

## ORIGINAL ARTICLE

## Breast feeding in infancy and social mobility: 60-year follow-up of the Boyd Orr cohort

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*Arch Dis Child* 2007;**92**:317–321. doi: 10.1136/adc.2006.105494**Objective:** To assess the association of having been breast fed with social class mobility between childhood and adulthood.**Design:** Historical cohort study with a 60-year follow-up from childhood into adulthood.**Setting:** 16 urban and rural centres in England and Scotland.**Participants:** 3182 original participants in the Boyd Orr Survey of Diet and Health in Pre-War Britain (1937–39) were sent follow-up questionnaires between 1997 and 1998. Analyses are based on 1414 (44%) responders with data on breast feeding measured in childhood and occupational social class in both childhood and adulthood.**Main outcome:** Odds of moving from a lower to a higher social class between childhood and adulthood in those who were ever breast fed versus those who were bottle fed.**Results:** The prevalence of breast feeding varied by survey district (range 45–86%) but not with household income ( $p=0.7$ ), expenditure on food ( $p=0.3$ ), number of siblings ( $p=0.7$ ), birth order ( $p=0.5$ ) or social class ( $p=0.4$ ) in childhood. Participants who had been breast fed were 41% (95% CI 10% to 82%) more likely to move up a social class in adulthood ( $p=0.007$ ) than bottle-fed infants. Longer breastfeeding duration was associated with greater odds of upward social mobility in fully adjusted models ( $p$  for trend=0.003). Additionally controlling for survey district, household income and food expenditure in childhood, childhood height, birth order or number of siblings did not attenuate these associations. In an analysis comparing social mobility among children within families with discordant breastfeeding histories, the association was somewhat attenuated (OR 1.16; 95% CI 0.74 to 1.8).**Conclusions:** Breast feeding was associated with upward social mobility. Confounding by other measured childhood predictors of social class in adulthood did not explain this effect, but we cannot exclude the possibility of residual or unmeasured confounding.

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Breast feeding in infancy may confer a number of health-related benefits. In the short-term, breastfed infants are at lower risk of infectious morbidity and mortality in both developing and industrialised settings.<sup>1–2</sup> In the longer term, breast feeding is positively associated with height,<sup>3–4</sup> may protect against several chronic diseases and their risk factors,<sup>5–7</sup> and is related to higher IQ,<sup>8–9</sup> improved eyesight<sup>10</sup> and lower risk of psychiatric disorders.<sup>11</sup>

If breast feeding improves health, stature and IQ, breastfed infants might be more likely to show upward social mobility (movement up the social class hierarchy during the course of life) compared with those who were not breast fed, as better health,<sup>12–13</sup> greater stature<sup>14</sup> and higher IQ<sup>15–16</sup> are associated with more favourable educational and occupational outcomes. We tested this hypothesis in the Boyd Orr cohort, a long-term follow-up of people born in the 1920s and 1930s in England and Scotland.<sup>17</sup> As in other studies from this era, there was little evidence of an association between social class in childhood and breast feeding in infancy in this cohort.<sup>3</sup> Thus, any association between breast feeding and upward social mobility is less likely to be explained by socioeconomic predictors of being breast fed that could in turn influence future social class.

## METHODS

The study is an historical cohort based on the Carnegie (Boyd Orr) Survey of Diet and Health in Pre-War Britain, 1937–39.<sup>18</sup> A total of 4999 children, aged 0–19 years, from 1343 families were surveyed at 16 centres in England and Scotland. Of the original participants, 4379 (88%) have been traced and flagged using the National Health Service Central Register (NHSCR). The

mean age of traced subjects at the time of the original pre-War survey was 7.1 years (SD 4.1 years; range 24 days to 19.6 years). Between 1997 and 1998, all 3182 surviving members of the Boyd Orr cohort traced at the NHSCR were sent health and lifestyle questionnaires—that is, 58–60 years after the original survey, when participants were aged between 58 and 79 years.<sup>19</sup> After two reminders, a total of 1648 completed questionnaires were returned (52% response).

For 1472 (89%) of the questionnaire responders, a record of infant feeding method was obtained from the mother at the time of the original survey.<sup>18</sup> We coded subjects as ever breast fed (at least 2 weeks) or exclusively bottle fed; for ever breastfed infants, we coded breastfeeding duration as: 2 weeks–2 months;  $\geq 2$ –<6 months;  $\geq 6$ –<12 months;  $\geq 12$  months; and unknown. Social class in childhood was determined from the occupation of the male head of the household at the time of the original survey (three categories: I/II, professional and managerial; III, skilled; IV/V, partly skilled, unskilled, other, unemployed and unclassifiable), classified according to the Registrar General's Decennial Supplement for 1931.<sup>20</sup> Social class in adulthood was based on the main employment of the subject (for men and unmarried women) or spouse (women), classified using the 1966 Classification of Occupations. Survey district, childhood height, number of siblings, birth order (based on the child's position among children in the household at the time of the survey<sup>3</sup>), per capita weekly household food expenditure and per capita weekly income in childhood (the latter two variables were coded in four categories as described previously<sup>3</sup>) were obtained from the original survey material.<sup>18</sup> A total of 1414 participants (44%

of potentially eligible participants) had data on social class in both childhood and adulthood and on breast feeding in infancy. Ethical approval for the revitalisation of the Boyd Orr study was provided by the United Bristol's Hospital Trust Local Research Ethics Committee.

## ANALYSIS

The distribution of breast feeding by categorical variables was compared using  $\chi^2$  tests. The variable social class mobility was derived from the childhood and adulthood social class of each participant. Those whose social class stayed the same in childhood and adulthood or who moved down at least one level of social class (ie, became less advantaged) between childhood and adulthood were coded as 0 and those who moved up at least one level of social class between childhood and adulthood (ie, became more advantaged) were coded as 1. The odds of upward social class mobility between childhood and adulthood for those who were breast fed versus those who were bottle fed was investigated by multivariable logistic regression. Robust standard errors were calculated to account for lack of independence between observations within families. We also repeated the analysis using ordinal logistic regression to test whether the results were robust to the use of a more refined measure of the outcome (coded as "moves down", "stays same" or "moves up").

The following sequentially adjusted models were developed: (1) controlling for age and sex; (2) additionally controlling for original survey district, as breast feeding was strongly geographically patterned in this cohort<sup>3</sup> and district of origin may have influenced social mobility; (3) additionally controlling for the following variables in childhood: weekly household income and food expenditure, height and number of siblings, as these factors were associated with breast feeding in multivariable models<sup>3</sup> and may have influenced social mobility.

We did not adjust for the participants' own educational level, as this variable may well be on the causal pathway—for example, if breast feeding improves IQ in childhood and this association in turn influences educational level and then subsequent social class. We did not have any direct measure of IQ, but we investigated whether educational level could be on the causal pathway, by (1) testing associations of breast feeding and a crude measure of education level based on the 1997–1998 questionnaire (no qualification, apprenticeship/clerical qualification, secondary school/college, first degree and higher degree); and (2) testing whether associations of breast feeding with social mobility were attenuated after controlling for educational level.

To further investigate the potential for confounding by shared environmental exposures other than breast feeding, the association between breast feeding and social class mobility was also estimated in the subset of families who had at least one pair of children discordant for breastfeeding status (within-family analysis). To assess the sensitivity of our conclusions to missing data, we repeated the analyses with inverse probability weighting.<sup>21</sup> This gives greater weight in the analysis to participants with an increased probability of missing observations and is based on developing a model predicting inclusion in the analysis. The following variables measured at baseline in childhood were included in the model predicting missing data: breastfeeding status, age at the time of the original survey, survey district, social class of the head of the household, per capita weekly family food expenditure and per capita weekly family income. Analyses were conducted using STATA V.9.

## RESULTS

Response rates to the 1997–1998 survey were similar among those breast fed and bottle fed ( $p = 0.97$ ). Those in social

classes IV and lower in childhood were 54% more likely to be non-responders (95% CI 31% to 82%,  $p < 0.001$ ) than social classes I–III, but there was no evidence that this socially patterned response rate differed among those who were breast fed compared with bottle fed ( $p$  for interaction = 0.15). The mean age of the 1414 participants was 6.7 years (interquartile range (IQR) 3.2–9.9) at the time of the original survey, and did not differ by whether subjects were breast fed or bottle fed ( $p = 0.5$ ; table 1). The prevalence of ever having been breast fed was 70% ( $n = 995$ ) and did not differ by sex ( $p = 0.5$ ). Of those who were breast fed, duration of breast feeding was recorded for 682 (69%), of whom 29% were breast fed for up to 6 months, 60% for 6–12 months and 11% for >12 months. As reported previously for the whole cohort, the prevalence of breast feeding varied by survey district<sup>3</sup> (range in this sample 45–86%). There was no association between breast feeding and household income ( $p = 0.7$ ), expenditure on food ( $p = 0.3$ ), number of siblings ( $p = 0.7$ ), birth order ( $p = 0.5$ ) or social class ( $p = 0.4$ ) in childhood (table 1). Those in the highest social classes in adulthood, however, were more likely to have been breast fed during infancy than those in the lowest social classes ( $p = 0.02$ ), and 58% of those breast fed moved up a social class level versus 50% of those who were bottle fed ( $p = 0.004$ ). Participants who were breast fed were 41% (95% CI 10% to 82%) more likely to move up a social class if they were breast fed during infancy than if bottle fed ( $p = 0.007$ ; table 2). Additionally controlling for original survey district or for original survey district and weekly food expenditure in childhood made little difference to the age and sex adjusted OR. Among 867 participants with additional data on number of siblings, birth order, height and household income in childhood, effect estimates were similar before (OR 1.62; 95% CI 1.2 to 2.19) and after (1.66; 1.22 to 2.26) also controlling for these additional factors. Results were the same if social mobility was based on a childhood social class variable that excluded those participants whose fathers were unemployed and unclassifiable ( $n = 929$ ). Longer duration of breast feeding was associated with increased odds of upward social mobility in fully adjusted models. Although there was statistical evidence for a linear trend with ever breast fed <6 months as baseline ( $p = 0.003$ ), the data do not suggest any additional benefit from breast feeding >6–12 months (table 2).

In a sensitivity analysis using the more refined measure of the outcome, we found that 61% of those who moved down a social class were breast fed, whereas 68% of those who stayed in the same class and 74% of those who moved up ( $p$  for heterogeneity = 0.007) were breast fed. In an ordinal logistic regression model, controlling for age and sex, the OR for the association of breast feeding with social mobility measured as this 3 level outcome was 1.44 (95% CI 1.15 to 1.8;  $p = 0.001$ ), and in the fully adjusted model the OR was 1.45 (95% CI 1.16 to 1.82;  $p = 0.001$ ). These data indicate that the results are robust to our categorisation of the outcome.

We found some evidence that those who were breast fed were more likely to achieve at least a secondary school qualification (27%) compared with those who were bottle fed (20%;  $p = 0.02$ ; table 1). In a model controlling for age, sex, childhood household food expenditure and childhood social class, breastfed infants were 56% (95% CI 7% to 126%) more likely to achieve at least a secondary school qualification compared with those who were bottle fed ( $p = 0.02$ ; in the basic age and sex adjusted model the OR was 1.50; 95% CI 1.06 to 2.13). In an analysis among those with information about education level ( $n = 1012$ ), the proportionate effect of breast feeding in relation to social mobility was attenuated by 18% (from an OR of 1.33 to 1.27) after additionally controlling for educational level.

**Table 1** Characteristics of the cohort

	Breast fed (n = 995)	Bottle fed (n = 419)	p Value
Age when assessed in childhood (mean, IQR)	6.7 (3.2 to 10)	6.6 (3.3 to 9.2)	0.5
Male	47%	45%	0.5
Social class in childhood			
I/II	7%	9%	0.4
III	20%	22%	
IV/V/other*	72%	69%	
Per capita weekly household income in childhood†			
<10s	68%	71%	0.7
10–15s	21%	19%	
>15–20s	5%	5%	
>20s	6%	6%	
Per capita weekly household expenditure on food in childhood‡			
<4s 11.75d	51%	56%	0.3
5s–6s 11.75d	28%	25%	
7s–8s 11.75d	13%	11%	
>9s	8%	9%	
Number of siblings (median, IQR)	4 (3–6)	4 (3–6)	0.7
Height in childhood, SD score (mean, IQR)	0.12 (–0.52–0.69)	0.02 (–0.63–0.62)	0.14
Birth order¶			
1	22%	26%	0.5
2	24%	23%	
3	19%	18%	
≥4	34%	33%	
Participant's own education level††			
Apprenticeship/clerical qualification or less	73%	80%	0.02
Secondary school or more	27%	20%	
Social class in adulthood			
I/II	28%	22%	0.02
III	46%	46%	
IV/V/other*	26%	32%	
Social mobility between childhood and adulthood			
Same or moved down	42%	50%	0.004
Moved up	58%	50%	

IQR, interquartile range.

\*Unemployed or unclassifiable.

†Income per head per week in shillings (s) as recorded in the original survey, but with the original last 3 groups collapsed into a single category (n = 1398; breast fed = 988, bottle fed = 410).

‡Shillings and pence per head per week spent on food as recorded in the original survey, but with the original last 3 groups collapsed into a single category.

¶Birth order based on the child's position among children in the household at the time of the survey (n = 1322; breast fed = 927, bottle fed = 395).

††n = 1024; breast fed = 741, bottle fed = 283.

**Table 2** Multivariable logistic regression analysis of social mobility in relation to ever having been breast fed and breast feeding duration in infancy (n = 1414)

	OR (95% CI)	p Value
Ever breast fed vs bottle fed		
Adjusted for age and sex	1.41 (1.1 to 1.82)	0.007
Adjusted for age, sex and survey district	1.4 (1.08 to 1.8)	0.01
Adjusted for age, sex, survey district and per capita weekly food expenditure in childhood*	1.41 (1.09 to 1.82)	0.008
Duration of breast feeding vs bottle fed†		
Breast fed <6 months	0.82 (0.57 to 1.18)	—
Breast fed 6–12 months	1.53 (1.12 to 2.1)	—
Breast fed >12 months	1.54 (0.9 to 2.63)	—
p Value for trend‡	—	0.003

\*Further adjustment for income group, childhood height, birth order or number of siblings in a sub-group made no material difference to the effect estimate.

†Adjusted for age, sex, survey district, per capita weekly household income and food expenditure in childhood.

‡Ever breast fed for &lt;6 months as baseline.

When the analyses were reweighted to allow for missing data, the observed effect size was hardly altered (fully adjusted OR 1.37; 95% CI 1.08 to 1.73). Restricting the analyses to families containing children with discordant breastfeeding history, a positive association between breast feeding and social mobility was observed in fully adjusted models, although it was attenuated with wide CIs ( $n=255$  families and 478 individuals; OR 1.16; 95% CI 0.74 to 1.8).

## DISCUSSION

We found that ever having been breast fed was positively associated with increased odds of upward social mobility in this cohort born in the 1920s and 1930s when there was little social patterning in infancy of breast feeding. One of the most consistent findings in the published literature on the long-term impact of infant-feeding is that breast feeding is associated with improved neurocognitive development,<sup>8–10</sup> which could influence future educational and occupational success and hence social mobility. Breast feeding was associated with education level in the Boyd Orr cohort and this variable partially attenuated the effect estimate for the breast feeding–social mobility association. Breast feeding could perhaps also influence social class in adulthood by a direct effect on long-term health.<sup>5–7, 11</sup> Alternatively, an effect of breast feeding on social mobility, perhaps via improved cognition, could be a mechanism promoting long-term health, as socioeconomic circumstances over a lifetime are strongly associated with morbidity and mortality.<sup>22</sup> Another implication of these results is that studies of the association of breast feeding with long-term health outcomes could be over-controlling for socioeconomic status if multivariable models adjust for social class in adulthood rather than in childhood.

The results should be interpreted with caution for a number of reasons. First, even though breast feeding was not as markedly socially patterned in the 1920s and 1930s as it is now,<sup>23–25</sup> it remains possible that mothers from that era who chose to breast feed their children differed from those who did not with respect to factors associated with improved occupational prospects. The large survey-centre variations in breast feeding in the Boyd Orr cohort are in line with other studies indicating that there were marked regional influences on a mother's decision to breast feed and the duration of breast feeding in the pre-1939 era, including the working habits of mothers which varied from town to town.<sup>25</sup> We adjusted for survey district, which may act as a proxy for regional influences affecting the decision to breast feed, but found no attenuation of effect estimates. The OR was also robust to adjustment for other factors at baseline that could be associated with adulthood social class—that is, height in childhood, number of siblings, birth order and the amount of income earned and money spent on food by their parents when the participants were children. Maternal educational level is an important potential confounding factor about which we lacked data, but we could find no empirical evidence that it was positively associated with breast feeding in the 1920s and 1930s.<sup>23–25</sup> The within-family analysis, however, while giving imprecise effect estimates, suggests the possibility of residual confounding because the OR was reduced from 1.41 in the full analysis to 1.16. Breast feeding may therefore be a marker for other factors that explain upward social mobility that were not fully captured by the measured covariables.

Second, although the odds of upward social mobility was highly significant ( $p=0.008$  in fully adjusted models), both the relative (41%) and absolute (8%) effect estimates in those breast fed versus those bottle-fed were modest. Third, reverse causality is another alternative explanation, if some of those babies who were put to the breast differed from those who were

## What is already known on this topic

- Breast feeding in infancy may confer a number of benefits associated with more favourable educational and occupational outcomes, including improved health, stature and IQ.

## What this study adds

- In a cohort where there was little social patterning of breast feeding in infancy, we found that breastfed infants were more likely to show upward social mobility compared with those who were bottle fed.
- Confounding by several measured childhood predictors of social class in adulthood did not explain this effect, but we cannot exclude the possibility of residual or unmeasured confounding and this finding warrants further investigation before firm conclusions are made.

not by perinatal factors associated with later socioeconomic status. For example, in the era in which this cohort was born, bottle feeding may have been limited to sicker babies already destined not to do as well in later life. We were not able to adjust for perinatal infant factors, such as early growth and health, although we have shown that birth weights were similar among breast and bottle fed infants in this cohort.<sup>3</sup> Fourth, only 44% of 3182 potentially eligible participants were included in the analysis. Response rates to the 1997–8 survey, however, were similar by infant feeding method, and were not differential with respect to childhood social class. There was no indication of selection bias when analyses were weighted to account for missing data. Although this model assumes that the distribution of missing data can be predicted from the observed data, a strength of this database was that we were able to include several baseline sociodemographic variables in the model to estimate the probability of an observation being present. There was little attenuation of the effect estimate when this model was implemented, suggesting limited evidence of non-response bias. A strength of the study is that breastfeeding status and duration were obtained from the mother when the participants were children, avoiding recall bias.

In conclusion, breast feeding was associated with upward social mobility. Our original hypothesis was that if breast feeding really does improve health, and increase stature and IQ (as reported in many epidemiological studies<sup>3–10</sup>), then breastfed infants might be more likely to show upward social mobility than those who were bottle fed. The relevance of this finding for contemporary children, therefore, is that it provides indirect support for the suggestion that having been breast fed may have long-term effects via associations with intermediate factors related to social mobility, such as growth,<sup>14</sup> health<sup>12, 13</sup> or IQ.<sup>15, 16</sup> The epidemiological associations of breast feeding with these factors is inconsistent,<sup>26, 27</sup> however, and we cannot exclude the possibility of residual or unmeasured confounding. This finding warrants further investigation, therefore, before firm conclusions are made.

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