Ethnic differences in obesity risk factors

This work includes investigation of ethnic differences in three risk factors for childhood obesity; infant diet, infant sleep and infant physical activity

1.1 Ethnic differences in Infant Diet

1.1.1 Introduction

In the first two years of life an infant's diet changes from milk as the sole food source, to foods and beverages that reflect the family diet. This transition represents the most rapid change in diet over the life course and is the developmental period when dietary preferences and habits are first established.[1] Furthermore, it has been shown that inappropriate early dietary patterns that are established during weaning may persist into the second year of life and beyond.[2, 3]

There is increasing consensus that many children consume inappropriate foods and consume food in excess of their energy requirements. A US survey of a national sample of the diets of infants and toddlers[4] showed that high-salt fast foods and high-sugar snacks and drinks are commonly consumed by infants. Energy intake in infants aged 7-11 months exceeded requirements by 23%, and in one to two year olds by 30%. In addition, fruit and vegetable consumption was low, with many toddlers consuming diets that were similar to adults. Data from a UK birth cohort[5] confirmed that such eating patterns are also a problem in the UK and that infants of mothers of lower education were more likely to have fizzy drinks and low-calorie soft drinks, and more likely to drink from a bottle than from a cup, both of which are associated with later obesity.

The characterisation of early life dietary patterns is essential to understand how early diet influences later outcomes. However to date there is limited evidence, particularly with regard to ethnic differences in dietary intake in early childhood. Dietary data was collected at two time points (12 months and 18 months) as part of the BIB1000 study to determine infant feeding patterns, timing of introduction of solids; intake of key indicator food groups, nutrients and dietary patterns of infants from White British and Pakistani origin. Additionally comparisons were made between the 2 time-points, to determine evidence of tracking of dietary intake between 12 and 18 months.

1.1.2 Methods

Dietary data was collected at 12 and 18 months from a validated Food Frequency Questionnaire (FFQ) from The Southampton Women's cohort study[6] which was modified for use in the multi-ethnic population of Bradford. The FFQ includes a list of 98 food items and allows the frequency of consumption and amounts consumed by the infant child over the preceding month to be recorded. Flash cards, and household utensils and measures were utilised in estimating quantities of food consumed.

The statistical analysis focuses on three areas of children's diets derived from the FFQ: (1) key indicator foods, (2) nutrients, and (3) dietary patterns.

The key indicator food groups were derived from the FFQ by grouping similar types of foods e.g. high fat, high sugar, high fibre, low sugar and associated with dietary energy intake. The

key indicator food groups used in analysis are listed in Table 3. The frequency of key indicator foods was tabulated across the full cohort and by ethnic group.

No dietary guidelines currently exist for this age group in the UK so it was not possible to categorise intake into those meeting, or not meeting, recommended intake levels. For further analysis we dichotomised the food groups into either consumer/non-consumer (i.e. any intake / zero intake) or into below and above the median intake for that key indicator food group (i.e. lower intake / higher intake).

The consumption of nutrients was calculated from the FFQ responses and for the analyses presented here we considered seven nutrients; total energy intake (kcal/day), protein (g/day), fat (g/day), carbohydrate (g/day), fibre (g/day), percentage energy from fat and percentage energy from carbohydrate.

At both 12 and 18 months, a principal components analysis (PCA) was carried out based on the thirteen key indicator food groups, with varimax rotation, restricted to orthogonal rotations only to define dietary patterns. The scree plot suggested that six principal components might be informative. Six components are included before the first change of direction in the plot and six components have eigenvalues greater than one. From these six components we assigned labels to each component, whilst these labels are subjective they do describe the over-riding characteristics. Each individual was scored on these six components, these scores were then dichotomised at the median and were then used as outcomes in further analysis.

Logistic regression was used to model the association between ethnicity and the key indicator foods, nutrients and dietary patterns. All models were adjusted for mother's and father's education and mother's age at follow-up visit. Odds ratios (OR) are presented for Pakistani infants compared to White British infants.

1.1.3 Results

1.1.3.1 Key indicator food group consumption at 12 months

The associations between consumption of the key indicator food groups at 12 months and ethnicity are shown in Table 3. A number of differences were observed between the White British and Pakistani infants in the cohort; Pakistani members were less likely to consume commercial savoury baby meals and processed meat products and more likely to consume commercial sweet baby meals, chips, roast potatoes or potato shapes, vegetables, fruit, sugar-sweetened drinks and pure fruit juice than White British infants.

Table 3. Key indicator food consumption at 12 months by ethnic group, median (IQR) and odds ratio (OR) of Pakistani relative to White British from adjusted logistic regression models

	Frequency of consumption (per day or per week)		Odds ratio of consumption (Pakistani relative to White British) of any or >median		
	White British	Pakistani			
Key indicator food group	Median (IQR)	Median (IQR)	Adjusted OR†	95% CI	P
Formula Milk (per day)*	0.0 (0.2, 2.0)	0.0 (0.2, 2.0)	1.23	(0.95, 1.59)	0.1
Commercial savoury baby meals (per week)*	0.0 (0.0, 4.0)	0.0 (0.2, 2.0)	0.59	(0.45, 0.76)	<0.001
Commercial sweet baby meals (per week)*	0.0 (0.0, 0.0)	0.0 (0.2, 2.0)	1.90	(1.40, 2.56)	<0.001
Chips, roast and potato shapes (per week)**	1.0 (0.0, 2.0)	1.0 (0.5, 2.0)	2.75	(2.09, 3.62)	<0.001
Processed meat products (per week)**	2.0 (0.5, 4.0)	0.0 (0.0, 1.0)	0.11	(0.08, 0.15)	<0.001
Vegetables (per day)**	1.6 (1.0, 2.3)	1.8 (0.9, 2.7)	1.34	(1.03, 1.73)	0.03
Fruit (per day)**	1.5 (0.9, 2.3)	2.1 (1.3, 3.0)	2.20	(1.70, 2.85)	<0.001
Cakes, biscuits, chocolates and sweets (per day)**	0.7 (0.4, 1.2)	0.6 (0.2, 1.1)	0.75	(0.58, 0.97)	0.03
Crisps and savoury snacks (per week)**	2.0 (0.0, 3.0)	2.0 (0.0, 4.0)	1.15	(0.89, 1.49)	0.3
Sugar-sweetened drinks (per week)*	0.0 (0.0, 3.0)	0.5 (0.0, 7.0)	1.68	(1.29, 2.18)	<0.001
Pure fruit juice (per week)**	0.0 (0.0, 3.8)	1.0 (0.0, 7.0)	1.87	(1.44, 2.41)	<0.001
Low-sugar drinks (per week)*	0.0 (0.0, 2.0)	0.0 (0.0, 1.0)	0.86	(0.65, 1.14)	0.3
Water (per day)**	2.0 (1.0, 3.0)	2.0 (1.0, 3.0)	1.09	(0.84, 1.42)	0.5

*consumption of any vs none

**consumption of >median vs <median

† Model adjusted for mother's and father's highest educational qualification and mother's age at the 12 month follow-up questionnaire

1.1.3.2 Key indicator food group consumption at 18 months

The associations between consumption of the key indicator food groups at 18 months and ethnicity are shown in Table 4. There were a number of differences between the White British and Pakistani members of the cohort at 18 months. Pakistani infants were less likely to consume any formula milk, processed meat products, vegetables, and low sugar drinks and more likely to consume commercial sweet baby meals, chips, roast potatoes or potato shapes, fruit, crisps and savoury snacks, sugar-sweetened drinks, pure fruit juice and water. The relationship between ethnicity and consumption of these key indicator food groups altered between 12 and 18 months.

Table 4. Key indicator food consumption at 18 months by ethnic group, median (IQR) and odds ratio (OR) of Pakistani relative to White British from adjusted logistic regression models

	Frequency of consumption (per	Odds ratio of consumption

	day or per week)		(Pakistani relative to White British) of any or >median		
	White British	Pakistani			
Key indicator food group	Median (IQR)	Median (IQR)	Adjusted OR†	95% CI	P
Formula Milk (per day)*	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.55	(0.39, 0.79)	0.001
Commercial savoury baby meals (per week)*	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.89	(0.57, 1.40)	0.6
Commercial sweet baby meals (per week)*	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	4.57	(2.49, 8.39)	<0.001
Chips, roast and potato shapes (per week)**	7.0 (7.0, 7.0)	7.0 (7.0, 7.0)	2.26	(1.50, 3.43)	<0.001
Processed meat products (per week)**	21.0 (14.0, 28.0)	7.0 (0.0, 7.0)	0.10	(0.06, 0.15)	<0.001
Vegetables (per day)**	6.0 (4.0, 7.0)	5.0 (4.0, 7.0)	0.56	(0.42, 0.74)	<0.001
Fruit (per day)**	5.0 (3.0, 6.0)	5.0 (4.0, 6.0)	1.40	(1.08, 1.81)	0.01
Cakes, biscuits, chocolates and sweets (per day)**	3.0 (2.0, 4.0)	3.0 (2.0, 4.0)	0.82	(0.63, 1.07)	0.1
Crisps and savoury snacks (per week)**	7.0 (7,0 7.0)	7.0 (7,0 7.0)	2.04	(1.42, 2.94)	<0.001
Sugar-sweetened drinks (per week)*	7.0 (0.0, 14.0)	7.0 (0.0, 14.0)	2.03	(1.53, 2.70)	<0.001
Pure fruit juice (per week)**	0.0 (0.0, 7.0)	7.0 (0.0, 7.0)	1.82	(1.40, 2.35)	<0.001
Low-sugar drinks (per week)*	0.0 (0,0 14.0)	0.0 (0.0, 0.7)	0.51	(0.39, 0.67)	<0.001
Water (per day)**	1.0 (0.0, 3.0)	3.0 (1.0, 4.0)	3.24	(2.46, 4.25)	<0.001

*consumption of any vs none

**consumption of >median vs <median

† Model adjusted for mother's and father's highest educational qualification and mother's age at the 18 month follow-up questionnaire

1.1.3.3 Nutrient analysis of the FFQ at 12 months

The associations between consumption of the key nutrients at 12 months and ethnicity are shown in Table 5. Ratios of mean nutrient intakes are presented for Pakistani cohort members compared to White British. There were a number of differences between the nutrient intake in infants of White British and Pakistani mothers, with Pakistani mothers reporting providing their infants with 7% lower total energy intake (95% CI: 2% to 11%), 6% lower protein intake (95% CI: 3% to 9%), and 10% lower fibre intake (95% CI: 6% to 14%) than White British mothers.

Table 5. Key nutrient consumption at 12 months by ethnic group, mean (SD) and ratio of mean nutrient intake of Pakistani relative to White British from adjusted models

Key Nutrient	White British Mean (SD)	Pakistani Mean (SD)	Adjusted ratio†	95% CI	P
Total energy intake (kcal/day)	1169 (440)	1083 (436)	0.93	(0.89, 0.98)	0.003

Protein (g/day)	41 (17)	37 (17)	0.94	(0.91, 0.97)	<0.001
Fat (g/day)	44 (19)	41 (19)	1.02	(0.99, 1.06)	0.2
Carbohydrate (g/day)	162 (63)	150 (64)	0.98	(0.94, 1.01)	0.2
Fibre (g/day)	10.1 (4.4)	8.7 (4.1)	0.90	(0.86, 0.94)	<0.001
% energy from fat (%)	34	34	1.02	(0.99, 1.06)	0.2
% energy from carbohydrate (%)	52	52	0.98	(0.94, 1.01)	0.2

† Model adjusted for mother's and father's highest educational qualification and mother's age at the 12 month follow-up questionnaire

1.1.3.4 Nutrient analysis of the FFQ at 18 months

The associations between consumption of the key nutrients at 18 months and ethnicity are shown in Table 6. Ratios of mean nutrient intakes are presented for Pakistani infants compared to White British infants. Total energy intake and protein intake were similar in both ethnic groups and fibre intake was 7% higher (95% CI: 4% to 10%) in Pakistani infants than White British infants. Pakistani infants consumed 8% less fat (95% CI: 5% to 11%) and 7% more carbohydrate (95% CI: 4% to 10%) than White British children.

Table 6. Key nutrient consumption at 18 months by ethnic group, mean (SD) and ratio of mean nutrient intake of Pakistani relative to White British from adjusted models

Key Nutrient	White British Mean (SD)	Pakistani Mean (SD)	Adjusted ratio†	95% CI	P
Total energy intake (kcal/day)	1085 (407)	1058 (392)	0.98	(0.94,1.03)	0.5
Protein (g/day)	40 (16)	37 (14)	0.98	(0.94,1.03)	0.5
Fat (g/day)	44 (18)	44 (18)	0.92	(0.89,0.95)	<0.001
Carbohydrate (g/day)	142 (58)	136 (57)	1.07	(1.04,1.10)	<0.001
Fibre (g/day)	8 (3.5)	7 (3.4)	1.07	(1.04,1.10)	<0.001
% energy from fat (%)	36 (5.3)	36 (6.0)	0.87	(0.84,0.91)	<0.001
% energy from carbohydrate (%)	49 (6.5)	48 (7.2)	0.97	(0.94,1.00)	0.07

† Model adjusted for mother's and father's highest educational qualification and mother's age at the 18 month follow-up questionnaire

1.1.3.5 Dietary patterns analysis at 12 months

The following subjective descriptions can be derived for the first six principal components from the PCA analysis at 12 months:

- ***Naughty:*** Predominantly high in chips and potatoes, processed meat, sweet snacks, savoury snacks and sugar-sweetened drinks.
- ***Healthy:*** Low in processed meat, high in fruit, vegetables and fruit juice.
- ***In a rush:*** Predominantly high in commercial sweet and savoury meals, savoury snacks and low in processed meat
- ***Low sugar:*** High in savoury snacks and low-sugar drinks, low in sugar-sweetened drinks and pure fruit juice
- ***Formula milk:*** Predominantly high in formula milk, processed meat and pure fruit juice, low in sugar-sweetened drinks
- ***Water:*** Predominantly high in water.

Associations between component scores and ethnicity are shown in Table 7. There were a number of differences between infants of White British and Pakistani mothers, with Pakistani mothers reporting substantially greater odds of being above average on the "healthy" component, the "in a rush" component, and the "water" component than White British mothers, and lower odds of being above average in the "low sugar" component.

Table 7. Odds ratios (OR) for association between ethnic group (Pakistani compared to White British) and component scores at 12 months

	Adjusted OR†	95% CI	P
"Naughty" component	1.23	(0.94, 1.60)	0.1
"Healthy" component	2.74	(2.10, 3.58)	<0.001
"In a rush" component	2.05	(1.57, 2.68)	<0.001

"Low-sugar" component	0.61	(0.47, 0.79)	<0.001
"Formula milk" component	0.90	(0.70, 1.16)	0.4
"Water" component	1.67	(1.29, 2.16)	<0.001

† Model adjusted for mother's and father's highest educational qualification and mother's age at the 12 month follow-up questionnaire

1.1.3.6 Dietary patterns analysis at 18 months

The 18-month dietary data was used to generate a new set of principal components also retaining six components. The following descriptions can be derived for the first six principal components, and a subjective label allocated:

- ***Fruit & vegetables***: Predominantly high in fruit and vegetables.
- ***Processed meat***: Predominantly high in processed meat, sweet snacks and sugar-sweetened drinks.
- ***Chips & crisps***: Predominantly high in chips and potatoes, and crisps and savoury snacks.
- ***Commercial meals*****:** Predominantly high in commercial sweet and savoury meals, and fruit juice.
- ***High-sugar drinks***: Predominantly high in sugar-sweetened drinks and pure fruit juice, predominantly low in low-sugar drinks.
- ***Formula milk***: Predominantly high in formula milk, high in water.

These components are similar in structure to those found at 12 months, with the previous "naughty" component now finding expression in two distinct components, with the first largely covering processed meat ("processed meat") and the second covering chips and potatoes, crisps and savoury snacks ("chips & crisps"). And the previous "formula milk" and "water" components now combining into one ("formula milk"). The previous "healthy" component is similar to the new "fruit & vegetables" component, the previous "in a rush" component is similar to the new "commercial meals" component, and the previous "low sugar" component is just the same as the new "high-sugar drinks" component, but just with the scoring reversed.

The associations between component scores and ethnicity are shown in Table 8. There were a number of differences between infants of White British and Pakistani mothers, with Pakistani mothers reporting substantially lower odds of being above average on the "processed meat" component, greater odds of being above average on the "chips & crisps" component, the "commercial meals" component, and the "high-sugar drinks" component than White British mothers, and lower odds of being above average in the "formula milk" component.

Table 8. Odds ratios (OR) for association between ethnic group (Pakistani compared to White British) and component scores at 18 months.

	Adjusted OR†	95% CI	P

"Fruit & vegetables" component	0.9	(0.70,1.17)	0.4
"Processed meat" component	0.13	(0.09,0.17)	<0.001
"Chips & crisps" component	1.67	(1.29,2.17)	<0.001
"Commercial meals" component	1.89	(1.46,2.45)	<0.001
"High-sugar drinks" component	2.23	(1.71,2.91)	<0.001
"Formula milk" component	0.6	(0.46,0.77)	<0.001

† Model adjusted for mother's and father's highest educational qualification and mother's age at the 18 month follow-up questionnaire

1.1.3.7 Comparison of dietary patterns at 12 months and 18 months

It is difficult to compare the PCA analysis at 12 and 18 months due to the principal components changing. Subsequently, we investigated differences between ethnic groups in terms of the same dietary patterns identified at 12 months, but applied to the 18 month data. At 12 months of age, Pakistani infants were slightly more likely than White British infants to score highly on the "naughty" component, and by 18 months this shifted to being less likely (p=0.05). However, their threefold advantage over White British in terms of being more likely to score highly on the "healthy" component decreased to a twofold advantage, although still better than White British infants. The biggest change was that, whilst at 12 months, Pakistani infants were twice as likely to use commercial meals, scoring highly on the "in a rush" component, this increased dramatically, so that by 18 months, Pakistani infants were even more likely to be consuming large amounts of these products (p<0.001). Pakistani infants continued to consume less of the "low-sugar" component than White British. Whilst at 12 months, Pakistani infants were just as likely as White British to have a high intake of the "formula milk" component, by 18 months they were half as likely as their White British counterparts (p<0.001). The Pakistani consumption of the "water" component was much higher than that of White British consumption at 18 months (p<0.001).

1.1.4 Discussion

Analyses of the dietary patterns found that, by 12 months of age, foods and drinks high in sugar and foods high in fat were consumed by infants. There was no fruit and vegetable consumption in 3% of infants; a higher intake of sweet commercial foods, fruit and high sugar drinks in Pakistani infants; higher intakes of savoury baby foods and processed meat products in White British infants.

In comparison to intakes of key indicator food groups at 12 months, the 18 month data shows large statistically significant and nutritionally concerning increases in the consumption of unhealthier food items across the cohort. Large increases are observed in the intake of chips, processed meat products, savoury snacks, and sugar sweetened drinks. Encouragingly intake of fruit, vegetables and low sugar drinks has also increased.

At 18 months Pakistani infants had a higher intake of chips, roast potatoes or potato shapes and consumed substantially less processed meat than White British infants. Pakistani children continued to drink more sugar-sweetened drinks and more pure fruit juice than their White British counterparts.

There were ethnic differences in the consumption of key nutrients and these also changed over time. These changes in diet may simply reflect different weaning strategies between

the ethnic groups; with Pakistani babies breastfed for longer reflected in lower protein and fibre intakes at 12 months, but patterns relating to consumption of solid food becoming more established by 18 months.

This analysis contributes to the limited evidence of dietary patterns in early childhood and highlights ethnic differences in some consumption patterns. There is evidence of dietary patterns that emerged at 12 months tracking to 18 months, and once established may form the basis of an unhealthy diet that may become ingrained and difficult to shift. This information helps to characterise early life dietary patterns and will allow us to examine how early diet influences later outcomes. It can be used to inform the development of community-tailored and culturally appropriate obesity prevention interventions aimed at improving the nutritional health of infants, toddlers and children.

1.2 Infant sleep patterns

1.2.1 Introduction

Shorter sleep duration during infancy is associated with later childhood overweight and obesity.(7, 8) In addition to data collected through questionnaires, we asked mothers to complete a 3-day infant sleep diary at 18 and 36 months. We describe the results from these diaries and the questionnaire data and investigate if there are ethnic differences in sleeping patterns of White British and Pakistani infants.

1.2.2 Methods

Infant sleep duration during the day time and night time was collected at each follow up visit. In addition all parents who completed the BiB1000 interviews at 18 and 36 months were asked to complete a sleep diary during the following week and return this to the BiB office. Two hundred and seventy six 18 month and 262 36 month diaries were returned, with 135 families completing both diaries. The Sleep Diary asked parents 7 questions about their infant's 'normal weekday sleep', followed by collecting sleep data for 3 specified days in the subsequent week. Each nightly diary comprised 16 questions covering the period from the child's last meal to getting up the next morning. We describe differences in sleeping patterns over time between White British and Pakistani infants as recorded at each follow up visit and we report on the timing and duration of night-time sleep as recorded in the sleep diaries.

1.2.3 Results

Mean night-time sleep duration as reported by parents at 6 monthly intervals between 6 and 24 months of age was remarkably consistent over time at 9.3 to 9.4 hours per night (SD 1.5-1.6). Mean twenty-four hour sleep was reported to decline progressively from 13.1 hours (SD 2.0) at 6 months to 12.4 (SD 1.5) at 24 months with a concomitant reduction in day-time sleep from 3.8 (SD 1.8) hours per day at 6 months to 3.1 (SD 1.8) hours per day at 24 months. A similar pattern in sleep duration was observed for each ethnic group.

The greatest change in reported sleep behaviour from the 6 to 24 month visits occurred among White British infants with 71.2% of White British boys and 69.8% of White British girls obtaining more than 12 hours sleep at 6 months, compared with 51.9% and 49.1% respectively at 24 months (reduction of 19.3% and 20.7%). In comparison 9% fewer

Pakistani boys and 12% fewer Pakistani girls were reported to sleep for more than 12 hours at 24 months than 6 months. Ethnic differences in sleeping arrangements may affect sleep duration or maternal knowledge (and subsequent reporting) of infant sleep duration.

1.2.3.1 18 month diaries

Of the 276 infants for whom parents provided data, 255 were full-term, (15 were <37 weeks gestation, 6 missing data), 145 were female, and 129 male (2 missing data). 139 infants were born to White British mothers, 95 Pakistani, and 38 other ethnicity (2 missing data). Mean child age at the completion of diary was 1.51 years.

Parent recorded sleep and wake times for one week night are presented for all infants and by ethnic group in Table 9. Infants fell asleep at 8:28pm on average, woke at 7:35am, obtained just over 11 hours of sleep and those who woke did so for just under 20 minutes. Substantial differences were observed by ethnic group, with Pakistani infants commencing sleep on average more than one and a half hours later than White British infants, and waking on average an hour and 10 minutes later. Pakistani infants experienced approximately half an hour less maximum sleep duration at night than White British infants, with night waking being of similar duration for those who woke in the night. The interview data indicate that 24 hour sleep duration did not differ by ethnicity at 18 months, so this suggests Pakistani infants obtained more daytime sleep than White British infants.

Table 9. Summary of sleep diaries at 18 and 36 months by ethnic group

	All	*White British*	*Pakistani*
18 months			
Sleep onset time (hh:mm)	20:28 (SD 1:19)	19:43 (SD 0:46)	21:25 (SD 1:09)
Wake time (hh:mm)	07:35 (SD 1:09)	07:02 (SD 0:54)	08:13 (SD 1:03)
Max sleep duration (hh:mm)	11:04 (SD 1:04)	11:18 (SD 1:00)	10:45 (SD 1:09)
Night wake duration(hh:mm)	0:18 (SD 0:23)	0:17 (SD 0:21)	0:21 (SD 0:30)
36 months			
Sleep onset time (hh:mm)	20:19 (SD 1:06)	19:46 (SD 0:49)	21:05 (SD 0:58)
Wake time (hh:mm)	07:31 (SD 1:03)	07:09 (SD 0:51)	08:07 (SD 1:02)
Max sleep duration (hh:mm)	11:11 (SD 0:53)	11:24 (SD 0:46)	11:02 (SD 0:59)
Night wake duration (hh:mm)	0:23 (SD 0:55)	0:32 (SD 1:11)	0:12 (SD 0:09)

1.2.3.2 36 month diaries

At 36 months, data were provided for 262 singleton infants: 244 were full-term (13 were <37 weeks gestation, 5 missing data). 121 were female, 141 were male. 139 infants were born to White British mothers, 82 to Pakistani mothers, and 40 were of other ethnicities (1 missing data). Mean child age at the completion of the diary was 3.03 years.

Overall, children fell asleep at 8:19pm on average, woke at 7:31am, obtained 11 hours 11 minutes of sleep and those who woke did so for 23 minutes (Table 9). Substantial differences are again observed by ethnic group in sleep onset and wake times. Sleep onset time for White British was almost unchanged from 18 months but for Pakistani children was 20 minutes earlier, reducing the gap between the groups. Wake times were also moved closer together. Due to the earlier average sleep onset time Pakistani children at 36 months experienced increased maximum sleep duration (just over 11 hours) compared with 18 months. This may reflect reduced day-time sleep opportunities that occur in the UK with the onset of nursery education at 3 years of age.

1.2.4 Discussion

We found ethnic differences in night time sleeping patterns with later sleep onset and wake times for Pakistani infants compared to White British infants at both 18 and 36 months, with Pakistani infants experiencing less maximum sleep duration. Ethnic differences in sleeping arrangements may be affecting sleep duration or maternal knowledge of infant sleep duration. For example, South Asian families tend to practice familial co-sleeping with all children sharing a room for sleep with their parents while White British families practice separate sleeping arrangements, often with one room per child. Such differences may therefore affect maternal knowledge of an infant's sleep duration such that South Asian mothers may be more likely to be aware of night-wakings. Sleep duration may also be affected if family members are more frequently disturbed by one another in the night.

1.3 Physical Activity

1.3.1 Introduction

Low levels of physical activity and high levels of sedentary behaviour are likely to be important contributing factors to childhood obesity.[9-12] The UK national guidelines are for early years children (aged 0-5 years old) to take part in 180 minutes of physical activity each day and to minimise sedentary time (being restrained or sitting for extending periods, except time spent sleeping).[13] Recent evidence suggests that UK children in their early years are not achieving this target[13, 14] and are spending high proportions of their time being sedentary.[15, 16] In South Asian adults[17] and school aged children living in the UK[18] levels of physical activity have been reported to be substantially lower than levels in White Europeans. Whether these differences emerge in early childhood and whether there are differences in the possible determinants of physical activity between ethnic groups is unknown.

1.3.2 Methods

Mothers completed a physical activity and sedentary behaviour questionnaire (BiB1000-PA) which was validated against accelerometry. For the purpose of validation, 95% limits of agreement for total physical activity and sedentary behaviour between parent report and accelerometry were calculated using the technique of Bland and Altman[19]. Daily time spent in physical activity and sedentary behaviour reported by 709 White British and Pakistani mothers were included in the analysis. Data were excluded from analysis if ≤5 hours of physical activity plus sedentary behaviour, or ≥18 hours of physical activity plus sedentary behaviour was reported (n = 361), or if covariable data were missing (n = 11). Ethnicity was categorised into White British (n=323) or Pakistani (n = 386).

Physical activity and sedentary behaviour data were assessed for normality and were found to be normally distributed. Differences in physical activity and sedentary behaviour at age 2 were compared between the two ethnic groups using ANCOVA. Child gender, Index of Multiple Deprivation (IMD) quintile (1 = most deprived, 5 = least deprived), parity (0, 1, 2, or 3+) and mother's age were identified as potential influences upon physical activity and sedentary behaviour and thus were included as covariates. Mother's BMI (collected during pregnancy between 8 and 12 weeks) was considered as a covariate, however data were missing from 66 mothers. The analysis was run both with and without including mothers BMI as a covariate, and no significant influences of mothers BMI was found, thus mother's BMI was excluded from the final analysis.

Mothers answered validated questions regarding possible determinants of physical activity[20]; these included questions about parental support, parental restrictions, maternal attitudes and perceptions, and barriers to physical activity. For each determinant, mothers were categorised into 2 or 3 groups depending on their answer to the question. Differences between the group in time spent in physical activity and sedentary behaviour by the children were compared using ANCOVA with child gender, IMD quintile, parity, mother's age, and ethnicity as covariates.

The differences between ethnic groups in possible determinants of physical activity and sedentary behaviour at 2 years were analysed using ANCOVA controlling for child gender, IMD quintile, parity and mother's age. All mothers who answered these questions from the BiB1000 questionnaire and had covariate data were included in this analysis (total = 1040, White British = 445, Pakistani=596).

1.3.3 Results

1.3.3.1 Ethnic differences in physical activity and sedentary behaviour at age 2

Overall, 80.6% of children met the UK national physical activity guidelines of 180 minutes of physical activity each day. Mean total daily physical activity and sedentary time for the children reported by the different ethnic groups is displayed in Table 10; there were no differences between the ethnic groups for any of the variables. There were, however, significant differences between the ethnic groups in the types of physical and sedentary activities engaged in. Pakistani mothers reported that their children spent significantly more time playing actively inside the house, less time playing actively in the garden/yard, in organised physical activity programmes or walking from place to place (e.g. to local shops), compared to White British mothers. The Pakistani children spent significantly less time in proactive sedentary activities each day (colouring, sitting playing with toys, reading, and sitting listening/singing to music) and engaged in more passive sedentary activity (TV and DVD viewing) each day compared to the White British children (Table 10).

Table 10. Ethnic differences in daily physical activity and sedentary behaviour (mean minutes per day (SD))

	All (n = 710)	White British (n = 323)	Pakistani (n = 387)	P value
Percentage meeting physical activity guidelines	**80.6 %**	**80.5%**	**80.5%**	**0.6**
Total daily physical activity	**312 (152)**	**319 (157)**	**305 (147)**	**0.3**
Playing actively inside the house	214 (127)	190 (121)	235 (128)	<0.001
Playing actively in the garden/yard	47 (59)	55 (65)	40 (52)	0.001
Organised physical activity programme (% participating in activity)	18.4%	29%	10%	<0.001
Walking to get from place to place	18 (26)	25 (31)	12 (20)	<0.001
Total daily sedentary behaviour	**243 (137)**	**257 (131)**	**230 (141)**	**0.07**
Colouring/drawing/craft	18 (28)	21 (25)	16 (31)	0.02
Sitting playing with toys	88 (87)	100 (88)	78 (84)	0.006
Watching TV/DVDs	87 (82)	73 (70)	99 (89)	<0.001
Playing on the computer[a] (% participating in activity)	12%	14%	11%	0.02
Sitting listening/singing to music	24 (36)	32 (42)	16 (29)	<0.001
Reading/being read to	21 (27)	29 (34)	14 (18)	<0.001

Model is adjusted for: child gender, IMD quintile, parity and mother's age. P-value for difference between ethnic groups

[a] Due to low numbers, this is presented as a percentage of children reported as any 'playing'

1.3.3.2 Determinants of physical activity and sedentary behaviour at age 2 and differences between ethnic groups

Compared to boys, girls took part in significantly less physical activity (327 ± 158 versus 297 ± 144 minute per day, p = 0.008) and more sedentary behaviour (230 ± 136 versus 253 ± 137 minutes per day, p = 0.03). There were no significant differences in child's physical activity and sedentary time between IMD quintiles, parity groups, or mothers of different ages (p>0.05).

Table 11. Reported time (mean minutes per day (SD)) spent in physical activity according to categories of the determinants of physical activity

		Never	ometimes	Everyday	P value
Barriers to physical activity	Weather	337 (151)	299 (150)	-	0.004
	Too busy	323 (158)	288 (135)	-	0.02
	Cost of activities/clubs	311 (155)	319 (134)	-	0.8
	Travel	314 (151)	312 (148)	-	0.7
	Worried child might get hurt	314 (157)	288 (133)	-	0.2
	No adult supervision	313 (153)	279 (144)	-	0.09
	Can't take child on their own	318 (153)	286 (155)	-	0.07
	No one else for child to play with	313 (153)	295 (143)	-	0.5
Parent support for physical activity	Encouraged child	315 (156)	305 (158)	315 (142)	0.8
	Participated with child	-	310 (158)	312 (145)	0.7
	Takes child to places to be physically active	-	312 (149)	-	-
Parent restrictions	TV restricted	321 (154)	307 (151)	298 (148)	0.3
	Outside play restricted	311 (142)	298 (151)	347 (174)	0.01
Parent perceptions and attitudes		**Less active**	**Similarly active**	**More active**	
	Compared to peers child is…	-	297 (145)	336 (158)	0.002
		Disagree	**Neutral**	**Agree**	
	It is important that my child doesn't watch too much TV	-	290 (157)	321 (149)	0.008

Model is adjusted for: child gender, IMD quintile, parity, mother's age and ethnicity.
- the percentage of the sample reporting this category is <10%.
P-value for difference between ethnic groups

Mothers who reported that the weather, or being too busy, were “never” barriers to their child’s participation in physical activity reported that their children spent more time each day in physical activity compared to mothers who reported that these variables were “sometimes” a barrier to participation (Table 11). There were no other significant associations between physical activity and any of the other barriers to physical activity. There were differences between the ethnicities in the reported barriers to children’s physical activity. White British mothers reported that the cost of child activity clubs (e.g. soccer tots) or leisure facilities (e.g. swimming pool) was more often a barrier than Pakistani mothers (Table 12). Pakistani mothers reported that the following were more often barriers compared to White British mothers: the weather, being busy, worried that their child might get hurt, not able to take them out on their own and no adult to supervise child playing (Table 12).

Table 12. Differences in possible determinants of physical activity between ethnic groups
Model is adjusted for: child gender, IMD quintile, parity and mother's age.
P-value for difference between ethnic groups

		White British			Pakistani			
		Never (%)	Sometimes (%)	Everyday (%)	Never (%)	Sometimes (%)	Everyday (%)	P value
Barriers to physical activity	Weather	40	56	4	33	58	9	0.003
	Too busy	72	27	0.5	58	32	9	<0.001
	Cost of activities/clubs	77	20	2.4	87	12	2	<0.001
	Travel	78	19	3	70	22	7	0.06
	Worried child might get hurt	94	4	1	71	18	12	<0.001
	No adult supervision	94	5	0.9	88	8	3	0.009
	Can't take child on their own	89	9	2.2	73	20	7	<0.001
	No one else for child to play with	90	9	0.7	85	1	2	0.05
Parent support for physical activity	Encouraged child	6.6	35	59	21	37	42	<0.001
	Participated with child	0.5	42	57	10	44	45	<0.001
	Takes child to places to be physically active	2.6	86	12	18	77	5	<0.001
Parent restriction	TV restricted	34	33	33	52	29	19	<0.001
	Outside play restricted	49	35	16	41	39	16	0.2
		Less	**Similar**	**More**	**Less**	**Similar**	**More**	
Parent perception and attitudes	Compared to peers child activity is…	1	64	35	4	55	41	0.09
		Disagree	**Neutral**	**Agree**	**Disagree**	**Neutral**	**Agree**	
	It is important that my child doesn't watch too much TV	1	20	79	9	16	75	<0.001

There were no differences in children's time spent physically active between parents who supported their children to be physically active every day and those who did not (Table 12). There were differences between the ethnicities in the support that parents gave their children to be physically active. White British mothers encouraged their children to be physically active, participated in physical activity with their child, and took them to places to be physically active more often than Pakistani mothers (Table 12).

Parents who restricted their child playing outside "everyday" reported more physical activity than those who "sometimes" or "never" restricted playing outside (Table 12). There were no differences in physical activity or sedentary behaviour according to how often parents restricted TV viewing. White British mothers restricted their child's amount of TV viewing significantly more often than Pakistani mothers; however there were no differences between the groups in restrictions upon children playing outside (Table 12).

Ninety six percent of mothers perceived that their children enjoyed being physically active and 96% of mothers agreed with the statement "I think it's important that my child is physically active." Parents who perceived their child to be more active than their peers (59%) reported more physical activity compared to children who were similarly active to peers (39%) (Table 11). There were no ethnic differences in mothers' perceptions of their child's enjoyment of physical activity or their child's physical activity level.

Three quarters of mothers agreed with the statement "I think it's important that my child doesn't watch too much TV", these mothers reported more time in physical activity and less time sedentary and watching TV/DVDs for their child (Table 11) compared with those who were neutral. Mothers' attitudes towards TV viewing were significantly different between the ethnic groups, with more White British mothers agreeing that not watching too much TV was important for their child compared to Pakistani mothers (Table 12).

1.3.4 Discussion

The majority of children in the BiB1000 cohort at age 2 were meeting the Chief Medical Officer's guidelines for physical activity of 180 minutes of physical activity each day[13]. This is comparable to recent accelerometer derived physical activity data from Canada which reports 73-100% of children aged 3-4 years meeting the 180 minutes guidelines.[21-23] However it contradicts previous data from the UK where proxy-reports of pre-school children's physical activity shows low levels of engagement,[24] with 3-4 years olds spending on average 120-150 minutes per day in physical activity and high amounts of time sedentary.[25] The discrepancies in reported physical activity between studies are likely to be due to methodological differences in measurement which is not standardised for children in the early years.

There were no differences between the ethnic groups in time spent in daily total physical activity and sedentary behaviour and TV/DVD viewing was high for the whole group (on average an hour and a half per day). There were however ethnic

differences in the types of physical and sedentary activities the children engaged in. White British children were reported to spend longer walking, in organised physical activity, playing outside and in proactive sedentary behaviours (e.g. being read to) compared to Pakistani children who spent longer each day playing inside and in passive sedentary behaviour (watching TV/DVDs). The Pakistani mothers were more likely to report either being neutral to or disagreed with the statement, "I think it's important that my child doesn't watch too much TV". Although this attitude towards sedentary behaviour was not related to time spent in physical activity or sedentary behaviour in the children at aged 2, it is possible that it could contribute to the differences in physical activity and sedentary behaviour between ethnic groups which have been reported later in childhood.[18] The differences in times spent in different types of activities may be important lifestyle differences as the children grow up since observational studies have shown that time outdoors correlate with PA levels in school-aged children.[26, 27] Time outdoors has also been associated with higher objectively measured physical activity[28, 29] and with lower prevalence of overweight.[28] There were other marked differences between the ethnicities in possible determinants of physical activity and sedentary behaviour which may also contribute to the reported differences between ethnic groups later in childhood.[18] These include Pakistani children being less frequently restricted in their TV viewing, having more barriers to physical activity, and receiving less frequent support to be physically active from their parents.

Children whose parents restricted them from spending time outside everyday were reported to engage in more physical activity. This may indicate that parenting styles influence participation in physical activity at age 2. Studies with older children have reported significant associations between parenting style and physical activity;[30-32] however there is no consensus regarding the parenting style that best facilitates engagement in physical activity. Further work is required to understand better the influences of parenting upon childhood physical activity and sedentary behaviours.

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1.4 Investigation of social and environmental determinants of childhood obesity

A qualitative exploration into determinants of childhood obesity

1.4.1 Background

What stops us grasping what people are up to is a lack of familiarity with their personal imaginative universe[1].

Obesity is linked to a medically defined anatomical measurement and used as both a disease category, "you are obese", or as risk assessment, "your chances of illness are greater"[2]. Simply bringing these categories into diagnostic or screening protocols does not mean they enter into lay discourse as anything other than one of several factors impacting on self-perception. One's size, and whether it is of concern to an individual, is not a simple artefact of a diagnostic or risk discourse. In lay discourse it is structured through a comparative measure: am I (or is my baby) overweight in relation to those around me; a chronological measure, how is my weight compared to how I was, or even to how my parent was; and, a socially conditioned measure which is in part shaped by a (changing) media ideal.[3, 4] In considerations of body size and of eating and exercise we cannot assume that making these areas public issues has meant they become something that is recognised as personal troubles.[5]

1.4.2 Evidence in existing qualitative literature

A systematic review of qualitative studies[6] reports a literature where parents attitudes to feeding their young children reflect a belief that the child is "picky", "fussy", "difficult", "always seeming hungry", and so on. Family dynamics, both between the parents and with other family members, also shape attitudes and behaviour. Different attitudes to being a parent, and different sets of knowledge about the desirable and the possible, both in terms of what healthy behaviour is and about what can and should be encouraged and supported, are also reported. Looking beyond the family, there are extra-familial influences including from friends, neighbourhoods, and the environment in which the family is living. There is also an influence that is attributed to the type and amount of resources available for the family. Intergenerational influences on parental health beliefs and knowledge suggest that health promotion strategies may be more effective if directed at the

wider family, rather than parents alone. Significantly, many parents believed strategies to promote healthy weight should start early in a child's life. This study summarises the range of relevant influences by using a "socio-ecological model" where individual, interpersonal, community, organisational and societal levels interact in complex ways to impact on parental perceptions about healthy behaviours for preventing child overweight.

In addition to this systematic review there is other qualitative evidence that points to the importance of intergenerational influences, specifically grandmothers. This seems particularly evident in understanding what constitutes an appropriate size for a "healthy baby", big babies are seen as healthy babies[7, 8].

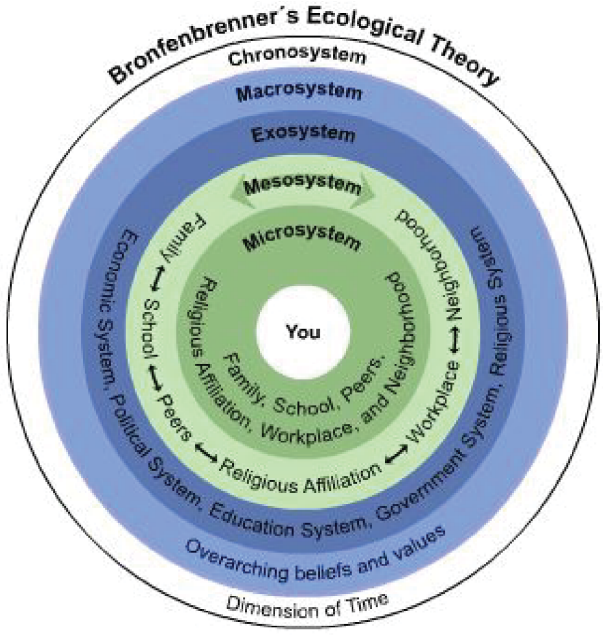
A systematic review of lay (mostly parental) views about infant size and growth [9] found that perceptions about what was a healthy size and healthy rate of growth were arrived at via comparison with what was considered by parents to be normal; parents valued their child being like everyone else. There was recognition that infants will differ in size, and differences in parental size, feeding practices, or the presence of specific "medical" reasons why an infant was a different size were invoked as explanations. If these explanations were not available, and parents thought their child was different to others, they were likely to express concerns. The idea of the normal is gathered from various sources; a straightforward comparison with other infants they see, conversations with health professionals especially around growth charts (where parents want reassurance their infant is normal) and comparison with social signifiers of normality like infant clothes sizes. Lucas et al[9], in this review, do wonder about the impact of cohort changes; "The value placed by parents on being like everyone else has implications for health promotion messages. If trends in infant size continue towards greater fatness, "being normal" will include infants who are fatter than those in the past"[9].

A study on initiating and then sustaining exclusive breastfeeding in South Asian women found that a clinic based peer support worker did not significantly increase breastfeeding. In considering the difficulties of shaping appropriate, acceptable and effective interventions it was noted that there is an absence of evidence about variations in the effectiveness of interventions according to ethnicity, socioeconomic status or an interaction of both[10]. At the very least we cannot assume that interventions designed to be appropriate for low income families will be appropriate for low income South Asian families, and vice versa.

As well as seeking to illuminate parental perceptions there are some qualitative studies that have provided evidence of the way that Asian women are stereotyped by professionals who use "Asian family" as a metonym of "supportive and helpful"[11]. Such discourse is a short step away from legitimising an approach to service development that builds on an assumption that little is needed because they "look after their own" [12], or paradoxically identifies health problems in Asian communities as a manifestation of cultural practices. [13]

Pocock et al's review[6] uses a socio-ecological approach[14, 15] to capture the range of influences that are relevant to childhood obesity prevention. There are areas that are best understood in terms of individual influence, interpersonal, community, organisational and societal zones. (Bronfenbrenner uses the terminology of micro, meso, exo and macro systems and also uses the dimension of time; a chronosystem[15] see figure 3). For example a child's personality and mood will have an influence on food preferences. So too will parental choices and peer influences, which in turn are shaped by media and marketing. If the child spends time in day-care then organisational choices also determine some food intake. (A survey in 2010 reported that the average toddler typically has almost 30% of their meals provided by people other than their parents (typically grandparents, child minders and nurseries) [16]). All of these influences will change over time. An intervention in any one zone is only likely to succeed if other zones support it. It is not likely to succeed if one wishes to act in one zone on behaviour/choices that are determined in another.

Figure 3: Bronfenbrenner Ecological Theory(15)



Our concern is focussed on early feeding practices in the context of a population where half the parents are of South Asian origin (predominantly Pakistani). This prompts some modification/addition to the Bronfenbrenner schema. In Bradford's Pakistani households (when compared to White British families) less mothers have had a formal involvement in the work-force; more live in extended family households; many have grown up in Pakistan, moving to the UK after their school years; most have an active engagement with their Mosque, a place not just for spiritual sustenance but a focus for worldly advice and for socialising[17]. These factors suggest that attitudes and practices developed in Pakistan may have considerable salience – for example around cooking styles/materials used and around perceptions of what is a desirable (and healthy) size for babies.

1.4.3 Method

45 mothers who had consented to be in the Born in Bradford study were contacted by letter when their baby was about 3 months old. The procedure for choosing who to invite to join the study involved purposive sampling, using data from the baseline questionnaire. Eight categories were identified (see Table 13).

Table 13. Purposive sampling categories

Mothers of Pakistani Origin	White mothers
a first baby where mother has a high BMI	a first baby where mother has a high BMI
a first baby where mother has a normal BMI	a first baby where mother has a normal BMI
with other children	with other children
living with extended family	
living in a nuclear family	

Mothers in all the purposive sampling categories were recruited and in total 14 mothers were interviewed. Interviews were scheduled so that the baby was around 4 months old with the expectation that the focus of the interview would be breastfeeding and weaning.

Table 14. Details of interviews

Mothers seen when baby was between 3 and 5.5 months old 3 not recorded, 11 recorded All interviews conducted in English except 1 in Mirpuri (baby's paternal grandmother in interview also. This interview was not recorded)
Who was interviewed
There was at least one mother in each of the purposive sampling categories. 2 interviews had fathers there who talked, and 2 others where father was there but didn't talk. 1 Grandmother. 5 white British mothers – 9 Pakistani. For 5 mothers it was their 1st baby (3 white and 2 Pakistani mothers)

The study involved visits to participants' homes. Interviews lasted between 15 minutes and one hour. With the participants consent the interview was tape recorded and subsequently transcribed and translated where necessary. In five of the interviews a husband/partner or relative was present.

The researcher, in each interview, sought to elicit the interviewee's responses in three areas:

1. What does the interviewee believe is a healthy diet for the baby, what does a healthy baby look like?
2. Who in the family makes choices about diet for the baby, are these choices influenced by advice from professionals eg Health Visitor or Children's Centre staff?
3. How far does the interviewee feel able to make decisions regarding the baby?

The full discussion guide can be found in appendix 2.1. Ethics approval was given by Bradford NHS Research Ethics Committee.

1.4.6 Data analysis

Transcripts were independently coded by both authors. Analysis sought to identify emerging themes using a thematic narrative approach[18]. Deviant cases were noted and analysed.

1.4.7 Results

The emerging themes differed from the intentions of the interview, described above. There was a preoccupation with sources of advice and support and with decisions about initiating and sustaining breastfeeding, with an allied concern about weaning. Not surprisingly there was some overlap between these themes. There was also considerable shared ground between White and Pakistani mothers. Mothers expressed some anxiety about very underweight babies but a concern with them being overweight was not strongly evident, "it's a problem for the future…an issue with older children". If they think the child is underweight then they may encourage them to eat "even if they are not hungry". For younger children who might be overweight the expectation (hope) was that "they will grow out of it" and with older children the problem was seen as a cosmetic rather than primarily a health concern. The context also reflected a sense of mothers having busy lives where many demands were made upon them. There is unlikely to be much time to prepare food and food can prove a valuable reward or distraction, perhaps augmented with TV time.

1.4.8 Initiating and sustaining breastfeeding

Although Mothers were interviewed when babies were between three and five and half months old there were only two white Mothers and one Pakistani Mother still breastfeeding. Half of the others had tried, averaging between a week and 10 days, then stopped. The most common answer as to why they had stopped was, "baby was not getting enough food". As well as baby led reasons another common response was, "I tried breast feeding but I gave up. It's better now that I'm not doing it, for me I get sleep, for baby I know what baby gets".
For some the crucial factor was support; "My husband was off (work) for a couple of weeks and I got a lot of support, I felt I could give baby 100% and it gradually got easier and easier."

For those who had not breastfed the importance of decisions arrived at either during pregnancy, or very soon after birth, was stressed. A decision not to breastfeed, arrived at before the birth, is unlikely to be changed; "I didn't give it to my first daughter so I won't give it to her – I'm scared. I've never tried it". Some Mothers had tried, "I tried it with my first, it didn't work, so didn't want to try again."

Some Mothers were conflicted, they wanted to try; "When I went into labour they put them fluids on and…I asked the midwife if I can give it to her and she was saying 'oh you have got them fluids inside you so you can't give it to her'. From then I started to give bottles and I thought it was best for her to just start giving her bottles

instead of my own." Another Mother said; "Labour was induced, and baby and me were very sleepy, he wasn't latching on".

A feature of many accounts (and considered in more detail below) was a sense of conflicting advice; "We were getting different advice (from hospital staff) which I found very worrying". "I was concerned he wasn't taking enough. Family members said, 'maybe you are not producing enough, you might need to bottle feed.'"

But some Mothers reported no sense of being conflicted. One 18 year old white mother, living with her partner and their first baby, gives baby formula and food "from jars". She wasn't sure what the fuss was about; "I do what's easiest, it's easy this. I've no worries, no concerns". (This was the interview that took 15 minutes!)

1.4.9 Weaning

Most Mothers interviewed were weaning already, often starting at around 4 months. They were using baby rice or food from "jars". Some Mothers reported they were also cooking their own food for baby. Pakistani Mothers were less prepared to say what they fed babies. Those who did discuss this described giving lentils and spices early on after weaning, "baby is not just given sweet food". Mothers talked of getting them used to a Pakistani diet: at weaning they get baby rice but the intention is to move as soon as possible to what the rest of the family eat, via jar foods and puree fruits. Some Mothers had heard from health visitors ideas about baby-led weaning, but none reported trying this.

Mothers were aware that there was guidance from health visitors about the correct time to wean. But there was a common complaint from those with older children that they had been told something different with this baby than they had heard before. They report the Health Visitor as saying 5 or 6 months, but the previous guidelines said 4 months.

There were stories about difficulties in both starting weaning and in delaying it. "When she was about 4 months I tried giving her cereal….but I've stopped and put her back on milk". One mother said her baby was now five and a half months and she would have started weaning at about 4 months but didn't because of the guidelines she had been told about. But she feared baby was not getting enough sleep.

The importance of what were seen as particularities of the child were reported. The child played an active part in food choices and not all children were the same. This one might be "a picky eater", or "not like exercise". Having more than one child created problems if their needs were very different, and there was a wish to reconcile their preferences and schedules.

1.4.10 Sources of advice and support

There were two strong, and interrelated, themes here; the importance of consistent advice was frequently reported, as was the many sources of advice that were available.

This Mother's intention was to breastfeed, "we were getting different advice (in hospital) with the day staff and getting different advice from the night staff about breastfeeding and what to do and how to feed him, so that initially was quite worrying." The same challenge of reconciling different advice also applied to weaning, "My Mother wanted me to wean at 4 months but the health visitor said no….it's confusing really when you go on the internet people start at 4 months."

One of the challenges of getting consistent advice was the wide range of sources of voices a new Mother heard. One reported getting advice from her Mother, her sister and her sisters friends, "all with kids", from a nursery nurse at a health centre where her GP was based, from one midwife at the birth and then from three different ones after the birth, and from health visitors, "I just think the health visitor sometimes is

very sketchy on the information they give you". Most Mothers just wanted Health Visitors to tell them "if baby was OK". This was reported in relation to discussion about centile charts in the "Red Book". Two Mothers understood them, one was a nurse and one a dental nurse. All the others said they didn't know what they were.

The Internet was commonly reported as a place to get information and advice, not just specific sites like *MumsNet* (http://www.mumsnet.com/) but by putting concerns/symptoms into Google to come up with suggestions as to what to do. There were two characteristic times/reasons to look to the internet; when baby had a problem that they were concerned about, for example if he/she appeared unwell, or when, more generally, they were not sure what to do, perhaps they had heard different views. There was also some sense that the internet was used to find advice that supported things they wanted to do anyway!

Many attend groups for Mothers and toddlers at local venues (not just Children's Centres). They compare their babies, looking at weight now as compared to weight at birth. Discussions are not just a simple comparison of size for age – but of how much a baby has grown. While there was some sense that "chubby babies are healthier" and comparisons can cause concern, sometimes other factors can be reassuring; "he's not bigger than the others.. ..but he's more alert than general babies his age".

Our interviews reinforce the importance of influence of grandmothers, and of aunts – many of our mothers live with extended family. "Loads of people, like my mother-in-law, have complained that she has gone right weak, because their babies are more massive than my daughter. Now my mother-in-law is saying, 'give her milk till she gets better', and then I'll start doing baby food."

Family give advice and support but they may also be seen as a problem. Mothers can experience Dads as undermining, "he just sits in front of the TV with them". Likewise Grandparents, "they give the children anything".

1.4.11 Discussion

These qualitative interviews have provided data that is consistent with that previously reported in the literature. Parental perceptions are developed through interactions with a range of sources of influence including family, friends and health professionals. The internet is of increasing prominence as a source of information. There is not a clear hierarchy of influence.

Perceptions and actions are mediated through interaction with the child/baby. They constitute empirical knowledge, learnt from this experience. The empirical knowledge gained from one's own previous children is an important influence.

The idea of an ecosystem, (developed by Bronfenbrenner[14] and supported in reviews of qualitative research) is a useful way to identify the many different zones of influence on family practices regarding infant feeding and attitudes to infant size. The exo-system might define a public problem (say being overweight, or eating

"junk" food) but if this isn't reinforced by the meso and micro-systems it doesn't become a personal concern. We have a glimpse that, while there are many shared experiences between White British and Pakistani families, there are different degrees of influence from various parts of the ecosystem that are more salient for the latter. One of these is a chrono-system that is still shaped by experiences of migration and attitudes and practices from the counties of origin. A more widely shared chrono-system idea that bigger ("bonnie") babies are healthier, and a resistance to seeing rates of weight gain in infancy as a pathology prevents the exo-system breaking through the complex webs of meaning that surround it, and that it surrounds, to effect a change in the person.

1.5 A mealtime observation study: obesity, ethnicity and observed maternal feeding styles

1.5.1 Background

Research is consistent in the finding that infants who have an obese parent are at an increased risk of obesity in childhood and adulthood. It has been reported that parental obesity more than doubles the risk of adult obesity among both obese and non-obese children of less than 10 years of age.[19] More recently, it was reported that having an obese parent increases the likelihood that a child will be obese 4-5 fold.[20]

While there is a recognised large genetic component to weight variation, the shared family environment is also a potentially important contributor to the heritability of obesity. It is parents who predominantly determine the availability of foods for their children including what, how and when specific foods are available. Parents serve as role models, socializing children to their food choices, eating habits and feeding behaviours, as well as providing examples for attitudes and coping skills and setting standards for perfection and acceptance. Parents are also important determiners of the social contexts in which children eat, including the emotional tone of different eating occasions which will be influenced by general parental styles and family context.

General parenting styles have been summarized as two dimensions comprising control/demandingness and warmth/responsiveness.[21, 22] These independent dimensions yield four different parenting styles: authoritarian, authoritative, permissive and uninvolved parenting. The applicability of these typologies to non-western groups has been challenged. For example, Chao[23] believes that authoritarian control is not a valid construct when applied to Chinese, and more broadly Asian, parenting. Control and restrictiveness that are characteristic of these families reflect a different set of underlying beliefs than those of European-Americans.

Within western culture, control and strictness tends to have negative connotations and are equated with domination, which may explain the negative outcomes

associated with high parental control. In contrast, within East Asian culture control is reflected in devotion to parents, the importance of education, respect for authority, and emotional restraint.[24] It could be argued that parenting typologies originally developed with American samples cannot be translated to other cultures, but instead reflect their socio-cultural contexts and underlying beliefs and ideas. There is certainly an absence of research regarding parenting styles of South Asian families, especially those living in the UK.

International studies regarding ethnicity and feeding practices are similarly limited; Asian populations are rarely included. In contrast, studies of feeding practices relating to parental or child obesity are increasing although it is difficult to determine consistency in outcome.

Observational studies have some advantages over retrospective questionnaire assessments but are more labour intensive and time consuming. Few have been directed at very young children and none have involved non-white families in the UK. Accordingly, the present study aimed to explore the influence of two factors, maternal weight and ethnicity, on mealtime interactions. Specifically, whether the meal structures and mealtime interactions of mothers categorised as obese, and their children, were different to healthy weight mothers; and whether there was a difference between South Asian and non-Asian mothers in the meal structures and mealtime interactions with their children.

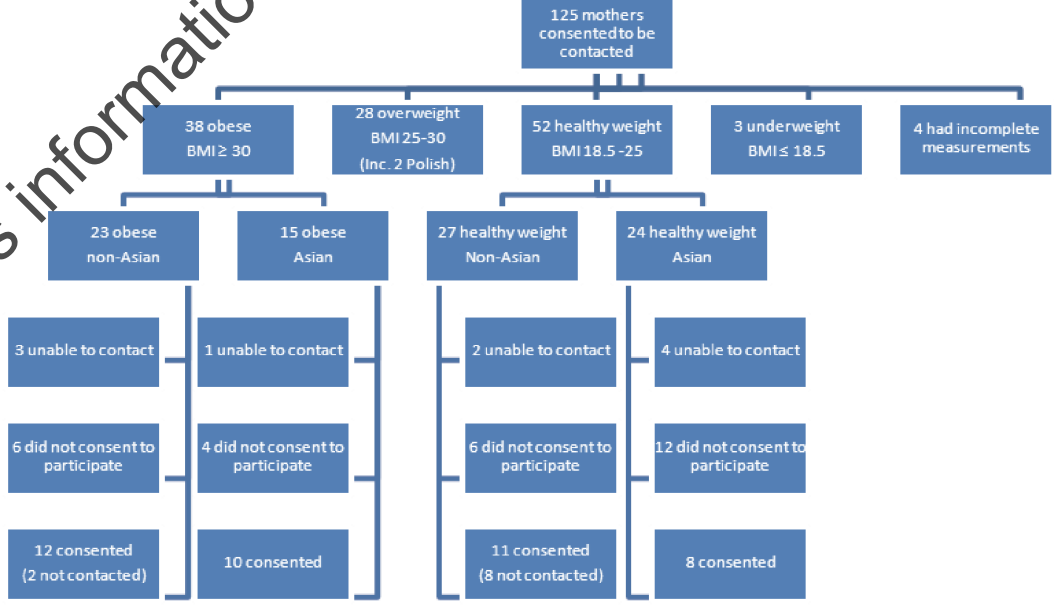
1.5.2 Methods

1.5.2.1 Participants

The present study recruited participants from clinics that BiB1000 mothers attended when their child was both 18-months and 2-years old. Mothers were contacted if they were eligible for the study on the basis of BMI (>30) and ethnicity. The intention was to recruit 40 mother-child dyads.

The participant recruitment flow can be seen in figure 4.

Figure 4: Participant recruitment flow



In total, 38 mothers took part in the study. Six of the South Asian mothers were born in Pakistan (three were obese and three were healthy weight) and one in Iran. Fifteen mothers identified themselves as Pakistani and two as Indian. Of the children there were more boys than girls in the total sample (24 *vs* 14).

The study was given favourable ethical review by the South Yorkshire Research Ethics Committee.

1.5.2.2 Meal observation

Mothers were asked to prepare an ordinary meal for their child on the day of the observation; neither the child's favourite meal, nor something that they had not tried before or that they disliked. A typical meal was recorded in the participant's home when the child was between 18 and 27 months old. All participants were provided with a copy of the mealtime recording on DVD and thanked, in writing, for participating in the study.

All recorded mealtimes were analysed using the Mealtime Observation Schedule: MOS[26], a coding system that originates from the Positive Parenting Program (known as Triple P), a copy of the coding schedule can be found in appendix 2.2. The MOS covers a wide range of parental and child behaviours and can be used without the need for extensive observer training. The length of meal times for each mother-infant dyad was noted. Using the recordings, mothers' and infants' verbal and nonverbal behaviour was coded in 10-second intervals. Behaviour categories were scored for their presence in a particular 10-second interval, but not for the frequency of occurrence. There are sixteen categories of parent behaviour in the MOS (nine positive, six negative and no interaction)[25]. A further eighteen categories relate specifically to child behaviour (seven positive, eleven negative).

The MOS has a good inter-rater reliability with a mean of 0.83 obtained for parent behaviour (range 0.71 – 0.99) and 0.80 for child behaviour (range = 0.50 – 0.99).(26)

1.5.2.3 Questionnaires

Parents completed 3 questionnaire assessments when their child was approximately 6, 12 and 24 months old. These were:

- The caregivers feeding styles questionnaire, which categorises caregivers into authoritative, authoritarian, indulgent and uninvolved child feeding styles, according to levels of demandingness and responsiveness.[27]
- The parenting practices questionnaire (Growing up in Australia Wave 1) assessing three dimensions: self-efficacy, warmth and hostility.
- The infant characteristics questionnaire assessing four factors: adaptability, fussiness/difficultness, dullness and predictability.[28]

In addition, the following demographic information was available from the BiB database: mother's country of birth, education status, current household structure, home postcode (for index of multiple deprivation 2010, IMD score).

1.5.2.4 Data analysis

Mealtimes where the mother and child spoke in Punjabi or Urdu (or in one case Arabic) were translated before the recordings were analysed. To ensure reliability of coding, two additional raters coded four mealtime recordings each; one selected from each of the participant groups. Two of these recordings were the same and therefore coded by all three raters. Inter-rater reliability was established by computing intra-class correlations. The mean intra-class correlation for three raters was 0.86 and for two raters was 0.83, indicating high levels of agreement.

Two-way between groups Analyses of Variance (with mother's age, child's age and IMD 2010 scores as covariates) tested whether there were differences in the mealtime interactions of obese and healthy weight mothers and the South Asian and non-South Asian mothers.

1.5.3 Results

1.5.3.1 Participant characteristics

Table 15 summarizes the characteristics of the mothers and their children who took part in the study. Overall, the mean age of the mothers was 29yr 8m and the mean age of the children was 1yr 9m. There was no significant difference between the groups in terms of mothers' or children's age, or IMD 2010 scores. There were ten mothers in the sample who were ranked as living in the most deprived decile in England.

Table 15. Mean (SD) and range of final sample characteristics

	South Asian obese (N=10)	South Asian healthy weight (N=8)	Non-South Asian obese (N=10)	Non-South Asian healthy weight (N=10)
Mother's BMI	35.8	22.9	34.1	21.6
	(4.9)	(2.7)	(4.7)	(1.4)
	30.0 - 45.1	19.0 - 25.0	30.2 - 43.7	18.9 - 23.4
Mother's age	31.7	27.6	31.1	28.8
(years)	(5.4)	(4.6)	(5.5)	(6.3)
	20 - 38	21 – 33	25 – 43	18 - 39
Child's age	2.0	1.9	1.8	1.7
(years)	(0.1)	(0.2)	(0.3)	(0.3)
	1.5 – 2.3	1.6 – 2.1	1.5 – 2.3	1.5 – 1.9
IMD Score	36.9	31.1	29.8	39.2
	(17.6)	(9.9)	(18.0)	(19.4)
IMD Ranking[a]	23.6	26.3	34.6	25.9
	(19.4)	(13.2)	(26.6)	(24.6)

[a]Areas are ranked from least deprived to most deprived on seven different dimensions of deprivation and an overall composite measure of multiple deprivation. Higher scores = more deprivation.

1.5.3.2 Organisation and environmental context of the mealtime

In total, six breakfasts, twenty-six lunches and six dinners were recorded. The majority of mothers felt that the recorded mealtime was typical, in that their child's behaviour was not much different to usual. Fifty per cent or more of mealtimes involved the provision of some fruit or vegetables. The mothers in the non-Asian healthy weight group supplied fruit or vegetables most frequently (70%). The number of children who ate their meal with no one else eating at the same time was comparable across all four groups. There was a tendency for non-Asian mothers to seat their child in a high chair or booster seat more than South Asian mothers.

South Asian mothers presented food more times to their child compared to non-Asian mothers ($F(1,31) = 4.15$, $p<0.05$). There was no effect of weight status or interaction ($F(1,31) = 0.57$, $p=0.46$). However, the interaction effect was statistically significant. Meal duration showed a significant interaction between maternal weight and ethnicity ($F(1,31) = 7.68$, $p=0.009$) and was shortest for the children whose mothers were South Asian and healthy weight and longest for the children whose mother was non-Asian and healthy weight. This pattern only occurred in the healthy weight groups. The speed at which the child ate was comparable across all four groups.

1.5.3.3 Positive parent behaviours

Overall, there was significantly less positive mother-child behaviour in the mealtimes of the South Asian mothers compared with the non-Asian mothers ($F(1,31) = 10.91$, $p=0.002$; Table 16). South. Asian mothers also used positive eating comments significantly less frequently than non-Asian mothers ($F(1,31) = 16.16$, $p<0.001$). They displayed significantly less positive social attention towards their children ($F(1,31) = 6.04$, $p=0.02$). There was no difference in verbal praise or in positive contact.

The only effect of maternal weight was that obese mothers made more positive comments than normal weight mothers ($F(1,31) = 10.25$, $p=0.003$). There were no significant interaction effects on any of these measures.

Table 16. Mean (SD) percentage of mealtime intervals that mother's positive behaviours occurred

	South Asian obese (N=10)	South Asian healthy weight (N=8)	Non-South Asian obese (N=10)	Non-South Asian healthy weight (N=10)
Total positive behaviours	75.9 (19.5)	61.4 (20.8)	87.6 (9.5)	89.0 (8.5)
Positive eating comment	23.3 (13.0)	10.3 (8.1)	36.9 (7.0)	25.9 (10.9)
Positive social attention	18.1 (14.5)	23.9 (12.0)	28.7 (9.6)	37.8 (16.3)
Praise	10.5	6.6	7.0	11.5

	(11.7)	(3.9)	(5.1)	(11.6)
Positive	16.5	12.5	4.9	4.6
contact	(30.6)	(10.6)	(3.7)	(2.1)

1.5.3.4 Negative parent behaviours

South Asian mothers displayed significantly more negative parenting during the mealtimes than non-Asian mothers ($F(1,31) = 5.58$, $p=0.03$; Table 17). A main effect for weight status ($F(1,31) = 8.84$, $p=0.01$) indicated that healthy weight mothers showed more negative parenting behaviours than obese mothers. All three covariates were significant in this analysis. There were weak and non-significant negative correlations between negative parenting behaviours and mother's age and deprivation score. There was a significant correlation with child's age ($r(36)=0.387$, $p=0.016$) indicating more negative parenting behaviours in older children.

Table 17. Mean (SD) percentage of mealtime intervals that mother's negative behaviours occurred

	South Asian obese (N=10)	South Asian healthy weight (N=8)	Non-South Asian obese (N=10)	Non-South Asian healthy weight (N=10)
Total negative behaviours	12.4 (12.1)	28.8 (23.4)	7.8 (9.3)	7.3 (8.0)
Negative eating comment	3.0 (3.0)	5.1 (6.1)	4.9 (10.7)	1.7 (3.7)
Negative contact	0.1 (0.3)	3.5 (6.0)	0.0 (0.0)	0.0 (0.0)

1.5.3.5 Positive child behaviours

There were no differences in total positive child behaviour during mealtimes by ethnicity or weight status (Table 18). Children with South Asian mothers did show higher levels of engaged activity ($F(1,31) = 6.83$, $p=0.01$). But these children took fewer independent self-bites ($F(1,31) = 5.44$, $p=0.026$) and there were fewer intervals coded as appropriate verbal interactions ($F(1,31) = 8.14$, $p=0.008$). There were no differences on other measures or of maternal weight.

Table 18. Mean (SD) percentage of mealtime intervals that child's positive behaviours occurred

	South Asian obese (N=10)	South Asian healthy weight (N=8)	Non-South Asian obese (N=10)	Non-South Asian healthy weight (N=10)
Total positive behaviours	71.2 (21.5)	51.6 (29.2)	71.1 (19.3)	80.3 (15.2)
Child's food preparation	10.6 (11.7)	10.5 (10.6)	7.7 (7.0)	15.6 (11.1)
Self bites	14.5 (12.8)	16.0 (17.1)	25.9 (14.4)	32.9 (20.6)
Prompted bites	17.8 (12.5)	12.2 (11.7)	9.3 (8.9)	8.3 (9.2)
Engaged activity	15.2 (13.3)	12.7 (11.9)	10.3 (6.4)	10.0 (5.0)
Appropriate verbal behaviour	6.5 (6.3)	3.9 (5.0)	10.7 (5.4)	10.8 (7.8)

1.5.3.6 Negative child behaviours

Children with South Asian mothers demonstrated marginally greater levels of negative behaviours during mealtimes ($F(1,31) = 4.01$, $p=0.054$) and there was a

main effect of ethnicity on time away from the table ($F(1,31) = 5.10$, $p = 0.03$; Table 19). The group of children who had healthy weight South Asian mothers showed the greatest frequency of these negative behaviours (as indicated by significant interaction effects). Note that children's age was a significant covariate indicating that older children spent more time away from the table ($r(36) = 0.637$, $p < 0.001$).There were no effects of maternal weight on these measures.

Table 19. Mean (SD) percentage of mealtime intervals that child's negative behaviours occurred

	South Asian obese (N=10)	South Asian healthy weight (N=8)	Non-South Asian obese (N=10)	Non-South Asian healthy weight (N=10)
Total negative behaviours	29.7 (20.5)	48.4 (29.2)	25.9 (12.3)	20.4 (14.6)
Non-compliance	1.8 (1.7)	5.9 (6.8)	2.6 (4.7)	0.7 (1.0)
Leave the table	0.4 (1.4)	22.1 (32.2)	6.1 (13.2)	0.5 (0.9)
Food refusal	8.6 (9.2)	9.2 (4.5)	5.2 (4.0)	5.5 (9.7)

1.5.3.7 Questionnaire measures

Scores on the caregivers feeding style questionnaire showed that obese mothers were significantly less demanding than healthy weight mothers ($F(1,31) = 6.83$, $p=0.014$). There was no main effect of ethnicity and there were no differences between the groups on reported responsiveness. In terms of overall parenting style obese mothers were most likely to report using indulgent parenting (N = 13/20). In contrast, healthy weight mothers were most likely to report using an authoritarian parenting style (N = 10/18).

The parenting practices questionnaire showed South Asian mothers to score lower on warmth of parenting than non-South Asian mothers ($F(1,31) = 5.52$, $p=0.026$). There were no effects of maternal weight or any differences in the measure of hostility.

Finally, analysis of the responses to the infant characteristics questionnaire revealed no group differences.

1.5.4 Discussion

The main aims of the study related to the potential influence of maternal obesity and ethnicity on the mealtimes interactions with young children. The following are the main learning points taken from this study that are considered relevant for an intervention directed at young childrens' mealtime interactions.

First, there was no evidence of maladaptive parenting in the mealtimes organised by obese mothers. Indeed, they used fewer negative parenting behaviours than healthy weight mothers and used a greater number of positive eating comments

during mealtimes. The children of obese mothers did not behave in a different way to the children of healthy weight mothers.

Second, many more differences were observed between the mealtimes of South Asian mothers and non-South Asian mothers. We found: there were differences in the physical organisation of mealtimes. For example, more of the South Asian mothers did not seat their child in a chair or use a table for their child's mealtime; South Asian mothers made fewer positive eating comments and spent less time during the mealtimes providing positive social attention; South Asian mothers showed a greater number of negative specific instructions than non-South Asian mothers; there were greater levels of negative child behaviour in the children of South Asian mothers; and South Asian mothers presented food to their child a greater number of times during a meal. This is consistent with the observation that their children demonstrated less independent eating. Overall, the results indicate that South Asian mothers exert a different *type* of control during mealtimes with their children by giving a greater number of specific and clear direct instructions. This may be in response to more challenging behaviour of their children.

Third, there were some inconsistencies between self-report and observational measures related to parenting. This may not be surprising given that the questionnaire measures related to overall parenting while the observation focused on a single meal and that the questionnaire refers to when children are 6 months of age and the meal-time observation is when the children are older. However, questionnaire responses showed obese mothers were more likely categorised as indulgent parents and non-obese mothers authoritarian. South Asian mothers scored lower on warmth in their parenting practices.

Fourth, age (but not deprivation) influenced mealtime interactions. For example, younger mothers had more positive physical contact with their children, regardless of weight status or ethnicity. In addition, older children demonstrated increased levels of non-compliance and spent more time away from the meal table.

General discussion and conclusions: investigation of social and environmental determinants of childhood obesity

This section reports on four discreet studies adopting different methodologies, and collecting data from four different groups, to explore the context and circumstances in which food choices are made. In the first study interviews with mothers with small babies revealed the relational nature of a social life within which they were making decisions about infant feeding. They receive advice from many different sources, from within their own family, from friends and neighbours, from a range of professionals and, increasingly, from sources they explore themselves on the Internet. They often experience the information they receive as contradictory. It appears that perceptions about appropriate size for infants and children, and concerns about rates of growth, are linked to parents concerns that their baby/child was "like others" of the same age. While the experience of having a new baby

produces demands that are similar for White and South Asian parents, the configuration of influences they operate within differs.

The rapid rise in the prevalence of childhood obesity has stimulated research on early parent feeding styles. The study of 38 mother-child dyads reported here recorded during a typical mealtime indicates that mothers of different ethnicities, living within the same geographical region, can demonstrate different parenting behaviours when feeding their toddlers. It has also revealed important differences in the frequency of positive and negative parenting strategies within, and between, groups that require further exploration.

The third study kept our focus on the home. Key food and drink items were noted in 100 homes of BiB participants (97 full data sets were collected) with White British and Pakistani families about equally represented in the sample. There did not appear to be a relationship between food availability and maternal weight status but there were differences by ethnicity, for example Pakistani participants had three times the number of sweetened drinks in the home when compared to white families. Key findings included that although the majority of homes have at least 1 type of fruit or vegetable available to them, there was variability in the amount and tinned/frozen fruits and vegetables were less common. Homes of Pakistani mothers tended to have a greater availability of fresh fruits than those of White British mothers; but also had significantly higher amounts of sugar sweetened beverages.

The fourth study shifted the focus from the individual account and the observation of family behaviour to consider the environment in which families are making their choices about food. Is proximity to food outlets which sell food high in saturated fat associated with deprivation, weight status and ethnicity? Food outlets were mapped in specific areas of the city, and linked with information on 1198 women within the Born in Bradford study. There was a strong association between deprivation and fast food outlet density, with poorer areas having higher density; but there was a negative association between BMI and fast food outlet density for South Asians. This study showed the rich data that can be obtained from looking in close detail at what sorts of food are available; but it also highlighted the need to consider how individuals make choices within their neighbourhood.

The results from these studies have the following implications for the development of a childhood obesity prevention intervention:

1) Understandings are arrived at, and choices are made, in the context of many interlinked systems of influence. Targeting only one has the potential that any change is undermined by alternative influences. Interventions should target the social nature of choices that impact on obesity and seek to achieve either system wide changes, changes in the immediate systems that surround the individual or enhanced confidence in individual agency on the part of parents. For example an educational intervention would need not only to offer culturally sensitive information in a way that is experienced as authoritative but it ought to be accompanied by enhancing the ability of the parent to make choices. This is more

likely if the intervention could be delivered to a group who could act as a peer support group.

1) Intervention effectiveness will be enhanced if practitioners know which components of parenting to target within a culturally sensitive context. Parenting styles vary according to ethnicity and those practices that might constitute targets for intervention in one group would not be applicable to another, or at least would not be of equal salience. This is an argument for bespoke interventions to impact on parenting styles that reflect ethnic variations.

3) Seeking to change food and drink consumption should focus on: a) promoting availability and quantity of all types of fruits and vegetables(e.g. encouraging purchase of tinned/frozen fruit in addition to fresh fruit); b) reducing purchase of crisps and biscuits (which were both available in over 80% of homes); c) discouraging purchase of sweetened beverages, especially within homes of Pakistani mothers (in which 85% of homes had at least one type of sweetened beverage available; d) promoting the availability of a greater variety of fruits and vegetables.

4) Living in close proximity (500m) to a fast food outlet was commonplace in the Bradford wards that were studied. This degree of proximity was observed in 95% participants. This should be considered when applications for further food outlets are made.

There are some limitations. Each of the four studies focus on children of different ages and so do not build up a composite picture of a particular child's world. While each of the studies refer to a wide literature they do not have a wide range of sources to draw on where the sorts of ethnic background that is characteristic of this study are explored. The qualitative study is relatively small scale and the food outlet study is limited in its geographical range but the mealtime observation study and the food inventory collection is of a size consistent with other studies exploring these areas. While acknowledging the contribution of these studies their limitations point to areas for further study. It is clear that ethnicity needs to be fore-grounded and modifications to prevalent assumptions and to previously tested interventions are required to ensure their appropriateness.

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