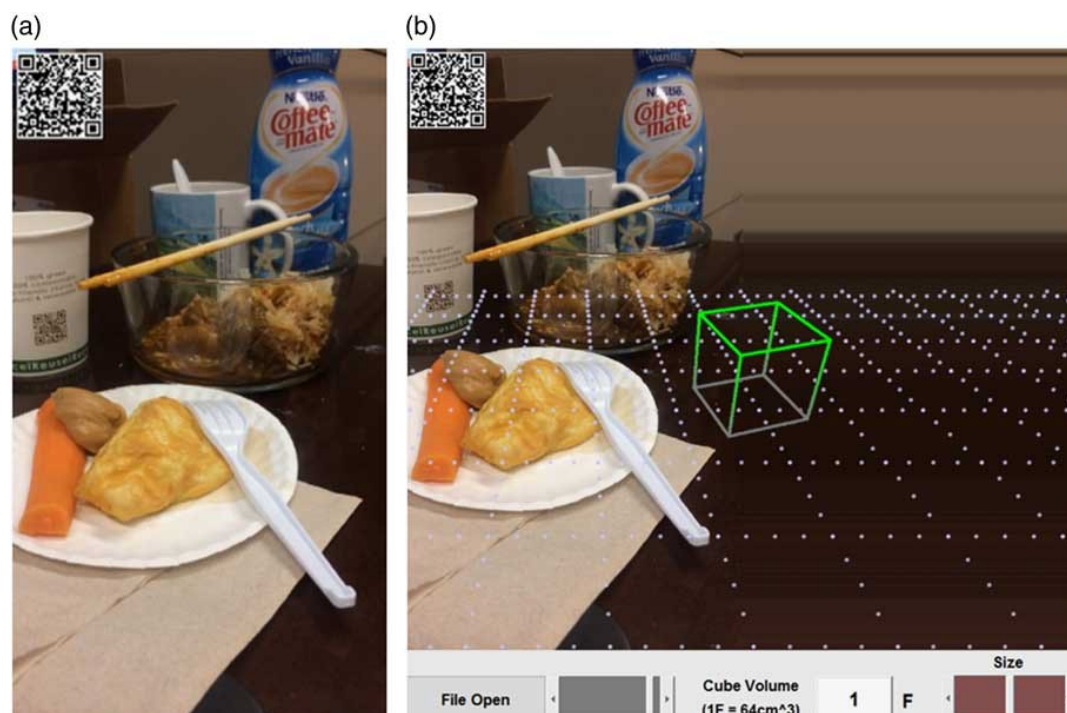
portion sizes for children aged 1 to 4 years should be given consideration in the design of a future portion cup (Note: Since the intervention was undertaken the Department of Health in Ireland has published Healthy eating for 1 to 4 year olds: the Children's Food Pyramid Guidelines which includes guidance on portion sizes for this age group (18)).

Portion size guidance is not consistent across both jurisdictions on the island of Ireland. Results from this study support the inclusion of practical portion size estimation aids, such as the 200-ml portion cup, to help educate consumers on appropriate portion sizes, which in turn may help them to better align food choices to dietary recommendations. Indeed, previous research, supported by *safefood*, identified that household measures, including practical portion size estimation aids (e.g. 200-ml cup or portion pots) were preferred by consumers and were more precise portion size estimation aids overall, compared to reference objects(10). As part of its recent 'Find your balance - get portion wise!' initiative (19), The British Nutrition Foundation published portion size guidance to consumers that utilises hand measures as a visual portion size estimation aids. A combination of portion cup and hand measures, such as that promoted within the Healthy Eating Guidelines in Ireland, may represent an effective strategy for promoting appropriate portion sizes within the family setting; however, research to definitively establish the efficacy of such an approach in this setting is recommended.

While the current project was not primarily designed as an educational intervention, an increased awareness of portion size was observed along with some reported changes in behaviour following introduction of the portion cup to the family setting. Some participants reported that the portion cup facilitated an appreciation of what appropriate portion sizes were, further supporting the notion that incorporation of this type of intervention into ongoing public health nutrition campaigns could be well received and relatively easy to implement. Furthermore, recent findings suggest that parental beliefs about their child's ideal and maximum portion size are more strongly associated with the child's BMI than the child's own beliefs of ideal portion size (20). Therefore, enhancing parental understanding of portion size could potentially be an effective method of preventing excessive energy consumption in children, although this would require further investigation. Whilst there was a general increase in awareness of what constitutes an appropriate portion size in the current study, future research should address how this could be translated into sustained behaviour changes in the longer-term. Whether such learned behaviour in the home would translate into more appropriate portion size selections impacting on overall dietary intake when eating outside the home also warrants investigation.

Practical tool-specific barriers to using the portion cup were highlighted. Some households reported that text was erased from the portion cup after repeated washing or was too small. Future iterations of the portion cup would need to address this limitation by either modifying the manufacturing process or using adjunctive methodologies to effectively convey information on portion size. One approach might be to integrate a visual portion size estimation aid, such as the 200-ml portion cup, with technology via the use of an embedded QR code, which would serve as a digital gateway to more detailed and specific portion size information on an app or website. Given that most households now have access to the internet and a range of mobile devices (21), such an approach might significantly enhance the reach and effectiveness of portion size interventions involving portion cup. Indeed, recent advances in this area have been reported whereby mobile phone technology has been used to estimate portion size through photographs without the use of a reference marker to quantify the volume of the food and shown to be valid (Figure 11) (22). However, this has mainly only been successful for estimating large-volume foods. This presents a potential opportunity to overcome a barrier to using mobile phones to monitor portion size.

Figure 11: (a) A complex real-world fiducial-marker-free* image; (b) extended virtual reality image from which any food item can be estimated by moving and scaling the International Food Unit™



* A fiducial is an object placed in the field of view of an imaging system that appears in the image produced, for use as a point of reference or a measure

Strengths and limitations

Several strengths and limitations of the current project should be acknowledged. A strength of the project is the adoption of a mixed methods research approach, which facilitated a comprehensive and balanced evaluation, and therefore, provided valuable insights into the use of the portion cup along with influencing factors. There was an excellent level of participant engagement, which could be due to the employment of community-based centres, many of whom will have well-established relations with service users. While the overall sample size is relatively small, and our results indicated good acceptability and usability of the portion cup within the family setting, research in a nationally representative sample would better inform the effectiveness of these types of interventions at a population level. The duration of the intervention was also relatively short (6-weeks) and as a result, no definitive conclusions can be drawn about the longer-term efficacy and use of portion cup in the family setting. This project also did not assess the impact of the introduction of the portion cup on overall dietary intake and therefore, future work should aim to investigate this, along with the effectiveness of using different portion size estimation aids for promoting appropriate portion size.

5 Conclusions

The results of this study indicate that a 200-ml portion cup is acceptable in the short-term within the family setting on the island of Ireland. Introducing the portion cup helped to raise consumer awareness of the importance of portion size and initiated some behaviour change within the household. However, it needs to be stressed that consumers are highly unlikely to use a portion cup on a regular basis once they become familiar with appropriate portion sizes for specific foods. Furthermore, it is not clear whether all members of the family, specifically males (adults and children), will engage with this type of intervention. This research adds to the existing evidence base regarding portion size and will provide useful data to support the design and implementation of portion size interventions on the IOI. It has also helped to identify areas for future research in this important area, which should be explored.

6 References

1. Dee A, Callinan A, Doherty E, Neill C, McVeigh T, Sweeney MR, et al. Overweight and obesity on the island of Ireland: an estimation of costs. *BMJ Open*. 2015;5(3):e006189.
2. Piernas C, Popkin BM. Increased portion sizes from energy-dense foods affect total energy intake at eating occasions in US children and adolescents: patterns and trends by age group and sociodemographic characteristics, 1977-2006. *Am J Clin Nutr*. 2011;94(5):1324-32.
3. Steenhuis I, Vermeer, W. Portion size: review and framework for interventions. *International Journal of Behavioral Nutrition and Physical Activity*. 2009;6(1):58.
4. Faulkner GP, Pourshahidi, L.K., Wallace, J.M., Kerr, M.A., Crorie, M., Livingstone M.B.E. Serving size guidance for consumers: is it effective? *Proc Nutr Soc*. 2012;71(4):610 - 21.
5. Pourshahidi LK, Kerr MA, McCaffrey TA, Livingstone MB. Influencing and modifying children's energy intake: the role of portion size and energy density. *Proc Nutr Soc*. 2014;73(3):397-406.
6. Nielsen SJ, Popkin, B.M. Patterns and trends in food portion sizes, 1977-1998. *JAMA*. 1998;289:450 - 3.
7. Wrieden WL, Momen NC. Workshop 3: Novel approaches for estimating portion sizes. *European journal of clinical nutrition*. 2009;63 Suppl 1:S80-1.
8. Almiron-Roig E, Majumdar A, Vaughan D, Jebb SA. Exploring the Experiences of People with Obesity Using Portion Control Tools-A Qualitative Study. *Nutrients*. 2019;11(5):1095.
9. Amoutzopoulos B, Page P, Roberts C, Roe M, Cade J, Steer T, et al. Portion size estimation in dietary assessment: a systematic review of existing tools, their strengths and limitations. *Nutrition reviews*. 2020;78(11):885-900.
10. Faulkner GP, Livingstone MBE, Pourshahidi LK, Spence M, Dean M, O'Brien S, et al. An evaluation of portion size estimation aids: precision, ease of use and likelihood of future use. *Public Health Nutrition*. 2016;19(13):2377-87.
11. Faulkner GP, Livingstone MBE, Pourshahidi LK, Spence M, Dean M, O'Brien S, et al. An evaluation of portion size estimation aids: Consumer perspectives on their effectiveness. *Appetite*. 2017;114:200-8.
12. Department of Health. *The Food Pyramid*. 2016.
13. Public Health England. *The Eatwell Guide*. 2018.
14. Department of Health. *A healthy weight for Ireland: Obesity policy and action plan 2016-2025*. 2016.
15. Department of Health Social Services and Public Safety. *A fitter future for all. Framework for preventing and addressing overweight and obesity in Northern Ireland 2012-2022*. Belfast; 2012.
16. Tashakkori A. *SAGE Handbook of Mixed Methods in Social & Behavioral Research*. Thousand Oaks, California 2010. Available from: <https://methods.sagepub.com/book/sage-handbook-of-mixed-methods-social-behavioral-research-2e>.

17. Braun V, Clarke, V. Using thematic analysis in psychology. *Qualitative Research in Psychology*. 2006;3(2):77-101.
18. Department of Health. Healthy eating guidelines for kids 2020 [Available from: <https://www.gov.ie/en/publication/da7f19-eat-well/?referrer=http://www.gov.ie/healthyireland/eatwell#healthy-eating-guidelines-for-kids>].
19. British Nutrition Foundation. Find your balance 2018 [Available from: <https://archive.nutrition.org.uk/healthyliving/find-your-balance.html>].
20. Potter C, Ferriday D, Griggs RL, Hamilton-Shield JP, Rogers PJ, Brunstrom JM. Parental beliefs about portion size, not children's own beliefs, predict child BMI. *Pediatric obesity*. 2018;13(4):232-8.
21. Ofcom. Communications Market Report. 2018.
22. Yang Y, Jia W, Bucher T, Zhang H, Sun M. Image-based food portion size estimation using a smartphone without a fiducial marker. *Public Health Nutrition*. 2019;22(7):1180-92.

Appendix 1: Portion control tool evaluation questionnaire

1. How concerned are you about portion sizes? (1 being not concerned at all, 5 being very concerned) *(please circle)*

1 2 3 4 5

2. Please select when you find portion size a problem *(tick all that apply)*

	Sometimes	Always	Never
Eating at home			
Eating outside of home			
Eating at work			
Eating with friends			
Stressful situations			
Lack of time			
Special occasions			
Eating late/after night out			
Eating while watching TV			
Preparing a meal			
Snacking			

3. Have you or any member of your family used any of the tools in the pack?

Yes	
No	

4. Which of the tools did you prefer using? (please tick all that apply)

The cup	
Child's plate	
Adult's plate	
Measuring Spoons	
None of the tools	

5. Have you or any member of your family used the cup when preparing or serving meals?

Yes	
No	

If no, please tell me if there was a reason for this: _____

6. Which meals was the cup used for? *(tick all that apply)*

Breakfast	
Lunch	
Dinner	
Snacks	
All of the above	

7. Who did you use the cup for and for what meals? *(tick all that apply)*

	Breakfast	Lunch	Dinner	Snacks
Everyone				
Adults only				
You only				
Children only				

Other *(please specify)*: _____

8. How often did you use the cup in a week? (*tick one option*)

Everyday 4-6 days 2-3 days 1 day or less

9. Which types of foods did you use the cup used for? (*tick all that apply and list what specific food was used with portion control tool and ask them to give examples*)

Cereals/rice/pasta _____

Fruits and vegetables _____

Drinks _____

Other (please specify) _____

10. On a scale of 1 to 5 (1 not very good, 5 very good), how would you rate the cup: (*please circle*)

Acceptable		1	2	3	4	5	
Easy to use		1	2	3	4	5	
Convenient		1	2	3	4	5	
Effective		1	2	3	4	5	

11. Did you have any problems with the cup?

Yes	
No	

Main problems

12. Has the cup helped you and/or your family become more aware of portion sizes in the following settings? (*please tick one option only*)

At home only	
Inside and outside the home (<i>both within your home & at takeaways/restaurants/cafes/corner shops</i>)	
Outside the home only (<i>takeaways/restaurants/cafes/corner shops</i>)	
Not sure	
No	

Any further comments on this?

13. Have you changed the amount of food (i.e. portion sizes) of food you serve as a result of using the cup? *(please tick one option only)*

Yes	<input type="checkbox"/>
No	<input type="checkbox"/>
Don't know	<input type="checkbox"/>

If answered 'Yes', please specify in what way the cup has led to a change in portion sizes when serving food in the home: *(please circle)*

	Not at all					Very much so
I'm considering making some changes to my portion sizes and/or those of my children since receiving the cup	1	2	3	4	5	
I've started to change my portion sizes and/or those of my children since receiving the cup	1	2	3	4	5	
I've changed my portion sizes and/or those of my children and maintained these changes since receiving the cup	1	2	3	4	5	
I made some changes to my portion sizes and/or those of my children but have not maintained these changes since receiving the cup	1	2	3	4	5	

Any comments on perceived change in behaviour? _____

14. what three foods do you think the cup would be:

a) most useful

1.
2.
3.

b) least useful

1.
2.
3.

15. In what situations do you think the cup would be useful? *(tick all that apply):*

- Serving food for yourself
- Serving food for your children
- Serving food for all the family
- Serving food outside of the home
- When trying to lose weight

Other *(please specify):* _____

16. Are you likely to keep using the cup when serving food?

Yes No Don't know

Comments: _____

17. Any other comments related to the cup?

Comments: _____

18. Do you use other measures or aids to serve food?

Yes	<input type="checkbox"/>
No	<input type="checkbox"/>

19. If so, what measures/aids do you use?

Appendix 2: Topic guide for focus groups

Explain research, safefood & UU- Portion Control Tools. Today we are going to have a focus group discussion. A focus group is a group discussion that focuses on a topic in depth. In the following hour we will be talking about issues related to the portion control cup that you were given by us. I am here to learn from you, to learn about your ideas, thoughts and comments on these issues.

It's important that I hear what you think. There are no right or wrong answers; there are neither stupid nor smart answers. It's a valuable answer as long as it's an HONEST answer. As it's an informal group discussion, you are strongly encouraged to interact with other people at the table. However, to hear each person clearly, may I ask you that one person speaks at a time.

Please feel free to speak up when you disagree or have differing opinions with someone else here. It's okay to disagree, and it's okay to have different opinions and ideas from others in the group, your thoughts might be like those of many people who are not here at the table. Also, it's helpful for us to hear different points of view.

Also, it's my job to see that everyone has a chance to voice their opinions, as well as to keep us moving along so that we have time to discuss all of the topics. So, at times, it might seem as though I am cutting you off, and this is not meant to be rude but rather to make sure that we have time to hear from everyone on each question.

We will be audio-recording and taking notes on our discussion. This is because we want to get everything that all of you say and we simply can't write fast enough to get it all down!

I want to assure you that all of your comments will be used only for research purposes. We have created participant IDs for each of you. By doing this, you will never be named or identifiable in any of the reports released from this research. In case anyone needs to use the bathroom, they are located _____. And if any of you has to leave early please let us know. Finally, would it be okay if we could ask you to put your mobiles on silent, just so it doesn't interrupt our discussion. Thanks. Does anyone have any questions? You can always get back to me later.

Thank you very much for agreeing to take part in our study. This study is initiated by **safefood** and Ulster University. The purpose is to assess the acceptability and usability of a portion control tool.

My name is *Researcher Name*. I am a researcher based in Ulster University, Coleraine. (Introduce any other team members at this point)

It's important to be aware that we are an independent research team and we are not promoting anything; we are conducting the research that **safefood** have asked. The only purpose that we are here today is to hear a bit about your thoughts and opinions. It's important to know this is a space where you can be completely honest, and anything you say will be anonymized.

Focus Group 'rules' and confidentiality

I am now going to turn on the audio recorder

ACTION: Make sure everyone has handed in the signed consent form.

Ice Breaker

What is your name, how many kids do you have/care for and what are their ages?

Key Discussion Points

Begin with: What was your experience of using the portion control cup during the intervention?

Allow discussion to flow as naturally as possible as some topics may be covered throughout the conversation.

Topics to be covered:

Factors influencing different family member's use of portion control cup

Mealtimes portion control cup was useful and least useful for- expand on this to find out why easier/more difficult for meals/foods.

Which foods the cup was commonly used for and why?

Challenges when using the cup for certain foods.

Attitudes towards the design of portion control cup

How acceptable the portion control cup was in the home? Further explanation required.

How effective the portion control cup was in the home? Further explanation required.

How convenient the portion control cup was in the home? Further explanation required.

Use of portion control cup outside of the home. Further explanation required.

Long term use of portion control cup. Any mention of duration to be expanded on

Maintenance of the cup- keeping it clean, washing, microwaving etc.

Any behavioural changes when using portion control cup. Any changes considered/started to make changes; changes made, and maintained/changes made and not maintained. Expand on each further as they are mentioned- what factors influence these changes?

Closing

Do you want to make any further comments or ideas that have not been covered in this discussion?

Thank you.

For confidentiality concerns, what has been shared in this room stays in the room.

Further probing questions may be used. Examples include:

- Could you give me an example of that?
- Would you mind explaining that further?
- Can you talk about that more etc?



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