



*Research article*

## **Regional differences in portion size consumption behaviour: Insights for the global food industry**

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**Abstract:** Given the influence of globalization on consumer food behaviour across the world, the purpose of this paper is to contribute to the theoretical discourse around food portion size as a global consumption-related symbol and its underlying socio-economic drivers for food industry strategy. Overall, 25,000 global food consumers were surveyed across 24 countries to elicit insight on portion size consumption behaviour as well as consumer perception on eating and drinking small portion size within selected socio-economic classes. The data was quantitatively analysed to answer the pertinent research objectives. In 20 out of the 24 global markets surveyed, large food portion size was statistically established as a prevalent consumption-related symbol. The paper found that there are regional differences in portion size food consumption behaviour, and further disparities exist across age, gender and income status in 24 countries covering all regions, including Australia, China, Mexico, South Africa, United Kingdom and United States of America. The outlined food industry implications reveal that adaptation and standardisation strategies are still relevant in global food and nutrition strategy as revealed by the variations in the preference for food portion sizes across various countries of the world.

**Keywords:** portion size; consumption-related symbol; consumption patterns; global food industry; global food marketing; nutrition strategy

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## 1. Introduction

Rapid improvements in technology enabling social communications and international food marketing promotions has exposed consumers to external cultural forces [1–3], to the extent that local behavioural tenets are no longer the prevalent norms across the world [4]. Indeed, Sobol et al. [5] indicates there is substantial evidence for the presence of a ‘global food consumer culture’ because of the profound effect of globalization [6].

Food consumers worldwide are constantly exposed to external cultural forces without having to leave their native countries [7]. As a result, food consumers employ common set of consumption-related symbols that transcend national borders for food consumption decision-making [8,9]. Admittedly, the meaning embedded in food consumption symbols, like international brands, portrays and exemplifies the core values and beliefs of a given culture [10]. For example, large food portion size could be another significant consumption-related symbol/attribute popularised through the globalised markets. This has implications for international food and nutrition research and practice [5].

Food portion size has long been linked with overweight and obesity in the developed world [11–13]. In fact, a Cochrane report found that people exposed to large portion size and packages consistently consumed larger quantities of food compared with those exposed to smaller portions [14]. Meanwhile, the need for significant adjustments in human behaviour at every level of society globally to achieve sustainability goals has found expression in the form of applying sustainable principles in food procurement [15], food supply chains [16] and linkages of food systems to public health [17]. Yet, rising overconsumption globally [18] presents a critical challenge to food and nutrition, public health and global environmental sustainability [19]. It is important to reiterate that the association between overweight and consumption of larger portion size is well known globally [13,20] and its public health challenges has been amply articulated by a Cochrane Report [14].

Suggested interventions to reduce the incidence of overconsumption to curb overweight and obesity includes (1) on-pack nutritional and portion size information [21,22]; (2) excluding larger portions [23] and also (3) a percentage reduction of portion size [24]. Despite the negative effects of overconsumption, portion size intervention research is not only limited in terms of numbers but also in terms of regional and global coverage. Meanwhile, many people across the world are reported to be consuming similar foods that are increasingly energy-dense and sweeter [12,25,26].

The increasing consumption of energy-dense and sweeter foods are also inevitably connected to the increases in food portion size [27,28]. It is also evident that people across the globe are constantly exposed to a variety of portion sizes, particularly larger portions due to globalisation; see, Benson [29] for the case study of food portion size changes in Britain based on the joint effects of globalisation and Americanisation. An important research question therefore is to what extent has portion size, especially larger food portions become a major food consumption-related symbol across the world. Another salient research question is to ascertain whether consumption of small food size is a common feature among consumers in countries around the world.

Overconsumption of food and other natural resources are major concerns to global nutrition status and environmental sustainability [30] as well as public health [31]. Eating larger portion size has long been associated with overconsumption [32,33] and the extant literature has shown that the main attractions to larger food portions are value for money advantage [11,34–36] and lack of portion size standards due to portion distortions [37–39]. We argue that the projection of larger portion size via

globalisation forces makes food portion size an important consumption-related factor across the world and there is a need for further research on the subject.

Studies such as Young and Nestle [40], Popkin [41], Mcleay and Oglethorpe [42] and Wappling et al. [43] have all underscored the contributing role of overconsumption to obesity and the incidence of non-communicable diseases. This alarming trend is partly influenced by eating larger food portions [13]. For example, massive changes in eating behaviours which accompanies varying socio-demographic indicators in many developing countries has been linked to the effects of globalisation on food systems across the world [44]. Whilst Howard [45] reports the gravity of the problems with obesity in Western countries, Mcleay and Oglethorpe [42] projects a positive correlation between progressive improvement in living standards in less developed countries and increased levels of obesity. This underlines the important role of socio-economic factors [46]. Indeed, Seyfang [19] reported that changes to individual consumption behaviour can be limited by socio-economic factors. Thus, an additional research objective of this paper is to examine the role of selected socio-economic factors in small food portion consumption behaviour across the world. This is essential because mapping food portion size across regional markets of the world provides a salient typology for effective international marketing strategy as well as public health and sustainable consumption policy interventions. Therefore, a global study to unravel the role of socioeconomic factors in eating and drinking small portions will extend research understanding on how living standards influence portion size choices globally.

Regarding regional coverage of food portion studies, only North America (USA) and a few European countries including Scandinavia, have been scantily captured by studies on the effectiveness of interventions aimed at managing portion size (see, (Harnack et al. [36], and Ueland, [22]. Young and Nestle [40] recommended focussing research attention and practical interventions on the consumption of smaller portions as part of the efforts to tackle obesity. This is a position well supported by subsequent studies [47–49]. Therefore, judging by the overwhelming approval to promote smaller food portion sizes, a global study to gauge the popularity and regional differences of eating and drinking small portions is essential.

The primary purpose of this paper is two-fold; firstly, to ascertain whether food portion size is a major consumption related-symbol across the world, thus contributing theoretically to the literature on the role of portion size in global food and nutrition strategy. Secondly, the study seeks to draw on the analysis of a global survey data to empirically investigate the prevalence of eating and drinking small portions across the world and examine how demographic indicators influence the decision to consume smaller food portions.

Theoretically, the paper contributes to food and nutrition research and global studies by reporting the overwhelming endorsement of food portion size as a consumption-related symbol across the world. This contribution was drawn from the finding that portion size was found to be a consumption-related symbol across the 24 countries selected from all regions of the world; even though there are global differences in the consumption of small portion sizes. In 20 out of the 24 global markets surveyed, large food portion size was statistically established as a prevalent consumption-related symbol. The study further found that income is not a key determining factor in small portion size consumption behaviour in many countries except for China, India, Saudi Arabia and the USA. In addition, there are strong associations of small portion consumption behaviour with age and gender across markets around the globe.

The paper begins by linking the literature on portion size and overweight and obesity and the market as well as individual factors driving consumption of large portion sizes. This is followed by a review of the extant literature on the increasing portion size due to globalisation forces and the influence of consumer demography. The paper then presents empirical evidence on the prevalence of eating and drinking small portion sizes as well the single and joint influences of age, gender and income on portion size eating behaviours across the selected countries. Thereafter, a discussion of the contribution of the study to food portion size field from regional and global perspectives is presented. Research limitations and the concluding section of the paper are then covered.

## 2. Portion size and food and nutrition system dynamics

### 2.1. *Food portion size: A contributing factor to overweight and obesity*

The continuous contribution of food portion size to overweight and obesity via its influence on energy intake [47,50–52] shows no sign of receding and its effect poses the single greatest threat to public health across the globe [53,54]. A section of the extant literature suggests that such a situation has arisen as a result of consistent increases in marketplace food portions [51,55,56]. However, another strand of studies points to the interplay between genetic predisposition and an obesogenic environment which encapsulates increased food portion sizes as the main cause of energy imbalance that leads to the prevalence of obesity [57–59]. Young and Nestle [40] traced the trajectory of portion size increases by the food industry in the USA from the 1970s, through the 1980s, up to 2009, and consequently recommended consuming smaller portions as part of efforts to tackle obesity.

### 2.2. *Drivers and motivations for larger food portions*

A significant number of studies have shown that exposing people to larger portions due to the absence of standard sizing leads to portion distortions and contributes to higher food intake and subsequently leads to overweight and obesity. Predisposition to larger food portion sizes has been connected with increased food consumption in all age groups (children, young adults and older adults), and across a variety of food types and consumption settings [38,60–62].

A situation where people perceive larger portion sizes that do not correspond to their weight and activity levels to be right amount of food to consume at a given eating setting is commonly described as experiencing portion distortion. It is therefore underpinned by the fact people experiencing portion distortion do not realize that their portions do not match their weight and activity levels and commonly exceed the recommended serving size [11,38,63]. Portion distortion is defined as perceiving large portion sizes as appropriate amounts to eat at a single eating occasion [63].

Steenhuis and Vermeer [11] outlined a collection of market and individual factors that have created an environment that creates portion distortions. These factors include: a myriad of food portion sizes on the market (see Church [64]); prevalence of larger portion sizes in the market (see Smickilas-Wright et al. [65], Nielsen and Popkin [66], Matthiessen et al. [37], Vermeer et al. [56]); lack of clear portion size labels on food packages (see Bryant and Dundes, [38]) consumer confusion emanating from the use of the terms such as ‘small’, ‘medium’ and ‘large’ (see Young and Nestle, [67]) and consumers construing package size as serving size (see Pelletier et al. [68]).

Taking advantage of value for money is another essential factor explaining why people buy and consume larger portion sizes than they need. For this reason larger portion sizes which offer lower unit cost for customers are more attractive than the smaller alternatives [35,69]. Therefore, value for money associated with buying large portion sizes appears to be more of a rational decision option which invariably leads to overconsumption [11,34]. In a similar vein, marketers have realised that by offering comparatively larger portion sizes at a slightly higher cost, food retailers can attract customers and make more profit [70].

### 2.3. *Portion size as consumption-related symbol*

Aaker [10] suggests that consumption symbols like commercial brands, being it, a local, national or international product play a similar role to that of cultural icons, reasons and public messages that serve as cultural conveyors. Undoubtedly, 'standard' food portion sizes of well-known major international brands are accepted within marketing research theory and practice as an important consumption related symbol at local and national levels of developed countries such as the USA, UK and mainland Europe [12] because it has long been linked with overweight and obesity [11,13]. It is common knowledge that the fast food industry has witnessed vast changes in serving and portion sizes over the last three decades. Indeed, a variety of offers ranging from super-size to value portions of fast food meals are all available to consumers [71].

Research at the global level to examine the dynamics of consumers' use of portion size as a shared set of consumption-related symbol is however limited [29]. Notwithstanding this research limitation, Benson's [29] work on increasing portion size in Britain is a classic case study that categorically links food portion size increases over two decades, prior to the study, to the effects of globalisation and Americanisation, as one of the three main reasons for the phenomenal growth in the average food portion size in Britain. This piece of evidence establishes portion size as a major consumption related symbol in Britain. The study further emphasises exposure to American culture via globalisation as a key promoter of larger portion sizes in Britain. In a similar vein, Davey [72] identified a comparable evolutionary pathway of British food production, marketing and consumption patterns to that of the USA.

Wrieden et al. [73] also reported that comparatively portion size patterns in Britain were not as expansive as in the United States of America. However, the introduction of 'giant', 'king size' 'Super-Size' chocolate bars and other sweets; 'Big Eat' packets crisps (Dave 2004) as pertained in USA, promotes overconsumption in Britain [74]. The Britain example reinforces the need to explore the role of portion size as a consumption related symbol across the world as products and eating cultures of developed countries, ably led by the USA, has been willingly adopted by the many people around the world and presently integrated into local or national cultures. Therefore, to capture these changes in food consumer behaviour across the world, because of globalization, global food and nutrition research ought to explore food consumers' dispositions toward food portion size as per the influence from foreign countries and globalization as well.

#### *2.4. The role of consumer demography (gender, age and income) in food portion size consumption behaviour*

In addition to value for money and portion size distortion, socioeconomic indicators such as age, income, gender among others act as moderators to influence portion size decisions. For instance, Seyfang [19] underlined the significance of sustainable consumption as a novel environmental policy objective, but underscored the limitations that socio-economic factors place on possible changes to individual consumption behaviour. Nelson et al. [75] found that the age, gender and body size of an individual play a role in their perception of portion size. Similarly, Levitsky and Young [76] established different periods for high food intake and its corresponding weight gain for male and female freshmen. Sociodemographic was established as one of the individual variables that moderates and mediates eating patterns [77]. On the contrary, sample personal characteristics did not have an effect on portion size and energy intake according to Diliberti et al. [25].

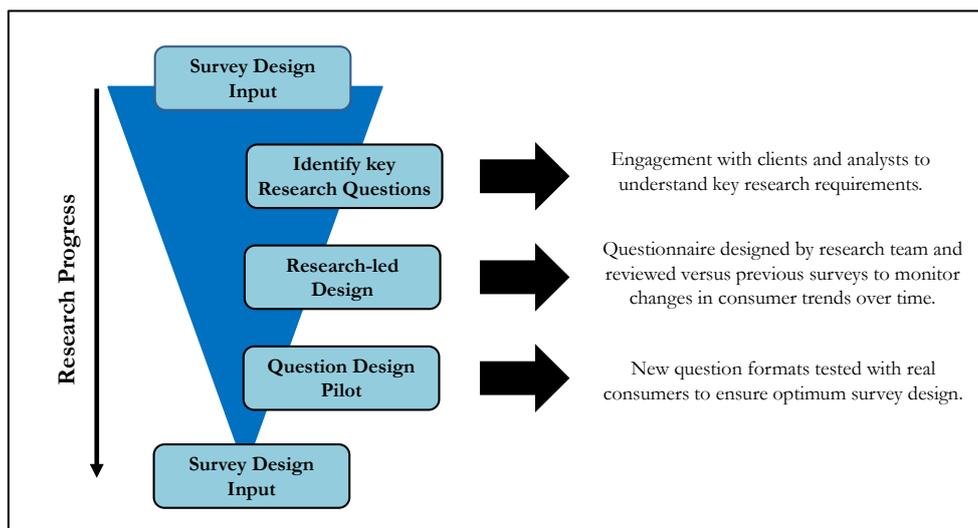
The limited extant literature in the field of portion size research [11,47,52] has established the role of globalisation forces in the increasing portion size in Britain [29]. In addition the existing literature also recommended eating and drinking small portion sizes as a key antidote to tackle the problem of overweight and obesity across the world [48,49]. Notwithstanding this, little is known regarding the extent to which portion size is a major consumption related symbol across the world and the degree of adoption of small portion size consumption patterns by food consumers across key markets of the world. This study seeks to bridge this gap by analysing global survey data on the position of food portion size as a consumption symbol of the global consumer in addition to eating and drinking small portion sizes and delineating the role of age, gender and income status in adopting such an important consumption pattern.

### **3. Research methodology**

#### *3.1. Data collection approach and analyses*

An empirical research approach was adopted in this study following a systematic research design process in which quantitative data was collected in a survey. The survey data from Canadean's 2013 Global Consumer Survey explored consumer behaviour and opinion across 24 countries regarding eating and drinking small portion sizes. The research approach adopted in the data collection process is presented in Figure 1.

The survey was carried out between April and June 2013 and captured 25,332 respondents globally. This was reduced to 23,020 (or 90.9% of the total) when respondents who provided all the key information required in this research was tallied together. Respondents were recruited via an online panel. The panel provider guaranteed that the sample was nationally representative in each country and the applied quotas ensured the sample was representative in terms of age, gender and income distribution for each country. Respondents aged 15 years or more were used in the survey. In addition to consumer demographics such as age, gender and income, the survey solicited views on the extent to which people try to eat and drink small portions from sampled consumers in 24 countries as presented in Figure 2.

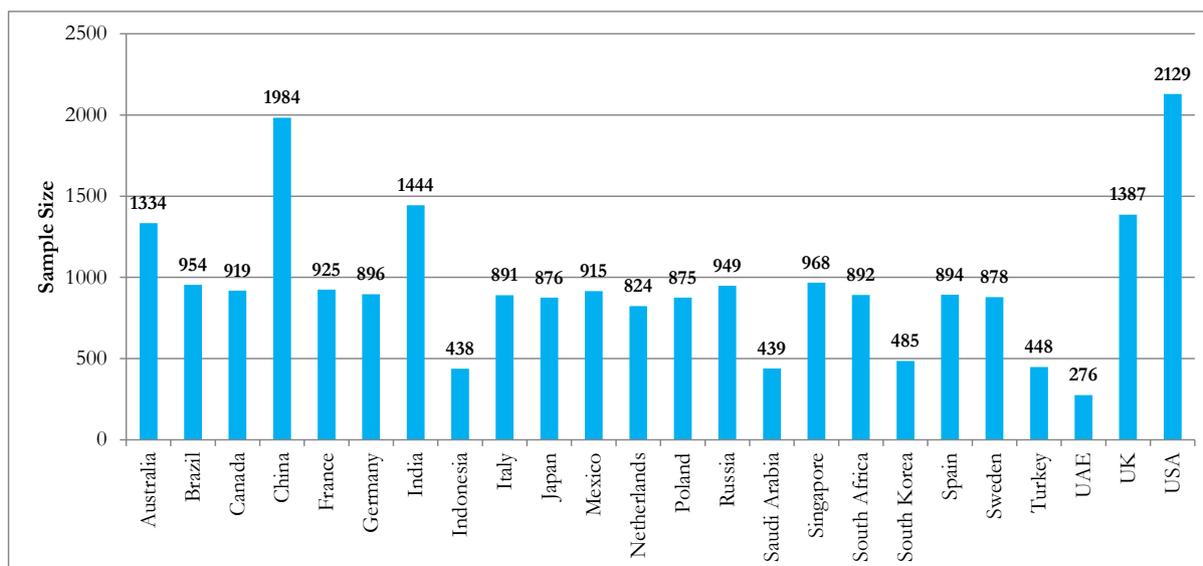


**Figure 1.** Data collection process adopted in the Canadean Global Consumer Survey.



**Figure 2.** Global nature of Canadean Global Consumer Survey.

The sample size per country for small portion sizes survey is presented in Figure 3. The sample size ranged from the smallest (United Arab Emirates with 276 respondents) to the largest (China with 1984 respondents). The survey for each country was implemented by random sampling to ensure that the sample size and data collected is statistically representative of the population of each country.



**Figure 3.** Sample Data for each country used in the study. (Source: Canadean's Global Consumer Survey, 2013).

### 3.2. Data analyses

To ascertain whether food portion size is a prevalent consumption-related symbol or not, a binomial proportionate test was conducted to determine if there was any statistical significance in consumers' portion size preferences across the 24 global markets in terms of wanting to eat and drink small portion sizes. Descriptive statistics were used to show global, regional and national perceptions of eating and drinking small portion sizes. Kruskal-Wallis test was used to examine whether there is significant difference between eating and drinking small food portion due to country differences. A binary logistic regression was also used to explore relative contributory roles of Gender, Age and Income Levels in small portion sizes consumption across the 24 countries. The binary logistic regression model was adopted because it has been proved to be a useful model as reported by Mccarty and Hastak [78] when analysing the relationships between a dichotomous dependent variable (in this case eating and drinking small portions and not eating and drinking small portions) and independent variables which are metric (in this case *AGE* and *INCOME LEVELS*) or dichotomous (in this case *GENDER*). In fact Coussement et al. [79] also emphasise that the logistic regression model is a conceptually simple and quick technique but also provides robust results compared to the other techniques.

$$\ln\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1 \cdot GENDER + \beta_2 \cdot AGE + \beta_3 \cdot \ln(INCOME) \quad (1)$$

In the Eq 1,  $p$  represents the probability of being a person who eats and drinks small portions and  $\left(\frac{p}{1-p}\right)$  the odds ratio which gives an indication of how much more likely, with respect to odds, eating and drinking small portions occurs.

$\beta_0$  is the logistic regression constant and  $\beta_1, \beta_2$  and  $\beta_3$  are the logistic regression coefficients for the independent variables or predictors *GENDER*, *AGE* and  $\ln(INCOME)$ . The natural log of

*INCOME LEVEL* was rather used as the independent variable and not *INCOME LEVEL* because of the rather large values of *INCOME LEVEL* compared to the other independent variables. In running the model, the independent variable *GENDER* was categorised as a binary variable with *MALE* assigned 1 and 0. Similarly, the dependent variable was also categorised as a binary variable with eating and drinking small portions assigned a 1 and not eating and drinking small portions 0. In applying logistic regression to the sampled data in the 24 countries, no assumption of normality, linearity and homogeneity of variance for the independent variables are made.

#### 4. Results and discussions

##### 4.1. Testing for food portion size as a prevalent consumption-related symbol

To ascertain whether food portion size is a prevalent consumption-related symbol or not, a binomial proportionate test was conducted to determine if there was any statistical significance in consumers across the 24 global markets wanting to eat and drink small portion sizes. The purpose of this is to test the hypothesis that there is equality of two binomial proportions; that is:

$$H_0: p_1 = p_2 \text{ and } H_A: p_1 \neq p_2 \quad (2)$$

The Null Hypothesis  $H_0$  is defined on the basis that there is no statistical significance between those wanting to eat and drink small portion sizes and those who do not. As such, if the Null Hypothesis is rejected because there is statistical significance between those wanting to eat and drink small portion sizes and those who do not, then Food Portion Size can now be put forward with some statistical certainty that it is a prevalent consumption-related symbol. The question now is; what aspect of Food Portion Size is globally, a prevalent consumption-related symbol? To answer this question, we assess those countries, with statistical significance between those wanting to eat and drink small portion sizes and those who do not want to eat and drink small portion sizes. Table 1 shows that, out of the 20 countries in which there is statistical significant difference between those wanting to eat and drink small portion sizes and those who do not, 16 countries have preference for large portion sizes. The exceptions are China, India, Singapore and Spain. It can therefore be inferred that large portion sizes is a prevalent consumption-related symbol. To validate this ascertain, a binomial proportionate test is conducted for the 20 countries in which there is statistical significant difference between those wanting to eat and drink small portion sizes and those who do not. The results, with a  $p$ -value of 0.000 and a proportion of 0.58 (not wanting to eat and drink small portions) to 0.42 (wanting to eat and drink small portions), statistically reinforces the paper's view that large food portion sizes in indeed a prevalent consumption-related symbol across global markets. Table 1 below are the results of the binomial proportionate test for the 24 global markets.

**Table 1.** Testing for food portion as a prevalent consumption-related symbol.

Country	Food Portion as a Consumption-related Symbol	Observed Proportion	Exact Sig (2-tailed)
Australia	No	0.58	0.000
	Yes	0.42	
Brazil	No	0.48	0.331
	Yes	0.52	
Canada	No	0.56	0.000
	Yes	0.44	
China	No	0.43	0.000
	Yes	0.57	
France	No	0.66	0.00
	Yes	0.34	
Germany	No	0.71	0.000
	Yes	0.29	
India	No	0.32	0.000
	Yes	0.68	
Indonesia	No	0.59	0.000
	Yes	0.41	
Italy	No	0.52	0.203
	Yes	0.48	
Japan	No	0.75	0.000
	Yes	0.25	
Mexico	No	0.52	0.234
	Yes	0.48	
Netherlands	No	0.67	0.000
	Yes	0.33	
Poland	No	0.57	0.000
	Yes	0.43	
Russia	No	0.61	0.000
	Yes	0.39	
Saudi Arabia	No	0.65	0.000
	Yes	0.35	
Singapore	No	0.42	0.000
	Yes	0.58	
South Africa	No	0.47	0.097
	Yes	0.53	
South Korea	No	0.73	0.000
	Yes	0.27	
Spain	No	0.44	0.00
	Yes	0.56	

*Continued on next page*

Country	Food Portion as a Consumption-related Symbol	Observed Proportion	Exact Sig (2-tailed)
Sweden	No	0.75	0.00
	Yes	0.25	
Turkey	No	0.54	0.049
	Yes	0.46	
UAE	No	0.52	0.577
	Yes	0.48	
UK	No	0.64	0.000
	Yes	0.36	
USA	No	0.56	0.000
	Yes	0.44	

#### 4.2. Small portion sizes eating patterns and trends

The results on the global patterns and trends on eating and drinking small portion sizes at the aggregated level are presented in Figure 4. It shows that Sweden (24.82%), Japan (25.0%), South Korea (28.55%) and Germany (29.3%) recorded lower inclination, and United Arab Emirates (50.7%), Brazil (51.6%), China (56.7%) and India (67.5%) recorded the higher percentage marks for efforts at eating small portion sizes. In this aggregated level analysis, respondents' who ate and drank small portions 'most of the time' and 'all the time' were considered to eat and drink small portions. However, those that 'never', 'rarely' or 'occasionally' eat and drink small portions were aggregately classed as not eating and drinking small portions.

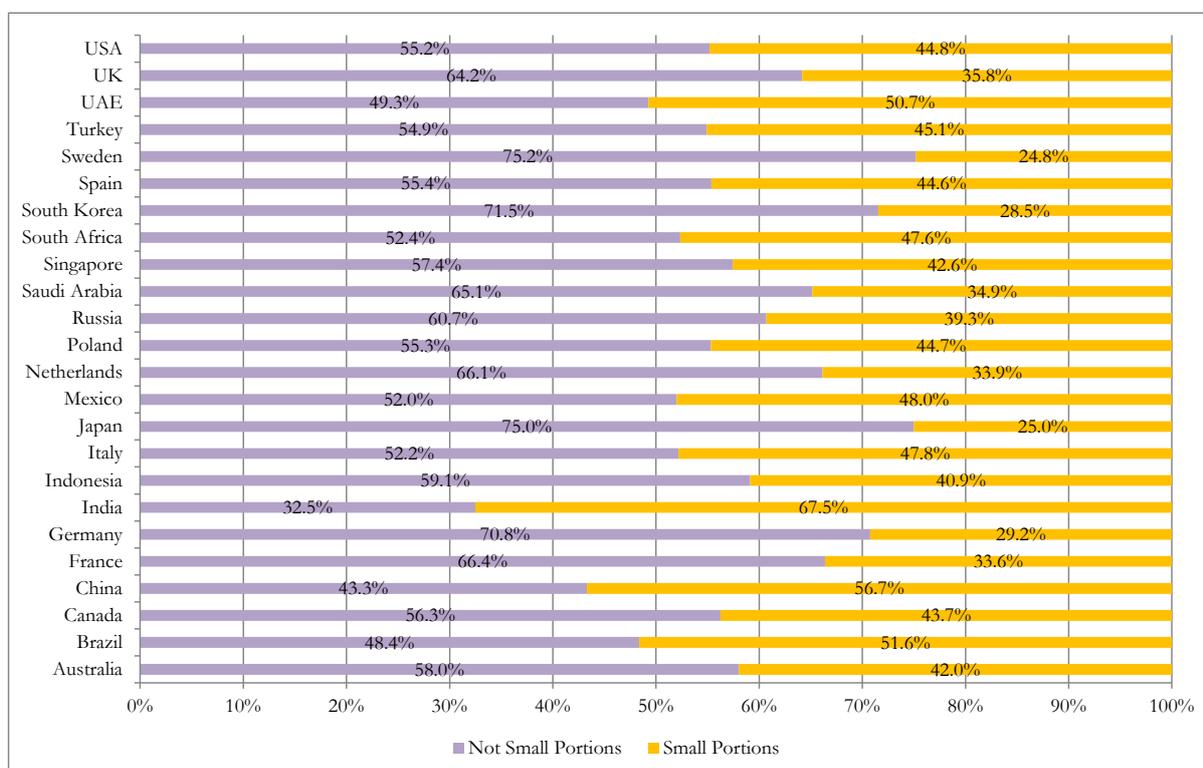
In terms of the level of development of the participating countries, there was a clear trend that the top 5 countries can be categorised as developing or emerging countries. Additionally, the bottom 5 countries are all developed nations. This leads to the suggestion that in developed countries such as Sweden, Japan, South Korea Germany, France, the status quo is to eat small portions hence there is less inclination to make a conscious effort to eat small portions. It can therefore be argued that there may be underlying cultural factors for this trend which needs to be investigated further at individual national levels. It also confirms the assertion made by Prentice [80] who suggested that social stigmatisation against obesity tends to be common in western countries.

The results based on the aggregated data (Figure 4) portray the fact that efforts to eat and drink small portions is not satisfactory given that of the respondents sampled in the 24 countries, results from 20 countries were below the half-way mark (50%) in terms of the effort at eating and drinking small portion sizes.

These highlighted figures could provide the needed catalyst to encourage the food industry to take keen interest in the small portion sizes market. Indeed, in an era where large portion sizes appear to be the 'norm' driving both consumer preferences and food marketing efforts [49] the important role of food manufacturers [81,82], employers in workplace canteens [83] and more importantly, consumers [84] in shifting behaviour patterns towards small food portions has become paramount.

It is important to reiterate that the case for small portion sizes has been variously made in terms of better health management and the consequential environmental benefits [47–49]. What seems to

be missing is whether there is a business case for manufacturing and retailing small portion sizes. Therefore, an empirical insight that suggests considerable marketing prospects for small food portion sizes particularly in developing markets as this study suggests ought to be good news for the food industry and health and environmental policy makers. However, an aggregated dataset has its unique limitation of oversimplifying issues and hence there is the need to look beyond the headline figures as well.



**Figure 4.** Aggregated global trends on the ratio of eating and drinking small portion sizes or not.

The results based on the disaggregated data provide more interesting insights into the dynamics of eating and drinking small patterns across the 24 countries. Consumers' views on the extent to which they try to eat and drink small portions 'all the time' (see Column 6 of Tables 2 and 3) was consistently lower than those that eat and drink small portions 'occasionally' and 'most of the time'. In fact, only 10.5% of the sample population made some effort to eat and drink small portions 'all the time'. This is a clear case confirming that large portion sizes still predominates across global markets [49,85].

The global average results on gender regarding eating and drinking small portion sizes (see Table 2) confirmed the long acknowledged notion that more females (12%) on the average consume small portion sizes than their male (9%) counterparts [86], although these do not reflect substantial markets for small food portion sizes. The results further revealed that global averages in terms of different age groups, that is, the seven age groups categorised in this research (See Table 2) regarding eating and drinking small portion sizes are not different as the findings range between 10% and 12%. This result leads to the suggestion that no single age group is largely associated with eating and drinking small portion sizes on the basis of global averages.

**Table 2.** Disaggregated results based on global averages for eating and drinking small portions, gender and age.

Independent variables	Eat and drink small portions				
	Never	Rarely	Occasionally	Most of the time	All the time
Global Average	6%	35%	16%	32%	11%
Gender					
Female	5%	14%	35%	34%	12%
Male	7%	18%	37%	30%	9%
Age					
15–17	8%	15%	35%	30%	12%
18–24	8%	19%	35%	26%	11%
25–34	6%	17%	36%	30%	11%
35–44	5%	15%	37%	33%	10%
45–54	5%	15%	37%	33%	10%
55–64	4%	13%	36%	37%	10%
65+	4%	11%	35%	39%	11%

Disaggregated results based on global averages for eating and drinking small portions across the 24 countries surveyed revealed significant insights, which reinforce the findings based on the aggregated results.

Disaggregated results based on global averages for eating and drinking small portions per country presented in the last column of Table 3 revealed the five top ranking countries in terms of ‘eating small portion all the time’ is as follows: First-India (23%), second-United Arab Emirates (17%), third-Brazil (16%), fourth-Mexico (14%) and fifth-China (13%). Comparing these values with ‘occasional’ and ‘most time’, the values shows that eating and drinking small portion sizes is not an established and fixed pattern across the world, even for those who recognise the need to eat small. Interestingly, percentage rankings for eating small portions ‘all the time’ revealed in a descending order: France (7%), Sweden (6%), Germany (5%), South Korea (4%) and Japan (4%) which are all developed nations.

Countries such as Japan and Sweden had relatively fewer percentages of people trying to eat and drink small portions “all the time” according to our Likert scale. This may be due to the fact that, the status quo in such countries is to eat small portions hence there is less inclination to make a conscious effort to eat small portions. Similarly, in countries where eating larger portions are prevalent such as USA, it is expected that there would be higher inclination to eat smaller portions, all things being equal. This therefore calls for detailed country specific studies on food consumption where specific country attributes can be examined to inform food and health policies. Indeed, a McKinsey Global Institute report on overcoming obesity recommended portion control as one of many general intervention options [83]. While this is useful, our results indicate that based on the consumption patterns of different countries, portion control as an intervention option will be more relevant to some countries than others. The test for significance results using Kruskal Wallis indicates that the observed differences in eating and drinking small food portion sizes due to

different country influence are significant and not due to chance. The Kruskal Wallis summary statistics generated a Chi-Square of 413.955 with a degree of freedom of 23 and Asymp. Sig. of 0.000.

**Table 3.** Disaggregated results based on global averages for eating and drinking small portions per country, which is ranked according to the percentage of response “All the Time”.

Countries	Eat and drink small portions				
	Never	Rarely	Occasion ally	Most of the time	All the time
India	2%	6%	25%	43%	23%
United Arab Emirates	3%	12%	33%	35%	17%
Brazil	4%	13%	32%	36%	16%
Mexico	4%	15%	33%	33%	15%
China	1%	8%	35%	43%	13%
Indonesia	5%	14%	43%	26%	12%
Italy	5%	13%	36%	34%	12%
Saudi Arabia	13%	20%	32%	23%	12%
Turkey	6%	18%	31%	33%	12%
South Africa	3%	16%	34%	36%	11%
United States of America	5%	14%	37%	33%	11%
Poland	6%	17%	35%	33%	10%
Russia	7%	21%	33%	29%	10%
Spain	4%	16%	37%	34%	10%
Australia	5%	15%	38%	33%	8%
Canada	4%	15%	39%	34%	8%
United Kingdom	6%	19%	39%	27%	8%
France	9%	22%	35%	26%	7%
Singapore	3%	14%	41%	35%	7%
Netherlands	8%	16%	43%	27%	6%
Sweden	12%	23%	39%	19%	6%
Germany	9%	23%	39%	23%	5%
Japan	18%	18%	40%	20%	4%
South Korea	8%	23%	41%	24%	4%

#### 4.3. Logistic regression: The role of demographic indicators (age, gender and income) in the consumption of small food portions.

The summarised logistics regression results derived using SPSS (or Statistical Package for the Social Science) for all 24 countries are shown in Table 4. It provides the output of the overall test results of the logistic regression model below which was applied to the sample data for each of the 24 countries.

$$\ln\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1 \cdot GENDER + \beta_2 \cdot AGE + \beta_3 \cdot \ln(INCOME LEVEL) \quad (3)$$

For each country, a  $p$ -value for the full model is presented in Column 5 of Table 4. This  $p$ -value provides a statistical test which represents the probability of obtaining the chi-square statistic (Column 3) or a more extreme value given that the null hypothesis is true. In this study, the null hypothesis  $H_0$  is that the independent: GENDER, AGE and INCOME LEVEL variables cannot be used to predict that a person will eat or drink small portions for a particular country. The alternative hypothesis  $H_1$  will therefore be that some of the independent variables will be used to predict that a person will eat or drink small portions for a particular country. Statistically, these hypotheses are represented as:

- Null Hypothesis  $H_0: \beta_1 = \beta_2 = \beta_3 = 0$
- Alternate Hypothesis  $H_1: \text{Not all of } \beta_1, \beta_2 \text{ and } \beta_3 \text{ are } 0$

It can be observed that of the 24 countries, only 5 countries namely: Indonesia, Italy, Japan, Sweden and United Arab Emirates (UAE) had  $p$ -values greater than 0.05 (assuming significance level of 95%). Hence, for these countries, the null hypothesis cannot be rejected implying that the model cannot be used to explain the data and there would be no logistic regression model for these countries.

For the rest of the other countries, the null hypothesis is rejected because the  $p$ -values are less than 0.05 (assuming significance level of 95%). This suggests that the model for these countries are statistically significant because there is enough evidence to say that at least one slope of the regression in the population is not zero and that at least one predictor variable from GENDER, AGE and INCOME LEVEL explains a significant amount of variability in the response variable regarding eating and drinking small portions.

The Hit Ratio of the model expressed as a percentage provides a measure of accuracy of the model. It therefore explains the number of cases that are correctly predicted by the model using a cut value of 0.5. This means that if the predicted probability is greater than 0.5 the model assumes that a correct prediction has been made and if less than 0.5 and incorrect prediction has been made. For instance, of the countries whose models are statistically significant, Germany has the highest Hit Ratio of 71.1%. This implies that the logistic regression model for Germany can be used to predict the probability of eating and drinking small portions among the population to an accuracy of 71.1% based on the independent variables. The statistical insignificance of the models for Indonesia, Italy, Japan, Sweden and UAE renders the Hit Ratio of these countries inapplicable.

The Logistic Regression Coefficients expressed in log-odds units are the coefficients for predicting the dependent variable from the independent variables. The  $p$ -values for each of the independent variables also provides an indication of those variables or predictors which are statistically significant ( $p$ -values less or equal to 0.05 and so highlighted in Green) and statistically insignificant ( $p$ -values greater than 0.05 and so highlighted in Red). An independent variable will be included in the model if it is significant and rejected if it is not significant. As an example, the logistic regression model for South Africa becomes:

$$\ln\left(\frac{p}{1-p}\right) = -1.779 + -0.701.GENDER + 0.022.AGE \quad (4)$$

Where  $p$ : probability of eating or drinking small portions. This logistic model provides an estimation of the amount of increase in the predicted log odds of being someone who eats and drinks small portions that would occur for a one-unit increase in a specific predictor, holding all other predictors constant.

**Table 4.** Summary results of the Logistic Regression Model for the 24 countries.

Country	Full Model					Gender		Age		LN (Income)		Constant	
	N	Chi-Square	df	p-Value	Hit Ratio [%]	Log. Ref. Coeff.	p-Values Coeff.						
Australia	1334	32.438	3	0.000	60.0	-0.558	0.000	0.010	0.004	0.065	0.386	-1.173	0.161
Brazil	954	29.317	3	0.000	56.7	-0.203	0.125	0.022	0.000	-0.065	0.287	-0.084	0.886
Canada	919	18.131	3	0.000	59.7	-0.446	0.001	0.011	0.009	0.120	0.186	-1.801	0.073
China	1984	20.734	3	0.000	57.9	-0.127	0.176	-0.006	0.028	0.219	0.000	-1.896	0.004
France	925	9.897	3	0.019	66.4	-0.282	0.047	0.011	0.015	-0.134	0.211	0.377	0.724
Germany	896	28.306	3	0.000	71.1	-0.432	0.005	0.020	0.000	-0.171	0.083	0.252	0.799
India	1444	15.400	3	0.002	67.5	-0.239	0.036	0.002	0.657	0.225	0.001	-2.100	0.016
Indonesia	438	4.920	3	0.178	59.1	-0.416	0.045	-0.001	0.935	-0.032	0.767	0.444	0.806
Italy	891	7.536	3	0.057	56.5	-0.304	0.025	0.006	0.134	0.036	0.718	-0.556	0.564
Japan	876	7.021	3	0.071	75.0	-0.287	0.084	0.020	0.274	0.162	0.051	-3.680	0.004
Mexico	915	28.330	3	0.000	57.4	-0.348	0.100	0.019	0.000	0.112	0.451	-1.284	0.090
Netherlands	824	36.230	3	0.000	66.5	-0.726	0.000	0.016	0.000	-0.057	0.232	-0.517	0.305
Poland	875	38.658	3	0.000	59.5	-0.719	0.000	0.012	0.001	0.120	0.167	-1.847	0.056
Russia	949	23.406	3	0.000	63.3	-0.557	0.000	0.046	0.008	0.100	0.168	-1.937	0.042
Saudi Arabia	439	30.774	3	0.000	64.0	-0.130	0.534	0.008	0.000	-0.412	0.001	2.399	0.069

*Continued on next page*

Country	Full Model					Gender		Age		LN (Income)		Constant	
	N	Chi-Square	df	p-Value	Hit Ratio [%]	Log. Ref. Coeff.	p-Values Coeff.						
Singapore	968	9.178	3	0.027	58.3	-0.261	0.047	0.008	0.050	0.097	0.257	-1.549	0.093
South Africa	892	45.318	3	0.000	60.2	-0.701	0.000	0.022	0.000	0.097	0.206	-1.779	0.049
South Korea	485	10.360	3	0.016	71.5	-0.034	0.870	0.018	0.006	0.214	0.187	-5.410	0.057
Spain	894	24.033	3	0.000	58.3	-0.478	0.001	0.015	0.000	-0.006	0.957	-0.555	0.581
Sweden	878	4.026	3	0.259	75.2	-0.134	0.394	0.006	0.261	-0.201	0.093	1.253	0.385
Turkey	448	10.076	3	0.018	56.5	-0.555	0.005	-0.006	0.429	-0.049	0.696	0.843	0.488
UAE	276	6.516	3	0.089	53.6	-0.392	0.115	0.029	0.031	-0.075	0.484	0.030	0.979
UK	1387	19.609	3	0.000	64.2	-0.499	0.000	0.002	0.568	0.023	0.758	-0.655	0.401
USA	2129	26.376	3	0.000	57.7	-0.371	0.000	0.006	0.027	0.118	0.029	-1.557	0.007

**Table 5.** Demographic factors influencing small eating and drinking portions by country.

Statistically significant demographic factors influencing small eating and drinking portions						
Gender	Age only	Income only	Gender and age	Gender and income	Age and income	Gender, Age and income
UK	Brazil	-	Australia	India	China	USA
Turkey	Mexico		Canada		Saudi Africa	
	South Korea		France			
			Germany			
			Netherlands			
			Poland			
			Russia			
			Singapore			
			South Africa			
			Spain			

In general, it can be argued that *INCOME LEVEL* is mostly insignificant besides China, India, Saudi Arabia and the USA in explaining variations in the data. Such finding reinforces earlier research findings that suggest consumers may be willingness to pay realistic or premium price for smaller portion options [47]. It is also only in USA can all three predictor variables and the constant be used in the model because they are all statistically significant. A summary of demographic factors, which are statistically significant and influence small eating and drinking portions in specific countries are highlighted in Table 5.

The overall negative sign on all coefficients of GENDER for all 24 countries is a confirmation that relatively females eat small portion sizes than men and that this is a global phenomenon. The consistent positive coefficient for AGE across all countries with the exception of China and Turkey is also an indication that on the whole that people tend to eat small portions as they grow older.

In general, the models which have been highlighted as statistically significant (refer to Column 5 in Table 4) can therefore be used as a proxy for determining the probability of a person in a particular country eating and drinking small portions or not.

#### 4.4. *Global food and nutrition and public health management implications*

The outlined global food and nutrition implications reveal that adaptation and standardisation strategies are still relevant in the area of food and nutrition strategy as revealed by the variations in the preference for food portion sizes across global markets. Additionally, the implication of this research is that despite the huge potential, societal and environmental wellbeing benefits that can be derived from eating and drinking small portion sizes, it will take further advocacy, awareness and change by the food industry beyond sustainable initiatives such as lean processing lean [87] to have it as a mainstream consumption habit around the world. Undeniably eating small portion sizes will ameliorate the negative effects of overweight and obesity [49] but this study suggests that making a clear business case to justify marketing preference for smaller portions is not amply supported by

consumer food portion sizes preferences across the globe. Additionally, regional differences in the small food portion size consumption behaviour is profound and this requires targeted rather than generic intervention to promote the adoption and consumption of small food sizes on the part of food industry and public health stakeholders operating within specific regions across the world. Therefore, making an argument to support the manufacturing and retailing of small food portion sizes, which could mean marketers changing highly profitable bigger and established portion sizes [88] is challenged by the absence of a considerable market size across regional markets around the world. However the lack of a considerable market size does not appear to be a satisfactory reason that will mitigate pressure from health, sustainable and other social agencies across the world that are grappling with the effects of obesity, for marketers to consider the effects of larger portion size on consumption [49,89]. Hence, the encouraging overall picture on efforts made to eat and drink small portions globally and the weak association of income level with small portion sizes consumption found through this research, coupled with earlier research findings that suggest food consumers are willingness to pay realistic or premium price for smaller portion options (see [47]) must serve as an incentive for the food industry and marketers to seriously consider smaller portion size options.

The findings that females tend to eat smaller portions compared to males, as well as unravelling that age has negative relationship with small portion consumption in all 24 countries around the world, are significant and have implications for food and nutrition policy interventions, marketing, natural resources utilisation and health management. Age and gender are still relevant demographic factors that ought to be considered in both portion size strategy and health management interventions. It is however important to emphasise that factoring age and gender into portion size strategy, sustainability and health management programmes to tackle the problem of overweight and obesity across the world [47–49] should take into account country variations as detailed in the findings of this research. Specifically, food and nutrition practitioners and other relevant stakeholders can capitalize on packaging as a route to aid portion control and also engage with younger food consumers through public health communication and as well as food on-pack labelling.

#### *4.5. Research limitations*

Although the study provides useful theoretical and empirical insight into the prevalence of reduced-size food consumption across the world, some research limitations need to be highlighted. Firstly, the use of self-reported data is known to be associated with varying degree of respondents' bias. Additionally, other potential socio-economic variables such as educational level, culture, religion, ethnicity could have been selected relative to what the study used. It is therefore highly recommended that a nested specification of a model which guarantees a widened pool of socio-economic factors can be adopted for future research. This method can be executed using experimentation and observation at country-level studies as an alternative to survey for data collection.

## **5. Conclusions**

This paper presents a theoretical and empirical insight into the prevalence and regional differences of small portion consumption behaviour, and disparities across age, gender and income status in 24 countries covering all regions globally, including Australia, China, Mexico, South Africa, United Kingdom and United States of America based on global survey data from over 25,000 food

consumers. The underlying methodology employed descriptive statistics and test of significance differences using Kruskal-Wallis methodology to show global, regional and national perceptions of eating and drinking small portion sizes and a binary logistic regression to explore relative contributory roles of gender, age and income levels to the perceived amount of food consumed across the 24 countries.

Theoretically, the paper contributes to food and nutrition research and global studies by reporting an overwhelming endorsement of food portion size as a consumption-related symbol for global consumers. This contribution was inferred from the results indicating that portion size was a consumption-related symbol across the 24 countries selected from all regions of the world; even though there are global differences in the consumption of small portion sizes. Indeed, in 20 out of the 24 global markets surveyed, large food portion size was statistically established as a prevalent consumption-related symbol.

The paper further establishes that at the aggregated level, food consumers particularly in developing and emerging countries such as India, UAE, Brazil and Mexico are placing greater importance on the size and the amount of food eaten on a regular basis. It also showed that income is not a key determining factor in portion size consumed in many countries with the exception of China, India, Saudi Arabia and the USA, and there are strong associations between small portion consumption behaviour and age and gender across global markets. This is especially the case for women, who tend to eat and drink small portions sizes than men, with about 50% of females indicating that they eat or drink smaller portions all or most of the time. An inference is drawn from the study that limited inclination to eat small portions all the time may have cultural and nutritional policy influences as shown in the case such as Japan and Sweden and vice versa as is the case of the USA. Given that food portion control is generally recommended as an intervention option, the study reports that portion control as an intervention option will be more relevant to some countries than others.

For food marketers operating across international markets, an innovative way of utilising smaller portion size eating patterns and the role of consumer demographics to inform portion size decision making, is presented with variations and similarities across global markets highlighted. Given the global nature of the negative effects of consuming larger portions, it is envisaged that food and nutrition, marketing, sustainable consumption and health management policy synergies can be derived by drawing on similar and/or dissimilar trends and patterns espoused between consumer demographics and the consumption of small food portions. Overall the paper provides unique insight into the prevalence and regional differences in portion sizes consumed globally and the role of age and gender to better equip marketers and social agencies across the world to address how small portion sizes might be employed in resolving the negative effects of overweight and obesity due to overconsumption.

It is proposed that future research on country-level food consumption patterns adopts a nested specification model which integrates a widened pool of socio-economic factors using alternative surveying methods such as experimentation and/or observation.

## References

1. Suarez M, Belk R (2017) Cultural resonance of global brands in Brazilian social movements. *Int Mark Rev* 34: 480–497.

2. Michaelidou N, Reynolds N, Greenacre L, et al. (2015) Cross-cultural and cross-national consumer research: Psychology, behavior and beyond. *Int Mark Rev*: 32(3/4).
3. Demartini M, Pinna C, Tonelli F, et al. (2018) Food industry digitalization: from challenges and trends to opportunities and solutions, In: *IFAC-PapersOnLine*, Belgium, 1371–1378.
4. Alden DL, Steenkamp J, Batra R (1999) Brand positioning through advertising in Asia, North America, and Europe: The role of global consumer culture. *J Mark*: 75–87.
5. Sobol K, Cleveland M, Laroche M (2018) Globalization, national identity, biculturalism and consumer behavior: A longitudinal study of Dutch consumers. *J Bus Res* 82: 340–353.
6. Özsoy A, Batra R, Chattopadhyay A, et al. (2012) A global brand management roadmap. *Int J Res Mark* 29: 1–4.
7. Samuel Craig C, Douglas SP, Bennett A (2009) Contextual and cultural factors underlying Americanization. *Int Mark Rev* 26: 90–109.
8. Peñaloza L, Gilly MC (1999) Marketer acculturation: The changer and the changed. *J Mark* 63: 84–104.
9. McCracken G (1986) Culture and consumption: A theoretical account of the structure and movement of the cultural meaning of consumer goods. *J Consum Res* 13: 71–84.
10. Aaker JL, Benet-Martinez V, Garolera J (2001) Consumption symbols as carriers of culture: A study of Japanese and Spanish brand personality constructs. *J Pers Social Psychol* 81: 492.
11. Steenhuis IH, Vermeer WH (2009) International journal of behavioral nutrition and physical activity. *Int J Behav Nutr Phys Act* 6: 58.
12. Duffey KJ, Popkin BM (2011) Energy density, portion size, and eating occasions: Contributions to increased energy intake in the United States, 1977–2006. *PLoS Med* 8: 790.
13. Spence M, Livingstone MBE, Hollywood LE, et al. (2013) A qualitative study of psychological, social and behavioral barriers to appropriate food portion size control. *Int J Behav Nutr Phys Act* 10: 92–101.
14. Hollands GJ, Shemilt I, Marteau TM, et al. (2015) Portion, package or tableware size for changing selection and consumption of food, alcohol and tobacco. *Cochrane Libr*.
15. Bloomfield C (2015) Putting sustainable development into practice: Hospital food procurement in Wales. *Reg Stud, Reg Sci* 2: 552–558.
16. Morgan K (2008) Greening the realm: Sustainable food chains and the public plate. *Reg Stud* 42: 1237–1250.
17. Story M, Hamm MW, Wallinga D (2009) Food systems and public health: Linkages to achieve healthier diets and healthier communities. *J Hunger Environ Nutr* 4: 219–224.
18. Hill JO, Peters JC (1998) Environmental contributions to the obesity epidemic. *Science* 280: 1371–1374.
19. Seyfang G (2006) Sustainable consumption, the new economics and community currencies: Developing new institutions for environmental governance. *Reg Stud* 40: 781–791.
20. Cronin J, McCarthy M, Brennan M, et al. (2014) The bigger society: Considering lived consumption experiences in managing social change around obesity. *Eur J Mark* 48: 1558–1578.
21. Antonuk B, Block LG (2006) The effect of single serving versus entire package nutritional information on consumption norms and actual consumption of a snack food. *J Nutr Educ Behav* 38: 365–370.

22. Ueland Ø, Cardello AV, Merrill EP, et al. (2009) Effect of portion size information on food intake. *J Am Diet Assoc* 109: 124–127.
23. Lieux E, Manning C (1992) Evening meals selected by college students: Impact of the foodservice system. *J Am Diet Assoc* 92: 560–566.
24. Rolls BJ, Roe LS, Meengs JS (2006) Reductions in portion size and energy density of foods are additive and lead to sustained decreases in energy intake. *Am J Clin Nutr* 83: 11–17.
25. Diliberti N, Bordi PL, Martha T, et al. (2004) Increased portion size leads to increased energy intake in a restaurant meal. *Obes Res* 12: 562–568.
26. Piernas C, Popkin BM (2011) Food portion patterns and trends among US children and the relationship to total eating occasion size, 1977–2006. *J Nutr* 141: 1159–1164.
27. Wansink B, Painter JE, North J (2005) Bottomless bowls: Why visual cues of portion size may influence intake. *Obesity* 13: 93–100.
28. Rolls BJ, Morris EL, Roe LS (2002) Portion size of food affects energy intake in normal-weight and overweight men and women. *Am J Clin Nutr* 76: 1207–1213.
29. Benson C (2009) Increasing portion size in Britain. *Soc Biol Hum Aff* 74: 4–20.
30. Brown PM, Cameron LD (2000) What can be done to reduce overconsumption? *Ecol Econ* 32: 27–41.
31. Cafaro PJ, Primack RB, Zimdahl RL (2006) The fat of the land: Linking American food overconsumption, obesity, and biodiversity loss. *J Agric Environ Ethics* 19: 541–561.
32. Vermeer WM, Steenhuis IH, Poelman M (2014) Small, medium, large or supersize? The development and evaluation of interventions targeted at portion size. *Int J Obes* 38: S13.
33. Ello-Martin JA, Ledikwe JH, Rolls BJ (2005) The influence of food portion size and energy density on energy intake: Implications for weight management. *Am J Clin Nutr* 82: 236S–241S.
34. Wansink B (1996) Can package size accelerate usage volume? *J Mark* 1996: 1–14.
35. Swinburn BA, Caterson I, Seidell JC (2004) Diet, nutrition and the prevention of excess weight gain and obesity. *Public Health Nutr* 7: 123–146.
36. Harnack LJ, French SA, Oakes JM, et al. (2008) Effects of calorie labeling and value size pricing on fast food meal choices: results from an experimental trial. *Int J Behav Nutr Phys Act* 5: 63.
37. Matthiessen J, Fagt S, Biloft-Jensen A, et al. (2003) Size makes a difference. *Public Health Nutr* 6: 65–72.
38. Bryant R, Dundes L (2005) Portion distortion: A study of college students. *J Consum Aff* 39: 399–408.
39. Condrasky M, Ledikwe JH, Flood JE, et al. (2007) Chefs' opinions of restaurant portion sizes. *Obesity* 15: 2086–2094.
40. Young LR, Nestle M (2002) The contribution of expanding portion sizes to the US obesity epidemic. *Am J Publ Health* 92: 246–249.
41. Popkin BM (2006) Global nutrition dynamics: the world is shifting rapidly toward a diet linked with noncommunicable diseases. *Am J Clin Nutr* 84: 289–298.
42. Mcleay FJ, Oglethorpe D (2013) Social marketing, parental purchasing decisions, and unhealthy food in developing countries: A Nigerian typology. *J Consum Behav* 12: 232–242.
43. Wappling A, Apostolidis C, McLeay F (2015) Tackling the obesity epidemic: Examining the relationship between food portion sizes and consumer behaviour, In: *2015 Academy of Marketing Conference—The Magic in Marketing 2015: 7th–9th July 2015, Ireland*.

44. Hawkes C (2006) Uneven dietary development: Linking the policies and processes of globalization with the nutrition transition, obesity and diet-related chronic diseases. *Globalization Health* 2: 4.
45. Howard C (2012) Obesity: The big picture. The world is getting wider, says Charlotte Howard. What can be done about it? *The Economist*.
46. Zlatevska N, Spence MT (2016) Parsing out the effects of personal consumption norms and industry influences on food consumption volume. *Eur J Mark* 50: 377–396.
47. Wansink B (2012) Package size, portion size, serving size, market size: The unconventional case for half-size servings. *Mark Sci* 31: 1–54.
48. Wansink B, van Ittersum K (2013) Portion size me: Plate-size induced consumption norms and win-win solutions for reducing food intake and waste. *J Exp Psychol: Appl* 19: 320.
49. Zlatevska N, Dubelaar C, Holden SS (2014) Sizing up the effect of portion size on consumption: A meta-analytic review. *J Mark* 78: 140–154.
50. Rolls BJ, Roe LS, Kral TVE, et al. (2004) Increasing the portion size of a packaged snack increases energy intake in men and women. *Appetite* 42: 63–69.
51. Ello-Martin JA, Ledikwe JH, Rolls BJ (2005) The influence of food portion size and energy density on energy intake: implications for weight management. *Am J Clin Nutr* 82: 236S–241S.
52. Livingstone MBE, Pourshahidi LK (2014) Portion size and obesity. *Adv Nutr Int Rev J* 5: 829–834.
53. Small L, Lane H, Vaughan L, et al. (2013) A systematic review of the evidence: The effects of portion size manipulation with children and portion education/training interventions on dietary intake with adults. *Worldviews Evidence-Based Nurs* 10: 69–81.
54. Collins K, Watson JF, Collins CE (2014) Food and beverage portion sizes in Australian children: A secondary analysis of 1995 and 2007 national data. *BMC Publ Health* 14: 517.
55. Ledikwe JH, Ello-Martin JA, Rolls BJ (2005) Portion sizes and the obesity epidemic. *J Nutr* 135: 905–909.
56. Vermeer WM, Steenhuis IH, Poelman M (2014) Small, medium, large or supersize? the development and evaluation of interventions targeted at portion size. *Int J Obes* 38: S13–S18.
57. Rennie KL, Johnson L, Jebb SA (2005) Behavioural determinants of obesity. *Best Pract Res Clin Endocrinol Metabol* 19: 343–358.
58. Tounian P (2007) Dietary factors in childhood obesity. *Curr Nutr Food Sci* 3: 135–140.
59. Agostoni C, Braegger C, Decsi T, et al. (2011) Role of dietary factors and food habits in the development of childhood obesity: A commentary by the ESPGHAN Committee on Nutrition. *J Pediatr Gastroenterol Nutr* 52: 662–669.
60. Rolls BJ, Roe LS, Meengs JS (2007) The effect of large portion sizes on energy intake is sustained for 11 days. *Obesity* 15: 1535–1543.
61. Almiron-Roig E, Tsiountsioura M, Lewis HB, et al. (2015) Large portion sizes increase bite size and eating rate in overweight women. *Physiol Behav* 139: 297–302.
62. Tarabashkina L, Quester PG, Crouch R (2017) Children and energy-dense foods—parents, peers, acceptability or advertising? *Eur J Mark* 51: 1669–1694.
63. Schwartz J, Byrd-Bredbenner C (2006) Portion distortion: Typical portion sizes selected by young adults. *J Am Diet Assoc* 106: 1412–1418.

64. Church S (2008) Trends in portion sizes in the UK-A preliminary review of published information Report. *Report to the Food Standards Agency*. Available from: <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.397.8604&rep=rep1&type=pdf>: UK.
65. Smiciklas-Wright H, Mitchell DC, Mickleet SJ, et al. (2003) Foods commonly eaten in the United States, 1989–1991 and 1994–1996: Are portion sizes changing? *J Am Diet Assoc* 103: 41–47.
66. Nielsen SJ, Popkin BM (2003) Patterns and trends in food portion sizes, 1977–1998. *Jama* 289: 450–453.
67. Young LR, Nestle M (1998) Variation in perceptions of a ‘medium’ food portion: Implications for dietary guidance. *J Acad Nutr Diet* 98: 458.
68. Pelletier AL, Chang WW, Delzell JE, et al. (2004) Patients’ understanding and use of snack food package nutrition labels. *J Am Board Fam Practice* 17: 319–323.
69. French SA (2005) Public health strategies for dietary change: Schools and workplaces. *J Nutr* 135: 910–912.
70. Dobson PW, Gerstner E (2010) For a few cents more: Why supersize unhealthy food? *Mark Sci* 29: 770–778.
71. Nestle M (2003) Increasing portion sizes in American diets: More calories, more obesity. *J Am Diet Assoc* 103: 39–40.
72. Davey R (2004) The obesity epidemic: Too much food for thought? *Br J Sports Med* 38: 360–363.
73. Wrieden W, Gregor A, Barton K (2008) Have food portion sizes increased in the UK over the last 20 years? *Proc Nutr Soc* 67(OCE).
74. Rozin P, Kabnick K, Peteet E, et al. (2003) The ecology of eating: smaller portion sizes in France than in the United States help explain the French paradox. *Psychol Sci* 14: 450–454.
75. Nelson M, Atkinson M, Darbyshire S (1994) Food photography I: The perception of food portion size from photographs. *Br J Nutr* 72: 649–663.
76. Levitsky DA, Youn T (2004) The more food young adults are served, the more they overeat. *J Nutr* 134: 2546–2549.
77. Glanz K, Sallis JF, Saelens BE, et al. (2005) Healthy nutrition environments: Concepts and measures. *Am J Health Promot* 19: 330–333.
78. McCarty JA, Hastak M (2007) Segmentation approaches in data-mining: A comparison of RFM, CHAID, and logistic regression. *J Bus Res* 60: 656–662.
79. Coussement K, Van den Bossche F, De Bock KW (2014) Data accuracy's impact on segmentation performance: Benchmarking RFM analysis, logistic regression, and decision trees. *J Bus Res* 67: 2751–2758.
80. Prentice AM (2006) The emerging epidemic of obesity in developing countries. *Int J Epidemiol* 35: 93–99.
81. Young LR, Nestle M (2007) Portion sizes and obesity: Responses of fast-food companies. *J Publ Health Policy* 28: 238–248.
82. Vermeer WM, Steenhuis IHM, Leeuwis FH, et al. (2011) Small portion sizes in worksite cafeterias: Do they help consumers to reduce their food intake? *Int J Obes* 35: 1200–1207.
83. Dobbs R, Sawers C, Thompson F, et al. (2014) Overcoming obesity: An initial economic analysis. McKinsey Global Institute.

84. Vermeer WM, Steenhuis IH, Seidell JC (2010) Portion size: A qualitative study of consumers' attitudes toward point-of-purchase interventions aimed at portion size. *Health Educ Res* 25: 109–120.
85. Dubois D, Rucker DD, Galinsky AD (2012) Super size me: Product size as a signal of status. *J Consum Res* 38: 1047–1062.
86. Rolls BJ (2014) What is the role of portion control in weight management [quest]. *Int J Obes* 38: S1–S8.
87. Tonelli F, Revetria R, Revello E (2008) Evaluating the impact of the lean approach on a food processing line, in 6th International Industrial Simulation Conference 2008, ISC 20082008, 93–98.
88. Jain S (2012) Marketing of vice goods: A strategic analysis of the package size decision. *Mark Sci* 31: 36–51.
89. Haws KL, Winterich KP (2013) When value trumps health in a supersized world. *J Mark* 77: 48–64.



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