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Forefronts in Portion Size – an overview and synthesis of a roundtable discussion

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Highlights

- Appropriate portion sizes are important to the prevention of obesity in children
- Large portion sizes promote high meal and total energy intakes
- Response to portion size in children reflects biological and social influences
- Parents adopt a variety of strategies around portion size when feeding children
- Evidence-based guidance to support healthy child portion sizes is needed

Abstract

Establishing eating habits in early life that include appropriate portion sizes of foods which are nutrient dense and low in energy density is considered important in the prevention of obesity in children. This special supplement presents the proceedings of a symposium focusing on advances in scientific understanding of the development of healthy food portion sizes in children and their families. Recent basic research highlights individual differences in children's responsiveness to portion size as well as potential mechanisms of portion size effects. Quantitative approaches highlight the influence of maternal serving in determining intake, whilst qualitative approaches seek to elaborate caregiver decisions around child portion sizes at meals and snacks. Family-based environmental interventions for child weight control involving food portion size are outlined. An overview of the overarching issues and roundtable discussion on the forefronts of portion size research are presented as well as policy considerations to promote healthy portion control.

Introduction

Large portion sizes of energy-dense foods have been considered a central feature of "obesogenic" dietary environments for decades[1]. Increases in portion size were noted in the marketplace beginning in the 1980s, when the rapid rise in obesity prevalence was first recorded[2]. A wide range of items within the consumer food landscape have increased in portion size including restaurant offerings, pre-packaged foods, and even cookbook recipes[3]. As will be presented in detail in this special supplement, two forms of converging evidence from epidemiological surveys and laboratory experiments demonstrate the importance of portion size as a major influence on food intake and appetite control. Consumers tend to eat more when offered more, and the power of portions has been observed in both adults and children[4-6]. In the laboratory across a range of foods, the portion size effect is profound. Even in non-human primates, food amounts are misperceived depending on the context in which the food is served[7].

Establishing healthy eating patterns in early development that include appropriate portion sizes of energy-dense foods is considered to be a central part of comprehensive approaches to obesity prevention[8]. This special supplement represents the proceedings of a symposium focusing on advances in scientific understanding of the development of healthy food portion sizes in children and their families. By way of introduction, this paper presents an overview of the overarching issues discussed during the symposium and roundtable that followed. This overview sets the scene for the special section by addressing the definition of

portion size and summarizing the key issues which are relevant to basic research on portion size. This is followed by applied research aimed at translatable, intervention strategies to assist children and their families in “downsizing” intake to counter the power of portions.

Definitions of Portion Size

One of the major problems facing families around issues of food portion size is confusion about the difference between a serving size, portion size, and portion control. Here we offer a definition of each term so that the reader is clear about how the terms have been operationalized within research and policy realms.

The meaning of the term “serving size” stems primarily from government-based nutrition guidance (e.g. Foods Standards Agency, UK; MyPlate, USDA) and refers to the amount listed on the nutrition information label of foods and in dietary guidelines for consumers. In the US, food manufacturers provide nutrition information on packaged foods based on a single serving[9]. The Nutrient Facts Panel (NFP) displays information about the serving size as well as the energy and nutrient content of that serving, even if there are multiple servings within one package. In addition, the percent Daily Value (%DV) is given for each nutrient, based on a 2000 kcal/d energy intake. Consumers claim to use the NFP in purchase decisions, yet cannot easily identify serving sizes from the information provided[10]. An important point of confusion is that serving size information on the NFP does not reflect government recommendations, but rather historical data relating to amounts typically consumed at one occasion. The FDA uses Reference

Amounts Customarily Consumed (RACC), derived from household food consumption survey data, to specify serving sizes for different types of foods[9]. The use of this reference data to specify serving sizes has been particularly problematic in cases where the RACC is much smaller than the amount packaged in an individual serving container. For example, a packet of potato chips that may reasonably be consumed at one eating occasion could have a RACC that stipulates a smaller serving size and results in multiple servings being listed on the label. Unfortunately, many consumers have difficulty understanding how to interpret correctly nutritional information when multiple servings are shown. For instance, when patients were asked to estimate the energy content of packaged snacks, Pelletier et al.[11] found that only 37% of the patients correctly identified that the packs contained multiple servings. Moreover, accurate estimation of even a single portion size is generally challenging for consumers. In one study, adults were asked to estimate a single serving of pasta, tinned pineapple, cooked ground beef and cranberry juice. The estimates of a single serving ranged in accuracy depending on the item, from 34% (for pasta) to 56% (for pineapple). The ability to estimate serving size with some accuracy is further challenged by low levels of literacy[12, 13]. Thus, even when consumers use nutrition information and are trained to look for this on packaging, many fail to identify the amount of a single serving, especially when the pack contains more than one serving[10]. Thus, while governments and food manufacturers provide nutritional guidance around serving size, this information is poorly understood and in any case how much is eaten may not relate to the amount recommended. Proposed changes to the Nutrition Facts Label under

consideration include providing nutritional information as a single serving for foods that can be reasonably consumed at one eating occasion[14].

The definition of the term “portion size” stems primarily from the research literature, and has often been used to refer to the amount of food offered to adult consumers[15] and children[4] as well as the amount selected. In the studies considered by Savage et al (this issue), children’s self-served portion sizes (i.e. “family-style”) has also been used to mean the amount selected by children from the amount of food made available to them at snacks or meals.

Finally, portion control refers to efforts to regulate or limit the amount or portion size of foods consumed, in adults but this can also apply to older children. Portion control has also been used to refer to one’s understanding how much a serving size of food is and how much energy it contains in the context of weight management.

What are “appropriate” portion sizes for children? The answer to this question is unfortunately complicated by a variety of factors including: a) the energy density (kcal/g) of foods, which influences the energy content of a given portion size; b) the context of consumption, for example, whether a food is consumed in isolation or with other foods as part of a meal; c) the fact that a variety of portion sizes may be consumed to meet overall nutrient needs within a particular food group; and d) the nutrient needs of the child which vary with age, gender, activity, and weight.

The amounts listed on food labels certainly do not reflect these needs, and the amounts used at home or offered in restaurants are arbitrary, dependent on habit and reflecting culture, cuisine, and custom. So standardization of portion size for practical purposes remains elusive, despite the appreciation that one size will not fit all.

Basic Research on Food Portion Size in Children

Three papers in this special supplement present basic research perspectives on current understanding of food portion size influences on children's eating and weight. Birch, Savage, & Fisher (this issue) present an overview of portion size effects on children's eating and weight. Overall, the research evidence is clear. Larger portions encourage greater snack, meal, and total daily energy intake and this is observed across a wide range of foods[4, 6]. There is increasing awareness of parent and child contributions to individual differences in children's susceptibility to portion size. The roles of child temperament and appetite traits in shaping children's susceptibility to large food portions as well as the effect of learning have been highlighted by English, Lasschuijt, & Keller (this issue) as well as Kral & Hetherington (this issue). Highlighted by the authors of these papers is the compelling need for observational research to evaluate long term effects of portion size on children's appetite, food intake, and weight outcomes.

Kral and Hetherington characterize environmental and genetic determinants of susceptibility, focusing on rapidly evolving understanding of the heritability of eating behaviors, meal size, and energy intake. Their paper presents the perspective that genetic contributions to individual differences in children's susceptibility to portion size may act along a continuum of sensory, cognitive, hormonal, and metabolic signals that regulate appetite, collectively understood as the satiety cascade. Genome wide association studies have led to the identification of common specific single nucleotide polymorphisms that explain variability in eating phenotypes. Thus determinants of meal size, amount eaten or portion size are associated with these eating phenotypes. With regard to learning, parental feeding styles (referring to the emotional climate surrounding feeding) and practices are also known to shape children's eating behavior, contributing to individual differences in the regulation of appetite. Kral & Hetherington acknowledge that biology and nurture are not independent, but likely have bi-directional relationships with eating outcomes, and may interact with each other to shape the trajectory of development.

The last of the three papers on the basic science of food portion size in children, by English, Lasschuijt, and Keller, focuses on potential mechanisms that may underlie food portion size effects. Their paper reviews research on visual cues, eating microstructure, and reward pathways in explaining portion size effects. The portion sizes of foods selected and consumed by adults (and in some studies of children) have been shown to be influenced by food packaging size and dishware

size. Though often explained in terms of visual illusion, size related cues may also influence subjective norms about appropriate portion size, in a process referred to as anchoring and adjustment. Portion size effects on children's eating, in turn, appear to act through changes to eating microstructure, particularly bite size. Children's response to food portion size may also reflect the accumulation of experience with and learning about food, through post-ingestive feedback. This experience may be central to expectations about satiation which have been clearly shown in adults to predict the portion sizes of foods consumed at meals. English, Lasschuijt, and Keller highlight the role of reward pathways in producing portion size effects and the potential value of neuro-imaging paradigms to identifying and characterizing the mechanisms underlying portion size effects.

Key Research Issues

Two overarching themes emerged across papers regarding basic research needs for studies of food portion size in children.

Developmental issues

Long term effects on eating regulation and weight are not clear in relation to manipulations of portion size. It is not yet known how and when children acquire an understanding of appropriate portion control, nor at what stage social norms regarding appropriate portion sizes for various foods develop. Early life is a critical time to teach about portions and whether mothers choose to breastfeed or formula feed, is already an important developmental window to encourage mothers to

consider appropriate portions as they prepare for complementary feeding. We need a better understanding of how portion control develops. If we know that certain aspects of portion size are regulated then a key question is whether this can be altered by strategic interventions during specific developmental stages. Also, most current research in portion size has been conducted in pre-school children, and more research during early infancy, later school age years and in teenagers must be supported and conducted. It is not yet clear how portion sizes are perceived and used as children get older and have greater autonomy in their food choice and purchase habits.

Methodological issues

For good reasons, epidemiological studies have tended to rely heavily on self-report or maternal-reporting of offspring intake patterns introducing high potential for bias. Therefore there is a strong need to develop alternative unbiased methods of portion size determination. Also, most experimental studies in this area of research have tended to be in small defined/homogenous groups. There is a need for studies in larger samples because there are so many variables and contributing/confounding factors that make it more complex to address the bigger and more important questions. In particular, the impact of ethnicity, concerns about household income, and food insecurity as moderating factors in the portion size effect must be taken account of in future research (Blake et al, this issue). As a complementary approach to the large scale questionnaire based research studies and small scale laboratory experiments, qualitative research provides a

rich source of untapped information to move the area forward (see Blake et al., and Johnson et al., this issue).

Translation to Intervention

The remainder of papers in this special supplement focuses on translational science aimed at informing the development of interventions to encourage healthy portion sizes among children – to eat larger portions of low energy density, high nutrient density foods and to reduce intake of high energy density non-core foods.

Johnson et al. described low-income parents' perceptions of and practices around food portion sizes offered to children at meals. Blake et al. provided a complementary perspective focusing on parenting practices used by low-income parents around the portion sizes of snack foods offered to preschool aged children. Finally, Robinson & Mattheson provide an exemplar of how simple environmental manipulations such as altering dishware size can be applied within in family-based treatment interventions for obese youth. This discussion on the use of dishware to alter how much is eaten brought us back to the Del Boeuf illusion, and the power of perceived portion size with its roots in how humans are programmed to detect and to select larger amounts[7].

The special issue includes a paper by Pomeranz and Miller who review food policy and government approaches for promoting healthy food choices by consumers. In particular, they argue that Government agencies have a unique role in setting regulations to guide

consumers via dietary recommendations and food labeling information. Pomeranz and Miller also highlight the role of food companies to assist families in providing information and packaging to promote healthy eating practices. This article is timely since initiatives like the Responsibility Deal in the UK[16] and Healthy Weight Commitment Foundation Pledge in the USA[17] provide guidance to food industry for voluntary changes to labeling, portion size modification, and reductions in salt, fat and sugar. Within the wider European context, EU directives to improve food labelling in 1990 and again in 2000 failed to address specific portion size advice (http://www.eufic.org/article/en/expid/importance-portion-information-from-consumer-health-perspective). Nevertheless, the impetus is apparent for governments and food companies to work together in responding to consumer needs for serving size information and how this can be adjusted for different members of the family including especially for children. Within the context of global food manufacturing and provision, it is timely and important that companies sign up to pledges to reduce portion sizes of high energy density items, provide user-friendly labels and aim for energy reduction where possible to assist consumers in their bid to eat well and to select a healthy, balanced diet.

Research Needs

Three overarching research needs were identified for translational research on promoting healthy food portion sizes in children and their families, namely food

insecurity, the importance of context, and the need for effective consumer communications around portion size.

Food insecurity, in particular aspects of economic hardship, plays a critical role in understanding the relationship between portion sizes offered and consumed as well as implications for risk of overweight and obesity. There is a marked increase in the prevalence of childhood obesity with increasing economic hardship, especially among families with extremely limited food budgets. In this situation a predominant issue is food economics and getting maximum number of calories at minimum price. This issue also encompasses another important aspect, eating in the absence of hunger, which is thought to be more problematic and lead to greater energy intake when food is periodically scarce[18]. Future translational research on portion size should consider the role of household and individual levels of food insecurity, household income, and economic considerations given the sensitive social gradient in the expression of obesity and the use of food as reward in low income contexts[19].

Alongside economic issues, the context, strategy and situation of interventions to encourage adjustment in portion control is an important factor for future research. Here, it is crucial to identify the contexts, location, and effort needed to develop the best targets for getting the biggest effect for where changes in portion size delivery to consumers might make the biggest difference. For example, targeting food portion sizes outside the home, for instance at restaurants and schools, may

provide effective environmental control of portion sizes. Similarly, the application of portion size reductions in pre-packaged foods may be easier to achieve than similar strategies for home cooked meals and snacks. Future research should identify those contexts in which portion size manipulations produce the strongest effect on expected outcomes. A better understanding of how these different contexts might interact in effects on norms and habits is also warranted. For example, are portion sizes offered at home influenced by portion sizes offered at restaurants? Is it going to be more effective to teach aspects of portion size versus manipulating the environment like plate/package size? There is a clear need for more research on identifying optimal strategies for manipulating/modifying portion size such as alterations in unit size of serving, package size, as well as manipulation of plate size on which food is served. A simple, short checklist for portion control could be developed for families based on small, easy to adopt "do-able" actions supported by government guidance.

Ultimately, a major challenge faced in this area is that we need to address the cultural norm that food consumers have come to expect more food for less money. Not only must research be conducted in the context of cultural understanding of the traditions and practices of the individuals and groups, but communicated in the context of the total child and his/her well-being. Broader "values" are important and effective communications strategies and messaging critical. A key question is at what stage to build in communications. Messages regarding smart-sizing, getting away from the notion that bigger is better are important but may be

unpopular. Portion control is not an appealing message, but messaging around eating more of nutrient dense foods, seeking value for money, keeping some high energy dense foods as treats may be more acceptable than focusing on eating less. Alternatively,"me-size" child portion sizes are rare in the marketplace, but could prove to be helpful in guiding child feeding and reinforcing age-appropriate norms. In addition, labeling is not helpful when parents want to know how much to serve their children; therefore, future research should provide an evidence-base for defining appropriate child portion sizes and guidance for caregivers, especially for children 2 years and under. In particular, research on responsive infant feeding strategies is needed so that caregivers are not tempted to empty the jar, pouch or portion when feeding their toddler.

Conclusions

The development of healthy food portion sizes is considered to be central to obesity prevention in early childhood[8]. There is considerable confusion among consumers about servings, portion size and portion control. In this overview, we have explored each of these constructs to provide clarity and to set the scene for the special issue. The aim of the Symposium "Forefronts in Portion Size" was to provide a forum for recent thinking about the development of healthy portion sizes among young children and their families, and within this we discussed:

- the impact of portion size on overeating among children and on individual differences in response to large food portions,
- the underlying mechanisms driving the portion size effect,

- how parents decide portion sizes for their children,
- how caregivers navigate portion sizes around snacking, and
- family-based environmental interventions for weight control involving food portion size, including downsizing dishware size.

The papers presented in this special supplement offer an insight into recent quantitative and qualitative methods to explore the portion size effect and how this can be translated into guiding interventions to affect behavior change. Finally, the implications from a food policy perspective provide a unique and important insight into how governments can influence consumer behavior with the aim of producing healthier eating for all. This call to action for academic, government, and industry highlights the need to develop an evidence base for promoting appropriate portion sizes among children and their families that spans environmental and behavioral strategies to effective consumer guidance and communications.

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