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Longitudinal Effects of Breastfeeding on Parent-Reported Child Behaviour

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ABSTRACT

Objective: Shorter breastfeeding duration has been linked to a range of difficulties in children. However, evidence linking shorter breastfeeding duration to child behavioural problems has been inconclusive. Owing to an almost exclusive focus on early childhood in previous research, little is known about breastfeeding effects on behaviour throughout childhood and adolescence. This study examines the longitudinal effect of breastfeeding on parent-reported behaviour in children aged 3 to 14.

Design: Data comes from the Millennium Cohort Study, a large, prospective, UK birth cohort study.

Participants: 11148 children, their parents and teachers.

Methods: This study maps the effect of breastfeeding duration on parent-reported child behaviour longitudinally, using latent growth curve modelling and on teacher-reported child behaviour using multiple regression analyses. Breastfeeding duration was assessed through parent interviews at child age 9-months. Children's behavioural development was measured using parent-reported Strengths and Difficulties Questionnaires (SDQ) at 3, 5, 7, 11 and 14 years and teacher-reported SDQs at 7 and 11 years.

Results: Breastfeeding was associated with fewer parent-reported behavioural difficulties at all ages even after adjusting for potential confounders (<2 months: *B*= -0.22, 95% *CI*= -0.39 to -0.04; 2-4 months: *B*= -0.53, 95% *CI*= -0.75 to -0.32; 4-6 months: *B*= -1.07, 95% *CI*= -1.33 to -0.81*;* >6 months: *B*= -1.24, 95% *CI*= -1.44 to -1.04; *B*= adjusted mean difference of raw SDQ scores at age 3, reference: never breastfed).

Conclusion: This study provides further evidence supporting links between breastfeeding duration and children's socio-emotional behavioural development. Potential implications include intervention strategies encouraging breastfeeding.

INTRODUCTION

Worldwide, 10 to 20% of children and adolescents have emotional or behavioural problems[1]. While many factors, such as poverty or limited parental education, are widely accepted to have a negative influence on children's behavioural development,[2] evidence for the effect of early infant feeding on children's behavioural development remains mixed. Studies have linked shorter breastfeeding duration to a wide range of physical and psychological deficits[3-6]. Accordingly, the World Health Organisation (WHO) recommends mothers exclusively breastfeed their babies for the first 6 months to support optimal growth, development and health[7]. However, evidence linking breastfeeding duration to behavioural development is inconclusive, with some studies reporting a significant relationship between longer breastfeeding duration and positive psychosocial child development[6, 8, 9], and others finding no association[10, 11].

Most of these studies only investigated the effect of breastfeeding on children's future behaviour at a single time point. For example, Heikkilä et. al tested the effect of breastfeeding on parent-reported child behaviour at age 5 in the Millennium Cohort Study (MCS) and found that longer breastfeeding durations are associated with fewer behavioural problems[6]. Since there is growing recognition that developmental trajectories of emotional and behavioural problems are important with respect to etiology, outcomes, and other clinically relevant factors, it is important to examine the effects of risk factors such as short breastfeeding duration on symptom trajectories[12, 13]. The present study extends Heikkilä et al's work by analysing MCS data at a further four time-points, at ages 3, 5, 7, 11 and 14 years, and its effect on changes in behaviour over time. Results were further validated using teacher-reported behavioural assessments at age 7 and 11. Specifically, this study addresses the following: (1) Does breastfeeding duration affect child behaviour as measured by the

Strength and Difficulties Questionnaire at age 3 when adjusting for potential confounders? (2) If so, does this effect persist through childhood and into adolescence? (3) Does breastfeeding duration affect the trajectory of behavioural difficulties throughout childhood and adolescence?

METHODS

The Millennium Cohort Study (MCS)

The MCS is a longitudinal study of 18522 families (18818 children) born in the United Kingdom between September 2000 and January 2002. Currently, seven data sweeps have been conducted, starting in 2001 when children were around 9 months old (range: 8.1 - 12.7 months). Subsequent sweeps were at ages 3, 5, 7, 11, 14 and 17. The cohort consists of a clustered, stratified sample of households identified from Child Benefit records from the British Government Department of Work and Pensions. A key strength of the MCS is that it intentionally over-sampled families from disadvantaged areas, minority ethnic groups, and those living in Wales, Scotland and Northern Ireland to ensure sufficient sample sizes for sub-group analyses. The MCS was approved by the London Multicentre Research Ethics Committee. For details, see MCS documentation[14, 15].

Participants

Participants were the N= 11148 children who participated in the MCS up until age 14 as well as their parents and teachers. Multiples were excluded from analyses as some studies suggest that twins' and triplets' behavioural development is different from singletons,[16-18]. Response rates are provided in the online supplementary materials (Table S1). For attrition details see MCS documentation[19, 20].

Measures

Exposure

This study focuses on duration of breastfeeding. This was ascertained in sweep 1 by asking the mother: "Did you ever try to breastfeed?" and "How old was your child when he or she last received breast milk?" Breastfeeding duration was coded into never, < 2.0 months, 2.0 to 3.9 months, 4.0 to 6.0 months and > 6.0 months. The first four categories are based on Heikkila et al.'s study that analysed the effect of breastfeeding duration on child behaviour at age 5 in the MCS[6], with an additional category (> 6.0 months) reflecting current recommendations of the WHO to exclusively breastfeed for the first 6 months of the baby's life[7].

Outcome

The outcome was children's socio-emotional behavioural problems measured by the Strength and Difficulties Questionnaire (SDQ); a behavioural screening questionnaire validated for 3 to 16-year-olds and with good internal consistency in the study sample[21, 22]. It has 25 items divided equally between five subscales: emotional symptoms, conduct problems, hyperactivity/inattention, peer relationship problems and prosocial behaviour. A total difficulty score (range: 1-40) is calculated by summing scores from all subscales, except for the prosocial behaviour subscale, with higher scores indicating more behavioural problems. Mothers completed the SDQ when the children were age 3, 5, 7, 11 and 14. Teacher-reported SDQ data were collected at ages 7 and 11 years.

Confounders

Potential confounders were selected a priori, in line with previous research on associations with child behaviour and breastfeeding duration. These included child's sex, child's ethnicity, birth weight, gestational age, parental income, area-based deprivation, whether the

child had siblings, or lived in a single parent household, maternal smoking during pregnancy, maternal age, maternal education, maternal psychological distress and maternal attachment[2, 8, 23–25]. Maternal smoking during pregnancy (Yes/No), maternal age, and maternal education (equivalent of National Vocational Qualification level 1 or above – Yes/No) were all ascertained from interviews with the mothers at sweep 1. Maternal psychological distress was measured in sweep 1 using a 9-item scale based on the Rutter Malaise Inventory with higher scores indicating greater psychological distress[26]. Maternal attachment was also measured in sweep 1 using a selection of 6 items of the 19-item Condon Maternal Attachment Questionnaire with higher scores indicating better attachment[27]. Child sex, gestational age in days and birth weight (kg) were derived from hospital records at the time of birth. Siblings (Yes/No), single parent household (Yes/No), the Index of Multiple Deprivation (IMD) and weighted OECD equivalised income quintiles were derived from all sweeps.

Statistical Methods

First, a multiple linear regression model was fit to investigate the effect of breastfeeding duration on total parent-reported SDQ scores at age 3 and cross-validated for teacher-reported SDQ scores at age 7 and at age 11. To assess the impact on behavioural developmental trajectories, a latent growth curve (LGC) model including an intercept, a linear and a quadratic growth factor was fit, with all growth factors regressed on all covariates and breastfeeding. More details on the LGC model can be found in the online supplementary materials. All models were adjusted for the complex survey design of the Millennium Cohort Study based on MCS guidelines[28, 29] using the R packages *survey*[30] and *lavaan.survey*[31], accounting for clustering and stratification, including a finite population correction factor, and accounting for sampling and attrition bias by including

sampling weights. The inclusion of attrition weight gives higher weights to observations that are less likely to be observed in the sample to counteract the underrepresentation of such cases, and should, hence, be effectively adjusting for bias due to non-response, assuming the data are missing at random, i.e., that it is predictable based on the variables included in the model independently of unobserved outcomes [32]. Models were estimated using full information maximum likelihood estimation with robust standard errors. Several fit indices were computed to evaluate the model's goodness of fit[33]. In addition, a sensitivity analysis using only observations with complete cases on the SDQ was conducted (see online supplementary materials Table S9, Table S10 and Table S11). Data sets were restructured and merged to allow for longitudinal analysis in R[34] and RStudio[35] (script: https://github.com/Lydia-G-S/Millennium-Cohort-Study-Data-Restructuring-in-R.).

RESULTS

Descriptive Statistics

Population Characteristics are presented in Table 1. Distributions of SDQ scores and breastfeeding duration are visualised in the online supplementary materials (Figure S1 and S2), along with a correlation matrix (Table S2). Figure 1 illustrates the trajectory of unadjusted total SDQ scores against breastfeeding duration.

[Table 1 about here.]

[Figure 1 about here.]

Breastfeeding and Behavioural Difficulties at Baseline

To establish whether breastfeeding duration has an effect on children's socio-emotional

behavioural difficulties at age 3, a multiple linear regression model, including all potential confounders, was built. Results suggested that children who had been breastfed had significantly lower SDQ scores than children who had never been breastfed (< 2 months: *B* = -0.50, 95% *CI* = -0.88 to -0.11, *t* = -2.53, *p* = .01; 2-4 months: *B* = -0.76, 95% *CI* = -1.91 to -0.33, *t* = -3.49, *p* = <.001; 4-6 months: *B* = -1.29, 95% *CI* = -1.83 to -0.76, *t* = -4.76, *p* = <.001; > 6 months: *B* = -1.28, 95% *CI* = -1.64 to -0.92, *t* = -6.92, *p* = <.001). Additional regressions for teacher-reported SDQ scores collected at age 7 also showed that breastfeeding for four to six months was associated with significantly lower SDQ scores (< 2 months: *B* = 0.41, 95% *CI* = -0.06 to 0.88, *t* = 1.73, *p* = .09; 2-4 months: *B* = 0.06, 95% *CI* = -0.50 to 0.62, *t* = 0.21, *p* = .84; 4-6 months: *B* = -0.78, 95% *CI* = -1.42 to -0.14, *t* = -2.41, *p* = .02; > 6 months: *B* = -0.32, 95% *CI* = -0.85 to 0.22, *t* = -1.17, *p* = .24). For teacher-reported SDQ scores at age 11, breastfeeding was not a statistically significant predictor (< 2 months: *B* = 0.16, 95% *CI* = -0.72 to 1.04, *t* = 0.36, *p* = .72; 2-4 months: *B* = 0.18, 95% *CI* = -1.17 to 1.54, *t* = 0.26, *p* = .79; 4-6 months: *B* = -0.14, 95% *CI* = -1.40 to 1.11, *t* = -0.22, *p* = .82; > 6 months: *B* = -0.37, 95% *CI* = -1.36 to 0.62, *t* = -0.74, *p* = .46). For the full results of regression analyses for parent reports at age 3 (Table S3), age 7 (Table S4) and age 11 (Table S5), and teacher reports at age 7 (Table S6) and 11 (Table S7), see the online supplementary materials.

Latent Growth Curve Model for Behavioural Child Development

After identifying breastfeeding duration as a significant predictor of behavioural difficulties at age 3, an LGC was built to model the trajectory of SDQ scores over time. To determine the optimal number of growth curve factors, several LGC models were compared, with a three three-factor model including an intercept, linear slope, and quadratic slope factor adopted as

it showed the best fit(2(6) = 1612.37; *CFI* = .95; *TLI* = 0.91; *RMSEA* = .15 with 90% *CI:* .15 to .16).

Links between Breastfeeding and Behavioural Development

Table 2 provides the parameter estimates for the latent growth curve part of the model which captures the overall trajectory of SDQ scores over time after adjusting for potential confounders. Figure 2 displays fitted growth trajectory of SDQ scores. Table 3 shows the regression parameters for time-invariant covariates and breastfeeding duration. Parameter estimates for the time-varying covariates (Table S8) and standardised regression coefficients (Table S12 and Table S13) can be found in the online supplementary materials. Results suggested that breastfeeding was significantly associated with a lower intercept, hence, lower baseline levels of behavioural difficulties. In addition, breastfeeding was significantly associated with the linear slope and the quadratic term, indicating that breastfeeding is also predictive of changes in SDQ scores over time. The model had a good fit with 2(120) =1352.65, *CFI* = .98, *TLI* = 0.97 and *RMSEA* = .03 with *CI* of 90% .02 to .03.

[Table 2 about here.]

[Figure 2 about here.]

[Table 3 about here.]

DISCUSSION

Breastfeeding was associated with a significant reduction in SDQ scores, that is, fewer socio-emotional behavioural difficulties. This association was significant after controlling for an extensive set of covariates. A latent growth curve model provided insights into the

impact of breastfeeding on the long-term trajectories of SDQ scores. On average, children showed a decrease in SDQ scores but with a concave shape whereby SDQ scores decline at first but then slowly increase again with a steeper increase around early adolescence. This could be expected since the transition from childhood to adolescence is a critical period of child development that has often been found to lead to an increase in mental health and behavioural difficulties[36].

Breastfeeding was shown to significantly modify individual developmental trajectories. Specifically, longer breastfeeding duration was shown to lead to fewer difficulties at the age 3 baseline. Further, breastfeeding was associated with a slower reduction of SDQ scores over time that changes its growth direction faster. Thus longer breastfeeding duration is associated with a slightly faster increase in behavioural difficulties over time even though it leads to fewer behavioural difficulties on average. One possible interpretation is that the effect of breastfeeding is stronger in younger years but then lessens as children reach late adolescence when other factors, e.g. peer relationships, start having a bigger impact on their behaviour. Another possible interpretation is that those with longer breastfeeding durations have a slightly accelerated development and thus traverse the normative trajectory of decreasing and then increasing behavioural difficulties faster. Further longitudinal research is needed to delineate the effect of breastfeeding once individuals reach late adolescences to gain better insight into this trend.

The main strengths of this study are that the participants come from a large study that oversampled families living in disadvantaged areas and ethnic minorities to ensure that they were adequately represented. The scale and richness of the MCS data also allowed for the inclusion of many potential confounders and, most importantly, enabled the examination of

the effect of breastfeeding longitudinally from early childhood into adolescence. Further, a multi-informant approach was facilitated by the availability of both parent- and teacher-reported data.

However, teacher-reported data were not available at all relevant waves and could, therefore, not be used to construct an LGC to replicate the parent-reported LGC analyses. An additional limitation of this study is that children's age ranges were relatively wide at the different measurement occasions such that the estimated SDQ trajectory might not capture the underlying trajectory perfectly.

Further studies are needed to clarify which aspects of breastfeeding are responsible for the observed association with lower SDQ scores as there are many potential mechanisms that could explain these findings. In particular, biological aspects of breastfeeding, such as the quality of the breast milk, should be incorporated into analyses as well as the infant's genome as there is growing evidence that suggests that the beneficial effects of breastfeeding might be moderated by genetic variations in fatty acid metabolism[37-40].

CONCLUSION

This study offers further evidence consistent with the idea that breastfeeding plays a crucial role in children's socio-emotional behavioural development. Longer breastfeeding durations are associated with fewer behavioural problems in the short and long term, though future research is required to illuminate the mechanisms. Results support current healthcare policies that seek to encourage mothers to exclusively breastfeed for the first six months of the infant's life[7].

Table 1 Population Characteristics

Variable	*Mean*	*SD*	*Range*	*N*
Breastfeeding Duration in Days	73	98	0-330	10993
Birthweight in Kilograms	3.34	0.58	0.39-7.23	11123
Gestational Age in Days	276	14	168-301	11021
Maternal Age	27.81	6.05	14-48	11132
Maternal Attachment	20.48	2.75	6-35	10768
Malaise Inventory	1.74	1.80	9-18	10714
SDQ at Age 3	9.94	5.33	0-30	9542
SDQ at Age 5	7.60	5.10	0-33	10113
SDQ at Age 7	7.76	5.56	0-35	9923
SDQ at Age 11	8.22	6.12	0-36	10212
SDQ at Age 14	8.80	6.36	0-38	10771

	Category	*%*	*N*
Breastfeeding	Never	33.1	3638
	< 2 months	25.5	2807
	2-4 months	13.1	1436
	4-6 months	8.2	901
	> 6 months	20.1	2211
Sex	Female	50.0	5566
	Male	50.0	5577
Child Ethnicity	White	82.7	9195
	Other Ethnicity	17.3	1928
Maternal Smoking during Pregnancy	Yes	20.1	2243
	No	79.9	8905
Maternal Basic Qualification	Yes	86.5	9620
	No	13.5	1501

	Wave 1		**Wave 2**		**Wave 3**		**Wave 4**		**Wave 5**		**Wave 6**	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*

Income	Lowest Income Quintile	2349	21.1	1814	18.3	1867	18.3	1811	18.1	1805	17.2	1859	16.7
	20 - <40%	2351	21.1	2015	20.3	2094	20.5	1911	19.1	1906	18.0	1867	16.7
	40 - <60%	2139	19.2	2046	20.7	2046	20.0	2034	20.3	2221	21.0	2267	20.3
	60 - <80%	2193	19.7	2017	20.4	2117	20.7	2127	21.3	2361	22.3	2583	23.2
	Highest Income Quintile	2085	18.8	2010	20.3	2084	20.4	2121	21.2	2273	21.5	2572	23.1
Deprivation	Most Deprived Decile	1773	15.9	1432	14.0	1411	13.4	1283	12.5	1239	11.7	1357	12.2
	10 - <20%	1529	13.7	1237	12.1	1267	12.1	1192	11.6	1208	11.4	1276	11.5
	20 - <30%	1363	12.2	1147	11.2	1139	10.8	1094	10.7	1087	10.3	1140	10.2
	30 - <40%	1105	9.9	1011	9.9	1010	9.6	970	9.5	994	9.4	1045	9.4
	40 - <50%	1004	9.4	961	9.4	979	9.3	921	9.0	983	9.3	1026	9.2
	50 - <60%	931	8.8	897	8.8	887	8.4	917	9.0	999	9.5	1035	9.3
	60 - <70%	816	7.8	799	7.8	867	8.3	886	8.6	919	8.7	962	8.6
	70 - <80%	829	8.0	819	8.0	887	8.4	889	8.7	923	8.7	988	8.9
	80 - <90%	896	9.1	935	9.1	986	9.4	996	9.7	1069	10.1	113	10.0
	Least Deprived Decile	902	9.6	985	9.6	1070	10.2	1096	10.7	1140	10.8	1198	10.8
Single Parent Household	Yes	1566	14.1	1402	14.2	1755	17.2	1858	18.6	2282	21.6	2704	24.3
	No	9677	85.9	8504	85.8	8464	82.8	8150	81.4	8284	78.4	8444	75.77
Siblings	Yes	6469	58.1	7477	75.2	8614	84.3	8870	88.6	9375	88.7	9645	86.5
	No	4674	41.9	2462	24.8	1605	15.7	1138	11.4	1191	11.3	1503	13.5

Mean and standard deviations (SD) were corrected for the survey design of the MCS. Income is based on OECD Equivalised Income Scores and deprivation is based on the Index of Multiple Deprivation

TABLE 2 Parameter Estimates for the Latent Growth Curve Model Part of the Model

	B	***95% CI***
Means:		
Intercept	11.93*	11.55 to 12.31
Slope	-5.71*	-7.22 to -4.19
Quadratic Term	3.28*	1.89 to 4.68
Variances:		
SDQ age 3	10.97*	10.56 to 11.38
SDQ age 5	7.26*	7.05 to 7.48
SDQ age 7	7.37*	7.13 to 7.61
SDQ age 11	9.45*	9.16 to 9.74
SDQ age 14	5.14*	4.53 to 5.75
Intercept	10.74*	10.28 to 11.19
Slope	73.46*	66.03 to 80.89
Quadratic Term	65.3*	58.7 to 71.9
Covariances:		
Intercept/Slope	1.77*	0.27 to 3.27
Intercept/Quadratic Term	-4.3*	-5.57 to -3.03
Slope/Quadratic Term	-59.57*	-66.22 to -52.92

Significant means for the linear slope and the quadratic term indicate that SDQ scores change significantly over time. A negative slope in conjunction with a positive quadratic term indicates a U-shaped curvilinear trajectory, i.e. initially SDQ scores decrease but then increase again. Parameter estimates were adjusted for the sample design of the MCS. Model fit statistics: 2(120) = 1352.65, *CFI* = .98, *TLI* = 0.97 and *RMSEA* = .02 with 90% *CI:* .02 to .03; *B* = unstandardised regression coefficient, *significant at $p < .05$.

TABLE 3 Regression Parameters with 95% Confidence Intervals (CI)

	Intercept		Linear Slope		Quadratic Term	
Parameter (Reference: Never Breastfed)	B_i	*95% CI*$_i$	B_l	*95% CI*$_l$	B_q	*95% CI*$_q$
Breastfeeding: < 2 months	-0.22*	-0.39 to -0.04	1.52*	0.85 to 2.19	-0.98*	-1.59 to -0.37
Breastfeeding: 2 - 4 months	-0.53*	-0.75 to -0.32	1.06*	0.22 to 1.90	-0.56	-1.32 to 0.21
Breastfeeding: 4 - 6 months	-1.07*	-1.33 to -0.81	2.19*	1.18 to 3.19	-1.48*	-2.4 to -0.56
Breastfeeding: > 6 months	-1.24*	-1.44 to -1.04	1.85*	1.08 to 2.62	-1.16*	-1.87 to -0.46
Female	-0.82*	-0.95 to -0.69	-2.56*	-3.06 to -2.06	2.72*	2.26 to 3.17
Single Parent: No	-0.59*	-0.82 to -0.36	0.98*	0.10 to 1.87	-0.62	-1.42 to 0.17
Deprivation	-0.02	-0.06 to 0.01	-0.30*	-0.45 to -0.15	0.25*	0.12 to 0.38
Income	-0.27*	-0.35 to -0.2	-0.55*	-0.83 to -0.27	0.39*	0.14 to 0.65
Siblings: Yes	-0.23*	-0.4 to -0.06	-0.41	-1.06 to 0.24	0.85*	0.26 to 1.43
Child White	-0.7*	-0.92 to -0.47	2.85*	1.97 to 3.74	-1.37*	-2.18 to -0.56
Mother has Qualification	-1.01*	-1.23 to -0.79	-1.01*	-1.87 to -0.15	1.65*	0.86 to 2.43
Maternal Age	-0.09*	-0.11 to -0.08	0.18*	0.12 to 0.23	-0.15*	-0.19 to -0.1
Maternal Smoking: No	-0.64*	-0.81 to -0.47	0.11	-0.55 to 0.77	-0.39	-0.99 to 0.22
Birthweight	-0.04	-0.19 to 0.1	-1.38*	-1.93 to -0.82	1.13*	0.62 to 1.63
Gestation	-0.01*	-0.02 to -0.01	0.02*	0.00 to 0.05	-0.02	-0.04 to 0.00
Maternal Psychological Distress	0.59*	0.55 to 0.63	0.22*	0.07 to 0.37	-0.15*	-0.29 to -0.01
Maternal Attachment	-0.08*	-0.1 to -0.05	0.32*	0.22 to 0.42	-0.24*	-0.33 to -0.15

The estimated intercept, slope and quadratic term which characterise the trajectory of SDQ scores (Table 2) were regressed on all covariates, with parameters indicating whether they were significantly associated with any of those growth factors. A significant intercept indicates a relationship of a variable with baseline SDQ scores whereas a significant slope or quadratic term indicates a significant relationship with the change in SDQ scores over time. For example, breastfeeding for more than 6 months is associated with lower SDQ scores at baseline (-1.24), with a slower reduction in SDQ scores over time (1.85) and a faster change in direction of the SDQ trajectory (-1.16). Parameter estimates were adjusted for the sample design of the MCS. Intercept, linear slope and quadratic term are referred to as i, l and q respectively; *B* = unstandardised regression coefficient, *significant at $p < .05$.

What is already known on this topic:

Evidence for the effect of early infant feeding on children's behavioural development is mixed.

Research has focused on the effect of breastfeeding on early childhood rather than on long term effects.

What this study adds:

This study offers evidence that longer breastfeeding durations are associated with fewer socio-emotional behavioural problems in the long term.

The effect of breastfeeding holds after adjusting for other factors contributing to behavioural child development.

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Data Sharing Statement: This is a secondary data analysis based on the Millennium Cohort Study data. The data and access policy are available online here: https://beta.ukdataservice.ac.uk/datacatalogue/series/series?id=2000031#!/access

Contributors' Statement

Ms Speyer conceptualized and designed the study, conducted analyses, drafted the initial manuscript, and reviewed and revised the manuscript.

Ms Hall and Dr Ushakova made substantial contributions to analysis and interpretation of data and critically reviewed the manuscript for important intellectual content.

Dr Murray, Dr Luciano and Dr Auyeung made substantial contributions to the conception and design of the study and critically reviewed the manuscript for important intellectual content.

All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

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Figure Legends:

Figure 1. Growth trajectory of unadjusted SDQ scores over time by breastfeeding duration.

Figure 2. Fitted growth trajectory of SDQ scores over time by breastfeeding duration.