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**Father involvement in early child-rearing and behavioural outcomes in the pre-adolescent period**

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## Abstract

*Objective:* To explore the nature of paternal involvement in early child-rearing, and estimated its effect on behavioural outcomes in 9 and 11 year-old children.

*Setting:* The data come from the Avon Longitudinal Study of Parents and Children (ALSPAC) cohort recruited in the southwest of England in the 1990s.

*Participants:* A total of 14,701 children were alive at 1 year; 10,440 children were living with both parents at 8 months and were therefore eligible. Outcome data were available for 6,898 children at 9 years and 6,328 children at 11 years.

*Main exposure:* Paternal involvement in infancy was measured using factor scores obtained through factor analysis of fathers' responses on their participation in, understanding of, and feelings about their child's early upbringing.

*Outcome:* Behavioural problems were measured using the Strengths and Difficulties Questionnaire (SDQ) total difficulties score.

*Results:* Three factors were identified in the factor analysis: Factor 1 described fathers' emotional response to the child; Factor 2 measured the frequency of fathers' involvement in domestic and childcare activities; Factor 3 characterised fathers' feelings of security in their role as parent and partner. Children of fathers with high scores on factors 1 and 3 had 14% (OR 0.86, 95%CI 0.79–0.94,  $p=0.001$ ) and 13% (OR 0.87, 95%CI 0.79–0.96,  $p=0.006$ ) respectively lower adjusted odds of behavioural problems at 9 years. Factors 1 and 3 were associated with a comparable reduction in adjusted odds of behavioural problems at 11 years (OR 0.89, 95%CI 0.81–0.98,  $p=0.017$  and OR 0.89, 95%CI 0.81–0.99,  $p=0.034$  respectively). Factor 2 was not associated with the outcome.

*Conclusion:* Psychological and emotional aspects of paternal involvement in children's early upbringing, particularly how new fathers see themselves as parents and adjust to the role, rather than the quantity of direct involvement in childcare, is associated with positive behavioural outcomes in children.

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**Strengths and limitations**

*Strengths*

- The study is based on a large sample derived from detailed cohort data.
- We have adopted a rigorous approach to explore the multi-faceted nature of the main exposure.

*Limitations*

- Findings are based on observational data which is often subject to unmeasured confounding.
- The main exposure and outcome are based on self-report, which may be subject to bias.

## Introduction

In most societies, the involvement of fathers in child rearing has traditionally been framed as the role of 'provider' [1], [2] with mothers doing most of the task-oriented caring and nurturing of children. However, in recent decades social changes including the rapid increase in the proportion of working mothers [3]–[5] and changes in employment regulations such as increased paternity leave have resulted in a shift towards more of the direct parenting duties being shared by both parents [6]. Understanding the nature and effect of fathers' involvement on the health and well-being of children could therefore help inform policies aimed at improving family psychological and health outcomes.

The nature of parenting in a child's early years is thought to play an important role in influencing the child's immediate and long-term well-being and mental health, including social development [7], [8], and cognitive and educational outcomes [9]. The nature and extent of fathers' involvement in parenting may change over the course of a child's life. However, early paternal involvement is often associated with continuing engagement and may be a proxy-measure of overall engagement [10]–[12]. Early parenting can also affect outcomes later in life [13], [14]. For these reasons we were interested in whether fathers' involvement early in their child's life was associated with the child's later mental health and social development. We focused on the child's behaviour as a component of mental health because of its strong link to cognitive and educational outcomes.

Paternal involvement can be characterised [15], [16] by: fathers' *accessibility* to their children measured by their frequency of contact with the child [17], [18], co-residence with the child [17] or even presence at the child's birth [19]; their *engagement* in childcare activities such as playing, feeding and bathing [20]–[22]; and their demonstration of *responsibility* in providing for the material [22] and emotional [23] needs of their children. Nevertheless, many studies have tended to characterise paternal involvement as a unidimensional construct [24]. The failure to adopt a more multi-dimensional approach may explain why the evidence for its effect on mental health outcomes in children is unclear.

In this study we sought to first identify the multi-dimensional aspects of paternal involvement before investigating their potential influence on pre-adolescent children's behaviour. We explored the relationship between paternal involvement in the child's upbringing at 8 weeks and 8 months postnatally and child behavioural outcomes at age 9 and 11 years.

## Methods

### Data

Data were drawn from the Avon Longitudinal Study of Parents and Children (ALSPAC) cohort [25], [26]. It is based on a sample of children born to mothers living in the former county of Avon in the southwest of

England between April 1991 and December 1992. A detailed description of the sample profile has been provided elsewhere [27], [28] and the study website contains details of all the data that is available through a fully searchable data dictionary [29].

There were 14,701 children in the total sample who were alive at 1 year. Data on 14,688 term singletons and twins who were alive at age 1 year were provided for these analyses and 13 observations on higher-order multiple births omitted from our data to preserve confidentiality. We also excluded 713 children recruited retrospectively when the children in the original core sample were around 7 years old (Phase II and Phase III recruitment) and 3,535 children whose mothers did not live with (or report living with) a partner at 8 months. Out of the remaining 10,440 eligible children, the analysis was based on 6,898 and 6,328 children whose mothers completed the SDQ questionnaires at age 9 and 11 years respectively (Figure 1).

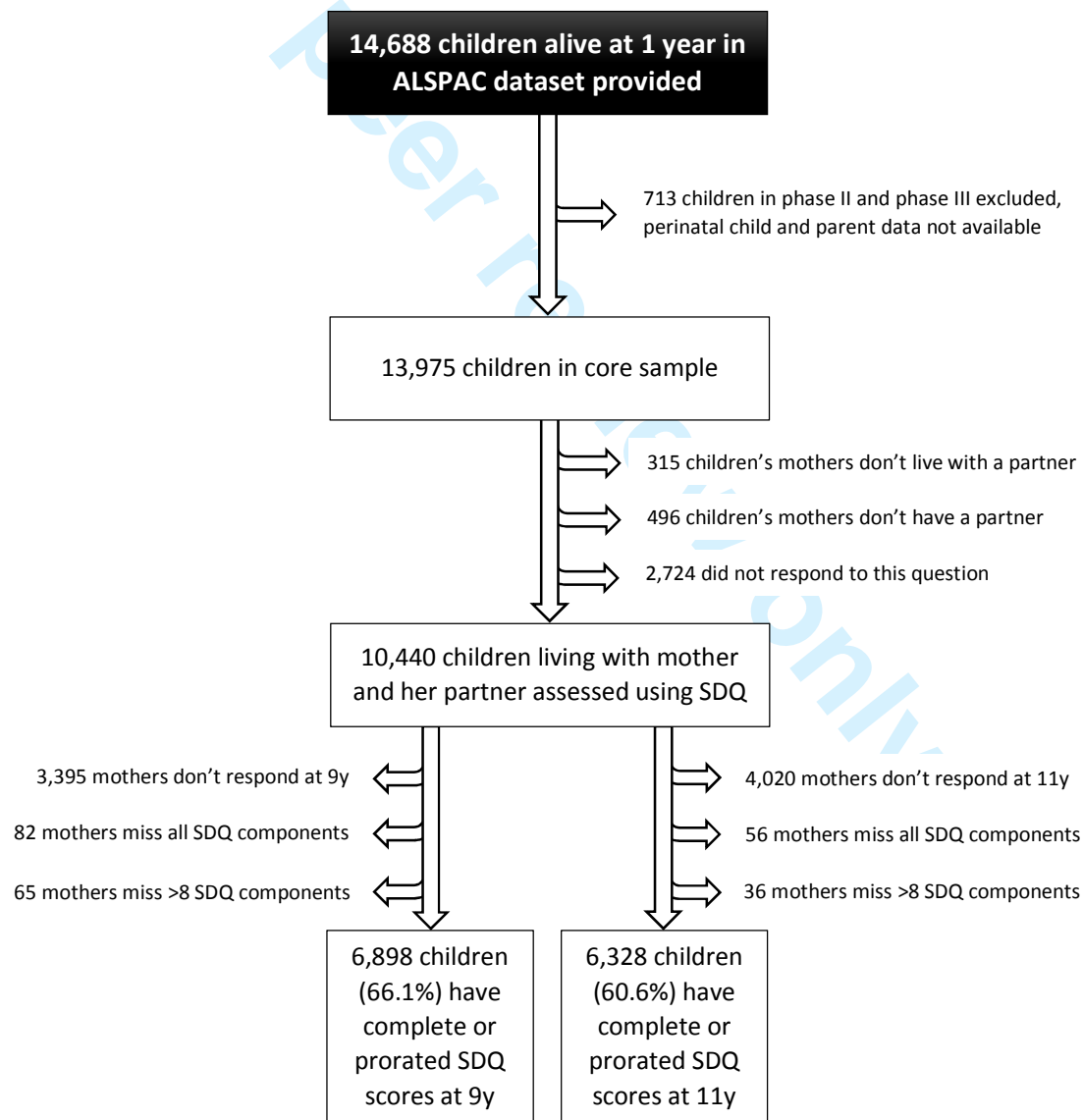


Figure 1: Sample profile of the children included in the analysis

### *Outcome, exposure and potential confounder variables*

Data were collected using self-completion questionnaires sent to mothers and their partners after recruitment and when the child was aged 8 weeks, 8 months, 9 years and 11 years. The questionnaires asked about mental health, parenting and childcare, behaviour, socio-economic status of parents, and child development.

The outcome was the child's behaviour measured by the Strengths and Difficulties Questionnaire (SDQ) completed by the mother [30]. This tool has 5 scales, namely 'emotional symptoms', 'conduct problems', 'hyperactivity', 'peer relationship problems' and 'prosocial behaviour'. Each scale is made up of 5 items giving a total of 25 items. The items are statements about psychological attributes, some positive and others negative. One of three ordered responses are given to each question: 0 ('not true'), 1 ('somewhat true') or 2 ('certainly true'). These are then summed up to obtain the scale scores and the total SDQ score. In our analyses we used the SDQ total difficulty score derived by summing up the scores of the first 4 scales of the SDQ [31] measured at age 9 and 11 years.

Paternal involvement was measured by asking fathers to rate their level of agreement – on 3 to 6-point ordinal scales – with 58 statements reflecting attitudes to parenting, attachment to child, and moods and feelings in the post-partum period at 8 weeks (37 items) and 8 months (21 items) after the birth of the child.

Data on other factors measured after recruitment which were potentially associated with the main outcome and/or exposure were also obtained including parental age, level of education (O-level/CSE/vocational training, A-level or university degree), depression symptoms measured 8 weeks postnatally on the Edinburgh Postnatal Depression Scale (EPDS) [32], socio-economic status derived from self-reported occupation using the Computer Assisted Structured Coding Tool (CASCOT) and coded into quintiles from 1 (lowest) to 5 (highest) [33], number of hours worked in the current or most recently held job, and child's age and gender.

### *Analysis*

Exploratory factor analysis (EFA) was performed on the items measuring fathers' attitudes, attachment, moods and feelings. Factors identified in this analysis were deemed to represent key aspects of paternal involvement. Next, confirmatory factor analysis (CFA) was undertaken to check whether the factor structure identified during EFA was a good fit for the data. To improve the fit of the CFA model items that loaded on more than one factor were removed from further analysis, as were items with low factor loadings (less than 0.3), because they were deemed to be poor measures of the underlying construct [34].

Once a well-fitting factor structure was identified, factor scores for each of the identified aspects of paternal involvement were calculated. Factor scores are standard normal estimates of each individual's relative position in the continuum of the latent characteristic being measured. They were calculated as the maximum of the posterior distribution (MAP) of the latent factors given the observed and unobserved responses corresponding to the individual [35]. Factor scores so derived yield unbiased regression slopes when used as predictors in models [36]. Labels corresponding to the construct represented by the items underpinning each factor were then attributed to the factor scores to facilitate interpretation of the results.

To explore the association between paternal involvement and behavioural outcomes a two-step procedure was undertaken. First, univariable ordered logistic regression models of SDQ total difficulties scores on the factor scores and paternal, maternal and child covariates were fitted to identify the factors which were associated with the outcome. Next, all factors found to be independently associated with SDQ score (likelihood ratio p-values less than 5%) were included in a multivariable model, retaining only those factors for which there was still evidence of association with the outcome even after adjustment. Potential differences in association for boys and girls were explored by fitting and testing interaction terms for gender. Separate models were fitted for SDQ measured at 9 and 11 years.

Missing data were dealt with in three ways. Firstly, the MAP estimation of factor scores allowed for the partial recovery of information contained in unobserved paternal involvement items. Secondly, missing data in SDQ component items were handled by prorating scale scores for up to two missing responses out of the five items in each scale [31]. It is a single imputation procedure which replaces an individual's missing item scores with the mean score for the scale to which the missing item belongs. Thirdly, missing values of covariates in the multivariable regression modelling were assumed to be missing completely at random. Multiple imputation was performed to recover the information contained in these missing values, with ten imputed datasets used to obtain the final estimates.

The proportional odds assumption underpinning the ordered logistic regression models was examined using the Brant test with  $\chi^2$  p-values less than 5% interpreted as a violation of this assumption [37]. Data management and manipulation were performed using Stata v13 [38]. Analyses were run in Stata v13 and MPlus v7 [39].

## Results

The characteristics of the samples at 9 years and 11 years were very similar (Table 1). Overall there were slightly more boys than girls. Fathers were on average aged 31 years and educated to O-level or CSE (examinations completed in the final year of compulsory schooling at age 16 years) or had some vocational (skills) training. They reported working about 45 hours per week in their current or most



recent job around the time when the child was 8 months old and had low depression scores on the EPDS. Mothers were on average 2 years younger than the fathers, were educated to a similar level, had slightly higher EPDS scores than fathers, and had 1 child prior to the one included in the study. Parents tended to be in similar SES categories. Most children had low total difficulties scores, with medians of 6 and 5 at the two respective time points.

*Table 1: Characteristics of the parents and children included in the analysis and the two time points*

	9 years [n = 6,898]	11 years [n = 6,328]
<b>Fathers</b>		
Age in years, mean (SD)	31.27 (5.4)	31.30 (5.4)
Highest level of education, n (%)		
O-level, CSE <sup>1</sup> or vocational	3,021 (43.8%)	2,758 (43.6%)
A-level <sup>2</sup>	1,482 (21.5%)	1,366 (21.6%)
University degree	1,048 (15.2%)	1,002 (15.8%)
Missing	1,347 (19.5%)	1,202 (19.0%)
Hours worked per week, mean (SD)	44.83 (9.8)	44.77 (9.9)
EPDS <sup>3</sup> score, median (IQR)	3 (1 – 6)	3 (1 – 6)
SES <sup>4</sup> category, n (%)		
1 – lowest	138 (2.0%)	122 (1.9%)
2	499 (7.2%)	453 (7.2%)
3	2,516 (36.5%)	2,297 (36.3%)
4	2,361 (34.2%)	2,184 (34.5%)
5 – highest	875 (12.7%)	823 (13.0%)
Missing	509 (7.4%)	449 (7.1%)
<b>Mothers</b>		
Age in years at delivery, mean (SD)	29.30 (4.4)	29.33 (4.4)
Highest level of education, n (%)		
O-level, CSE or vocational	2,564 (37.2%)	2,317 (36.6%)
A-level	1,665 (24.1%)	1,564 (24.7%)
University degree	1,413 (20.5%)	1,329 (21.0%)
Missing	1,256 (18.2%)	1,118 (17.7%)
Parity, median (IQR)	1 (0 – 1)	1 (0 – 1)
EPDS score, median (IQR)	5 (2 – 8)	5 (2 – 8)
SES category, n (%)		
1 – lowest	86 (1.3%)	79 (1.3%)
2	443 (6.4%)	417 (6.6%)
3	2,844 (41.2%)	2,613 (41.3%)
4	2,099 (30.4%)	1,926 (30.4%)
5 – highest	441 (6.4%)	423 (6.7%)
Missing	985 (14.3%)	870 (13.6%)
<b>Children</b>		
Mean age difference in months, mean (SD)	0.00 (5.8)	0.00 (5.8)
Gender, n (%)		
Boys	3,499 (50.7%)	3,170 (50.1%)
Girls	3,399 (49.3%)	3,158 (49.9%)
SDQ <sup>5</sup> total difficulties score, median (IQR)	6 (3 – 9)	5 (3 – 9)
<p>1. O-level and CSE were the national exams which students in England sat in their last year of compulsory school education at age 16</p> <p>2. A-levels are pre-university examinations</p> <p>3. EPDS is the Edinburgh Postnatal Depression Scale</p> <p>4. SES is socioeconomic status, derived from the Computer-assisted structured coding tool (CASCoT)</p> <p>5. SDQ is the Strengths and Difficulties Questionnaire</p>		

There were complete responses to the 58 paternal involvement questions for between 4,560 and 5,381 children at 8 weeks and 8 months. A total of 45 out of the 58 items reflecting paternal involvement were included in the exploratory factor analysis. Reasons for exclusion of 13 items were: high uniqueness coefficients of greater than 0.9 affecting 8 items; low loadings on the retained factors affecting 1 item; large amounts of missing data – more than 50% – affecting 3 items; and similarity between two items leading to one of them being dropped. Table 2 presents the results of the exploratory factor analysis.

Three factors of paternal involvement, explaining 66.0% of the total variance in included items, were identified: items in the first factor, explaining 31.4% of total variance, described fathers' emotional response to the baby and their parenting role; items in the second factor, explaining 17.7% of total variance, measured fathers' level of engagement in domestic and childcare activities; and items in the third factor, explaining 16.9% of total variance, characterised fathers' security in their role as a parent and partner. Confirmatory factor analysis showed this factor structure to be an acceptable representation of the correlations between items in the data (CFI = 0.916, TLI = 0.911, RMSEA = 0.065).

Unadjusted ordered logistic regression showed strong evidence that the first and third factor scores were associated with the outcome (Table 3). Children of fathers whose responses corresponded to higher Factor 1 scores had 21% and 19% reductions in proportional odds of higher SDQ total difficulty scores at ages 9 and 11 respectively, and children of fathers whose responses corresponded to higher Factor 3 scores had 28% reduction in proportional odds of higher SDQ total difficulty scores at both times. Other factors were also found to be associated with the outcome. Specifically, higher parental age, level of education and SES category were associated with reduced proportional odds of higher behavioural difficulty scores, while more hours worked per week, higher EPDS scores, child's age and male gender were associated with poorer behavioural outcomes.

Multivariable models adjusting for these potential confounders were fitted, with multiple imputation of missing values of covariates. The adjusted proportional odds of higher behavioural problems scores were 15% lower at 9 years and 12% lower at 11 years per unit increase in Factor 1 scores and 12% lower at 9 years and 10% lower at 11 years per unit increase in Factor 3 scores, comparing children of the same age and gender, family size, socio-economic status, who were exposed to the same level of parental depression (Table 3). There was no evidence of a difference in the effect of paternal involvement in boys versus girls; p-values for interaction of child's gender with Factor 1 and with Factor 3 were 0.907 and 0.864 respectively in models of the outcome at 9 years, and 0.189 and 0.918 respectively at 11 years. The proportional odds assumption was not violated in these models; Brant test p-values were 0.078 and 0.050 for models on data at 9 years and 0.316 and 0.514 on models at 11 years.

*Table 2: Exploratory factor analysis on the indicators of paternal involvement*

Indicator	Rotated loadings*		
	Factor 1	Factor 2	Factor 3
Helped with shopping since birth		0.4891	
Helped with cleaning home since birth		0.7112	
Helped with meal preparation since birth		0.7013	
Helped with washing up since birth		0.6077	
Helped with housework since birth		0.7573	
Helped with cooking meals since birth		0.6882	
Helped with clothes wash since birth		0.5878	
How frequently partner changes nappy per week		0.5178	
How frequently partner bathes child per week		0.4293	
How frequently partner plays with child per week	0.4324	0.4107	
How frequently partner walks child outside per week		0.4284	
How frequently partner puts child to bed per week		0.4225	
How frequently partner feeds/helps at night per week		0.4294	
Mum excludes partner from childcare			0.7346
Feel confident with child	0.3857		-0.3201
Feel mum does not trust partner with child			0.6817
Happy with the way mum brings up child	0.3652		-0.4507
Happy with the way partner brings up child	0.5094		-0.4468
Making a strong bond with child	0.6147		
My stress is a bad influence on child	-0.3728		0.4486
Home is woman's place, no part for me		-0.3643	0.3871

Indicator	Rotated loadings*		
	Factor 1	Factor 2	Factor 3
Partner always getting under mum's feet			0.4928
Mum dislikes partner being involved with child			0.7315
Partner guilty at not enjoying child	-0.5480		0.4373
Partner regrets having child	-0.6553		
Partner regrets lack of experience of children			0.3160
This child has made partner more fulfilled	0.6465		
Parenthood has made partner and mum closer	0.5038		
Mum no longer gives partner attention			0.5413
Feel hurt by attention mum gives child			0.5760
Partner well prepared for birth and childcare			-0.3166
Partner enjoys getting home to see mum & child	0.6307		
Enjoy the baby	0.8294		
Preferred not to have had baby	-0.5550		
Feel confident with baby	0.5776		
Dislike mess surrounding baby	-0.3707		
Pleasure watching baby develop	0.8240		
Find baby crying unbearable	-0.3836		
Constantly unsure whether doing right thing			0.3160
Feel should enjoy baby but am not	-0.6869		
No time to self	-0.4583		
Baby made feel more fulfilled	0.7315		
Feel babies are fun	0.8185		
Talking to baby is important	0.4211		
Cuddling baby is very important	0.4612		

\*Displaying only loadings greater than 0.3

Table 3: Unadjusted and adjusted proportional odds ratios for the effect of paternal involvement on SDQ scores at ages 9 and 11 years, with 95% confidence intervals and p-values

Paternal involvement factor scores	9 years		11 years	
	Unadjusted [n = 5,717]	Adjusted* [n = 6,223]	Unadjusted [n = 5,262]	Adjusted* [n = 5,500]
Factor 1: “emotional response to baby and parenting”	0.79 0.73 – 0.86 <0.001	0.86 0.79 – 0.94 0.001	0.81 0.74 – 0.88 <0.001	0.89 0.81 – 0.98 0.017
Factor 2: “engagement in domestic and childcare activities”	1.01 0.90 – 1.14 0.854	–	1.09 0.97 – 1.24 0.160	–
Factor 3: “security in role as parent and partner”	0.72 0.66 – 0.78 <0.001	0.87 0.79 – 0.96 0.006	0.72 0.66 – 0.79 0.001	0.89 0.81 – 0.99 0.034

\*Adjusting for paternal and maternal EPDS score, parity, maternal age, family SES score, child’s age and child’s gender

Discussion

This analysis of data from almost 7,500 children in the south-west of England characterised the nature of paternal involvement in early child upbringing and explored its effects on behavioural outcomes in pre-adolescent children. We found that the children of fathers whom we characterised as having a positive emotional response to parenting and a sense of security in their role as a parent and partner early in the child’s life – corresponding to higher scores on Factor 1 and Factor 3 respectively – were less likely to exhibit behavioural problems at 9 and 11 years of age. Our analyses also show that the amount of paternal involvement with childcare and household tasks such as shopping, cleaning, cooking, and childcare activities was not associated with behavioural problems.

Our findings are consistent with previous suggestions that paternal involvement may encompass different aspects of how fathers interact with their children and partners, and these aspects potentially differ in terms of how they manifest themselves in father-child interactions, and also in their effects on child outcomes. While paternal involvement is broadly associated with a variety of positive outcomes for children – either directly or indirectly such as through resource-related benefits on health, education and general well-being – previous evidence for whether it contributes to mental health outcomes has not been consistent. For example, paternal presence and involvement in childcare [40], and shared activities, supportive behaviour and feelings of affection towards children [41] have been shown to be associated with lower likelihood of behavioural problems in 3 and 5 to 18 year olds respectively. Similarly, fathers’ involvement in childcare has been linked to cognitive outcomes in 2 to 6 year olds [42], [43]. However, other studies have found little or no evidence of an effect of fathers’ involvement in childcare on behavioural outcomes [42]–[44]. This may imply that the

amount of paternal involvement in these activities may not be as important for this outcome as the type of involvement [23].

Although we measured paternal involvement as a multi-dimensional construct, our approach did not mirror the three defining elements of an involved father – engagement, accessibility and responsibility – proposed by Lamb, Pleck and others [16]. We included in our analysis only children whose fathers (or father-figures) were present in the early years but who varied in terms of their level of financial contribution to their families; so although we attempted to ensure that the level of fathers' accessibility was approximately the same for these children, we were not able to distinguish between different levels of fathers' financial contributions. However our analysis adjusted for socio-economic differences between families based on the likely income level of both parents. This may be a better way of dealing with financial contribution in general since it is increasingly common for either or both parents to be breadwinners, and as such fathers making little or no financial contribution to their family would not necessarily imply a lack of responsibility. Further deviating from the original Lamb-Pleck conceptual framework, our analysis suggests that paternal engagement may extend beyond activities encompassing direct childcare to include those performed for the general well-being of the child and the rest of the family, including cooking, cleaning and shopping.

Positive parenting by fathers may contribute to good outcomes in children in a number of ways. Involved fathers may influence children indirectly by being a source of instrumental and emotional support to mothers who provide more of the direct care for children [23]. The potential positive effect of this on mothers' well-being and parenting strategies [45] may then lead to better outcomes in children [46]. There is evidence that fathers' involvement can also alleviate the impact of factors such as maternal depression which are known to increase children's risk of behavioural problems [47]. Greater paternal involvement may also lead to or be a manifestation of a happy and cohesive family [48], and this may bring about better outcomes in children. Social and cultural differences within and across societies may limit the generalisability of these findings.

These findings are based on observational data, and although we have adjusted for several factors known to be associated with child behaviour, we cannot rule out the possibility of residual confounding. There were also a number of sources of potential bias. For example, child behavioural outcome measures reported by mothers could have been influenced by the mothers' own mental health or her attitudes to her children which in turn could be associated with paternal involvement [49]–[51]. However in these data parent-level predictors preceded child-level outcomes by up to a decade, which is likely to have weakened this bias. We used fathers' own reports of their involvement, and this may have further reduced the potential for information bias that may arise with mother-reported measures of paternal involvement. The large sample size, detailed data on fathers'

involvement and our rigorous approach to the analysis were also a strength, particularly in exploring the multi-faceted nature of paternal involvement. Lastly, a number of plausible mechanisms of the association between paternal involvement and child behaviour support the observed associations.

There is some scope for further research to address some related questions. These include exploring the effect of paternal involvement on other mental health outcomes such as identity, self-esteem, emotional and social development, and how they vary over time. For example, the effect of paternal involvement on child behaviour may become less important over time especially in the adolescent period when other factors such as age and gender start being more influential. This could be explored using growth curve models, but would have required at least a third data point for the outcome.

**Conclusion**

The findings of this research study suggest that it is psychological and emotional aspects of paternal involvement in a child’s infancy that are most powerful in influencing later child behaviour and not the amount of time that fathers are engaged in childcare or domestic tasks in the household. How new fathers see themselves as parents, how they value their role as a parent and how they adjust to this new role, rather than the amount of direct involvement in childcare in this period, appears to be associated with positive behavioural outcomes in children.



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## Author contributions

All authors contributed to the study design. CO conducted the analysis and all authors interpreted the results. CO produced the draft manuscript to which all authors contributed and provided feedback during its development. All authors approved the final version of the manuscript and will serve as guarantors for its contents.

## Competing interests

There are no competing interests.

## Data availability

Data are available from the Avon Longitudinal Study of Parents and Children (ALSPAC) at the University of Bristol for researchers who meet the criteria for access to confidential data. The authors do not own this data, and have signed a legal agreement with the data owners not to share the data publicly. Permission to access the data is granted by the ALSPAC project at the University of Bristol. Information on data access is available at <http://www.bristol.ac.uk/alspac/researchers/data-access/>.

## Ethical approval

Ethical approval for the study was obtained from the ALSPAC Ethics and Law Committee and the Local Research Ethics Committees.

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## STROBE Statement — checklist of items that should be included in reports of observational studies

	Item	Recommendation	Included
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	Yes – p2
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	Yes – p2
<b>Introduction</b>			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	Yes – p4
Objectives	3	State specific objectives, including any prespecified hypotheses	Yes – p4
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	Yes – p4, p5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Yes – p4, p5
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	Yes – p4, p5
		<i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls	
		<i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants	
		(b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed	No – not a matched study
		<i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Yes – p6
Data sources/measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Yes – p4, p5, p6
Bias	9	Describe any efforts to address potential sources of bias	Included in description of overarching study, referenced in [28] (p5)
Study size	10	Explain how the study size was arrived at	No – not estimating effect size in this secondary analysis
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Yes – p6
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	Yes – p6
		(b) Describe any methods used to examine subgroups and interactions	Yes – p6
		(c) Explain how missing data were addressed	Yes – p6
		(d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed	Yes – p5: loss-to-follow-up was an exclusion criterion
		<i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed	
		<i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy	
		(e) Describe any sensitivity analyses	Sensitivity analysis not done

Continued on next page

Item		Recommendation	Done?
<b>Results</b>			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Yes – p5
		(b) Give reasons for non-participation at each stage	Yes – p5
		(c) Consider use of a flow diagram	Yes – p5
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Yes – p8
		(b) Indicate number of participants with missing data for each variable of interest	Yes – p8
		(c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	Yes – p6: analysis limited to 11 years
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time	Yes – p6 reported at 9 and 11 years
		<i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure	Not applicable
		<i>Cross-sectional study</i> —Report numbers of outcome events or summary measures	Not applicable
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Yes – p9, p11
		(b) Report category boundaries when continuous variables were categorized	Yes – p6: for SES in ‘Methods’
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	Not applicable
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	Yes – p9
<b>Discussion</b>			
Key results	18	Summarise key results with reference to study objectives	Yes – p11
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Yes – p11
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Yes – p11
Generalisability	21	Discuss the generalisability (external validity) of the study results	Yes – p12
<b>Other information</b>			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Yes – p14

\*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).

# BMJ Open

## Father involvement in early child-rearing and behavioural outcomes in their pre-adolescent children: evidence from the ALSPAC UK birth cohort

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Keywords:	fathers involvement, child-rearing, behavioural outcomes, ALSPAC

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Father involvement in early child-rearing and behavioural outcomes in their pre-adolescent children: evidence from the ALSPAC UK birth cohort

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**Word counts:** abstract – 300; main text – 3,361; tables – 3; figures – 1.

**Key words:** fathers involvement; child-rearing; behavioural outcomes; ALSPAC



## Abstract

*Objective:* To explore the nature of paternal involvement in early child-rearing adopting a social developmental perspective, and estimate its effect on behavioural outcomes of 9 and 11 year-olds.

*Setting:* The data come from the Avon Longitudinal Study of Parents and Children (ALSPAC) cohort recruited in the former county of Avon in the southwest of England.

*Participants:* Out of the 14,701 children in this cohort who were alive at 1 year, 10,440 children were living with both parents at 8 months and were therefore eligible. Outcome data were available for 6,898 children at 9 years and 6,328 children at 11 years.

*Main exposure:* Paternal involvement was measured using factor scores obtained through factor analysis of fathers' responses on their participation in, understanding of, and feelings about their child's early upbringing.

*Outcome:* Behavioural problems were measured using the Strengths and Difficulties Questionnaire (SDQ) total difficulties score.

*Results:* Three factors were identified in the factor analysis: Factor 1 described fathers' emotional response to the child; Factor 2 measured the frequency of fathers' involvement in domestic and childcare activities; Factor 3 characterised fathers' feelings of security in their role as parent and partner. Children of fathers with high scores on factors 1 and 3 had 14% (OR 0.86, 95%CI 0.79–0.94,  $p=0.001$ ) and 13% (OR 0.87, 95%CI 0.79–0.96,  $p=0.006$ ) respectively lower adjusted odds of behavioural problems at 9 years. Factors 1 and 3 were associated with comparable reduction in adjusted odds of behavioural problems at 11 years (OR 0.89, 95%CI 0.81–0.98,  $p=0.017$  and OR 0.89, 95%CI 0.81–0.99,  $p=0.034$  respectively). Factor 2 was not associated with the outcome.

*Conclusion:* Psychological and emotional aspects of paternal involvement in children's early upbringing, particularly how new fathers see themselves as parents and adjust to the role, rather than the quantity of direct involvement in childcare, is associated with positive behavioural outcomes in children.

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**Strengths and limitations**

*Strengths*

- The study is based on a large sample derived from detailed cohort data.
- A rigorous approach has been adopted to explore the multi-faceted nature of the main exposure.
- The study highlights the role of fathers in child development, which has been relatively under-researched.

*Limitations*

- Findings are based on observational data which is often subject to unmeasured confounding.
- The main exposure and outcome are based on self-report, which may be subject to bias.



## Introduction

In most societies, the involvement of fathers in child rearing has traditionally been framed as the role of 'provider' [1], [2] with mothers doing most of the task-oriented caring and nurturing of children. However, in recent decades social changes including the rapid increase in the proportion of working mothers [3]–[5] and changes in employment regulations such as increased paternity leave have resulted in a shift towards more of the direct parenting duties being shared by both parents [6]. Understanding the nature and effect of fathers' involvement on the health and well-being of children could therefore help inform policies aimed at improving family psychological and health outcomes.

The nature of parenting in a child's early years is thought to play an important role in influencing the child's immediate and long-term well-being and mental health, including social development [7], [8], and cognitive and educational outcomes [9]. The years of middle childhood preceding adolescence represent a developmental stage that is marked by rapid physical growth, cognitive change and the development of social awareness and skills[10]. The nature and extent of fathers' involvement in parenting may change over the course of a child's life. However, early paternal involvement is often associated with continuing engagement and may be a proxy-measure of overall engagement [11]–[13]. Early parenting can also affect outcomes later in life [14], [15]. For these reasons we were interested in whether fathers' involvement early in their child's life was associated with the child's later mental health and social development. We focused on the child's behaviour as a component of mental health because of its strong link with cognitive [16] and educational outcomes [17].

Paternal involvement, as with maternal involvement and that of the family more broadly, is multifaceted [18], [19]. It can be characterised by: fathers' *accessibility* to their children measured by their frequency of contact with the child [20], [21], co-residence with the child [20] or even presence at the child's birth [22]; their *engagement* in childcare activities such as playing, feeding and bathing [23]–[25]; and their demonstration of *responsibility* in providing for the material [25] and emotional [26] needs of their children. Nevertheless, many studies have tended to characterise paternal involvement as a unidimensional construct [27]. The failure to adopt a more multi-dimensional approach may explain why the evidence for its effect on mental health outcomes in children is unclear.

In this study we sought to first identify the multi-dimensional aspects of paternal involvement before investigating their potential influence on pre-adolescent children's behaviour. We then explored the relationship between paternal involvement in the child's upbringing at 8 weeks and 8 months postnatally and child behavioural outcomes at age 9 and 11 years, hypothesising that greater early paternal involvement would be associated with positive behavioural outcomes.

**Methods**

*Data*

Data were drawn from the Avon Longitudinal Study of Parents and Children (ALSPAC) cohort [28], [29]. It is based on a sample of children born to mothers living in the former county of Avon in the southwest of England between April 1991 and December 1992. A detailed description of the sample profile has been provided elsewhere [30], [31] and the study website contains details of all the data that is available through a fully searchable data dictionary [32].

There were 14,701 children in the total sample who were alive at 1 year. Data on 14,688 term singletons and twins who were alive at age 1 year were provided for these analyses and 13 observations on higher-order multiple births omitted from our data to preserve confidentiality. We also excluded 713 children recruited retrospectively when the children in the original core sample were around 7 years old (Phase II and Phase III recruitment) and 3,535 children whose mothers did not live with (or report living with) a partner at 8 months. Out of the remaining 10,440 eligible children, the analysis was based on 6,898 and 6,328 children whose mothers completed the SDQ questionnaires at age 9 and 11 years respectively (Figure 1).

*Figure 1: Sample profile of the children included in the analysis*

*Outcome, exposure and potential confounder variables*

Data were collected using self-completion questionnaires sent to mothers and their partners after recruitment and when the child was aged 8 weeks, 8 months, 9 years and 11 years. The questionnaires asked about mental health, parenting and childcare, behaviour, socio-economic status of parents, and child development.

The outcome was the child's behaviour measured by the Strengths and Difficulties Questionnaire (SDQ) completed by the mother [33]. This tool has 5 sub-scales, namely 'emotional symptoms', 'conduct problems', 'hyperactivity', 'peer relationship problems' and 'prosocial behaviour'. Each scale is made up of 5 items giving a total of 25 items. The items are statements about psychological attributes, some positive (e.g. 'considerate of other people's feelings' and 'kind to younger children') and others negative (e.g. 'restless, overactive, cannot stay still for long' and 'nervous or clingy in new situations, easily loses confidence'). One of three ordered responses are given to each question: 0 ('not true'), 1 ('somewhat true') or 2 ('certainly true'). These are then summed up to obtain the scale scores and the total SDQ score. In our analyses we used the SDQ total difficulty score derived by summing up the scores of the first 4 scales of the SDQ [34] measured at age 9 and 11 years.

Paternal involvement was measured by asking fathers to rate their level of agreement – on 3 to 6-point ordinal scales – with items developed exclusively for the study by the ALSPAC study team and not drawn from an existing scale. We identified and selected 58 statements based on paternal report which reflected direct care and associated household tasks, fathers' attitudes to parenting, relationship with child, and fathers' moods and feelings in the post-partum period at 8 weeks (37 items) and 8 months (21 items) after the birth of the child.

Data on other factors measured after recruitment which, according to the literature [35]–[40], were potentially associated with the main outcome and/or exposure were also obtained including parental age, level of education (O-level/CSE/vocational training, A-level or university degree), depression symptoms measured 8 weeks postnatally on the Edinburgh Postnatal Depression Scale (EPDS) [41], socio-economic status derived from self-reported occupation using the Computer Assisted Structured Coding Tool (CASCOT) and coded into quintiles from 1 (lowest) to 5 (highest) [42], number of hours worked in the current or most recently held job, and child's age and gender.

### Analysis

Exploratory factor analysis (EFA) was performed on the items measuring fathers' direct care and associated household tasks, attitudes, relationship with child, and moods and feelings in the early months. Factors identified in this analysis were deemed to represent key aspects of paternal involvement. Next, confirmatory factor analysis (CFA) was undertaken to check whether the factor structure identified during EFA was a good fit for the data. To improve the fit of the CFA model items that loaded on more than one factor were removed from further analysis, as were items with low factor loadings (less than 0.3), because they were deemed to be poor measures of the underlying construct [43]. Once a well-fitting factor structure was identified, factor scores for each of the identified aspects of paternal involvement were calculated. Factor scores are standard normal estimates of each individual's relative position in the continuum of the latent characteristic being measured. They were calculated as the maximum of the posterior distribution (MAP) of the latent factors given the observed and unobserved responses corresponding to the individual [44]. Factor scores so derived yield unbiased regression slopes when used as predictors in models [45]. Labels corresponding to the construct represented by the items underpinning each factor were then attributed to the factor scores to facilitate interpretation of the results.

To explore the association between paternal involvement and behavioural outcomes a two-step procedure was undertaken. First, univariable ordered logistic regression models of SDQ total difficulties scores on the factor scores and paternal, maternal and child covariates were fitted to identify the factors which were associated with the outcome. Next, all factors found to be independently associated

with SDQ score (likelihood ratio p-values less than 5%) were included in a multivariable model, retaining only those factors for which there was still evidence of association with the outcome even after adjustment. Potential differences in association for boys and girls were explored by fitting and testing interaction terms for gender. Separate models were fitted for SDQ measured at 9 and 11 years.

Missing data were dealt with in three ways. Firstly, the MAP estimation of factor scores allowed for the partial recovery of information contained in unobserved paternal involvement items. Secondly, missing data in SDQ component items were handled by prorating scale scores for up to two missing responses out of the five items in each scale [34]. It is a single imputation procedure which replaces an individual's missing item scores with the mean score for the scale to which the missing item belongs. Thirdly, missing values of covariates in the multivariable regression modelling were assumed to be missing completely at random. Multiple imputation was performed to recover the information contained in these missing values, with ten imputed datasets used to obtain the final estimates.

The proportional odds assumption underpinning the ordered logistic regression models was examined using the Brant test with  $\chi^2$  p-values less than 5% interpreted as a violation of this assumption [46]. Data management and manipulation were performed using Stata v13 [47]. Analyses were run in Stata v13 and MPlus v7 [48].

**Results**

The characteristics of the samples at 9 years and 11 years were very similar (Table 1). Overall there were slightly more boys than girls. Fathers were on average aged 31 years and educated to O-level or CSE (examinations completed in the final year of compulsory schooling at age 16 years) or had some vocational (skills) training. They reported working about 45 hours per week in their current or most recent job around the time when the child was 8 months old and had low depression scores on the EPDS. Mothers were on average 2 years younger than the fathers, were educated to a similar level, had slightly higher EPDS scores than fathers, and had 1 child prior to the one included in the study. Parents tended to be in similar SES categories. Most children had low total difficulties scores, with medians of 6 and 5 at the two respective time points.

Table 1: Characteristics of the parents and children included in the samples at the two time points

	9 years [n = 6,898]	11 years [n = 6,328]
<b>Fathers</b>		
Age in years 18 weeks after birth of child, mean (SD)	31.27 (5.4)	31.30 (5.4)
Highest level of education, n (%)		
O-level, CSE <sup>1</sup> or vocational	3,021 (43.8%)	2,758 (43.6%)
A-level <sup>2</sup>	1,482 (21.5%)	1,366 (21.6%)
University degree	1,048 (15.2%)	1,002 (15.8%)
Missing	1,347 (19.5%)	1,202 (19.0%)
Hours worked per week, mean (SD)	44.83 (9.8)	44.77 (9.9)
EPDS <sup>3</sup> score, median (IQR)	3 (1 – 6)	3 (1 – 6)
SES <sup>4</sup> category, n (%)		
1 – lowest	138 (2.0%)	122 (1.9%)
2	499 (7.2%)	453 (7.2%)
3	2,516 (36.5%)	2,297 (36.3%)
4	2,361 (34.2%)	2,184 (34.5%)
5 – highest	875 (12.7%)	823 (13.0%)
Missing	509 (7.4%)	449 (7.1%)
<b>Mothers</b>		
Age in years at birth of child, mean (SD)	29.30 (4.4)	29.33 (4.4)
Highest level of education, n (%)		
O-level, CSE or vocational	2,564 (37.2%)	2,317 (36.6%)
A-level	1,665 (24.1%)	1,564 (24.7%)
University degree	1,413 (20.5%)	1,329 (21.0%)
Missing	1,256 (18.2%)	1,118 (17.7%)
Parity, median (IQR)	1 (0 – 1)	1 (0 – 1)
EPDS score, median (IQR)	5 (2 – 8)	5 (2 – 8)
SES category, n (%)		
1 – lowest	86 (1.3%)	79 (1.3%)
2	443 (6.4%)	417 (6.6%)
3	2,844 (41.2%)	2,613 (41.3%)
4	2,099 (30.4%)	1,926 (30.4%)
5 – highest	441 (6.4%)	423 (6.7%)
Missing	985 (14.3%)	870 (13.6%)
<b>Children</b>		
Mean age difference in months, mean (SD)	0.00 (5.8)	0.00 (5.8)
Gender, n (%)		
Boys	3,499 (50.7%)	3,170 (50.1%)
Girls	3,399 (49.3%)	3,158 (49.9%)
SDQ <sup>5</sup> total difficulties score, median (IQR)	6 (3 – 9)	5 (3 – 9)
1. O-level and CSE were the national exams which students in England sat in their last year of compulsory school education at age 16 2. A-levels are pre-university examinations 3. EPDS is the Edinburgh Postnatal Depression Scale 4. SES is socioeconomic status, derived from the Computer-assisted structured coding tool (CASCOT) 5. SDQ is the Strengths and Difficulties Questionnaire		

There were complete responses to the 58 paternal involvement questions for between 4,560 and 5,381 children at 8 weeks and 8 months. A total of 45 out of the 58 items reflecting paternal involvement were included in the exploratory factor analysis. Reasons for exclusion of 13 items were: high uniqueness coefficients of greater than 0.9 affecting 8 items; low loadings on the retained factors affecting 1 item;

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large amounts of missing data – more than 50% – affecting 3 items; and similarity between two items leading to one of them being dropped. Table 2 presents the results of the exploratory factor analysis.

Three factors of paternal involvement, explaining 66.0% of the total variance in included items, were identified: items in the first factor, explaining 31.4% of total variance, described fathers’ emotional response to the baby and their parenting role; items in the second factor, explaining 17.7% of total variance, measured fathers’ level of engagement in domestic and childcare activities; and items in the third factor, explaining 16.9% of total variance, characterised fathers’ security in their role as a parent and partner. Confirmatory factor analysis, which excluded cross-loading items (since this implies that they poorly discriminate between factors [49]), showed this factor structure to be an acceptable representation of the correlations between items in the data (CFI = 0.916, TLI = 0.911, RMSEA = 0.065).

Unadjusted ordered logistic regression showed strong evidence that the first and third factor scores were associated with the outcome (Table 3). Children of fathers whose responses corresponded to higher Factor 1 scores had 21% and 19% reductions in proportional odds of higher SDQ total difficulty scores at ages 9 and 11 respectively, and children of fathers whose responses corresponded to higher Factor 3 scores had 28% reduction in proportional odds of higher SDQ total difficulty scores at both times. Other factors were also found to be associated with the outcome. Specifically, higher parental age, level of education and SES category were associated with reduced proportional odds of higher behavioural difficulty scores, while more hours worked per week, higher EPDS scores, child’s age and male gender were associated with poorer behavioural outcomes.

Multivariable models adjusting for these potential confounders were fitted, with multiple imputation of missing values of covariates. The adjusted proportional odds of higher behavioural problems scores were 15% lower at 9 years and 12% lower at 11 years per unit increase in Factor 1 scores and 12% lower at 9 years and 10% lower at 11 years per unit increase in Factor 3 scores, comparing children of the same age and gender, family size, socio-economic status, who were exposed to the same level of parental depression (Table 3). There was no evidence of a difference in the effect of paternal involvement in boys versus girls; p-values for interaction of child’s gender with Factor 1 and with Factor 3 were 0.907 and 0.864 respectively in models of the outcome at 9 years, and 0.189 and 0.918 respectively at 11 years. The proportional odds assumption was not violated in these models; Brant test p-values were 0.078 and 0.050 for models on data at 9 years and 0.316 and 0.514 on models at 11 years.



Table 2: Exploratory factor analysis on the indicators of paternal involvement

Indicator	Rotated loadings*		
	Factor 1	Factor 2	Factor 3
Helped with shopping since birth		0.4891	
Helped with cleaning home since birth		0.7112	
Helped with meal preparation since birth		0.7013	
Helped with washing up since birth		0.6077	
Helped with housework since birth		0.7573	
Helped with cooking meals since birth		0.6882	
Helped with clothes wash since birth		0.5878	
How frequently partner changes nappy per week		0.5178	
How frequently partner bathes child per week		0.4293	
How frequently partner plays with child per week	0.4324	0.4107	
How frequently partner walks child outside per week		0.4284	
How frequently partner puts child to bed per week		0.4225	
How frequently partner feeds/helps at night per week		0.4294	
Mum excludes partner from childcare			0.7346
Feel confident with child	0.3857		-0.3201
Feel mum does not trust partner with child			0.6817
Happy with the way mum brings up child	0.3652		-0.4507
Happy with the way partner brings up child	0.5094		-0.4468
Making a strong bond with child	0.6147		
My stress is a bad influence on child	-0.3728		0.4486
Home is woman's place, no part for me		-0.3643	0.3871

Indicator	Rotated loadings*		
	Factor 1	Factor 2	Factor 3
Partner always getting under mum's feet			0.4928
Mum dislikes partner being involved with child			0.7315
Partner guilty at not enjoying child	-0.5480		0.4373
Partner regrets having child	-0.6553		
Partner regrets lack of experience of children			0.3160
This child has made partner more fulfilled	0.6465		
Parenthood has made partner and mum closer	0.5038		
Mum no longer gives partner attention			0.5413
Feel hurt by attention mum gives child			0.5760
Partner well prepared for birth and childcare			-0.3166
Partner enjoys getting home to see mum & child	0.6307		
Enjoy the baby	0.8294		
Preferred not to have had baby	-0.5550		
Feel confident with baby	0.5776		
Dislike mess surrounding baby	-0.3707		
Pleasure watching baby develop	0.8240		
Find baby crying unbearable	-0.3836		
Constantly unsure whether doing right thing			0.3160
Feel should enjoy baby but am not	-0.6869		
No time to self	-0.4583		
Baby made feel more fulfilled	0.7315		
Feel babies are fun	0.8185		
Talking to baby is important	0.4211		
Cuddling baby is very important	0.4612		

\*Displaying only loadings greater than 0.3

Table 3: Unadjusted and adjusted proportional odds ratios for the effect of paternal involvement on SDQ scores at ages 9 and 11 years, with 95% confidence intervals and p-values

Paternal involvement factor scores	9 years		11 years	
	Unadjusted [n = 5,717]	Adjusted* [n = 6,223]	Unadjusted [n = 5,262]	Adjusted* [n = 5,500]
Factor 1: “emotional response to baby and parenting”	0.79 0.73 – 0.86 <0.001	0.86 0.79 – 0.94 0.001	0.81 0.74 – 0.88 <0.001	0.89 0.81 – 0.98 0.017
Factor 2: “engagement in domestic and childcare activities”	1.01 0.90 – 1.14 0.854	–	1.09 0.97 – 1.24 0.160	–
Factor 3: “security in role as parent and partner”	0.72 0.66 – 0.78 <0.001	0.87 0.79 – 0.96 0.006	0.72 0.66 – 0.79 0.001	0.89 0.81 – 0.99 0.034

\*Adjusting for paternal and maternal EPDS score, parity, maternal age, family SES score, child’s age and child’s gender

Discussion

This analysis of data from over 6,000 fathers and children in the south-west of England characterised the nature of paternal involvement in early child upbringing and explored its effects on behavioural outcomes in pre-adolescent children. We found that the children of fathers whom we characterised as having a positive emotional response to parenting and a sense of security in their role as a parent and partner early in the child’s life – corresponding to higher scores on Factor 1 and Factor 3 respectively – were less likely to exhibit behavioural problems at 9 and 11 years of age. These factors may reflect ways of behaving and interacting that are a marker of favourable parental characteristics and positive parenting in the longer term. Our analyses also show that the amount of paternal involvement with childcare and household tasks such as shopping, cleaning, cooking, and childcare activities was not associated with later child behavioural problems. This may be because provision of more direct childcare by fathers may simply reflect temporary circumstances and needs, for example, the absence of extended family support and type of partner employment.

Our findings are consistent with previous suggestions that paternal involvement may encompass different aspects of how fathers interact with their children and partners, and these aspects potentially differ in terms of how they manifest themselves in father-child interactions, and also in their effects on child outcomes. While paternal involvement is broadly associated with a variety of positive outcomes for children – either directly or indirectly such as through resource-related benefits on health, education and general well-being – previous evidence for whether it contributes to mental health outcomes has not been consistent. For example, paternal presence and involvement in childcare [50], and shared activities, supportive behaviour and feelings of affection towards children [51] have been shown to be associated with lower likelihood of behavioural problems in 3 and 5 to 18



year olds respectively. Similarly, fathers' involvement in childcare has been linked to cognitive outcomes in 2 to 6 year olds [52], [53]. However, as in this study, others have found little or no evidence of an effect of fathers' involvement in childcare on behavioural outcomes [52]–[54], suggesting that the amount of paternal involvement in these activities may not be as important for this outcome as the type of involvement and attitudes towards parenting [26].

Although we measured paternal involvement as a multi-dimensional construct, our approach did not mirror the three defining elements of an involved father – engagement, accessibility and responsibility – originally proposed by Lamb, Pleck and others in 1985 [19]. We included in our analysis only children whose fathers (or father-figures) were present in the early years but who varied in terms of their level of financial contribution to their families, and as such were not able to distinguish between different levels of fathers' financial contributions. However our analysis adjusted for socio-economic differences between families based on the likely income level of both parents. This may be a better way of dealing with financial contribution in general since it is increasingly common for either or both parents to be breadwinners, and as such fathers making little or no financial contribution to their family would not necessarily imply a lack of responsibility. Further deviating from the original Lamb-Pleck conceptual framework, our analysis suggests that paternal involvement may extend beyond activities encompassing direct childcare to associated activities and fathers' attitudes towards the child and themselves as parents.

Positive parenting by fathers may contribute to good outcomes in children in a number of ways. Involved fathers may influence children indirectly by being a source of instrumental and emotional support to mothers who provide more of the direct care for children [26]. The potential positive effect of this on mothers' well-being and parenting strategies [55] may then lead to better outcomes in children [56]. There is evidence that fathers' involvement can also alleviate the impact of factors such as maternal depression which are known to increase children's risk of behavioural problems [57]. Greater paternal involvement may also lead to or be a manifestation of a happy and cohesive family [58], and this may bring about better outcomes in children. Social and cultural differences within and across societies may limit the generalisability of these findings.

There are several limitations to this study. The nature of paternal involvement continues to evolve over time, and because this study is based on a cohort which was born 25 years ago there may be a limit to how generalizable its findings are to the present day. This was an analysis of observational data, and although we have adjusted for several factors known to be associated with child behaviour, we cannot rule out the possibility of residual confounding. There were a number of sources of potential bias. For example, child behavioural outcome measures reported by mothers could have been influenced by the mothers' own mental health or her attitudes to her children which in turn

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could be associated with paternal involvement [59]–[61]. However in these data parent-level predictors preceded child-level outcomes by up to a decade, which is likely to have weakened this bias. We used fathers’ own reports of their involvement, and this may have further reduced the potential for information bias that may arise with mother-reported measures of paternal involvement. The large sample size, detailed data on fathers’ involvement and our rigorous approach to the analysis were also a strength, particularly in exploring the multi-faceted nature of paternal involvement. Lastly, a number of plausible mechanisms of the association between paternal involvement and child behaviour support the observed associations.

While acknowledging the impact of both parents on children’s development and outcomes, there is scope for further research to address some related questions concerning the role of fathers. These include exploring the effect of paternal involvement on other mental health outcomes such as identity, self-esteem, emotional and social development, and how they vary over time. For example, the effect of paternal involvement on child behaviour may become less important over time especially in the adolescent period when peer relationships and other factors such as age and gender start being more influential. This could be explored using growth curve models, but would require further outcome data points.

**Conclusion**

The findings of this research study suggest that it is psychological and emotional aspects of paternal involvement in a child’s infancy that are most powerful in influencing later child behaviour and not the amount of time that fathers are engaged in childcare or domestic tasks in the household. How new fathers see themselves as parents, how they value their role as a parent and how they adjust to this new role, rather than the amount of direct involvement in childcare in this period, appears to be associated with positive behavioural outcomes in children.

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## Author contributions

All authors contributed to the study design. CO conducted the analysis and all authors interpreted the results. CO produced the draft manuscript to which all authors contributed and provided feedback during its development. All authors approved the final version of the manuscript and will serve as guarantors for its contents.

## Competing interests

There are no competing interests.

## Data availability

Data are available from the Avon Longitudinal Study of Parents and Children (ALSPAC) at the University of Bristol for researchers who meet the criteria for access to confidential data. The authors do not own this data, and have signed a legal agreement with the data owners not to share the data publicly. Permission to access the data is granted by the ALSPAC project at the University of Bristol. Information on data access is available at <http://www.bristol.ac.uk/alspac/researchers/data-access/>.

## Ethical approval

Ethical approval for the study was obtained from the ALSPAC Ethics and Law Committee and the Local Research Ethics Committees.

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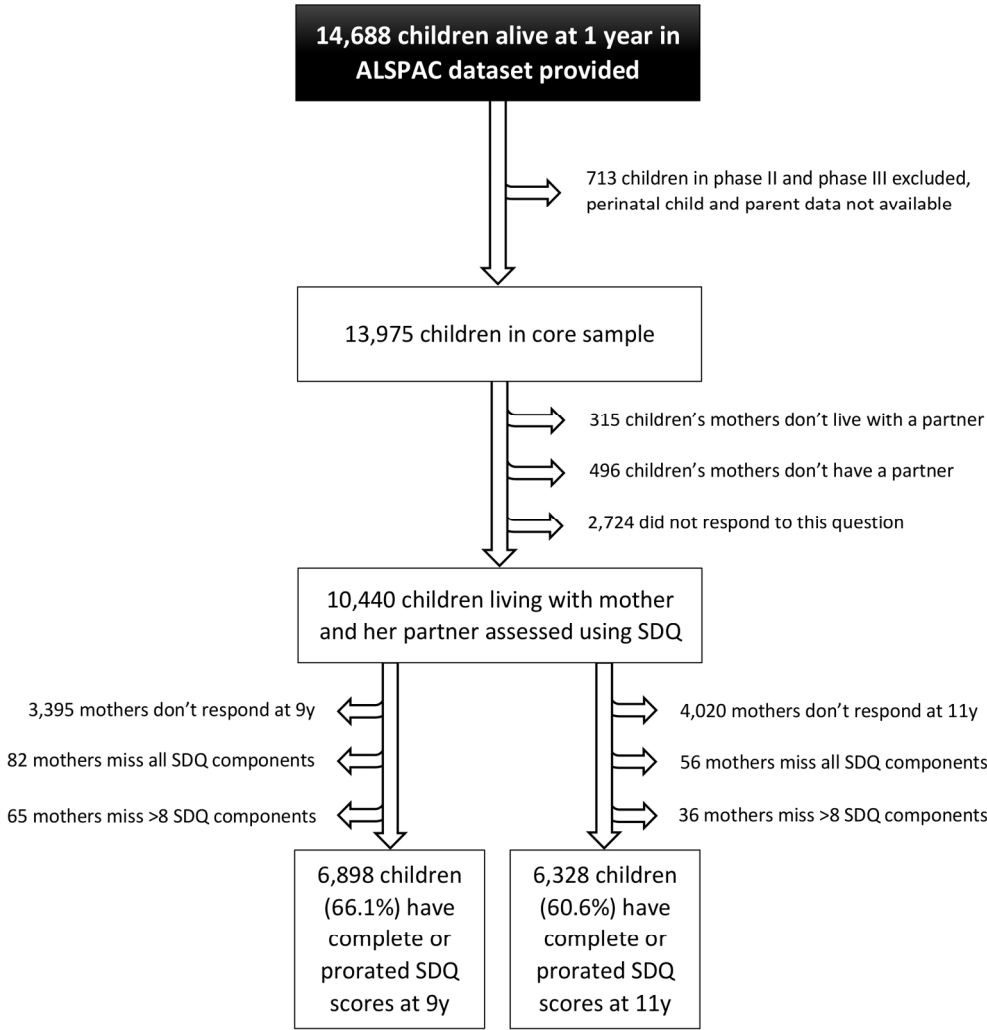
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## STROBE Statement — checklist of items that should be included in reports of observational studies

Section	Item	Recommendation	Included
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	Yes – p2
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	Yes – p2
<b>Introduction</b>			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	Yes – p4
Objectives	3	State specific objectives, including any prespecified hypotheses	Yes – p4
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	Yes – p5, p6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Yes – p5, p6
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants	Yes – p5, p6
		(b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case	No – not a matched study
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Yes – p5, p6
Data sources/measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Yes – p5, p6, p7
Bias	9	Describe any efforts to address potential sources of bias	Included in description of overarching study, referenced in [28] (p5)
Study size	10	Explain how the study size was arrived at	No – not estimating effect size in this secondary analysis
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Yes – p6, p7
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	Yes – p6, p7
		(b) Describe any methods used to examine subgroups and interactions	Yes – p6, p7
		(c) Explain how missing data were addressed	Yes – p6, p7
		(d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy	Yes – p5: loss-to-follow-up was an exclusion criterion
		(e) Describe any sensitivity analyses	Sensitivity analysis not done

Continued on next page

Section	Item	Recommendation	Done?
<b>Results</b>			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Yes – p5
		(b) Give reasons for non-participation at each stage	Yes – p5
		(c) Consider use of a flow diagram	Yes – p5
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Yes – p8, p9
		(b) Indicate number of participants with missing data for each variable of interest	Yes – p9
		(c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	Yes – p5: analysis limited to 11 years
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time	Yes – p5 reported at 9 and 11 years
		<i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure	Not applicable
		<i>Cross-sectional study</i> —Report numbers of outcome events or summary measures	Not applicable
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Yes – p9, p11
		(b) Report category boundaries when continuous variables were categorized	Yes – p6: for SES in ‘Methods’
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	Not applicable
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	Yes – p9
<b>Discussion</b>			
Key results	18	Summarise key results with reference to study objectives	Yes – p11
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Yes – p12, p13
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Yes – p11, p12
Generalisability	21	Discuss the generalisability (external validity) of the study results	Yes – p13
<b>Other information</b>			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Yes – p14

\*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).