Separating the effects of ethnicity and socio-economic status on sleep practices of 6- to 7-month-old infants

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Abstract

Infant sleep undergoes significant re-organization throughout the first 12 months of life, with sleep quality having significant consequences for infant learning and cognitive development. While there has been great interest in the neural basis and developmental trajectories of infant sleep in general, relatively little is known about individual differences in infant sleep and the socio-economic and cultural sources of that variability. We investigated this using questionnaire sleep data in a large, unique multi-ethnic sample of 6-7 month-olds (n=174), with families from South Asian ethnic groups in the UK (Indian, Pakistani and Bangladeshi) being especially well represented. Consistent with previous data from less variable samples, no effects of SES on sleep latency or nocturnal sleep duration emerged. However, perinatal risk factors and ethnic differences did predict daytime sleep, sleep fragmentation and sleep-onset time. While these results should be interpreted with caution due to several limitations, they likely demonstrate that even when socio-economic status and ethnicity are much less confounded than in previous studies, they have a surprisingly limited impact on individual differences in sleep patterns in young infants.

1. Introduction

In children, sleep patterns are related to cognitive functioning, especially to learning and memory during the first years of life (Gomez, Newman-Smith, Breslin, & Bootzin, 2011; Hill, Hogan, & Karmiloff-Smith, 2007) and later in childhood (Ashworth, Hill, Karmiloff-Smith, & Dimitriou, 2014). Daytime naps have been shown to facilitate language learning in infants and toddlers (Gómez, Bootzin, Nadel, & Gomez, 2006; Hupbach, Gomez, Bootzin, & Nadel, 2009), while nocturnal sleep duration is associated with retention in 3-month-olds (Fagen & Rovee-Collier, 1983), and encoding and generalisation in imitative learning in 10-month-olds (Lukowski & Milojevich, 2013).

Individual differences in sleep architecture predict cognitive functioning in infancy and beyond. Clinical studies with infants younger than 12 months showed associations between sleep duration, number of awakenings and sleep morphology in EEG with concurrent and later scores in standardised developmental batteries (Becker & Thoman, 1981; Freudigman & Thoman, 1993; Scher, Steppe, & Banks, 1996; for a review see Ednick et al., 2009). Longitudinal relationships across longer periods of development have also been found for toddlers (Dearing, McCartney, Marshall, & Warner, 2001) and school-aged children (Buckhalt, El-Sheikh, & Keller, 2007; Buckhalt, El-Sheikh, Keller, & Kelly, 2009).

Sleep problems are more frequent in children with behavioural problems (Arman et al., 2011), depression (Gregory, Rijsdijk, Lau, Dahl, & Eley, 2009), ADHD (Gruber, Sadeh, & Raviv, 2000) and in several developmental disorders (Annaz, Hill, Ashworth, Holley, & Karmiloff-Smith, 2011; Ashworth, Hill, Karmiloff-Smith, & Dimitriou, 2013). There are data pointing to a longitudinal relationship between early sleep difficulties and later behavioural problems in children (Gregory & O'Connor, 2002).

Since sleeping conditions, parental care, and risk of developmental difficulties in children vary greatly with family socio-economic status (SES), several studies have examined the relationships between these factors (Mindell, Sadeh, Kohyama, & How, 2010). A particular challenge in this research is to separate cultural and ethnic influences on sleep practices from other effects of the socio-economic circumstances in which the family lives. To date, the majority of studies in Western countries (and particularly in the US) have compared people of African ethnic origin with those of European origin, with SES co-varying with ethnicity. Lozoff, Askew and Wolf (1996) found an association between regular co-sleeping and increased night waking or bedtime protests in children aged 6 to 48 months from low-SES European-American and high-SES African-American families. African-American infants from higher SES families had longer but less frequent bouts of sleep compared with the lower SES group (Fouts, Roopnarine, & Lamb, 2007). In a group of 8- to 9-year-olds, higher SES moderated the effects of sleep disruptions on cognitive performance. After controlling for SES, ethnic differences in sleep emerged with the African-American group showing greater variability in sleep-onset time, shorter sleep duration and higher incidence of co-sleeping and of sleep problems (Buckhalt et al., 2007). Critically, African-American children were at increased risk of lower cognitive performance when sleep problems were present, suggesting that cultural practices may play a significant role in negotiating the extent of cognitive impairments when sleep problems persist. In another study of pre-schoolers, ethnic differences (White/Latino/African-American) were identified for sleeping arrangements, falling asleep routines, and the rate of sleep-related concerns after controlling for SES (Milan, Snow, & Belay, 2007).

To date, the majority of studies compared the effects of ethnicity and SES on sleep in samples with very few ethnic groups, which often simultaneously differed in their income and social status. In order to separate out these effects, it is crucial to study samples with greater ethnic diversity and income variability. Motivated by this deficiency, we investigated this issue in a unique multi-ethnic sample of infants aged 6-7 months, which had a far more diverse range of ethnicities than assessed in previous studies and high SES variability that was more distributed across different ethnicities.

2. Methods

2.1 Data collection sites. The study was conducted in community settings, in seven Sure Start Children Centres (United Kingdom), located in areas with the highest levels of multiple deprivation nationwide (ranked 3-30% of most deprived areas in England). Participating families were identified by Children's Centre staff through birth registers and/or registers of public service users. Information about the study was mailed to each eligible family in the catchment area of each Centre, and distributed by practitioners among families during their visits to target Centres. All eligible families that expressed interest in the study were scheduled to take part. While every effort was made to inform all eligible users about the study, due to limited user registers it was not possible to precisely measure the number of families who declined to participate, although Centre managers' estimates ranged between 35% and 67%. While special care was taken to recruit teenage parents, only three such families took part. An equal proportion of participants came from Children's Centres in each borough. For a complete description of the broader study design, sample characteristics, and recruitment procedures see Ballieux et al. (in press).

2.2 Participants. The final infant sample consisted of 174 infants aged between 6 months 1 day and 7 months 30 days (M = 209.26 days 29.45 weeks), with 68 girls (39.1%) and 106 boys (60.9%). We note higher than expected sex ratio in the sample but on the basis of existing literature we could not establish beyond reasonable doubt any explanation related to cultural or socio-economic factors. Ethnicity data were obtained using a standard UK government form. Reflecting the diverse ethnic composition of East London, the final sample comprised 33 (15.3%) White British, 26 (11.2%) Other White, 20 (11.8%) Afro-Caribbean, 41 (21.2%) Asian Indian/Pakistani, 26 (14%) Asian Bangladeshi, and 28 (26.5%) Mixed/Other ethnicity infants, originating from different countries, and speaking different languages. More than half of the families had English as their first language (58.6%), with 71.3% reporting more than one language being used at home. All infant participants included in the sample were born full-term (36-42 weeks gestational age, M = 39.5 weeks, SD = 1.5), with birth weight ranging from 2000 to 5400g (M = 3229.1, SD = 501.5, twelve infants below 2500 g). The following exclusion criteria were used: preterm birth (< 36 weeks), an older sibling with autism, any major delivery complications or major medical conditions (genetic, metabolic or other chronic illness), maternal use of recreational drugs during pregnancy. Fifty-eight percent of infants were breastfed at the time the data were collected.

The study received ethical approval from the local university board and from Tower Hamlets local government authority. All parents gave written informed consent and received small gifts in return for their participation.

2.3 Sleep measure. Infant sleeping patterns were reported by parents during the interview with the experimenter, who asked questions from the Brief Infant Sleep Questionnaire (Sadeh, 2004) and recorded the responses. BISQ is a popular screening tool for infants and toddlers, with good reliability, and superior clinical validity in comparison with actigraphy (but see section 4.5). For the period of the week preceding testing at the Centre, the parents reported: nocturnal (7 pm - 7 am) and daytime (7 am - 7pm) sleep duration, duration of wakefulness at night (10pm – 5 am), number of night wakings, nocturnal sleep-onset time (clock time at which the child falls asleep at night) and settling time (latency to fall asleep for the night). Additional questions were asked for preferred sleeping position (on back, side, belly; parents could report all three), the most common method of falling asleep (while feeding, being rocked, held, in bed alone, in bed near parent), the usual location of sleep (parent's bed, crib in parent's room, crib in separate room, crib in room with sibling) and whether the parents considered the infant's sleep problematic.

2.4 Demographic data collection. During their first visit to the local Children's Centre to participate in the infant development study, parents were asked by the experimenter an extensive set of questions regarding family demographic information, socio-economic status, infant birth, sleep and medical history. Thus all socio-economic data comes from parental self-report. Either the mothers (96% of sample) or the fathers (4%) participated in the study with the infant and answered all questions.

2.5 Statistical analyses. Between-group comparisons of ethnic and SES differences in sleeping arrangements were carried out using chi-square statistics. Analogous comparisons of sleep durations were carried out using one-way ANOVAs, with additional Bonferroni-corrected pairwise comparisons, where necessary. Sleep duration data met parametric test assumptions, except for nocturnal wakefulness and latency to fall asleep, which were log-transformed to achieve normal distribution. Ethnic differences in the number of night wakings (range 0-10) were analysed using non-parametric Kruskall-Wallis test.

Hierarchical multiple regression analyses were conducted to establish whether family characteristics, perinatal risk factors, maternal and paternal SES gradients and breastfeeding predicted infant sleep duration at 6-7 months of age beyond the effects of ethnicity. Predictors were selected on the basis of previous literature concerning sleep and cognitive development (Buckhalt et al., 2007). Ethnicity was entered in the first step, with the remaining predictors being entered in the second step. Where necessary, dependent variables were analysed after log-transformation (see above). Parametric variables were mean-centred. Preliminary regression analyses (not reported here) investigated potential interactions between SES measures (income, parental occupation and education) and ethnicity and did not yield any significant results. Therefore, interaction terms (SES x ethnicity) were omitted from the final models (see section 3.7).

Participants with missing data points were excluded from particular sets of analyses. In regression analyses 19 families were excluded because they did not disclose their income. Because of the relatively high proportion of infants of Mixed/Other ethnicity, we used maternal ethnicity for analyses, since mothers had spent the most time with their infants over the previous six months, thereby best reflecting the cultural practices in which the infants were immersed.

3. Results

3.1 Demographic data

Gross household income showed high variability (M = £49,487, SD = 65,456), with 41% of families living below the national poverty line, calculated as income-to-needs ratio. Only 28.7% of families reported owning their house or flat, while 25.9% lived in social housing. Maternal and paternal job status was coded using the UK national classification (UK Office for National Statistics, 2010) and then reduced for statistical analyses to three: professional/managerial occupations (32.8% mothers and 47.2% fathers), intermediate occupations (previously categories 2 and 3; 9.1% mothers and 12.4% fathers) and routine/manual jobs and long-term unemployed (categories 4-6; 58.1% mothers and 40.3% fathers). There were relatively high levels of education – 55.2% mothers and 50.6% fathers reported having a college/university degree or more. This reflects the particular socio-economic situation of the local population, where many families experience income deprivation despite high levels of education. Socio-economic variability was substantially greater than in a previous laboratory sample of families from this region and was close to levels observed generally in this geographic area (see Ballieux et al., in press).

3.2 Ethnic differences in SES

Parents from two ethnic groups (Afro-Caribbean and Asian Bangladeshi) showed a significantly lower likelihood of having a managerial/professional job (mothers: $\chi^2(10) = 37.89$, $p < .001$; fathers: $\chi^2(10) = 26.83$, $p = .003$), of obtaining higher education (mothers: $\chi^2(5) = 22.59$, $p < .001$; no effect for fathers: $\chi^2(5) = 8.18$, $p = .15$), and of home ownership ($\chi^2(5) = 11.75$, $p = .041$) than other groups. Afro-Caribbean and Asian Bangladeshi families also had lower household income ($F(5,155) = 6.55$, $p < .001$; pairwise comparisons, all *p*s < .02), than other groups. The other four ethnic groups (White British, Other White, Asian Indian/Pakistani, Mixed/Other) did not differ from each other in terms of income.

3.3 Ethnic differences in infant sleep

One-way ANOVA comparisons of ethnic differences in infant sleep duration did not reveal any significant results for nocturnal, daytime and total sleep duration (see Table 1). There were, however, significant differences in the duration of nocturnal wakefulness and the number of night wakings, with infants of Other White and Asian Indian/Pakistani origin waking more often than other groups (2.64 and 2.17 times per night, respectively). Finally, Asian Bangladeshi infants on average fell asleep close to 10pm, significantly later than White British (M = 19:57), Other White (M = 20:47) and Mixed/Other origin (M = 20:29) infants (pairwise comparisons, all *p*s < .05). Similarly, infants of Asian Indian/Pakistani mothers fell asleep significantly later (M = 21:20) than White British infants ($p < .001$).

- Table 1 about here –

3.4 Ethnic differences in sleeping arrangements

The frequency of bed-sharing differed significantly among ethnic groups ($\chi^2(10) = 18.85$, p = .031, see Table 2). While approximately one third of infants of Asian origin shared a bed with their parents, only 12.1% of infants of White British mothers did so. Moreover, White British parents were more likely to place their infant's cot in a separate room (42.4%, versus 19% for the entire sample). Asian Bangladeshi, Afro-Caribbean, and Asian Indian/Pakistani mothers were least likely to sleep in a separate room from their infant, and most likely to share their bed with the infant.

- Table 2 about here -

3.5 SES differences in sleeping arrangements

Bed-sharing was more frequent in the two ethnic groups with the lowest SES (Afro-Caribbean and Asian Bangladeshi). Comparisons of bed-sharing and sleeping in a separate room in families differing by parental occupation and home ownership showed significant associations with these factors, while no differences were found by parental education.

Parental occupation. Higher occupational status of either parent was associated with higher frequency of infant sleeping in a cot in a separate room, as well as lower frequency of bed-sharing (maternal SEC: $\chi^2(4) = 11.43$, p = .022; paternal SEC: $\chi^2(4) = 15.77$, p = .003). Infants of parents with managerial/professional jobs more often slept in a separate room (mothers: 24.6%, fathers: 27.6%) or in a cot in their parents' bedroom (mothers: 61.4%, fathers: 52.6%) than with their parents (mothers: 14%, fathers: 19.7%). Parents performing unskilled/manual jobs or long-term unemployed more often shared a bed with their infant (mothers: 33.7%, fathers: 35.9%) than placed a cot in a separate room (mothers: 15.8%, fathers: 9.4%).

Home ownership. Families of White British, but also of Asian Indian/Pakistani origin, were more likely to own their home (48.5% and 34.1%, respectively), particularly in comparison with those of Afro-Caribbean or Asian Bangladeshi origin (15% and 15.4%, respectively; $\chi^2(5) = 11.75$, p = .041). Families reporting home ownership more frequently put their infant to sleep in a cot in a separate room or in their bedroom (30% and 54%, respectively, $\chi^2(2) = 6.73$, p = .035) than in their bed (16%), while those living in a rented accommodation shared a bed with their infant.

3.6 Infant bed-sharing – effects on sleep duration

Since socio-economic and cultural factors were associated with bed-sharing in the current sample, we investigated the effects of bed sharing on sleep duration with one-way ANOVAs. Bed-sharing infants had nocturnal sleep on average 50 minutes shorter than those in a separate room (respectively, M = 590.23 and M = 642.73; F(2,173) = 3.57, p = .03, Bonferroni pairwise comparison, p = .037). Time spent putting to sleep was shorter for cot-separate room sleepers (M = 14.85, SD = 11.76) than co-sleepers (M = 27.10, SD = 25.70; F(2,173) = 3.40, p = .036; pairwise comparison, p = .03). Also, bed-sharing infants (M = 21:19) and those sleeping in their parents' room (M = 21:02) had significantly later sleep-onset time than those sleeping alone in a separate room (M = 19:59; main effect of sleeping arrangement, F(2,173) = 9.07, p < .001; pairwise comparisons, both *p*s < .002).

3.7 Regression analyses of sleep durations

Multiple regression analyses were conducted to establish whether family characteristics, perinatal risk factors, maternal and paternal SES gradients and breastfeeding predicted infant sleep duration beyond the effects of ethnicity. Since ethnicity differences in sleep durations were described in section 3.2, here we report only significant associations of other variables with infant sleep. Regression models for nocturnal sleep duration ($F(20,129) = 0.97$, $p = .50$) and latency to fall asleep ($F(20,129) = 0.33$, $p = .99$) did not reach significance. Thus, Table 3 presents only statistically significant models for daytime sleep duration, nocturnal wakefulness duration, and sleep-onset time.

- Table 3 about here –

3.6.1 Daytime sleep. Ethnicity entered in the first step explained 9% of the variance ($F(5,129) = 2.4$, $p = .041$). In the second step, higher birth weight and breastfeeding predicted longer daytime sleep, explaining an additional 15% of the variance ($F_{change}(11,113) = 2.02$, $p = .033$; final model $R^2 = .24$, $F(16,129) = 2.04$, $p = .009$).

3.6.2 Nocturnal wakefulness. Ethnicity entered in the first step explained nearly 16% of the variance ($F(5,129) = 4.59$, $p = .001$). Out of variables entered in the second step only breastfeeding significantly predicted longer duration of wakefulness, additionally explaining nearly 19% of the variance ($F_{change}(11,113) = 2.88$, $p = .002$; final model $R^2 = .34$, $F(16,129) = 2.77$, $p < .001$).

3.6.3 Sleep-onset time. Ethnicity was associated with significant differences in sleep-onset time ($R^2 = .24$, $F(5,129) = 7.67$, $p < .001$). Out of variables entered in the second step, two significantly predicted sleep-onset time. Maternal managerial/professional job and higher gestational age were associated with earlier time of falling asleep, explaining nearly 39% of the variance ($F(16,129) = 2.70$, $p < .001$).

4. Discussion

In this paper we sought to explore the sources of variability in infant sleep at 6-7 months to separate out the effects of ethnicity and socio-economic gradients. The main finding of our study is that the effects of both groups of factors on infant sleep were rather limited. We did not find any effects of ethnicity or family SES on nocturnal sleep and latency to fall asleep. However, ethnic differences did predict nocturnal wakefulness, daytime sleep, and sleep-onset time, with the latter two also being associated with perinatal risk factors. We further found a strong positive association between breastfeeding and longer duration of nocturnal wakefulness. While our results need to be interpreted with caution (see section 4.5), they demonstrate that even when socio-economic status and ethnicity are not confounded, they have a limited impact on individual differences in sleep patterns in young infants.

To date the majority of the literature on this subject has explored SES and ethnicity in relation to child sleep in populations where the two factors were correlated (Buckhalt et al., 2007) or explored practices specific to single cultures or countries (Anuntaseree et al., 2008; Worthman & Brown, 2007). The sample in the current study was unique in that it represented multiple ethnicities and cultures living in a single area in a developed country, albeit with high variability of income, housing, and parental occupations. The population of East London offers a rare opportunity in this regard: a relatively high proportion of recent or second-generation migrants from many Eastern and South Asian, African, Caribbean, and European countries, often with higher education (avoiding the confounding of SES and education), but with highly varied job prospects, from investment banking to unskilled work well below their qualifications. Cultural and ethnic factors and their relationships with local socio-economic circumstances pose a unique set of challenges for studies of cognitive and brain development (see e.g. Jukes & Grigorenko, 2010; Reich et al., 2013; Zhan et al., 2011). Charting these territories is a prerequisite to research on cultural specificity in developmental disorders and resulting differences in response to early interventions (Yasui & Dishion, 2007).

4.1. Socio-economic gradients

Regression analyses revealed almost no effect of either maternal or paternal SES gradients on infant sleep. This is a robust result given the sample size and the variety of SES indicators that were analysed: education and job status of each parent, household income, and house/apartment ownership.

No effects of SES gradients were found for nocturnal and daytime sleep duration or latency to fall asleep. Only in the case of maternal occupation did professional/managerial job status predict earlier sleep-onset time. These results are somewhat surprising given how early in life family SES has been shown to influence cognitive and brain development (Clearfield & Jedd, 2013; Hanson et al., 2013; Tomalski et al., 2013). While the literature is rather limited, this lack of SES effects is consistent with a previous lab-based study of a similar, albeit smaller sample (Tomalski et al., 2013) and with data from other populations (Bayer, Hiscock, Hampton, & Wake, 2007).

4.2 Perinatal risk factors

Perinatal risk factors such as low birth weight, premature birth, and older maternal age at birth are important predictors of developmental outcomes in physical and mental health, as well as in brain and cognitive development (see e.g. Baron & Rey-Casserly, 2010; Dong, Chen, & Yu, 2012). Regression analysis revealed a positive association of higher birth weight with longer daytime sleep, while older gestational age predicted earlier sleep-onset time. No effects of perinatal factors were found for duration of nocturnal sleep and wakefulness. Given the variability of birth weight (lower boundary at 1500 g) and increased risk due to older average maternal age, it is unlikely that these results can be explained solely by low sample variability.

4.3 Ethnicity

No effects of ethnic group were found on the duration of nocturnal sleep and latency to fall sleep. By contrast, these effects were apparent in the duration of nocturnal wakefulness, the number of night wakings, and the sleep-onset time. Mothers in the Other White group, as well as both Asian groups, put their infants to bed significantly later than those of White British ethnicity. Infants of Asian Indian/Pakistani mothers remained awake more often and for longer periods of time than those of White British ethnicity, a fact which perhaps can be explained by differences in sleeping arrangements, especially the tendency for bed-sharing.

4.4 Bed-sharing

Both ethnic and socio-economic factors were related to sleeping arrangements, while breastfeeding was associated with bed-sharing irrespective of family ethnicity. This last result is consistent with existing data (Ball, 2003; McCoy et al., 2004).

Families with higher income were more likely to put their infant to sleep in a cot in a separate room. On the other hand, decisions about bed sharing were related to cultural practices. While Asian Indian/Pakistani and Asian Bangladeshi families differed significantly on a range of SES measures, these disparities did not lead to differences in the frequency of bed-sharing. This is consistent with existing data for South Asian families in the UK (Ball et al., 2012). Bed-sharing is one aspect of sleeping arrangements with considerable cultural variation. It is more frequent among low SES families in Western countries (Mindell et al., 2010), but in many non-Western cultures bed-sharing is a common practice, which may improve sleep quality (Anuntaseree et al., 2008).

4.5 Limitations

Some aspects of this study suggest that the results should be interpreted with caution. Firstly, the infant sleep measure - the BISQ - is a short parental report questionnaire. Thus, our data are reliant on a single source of information. For example, parental perceptions of infant's night awakenings can vary depending on the sleeping location, thus leading to differences in reported nocturnal wakefulness. Secondly, voluntary participation means that we studied a convenience sample, without the possibility of firmly establishing the rates of participation decline across different ethnic groups. Also, the unequal number of male and female infants may have lead to systematic differences in reported sleep durations, while limited age range renders them less generalizable to older age groups. In summary, our results need to be replicated in a longitudinal design with more direct measures of infant sleep. Nonetheless, they constitute an important first step in highlighting the probable lack of SES- and ethnicity-related differences in sleep behaviour.

4.6 Conclusion

Taken together, our results demonstrate that even when socio-economic status and ethnicity can be independently examined, they each have a surprisingly limited impact on individual differences in sleep patterns in young infants, when examining a more diverse range of ethnicities than has previously been the case.

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Table 1

Measure	**Overall Sample** (n=174)	**Overall Range** (n=174)	**White British** (n=33)	**Other White** (n=26)	**Afro-Caribbean** (n=20)	**Asian Indian/ Pakistani** (n=41)	**Asian Bangladeshi** (n=26)	**Mixed/ Other** (n=28)	**Test statistic**
Nocturnal sleep duration (min.)	606.38 (91.04)	300–780	626.36 (99.99)	609.23 (84.76)	597.00 (92.29)	586.10 (93.70)	578.08 (85.93)	642.86 (73.68)	F = 2.25 *p* = *.051*
Daytime sleep duration (min.)	152.07 (80.18)	0–480	124.55 (54.79)	184.62 (82.13)	153.00 (83.10)	161.71 (88.64)	133.85 (79.36)	156.43 (80.18)	F = 2.10 *p* = *.067*
Total sleep duration (min.)	758.45 (117.63)	360–1050	750.91 (119.47)	793.84 (106.06)	750.00 (134.52)	747.80 (111.93)	711.92 (116.59)	799.29 (110.14)	F = 2.14 *p* = *.063*
No. night wakings	1.81 (1.69)	0–10	1.38 (1.21)	2.64 (1.52)	1.47 (1.54)	2.17 (1.90)	1.54 (2.08)	1.50 (1.40)	**χ^2 = 16.38** ***p* = .006**
Nocturnal wakefulness (min.)	16.01 (24.79)	0–180	10.85 (10.68)	18.50 (20.55)	9.25 (11.15)	23.85 (34.10)	13.38 (35.29	15.54 (16.58)	**F = 4.40** ***p* = .001**
Latency to fall asleep (min.)	22.04 (20.62)	0–120	21.82 (20.15)	22.31 (12.02)	14.00 (12.52)	25.12 (26.47)	23.27 (24.00)	22.14 (19.12)	F = 1.02 *p* = *.41*
Sleep-onset time (hh:mm)	20:54 (1:29)	18:00 – 2:00	19:57 (1:08)	20:47 (1:10)	21:00 (1.06)	21:20 (1.39)	21:57 (1:30)	20:29 (1:19)	**F = 7.64** ***p* < .001**

Table 1. Average infant sleep duration at age 6-7 months for the overall sample and each ethnicity (SD in brackets, *F* statistics and *p* values for one-way ANOVA comparisons, df1 = 5, df2 = 173; for night wakings Kruskall-Wallis χ^2 and *p* value, df = 5).

Table 2

Measure	**Overall Sample (n=174)**	**White British** (n=33)	**Other White** (n=26)	**Afro-Caribbean** (n=20)	**Asian Indian/ Pakistani** (n=41)	**Asian Bangladeshi** (n=26)	**Mixed/ Other** (n=28)	**Test statistic**
Sleeping arrangements								
Cot - separate room	19.0 %	42.4%	19.2%	10.0%	12.2%	3.8%	21.4%	**χ^2 = 19.85**
Cot - parent's room	56.3 %	45.5%	57.5%	65.0%	56.1%	61.5%	57.1%	***p* = .034**
Parents' bed	24.7 %	12.1%	23.1%	25.0%	31.7%	34.6%	21.4%	**df = 10**
Sleeping position								all dfs = 5
Side	54.6%	45.5%	46.2%	60.0%	61.0%	57.7%	57.1%	χ^2 = 2.94 *p* = .71
Belly	47.1%	36.4%	50.0%	65.0%	53.7%	38.5%	42.9%	χ^2 = 5.88 *p* = .32
Back	64.4%	66.7%	69.2%	50.0%	68.3%	57.7%	67.9%	χ^2 = 3.07 *p* = .69
Falling asleep position								
While feeding	59.8 %	42.4%	80.0%	70.0%	57.5%	48.0%	69.2%	χ^2 = 12.17
Being held/rocked	14.2%	21.2%	8.0%	10.0%	15.0%	20.0%	7.7%	*p* = .27
In bed alone & other	26.0%	36.4%	12.0%	20%	27.5%	32.0%	23.1%	df = 10
Is sleep a problem?								
Very serious problem	1.7 %	0%	0%	0%	4.9%	3.8%	0%	χ^2 = 15.44
Small problem	19.7 %	15.2%	30.8%	5.3%	17.1%	11.5%	35.7%	*p* = .12
Not a problem at all	78.6 %	84.8%	69.2%	94.7%	78.0%	84.6%	64.3%	df = 10

Table 2. Frequencies for sleeping arrangements in each ethnicity and in the overall sample (chi-square statistics, *p*-values and degrees of freedom for between-ethnicity comparisons).

Table 3

	Daytime sleep duration		Nocturnal wakefulness duration		Sleep-onset time	
Predictor	***B***	***SE B***	***B***	***SE B***	***B***	***SE B***
Step 1						
Ethnicity						
2 versus 1	.80*	.31	.50	.17	.60*	.26
3 versus 1	.69	.36	-.60	.34	.61*	.30
4 versus 1	.54*	.27	.46	.25	.73**	.22
5 versus 1	.06	.29	-.43	.27	1.32***	.24
6 versus 1	.62*	.30	.30	.28	.13	.25
R^2	**.09***		**.16****		**.24*****	
Step 2						
Ethnicity						
2 versus 1	.74*	.31	.38	.28	.67**	.25
3 versus 1	.46	.38	-.57	.34	.17	.31
4 versus 1	.53	.28	.47	.25	.58*	.22
5 versus 1	-.10	.32	-.44	.29	1.13***	.26
6 versus 1	.57	.30	.19	.27	.06	.24
Age	-.03	.09	-.02	.08	-.14	.07
Gender	-.30	.19	-.27	.17	-.04	.15
Birth weight	.27**	.10	.03	.09	.06	.08
Gestational age	-.13	.10	-.05	.59	-.17*	.08
No children	.17	.10	-.03	.09	-.01	.08
Gross household income	.15	.10	-.02	.09	.08	.08
Maternal education	.21	.22	.28	.20	.14	.18
Paternal education	.19	.21	.04	.19	.03	.17
Maternal occupation	-.40	.22	.17	.20	-.66***	.18
Paternal occupation	-.06	.23	-.13	.21	-.12	.19
Breastfeeding	.37*	.19	.86***	.17	.25	.10
ΔR^2	**.15***		**.19****		**.15****	
R^2	**.24****		**.34*****		**.39*****	

Table 3. Multiple regression analyses of demographic and perinatal risk predictors of sleep measures. Ethnicities: (1) White British, (2) Other White, (3) Afro-Caribbean, (4) Asian Indian/Pakistani, (5) Asian Bangladeshi, (6) Mixed/Other. Unstandardized betas and standard errors; significant predictors marked with asterisks: *** p < .001; ** p < .01; * p < .05.