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Drivers of overweight mothers' food choice behaviors depend on child gender[☆]

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Abstract

Background—National data suggest a higher prevalence of obesity among boys. One possible cause could be the food choices made by parents on behalf of their children.

Objectives—This study sought to determine whether and how mothers' food choices for their children differ by child gender and to understand the drivers of these differences.

Design—Data were analyzed from a randomized controlled trial conducted using a virtual reality-based buffet restaurant. Overweight mothers filled out questionnaires and received an information module. They were then immersed in a virtual buffet restaurant to select a lunch for their 4- to 5-year-old child.

Results—Of the 221 overweight mothers recruited, 55% identified their daughters as the child for whom they would be choosing the food. The caloric content of boys' meals was 43 calories higher than girls' ($p = .015$). This difference was due to extra calories from the less healthy food category ($p = .04$). Multivariate analyses identified more predictors of calorie choices for daughters' than sons' meals. Predictors of calories chosen for girls included: having both biological parents overweight ($\beta = 0.26$; $p = .003$), mother's weight ($\beta = 0.17$; $p = .05$), mother's education ($\beta = -0.28$; $p = .001$), her restriction of her child's food intake ($\beta = -0.20$; $p = .02$), and her beliefs about the importance of genetics in causing obesity ($\beta = 0.19$; $p = .03$). Mother's weight was the sole predictor of boys' meal calories ($\beta = 0.20$; $p = .04$).

Conclusions—Differences in dietary choices made for young girls and boys may contribute to lifelong gender differences in eating patterns. A better understanding of differences in feeding choices made for girls versus boys could improve the design of childhood obesity prevention interventions.

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Authors' contributions

All authors designed the research, SB performed statistical analysis and wrote the paper, SB and SP had primary responsibility for final content. All authors read and approved the final manuscript.

Keywords

Overweight mothers; Feeding behavior; Body weight; Child gender

Introduction

Data from the National Health and Nutrition Examination Survey (NHANES) show that in 2009–2010, almost 17% of American children aged 2 to 19 years old were obese, with a Body Mass Index (BMI) greater than or equal to the 95th percentile on the BMI-forage growth charts (Ogden, Carroll, Kit, & Flegal, 2012). However, boys and girls are not affected equally by the obesity epidemic. For all age groups, the prevalence of obesity among males is significantly higher compared to females (18.6% and 15.0%, respectively). For the youngest age group of 2–5 year olds in particular, obesity prevalence reaches 12%, with 9.6% of girls and 14.4% of boys being obese. Although recently there are indications that the obesity prevalence is plateauing, more detailed analyses of the overall trends over 12 years (1999–2010) show a significant increase in obesity prevalence among 2- to 19-year-old boys (Ogden et al., 2012). These trends seem to track into adulthood, as over the same 12-year time period, obesity increased significantly among adult men compared to women (Flegal, Carroll, Kit, & Ogden, 2012). Obesity itself, and eating behavior more specifically, are complex and are influenced by myriad factors including those stemming from genetics, environment, behavior, and their interactions (Kral & Faith, 2009). Literature investigating gender differences in the underlying mechanisms leading to childhood obesity is scarce (Wisniewski & Chernausek, 2009). There is some evidence of gender differences in food preferences among school-aged children, with girls reporting a stronger preference for fruits and vegetables, whereas boys report a stronger preference for meat, fish and poultry products (Caine-Bish & Scheule, 2009; Cooke & Wardle, 2005). Compared to their male peers, girls have healthier food choices in general (Liem, Bogers, Dagnelie, & de Graaf, 2006; Robinson & Thomas, 2004; Sweeting, 2008). Differences in diets are likely due to a diverse set of causal processes (Liem et al., 2006; Vollrath, Hampson, & Juliusson, 2012). However, for very young children, feeding decisions that parents make may be most relevant.

Little attention has been given to the food choices that adults make on behalf of children during early life stages and to the origins of calories that comprise children's meals. Most importantly for the current discussion, it is unknown how parental choices differ when they are made for young girls versus young boys, and what factors drive parents to make food choices for each. Parents are the primary gatekeepers when it comes to providing a healthy eating environment for their young children (Kral & Faith, 2009; Wardle, 1995). These eating experiences set the foundation for eating behavior and weight control as children grow. This is of importance especially for children who are at a high risk of developing overweight/obesity, such as those for whom overweight runs in the family (Berkowitz et al., 2010). Therefore, a key first step is to examine the feeding choices of parents who are themselves overweight as their children are at increased risk for obesity in later life. One way to better understand the reasons for the different food choices that mothers might make for their boys versus girls is to consider their individual characteristics, their beliefs, as well as their risk perceptions and attitudes.

Models such as the Risk Information Seeking and Processing Model (Griffin, Dunwoody, & Neuwirth, 1999) and the Social Cognitive Model (Bandura, 1977), posit a cascade of factors that can be applied to predicting child feeding behaviors. On the one hand, there are individual characteristics that might correlate with child feeding practices. The family's socioeconomic status not only influences foods available in the home (Hupkens, Knibbe, van Otterloo, & Drop, 1998), but mothers in higher social classes are more likely to exert control over food or restrict their children's access to unhealthy foods (Brown, Ogden, Vögele, & Gibson, 2008). In addition, biological parents' weight status has a recognized effect on the intergenerational transmission of obesity and obesity risk, which might shape the family feeding environment and contribute to obesity (Hecker, Martin, & Martin, 1986; Wardle, Sanderson, Guthrie, Rapoport, & Plomin, 2002). On the other hand, theoretical models also suggest that beliefs, perceptions and attitudes influence behaviors. In the feeding domain for instance, parents' concern about and perception of their children's weight is an important factor in understanding child feeding practices (Faith, Scanlon, Birch, Francis, & Sherry, 2004; Francis, Hofer, & Birch, 2001). Mothers who are concerned about their children's weight tend to have restrictive feeding practices in an attempt to reduce calories and control the child's weight (Webber, Hill, Cooke, Carnell, & Wardle, 2010). However, restriction is associated with a higher risk of overweight (Faith et al., 2004) as well as disturbances in later eating patterns (Birch & Fisher, 2000). Food restriction behaviors represent a key example of a process where mothers' feeding decisions vary by the child's gender. In this case, restriction is much more common for girls (Birch, 1998).

It may be helpful to consider using different approaches for parents of boys versus those of girls in childhood obesity interventions. Currently, pediatric health-related or obesity-related interventions typically do not consider the child's gender in their design. In order to do so, research first needs to fill the considerable gap in the literature concerning the drivers of mothers' food choices for their young girls versus young boys. One obstacle to this goal is the identification of accurate and innovative measurement methods to collect information about mothers' behavior. To this end, immersive virtual reality is a technology that goes beyond self-report measures and allows researchers to explore mothers' engagement with food in a naturalistic, but controlled manner (McBride, Persky, Wagner, Faith, & Ward, 2013; Persky, 2011). In this study we developed a virtual buffet restaurant where mothers could chose a meal for their young child, allowing a direct observation of their feeding behavior. Specific research questions in the current analysis included: (1) Does the number of calories mothers choose for a boy differ from those chosen for a girl? (2) Does the source of calories differ for boys and girls? And (3) What background, cognitive, and attitudinal factors predict mothers' food choices for girls versus boys? To answer these questions, we analyzed data from an experimental study that tested the effect of family health history-based (FHH) risk information provision on overweight mothers' food choices for their 4- to 5-year-old child (McBride et al., 2013).

Methods

Participants

Participants were enrolled in a randomized controlled experiment (the Mothers' TAKE study) that assessed mothers' feeding behavior in response to family health history-based (FHH) feedback regarding their child's risk of obesity. The study design is described in detail elsewhere (McBride et al., 2013). Briefly, 221 participants were randomly assigned to one of three groups: food safety information control (n = 73), behavioral risk information alone (n = 73), and behavioral risk information plus FHH-based obesity risk feedback for the child (n = 75). Participants from all three conditions of the trial are included in the present analyses. The activities were approved by the Institutional Review Board of the National Human Genome Research Institute.

Procedure

Participants (121 mothers of girls and 100 mothers of boys) were told that they were participating in a study investigating the impact of health information on food choices that mothers make for their children using a new technology called virtual reality. Inclusion criteria included: (1) being the mother of a biological child between the ages of 4 and 5, (2) the child having no major food allergies or diet-related health conditions; and (3) mothers having a self-reported body mass index of greater than or equal to 25 kg/m^2. The exhaustive list of inclusion and exclusion criteria is available elsewhere (McBride et al., 2013). During the initial telephone screening call, eligible mothers identified a 4- to 5-year-old son or daughter as the 'index child' they would consider while completing study tasks. After the screening, mothers logged into the study website, provided their informed consent, and completed an online survey. As part of the survey, they provided the child's weight and height either by measuring the child or by reporting the measure from the last doctor's appointment. Participants then came to the Immersive Virtual Environment Testing Area at the NIH clinical center where they again indicated consent to participate. They were given instructions and had a training session on how to use the virtual buffet. Mothers then received the information corresponding to one of the three experimental groups (McBride et al., 2013). Food safety group (control) received general information about food-borne illness and techniques to safely prepare foods. The behavioral risk information group received information about childhood obesity trends, behavioral risk factors associated with obesity, and the importance of the family in implementing health behavior change. The last group received the same information as the behavioral risk information group plus FHH-based obesity risk feedback for their child. Using the parents' weight status, this group received a risk estimate for their child i.e., if one parent is overweight, it increases the child's risk of becoming overweight as an adult from 13% to 28%, and if both parents are overweight from 13% to 58%. A second short survey followed information provision. Mothers then completed the virtual buffet measure. They were instructed to choose foods and a beverage for a hypothetical lunch for the index child. In order to complete the virtual reality task, participants wore a head mounted display connected to computer equipment and used a pointing device to select the desired types and amounts of food and beverage for the child. All participants were compensated and debriefed following the session.

Virtual buffet

Included on the buffet were foods and beverages meeting the following criteria: representative of those typically found at buffet restaurants, palatable to children, and comprising a range of nutrient profiles and calorie densities. Participants were able to choose as many servings of as many foods as they wanted as long as the amount fit on the virtual plate. The buffet contained at least two options for each food category that would typically be present at lunch (main dish, vegetable, fruit, starch, dessert, condiments, and beverages). Foods were categorized using the Coordinated Approach to Child Health categories (We Can!, 2002), a heuristic approach classifying foods as “Go” (the most healthy options), “Slow” (less healthy options) and “Whoa” (relatively unhealthy options). For further analyses, we combined the slow and whoa food categories. This grouping was based on the fact that the groups refer to the less and least healthy food categories which should not be eaten frequently and that might contribute to weight problems. In addition, there is no straightforward designation for some foods included in the buffet that contain ingredient combinations or that depend upon preparation method (e.g., applesauce, pizza bagel).

Mothers reported finding the virtual restaurant buffet as highly realistic, and said that the amount that ended up in their plate was the amount they intended to select (McBride et al., 2013).

Measures

Plated calories—The mother’s food choice behavior was assessed by calculating the total calories selected including foods, condiments and the beverage selected for the child from the virtual buffet. The final calorie content of each meal (foods, condiments and beverage) chosen for a child by his/her mother was calculated by taking the cubic volume of each type of virtual food chosen and associating it with the appropriate weight of this amount of the food item. The number of calories associated with the weight of the food selected for the meal was determined using information contained in food nutrient databases or from food packaging where the information was not available on the food database.

Potential predictors—Variables were based on the Risk Information Seeking and Processing Model (Griffin et al., 1999) and the Social Cognitive Model (Bandura, 1977) (Fig. 1). These included the mother’s *individual characteristics*: her weight status (overweight versus obese); whether the child’s biological father was also overweight (yes or no); and her education level (less than college education versus college education or above). We also created a composite variable measuring mother’s *obesity genetic causal beliefs* by averaging two items (rated on 7-point Likert scales): “obesity is almost never affected by one’s genetic makeup” (reverse scored) and “how important do you think the child’s family history of obesity is, in causing childhood obesity?”, adapted from (Taveras, Mitchell, & Gortmaker, 2009). A third set of variables assessed *obesity behavioral causal beliefs*. These included variables assessing the mother’s perceived importance of family eating patterns in causing childhood obesity and the mother’s perceived importance of the amount of fast food intake in causing childhood obesity, both adapted from Taveras et al. (2009); both questions were answered on a 7-point Likert scale from 1 ‘not at all important’ to 7 ‘very important’. Lastly, we assessed the mother’s *risk perception and attitudes*. This assessment includes perception of the child's weight using an item from the Child Feeding Questionnaire (Birch et al., 2001), where mothers were asked to indicate which category best describes their children's weight. We dichotomized the responses by combining the categories of markedly underweight/underweight/normal weight versus overweight/obese. We also assessed the mother's rated concern about the child's weight status based on three weight-concern items from the Child Feeding Questionnaire (Birch et al., 2001), e.g. "how concerned are you about [child] becoming overweight", $\alpha = 0.80$. We measured the mother's reported restriction of her child's food intake, using the eight item subscale of the Child Feeding Questionnaire (Birch et al., 2001); e.g. "I have to be sure that my child does not eat too much of his/her favorite foods", $\alpha = 0.74$. Finally, we included items related to the mother's thoughts about her child's relative risk for becoming obese in the future: "compared to other [boys/girls] [child]'s age, how likely do you think she/he is to be obese before she/he reaches age 18?", scored on a 7 point Likert scale from 1 'a lot less likely' to 7 'a lot more likely', based on common approaches in the field. All these variables except the mother's perception of her child's weight were collected prior to the virtual buffet food choice measure.

Other behavioral indicators—The virtual buffet environment also allowed us to gather information about mothers' behaviors including the number of food servings selected and time spent choosing food for the child. These measures are a proxy for the mother's engagement with the buffet.

Data analysis

We compared mothers of girls and those of boys in terms of their behavior at the buffet: number of food servings selected and time spent choosing food for their child. T-tests were also used to compare calories from Go, Slow/Whoa food categories and Go, Slow/Whoa beverages chosen for boys' and girls' meals.

For each gender separately, we ran multivariate models predicting the calorie content of the meal, using a backward entry method, retaining variables with a $p < 0.20$ to allow for more complex models. Given the exploratory and hypothesis-generating character of this study and the absence of existing knowledge about the predictors of overweight mothers' food selection for girls and boys, we employed a stepwise regression method with backward elimination to arrive at final models in our analysis. This approach maximizes the power to detect effects of the dependent variable and was shown to be effective for selecting independent variables explaining the residual variance and boosts the power to detect effects while controlling for potential confounders and dropping covariates at the $p > 0.20$ criterion from the final model (Budtz-Jørgensen, Keiding, Grandjean, & Weihe, 2007; Maldonado & Greenland, 1993). The same predictors were considered in models for boys and for girls. The predictor variables initially entered in the model included those assessing individual characteristics, the mother's obesity genetic causal beliefs, her obesity behavioral causal beliefs and her attitudes and risk perception as described above. Experimental group effect was controlled for in these analyses given its previously reported effects on calorie choices (McBride et al., 2013). Analyses were run using SAS System for Windows version 9.3 (SAS

Institute Inc., Cary, NC, USA). Significance was set at $p \leq 0.05$ and $p \leq 0.10$ for tendencies. Results are reported as means ± SEM (Standard Error of the Mean).

Results

Demographics

According to the results shown in Table 1, there were no significant differences in the demographic characteristics of mothers who indicated that the index child was a boy versus mothers who indicated that the child was a girl. It is noteworthy that based on their mothers' report of height and weight, 42% of the girls and 35% of the boys in our sample would meet criteria for overweight or obesity. In this sample, 60% of girls and 66% of boys have two overweight or obese parents.

Calorie content of food and beverage choices

Mothers chose significantly more calories when they were selecting for a boy versus a girl [$F(1, 215) = 6.30$, $p = 0.01$]. Mothers chose an average of 388 ± 13 calories when selecting a meal for boys, compared to an average of 345 ± 12 calories for girls. Consistent with the primary findings of the Mothers' TAKE project (McBride et al., 2013), there was also a main effect of the experimental group on calories [$F(2, 215) = 3.41$, $p = 0.03$], with mothers who received the behavioral risk information plus FHH-based obesity risk feedback for the child filling their child's plate with fewer calories than the control group. No difference was found between the behavioral risk information and the control groups. No interaction between the experimental group and the child's gender was found [$F(2, 215) = 0.84$, $p = 0.43$].

Calorie content of food and beverage categories

In order to get more information about the sources of calories chosen for girls versus boys, especially the sources of extra calories selected, we compared the caloric content of foods chosen for boys versus girls from each of the Go, and the Slow/Whoa categories described earlier. Calories chosen for boys versus girls did not differ for beverages: Go-drinks [$t(62) = -0.48$; $p = 0.63$], Slow/Whoa-drinks [$t(155) = 0.53$; $p = 0.59$]. Differences in selection of Go-foods between boys and girls showed a trend toward more calories for boys than girls: $t(219) = -1.89$; $p = 0.06$. However, boys got significantly more calories from Slow/Whoa-foods than girls [$t(219) = -2.06$; $p = 0.04$] with an average of 28 extra calories.

Predictors of calories chosen

Predictors of calories chosen for boys—The final model predicting the calories selected for boys is presented in Table 2. This model was statistically significant, with approximately 10% of the variance of boys' meal calories accounted for by the model [$F(3, 95) = 3.70$, $p = 0.01$]. We entered the experimental group as a control variable and found that it did impact the amount of calories selected for the boys: compared to the control group, receiving the behavioral risk information plus FHH-based obesity risk feedback for the child resulted in a plate filled with fewer calories. The mother's weight status also predicted the calories selected for boys: obese mothers selected 53 extra calories for their boys compared to overweight mothers. Although the mothers' obesity genetic causal beliefs was retained in the model, its contribution to predicting boys' meal calories did not reach significance (p = 0.17). None of the other anticipated predictor variables explained the calorie content of mothers' food and beverage choices for boys in the final model and were therefore dropped.

Predictors of calories chosen for girls—The multivariate model to predict calories selected for girls shows that a number of variables were associated with total calories (Table 3). The final model was statistically significant, with approximately 25% of the variance of girls' meal calories accounted for by the model [$F(6, 111) = 6.17$, $p < .0001$].

With respect to the impact of individual characteristics, results show that mothers chose an additional 70 calories for girls when the biological father was also overweight compared to when only the mother was overweight ($p = 0.003$). There was also a trend for the mother's own weight status (overweight versus obese) to influence the amount of calories she selected for her daughter's meal (46 calories more when the mother was obese; $p = 0.05$). Mothers with higher education status selected 86 fewer calories for their daughters' meal than mothers with less than a college education ($p = 0.001$).

The mother's obesity genetic causal beliefs also significantly predicted the calories chosen for girls ($p = 0.02$). Mothers selected more calories for their daughters when they believed that genetics is important in causing obesity (additional 27 calories with each unit increase in scale rating).

In terms of obesity behavioral causal beliefs, the mother's perceived importance of the amount of fast food intake in causing childhood obesity was retained in the model, although its contribution to predicting girls' meal calories did not reach significance ($p = 0.06$).

Finally, for risk perceptions and attitudes, only the mother's reported restriction of her child's food intake was a significant predictor of girls' meal calories. With each unit increase in mother's restriction score, she selected 41 fewer calories for her daughter ($p = 0.02$). The experimental group assignment was not a predictor of the calories mothers selected for their daughters, and was dropped from the final model.

Number of servings chosen

We summed the number of food servings (spoonfuls or pieces) that mothers selected for their sons or daughters. Mothers chose significantly more servings when they were choosing for their sons versus daughters [$t(219) = -2.77$; $p = 0.0061$]. Mothers chose on average 26 servings of food when they were choosing for their daughters, and 29 servings when they were choosing for their sons.

Time spent at the buffet

Results show a tendency toward mothers spending more time at the buffet while choosing foods for a daughter than when choosing for a son [$t(199.14) = 1.84$; $p = 0.067$]. Mothers spent 460 ± 57 s to choose their daughters' meal, while spending only 365 ± 37 s choosing for their sons.

Discussion

Mothers in our study chose 12% more calories for their sons than they did for their daughters, and this difference came primarily from calorie-dense foods. These results are consistent with recommendations for higher energy intake among boys as young as 4–5 years old (Gidding et al., 2005). The American Heart Association recommends an intake of 1200 kcal per day for girls versus 1400 kcal per day for boys. However, our results suggest that mothers may not be implementing these energy intake recommendations with adequate consideration to calorie quality and risk of becoming overweight. Moreover, mothers' choices of calorie-dense foods for boys may orient boys to life-long patterns of eating more high-calorie foods and thereby increasing the risk of obesity.

In order to understand how to positively influence mothers' food choices for their sons and daughters, it is important to gain insight into the reasons behind the food choices they make. We assessed 10 potential predictors to explore their association with the meal calories that mothers chose. Few of these variables were significant predictors of calories selected for sons, whereas several variables significantly predicted calories selected for daughters.

A possible explanation for this overall pattern is that mothers were generally more thoughtful about choosing foods when the index child was a daughter. Although we cannot definitively conclude this with the current data, this interpretation is supported by our finding that, although mothers of girls put fewer servings of food on their daughter's plate, they tended to spend more time at the buffet making their selections. Previous research supports these findings in showing that mothers tend to have more concern about their daughters gaining weight than their sons (Tiggemann & Lowes, 2002). Mothers are also less willing to engage in a confrontation over food with boys (Vollrath et al., 2012). Taken together, mothers may be more likely to select foods in line with their boys' preferences, but may consider other factors when choosing foods for their daughters. The present study advances understanding of the factors that influence differences in mothers' choices of foods for their daughters and sons.

In considering the individual constructs that predicted the calorie content of the meals mothers chose, only the mother's weight status significantly explained choices made for boys. Obese mothers chose more calories for their sons than overweight mothers. This finding is in line with a recent study of Latina mothers of 5–7 year olds showing that the higher the mother's weight, the more likely she was to use the taste of food as a criterion when choosing food for her son, but not for her daughter (Contento, Basch, & Zybert, 2003).

In contrast, several factors influenced the calories that mothers chose for their daughters. We found that mothers who were more highly educated selected fewer calories. Previous findings suggest that highly educated mothers are more restrictive over their children's food intake in general (Saxton, Carnell, van Jaarsveld, & Wardle, 2009), and that maternal education level is the strongest socioeconomic factor associated with health behaviors and healthy eating of mothers and their children (Saxton et al., 2009; Vereecken, Keukelier, & Maes, 2004). It also seems that mothers are considering their perceived need to restrict food intake when choosing foods for their daughters but not for their sons. Existing evidence shows that restrictive feeding practices are more common in mothers of girls (Birch, 1998). This may link to the higher prevalence of dieting practices and weight concerns among women and girls versus men and boys (Goodrick, Poston, & Foreyt, 1996).

Mothers' obesity genetic causal beliefs predicted the meal calories selected for their daughters while their beliefs about behavioral or lifestyle causes of obesity did not. No data are available to date addressing the relationship between mothers' obesity (genetic versus lifestyle) causal beliefs as determinants of their child-feeding behavior. In the present sample, wherein all mothers were overweight, acknowledging the importance of heredity in causing obesity might drive mothers to identify with their daughter while choosing her food. Mothers might therefore make choices for their daughters using similar criteria to those they use for themselves. Besides, we observed that obese mothers chose more calories for their daughters compared to overweight mothers. On a related note, having not only an overweight mother but also an overweight biological father was a predictor of more calories chosen for girls. One possible explanation is that in families where both parents are overweight, there is a family-wide tendency to eat more and/or eat higher calorie foods. This might be more problematic in families with girls. Research has shown that the family food environment might be more influential on girls' weight than boys' weight (Dubois et al., 2012). Another possible explanation is that when a mother acknowledges the importance of genetics in causing obesity, and her child is at high risk as she has two overweight parents, the mother might feel that she has less control over the child's weight. This could result in choosing more calories, as the mother might perceive that efforts she would make to manage her daughter's weight are unlikely to be successful (McBride et al., 2013).

If different processes are at play in shaping a mother's choices depending on her child's gender, this could mean that different approaches should be considered when planning health-promotion interventions, especially when they target young children. To inform these efforts, more research is needed to understand how mothers, consciously or unconsciously, consider their children's gender in their feeding practices.

There were a number of limitations to our study that must be considered in interpreting the results. Although the information presented as part of the main trial manipulation is likely to be familiar to participants, and did not influence mothers differently depending on child gender, exposure to the manipulation may limit generalizing these results to broader study populations. In addition, it is likely that other factors not assessed may explain the food choices mothers make for their daughters and sons. For example, we did not measure mothers' dietary restraint which has been shown to relate to their restriction of their daughters' food intake in particular (Fisher & Birch, 1999). Also, the child's level of physical activity was not assessed for the present project. It is possible that mothers may perceive their sons to be more active (Riddoch et al., 2004; Sallis, Prochaska, & Taylor, 2000), and therefore feel less need to consider calorie content of their meals. It is noteworthy that calorie allowances are themselves based on the level of children's physical activity to accommodate their needs for a normal growth (Gidding et al., 2006). Another limitation is that both the mother's and the child's weight status were based on mothers' reports. Furthermore, we considered as a predictor in the models mothers' perceptions of children's weight status. Although this measure is widely used in the child feeding literature, it can be biased by one's own experiences or by other factors. Additionally, all participants were overweight or obese. Thus, the results may not be generalized to other populations. It would be worth considering the research questions with a broader population that includes normal weight or lean mothers. In addition, the present sample might not be representative of the larger population, as mothers had to be interested enough in their child's diet to agree to participate in the study and travel to the data collection site. That said, the current study offers a first step to investigating parental food choices on behalf of their children by observing and recording mothers' actual behavior related to food selection. Use of virtual reality technology provided a more controlled setting and comparability of study environment among all participants. Therefore, an important strength of this work is its hypotheses-generating nature, providing an initial foundation of evidence for further investigations in this under-researched area. Clearly, the next steps are to investigate the current findings with a conceptually driven study that broadens recruitment.

In sum, the present study is among the first to investigate overweight mothers' food choices for their children and assess predictors of mothers' meal calorie choices for their daughters and sons. This is particularly important to assess among mothers whose children are at an age where parents are responsible for these choices and while eating behaviors are being set for later life (Nicklaus, Boggio, Chabanet, & Issanchou, 2005).

There is an emerging interest and open discussion about the utility and possibility of including child gender while planning health promotion and obesity interventions (Simen-Kapeu & Veugelers, 2010). However, in order to include this as a factor for consideration, it must first be understood. Indeed, Wardle and colleagues noted that there is an important need "to go beyond simply noting gender differences to seeking to understand them" (Wardle et al., 2004). The current investigation has made steps in this regard in describing the ways in which overweight mothers make differential feeding decisions based on their children's gender, and also in suggesting some predictors of feeding decisions that could be amenable to change. Future efforts in this direction could aid in reducing obesity among young boys.

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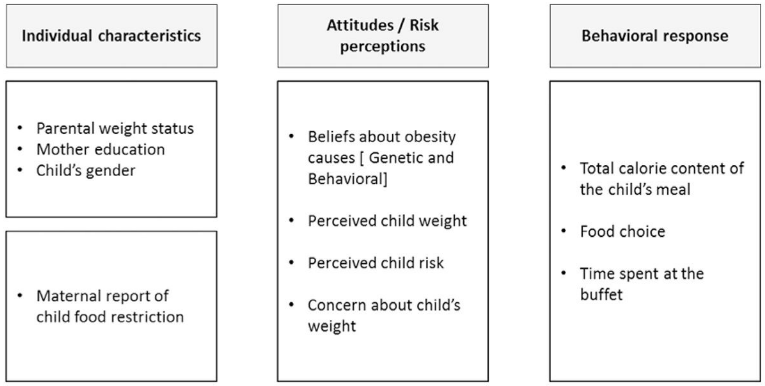

Fig. 1.
Predictors and outcome variables included in the multivariate models.

Table 1

Demographics of children by gender and demographics of mother by child's gender. ANOVAs were used for continuous outcomes and χ^2 tests were used for categorical outcomes.

	Child gender		
Child characteristics	**Girls**	**Boys**	***p* value**
N (%)	121 (54.75%)	100 (45.25%)	0.16
BMI status (reported by the mother)			
Normal weight (<85th BMI percentile)	58%	65%	0.67
Overweight (≥85th BMI percentile)	42%	35%	0.08
Two overweight/obese parents[a] (Yes)	60%	66%	0.61
Mother characteristics	Girls	Boys	*p* value
Age (years; mean ± SD)	37.9 ± 5.4	37.05 ± 5.9	0.29
BMI status (self-report)			
Overweight [≥25–<30 kg/m^2]	62%	57%	0.12
Obese [≥30 kg/m^2]	38%	43%	0.75
Education			
Some college or less	26%	26%	0.51
College or above	74%	74%	0.21
White race[a]	44%	50%	0.77

[a]Data were missing for one girl.

Table 2

Final multivariate model after backward elimination predicting calories that mothers chose for boys.

Model for boys	Parameter estimate (B)	SE	t value	Standardized estimate (β)	*p*
Intercept	264	102	2.58	0	0.011
Experimental group to which the mother was randomized[a]	−31	15	−2.10	−0.20	0.038
Mother's obesity genetic causal beliefs[b]	18	13	1.38	0.14	0.171
Mother's weight status[c]	53	26	2.06	0.20	0.041

[a]Three groups: control; Behavioral Risk Information; Behavioral Risk Information plus Family History.

[b]7-point Likert scale.

[c]Overweight vs. Obese.

Table 3

Final multivariate model after backward elimination predicting calories that mothers chose for girls.

Model for girls	Parameter estimate (B)	SE	t value	Standardized estimate (*β*)	*p*
Intercept	576	135	4.27	0	<.0001
Mother's obesity genetic causal beliefs[a]	27	12	2.22	0.19	0.028
Mother's weight status[b]	46	23	1.99	0.17	0.049
Both biological parents are overweight[c]	70	23	3.08	0.26	0.003
Mother's education level[d]	−86	26	−3.29	−0.28	0.001
Mother's perceived importance of the amount of fast food intake in causing childhood obesity[e]	−30	16	−1.88	−0.16	0.062
Mother's restriction of her daughter's food intake[f]	−41	17	−2.45	−0.21	0.016

[a] 7-point Likert scale.

[b] Overweight vs. Obese.

[c] Yes vs. No.

[d] Less than college education vs. college education or above.

[e] 7-point Likert scale.

[f] 5-point Likert scale.