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## **Selection of design project with the consideration of designers' satisfaction factors and collaboration ability**

Guangying JIN<sup>1</sup>. Séverine SPERANDIO<sup>2</sup> and Philippe GIRARD<sup>3</sup>

<sup>1</sup> IMS, UMR 5218 University of Bordeaux, 351 Cours de la libération, 33405 Talence cedex, France  
(email : [guangying.jin@u-bordeaux.fr](mailto:guangying.jin@u-bordeaux.fr)).

<sup>2</sup> IMS, UMR 5218 University of Bordeaux, 351 Cours de la libération, 33405 Talence cedex, France  
(email : [severine.sperandio-robin@u-bordeaux.fr](mailto:severine.sperandio-robin@u-bordeaux.fr)).

<sup>3</sup> IMS, UMR 5218 University of Bordeaux, 351 Cours de la libération, 33405 Talence cedex, France  
(email : [philippe.girard@ims-bordeaux.fr](mailto:philippe.girard@ims-bordeaux.fr)).

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### **Corresponding Author:**

Guangying JIN

IMS, UMR 5218 University of Bordeaux,

351 Cours de la libération,

33405 Talence cedex, France

Tel : 0033667674784

Email : [guangying.jin@u-bordeaux.fr](mailto:guangying.jin@u-bordeaux.fr)

1 **Title**

2 Food portion at ages 8-11 and obesogeny: The amount of food given to children varies with the mother's  
3 education and the child's appetite arousal.

4

5

6

7 **Abstract**

8 During childhood, the amount of food consumed, associated with adiposity and overweight risk,  
9 depends mainly on the amount of food that is served, especially by parents. This study focuses on the  
10 food amount served by parents ("Portion"), with two objectives: 1/ to confirm (or not) its link with the  
11 food amount eaten ("Intake") by their child; 2/ to identify some of its correlates, i.e., maternal education,  
12 and child's appetite arousal. Five hundred and three French children aged between 8 and 11 years and  
13 one of their parents completed different self-administrated questionnaires online. Results indicated that  
14 Portion and Intake were highly correlated, and that mothers with lower levels of education gave larger  
15 portions to their child, especially if he/she had a high appetite arousal. Moreover, these mothers,  
16 compared to others, were more concerned by taste preferences and less by health with regard to their  
17 child's diet. Such differences in taste and health considerations may contribute to underlie the  
18 educational inequality in food portion size.

19

20 **Key words** : Health inequalities; education; portion size; children; intake; obesity; temperament,  
21 France.

22

## 23 **1. Introduction**

24 Throughout the world, the prevalence of obesity among children aged 5 to 19 rose from 0.77%  
25 in 1975 to 5.6% in 2016 (Abarca-Gómez et al., 2017). In France more specifically, pediatric obesity  
26 prevalence reached 3.6% in 2015 (Guignon et al., 2017). However, as in other countries (Costa-Font &  
27 Joan, 2013; Greves Grow et al., 2010), the weight status of French children is marked by a social  
28 gradient. Overweight affects children of workers (or machine operators) more than those of executives  
29 (or managerial staff) (Moisy, 2017), and is higher in households with lower incomes and in which the  
30 head of a family has only an undergraduate degree (Tavoularis & Hébel, 2017). While these results are  
31 classic (Baum & Ruhm, 2009; Castetbon, 2015; Danielzik Czerwinski-Mast, Langnäse, Dilba & Müller,  
32 2004; O’Dea & Caputi, 2001; Parika et al., 2015; Regnier, 2006), the detailed mechanisms that produce  
33 them are unclear. This paper goes beyond socio-demographics and BMI and explores the amount of  
34 food served to children as a proximal determinant, and its connection to mothers’ education and their  
35 beliefs in the food domain.

36 A strong environmental factor that is believed to contribute to the children’s obesity epidemic  
37 is food portion size, the amount of food served on the plate (Portion). Indeed, literature has shown that  
38 humans tend to eat more (Intake) if they are served larger portions (see Steenhuis & Vermeer, 2009 for  
39 a review), and that is especially the case for children (Birch, Savage, & Fisher, 2015; Fisher et al., 2007;  
40 Fisher, Arreola, Birch, & Rolls, 2007). This is consistent with the facts that countries that offer  
41 particularly large food sizes have a high prevalence of obesity (Rozin, Kabnick, Pete, Fischler, &  
42 Shields, 2003), and that epidemiological surveys have revealed that an increase in food portion sizes has  
43 coincided with a rise in the prevalence of obesity (Piernas & Popkin, 2011; Young & Nestle, 2002).  
44 Moreover, correlational data have indicated that the amounts served to children are strongly associated  
45 with the amounts children consume (Johnson et al., 2014; Nicklas et al., 2013). Finally, experimental  
46 studies have shown that increases in portion size lead to increases in energy and/or the risk of becoming  
47 overweight, especially during childhood (for a review, see Birch et al., 2015). For example, doubling an  
48 age-appropriate portion of one or several starters increased intake of starters by 25% (Fisher et al., 2003)  
49 and 23% (Fisher et al., 2007) in children between 2 and 5 years and 5-yr-old children respectively. Thus,

50 the effect of portion size on food intake is rather well established, especially with regard to its causal  
51 arrow.

52         However, less is known about the distal correlates of food portion size - that is the proximal  
53 correlate of intake. During childhood, because most meals are taken at home, the portion size eaten by  
54 children depends mainly on the size they are served by their parents or served under the control of  
55 parents at the meal table. This is especially the case in France, where family meals are still the norm  
56 (Mathé et al., 2009). The question is thus to understand why some parents feed their child large portion  
57 sizes, especially of high-energy, palatable foods. In this study, we focused on two correlates: maternal  
58 socio-demographic characteristics and a children's food-related temperamental trait. The education level  
59 of mothers, and not that of fathers, was considered, insofar as in French families with children, we  
60 observe a great disparity between mothers and fathers in the performance of household tasks, and in  
61 particular with regard to food (Tavoularis, Hébel, Billman, & Lelarge, 2016).

62         Different socio-demographic correlates are used to categorize social class, i.e. education,  
63 occupation and income. Winkleby et al. (1992) and Pill et al. (1995) compared these measures for their  
64 power to predict health behaviors and reported that, of these, educational level is usually the most  
65 reliable correlate. In the food domain, Renzaho et al. (2014) indicated that low caregiver education was  
66 consistently associated with poor eating habits. More specifically, regarding intake, Wijtzes et al. (2013)  
67 showed that children of mothers with a low and medium-low level of education were significantly more  
68 likely to consume excessive amounts of high-calorie snacks and sugary drinks compared to children of  
69 highly educated mothers. Hupkens et al. (1998) indicated that the proportion of mothers who restrict  
70 their child's intake of sweets, soft drinks, chips and white bread was smaller in lower educated classes  
71 than in higher educated classes. The results of a French survey revealed differences by education for  
72 eight food groups out of thirty-seven, with larger portions in less educated families (Hébel, 2017); these  
73 foods were: sweet biscuits, processed meat, condiments, dried fruits, juices and squashes, vegetables,  
74 pasta, ready meals and sandwiches. In short, children of lower educated mothers tend to be more exposed  
75 to large servings, especially regarding high energy foods.

76         Interestingly, Hupkens et al. (1998) examined the mothers' health and taste considerations  
77 according to their educational level. The mothers were asked how often they took health into account

78 when they bought or prepared foods, and to what extent they agreed with the statements that serving  
79 tasty food is important to please children. Their results suggested that the proportion of mothers who  
80 took health into account increased significantly with education, whereas it decreased with regard to the  
81 pleasure motive. These findings are in line with some ecological models that emphasize the role of the  
82 social environment, and more specifically the family, in the development of the child (Bronfenbrenner,  
83 1979; Harkness & Super, 1994).

84 However, more recently, in connection with the issue of overweight, the Parenting X  
85 Temperament model has shown its effectiveness, indicating that children's temperamental features such  
86 as inhibitory control (Rollins et al., 2014), easiness (Wu et al., 2011; Zeller et al., 2008) and appetite  
87 reactivity (Godefroy et al., 2018) must also be considered. Because parents may adapt their serving  
88 behavior to the child's temperament, introducing this variable improves the understanding of the system  
89 that may produce overweight.

90 Several appetitive temperamental traits have been related to food approach behaviors: Food  
91 responsiveness and Enjoyment of food (Wardle et al., 2001), Appetite arousal (Godefroy, Trinchera,  
92 Romo, & Rigal, 2016), and Food addiction (Gearhardt, Roberto, Seaman, Corbin, & Brownell, 2013).  
93 High scores on these different scales have been associated with overeating and/or higher BMIs in  
94 children (Domoff et al., 2015; Gearhardt et al., 2013; Godefroy et al., 2016). However, their relationship  
95 to portion size remains unexplored. We could hypothesize that children with a "high" food approach  
96 level would be served large portion sizes in response to their expressions of excitement when presented  
97 with palatable foods.

98 In France, public health policies make nine recommendations with regard to food in order to  
99 protect children's health (National Nutrition and Health Program, [www.mangerbouger.fr](http://www.mangerbouger.fr)). Two of them  
100 concern the limitation of the consumption of energy dense products: those containing fat and sugar, but  
101 no indication is given about the size of portions to limit these products. However, parents must be guided  
102 when considering the size of portions served. An initial way of achieving this is by identifying the  
103 motivation criteria in the size of the portions they serve, namely their education level, their concerns in  
104 terms of health and taste preferences, as well as of the expectations their child displays via their food  
105 temperament.

106 This study focused on the food portion size served by parents to their child (Portion), with two  
107 objectives: 1/ to assess its links with the food portion size consumed by their child (Intake) (with the  
108 hypothesis that the Intake increases with Portion); 2/ to identify some of its correlates: maternal  
109 education and concern for health and taste preferences (with the hypothesis that low-educated mothers  
110 give larger Portions, and are less concerned by health and more concerned by taste preferences), and the  
111 child's food temperament (with the hypothesis that children with high appetite arousal are fed larger  
112 Portions).

113

## 114 **2. Methods and material**

115

### 116 **2.1 Study design and procedure**

117 This cross-sectional study was based on reports by the children and one of their parents. The  
118 responses of mothers (93%) and fathers (7%) were taken into account in the analyses. The participants  
119 were selected in 2014 by the Research Center for the Study of Living Conditions (CREDOC) from an  
120 access panel of 378 000 French households. CREDOC offered the participants 'points' that were  
121 convertible into gift-certificates in exchange for their participation and selected two-parent families  
122 living in the Ile de France region with children between 8 and 11 years of age without any severe food  
123 allergies or chronic medical problems.

124 After being recruited for the study, parents received an e-mail with a link to the questionnaire.  
125 Firstly, parents had to answer a few questions about the socio-demographic background of their family,  
126 including the maternal level of education (see below). Then, they were invited to complete the  
127 questionnaire on the food portions they give their child and their child's height and weight. After an  
128 automatic message asking parents to leave their child on their own, the child answered questions about  
129 his/her eating temperament and the food portion sizes he/she consumed.

130

### 131 **2.2 Measurements**

132

#### 133 **2.2.1 Maternal education**

134 Four levels were used to categorize the maternal level of education (Education): Middle school  
135 ( $\leq 9^{\text{th}}$  grade), High school ( $10^{\text{th}}$  to  $12^{\text{th}}$  grades), College (13 to 15 yrs. of education) and Master's  
136 (minimum of 16 yrs. of education).

137

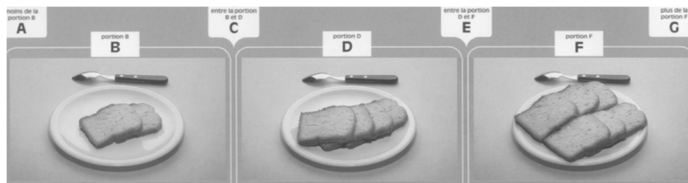
### 138 **2.2.2 Portion and Intake**

139 Portion sizes were assessed using 10 food items considered as high-energy dense, either savory  
140 (breaded fish, roast beef, sausage, pasta, chips) or sweet (pound cake, chocolate cake, pastries, chocolate  
141 and sweets). These 10 items were selected because, as they are common in the French diet and high in  
142 energy content, their consumption in large amounts puts children at risk of becoming overweight.

143 Two types of portion sizes were assessed: the one usually served by the parents and the one  
144 usually consumed by the child. Both types were assessed on the basis of the 10 food images extracted  
145 from the photographic document used for the SU.VI.MAX study (LeMoullec et al., 1996). Each food  
146 was presented in seven increasing portion sizes, quoted from size A (=1) to size G (=7) (Figure 1).

147

148



149  
150  
151 *Figure 1. Example of SU.VI.MAX food pictures*

152

153 Parents were invited to imagine a normal family meal and asked to choose between one of the  
154 seven portion sizes for each of the 10 foods in answer to the question: "Which amount do you generally  
155 give your child at home?". Children had to complete the same task but in answer to the question "Which  
156 amount do you generally eat at home?". We therefore have an estimation of Portion by the parent, and  
157 of Intake by the child.

158 With these data for the 10 food items, the mean food portion size served by parents (Portion)  
159 and the mean food portion size usually consumed by the child (Intake) were calculated for each child.  
160 Through the use of Cronbach's Alpha, we checked the validity of these two mean food portion sizes. It  
161 showed that the Portion ( $\alpha = .72$ ) and the Intake ( $\alpha = .69$ ) were reliable measures.



162

### 163 **2.2.3 Child's appetite arousal**

164           Appetite arousal was measured through the six items of one subscale of the Adolescent Eating  
165 Temperament Questionnaire (Godefroy et al., 2016) (e.g., "As soon as I think about food, I feel like  
166 eating"). Answers were recorded using a 4-point frequency scale from 1 (never) to 4 (always). The  
167 reliability of the subscale was acceptable for the present data ( $\alpha = .75$ ).

168

### 169 **2.2.4 Health and Preferences concerns**

170           Parents had to complete two subscales of the Child Food Motivation Questionnaire (Rigal,  
171 Chabanet, Issanchou, & Monnery-Patris, 2012). All questions required responses to the phrase: " For  
172 my child, I am careful to buy foods which are ... ". Three items were proposed for the Health dimension  
173 (e.g., "... high in vitamins") and for the Child's preferences dimension (e.g., "... accepted by my child").  
174 Answers were recorded using a 4-point frequency scale from 1 (never) to 4 (always). In the actual study,  
175 the reliability of these subscales was satisfactory ( $\alpha = .78$  and  $\alpha = .70$ ).

176

### 177 **2.2.5 Child's BMI**

178           Parents were asked to report their child's current height and weight, only if they knew these  
179 measurements from recent entries in their child's Health Record. Their BMI-for-age and sex was  
180 calculated according to WHO guidelines (Onis et al., 2007).

181

## 182 **2.3 Ethics**

183           The independent Ethics Committee of Paris Nanterre University approved this study. Parents'  
184 and children's consent were required for participation. In order to guarantee privacy, questionnaires were  
185 anonymous.

186

## 187 **2.4 Statistical analysis**

188           A Bravais-Pearson correlation was used to test the association between the two amount variables  
189 (Portion and Intake) and between Portion and the two Concern variables (Health and Preferences).

190 Three ANOVAs were also performed : 1/ One 2 way ANOVA, with Maternal education (4) and  
 191 Appetite arousal (2) as independent variables and Portion as the outcome variable, to test the interaction  
 192 between Maternal education and Appetite arousal -Appetite arousal being dichotomized at the median-  
 193 ; 2/ Two 1 way ANOVAs, with Maternal education (4) as the independent variable and Health concern  
 194 (or Preferences concern) as the outcome variable, to test the differences of concern by Maternal  
 195 education. For Portion, Age was entered as a covariate. LSD was used as a post hoc test.

196

### 197 3. Results

198

#### 199 3.1 Participants

200 The characteristics of the 503 dyads who completed the questionnaires are presented in Table  
 201 1. The mean age of the children was 9.44 yrs. ( $\pm 1.12$ ), with equal distribution by Gender. No difference  
 202 with Gender was observed on any variables, whereas differences with Age were noted for Portion and  
 203 Intake,  $F(3, 499) = 4.75, p = .003$  and  $F(3, 499) = 5.02, p = .005$ , respectively, with portion sizes  
 204 increasing with age.

205 Missing data for the child's weight and/or height were reported for 80 children. The distribution  
 206 of weight status for the 423 remaining children was close to the French standard population, as was the  
 207 distribution of maternal education level (4 missing data,  $n = 499$ ).

208

209

#### 210 **Table 1**

211 *Demographic characteristics for children and mothers*

212

	n (%)
<u>Children</u>	
Age (yrs) n = 503	
8	141 (28)
9	115 (22.9)
10	132 (26.2)
11	115 (22.9)
Gender n = 503	
Girls	235 (46.7)
Boys	268 (53.3)
Weight status n = 423	
Underweight	29 (6.9)
Normal weight	300 (70.9)
Overweight	75 (17.7)

Obese	19 (4.5)
<u>Mothers</u>	
Education n = 499	
Middle school	71 (14.2)
High school	99 (19.8)
College	209 (41.9)
Master	120 (24)
Weight status n = 359	
Underweight	37 (10.3)
Normal weight	205 (57.1)
Overweight	72 (20.1)
Obese	45 (12.5)

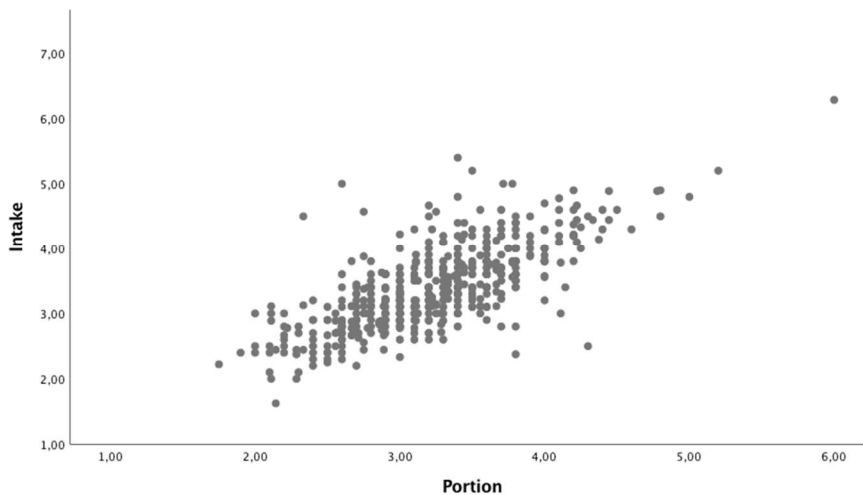
213

214

215 **3.2 Served and eaten amounts (Portion and Intake)**

216 The overall distribution (minimum, maximum, mean and standard deviation) of the two  
 217 variables Portion and Intake were quite similar, with for Portion:  $Min = 1.75, Max = 6.00, M = 3.24$   
 218  $\pm 0.57$ , and for Intake:  $Min = 1.63, Max = 6.29, M = 3.42 \pm 0.63$ .

219 The correlation between the two variables was very strong and positive,  $r(503) = .73, p = .000$   
 220 (Figure 2).



221

222 *Figure 2. Correlations between Portion and Intake (Scatter-plot)*

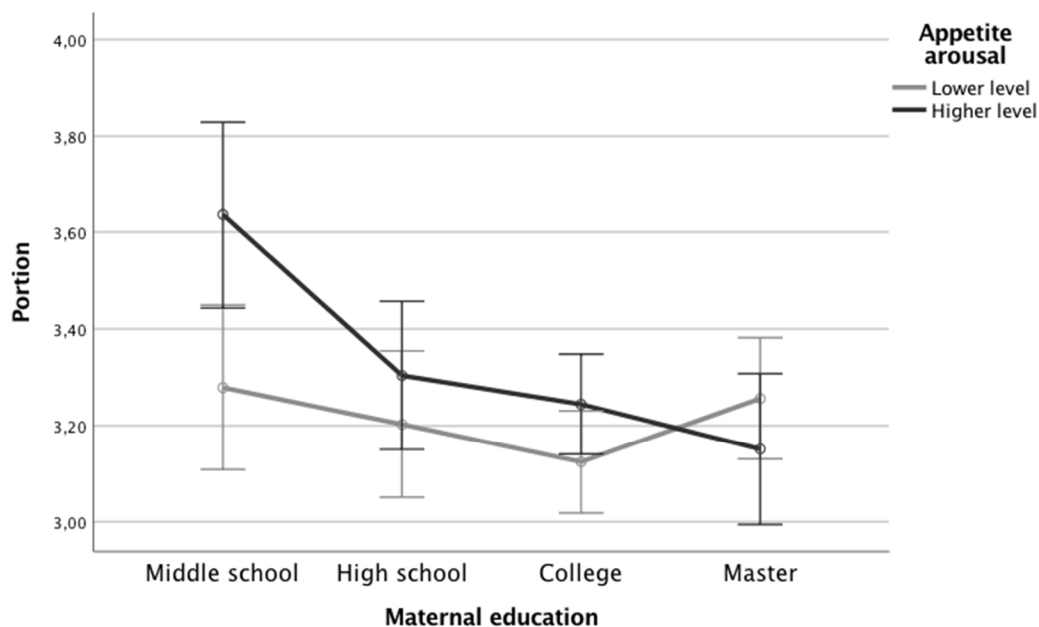
223

224 The correlations between BMI z-scores and Portion and Intake respectively were significant  
 225 though modest,  $r(423) = .13, p = .007$  and  $r(423) = .15, p = .002$ . Also significant but modest were the  
 226 correlations between Portion and Health and Preferences concerns respectively,  $r(502) = -.13, p = .003$   
 227 and  $r(502) = .14, p = .002$ .

228

### 229 3.3 Correlates of Portion

230 A 2 between-subjects ANOVA (Education (4) X Appetite arousal (2)) was performed on  
231 Portion. The two main effects were significant,  $F(3, 495) = 4.57, p = .004$  and  $F(1, 495) = 4.93, p =$   
232  $.027$ , with higher portions being served by middle school-educated mothers and to children with a higher  
233 level of Appetite arousal. Moreover, an interactive effect was observed,  $F(3, 495) = 2.65, p = .048$ :  
234 Portion was not different by children's level of Appetite arousal, except for the Middle school-educated  
235 mothers who fed a larger portion to their children with a higher level of Appetite arousal than to those  
236 with a lower level of Appetite arousal (Figure 3).

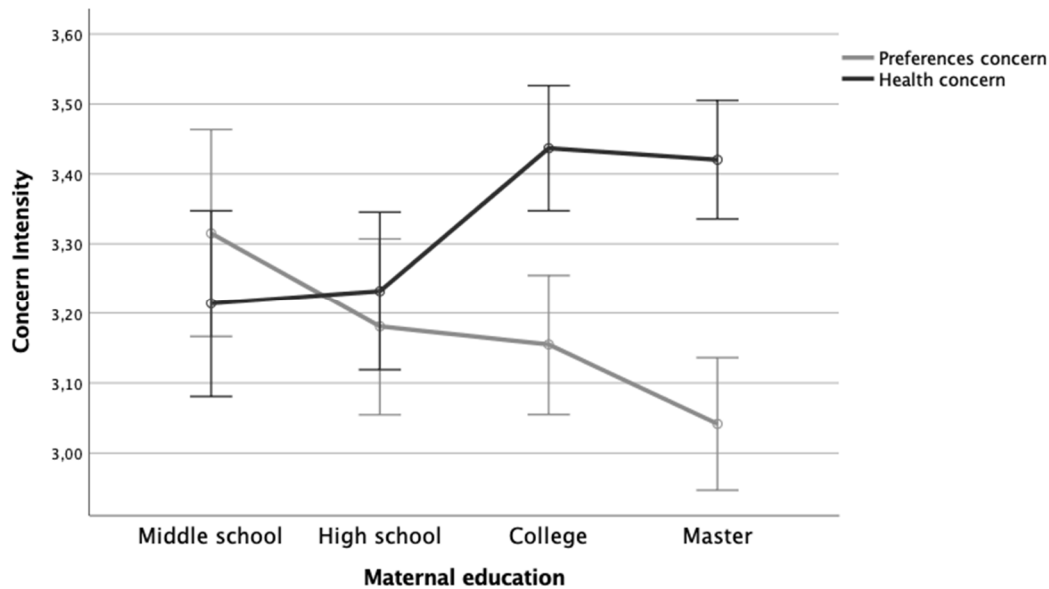


237

238 *Figure 3. Portion size by Maternal education level and Child's appetite arousal*

239

240 Differences were also noted by Education for Health and for Preferences concerns (Figure 4).  
241 Mothers with no college education were less concerned by Health than more educated mothers (either  
242 college or master's degrees),  $F(3, 495) = 4.77, p = .003$ . Moreover, they were more concerned by  
243 Preferences than mothers with a postgraduate education (only in tendency for College-educated  
244 mothers),  $F(3, 495) = 3.19, p = .023$ .



245

246 *Figure 4. Health and Preferences concerns by Maternal educational*

247

#### 248 **4. Discussion**

249 The objective of our study was to explore how variations in amounts of high energy-dense foods  
 250 offered by parents are related to some children's (amount consumed, appetite arousal) and mothers'  
 251 characteristics (level of education, motivations related to their child's diet).

252 Our results indicated firstly that the amount of food offered by parents was positively and highly  
 253 correlated with the amount of food consumed by their child. These results are consistent with those of  
 254 Johnson et al. (2014) and Nicklas et al. (2013) obtained with younger US children. However,  
 255 methodological differences should be noted between studies. Whereas the results of Johnson and  
 256 Nicklas relied on observational data with foods being weighted, ours were based on self-reported  
 257 responses. Both measurements present advantages and disadvantages. Observational data are highly  
 258 objective but are not convenient for large samples of subjects and are susceptible to context variations.  
 259 Self-reported responses may be biased by under-reporting, especially in overweight subjects, but may  
 260 address the "usual" portion size, as in our study, and hence are less susceptible to context variations such  
 261 as the respondents' level of hunger (Lock et al., 2016). Besides, our measurement seems reliable as  
 262 parents' and children's responses are highly correlated (convergent validity). Moreover, Martin et al.

263 (2007) have demonstrated the validity of measuring children's food intake using photography. However,  
264 while our data suggest the existence of a familial pattern in food portion sizes for 8-11-year-old children,  
265 the causal arrow between parental and children's behaviors needs to be checked.

266 Then, we observed that the two types of portion sizes (served and consumed) differed by  
267 maternal education, with the larger portion sizes found in families of the less educated mothers in  
268 accordance with the results of Hupkens et al. (1998), Wijtzes et al. (2013) and Hébel (2017). This is to  
269 be related to the finding that pediatric adiposity decreases with parental education (Tavoularis & Hébel,  
270 2017). Indeed, our results suggested that the familial pattern in portion sizes may be one of the  
271 determinants of overweight risk in children of low-educated parents as children of low-educated parents  
272 are served (and eat) larger portions. However, this suggestion should be confirmed by longitudinal data.

273 Maternal motivation related to their child's diet may provide insight as to why educational  
274 differences exist in the familial pattern of portion sizes. Our results indicated that, compared to other  
275 mothers, those with no college education reported themselves more concerned by children's preferences  
276 and less concerned by health when buying foods for their children, in accordance with the findings of  
277 Hupkens et al. (1998). These child-centered (versus health-centered) mothers would find it difficult to  
278 disappoint their children insofar as high energy dense foods induce strong and immediate pleasure, and  
279 furthermore would not be stopped in this tendency by their health beliefs which are less of a concern to  
280 them. This interpretation is in line with previous findings indicating that low-educated mothers are more  
281 permissive compared to other mothers in the food domain (Vereecken, Keukelier, & Maes, 2004). While  
282 social norms (in terms of what is appropriate to feed a child or to how to raise a child) likely play an  
283 important role in the understanding of these results, our findings shed a light on the values underlying  
284 such norms, as they make explicit what mothers of different levels of education pay attention to in their  
285 decision to size the portions.

286 This interpretation is also supported by our result indicating that the Education x Portion size  
287 effect was reinforced by the child's level of appetite arousal. Low-educated/child-centered mothers  
288 would have difficulty resisting expressions of excitement from their high appetite arousal child when  
289 presented with palatable foods. Whereas mothers with a postgraduate education, more health-centered,  
290 would tend to inhibit their desire to satisfy their child in order to protect their long-term health, because

291 they would feel rewarded as mothers in doing what they believe is good for the child. Again, this  
292 interpretation should be confirmed by future research.

293

#### 294 **Limitations**

295 Our results are only valid for the ten food items included in the study and therefore cannot be  
296 generalized for the children's entire diet.

297 It is possible that other variables have confounded the association between maternal education  
298 and the outcome variables such as children eating lunch at school, and parents' social norms with respect  
299 to nutrition or contextual variables, for example the proportion of fast food restaurants in the  
300 neighborhood.

301 Parents reported their child's height and weight, and thus may have reported wrong values, either  
302 because they did not have access to recent ones or because of a social desirability bias.

303 Finally, because of our cross-sectional design, the causal arrow between the served and  
304 consumed portions remains uncertain. On the one hand, parents may provide the norm of the "usual  
305 portion" which, if too large, puts the child at risk of becoming overweight. On the other hand, parents  
306 may adjust the portion they serve to their child's needs, which increase with adiposity. There is a need  
307 for longitudinal designs to validate causal relationships and reciprocal influences between the two  
308 variables.

309

#### 310 **Conclusion**

311 This paper explored the relation between portions served to children and some characteristics  
312 of families and children. It indicated that larger portions are correlated with a higher food intake, and  
313 that in low educated families, children are served large portions of energy dense foods. While this causal  
314 chain may account for a higher prevalence of obesity in lower educated groups, it was less clear why  
315 these children were served larger portions. This research showed that the serving of larger portions  
316 among low-educated families is linked to more attention to the child's desires (preferences and  
317 appetite for food), as well as less concern for health. This suggests that one causal mechanism involved  
318 would be that less educated mothers' conception of care when they serve food is based on satisfying

319 their child's appetite (including for palatable but energy dense foods), while for more educated mothers  
320 the same tendency might be counterbalanced by another social norm that gives more importance to long-  
321 term benefits than immediate satisfaction.

322         The paper introduces some hypotheses that may have, if verified by other studies, a significant  
323 impact on public health policies and communications by health personnel. Indeed, it showed that there  
324 is a need to explore specific food habit drivers when considering less educated families who are the ones  
325 that present the highest prevalence of overweight. It seems that some parents, especially those with a  
326 low level of education, should be guided to the "right portion size". In France, no recommendation  
327 along these lines has been made by public healthcare services. Through the PNNS program (National  
328 Nutrition and Health Program, [www.mangerbouger.fr](http://www.mangerbouger.fr)), French parents are encouraged to limit the  
329 consumption of fats and sugars, but no indication is given about the size of portions. The results of a  
330 study seeking to assess the effects of this program showed that the program has had no effect among  
331 more deprived families (de Batz, Faucon & Voynet, 2016), probably due to the fact that the program is  
332 based on nutritional knowledge without taking into account the social norms of people with a lower  
333 level of education.

334         With this in mind, top-down guidance may be ineffective in this population. Indeed, if our  
335 interpretations are correct, the issue is not simply a "deficit" of knowledge in nutrition among  
336 uneducated parents, but a matter of social norms that parents use to measure their own worth as parents.  
337 This suggests that for a public health and clinical strategy, parental motivations and social norms around  
338 food should be considered from this broader perspective of "being a good parent". It would be worth  
339 giving more consideration to the importance given to immediate child satisfaction vs long-term health  
340 benefits in families with lower educated mothers.

341

## 342 **References**

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