

**Breastfeeding and Offspring's Compassion and Empathy in Adulthood:
A Study With an Over 30-Year Follow-Up**

Running head: Breastfeeding, compassion, and empathy

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Acknowledgments

This study was supported financially by the Academy of Finland (M.H., grant numbers 308676 and 258578); Signe and Ane Gyllenberg Foundation (M.H.); the Jenny and Antti Wiguri Foundation (L.P.-R.); and by Mannerheim League for Child Welfare's Research Foundation and Finnish Cultural Foundation (E.O.). The Young Finns Study has been financially supported by the Academy of Finland: Grants 286284, 134309 (Eye), 126925, 121584, 124282, 129378 (Salve), 117797 (Gendi), and 41071 (Skidi); the Social Insurance Institution of Finland; Competitive State Research Financing of the Expert Responsibility area of Kuopio, Tampere and Turku University Hospitals (grant X51001); the Juho Vainio Foundation; the Sigrid Juselius Foundation; the Yrjö Jahnsson Foundation; the Paavo Nurmi Foundation; the Finnish Foundation of Cardiovascular Research and Finnish Cultural Foundation; the Tampere Tuberculosis Foundation; the Emil Aaltonen Foundation; and Diabetes Research Foundation of Finnish Diabetes Association.

Role of the funding source

The funding source had no role in study design, data collection, data analysis, data interpretation, writing of the report, or in the decision to submit the article for publication.

Conflict of interest

None.

Abstract

This study investigated whether breastfeeding predicts offspring's dispositional compassion and empathy from early adulthood to middle age. The parents of the participants ($N=1394$) of the Young Finns study answered questions about breastfeeding in 1983, and the participants' compassion and empathy were evaluated in 1997–2012 (participants were aged 20–50 years). Breastfeeding did not predict the course of compassion or empathy in adulthood at the age of 20–50 years. The associations remained nonsignificant, when adjusted for age, gender, socioeconomic factors, and a wide range of characteristics of the family environment (including mother's gestational age; premature birth; birth weight; number of other children at home; parental mental disorder; parental relationship status; parental postnatal smoking; parental postnatal alcohol use; parenting behavior; and child's externalizing behavior). In conclusion, breastfeeding seems not to predict offspring's compassion or empathy in adulthood. The findings may present a hopeful perspective for children growing up with non-breastfeeding caregivers.

1 Introduction

The benefits of breastfeeding on offspring development have been repeatedly reported. Breastfeeding is linked with better somatic health of the offspring, such as a lower serum total concentration in adulthood (Owen, Whincup, Odoki, Gilg, & Cook, 2002), a lower risk for asthma and allergies (Friedman & Zeiger, 2005), a lower risk for obesity (Arenz, Ruckerl, Koletzko, & von Kries, 2004), respiratory diseases (Oddy et al., 2003), atopic eczema (Gdalevich, Mimouni, David, & Mimouni, 2001), gastroenterological infection (Wold & Adlerberth, 2002), and coeliac disease (Akobeng, Ramanan, Buchan, & Heller, 2006). The current recommendations of the World Health Organization state that infants should be exclusively breastfed for the first 6 months of life, and breastfeeding should continue non-exclusively for up to 2 years of age while introducing complementary foods (WHO & UNICEF, 2003). Especially in the developing countries, suboptimal breastfeeding is found to be a crucial factor contributing to neonatal morbidity and mortality (e.g. Huffman, Zehner, & Victora, 2001; Müller & Krawinkel, 2005). It has been estimated that implementing optimal breastfeeding could save even 1.45 million children's lives each year globally in developing countries (Lauer, Betrán, Barros, & de Onís, 2006).

It has been highlighted, nevertheless, that breastfeeding should be regarded not only as a feeding event promoting infant's somatic health, but also as a crucial moment of psychosocial dialogue and sensory exchange between the mother and child (Raju, 2011). It has been found that breastfeeding is associated with a higher alertness of the infant during social interactions (Feldman & Eidelman, 2003), more frequent maternal affectionate touch to the child (Moore, Anderson, Bergman, & Dowswell, 2007), higher maternal sensitivity to the infant's socioemotional cues (Kim et al., 2011; Papp, 2014), less intrusive parenting behavior toward the child (Else-Quest, Hyde, & Clark, 2003), a closer mother-child bonding

(Bystrova et al., 2009; Cernadas, Noceda, Barrera, Martinez, & Garsd, 2003). A warm parent-child relationship, in turn, is found to predict higher compassion for others in adulthood (Hintsanen et al., 2019). Additionally, breastfeeding is related to a more secure attachment style of the child (Britton, Britton, & Gronwaldt, 2006). Secure attachment, in turn, is shown to be comparatively stable over the life course, so that close and supportive interpersonal relationships in childhood predict such relationship qualities also in adulthood (Fraley, 2002; Waters, Merrick, Treboux, Crowell, & Albersheim, 2000). In related vein, there is evidence that high interpersonal connectedness and high social warmth toward others are linked with higher empathy and compassion (García et al., 2012; Hutcherson, Seppala, & Gross, 2008). Thus, there seems to be a developmental pathway from breastfeeding to close and supportive parent-child relationship and secure attachment, which in turn promote the development of compassion.

Despite the supposed developmental pathways from breastfeeding to higher levels of empathy and compassion of the offspring, previous studies have found no evidence for a link between breastfeeding and compassion-related outcomes in childhood. Specifically, longitudinal studies in non-clinical populations have suggested that the duration of breastfeeding does not predict the level of prosocial behavior at the age of 5 years (Tanaka, Kon, Ohkawa, Yoshikawa, & Shimizu, 2009), 6 years (Lind, Li, Perrine, & Schieve, 2014), 6.5 years (Kramer et al., 2008, 2009, 2011), or 7–10 years (Belfort et al., 2016). Additionally, some studies have indicated that breastfeeding does not predict sociability at the age of 1–3 years (Oddy et al., 2011) or the degree of emotional difficulties among 6-year-old children (Kramer et al., 2008, 2009, 2011; Kramer, 2010; Lind et al., 2014).

Importantly, however, no study has investigated whether breastfeeding predicts offspring's empathy or compassion in adulthood. Empathy is defined as the capacity to resonate with others' affective states, i.e. to share both positive and negative feelings of

others (Singer & Klimecki, 2014). In some cases, empathy may result in experiencing emotional distress and withdrawing from social contacts, in order to protect oneself against excessive negative feelings (Goetz et al., 2010; Singer & Klimecki, 2014). Compassion, instead, refers to a disposition to feel concern for other's suffering that is followed by the motivation and desire to alleviate the suffering and improve other's well-being (Goetz et al., 2010). Thus, compassion is characterized by positive feelings such as warmth, concern and care for the other (Singer & Klimecki, 2014). Low levels of compassion and empathy are known to be related to higher aggression (García et al., 2012; Lee et al., 2012) and higher narcissistic (De Fruyt et al., 2006; Ronningstam et al., 2010) and psychopathic traits (Paal et al., 2007).

Previous evidence suggests the levels of compassion and empathy increase over age in adulthood (Hintsanen et al., 2019; O'Brien et al., 2013). The courses of compassion and empathy in adulthood appear to be related to normative maturation of personality (Josefsson et al., 2013) and also childhood factors such as parenting attitudes (Hintsanen et al., 2019) and child's temperamental dispositions (Luengo et al., 2013). However, it has remained uninvestigated whether breastfeeding might predict the trajectories of compassion or empathy in adulthood.

Previously, it has been highlighted that the developmental influences of breastfeeding are likely manifested differently over the offspring's life course (Friedman & Zeiger, 2005). For example, breastfeeding may have such maturational brain programming effects on the offspring that can be obtained only after early childhood (Kramer, 2010). By now, one longitudinal study suggested that the influence of breastfeeding on offspring's prosocial behavior slightly varies between ages 3.5–12 years (Borra, Iacovou, & Sevilla, 2012). Further, it has been found that after adjusting for childhood socioeconomic status and a variety of psychosocial and birth-related factors, non-breastfed children have an increased

risk for adulthood hostility (Merjonen et al., 2011) as well as borderline personality disorder (Schwarze, Hellhammer, Stroehle, Lieb, & Mobascher, 2015), which by definition refers to severe disturbances in socioemotional development (APA, 2013). Consequently, previous studies imply that the relationship of breastfeeding with offspring's development of prosocial tendencies in later age periods may differ from childhood, but specific evidence regarding compassion and empathy is still lacking.

The aim of the present study was to examine whether breastfeeding predicts the trajectories of compassion and empathy in adulthood. Specifically, we investigated whether having received breastfeeding or not, or the duration of breastfeeding predict the course of dispositional compassion and empathy from age 20 to 50, i.e. from early adulthood to middle age. We used a Finnish population-based data with an over 30-year prospective follow-up. Our data also provided exceptional possibilities to take into account a wide range of other characteristics of the child and family environment.

2 Method

2.1 Participants

Our data consisted of the participants of the prospective Young Finns Study (YFS). The original sample included 3596 participants that were selected randomly from six age cohorts (who were born in 1962, 1965, 1968, 1971, 1974, and 1977) from the population register of the Social Insurance Institution that covers the whole population of Finland. The baseline measurement time was in 1980, and the participants have been followed since then so that the most recent measurement time was in 2012 (participants were aged 35–50 years). The study was carried out in accordance with the Declaration of Helsinki, and the study design was approved by the ethical committees of all those Finnish universities that have medical faculties. All the participants or their parents (for participants aged 12 years or under)

provided their written informed consent. The design and sample of the YFS is described with more detail elsewhere (Raitakari et al., 2008).

Breastfeeding was assessed in 1983, dispositional compassion and empathy in 1997, 2001, and 2012, and socioeconomic factors in 1980 and 2007. We included in the analyses all participants with full data on breastfeeding, compassion, empathy, and socioeconomic factors in at least one of the measurement years (i.e. full data on breastfeeding in 1983; full data on compassion and empathy in 1997, 2001, or 2012 etc.). The final data consisted of 1394 participants.

2.2 Measures

Dispositional compassion and empathy were measured with the version 9 of the Temperament and Character Inventory (TCI, Cloninger, Przybeck, Svrakic, & Wetzel, 1994). Compassion and empathy are subscales of character dimension Cooperativeness in the TCI. The TCI was filled in by the participants. The compassion scale ($\alpha = .86$ in 1997, 2001, and 2012) consists of 10 self-rating items (e.g. “It gives me pleasure to help others, even if they have treated me badly”) and the empathy scale ($\alpha = .60-.63$) includes 7 items (e.g. “I often consider another person’s feelings as much as my own”). Items are answered with a 5-point Likert-scale (1 = completely disagree, 5 = completely agree). For each measurement year, we calculated a total score of compassion and empathy and standardized them with the mean and standard deviation of year 1997 measurement. For each year, we calculated a total score of compassion and empathy for all the included participants who had no missing values in the scale in that measurement year.

The validity of the dispositional compassion and empathy scales has been confirmed previously. Low scores of the compassion scale are linked to higher aggression and hostility (García et al., 2012; Lee et al., 2012) and higher narcissistic (De Fruyt et al.,

2006) and psychopathic traits (Paal et al., 2007). High values of the compassion scale, in turn, are related to higher altruistic behavior, social warmth, and sociability (García et al., 2012; Schmidt et al., 2003). Regarding empathy, high scores of the empathy scale are related to higher attachment and sentimentality toward others (Hansenne et al., 2001) and stronger neural responses to social reward (Goerlich et al., 2017). Furthermore, the compassion and empathy scales have also high test-retest reliability (e.g. Hansenne et al, 2005; Pélioso & Lépine, 2000).

Breastfeeding and its duration were evaluated with a paper/pencil questionnaire presented for parents in 1983. The parents were asked whether the child had been breastfed or not (yes/no), and how long time had the child been breastfed (in months). The parents were advised to check this information from the child's personal record cards obtained from well-baby clinics, if possible. This measure of breastfeeding has been used also previously and is found to predict hostility in adulthood, for example (Merjonen et al., 2011). We computed 4 separate variables for breastfeeding that have been used also in previous studies (e.g. Kramer et al., 2011; Lind et al., 2014; Narvaez et al., 2013). The variables were as follows: (1) a dichotomous variable referring to whether the child had received breastfeeding or not; (2) a four-class variable representing the duration of breastfeeding in months (0–4 months; 5–8 months; 9–12 months; over 12 months); (3) a dichotomous variable referring to whether the child had been breastfed for 0–12 months or over 12 months; and (4) a continuous score for duration of breastfeeding in months. The cut-off of 12 months was selected on the basis of the American Academy of Pediatrics (AAP) and the Finnish Ministry of Social Affairs and Health as they recommend that infants should be exclusively breastfed for the first 6 months and breastfeeding should continue for the first 12 months. The cut-off of 4 months was selected because it has been used also previously in longitudinal studies (e.g. Woo et al., 2008) and because, in practice, a common duration of breastfeeding is 4 months (Cernadas et

al., 2003).

Socioeconomic factors included participants and their parents' occupational status and educational level. Educational level was classified into three categories (1 = comprehensive school, 2 = high school or occupational school, 3 = academic level). Occupational status was also classified into three classes (1 = manual, 2 = lower grade non-manual, 3 = upper grade non-manual), as has been done also previously (e.g. Pulkki-Råback et al., 2015).

For additional statistical analyses, we measured also a range of covariates related to the child and family environment, as has been done also in some previous studies (e.g. Belfort et al., 2016; Lind et al., 2014). Covariates (measured in 1980 and 1983) were as follows: mother's gestational age; premature birth; birth weight; number of other children at home; parental mental disorder; parental relationship status (whether living together or separated); parental postnatal smoking (frequency of smoking); parental postnatal alcohol use (frequency of alcohol use); parenting; and child's externalizing behavior. Information about the childhood covariates was collected via questionnaires filled by the parents.

Parenting was assessed using a scale derived from the Operation Family study (Makkonen et al., 1981), filled by the parents. It consisted of parental acceptance toward the child, parental disciplinary style, and parental emotional warmth. Parental acceptance was evaluated with a scale including three items (e.g. "The child makes me nervous"), which were answered with a 5-point Likert-scale ($\alpha = .72$). The scale of parental disciplinary style included two items (e.g. "Disciplinary actions are regularly needed with the child"), which were rated dichotomously (1 = no, 2 = yes). Parental emotional warmth was measured using four items (e.g. "The child is significant to me"), which were answered using a 5-point Likert-scale ($\alpha = .73$). The reliability of the parenting scales has been confirmed also in previous studies (e.g. Josefsson et al., 2013; Keltikangas-Järvinen et al., 2009). The scores of

parental acceptance toward the child, parental disciplinary style, and the parental emotional warmth were standardized and summed together. The sum score of parenting was standardized and treated as a continuous variable in the analyses.

Child's externalizing behavior was evaluated with a questionnaire derived from the Health Examination Survey (Wells, 1980). The questionnaire was filled by the parents. It consisted of aggression, hyperactivity, and social maladjustment. Aggression scale included 6 items (e.g. "Other children say that my child gets easily into fights") that parents were answered with 2-point scales (1 = "Description fits my child") or 2 ("Description does not fit my child"). Hyperactivity was measured by one question asking parents to describe their child with a 4-point scale (ranging from 1 = "The child stays calm even after most other children have become restless" to 4 = "The child is always on the move, talks non-stop, and the child's activity is striking"). Social maladjustment was evaluated by asking parents to rate their child's general level of adjustment and their worry about the child's adjustment with a 3-point scale (ranging from 1 = "The child survives well in everyday life" to 3 = "I am worried about my child's behavior and I am afraid my child will become a problem child"). The construct and predictive validity of the externalizing behavior scale has been confirmed previously (e.g. Katainen, Räikkönen, Keskivaara, & Keltikangas-Järvinen, 1999; Pesonen, Räikkönen, Keskivaara, & Keltikangas-Järvinen, 2003; Pulkki-Råback, Elovainio, Kivimäki, Raitakari, & Keltikangas-Järvinen, 2005). We standardized the scores of aggression, hyperactivity, and social maladjustment and summed them together. The sum score of externalizing behavior was standardized and treated as a continuous variable in the analyses.

2.3 Statistical Analyses

Statistical analyses were conducted with Stata SE version 13.0. Attrition was examined by comparing the study variables of the included ($n = 1394$) and excluded ($n = 2202$)

participants. We examined the longitudinal associations of breastfeeding with dispositional compassion and empathy using multilevel models (MLMs) for repeated measurements design with maximum likelihood estimation. MLMs estimate both fixed effects (classic regression coefficients) and random effects that refer to individual-level variation in intercept and slopes. Cox and Snell's generalized R squareds (Cox & Snell, 1989) were calculated for all the models. Age referred to participant's age at each measurement year, ranging from 20 (the age of the youngest study cohort in 1997) to 50 (the age of the oldest study cohort in 2012). Age was centered at age 20.

We ran separate growth-curve models for compassion and empathy.

Compassion and empathy were predicted separately by each breastfeeding variable (in models A by the dichotomous score of breastfeeding; in models B by the 4-class variable of breastfeeding; in models C by the 2-class variable of breastfeeding; and in models D by the continuous score of breastfeeding). In models 1, the associations of breastfeeding with compassion and empathy were adjusted for age and gender. Specifically, intercept, age, age-squared, and gender were added to the model as fixed effects, and intercept was treated also as random effect. In models 2, the associations were adjusted also for socioeconomic factors. As additional analyses, we adjusted the associations of breastfeeding with compassion and empathy for a wider range of psychosocial factors of the child and family environment ($N = 1050$, including all the participants who had information about the childhood covariates). Specifically, we added all the following covariates simultaneously to the model: mother's gestational age; premature birth; birth weight; number of other children at home; parental mental disorder; parental relationship status; parental postnatal smoking; parental postnatal alcohol use; parenting; and child's externalizing behavior.

3 Results

Descriptive statistics are shown in Table 1. The maximum duration of breast-feeding was 36 months. Altogether 36 participants were breastfed for more than 12 months. With regard to attrition analyses, it was revealed that women were more likely to participate than men in the measurement of empathy and compassion (47.6% vs. 40.9%, $p < .001$). Included participants had higher scores of compassion (36.76 vs. 36.02, $p < .01$) and empathy (25.70 vs. 25.45, $p < .05$). There was no difference in the duration of breastfeeding or in the likelihood of having been breastfed between included and excluded participants. Included participants were more likely to be upper grade non-manual workers (48.7% vs. 36.4%, $p < .001$) and to have high educational level (18.9% vs. 12.6%, $p < .001$) than excluded participants. Regarding parental socioeconomic status, included participants' parents were less likely to be manual workers (37.1% vs. 41.8%, $p < .01$) and more likely to have high educational level (26.7% vs. 23.6%, $p < .05$) than excluded participants' parents.

(Table 1 about here)

The associations of breastfeeding with dispositional compassion and empathy are shown in Tables 2 and 3. We found that none of the breastfeeding variables predicted the course of compassion or empathy between ages 20 and 50. The associations remained non-significant in all the models, i.e. when the associations were adjusted for age and gender and when adjusted also for socioeconomic factors. Moreover, there were no significant interaction effects of breastfeeding with age or gender, indicating that the association of breastfeeding with compassion or empathy was non-significant in all age cohorts and among male and female.

In the additional analyses, we controlled also for a wider range of covariates

related to the child, home environment, and parenting (including mother's gestational age; premature birth; birth weight; number of other children at home; parental mental disorder; parental relationship status; parental postnatal smoking; parental postnatal alcohol use; parenting behavior; and child's externalizing behavior). The associations between breastfeeding and compassion remained non-significant.

(Table 2, Table 3, Figure 1, and Figure 2 about here)

As additional analyses, we imputed the missing values of the study variables with multiple imputation using the R 'mice' package (multivariate imputation by chained equations) (Buuren & Groothuis-Oudshoorn, 2011). Thereafter, we reran all the analyses in the imputed dataset ($N = 2163$). All the results were replicated, i.e. all the associations of breastfeeding variables with dispositional compassion and empathy remained non-significant.

As further analyses, we investigated the relationship of breast-feeding with dispositional compassion and empathy using linear regression analyses ($N = 1394$, see Appendix A and B). Specifically, we calculated the mean scores of compassion and empathy between years 1997, 2001, and 2012 for all the participants who had data available on empathy and compassion in at least one of the measurement times. Next, we predicted the mean values of compassion and empathy by each breast-feeding variable (in models A by the dichotomous score of breastfeeding; in models B by the 4-class variable of breastfeeding; in models C by the 2-class variable of breastfeeding; and in models D by the continuous score of breastfeeding). When adjusted only by age and gender or also by socioeconomic factors, all the associations of breast-feeding with dispositional compassion and empathy remained non-significant.

4 Discussion

To the best of our knowledge, this is the first study to investigate whether breastfeeding predicts off-spring's compassion or empathy in adulthood. Our results revealed that neither having received breastfeeding, nor the duration of breastfeeding did predict the course of compassion or empathy from ages 20 to 50, i.e. from early adulthood to middle age. The associations of breastfeeding with compassion and empathy remained nonsignificant over the whole follow-up, when adjusted for age and gender, when adjusted also for socioeconomic factors in childhood and adulthood, and when additionally adjusted for a wider range of characteristics of the child, home environment, and parenting (i.e. mother's gestational age; premature birth; birth weight; number of other children at home; parental mental disorder; parental relationship status; parental postnatal smoking; parental postnatal alcohol use; parenting behavior; and child's externalizing behavior). Moreover, the effect of breastfeeding on compassion and empathy remained non-significant also in the multiple imputed dataset, indicating that the non-significant associations were not accounted for by some attrition biases over the follow-up. Taken together, our study provided evidence that breastfeeding does not predict the development of dispositional compassion or empathy of the offspring in adulthood.

It has been suggested that the previous null results regarding breastfeeding and socioemotional outcomes might be at least partly accounted for by a limited range of control variables (Jansen, de Weerth, & Riksen-Walraven, 2008). That is, there might be some selection bias between breastfeeding and non-breastfeeding mothers with regard to other qualities. For example, non-breastfeeding mothers may be more career-oriented (Stewart-Knox, Gardiner, & Wright, 2003) and more likely able to provide a favorable home environment with regard to socioeconomic factors. In the present study, however, we controlled for a relatively comprehensive range of the characteristics of the child and home

environment. Nevertheless, all the associations of breastfeeding with offspring's compassion or empathy remained non-significant. Hence, this implies that breastfeeding may not predict offspring's compassion or empathy in adulthood indirectly via other qualities of the family environment.

Another explanation for the previous results, which have found no link for breastfeeding to offspring's socioemotional development in childhood, might potentially be that compassion may not be fully developed yet in early childhood. Several studies have investigated socioemotional outcomes among children aged as young as 1–3.5 years (e.g. Oddy et al., 2011; Borra et al., 2012). It has been suggested that there might be cognitive requirements for being able to feel compassion: e.g. one must be able to imagine himself or herself to the same situation and to imagine how it would feel like (Cassell, 2002). Our study demonstrated that there exist no association of breastfeeding with compassion after childhood and cognitive maturation.

Compassion and empathy are generally regarded as cornerstones of one's socioemotional development. Deficits in compassion or empathy constitute a central feature of a range of psychiatric disorders, for example, antisocial personality disorder and paranoia (APA, 2013). Hence, our results, which showed no association of breastfeeding with empathy or compassion, tentatively suggest that non-breastfeeding does not predispose the child to socioemotional deficits or to psychiatric disorders through them. This is in line with a previous study demonstrating that breastfeeding is not linked with violent behavior in adulthood (Caicedo, Gonçalves, González, & Victora, 2010).

In our study, there were some limitations that are necessary to be taken into consideration. Breastfeeding was evaluated by asking parents whether the child had received breastfeeding and for how many months breastfeeding had occurred. It was not assessed, however, whether the child had been exclusively or non-exclusively breastfed, i.e. whether

the child had received also complementary food or other nutritions during breastfeeding. However, breastfeeding has been commonly assessed this way in previous studies (e.g. Belfort et al., 2016; Narvaez et al., 2013). Moreover, such studies that have differentiated between exclusive and non-exclusive breastfeeding have found no differences between the effects of exclusive vs. non-exclusive breastfeeding on socioemotional outcomes in childhood (e.g. Kramer et al., 2011; Lind et al., 2014).

Moreover, breast-feeding was evaluated retrospectively. Previously, the length of recall period is found to positively correlate with recall bias (Horta et al., 2013). In this study, we aimed to minimize potential recall bias by asking parents about breastfeeding in 1983 (i.e. in the first follow-up measurement). Further, it has been highlighted that the duration of breastfeeding should be checked from many sources if possible (Horta et al., 2013). We advised the parents to check this information from the child's personal record cards obtained from well-baby clinics. Finally, there is evidence that high parental socioeconomic status is related to underestimation of the duration of breastfeeding (Huttly et al., 1990). In this study, we controlled for a variety of childhood covariates, including parental socioeconomic status.

Finally, the rate of non-breastfed children was comparatively low in the present study (7.5%). Also previous studies have found the rate of non-breastfed children varies between 0.5 and 26% in Europe (Clements et al., 1997; Hörnell et al., 1999; Michaelsen et al., 1994). Hence, no firm conclusions cannot be made about the effects of non-breastfeeding on the course of compassion and empathy. Nevertheless, there were a higher frequency of participants who had been breastfed over a comparatively short time period (e.g. 4 months) and they did not differ from others in their compassion or empathy levels. Overall, previous studies have suggested that the potential association of breastfeeding with compassion and empathy might go indirectly via close and supportive parent-child relationship (Bystrova et

al., 2009; Cernadas et al., 2003) and secure attachment (Britton et al., 2006). In the light of previous evidence, that kind of mediating socioemotional factors are unlikely to develop over a short period of breastfeeding.

The present study had a variety of substantial strengths. Firstly, we had a prospective follow-up of over 30 years and a comparatively large population-based sample consisting of six different age cohorts. Our data enabled us to investigate the course of dispositional compassion and empathy from ages 20 to 50, i.e. from early adulthood to middle age. Thirdly, we used multilevel models for repeated measurements that have comparatively strong statistical power (Gelman & Hill, 2006), so that also modest associations between the study variables could be obtained. Fourthly, we replicated all the analyses in a multiple imputed dataset in order to ensure that the results were not accounted for by certain attrition biases in our sample. Finally, we could control for a range of potential confounding variables, such as age, gender, socioeconomic factors in childhood and adulthood, and also a range of characteristics of the child and family environment. Taken together, our data provided exceptional possibilities to investigate whether breastfeeding predicts the course of compassion and empathy of the offspring in adulthood.

Suboptimal breastfeeding is common not only in developing countries (Huffman et al., 2001; Müller & Krawinkel, 2005) but also in Western countries. In the US, for example, only about one third of mothers continue breastfeeding the infant for the first 6 months (McDowell, Wang, & Kennedy-Stephenson, 2008), although the WHO has recommended exclusive breastfeeding for the first 6 months of life (WHO & UNICEF, 2003). There are a variety of reasons for suboptimal breastfeeding, including experiences of restricted freedom, conflicts between motherhood and pursuing a career, sexuality-related feelings, and perceived social isolation (Stewart-Knox et al., 2003; Van Esterik, 2002). Importantly, many mothers are also forced to introduce formula-feeding because of hormonal

or nutritional reasons (Goldman, Hopkinson, & Rassin, 2007; Jansen et al., 2008). Still, however, breastfeeding is considered even as an aspect of morality or a measure of the quality of motherhood in some populations (Lee, 2007). Consequently, a review concluded that mothers who introduce formula-feeding frequently experience feelings of guilt, uncertainty and failure (Lakshman, Ogilvie, & Ong, 2009). In many cases, formula-feeding mothers have to defend their feeding methods when visiting child care services, which may lower their trust toward health-care professionals (Lee, 2007).

In the context child health-care services, it is necessary to clarify the precise arguments for breastfeeding for mothers. There is a great amount of evidence that breastfeeding is linked with better somatic health of the child, including properties from blood pressure to respiratory diseases and allergies (e.g. Friedman & Zeiger, 2005; Owen et al., 2002; Wold & Adlerberth, 2002). On the other hand, previous meta-analyses have concluded that breastfeeding does not predict higher intelligence or cognitive abilities of the offspring (e.g. Horta, Loret de Mola, & Victora, 2015; Walfisch, Sermer, Cressman, & Koren, 2013). Moreover, most previous studies have found no evidence for a link for breastfeeding to prosocial behavior, sociability, or emotional difficulties in childhood (e.g. Tanaka et al., 2009; Lind et al., 2014; Oddy et al., 2011; Kramer et al., 2008). In line with these findings, the present study showed that breastfeeding does not predict compassion or empathy of the offspring in adulthood. Our findings may present a hopeful and encouraging perspective for children growing up with non-breastfeeding caregivers.

References

- Akobeng, A. K., Ramanan, A. V., Buchan, I., & Heller, R. F. (2006). Effect of breast feeding on risk of coeliac disease: a systematic review and meta-analysis of observational studies. *Archives of Disease in Childhood*, *91*, 39–43. doi: 10.1136/adc.2005.082016
- American Psychiatric Association (APA) (2013). Diagnostic and Statistical Manual of Mental Disorders (DSM-5®). Fifth Edition. American Psychiatric Pub.
- Arenz, S., Ruckerl, R., Koletzko, B., & von Kries, R. (2004). Breast-feeding and childhood obesity - a systematic review. *International Journal of Obesity*, *28*, 1247–1256. doi: 10.1038/sj.ijo.0802758
- Belfort, M. B., Rifas-Shiman, S. L., Kleinman, K. P., Bellinger, D. C., Harris, M. H., Taveras, E. M., . . . Oken, E. (2016). Infant Breastfeeding Duration and Mid-Childhood Executive Function, Behavior, and Social-Emotional Development. *Journal of Developmental and Behavioral Pediatrics*, *37*, 43–52. doi: 10.1097/DBP.0000000000000237
- Bird, G., & Viding, E. (2014). The self to other model of empathy: providing a new framework for understanding empathy impairments in psychopathy, autism, and alexithymia. *Neuroscience & Biobehavioral Reviews*, *47*, 520–532.
- Borra, C., Iacovou, M., & Sevilla, A. (2012). The effect of breastfeeding on children's cognitive and noncognitive development. *Labour Economics*, *19*, 496–515. doi:10.1016/j.labeco.2012.05.007
- Britton, J. R., Britton, H. L., & Gronwaldt, V. (2006). Breastfeeding, sensitivity, and attachment. *Pediatrics*, *118*, e1436–e1443. doi: 10.1542/peds.2005-2916
- Buuren, S., & Groothuis-Oudshoorn, K. (2011). Mice: Multivariate imputation by chained equations in R. *Journal of Statistical Software*, *45*, 901–911.
- Bystrova, K., Ivanova, V., Edhborg, M., Matthiesen, A. S., Ransjö-Arvidson, A. B.,

- Mukhamedrakhimov, R., ... & Widström, A. M. (2009). Early contact versus separation: effects on mother–infant interaction one year later. *Birth*, *36*, 97–109.
doi: 10.1111/j.1523-536X.2009.00307.x
- Caicedo, B., Gonçalves, H., González, D. A., & Victora, C. G. (2010). Violent delinquency in a Brazilian birth cohort: the roles of breast feeding, early poverty and demographic factors. *Paediatric and Perinatal Epidemiology*, *24*, 12–23. doi: 10.1111/j.1365-3016.2009.01091.x
- Cassell, E. J. (2002). Compassion. In S. J. Lopez & C. R. Snyder (Eds.), *The Oxford Handbook of Positive Psychology* (2nd ed., pp. 393–404). Oxford: Oxford University Press.
- Cernadas, J. M., Noceda, G., Barrera, L., Martinez, A. M., & Garsd, A. (2003). Maternal and perinatal factors influencing the duration of exclusive breastfeeding during the first 6 months of life. *Journal of Human Lactation*, *19*, 136–144. doi: 10.1177/0890334403253292
- Clements, M. S., Mitchell, E. A., Wright, S. P., Esmail, A., Jones, D. R., & Ford, R. P. K. (1997). Influences on breastfeeding in southeast England. *Acta Paediatrica*, *86*, 51–56.
- Cloninger, C. R., Przybeck, T. R., Svrakic, D. M., & Wetzel, R. D. (1994). *The Temperament and Character Inventory (TCI): A guide to its development and use*. St. Louis, MO: Washington University, Center for Psychobiology of Personality.
- Cox, D. R., Snell, E. J. (1989). *The Analysis of Binary Data. Second edition*. Chapman & Hall, London, pp. 208–209.
- De Fruyt, F., De Clercq, B. J., van de Wiele, L., & Van Heeringen, K. (2006). The validity of Cloninger's Psychobiological Model versus the Five-Factor Model to predict DSM-IV personality disorders in a heterogeneous psychiatric sample: Domain facet and residualized descriptions. *Journal of Personality*, *74*, 479–510.

- Else-Quest, N.-M., Hyde, N.-S., & Clark, R. (2003). Breastfeeding, bonding, and the mother–infant relationship. *Merrill-Palmer-Quarterly*, *49*, 495–517. doi: 10.1353/mpq.2003.0020
- Feldman, R., & Eidelman, A. I. (2003). Direct and indirect effects of breast milk on the neurobehavioral and cognitive development of premature infants. *Developmental Psychobiology*, *43*, 109–119. doi: 10.1002/dev.10126
- Fraley, R. (2002). Attachment stability from infancy to adulthood: Meta-analysis and dynamic modeling of developmental mechanisms. *Personality and Social Psychology Review*, *6*, 123–151. doi: 10.1207/S15327957PSPR0602_03
- Friedman, N. J., & Zeiger, R. S. (2005). The role of breastfeeding in the development of allergies and asthma. *Journal of Allergy and Clinical Immunology*, *115*, 1238–1248. doi: 10.1016/j.jaci.2005.01.069
- García, Ó., Aluja, A., García, L. F., Escorial, S., & Blanch, A. (2012). Zuckerman-Kuhlman-Aluja Personality Questionnaire (ZKA-PQ) and Cloninger’s Temperament and Character Inventory Revised (TCI-R): A comparative study. *Scandinavian Journal of Psychology*, *53*, 247–257.
- Gdalevich, M., Mimouni, D., David, M., & Mimouni, M. (2001). Breastfeeding and the onset of atopic dermatitis in childhood: a systematic review and meta-analysis of prospective studies. *Journal of the American Academy of Dermatology*, *45*, 520–527. doi: 10.1067/mjd.2001.114741
- Gelman, A., & Hill, J. (2006). *Data analysis using regression and multilevel/hierarchical models*. Cambridge University Press.
- Goerlich, K. S., Votinov, M., Lammertz, S. E., Winkler, L., Spreckelmeyer, K. N., Habel, U., ... & Gossen, A. (2017). Effects of alexithymia and empathy on the neural processing of social and monetary rewards. *Brain Structure and Function*, *222*, 2235–2250. doi: 10.1007/s00429-016-1339-1

- Goetz, J. L., Keltner, D., & Simon-Thomas, E. (2010). Compassion: an evolutionary analysis and empirical review. *Psychological Bulletin*, *136*, 351–374.
- Goldman, A. S., Hopkinson, J. M., & Rassin, D. K. (2007). Benefits and risks of breastfeeding. *Advances in Pediatrics*, *54*, 275–304. doi:10.1016/j.yapd.2007.03.014
- Hansenne, M., Delhez, M., & Cloninger, C. R. (2005). Psychometric properties of the Temperament and Character Inventory–Revised (TCI–R) in a Belgian sample. *Journal of Personality Assessment*, *85*, 40–49.
- Hansenne, M., Le Bon, O., Gauthier, A., & Ansseau, M. (2001). Belgian normative data of the Temperament and Character Inventory. *European Journal of Psychological Assessment*, *17*, 56. doi: 10.1027//1015-5759.17.1.56
- Hintsanen, M., Gluschkoff, K., Dobewall, H., Cloninger, C. R., Keltner, D., Saarinen, A., ... & Pulkki-Råback, L. (2019). Parent–child-relationship quality predicts offspring dispositional compassion in adulthood: A prospective follow-up study over three decades. *Developmental Psychology*, *55*, 216–225. doi:10.1037/dev0000633
- Horta, B. L., Loret de Mola, C., & Victora, C. G. (2015). Breastfeeding and intelligence: a systematic review and meta-analysis. *Acta paediatrica*, *104*(S467), 14-19. doi: 10.1111/apa.13139
- Horta, B. L., V., Victora, C. G., & World Health Organization (2013). Long-term effects of breastfeeding: a systematic review. WHO Press, World Health Organization.
- Huffman, S. L., Zehner, E. R., & Victora, C. (2001). Can improvements in breast-feeding practices reduce neonatal mortality in developing countries? *Midwifery*, *17*, 80–92. doi: 10.1054/midw.2001.0253
- Hutcherson, C. A., Seppala, E. M., & Gross, J. J. (2008). Loving-kindness meditation increases social connectedness. *Emotion*, *8*, 720–724. doi: 10.1037/a0013237

Huttly, S. R., Barros, F. C., Victora, C. G., Beria, J. U., & Vaughan, J. P. (1990). Do mothers overestimate breast feeding duration? An example of recall bias from a study in southern Brazil. *American Journal of Epidemiology*, *132*, 572-575. doi:

10.1093/oxfordjournals.aje.a115693

Hörnell, A., Aarts, C., Kylberg, E., Hofvander, Y., & Gebre-Medhin, M. (1999).

Breastfeeding patterns in exclusively breastfed infants: a longitudinal prospective study in Uppsala, Sweden. *Acta Paediatrica*, *88*, 203–211.

Jansen, J., de Weerth, C., & Riksen-Walraven, J. M. (2008). Breastfeeding and the mother-infant relationship - a review. *Developmental Review*, *28*, 503–521. doi:

10.1016/j.dr.2008.07.001

Josefsson, K., Jokela, M., Cloninger, C. R., Hintsanen, M., Salo, J., Hintsala, T., ... &

Keltikangas-Järvinen, L. (2013). Maturity and change in personality: developmental trends of temperament and character in adulthood. *Development and Psychopathology*, *25*, 713-727.

Josefsson, K., Jokela, M., Hintsanen, M., Cloninger, C. R., Pulkki-Råback, L., Merjonen, P., .

. . Keltikangas-Järvinen, L. (2013). Parental care-giving and home environment predicting offspring's temperament and character traits after 18 years. *Psychiatry Research*, *209*, 643–651. doi: 10.1016/j.psychres.2013.01.007

Katainen, S., Räikkönen, K., Keskivaara, P., & Keltikangas-Järvinen, L. (1999). Maternal child-rearing attitudes and role satisfaction and children's temperament as antecedents of adolescent depressive tendencies: Follow-up study of 6- to 15- years-olds. *Journal of Youth & Adolescence*, *28*, 139–163. doi: 10.1023/A:1021645213549

Keltikangas-Järvinen, L., Pulkki-Råback, L., Elovainio, M., Raitakari, O., Viikari, J., &

Lehtimäki, T. (2009). DRD2 C32806T modifies the effect of child-rearing environment

- on adulthood novelty seeking. *American Journal of Medical Genetics Part B: Neuropsychiatric Genetics*, *150*, 389–394. doi: 10.1002/ajmg.b.30830
- Kim, P., Feldman, R., Mayes, L. C., Eicher, V., Thompson, N., Leckman, J. F., & Swain, J. E. (2011). Breastfeeding, brain activation to own infant cry, and maternal sensitivity. *Journal of Child Psychology and Psychiatry*, *52*, 907–915. doi: 10.1111/j.1469-7610.2011.02406.x
- Kramer, M. S. (2010). “Breast is best”: The evidence. *Early Human Development*, *86*, 729–732. doi: 10.1016/j.earlhumdev.2010.08.005
- Kramer, M. S., Fombonne, E., Igumnov, S., Vanilovich, I., Matush, L., Mironova, E., . . . Platt, R. W. (2008). Effects of prolonged and exclusive breastfeeding on child behavior and maternal adjustment: evidence from a large, randomized trial. *Pediatrics*, *121*, e435–e440. doi: 10.1542/peds.2007-1248
- Kramer, M. S., Fombonne, E., Matush, L., Bogdanovich, N., Dahhou, M., & Platt, R. W. (2011). Long-term behavioural consequences of infant feeding: the limits of observational studies. *Paediatric and Perinatal Epidemiology*, *25*, 500–506. doi: 10.1111/j.1365-3016.2011.01211.x
- Kramer, M. S., Matush, L., Bogdanovich, N., Aboud, F., Mazer, B., Fombonne, E., . . . Platt, R. W. (2009). Health and development outcomes in 6.5-y-old children breastfed exclusively for 3 or 6 mo. *The American Journal of Clinical Nutrition*, *90*, 1070–1074. doi: 10.3945/ajcn.2009.28021
- Lakshman, R., Ogilvie, D., & Ong, K. K. (2009). Mothers’ experiences of bottle-feeding: a systematic review of qualitative and quantitative studies. *Archives of Disease in Childhood*, *94*, 596–601. doi: 10.1136/adc.2008.151910
- Lauer, J. A., Betrán, A. P., Barros, A. J., & de Onís, M. (2006). Deaths and years of life lost due to suboptimal breast-feeding among children in the developing world: a global

- ecological risk assessment. *Public Health Nutrition*, 9, 673–685. doi:
10.1079/PHN2005891
- Lee, E. (2007). Health, morality, and infant feeding: British mothers' experiences of formula milk use in the early weeks. *Sociology of Health & Illness*, 29, 1075–1090. doi:
10.1111/j.1467-9566.2007.01020.x
- Lee, J., Min, S. K., Kim, K.-H., Kim, B., Cho, S. J., Lee, S.-H., . . . Suh, S.-Y. (2012). Differences in temperament and character dimensions of personality between patients with Hwa-byung, an anger syndrome, and patients with major depressive disorder. *Journal of Affective Disorders*, 138, 110–116.
- Lind, J. N., Li, R., Perrine, C. G., & Schieve, L. A. (2014). Breastfeeding and later psychosocial development of children at 6 years of age. *Pediatrics*, 134, 36–41. doi:
10.1542/peds.2014-0646G
- Luengo Kanacri, B. P., Pastorelli, C., Eisenberg, N., Zuffianò, A., & Caprara, G. V. (2013). The development of prosociality from adolescence to early adulthood: The role of effortful control. *Journal of Personality*, 81, 302-312.
- Makkonen, T., Ruoppila, I., Rönkä, T., Timonen, S., Valvanne, L., & Österlund, K. (1981). *Operaatio perhe – isä ja synnytys: Tutkimus perhesynnytyksestä, vierihoidosta ja esikoisperheen vuorovaikutuksesta. Lapsiraportti A 34. [Operation family. Child report, No. A. 34].* Helsinki: Mannerheim League of Child Welfare.
- McDowell, M. M., Wang, C. Y., & Kennedy-Stephenson, J. (2008). *Breastfeeding in the United States: findings from the national health and nutrition examination surveys, 1999–2006* (No. 5). New York: US Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics.

- Merjonen, P., Jokela, M., Pulkki-Råback, L., Hintsanen, M., Raitakari, O. T., Viikari, J., & Keltikangas-Järvinen, L. (2011). Breastfeeding and offspring hostility in adulthood. *Psychotherapy and Psychosomatics*, *80*, 371–373. doi: 10.1159/000324748
- Michaelsen, K. F., Larsen, P. S., Thomsen, B. L., & Samuelson, G. (1994). The Copenhagen cohort study on infant nutrition and growth: duration of breast feeding and influencing factors. *Acta Paediatrica*, *83*, 565–571.
- Moore, E. R., Anderson, G. C., Bergman, N., & Dowswell, T. (2007). Early skin-to-skin contact for mothers and their healthy newborn infants. *Cochrane Database of Systematic Reviews*, *3*(3). doi: 10.1002/14651858.CD003519.pub2
- Müller, O., & Krawinkel, M. (2005). Malnutrition and health in developing countries. *Canadian Medical Association Journal*, *173*, 279-286. doi: 10.1503/cmaj.050342
- Narvaez, D., Gleason, T., Wang, L., Brooks, J., Lefever, J. B., Cheng, Y., & Centers for the Prevention of Child Neglect (2013). The evolved development niche: Longitudinal effects of caregiving practices on early childhood psychosocial development. *Early Childhood Research Quarterly*, *28*, 759–773. doi: 10.1016/j.ecresq.2013.07.003
- O'Brien, E., Konrath, S. H., Grühn, D., & Hagen, A. L. (2012). Empathic concern and perspective taking: Linear and quadratic effects of age across the adult life span. *Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, *68*, 168-175.
- Oddy, W. H., Robinson, M., Kendall, G. E., Li, J., Zubrick, S. R., & Stanley, F. J. (2011). Breastfeeding and early child development: a prospective cohort study. *Acta Paediatrica*, *100*, 992–999. doi: 10.1111/j.1651-2227.2011.02199.x

- Oddy, W. H., Sly, P. D., de Klerk, N. H., Landau, L. I., Kendall, G. E., Holt, P. G., & Stanley, F. J. (2003). Breast feeding and respiratory morbidity in infancy: a birth cohort study. *Archives of Disease in Childhood*, *88*, 224–228. doi: 10.1136/adc.88.3.224
- Owen, C. G., Whincup, P. H., Odoki, K., Gilg, J. A., & Cook, D. G. (2002). Infant feeding and blood cholesterol: a study in adolescents and a systematic review. *Pediatrics*, *110*, 597–608. doi: 10.1542/peds.110.3.597
- Paal, T., & Bereczkei, T. (2007). Adult theory of mind, cooperation, Machiavellianism: The effect of mindreading on social relations. *Personality and Individual Differences*, *43*, 541–551.
- Papp, L. M. (2014). Longitudinal associations between breastfeeding and observed mother–child interaction qualities in early childhood. *Child: Care, Health and Development*, *40*, 740–746. doi: 10.1111/cch.12106
- Pélissolo, A., & Lépine, J. P. (2000). Normative data and factor structure of the Temperament and Character Inventory (TCI) in the French version. *Psychiatry Research*, *94*, 67-76.
- Pesonen, A., Räikkönen, K., Keskivaara, P., & Keltikangas-Järvinen, L. (2003). Difficult temperament in childhood and adulthood: Continuity from maternal perceptions to self-ratings over 17 years. *Personality & Individual Differences*, *34*, 19–31. doi: 10.1016/S0191-8869(02)00021-1
- Pulkki-Råback, L., Elovainio, M., Hakulinen, C., Lipsanen, J., Hintsanen, M., Jokela, M., ... & Keltikangas-Järvinen, L. (2015). Cumulative effect of psychosocial factors in youth on ideal cardiovascular health in adulthood: the Cardiovascular Risk in Young Finns Study. *Circulation*, *131*, 245–253. doi: 10.1161/CIRCULATIONAHA.113.007104
- Pulkki-Råback, L., Elovainio, M., Kivimäki, M., Raitakari, O. T., & Keltikangas-Järvinen, L. (2005). Temperament in childhood predicts body mass in adulthood: The cardiovascular

- risk in young Finns study. *Health Psychology*, *24*, 307–15. doi: 10.1037/0278-6133.24.3.307
- Raitakari, O.T., Juonala, M., Rönnemaa, T., Keltikangas-Järvinen, L., Räsänen, L., Pietikäinen, M., . . . Viikari, J. (2008). Cohort profile: the cardiovascular risk in Young Finns Study. *International Journal of Epidemiology*, *37*, 1220–1226. doi: 10.1093/ije/dym225
- Raju, T. N. (2011). Breastfeeding is a dynamic biological process - not simply a meal at the breast. *Breastfeeding Medicine*, *6*, 257–259. doi: 10.1089/bfm.2011.0081
- Ronningstam, E. (2010). Narcissistic personality disorder: a current review. *Current Psychiatry Reports*, *12*, 68–75.
- Schmidt, K. M., Llewellyn, P. L., Taylor, G. J., Weber, P. G., Hong, B., Sellers, R., Wise, C., Wolak, C., McGaw, L., & Nielson, S. (2003). Cloninger's Temperament and Character Inventory Correlates with Personality Characteristics of Organ Donation Advocates. *Journal of Clinical Psychology in Medical Settings*, *10*, 173–185.
- Schwarze, C. E., Hellhammer, D. H., Stroehle, V., Lieb, K., & Mobascher, A. (2015). Lack of breastfeeding: A potential risk factor in the multifactorial genesis of borderline personality disorder and impaired maternal bonding. *Journal of Personality Disorders*, *29*, 610–626. doi: 10.1521/pedi_2014_28_160
- Singer, T., & Klimecki, O. M. (2014). Empathy and compassion. *Current Biology*, *24*, R875–R878.
- Stewart-Knox, B., Gardiner, K., & Wright, M. (2003). What is the problem with breast-feeding? A qualitative analysis of infant feeding perceptions. *Journal of Human Nutrition and Dietetics*, *16*, 265–273. doi: 10.1046/j.1365-277X.2003.00446.x
- Tanaka, K., Kon, N., Ohkawa, N., Yoshikawa, N., & Shimizu, T. (2009). Does breastfeeding in the neonatal period influence the cognitive function of very-low-birth-weight infants at

- 5 years of age? *Brain and Development*, 31, 288–293. doi:
10.1016/j.braindev.2008.05.011
- Van Esterik, P. (2002). Contemporary trends in infant feeding research. *Annual Review of Anthropology*, 31, 257–278. doi: 10.1146/annurev.anthro.31.040402.085428
- Walfisch, A., Sermer, C., Cressman, A., & Koren, G. (2013). Breast milk and cognitive development - the role of confounders: a systematic review. *BMJ Open*, 3, e003259. doi: 10.1136/bmjopen-2013-003259
- Waters, E., Merrick, S., Treboux, D., Crowell, J., & Albersheim, L. (2000). Attachment security in infancy and early adulthood: A twenty-year longitudinal study. *Child Development*, 71, 684–689. doi: 10.1111/1467-8624.00176
- Wells, E. (1980). Behavioral pattern of children in school. Vitality Health Statistics, No. 113.
- Wold, A. E., & Adlerberth, I. (2002). Breast feeding and the intestinal microflora of the infant - implications for protection against infectious diseases. In *Short and Long Term Effects of Breast Feeding on Child Health* (pp. 77–93). Springer, Boston, MA.
- Woo, J. G., Dolan, L. M., Morrow, A. L., Geraghty, S. R., & Goodman, E. (2008). Breastfeeding helps explain racial and socioeconomic status disparities in adolescent adiposity. *Pediatrics*, 121, e458-e465.
- World Health Organization (WHO) & UNICEF (2003). *Global Strategy for Infant and Young Child Feeding*. World Health Organization.

Table 1. Means, standard deviations (SD), and frequencies of the study variables.

	Mean	SD	Frequency (%)
Received breastfeeding			1290 (92.5)
Not received breastfeeding			104 (7.5)
Duration of breastfeeding	3.80	3.60	
1–4 months			913 (65.5)
5–8 months			262 (18.8)
9–12 months			79 (5.7)
Over 12 months			36 (2.6)
Dispositional compassion			
1997	36.03	6.55	
2001	36.80	6.37	
2012	37.51	6.05	
Dispositional empathy			
1997	25.79	3.37	
2001	25.90	3.29	
2012	25.59	3.24	
Gender			
Female			761 (54.6)
Male			633 (45.4)
Age (in 1997)	27.15	4.91	
Occupational status			
Manual			437 (31.3)
Lower grade non-manual			269 (19.3)
Upper grade non-manual			688 (49.4)
Educational level			
Comprehensive school			456 (32.7)
High school or occupational school			667 (47.8)
Academic level			271 (19.4)
Parental occupational status			
Manual			489 (35.1)
Lower grade non-manual			641 (46.0)
Upper grade non-manual			264 (18.9)
Parental educational level			
Comprehensive school			397 (28.5)
High school or occupational school			607 (43.5)
Academic level			390 (28.0)

Table 2. Estimates (B) with 95% confidence intervals (CI) of breastfeeding variables, when predicting the course of compassion in 1997–2012 using multilevel models.

	Dispositional compassion			
	Model 1 (adjusted for age and gender)		Model 2 (adjusted for age, gender, and socioeconomic factors)	
	B	95% CI	B	95% CI
Model A				
No breastfeeding ^a	-	-	-	-
Breastfeeding	0.0085	-0.17; 0.18	-0.00086	-0.17; 0.17
Model B				
Breastfeeding				
0–4 months ^a	-	-	-	-
5–8 months	-0.044	-0.12; 0.11	-0.0024	-0.12; 0.11
9–12 months	0.19	-0.021; 0.37	0.19	-0.0093; 0.38
Over 12 months	0.0068	-0.28; 0.30	-0.0017	-0.29; 0.29
Model C				
Breastfeeding				
At most 12 months ^a	-	-	-	-
Over 12 months	0.032	-0.20; 0.26	0.038	-0.19; 0.27
Model D				
Breastfeeding (continuous score)	0.00060	-0.0066; 0.019	0.0059	-0.0067; 0.019

* $p < .05$ ** $p < .01$ *** $p < .001$ ^a The reference group. $N = 1394$

Table 3. Estimates (B) with 95% confidence intervals (CI) of breastfeeding variables, when predicting the course of empathy in 1997–2012 using multilevel models.

	Dispositional empathy			
	Model 1 (adjusted for age and gender)		Model 2 (adjusted for age, gender, and socioeconomic factors)	
	B	95% CI	B	95% CI
Model A				
Not received breastfeeding ^a	-	-	-	-
Received breastfeeding	-0.047	-0.22; 0.12	-0.055	-0.22; 0.11
Model B				
Breastfeeding				
0–4 months ^a	-	-	-	-
5–8 months	0.023	-0.090; 0.14	0.031	-0.81; 0.14
9–12 months	0.032	-0.16; 0.22	0.047	-0.14; 0.23
Over 12 months	0.11	-0.17; 0.39	0.10	-0.17; 0.39
Model C				
Breastfeeding				
At most 12 months ^a	-	-	-	-
Over 12 months	0.084	-0.14; 0.30	0.094	-0.12; 0.31
Model D				
Breastfeeding (continuous score)	0.0039	-0.0083; 0.016	0.0042	-0.0078; 0.016

* $p < .05$ ** $p < .01$ *** $p < .001$ ^a The reference group. *Note:* Models 3: Adjusted for age and gender. Models 4: Adjusted for age, gender, and socioeconomic factors in childhood and adulthood. $N = 1394$

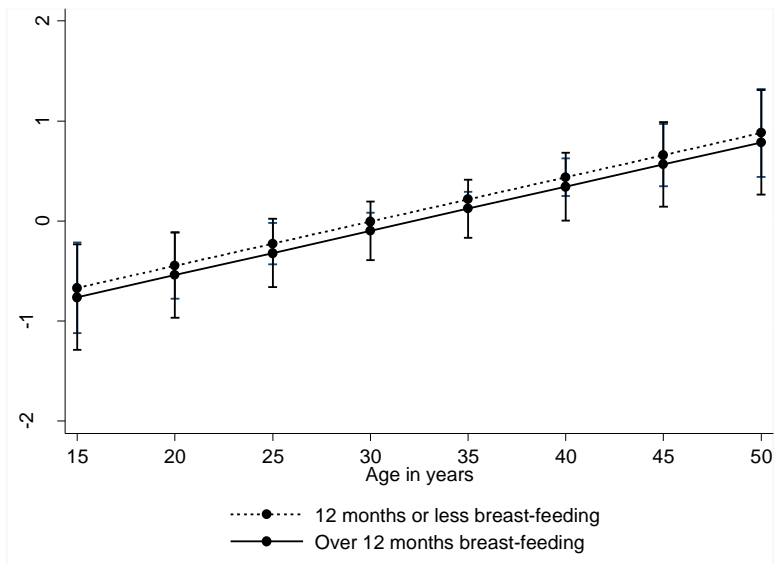


Figure 1. Growth trajectories of standardized scores of compassion from age 20 to 50 separately for individuals who received breastfeeding for 12 months or less and for over 12 months. Predicted means with 95% confidence intervals.

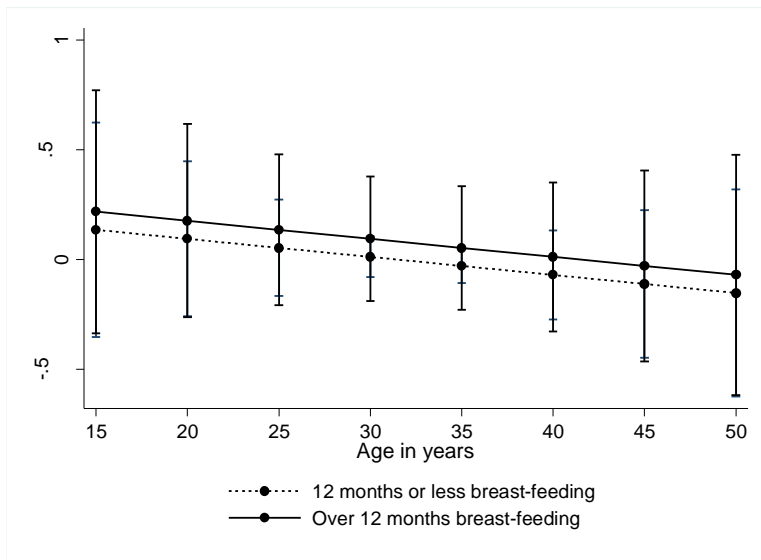


Figure 2. Growth trajectories of standardized scores of empathy from age 20 to 50 separately for individuals who received breastfeeding for 12 months or less and for over 12 months.

Predicted means with 95% confidence intervals.

Appendix A. Estimates (B) with 95% confidence intervals (CI) of breastfeeding, when predicting dispositional compassion by breastfeeding using linear regression analyses.

	Dispositional compassion			
	Model 1 (adjusted for age and gender)		Model 2 (adjusted for age, gender, and socioeconomic factors)	
	B	95% CI	B	95% CI
Model A				
Not received breastfeeding ^a	-	-	-	-
Received breastfeeding	-0.065	-1.23; 1.09	-0.11	-1.27; 1.04
Model B				
Breastfeeding				
0–4 months ^a	-	-	-	-
5–8 months	-0.10	-0.88; 0.67	-0.099	-0.088; 0.68
9–12 months	1.24	-0.077; 2.55	1.29	-0.022; 2.60
Over 12 months	-0.087	-2.00; 1.82	-0.11	-2.01; 1.80
Model C				
Breastfeeding				
At most 12 months ^a	-	-	-	-
Over 12 months	0.15	-1.36; 1.66	0.19	-1.33; 1.70
Model D				
Breastfeeding (continuous score)	0.033	-0.051; 0.12	0.032	-0.052; 0.12

* $p < .05$ ** $p < .01$ *** $p < .001$ ^a The reference group. $N = 1394$

Appendix B. Estimates (B) with 95% confidence intervals (CI) of breastfeeding, when predicting dispositional empathy by breast-feeding using linear regression analyses.

	Dispositional empathy			
	Model 1 (adjusted for age and gender)		Model 2 (adjusted for age, gender, and socioeconomic factors)	
	B	95% CI	B	95% CI
Model A				
Not received breastfeeding ^a	-	-	-	-
Received breastfeeding	-0.19	-0.77; 0.38	-0.22	-0.79; 0.35
Model B				
Breastfeeding				
0–4 months ^a	-	-	-	-
5–8 months	0.058	-0.33; 0.44	0.064	-0.032; 0.45
9–12 months	0.15	-0.50; 0.81	0.16	-0.48; 0.81
Over 12 months	0.29	-0.66; 1.24	0.25	-0.69; 1.19
Model C				
Breastfeeding				
At most 12 months ^a	-	-	-	-
Over 12 months	0.24	-0.51; 0.98	0.22	-0.53; 0.97
Model D				
Breastfeeding (continuous score)	0.010	-0.031; 0.052	0.0082	-0.033; 0.050

* $p < .05$ ** $p < .01$ *** $p < .001$ ^a The reference group. $N = 1394$