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Title of the article: Dietary intake in the early years and its relationship to BMI in a bi-ethnic group: the Born in Bradford 1000 study

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Shortened version of the title: Dietary intake and its relationship to BMI

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1 **Dietary intake in the early years and its relationship to BMI in a bi-ethnic group: the Born in**
2 **Bradford 1000 study**

3 **Abstract**

4 Objective: To assess relationships between dietary intake at age 12, 18 and 36 months and body
5 mass index (BMI) z-scores at age 36 months in a bi-ethnic group.

6 Design: A prospective cohort study comparing cross-sectional and longitudinal data. Exposures
7 included dietary intake at 12, 18 and 36 months (Food Frequency Questionnaire) with an outcome
8 of BMI z-score at age 36 months.

9 Setting: Born in Bradford 1000 study, Bradford, UK.

10 Subjects: Infants at age 12 months (n 722; 44% White British, 56% Pakistani), 18 months (n 779;
11 44% White British, 56% Pakistani) and 36 months (n 845; 45% White British, 55% Pakistani).

12 Results: Diet at age 12 months was not associated with BMI z-score at age 36 months. Higher
13 consumption of vegetables at 18 and 36 months was associated with a lower BMI z-score at 36
14 months (-0.20 (95% CI (-0.36, -0.03)) and -0.16 (95% CI (-0.31, -0.02)) respectively). Higher
15 consumption of high fat chips at age 36 months was associated with a lower BMI z-score at age 36
16 months (-0.16 (95% CI (-0.32, 0.00))). Overall, White British children had higher 36 month BMI z-
17 scores than Pakistani children (adjusted mean difference of 0.21 (95% CI (0.02, 0.41))).

18 Conclusion: Our findings indicate that dietary intake at 18 and 36 months was somewhat related to
19 BMI z-score at age 36 months and suggest the importance of early interventions aimed at
20 establishing healthy eating behaviours.

21 Key words: Diet: Infant: Ethnicity: Obesity: BMI

29 **Introduction**

30 Although childhood obesity is levelling off in some populations, worldwide prevalence remains
31 high^(1,2) even at very young ages. The number of infants, toddlers and children (ages 0 to 5 years)
32 who were overweight increased from 32 million globally in 1990 to 42 million in 2013. This figure
33 is predicted to rise to 70 million by 2025⁽³⁾.

34 In the UK, the most recent data provided by the National Child Measurement Programme (NCMP)
35 including over one million children showed 9.3% of reception aged children (ages 4-5 years) were
36 obese and another 12.8% were overweight⁽⁴⁾. Prevalence then increases further in the first few years
37 of school; for Year 6 children (ages 10-11 years) 14.3% were overweight and a further 19.8% were
38 obese⁽⁴⁾. It is estimated by 2020 that 20% of all boys and 33% of all girls will be obese⁽⁵⁾. Infant
39 weight gain has a positive association with subsequent obesity risk^(6,7); highlighting the importance
40 of research describing the aetiology of childhood obesity to support the development and
41 implementation of effective policies and interventions.

42 Obesity prevalence assessed using body mass index (BMI) in the UK is significantly higher in
43 children of South Asian origin compared with White British children^(8,9) although this may in part
44 be due to differences in body composition. Adults of South Asian origin are at greater risk of
45 obesity-related conditions, such as type 2 diabetes⁽¹⁰⁾, even at lower levels of obesity (measured
46 using BMI) compared to White British populations. Children with obesity are more likely to
47 become obese in adulthood and develop a variety of health problems, including cardiovascular
48 disease, insulin resistance, musculoskeletal disorders, some cancers and disabilities⁽³⁾; and obesity
49 in later childhood (ages 7 to < 18 years) and early adulthood (ages 18-30 years) is positively
50 associated with risk of coronary heart disease⁽¹¹⁾. In addition, overweight and obesity in childhood
51 and adolescence have adverse consequences on premature mortality and physical morbidity in
52 adulthood⁽¹²⁾. Overweight or obese adults who were obese as children have an increased risk of type
53 2 diabetes, hypertension, dyslipidaemia, and carotid-artery atherosclerosis⁽¹³⁾. Importantly, risk of
54 adverse outcomes do not persist if children are no longer obese in adulthood⁽¹³⁾; highlighting the
55 importance of early population-based interventions.

56 Optimizing a child's diet before the age of two years may be critical in preventing obesity and
57 obesity-related diseases⁽¹⁴⁾ as inappropriate early eating behaviours established during the
58 complementary feeding period (weaning) and the first few years of life may persist^(15,16). It is
59 important to understand the early risk factors for obesity and develop effective interventions for
60 parents and their offspring supporting healthy weight behaviours⁽¹⁷⁾. With this in mind, we aimed to
61 explore associations between dietary intake at age 12, 18 and 36 months with BMI z-score at age 36

62 months in a bi-ethnic sample of White British and Pakistani origin infants and children alongside
63 examining ethnic differences in dietary intake and BMI z-score at age 36 months.

64 **Methods**

65 Participants and study design

66 The Born in Bradford (BiB) study is a longitudinal, multi-ethnic birth cohort study designed to
67 examine the impact of environmental, psychological and genetic factors on maternal and child
68 health and well-being⁽¹⁸⁾. Bradford is the sixth largest city in the UK, with a population of about
69 half a million and high rates of childhood morbidity and mortality⁽¹⁸⁾. Compared to the national
70 average infant mortality rate in 2003 of 5.5 deaths/1,000 live births, in Bradford it peaked at 9.4
71 deaths/1,000 live births⁽¹⁸⁾. BiB was created in response to rising concerns about the high rates of
72 childhood morbidity and mortality in Bradford. 12,453 women comprising of 13,776 pregnancies
73 were recruited to the BiB cohort between March 2007 and December 2010. Mothers were recruited
74 at 26-28 weeks gestation within Bradford Royal Infirmary while waiting for their routine glucose
75 tolerance test.

76 The Born in Bradford 1000 cohort (BiB1000) is a sub-sample of the full BiB cohort specifically
77 examining the determinants of childhood obesity⁽¹⁹⁾. From August 2008 to March 2009, all mothers
78 recruited to the full BiB cohort were eligible for participation in BiB1000. This study involved
79 further assessments at 6, 12, 18, 24 and 36 months of age, including detailed measurements of
80 anthropometry and social, behavioural and environmental factors that were hypothesized to relate to
81 obesity development⁽¹⁹⁾. Dietary data were collected when children were aged 12, 18 and 36
82 months.

83 Measurements

84 *12 and 18 month dietary intake*

85 Dietary data were collected when children were aged 12 and 18 months using a validated parent
86 reported food frequency questionnaire (FFQ) from the Southampton Women's Survey cohort
87 study⁽²⁰⁾. The questionnaire was adapted for BiB1000 to reflect dietary intake within the multi-
88 ethnic population of Bradford, based on findings from 24 hour dietary recalls in the area and
89 resulted in eight additional items (chapattis (white flour), chapattis (wholemeal flour), boiled rice,
90 fried rice, semolina pudding, milk-based puddings, sponge puddings and other vegetables (e.g. okra,
91 aubergine)). The resulting FFQ therefore included a list of ninety-eight food items, allowing the
92 frequency of consumption and amounts consumed over the preceding month to be recorded⁽²¹⁾. The

93 response categories for each food were ‘never’ (recorded as 0), ‘less than once a week’ (recorded as
94 0.5), ‘food eaten weekly’ (recorded as the number of times per week) and ‘food eaten more than
95 once a day’ (recorded as the number of times per day). An open response section in the same format
96 is included to allow frequencies of consumption and amounts of any foods that are not listed in the
97 ninety-eight foods. Flash cards were used to show the foods included in each food group, to
98 promote standardized responses to the FFQ. Household utensils (tablespoons, teaspoons, bowls and
99 feeding beakers) were used to estimate portion sizes and quantities of foods and drinks consumed.
100 The FFQ was administered by a team of multilingual community research administrators, who were
101 trained by dietitians.

102 For the purposes of analysis at 12 and 18 months, thirteen key indicator food categories were
103 formed from the ninety-eight foods. The key indicator foods were defined as those consumed by
104 this age group as identified through dietary surveys⁽²²⁾ and associated with high energy density
105 (high fat, high sugar) and low energy density (high fibre, low fat, low sugar), and therefore assumed
106 to have a plausible role in obesity development⁽²³⁾. The key indicator foods (Table 1) were selected
107 on the basis of their contribution to dietary patterns associated with the development of obesity⁽²¹⁾.

108 *36 month dietary intake*

109 The 36 month validated FFQ was a modified version of the Survey of Sugar Intake among children
110 in Scotland study⁽²⁴⁾. This FFQ included questions on 140 types of food and drink within sixteen
111 categories. Parents were asked to describe their child’s diet over the previous two to three months,
112 including all main meals, snacks and drinks. It also included any foods and drinks their child
113 consumed outside their home (e.g. at school or nursery, out of school clubs, restaurants, cafes or
114 with family and friends). Descriptions of portion sizes were provided to help parents estimate the
115 quantities of their child’s food intake (e.g. small bowl, slice, teaspoon, small slice, medium glass
116 and small glass). The response categories were ‘rarely or never’, ‘1-2 per week’, ‘1 per week’, ‘2-3
117 per week’, ‘4-6 per week’, ‘1 per day’, ‘2-3 per day’, ‘4-6 per day’ and ‘7 or more per day’ and
118 these were recorded as 1-9 respectively. For the purposes of analysis the responses were converted
119 to daily totals. As with the 12 and 18 month analysis, key indicator food categories were created;
120 defined as those consumed by this age group as identified through dietary surveys⁽²⁵⁾ and associated
121 with high energy density (high fat, high sugar) and low energy density (high fibre, low fat, low
122 sugar), and therefore assumed to have a plausible role in obesity development⁽²³⁾ (Table 1). Of the
123 140 foods captured in the FFQ ninety-five were used for the analysis, in some cases the food
124 groupings were those used in the FFQ, for example fruit, and in other cases foods from different
125 categories were combined for consistency with the 12 and 18 month groupings, ‘cakes’ for example

126 was a combination of ‘biscuits and cakes’, ‘desserts’ and ‘sweets, chocolates and ice-cream’. Some
127 foods were also split within their own categories, meat and fish for example were split into non-
128 processed and processed foods. The list of key indicator foods were not identical to those used at 12
129 and 18 months due to the necessity of using a validated age appropriate FFQ.

130 *Ethnicity*

131 Maternal and child ethnicity was self-assigned by the mother at the baseline assessment (26-28
132 weeks gestation) using the same ethnic group classification as the 2001 UK census⁽²⁶⁾ and
133 categorized into White British, Pakistani, Other South Asian (Indian, Bangladeshi) and Other
134 ethnicities (White other, Black, mixed race, other unspecified). Due to the smaller numbers within
135 the other ethnic groups in the sample, data are presented for the two larger groups at 12 months
136 (White British (38%) and Pakistani (49%)), 18 months (White British (37%) and Pakistani (49%))
137 and at 36 months (White British (38%) and Pakistani (48%)).

138 *BMI z-score*

139 Weight (kg) and height (m) was measured by trained researchers when children were aged 36
140 months. Age and gender adjusted BMI (weight (kg) / height (m)²) z-scores were then calculated
141 based on World Health Organization (WHO) 2006 standards⁽²⁷⁾.

142 Data analysis

143 The frequencies of consumption of key indicator foods at age 12, 18 and 36 months were tabulated
144 across children’s BMI z-score at age 36 months for the full sample and by ethnic group; see Tables
145 2 and 3 for the median frequency and interquartile range (IQR) of consumption for each key
146 indicator food by ethnic group. Although the FFQ assesses both frequency and quantity, we chose
147 to evaluate frequency of consumption of foods as it was deemed more appropriate to identify and
148 inform key public health messages. Quantitative recommended dietary intake guidelines do not
149 currently exist for all of the key indicator foods for this age group in the UK, so it was not possible
150 to categorize intake into those meeting or not meeting recommended intake levels. A pragmatic
151 approach to defining cut-offs was therefore used to define high and low intakes; where intake were
152 dichotomized into consumer/non-consumer (i.e. zero intake/any intake) and below and equal
153 to/above the median intake for that key indicator food (i.e. lower intake/higher intake); see Table 1.
154 Foods with a median intake of zero were those dichotomized into consumer/non-consumer and
155 foods with a median intake of greater than zero were those dichotomized into below and equal
156 to/above the median intake. Cross-tabulation of ethnicity against the categorizations (high and low
157 consumption) of each food at 12, 18 and 36 months are shown in Supplementary Table 1. Also

158 shown are p-values from chi-squared tests of independence between ethnicity and consumption for
159 each food group, using a false discovery rate correction for multiple testing.

160 Multiple linear regression was used to model associations between consumption of key indicator
161 foods at age 12, 18 and 36 months with BMI z-score at age 36 months, adjusted for ethnicity,
162 gender and birthweight, with BMI z-score at age 36 months being the response variable and
163 ethnicity, gender and birthweight plus key indicator food consumption variables being predictors in
164 the models. Multiple logistic regression was used to model associations between ethnicity and
165 consumption of key indicator foods at age 36 months. The coefficients for the key indicator foods in
166 Tables 4, 5 and 6 represent the change in 36 month BMI z-score for children consuming those foods
167 or those consuming those foods more than the median frequency time (i.e. an increased
168 consumption). **The intercept represents a baseline BMI z-score value and an effect for Pakistani**
169 **children, the ethnicity variable represents the difference in BMI z-score for White British children.**
170 Ethnic differences in 36 month BMI z-score, adjusted for dietary intake, gender and birthweight
171 was assessed using these linear regression models, utilising the coefficients and associated
172 confidence intervals for ethnicity.

173 The statistical software package R version 2.15.1 (2012) was used for the analyses⁽²⁸⁾.

174 **Results**

175 1,735 (91%) mothers from 1,916 who were invited agreed to take part in BiB1000. For the current
176 study, participants were excluded if they had multiple births (n 28 / 56 infants), missing child
177 dietary data, missing child BMI z-score at age 36 months or were not of White British or Pakistani
178 ethnicity. The sample therefore consists of 722 singleton infants with 12-month data, 779 children
179 with 18-month data and 845 children with 36-month data.

180 Table 7 provides information on the characteristics of the sample. Data are presented for White
181 British and Pakistani infants only as they form the largest ethnic groups in the population of
182 interest. Birthweight (grams) and 36 month BMI z-scores have been summarized, split by ethnicity
183 and gender for the three time points of interest. There were a number of statistically significant
184 differences between ethnicity and gender with respect to 36 month BMI z-score and birthweight,
185 therefore including ethnicity, gender and birthweight as confounders in the linear regression models
186 was justified.

187 Exploring dietary intake and patterns between 12, 18 and 36 months

188 Table 3 presents the associations between consumption of the key indicator foods at 36 months and
189 ethnicity. Odds ratios are presented for Pakistani infants compared with White British infants. There
190 were a number of statistically significant differences at 36 months, with Pakistani infants more
191 likely to consume high fat chips, processed fish, fruit and water (0.15 (95% CI (0.09, 0.24)), 0.32
192 (95% CI (0.20, 0.51)), 0.49 (95% CI (0.31, 0.76)) and 0.31 (95% CI (0.20, 0.48)) respectively) than
193 White British infants. White British infants were more likely to consume low fat milk, low fat
194 chips, non-processed meat, processed meat, low sugar drinks and low sugar cereals (2.70 (95% CI
195 (1.73, 4.23)), 4.91 (95% CI (3.09, 7.93)), 3.23 (95% CI (2.08, 5.06)), 9.22 (95% CI (5.67, 15.42)),
196 3.22 (95% CI (2.11, 4.97)) and 1.76 (95% CI (1.15, 2.68)) respectively) than Pakistani infants.

197 Associations between intake of key indicator food consumption at 12 months with 36 month BMI z-
198 scores

199 Table 4 shows the median frequency of consumption and associated IQR for the key indicator foods
200 at age 12 months in White British and Pakistani infants (n 722) and associations between
201 consumption of key indicator foods of infants aged 12 months with BMI z-score at age 36 months,
202 adjusted for ethnicity, gender and birthweight. There were no significant associations between
203 consumption of any key indicator food groups at age 12 months and BMI z-score at age 36 months.

204 Associations between intake of key indicator food consumption at 18 months with 36 month BMI z-
205 scores

206 Table 5 shows the median frequency of consumption and associated IQR for the key indicator foods
207 at age 18 months in White British and Pakistani children (n 779) and associations between
208 consumption of key indicator food groups of children aged 18 months with BMI z-score at age 36
209 months, adjusted for ethnicity, gender and birthweight.

210 Intake of vegetables at 18 months was associated with BMI z-score at age 36 months (coefficient of
211 -0.20 (95% CI (-0.36, -0.03))), with children who consume vegetables more frequently than the
212 median time (6.0 (IQR 4.0-7.0) times per day) at age 18 months being more likely to have a lower
213 BMI z-score at age 36 months than children consuming vegetables less frequently than or equal to
214 the median time. Intake of other key indicator foods at age 18 months was not related to BMI z-
215 score at age 36 months.

216 With assessment of the same key indicator foods at 12 and 18 months, the effect sizes and
217 confidence intervals can be directly compared over time (Figure 1). Confidence intervals to the
218 right of the vertical dashed line at zero show variables which are associated with an increase in 36
219 month BMI z-score. Whereas those to the left show variables which are associated with a decrease

220 in 36 month BMI z-score. The upper limit for the vegetables confidence interval at 18 months lies
221 below zero indicating a negative association and therefore a higher consumption of vegetables at 18
222 months is associated with a lower BMI z-score at 36 months. In addition, the confidence intervals at
223 12 and 18 months for each key indicator food overlap substantially, indicating no inconsistent
224 effects of diet at age 12 and 18 months on BMI z-score at 36 months.

225 Associations between intake of key indicator food consumption at 36 months with 36 month BMI z- 226 scores

227 Table 6 shows the median frequency of consumption and the IQR for the key indicator foods at age
228 36 months in White British and Pakistani children (n 845) along with the associations between
229 consumption of key indicator foods for children aged 36 months with BMI z-score at age 36
230 months, adjusted for ethnicity, gender and birthweight.

231 Children consuming high fat chips more frequently than the median frequency at age 36 months
232 (0.4 (IQR 0.2-0.7) times per day) were more likely to have lower BMI z-scores at age 36 months
233 than those consuming high fat chips less frequently or equal to the median frequency (coefficient of
234 -0.16 (95% CI (-0.32, 0.00))). There remained an association between vegetable intake and 36
235 month BMI z-score (coefficient of -0.16 (95% CI (-0.31, -0.02))), with children consuming
236 vegetables more frequently than the median frequency at age 36 months (2.4 (IQR 1.4-3.6) times
237 per day) being more likely to have a lower BMI z-score at age 36 months than children consuming
238 vegetables less frequently or equal to the median frequency. Intake of other key indicator foods at
239 age 36 months was not related to BMI z-score at age 36 months, although a weak association was
240 found between consumption of non-processed fish and 36 month BMI z-score, where children
241 consuming non-processed fish more frequently than the median frequency at age 36 months (0.1
242 (IQR 0.0-0.3) times per day) were more likely to have higher BMI z-scores at age 36 months than
243 those consuming non-processed fish less frequently or equal to the median frequency (coefficient of
244 0.14 (95% CI (-0.01, 0.29))).

245 Ethnic differences in 36 month BMI Z-scores

246 Ethnic differences in 36 month BMI z-scores were consistent regardless of which dietary data (12,
247 18 and 36 months) were included in the model. Figure 2 shows the comparison of the ethnicity
248 effect sizes and confidence intervals on 36 month BMI z-score at 12, 18 and 36 months. These
249 estimates were obtained from the linear regression models (Tables 4, 5 and 6) where ethnicity was
250 used as a confounder **and represents the difference in BMI z-score (White British - Pakistani**
251 **children)**. White British children had a higher mean 36 month BMI z-score than Pakistani children

252 when adjusted for gender, birthweight and dietary intake at age 12, 18 and 36 months (0.29 (95% CI
253 (0.10, 0.49)), 0.21 (95% CI (0.03, 0.39)) and 0.21 (95% CI (0.02, 0.41)) respectively). These
254 conclusions suggest ethnic differences in growth patterns such as BMI and weight which have
255 shown to exist at birth are likely to continue to at least 36 months of age.

256 **Discussion**

257 In our study, White British children had higher BMI z-scores at age 36 months compared to
258 Pakistani children, consistent with other data stating Pakistani infants are lighter and have shorter
259 lengths than White British infants at birth⁽²⁹⁻³³⁾. This demonstrates that ethnic differences in growth
260 characteristics (weight and height) are present from birth to at least 36 months of age. Our research
261 also provides evidence that higher intake of vegetables at ages 18 and 36 months is associated with
262 a lower BMI z-score at age 36 months. Previous literature in this area is inconsistent, which could
263 be attributed to heterogeneity in populations, particularly differences in age groups. Inconsistent
264 findings have been identified in a previous systematic review⁽³⁴⁾ indicating dietary patterns that are
265 high in energy-dense, high-fat and low-fibre foods predispose young people to later overweight and
266 obesity. This review also highlighted that examining multiple dietary factors within a dietary pattern
267 may better explain obesity risk than individual nutrients or foods. Some literature suggests that the
268 evidence of a relationship between vegetable consumption and body mass index is inconsistent,
269 especially among children⁽³⁵⁾; however others report negative associations between fruit and
270 vegetable consumption and BMI/obesity^(36,37). On balance, early introduction of vegetables to
271 infants diets is warranted, not only due to its possible association with a reduction in BMI z-score
272 but also for its contribution towards a healthy balanced diet (high fibre, vitamin A, vitamin C and
273 lower energy density for example). It is however unknown whether encouraging fruit and vegetable
274 consumption displaces other high energy density foods in diets.

275 Dietary intakes for infants and children aged 12 and 18 months in this sample have been discussed
276 previously⁽²¹⁾, showing consumption of foods high in sugar and fat is evident in diets before age 36
277 months. Foods such as chips; roast potatoes and potato shapes; cakes, biscuits, chocolates and
278 sweets; crisps and savoury snacks and processed meat products featured regularly in the diets of
279 children. At 12 months Pakistani infants were more likely to consume fruit and chips or potatoes
280 (adjusted odds ratios, 2.20 (95% CI (1.70, 2.85)) and 2.75 (95% CI (2.09, 3.62)) respectively) but
281 less likely to consume processed meat products than White British infants (adjusted odds ratio, 0.11
282 (95% CI (0.08, 0.15)))⁽²¹⁾. At 18 months, Pakistani infants were more likely to consume fruit, chips
283 or potatoes and water (adjusted odds ratios, 1.40 (95% CI (1.08, 1.81)), 2.26 (95% CI (1.50, 3.43))
284 and 3.24 (95% CI (2.46, 4.25)) respectively) but less likely to consume processed meat products

285 than White British infants (adjusted odds ratio, 0.10 (95% CI (0.06, 0.15)))⁽²¹⁾. These patterns are
286 shown to still be present at 36 months, indicating ethnic differences in food consumption start early
287 (12 and 18 months) and continue at 36 months. Here we have shown additional dietary data at age
288 36 months (Table 6), indicating persistent patterns with median consumption of cakes and high
289 sugar drinks of 2.1 and 2.0 times per day respectively. However there is evidence to suggest the five
290 fruit and vegetables a day message may be starting to get through, with median consumption of 6.0
291 times per day (fruit 3.2 and vegetables 2.4). Although children eating fruit and vegetables on more
292 than five occasions per day is encouraging we shouldn't confuse this result with five portions a day
293 since the quantity eaten is not included in our analysis. Even so, five times a day is beneficial
294 because this will hopefully displace other unhealthier foods at this young age⁽³⁸⁻⁴¹⁾. We
295 acknowledge that looking at dietary patterns, for example, a combination of foods consumed might
296 be better at reflecting associations with weight rather than individual foods (or food groups), as has
297 been previously suggested⁽³⁴⁾ but for consistency with the analysis performed at 12 and 18
298 months⁽²¹⁾ and in order to perform comparisons, food groups (a combination of similar foods) were
299 used instead.

300 Our research suggests that relationships between 36 month BMI z-score and key indicator foods are
301 present at 18 and 36 months, however, using cross-sectional data means causality cannot be
302 established. This was apparent in anticipated foods such as vegetables but we also found other,
303 more unexpected, associations between intake of non-processed fish (grilled or poached white fish,
304 fried oily fish, smoked oily fish, tinned tuna, tinned salmon, sardines, mackerel, pilchards and
305 prawns) and high fat chips at age 36 months and BMI z-score at age 36 months; related to higher
306 and lower BMI z-scores respectively. These unexpected results could be attributed to our method of
307 dietary assessment, however previous literature has reported high intake of fish products is
308 associated with an increased body weight status in school aged children due to accumulation of fat-
309 free mass⁽⁴²⁾. We considered whether the level of breastfeeding in this age group was more
310 important than diet but previous research in this sample has shown there are no associations
311 between infant feeding practices and BMI at 3 years⁽⁴³⁾.

312 Research exists reporting that obese children eat chips more frequently than normal weight
313 children⁽⁴⁴⁾, offering french fries and similar potato products in school meals more than once per
314 week is associated with a significantly higher likelihood of obesity⁽⁴⁵⁾ and higher BMI z-scores are
315 strongly associated with the consumption of high fat foods (including chips and french fries)⁽⁴⁶⁾,
316 our research appears to disagree with these results and goes against intuition. More research is
317 warranted in this population to fully investigate the relationship between high fat chips consumption
318 and obesity (BMI z-score).

319 Our identified relationships between diet and 36 month BMI z-score contribute to evidence
320 highlighting the importance of appropriate diets for all children from a young age⁽³⁴⁾. As promoting
321 consumption of vegetables is notoriously more difficult than fruit⁽⁴⁷⁾, it is encouraging to report that
322 in our sample, children aged 36 months were reported to consume vegetables on average almost two
323 and a half times per day and fruit and vegetables six times per day. With inappropriate eating
324 behaviours established early in life^(15,16) the early introduction of foods associated with a decrease in
325 BMI z-score are essential. The results presented regarding the association between vegetable
326 consumption and 36 month BMI z-score leaves the question of what interventions could be
327 encouraged? Examples are parents setting an example, the one bite rule and rewarding attempts to
328 eat vegetables⁽⁴⁸⁾. Repeated exposure is a simple effective technique that can be used to improve
329 acceptance of novel vegetables⁽⁴⁹⁾. Other aspects of a child's diet can be improved by eating a
330 healthy breakfast, healthier snacks (i.e. fewer crisps and biscuits for example), making water the
331 drink of choice, eating meals together and allowing children to get involved in the preparation of
332 meals⁽⁵⁰⁾.

333 This study has highlighted ethnic differences in BMI z-score in early childhood; consistent with
334 previous research on growth patterns^(29,30). Ethnic disparities in obesity prevalence are already
335 present by the pre-school years, suggesting disparities in childhood obesity prevalence may have
336 their origins in the earliest stages of life⁽⁵¹⁾. Previous research has shown associations between
337 dietary intake during infancy and the early childhood period by ethnicity in the Born in Bradford
338 sample⁽²¹⁾; with consumption patterns of processed meat products, fruit and chips or potatoes being
339 evident in White British and Pakistani infants at 12 months and increasing by 18 months of age,
340 with further consumption patterns in water and low sugar drinks being established at 18 months⁽²¹⁾.
341 Research by the Avon Longitudinal Study of Parents and Children (ALSPAC) has also reported an
342 impact of early nutrition on excess growth⁽⁵²⁾. In one study, breastfeeding status was associated with
343 later obesity, though this was predominantly observed later, when children were school aged⁽⁵³⁾. It
344 is possible that differences in the data between ALSPAC and BiB are due to differences in ethnicity
345 between the cohorts (e.g. 71% of the ALSPAC participants were White). It is also possible that the
346 trajectory of excess weight gain in BiB would continue to increase after school entry, but these data
347 are not available to test this hypothesis.

348 We have identified associations between consumption of some foods and BMI z-score in early
349 childhood. Further research is warranted to determine whether associations are maintained in later
350 childhood.

351 Our study included a large bi-ethnic sample with longitudinal exposure data collected at 12, 18 and
352 36 months of age. Dietary data may have been affected by the use of parent reported FFQs^(20,24),
353 which may be prone to overestimation of some foods and underestimation of others. Assessment of
354 dietary intake via FFQs in large cohort studies is common⁽⁵⁴⁻⁵⁶⁾ and is a standard, feasible approach
355 in large samples⁽⁵⁷⁾. Further, two validated questionnaires were used^(20,24). To our knowledge, there
356 is no systematic error in reporting within FFQs by ethnicity⁽⁵⁸⁾.

357 A limitation of this study is that only infants and children of White British and Pakistani ethnicity
358 were included in the analysis, constituting only two ethnicities and one South Asian group. Due to
359 the heterogeneous nature of this ethnic group, the data cannot be generalized to other South Asian
360 infants and children. In addition, our study only used data from one UK geographical region,
361 Bradford, and the results presented may not be generalizable to other areas. We accept that BMI z-
362 score may not be the most appropriate measure to use as BMI does not directly measure
363 adiposity⁽⁵⁹⁾. Given that previous BiB literature^(29,30) reporting differences in Pakistani and White
364 British infants growth measurements exists, a more suitable indicator for obesity such as percent
365 body fat could be used.

366 **Stratified analysis by utilising two-way interaction terms in our linear regression models (ethnicity**
367 **with each key indicator food) was considered. However, the two-way interaction terms were all**
368 **insignificant meaning the stratified analysis provided equivalent conclusions to the models without**
369 **interaction terms. Therefore, the simpler models were presented as they gave better estimates of the**
370 **effect sizes by pooling the ethnicities, hence increasing the sample size giving smaller standard**
371 **errors and more precise estimates.**

372 It has been suggested that dietary patterns which emerge early⁽⁶⁰⁾ track through infancy⁽⁶¹⁾ and into
373 later childhood⁽⁶²⁾ persist into adulthood⁽⁶³⁾. Findings in this study imply the importance of early life
374 exposures, with some evidence of associations between dietary intake and 36 month BMI z-score
375 being established early in life (18 and 36 months). This is an important conclusion as other studies
376 which have shown relationships between food consumption and growth⁽⁶⁴⁾ have tended to focus on
377 children of school age or older rather than pre-schoolchildren⁽⁶⁵⁻⁶⁷⁾ or solely focused on growth
378 characteristics^(68,69) or diet^(22,70). These results should be used as a foundation to investigate
379 relationships in other populations and links to BMI later in life. With the prediction that 20% of all
380 boys and 33% of all girls will be obese by 2020⁽⁵⁾ it is important to use the information from studies
381 such as this one to develop tailored obesity prevention interventions aimed at pregnant women and
382 new parents.

383 **Conclusion**

384 We found ethnic differences in BMI z-score at age 36 months in our sample, in addition we found
385 some evidence that dietary intake during infancy and early childhood is associated with BMI z-
386 score at age 36 months.

387 This information adds to the evidence base of the importance of diet in early childhood and supports
388 the development of tailored interventions aimed to support parents and carers to optimize early
389 healthy weight behaviours. Further research is required to establish the influence of these dietary
390 patterns in infancy and early childhood on later health outcomes, including childhood obesity,
391 across other ethnic groups.

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Table 1: List of key indicator foods and categorizations of consumption at 12, 18 and 36 months

<u>12 and 18 Months</u>		<u>36 Months</u>	
<u>Key Indicator Food Group</u>	<u>Categorization</u>	<u>Key Indicator Food Group</u>	<u>Categorization</u>
Baby formula milk (inc. all formula milk drinks)	Consumer/non-consumer	High fat milk	≤Median/>median
Baby savoury commercial foods (incl. dried, jars, tinned varieties)	Consumer/non-consumer	Low fat milk	Consumer/non-consumer
Baby sweet commercial foods (incl. dried, jars, tinned varieties)	Consumer/non-consumer	High fat chips	≤Median/>median
Chips, roast and potato shapes	≤Median/>median	Low fat chips	≤Median/>median
Processed meat products	≤Median/>median	Non-processed meat	≤Median/>median
Vegetables (incl. tinned and salad)	≤Median/>median	Processed meat	≤Median/>median
Fruit (incl. fresh, tinned and cooked fruit)	≤Median/>median	Non-processed fish	≤Median/>median
Sweet snacks (incl. cakes, biscuits, chocolate, sweets)	≤Median/>median	Processed fish	≤Median/>median
Savoury crisp-type snacks	≤Median/>median	Vegetables	≤Median/>median
Sugar-sweetened drinks	Consumer/non-consumer (12 months) ≤Median/>median (18 months)	Fruit	≤Median/>median
Pure fruit juices and baby fruit juices	Consumer/non-consumer (12 months) ≤Median/>median (18 months)	Crisps	≤Median/>median
Low-sugar drinks (artificially sweetened)	Consumer/non-consumer	Cakes	≤Median/>median
Water	≤Median/>median	Chocolate	≤Median/>median
-	-	Water	≤Median/>median
-	-	High sugar drinks	≤Median/>median
-	-	Low sugar drinks	≤Median/>median
-	-	Low sugar cereals	≤Median/>median
-	-	Sweetened cereals	≤Median/>median

Table 2: Key indicator food consumption at 12 and 18 months (median and IQR) split by ethnicity

<u>Key Indicator Food Group</u>	<u>Frequency of consumption (per day or per week)</u>							
	<u>12 Months</u>				<u>18 Months</u>			
	<u>White British</u>		<u>Pakistani</u>		<u>White British</u>		<u>Pakistani</u>	
	<u>Median</u>	<u>IQR</u>	<u>Median</u>	<u>IQR</u>	<u>Median</u>	<u>IQR</u>	<u>Median</u>	<u>IQR</u>
Key 1: Formula milk (frequency/day)*	0.0	0.0-2.0	0.0	0.0-2.0	0.0	0.0-0.0	0.0	0.0-0.0
Key 2: Commercial savoury baby foods (frequency/week)*	0.0	0.0-4.0	0.0	0.0-2.0	0.0	0.0-0.0	0.0	0.0-0.0
Key 3: Commercial sweet baby foods (frequency/week)*	0.0	0.0-0.0	0.0	0.0-2.0	0.0	0.0-0.0	0.0	0.0-0.0
Key 4: Chips, roast and potato shapes (frequency/week)†	0.5	0.0-2.0	1.0	1.0-2.0	7.0	7.0-7.0	7.0	7.0-7.0
Key 5: Processed meat products (frequency/week)†	2.0	0.5-3.5	0.0	0.0-1.0	21.0	14.0-28.0	7.0	0.0-7.0
Key 6: Vegetables (incl. tinned and salad) (frequency/day)†	1.7	1.1-2.3	1.9	1.0-2.7	6.0	4.0-7.0	5.0	4.0-7.0
Key 7: Fruit (incl. fresh, tinned and cooked) (frequency/day)†	1.5	0.9-2.4	2.1	1.3-3.1	5.0	3.5-6.0	5.0	4.0-6.0
Key 8: Cakes, biscuits, chocolate and sweets (frequency/day)†	0.7	0.4-1.2	0.6	0.2-1.1	3.0	2.0-4.0	3.0	2.0-4.0
Key 9: Crisps and savoury snacks (frequency/week)†	2.0	0.0-3.0	2.0	0.5-4.0	7.0	7.0-7.0	7.0	7.0-7.0
Key 10: Sugar-sweetened drinks (frequency/week)*/†	0.0	0.0-3.0	1.0	0.0-7.0	7.0	0.0-14.0	7.0	7.0-14.0
Key 11: Pure fruit juice (frequency/week)*/†	0.0	0.0-4.0	0.5	0.0-7.0	0.0	0.0-7.0	7.0	0.0-7.0
Key 12: Low-sugar drinks (frequency/week)*	0.0	0.0-2.0	0.0	0.0-0.8	0.0	0.0-14.0	0.0	0.0-7.0
Key 13: Water (frequency/day)†	2.0	1.0-3.0	2.0	1.0-3.0	1.0	0.0-3.0	3.0	1.8-4.0

IQR, interquartile range

* Consumption of any or none

† Consumption of > median or =< median

Table 3: Key indicator food consumption at 36 months (median and IQR) split by ethnicity with logistic regression model properties

<u>Key Indicator Food Group/Intercept</u>	<u>Frequency of consumption (per day)</u>				<u>Model Properties</u>				
	<u>White British</u>		<u>Pakistani</u>		<u>Log OR</u>	<u>95% CI</u>	<u>OR</u>	<u>95% CI</u>	<u>p-value</u>
<u>Median</u>	<u>IQR</u>	<u>Median</u>	<u>IQR</u>						
Intercept	-	-	-	-	-0.87	(-1.48, -0.27)	0.42	(0.23, 0.76)	0.005
Key 1: High fat milk (frequency/day)†	1.0	0.4-2.5	2.5	1.0-2.5	-0.03	(-0.45, 0.40)	0.97	(0.63, 1.50)	0.90
Key 2: Low fat milk (frequency/day)*	0.0	0.0-1.0	0.0	0.0-0.0	0.99	(0.55, 1.44)	2.70	(1.73, 4.23)	< 0.001
Key 3: High fat chips (frequency/day)†	0.2	0.1-0.5	0.5	0.3-0.8	-1.92	(-2.45, -1.41)	0.15	(0.09, 0.24)	< 0.001
Key 4: Low fat chips (frequency/day)†	0.5	0.4-0.7	0.2	0.0-0.4	1.59	(1.13, 2.07)	4.91	(3.09, 7.93)	< 0.001
Key 5: Non-processed meat (frequency/day)†	0.6	0.4-1.0	0.4	0.1-0.8	1.17	(0.73, 1.62)	3.23	(2.08, 5.06)	< 0.001
Key 6: Processed meat (frequency/day)†	0.6	0.4-0.9	0.3	0.1-0.5	2.22	(1.73, 2.74)	9.22	(5.67, 15.42)	< 0.001
Key 7: Non-processed fish (frequency/day)†	0.2	0.0-0.3	0.1	0.0-0.3	0.11	(-0.35, 0.57)	1.12	(0.71, 1.76)	0.63
Key 8: Processed fish (frequency/day)†	0.3	0.1-0.4	0.4	0.1-0.6	-1.14	(-1.61, -0.67)	0.32	(0.20, 0.51)	< 0.001
Key 9: Vegetables (frequency/day)†	2.5	1.6-3.4	2.4	1.2-3.8	0.09	(-0.35, 0.53)	1.10	(0.70, 1.71)	0.69
Key 10: Fruit (frequency/day)†	2.9	1.7-4.7	3.7	2.2-5.3	-0.72	(-1.16, -0.28)	0.49	(0.31, 0.76)	0.001
Key 11: Crisps (frequency/day)†	0.5	0.3-0.8	0.7	0.4-1.1	-0.42	(-0.88, 0.04)	0.66	(0.41, 1.04)	0.08
Key 12: Cakes (frequency/day)†	1.9	1.1-3.0	2.3	1.3-3.9	-0.24	(-0.71, 0.23)	0.79	(0.49, 1.26)	0.31
Key 13: Chocolate (frequency/day)†	0.4	0.1-0.7	0.4	0.2-1.1	-0.25	(-0.71, 0.20)	0.78	(0.49, 1.23)	0.28
Key 14: Water (frequency/day)†	0.7	0.1-2.5	2.5	1.0-5.0	-1.16	(-1.60, -0.73)	0.31	(0.20, 0.48)	< 0.001
Key 15: High sugar drinks (frequency/day)†	1.7	0.8-3.5	2.1	1.1-3.6	-0.43	(-0.89, 0.02)	0.65	(0.41, 1.02)	0.06
Key 16: Low sugar drinks (frequency/day)†	1.7	0.5-5.0	0.3	0.0-1.0	1.17	(0.75, 1.60)	3.22	(2.11, 4.97)	< 0.001
Key 17: Low sugar cereals (frequency/day)†	1.0	0.4-1.1	0.7	0.4-1.0	0.56	(0.14, 0.99)	1.76	(1.15, 2.68)	0.01
Key 18: Sweetened cereals (frequency/day)†	0.1	0.0-0.4	0.1	0.0-0.4	-0.35	(-0.78, 0.08)	0.71	(0.46, 1.09)	0.11

IQR, interquartile range

* Consumption of any or none

† Consumption of > median or =< median

Table 4: Key indicator food consumption at 12 months (median and IQR) and linear regression model properties and mean 36 month BMI z-scores

<u>Key Indicator Food Group/Intercept/Ethnicity</u>	<u>Intake at 12 Months</u>		<u>Model Properties</u>		
	<u>Median</u>	<u>IQR</u>	<u>Coeff</u>	<u>95% CI</u>	<u>p-value</u>
Intercept	-	-	-1.11	(-1.71, -0.52)	< 0.001
Ethnicity	-	-	0.29	(0.10, 0.49)	0.003
Key 1: Formula milk (frequency/day)*	0.0	0.0-2.0	0.08	(-0.08, 0.23)	0.33
Key 2: Commercial savoury baby foods (frequency/week)*	0.0	0.0-3.0	-0.02	(-0.19, 0.15)	0.82
Key 3: Commercial sweet baby foods (frequency/week)*	0.0	0.0-0.5	0.11	(-0.08, 0.30)	0.25
Key 4: Chips, roast and potato shapes (frequency/week)†	1.0	0.0-2.0	-0.04	(-0.21, 0.13)	0.65
Key 5: Processed meat products (frequency/week)†	0.5	0.0-2.0	0.01	(-0.16, 0.19)	0.88
Key 6: Vegetables (incl. tinned and salad) (frequency/day)†	1.7	1.1-2.6	-0.06	(-0.21, 0.10)	0.48
Key 7: Fruit (incl. fresh, tinned and cooked) (frequency/day)†	1.9	1.1-2.9	0.09	(-0.07, 0.25)	0.25
Key 8: Cakes, biscuits, chocolate and sweets (frequency/day)†	0.6	0.3-1.1	-0.05	(-0.21, 0.11)	0.54
Key 9: Crisps and savoury snacks (frequency/week)†	2.0	0.0-3.0	-0.02	(-0.18, 0.13)	0.76
Key 10: Sugar-sweetened drinks (frequency/week)*	0.0	0.0-0.5	0.07	(-0.08, 0.23)	0.36
Key 11: Pure fruit juice (frequency/week)*	0.0	0.0-0.5	-0.05	(-0.20, 0.10)	0.53
Key 12: Low-sugar drinks (frequency/week)*	0.0	0.0-1.0	0.09	(-0.08, 0.26)	0.32
Key 13: Water (frequency/day)†	2.0	1.0-3.0	-0.12	(-0.27, 0.04)	0.13
				Mean	95% CI
			<i>White British</i>	0.76	(0.67, 0.86)
			<i>Pakistani</i>	0.40	(0.29, 0.52)
			<i>Overall</i>	0.56	(0.49, 0.64)
36 Month BMI z-scores					

IQR, interquartile range

* Consumption of any or none

† Consumption of > median or =< median

Table 5: Key indicator food consumption at 18 months (median and IQR) with linear regression model properties and mean 36 month BMI z-scores

<u>Key Indicator Food Group/Intercept/Ethnicity</u>	<u>Intake at 18 Months</u>		<u>Model Properties</u>		
	<u>Median</u>	<u>IQR</u>	<u>Coeff</u>	<u>95% CI</u>	<u>p-value</u>
Intercept	-	-	-0.77	(-1.39, -0.14)	0.02
Ethnicity	-	-	0.21	(0.03, 0.39)	0.02
Key 1: Formula milk (frequency/day)*	0.0	0.0-0.0	0.05	(-0.15, 0.25)	0.61
Key 2: Commercial savoury baby foods (frequency/week)*	0.0	0.0-0.0	-0.08	(-0.34, 0.18)	0.56
Key 3: Commercial sweet baby foods (frequency/week)*	0.0	0.0-0.0	-0.04	(-0.31, 0.23)	0.76
Key 4: Chips, roast and potato shapes (frequency/week)†	7.0	7.0-7.0	-0.21	(-0.46, 0.03)	0.08
Key 5: Processed meat products (frequency/week)†	7.0	0.0-21.0	0.00	(-0.19, 0.18)	0.97
Key 6: Vegetables (incl. tinned and salad) (frequency/day)†	6.0	4.0-7.0	-0.20	(-0.36, -0.03)	0.02
Key 7: Fruit (incl. fresh, tinned and cooked) (frequency/day)†	5.0	4.0-6.0	-0.04	(-0.19, 0.11)	0.60
Key 8: Cakes, biscuits, chocolate and sweets (frequency/day)†	3.0	2.0-4.0	0.00	(-0.16, 0.15)	0.99
Key 9: Crisps and savoury snacks (frequency/week)†	7.0	7.0-7.0	-0.02	(-0.24, 0.20)	0.85
Key 10: Sugar-sweetened drinks (frequency/week) †	7.0	0.0-14.0	-0.01	(-0.18, 0.16)	0.91
Key 11: Pure fruit juice (frequency/week)†	7.0	0.0-7.0	-0.07	(-0.21, 0.08)	0.37
Key 12: Low-sugar drinks (frequency/week)*	0.0	0.0-7.0	0.11	(-0.04, 0.27)	0.15
Key 13: Water (frequency/day)†	2.0	1.0-4.0	-0.04	(-0.19, 0.12)	0.66
				Mean	95% CI
			<i>White British</i>	0.76	(0.66, 0.85)
			<i>Pakistani</i>	0.41	(0.31, 0.52)
			<i>Overall</i>	0.56	(0.49, 0.64)
36 Month BMI z-scores					

IQR, interquartile range

* Consumption of any or none

† Consumption of > median or =< median

Table 6: Key indicator food consumption at 36 months (median and IQR) with linear regression model properties and mean 36 month BMI z-scores

<u>Key Indicator Food Group/Intercept/Ethnicity</u>	<u>Intake at 36 Months</u>		<u>Model Properties</u>		
	<u>Median</u>	<u>IQR</u>	<u>Coeff</u>	<u>95% CI</u>	<u>p-value</u>
Intercept	-	-	-0.90	(-1.42, -0.39)	< 0.001
Ethnicity	-	-	0.21	(0.02, 0.41)	0.03
Key 1: High fat milk (frequency/day)†	1.4	0.7-2.5	-0.02	(-0.17, 0.12)	0.77
Key 2: Low fat milk (frequency/day)*	0.0	0.0-0.4	0.07	(-0.09, 0.23)	0.39
Key 3: High fat chips (frequency/day)†	0.4	0.2-0.7	-0.16	(-0.32, 0.00)	0.05
Key 4: Low fat chips (frequency/day)†	0.4	0.1-0.5	-0.04	(-0.20, 0.12)	0.62
Key 5: Non-processed meat (frequency/day)†	0.5	0.2-0.9	-0.09	(-0.23, 0.06)	0.25
Key 6: Processed meat (frequency/day)†	0.4	0.2-0.7	-0.08	(-0.24, 0.08)	0.32
Key 7: Non-processed fish (frequency/day)†	0.1	0.0-0.3	0.14	(-0.01, 0.29)	0.07
Key 8: Processed fish (frequency/day)†	0.3	0.1-0.5	-0.07	(-0.22, 0.08)	0.38
Key 9: Vegetables (frequency/day)†	2.4	1.4-3.6	-0.16	(-0.31, -0.02)	0.03
Key 10: Fruit (frequency/day)†	3.2	1.9-5.0	-0.09	(-0.24, 0.05)	0.21
Key 11: Crisps (frequency/day)†	0.6	0.4-1.0	0.01	(-0.13, 0.16)	0.85
Key 12: Cakes (frequency/day)†	2.1	1.2-3.5	0.04	(-0.12, 0.19)	0.63
Key 13: Chocolate (frequency/day)†	0.4	0.1-0.7	0.00	(-0.15, 0.15)	1.00
Key 14: Water (frequency/day)†	1.0	0.4-2.5	0.07	(-0.07, 0.22)	0.32
Key 15: High sugar drinks (frequency/day)†	2.0	1.0-3.5	0.01	(-0.13, 0.16)	0.87
Key 16: Low sugar drinks (frequency/day)†	0.7	0.0-2.5	0.13	(-0.01, 0.28)	0.08
Key 17: Low sugar cereals (frequency/day)†	0.7	0.4-1.1	-0.07	(-0.21, 0.07)	0.31
Key 18: Sweetened cereals (frequency/day)†	0.1	0.0-0.4	-0.02	(-0.17, 0.12)	0.74
				Mean	95% CI
36 Month BMI z-scores		White British		0.74	(0.65, 0.83)
		Pakistani		0.39	(0.29, 0.49)
		Overall		0.55	(0.48, 0.62)

IQR, interquartile range

* Consumption of any or none

† Consumption of $>$ median or \leq median

Table 7: Characteristics of the sample

	<u>36 Month BMI z-score for 12 Month Population</u>			<u>36 Month BMI z-score for 18 Month Population</u>			<u>36 Month BMI z-score in for Month Population</u>		
	<u>n</u>	<u>Mean (Median)</u>	<u>SD (IQR)</u>	<u>n</u>	<u>Mean (Median)</u>	<u>SD (IQR)</u>	<u>n</u>	<u>Mean (Median)</u>	<u>SD (IQR)</u>
Ethnicity: White British	31 9	0.76 (0.74)	0.89 (0.17-1.36)	34 3	0.76 (0.74)	0.89 (0.17-1.36)	37 9	0.74 (0.71)	0.88 (0.15-1.36)
Ethnicity: Pakistani	40 3	0.40 (0.33)	1.14 (-0.29-1.08)	43 6	0.41 (0.32)	1.14 (-0.29-1.11)	46 6	0.39 (0.30)	1.12 (-0.29-1.07)
Sex: Male	33 4	0.53 (0.51)	1.01 (-0.14-1.23)	36 1	0.52 (0.48)	1.02 (-0.14-1.23)	39 1	0.51 (0.48)	1.00 (-0.13-1.21)
Sex: Female	38 8	0.59 (0.52)	1.08 (-0.15-1.26)	41 8	0.60 (0.54)	1.08 (-0.13-1.27)	45 4	0.58 (0.50)	1.06 (-0.15-1.25)
Total	72 2	0.56 (0.51)	1.05 (-0.14-1.25)	77 9	0.56 (0.51)	1.05 (-0.14-1.25)	84 5	0.55 (0.50)	1.03 (-0.14-1.23)
	<u>Birthweight (grams) in 12 Month Population</u>			<u>Birthweight (grams) in 18 Month Population</u>			<u>Birthweight (grams) in 36 Month Population</u>		
	<u>n</u>	<u>Mean (Median)</u>	<u>SD (IQR)</u>	<u>n</u>	<u>Mean (Median)</u>	<u>SD (IQR)</u>	<u>n</u>	<u>Mean (Median)</u>	<u>SD (IQR)</u>
Ethnicity: White British	31 9	3346.53 (3360.0)	534.26 (3050.0-3670.0)	34 3	3327.94 (3340.0)	567.82 (3020.0-3660.0)	37 9	3320.64 (3340.0)	572.05 (3000.0-3665.0)
Ethnicity: Pakistani	40 3	3145.19 (3120.0)	494.87 (2820.0-3450.0)	43 6	3130.56 (3110.0)	504.05 (2800.0-3422.5)	46 6	3127.99 (3105.0)	501.93 (2800.0-3415.0)
Sex: Male	33 4	3289.73 (3280.0)	560.70 (2980.0-3637.5)	36 1	3274.44 (3280.0)	591.41 (2980.0-3640.0)	39 1	3277.60 (3280.0)	590.27 (2960.0-3640.0)
Sex: Female	38 8	3186.30 (3180.0)	481.77 (2840.0-3520.0)	41 8	3168.27 (3140.0)	490.11 (2820.0-3497.5)	45 4	3159.97 (3140.0)	492.36 (2820.0-3480.0)
Total	72 2	3234.15 (3220.0)	521.97 (2900.0-3560.0)	77 9	3217.47 (3220.0)	541.67 (2860.0-3560.0)	84 5	3214.40 (3203.0)	542.73 (2860.0-3560.0)

IQR, interquartile range

Figure Legends

Figure 1: Comparison of Effect Sizes and 95% Confidence Intervals at 12 and 18 Months

Figure 2: Comparison of the Ethnicity Effect Sizes (White British – Pakistani Children) and Confidence Intervals on 36 Month BMI z-score

Figure 1: Comparison of Effect Sizes and 95% Confidence Intervals at 12 and 18 Months

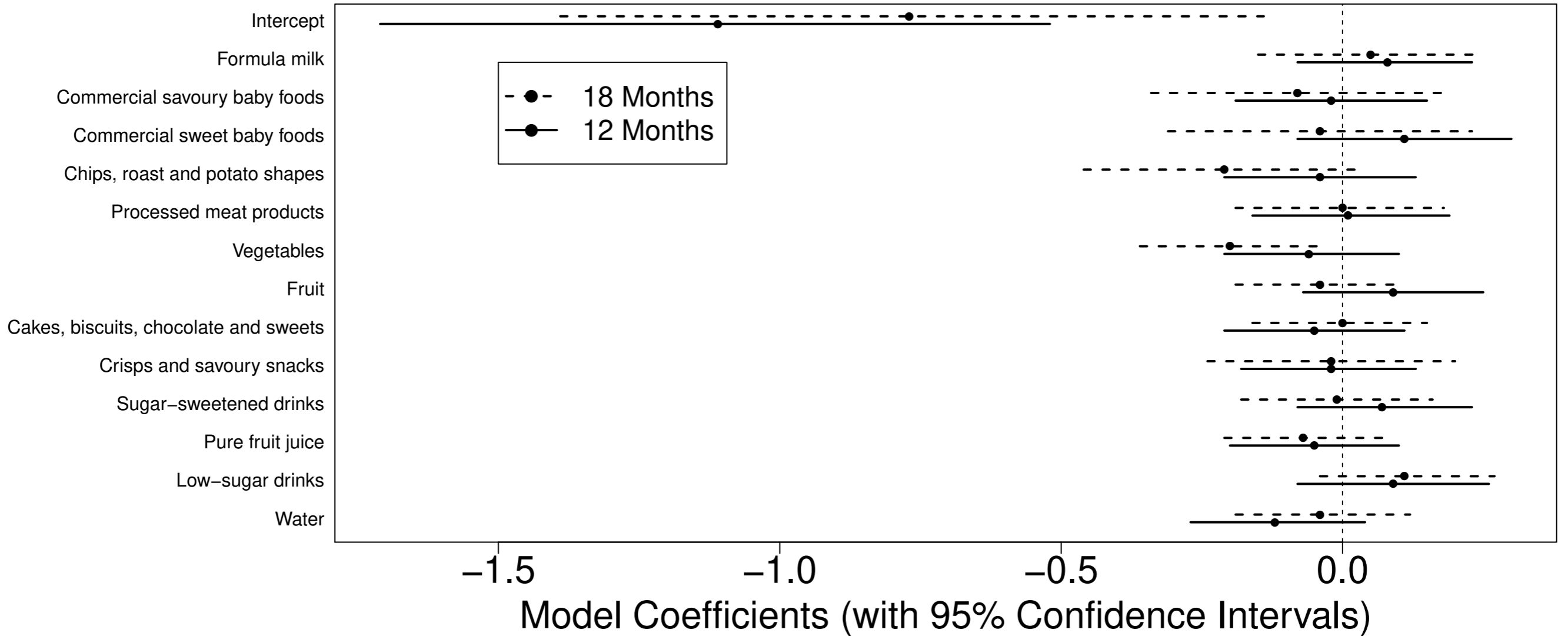
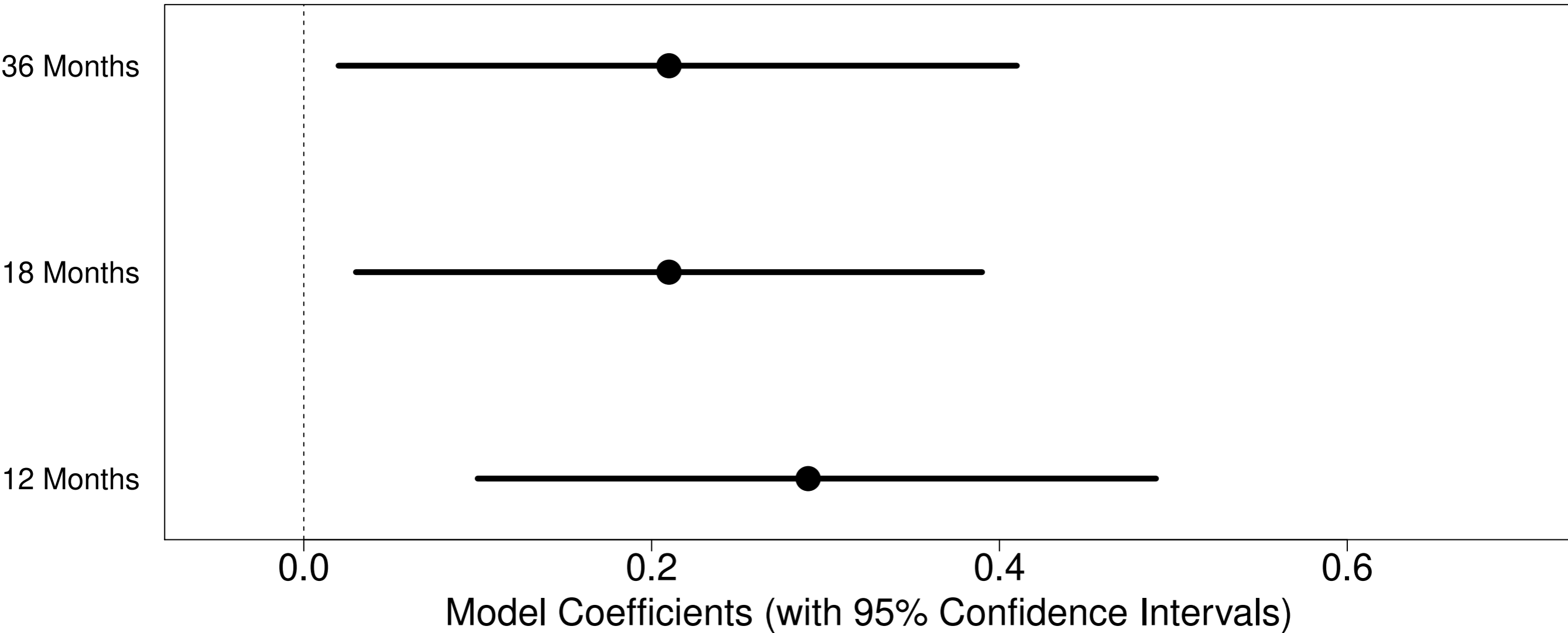


Figure 2: Comparison of the Ethnicity Effect Sizes (White British – Pakistani Children) and Confidence Intervals on BMI z-score



Supplementary Table 1: Frequency tables of ethnicity and dietary intake including a multiple testing procedure

12 Months

		Formula milk		Commercial savoury baby foods		Commercial sweet baby foods		Chips, roast and potato shapes		Processed meat products		Vegetables	
		Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
Ethnicity	Pakistani	243	160	275	128	268	135	98	305	253	150	181	222
	White British	208	111	169	150	258	61	165	154	60	259	159	160
p-value		0.28		< 0.001		< 0.001		< 0.001		< 0.001		0.28	

		Fruit		Cakes, biscuits, chocolate and sweets		Crisps and savoury snacks		Sugar-sweetened drinks		Pure fruit juice		Low-sugar drinks	
		Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
Ethnicity	Pakistani	160	243	209	194	175	228	184	219	189	214	295	108
	White British	189	130	148	171	152	167	188	131	192	127	228	91
p-value		< 0.001		0.27		0.34		0.001		0.001		0.67	

		Water	
		Low	High
Ethnicity	Pakistani	141	262
	White British	119	200
p-value		0.62	

18 Months

		Formula milk		Commercial savoury baby foods		Commercial sweet baby foods		Chips, roast and potato shapes		Processed meat products		Vegetables	
		Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
Ethnicity	Pakistani	383	53	406	30	385	51	31	405	180	256	157	279
	White British	272	71	307	36	331	12	57	286	24	319	89	254
p-value		0.002		0.10		< 0.001		< 0.001		< 0.001		0.005	

		Fruit		Cakes, biscuits, chocolate and sweets		Crisps and savoury snacks		Sugar-sweetened drinks		Pure fruit juice		Low-sugar drinks	
		Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
Ethnicity	Pakistani	170	266	182	254	39	397	102	334	166	270	308	128
	White British	163	180	121	222	66	277	136	207	182	161	194	149
p-value		0.02		0.08		< 0.001		< 0.001		< 0.001		< 0.001	

		Water	
		Low	High
Ethnicity	Pakistani	109	327
	White British	189	154
p-value		< 0.001	

36 Months

		High fat milk		Low fat milk		High fat chips		Low fat chips		Non-processed meat		Processed meat	
		Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
Ethnicity	Pakistani	207	259	367	99	185	281	343	123	287	179	318	148
	White British	237	142	174	205	252	127	129	250	143	236	109	270
p-value		< 0.001		< 0.001		< 0.001		< 0.001		< 0.001		< 0.001	

		Non-processed fish		Processed fish		Vegetables		Fruit		Crisps		Cakes	
		Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
Ethnicity	Pakistani	289	177	196	270	240	226	203	263	200	266	206	260
	White British	183	196	245	134	184	195	222	157	223	156	217	162
p-value		< 0.001		< 0.001		0.43		< 0.001		< 0.001		< 0.001	

		Chocolate		Water		High sugar drinks		Low sugar drinks		Low sugar cereals		Sweetened cereals	
		Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
Ethnicity	Pakistani	217	249	184	282	225	241	310	156	270	196	239	227
	White British	216	163	253	126	205	174	132	247	159	220	234	145
p-value		0.004		< 0.001		0.11		< 0.001		< 0.001		0.004	