

Breastfeeding and the Development of Socio-Emotional Competencies: A Systematic Review

Samantha Turner,¹ Jessica Mayumi Maruyama,² Alicia Matijasevich,² and María Pastor-Valero^{1,3}

Abstract

Aim: To assess the current scientific evidence about the relationship between breastfeeding and the development of infant's socio-emotional competencies.

Materials and Methods: A systematic review of literature was conducted through PubMed, LILACS (*Literatura Latinoamericana y del Caribe en Ciencias de la Salud*), and PsycINFO of population-based cohorts. Records were screened, data extracted, and a quality assessment performed by two authors independently.

Results: Thirteen studies were included in the review with six finding a statistically significant association between breastfeeding and the development of socio-emotional competencies such as problem solving, agreeableness, and optimism. In five studies, no statistically significant association was found, and in three, a negative association existed. Regarding quality assessment, four studies had a strong global rating, four had a moderate rating, and five had a weak global rating.

Conclusion: Almost half (6/13) of the studies found a positive association between breastfeeding and the development of social-emotional competencies in infants; however, a great heterogeneity was present in the quality of the included studies. There is a need for further and higher quality research into this field of study.

Keywords: breastfeeding, socio-emotional competencies, systematic review

Introduction

BREASTFEEDING IS THE BASIS of initial nutrition in mammals, on which health, growth, and development of the species depend. In the human species, breast milk has frequently been substituted by industrial made formula developed in the 1970s and rates of breastfeeding have changed drastically over the last century.¹ Multiple complex factors located at individual, family, health system, and society levels influence the decision to breastfeed.²

The World Health Organization (WHO) recommends that breastfeeding should be initiated within the first hour of birth, and that infants should be exclusively breastfed (EBF) for the first 6 months, and mixed fed up until at least 24 months.³ However, in low- and middle-income countries, only 37% of infants younger than 6 months are EBF, while in most high-income countries, this figure is lower than 20%, even reaching under 1% in the United Kingdom.¹ Although

breastfeeding rates have risen over the last few decades, with EBF having increased up to around 15% between 1993 and 2013, continued breastfeeding at 12 months has shown a decrease over this period.¹

One of the main reasons such effort has been placed into promoting breastfeeding is the increased awareness of its benefits for both the infant and the mother.⁴⁻⁷ In the short term, breastfeeding has been associated with a lower mortality in both lower- and higher-income countries.^{4,5} Ip et al. showed a 36% reduction of sudden infant deaths in those who were ever breastfed compared with those never breastfed in high-income countries.⁴ Horta et al., in 2013, concluded that in low- and middle-income countries, around half of all episodes of diarrhea and a third of respiratory tract infections would be avoided by breastfeeding.⁵ Regarding the long-term effects, in 2015, Horta et al. found that longer breastfeeding duration was associated with a 26% reduction in overweight and obesity and a 35% decrease in type 2 diabetes.⁶ In another

¹Department of Public Health, History of Science and Gynaecology, Faculty of Medicine, Miguel Hernández University, Sant Joan d'Alacant, Spain.

²Departamento de Medicina Preventiva, Faculdade de Medicina FMUSP, Universidade de Sao Paulo, São Paulo, Brazil.

³CIBER in Epidemiology and Public Health (CIBERESP), Madrid, Spain.

meta-analysis⁷ an association was found between breastfeeding and intelligence quotient with an increase of up to 3.4 points in ever breastfed compared with never breastfed, which modified to 2.62 after controlling for maternal intelligence.

The research to date has predominantly focused on the association between breastfeeding and a multitude of outcomes related to prevention of diseases and cognitive development.⁴⁻⁷ Less attention has been paid to the effects of breastfeeding on offspring's socio-emotional competencies, although recently, there has been a surge in investigation into the physiological effects of breastfeeding on the infant brain and how this therefore affects functions such as the perception and processing of emotions.⁸

The meaning of socio-emotional competencies has been debated for centuries,⁹ and can be broadly defined as the capacity to integrate knowledge, skills, attitudes, and values to deal effectively with everyday challenges, which in turn enables self-development.⁹ They are considered to be acquired competences that are dynamic and multidimensional,¹⁰ developing through education, parenting, and environment at different stages in life.¹¹ These competencies include self-efficacy, motivation, self-control, and self-esteem among others.¹²

Over the last couple of decades, awareness of the impact of socio-emotional competencies on academic achievement has increased.^{13,14} Heckman and Kautz stated in 2012 that "success in life depends on personality traits that are not well captured by measures of cognition."¹¹ Duckworth and Seligman showed that self-discipline predicted the academic performance of eighth graders better than intelligence, and also predicts the improvement of grades over the school year.¹³ Conscientiousness (the tendency to be organized, hardworking, and responsible) is another competence that has shown to be comparable with intelligence in determining years of study and school performance, while emotional stability is associated with better academic development.¹⁴

Socio-emotional competencies have also been related to improved outcomes in other aspects of life apart from academic development.¹⁵⁻¹⁹ DeLisi et al. proved that self-control is a characteristic predictive of criminal activity in males.¹⁵ Roberts et al. reviewed literature linking personality traits to mortality, divorce, and occupational attainment.¹⁶ Findings included an association between conscientiousness, positive emotionality and extraversion, and increased longevity, while premature mortality was associated with neuroticism and pessimism. This could be explained through various theories, including how personality traits can affect systems such as immunology and neuroendocrinology, therefore predisposing certain medical conditions.¹⁷ Socio-emotional competencies can also be associated with certain health-promoting or health-damaging behaviors such as smoking, alcoholism, and poor diet,¹⁸ and they can also predict individual reaction to illness, which in turn affects adherence to treatment¹⁹ and coping mechanisms among others.

In light of the increasing awareness of the impact that socio-emotional competencies have on several beneficial outcomes and its possible link to breastfeeding, a systematic review of available literature was performed to describe the association between breastfeeding and the development of socio-emotional competencies. Methodological robustness of the included articles was also examined.

Materials and Methods

This systematic review was carried out in accordance with the Preferred Reporting Items for Systematic Review and Meta-analyses (PRISMA) statement 2009.²⁰ The study protocol was registered with the University of York Center for Reviews and Dissemination International prospective register of systematic reviews (PROSPERO Record CRD42019122489).

Search strategies

All studies published before December 20, 2018, were searched by two reviewers in the following databases: Medline, LILACS (*Literatura Latinoamericana y del Caribe en Ciencias de la Salud*), and PsycINFO. The definite search strategy was developed to be used on Medline, through PubMed, through key free text terms using the Medical Subject Headings (MeSH), Thesaurus developed by the U.S. National Library of Medicine, and Boolean operators as follows: ("Breast Feeding"[Title/Abstract] OR Breastfeeding [Title/Abstract] OR "Breast Feeding"[Mesh] OR "Lactation"[Mesh] OR Lactation[Title/Abstract]) AND ("socio emotional"[Title/Abstract] OR "emotional skills"[Title/Abstract] OR "self- knowledge"[Title/Abstract] OR "self-control"[Title/Abstract] OR "social awareness"[Title/Abstract] OR "social skills"[Title/Abstract] OR "decision making"[Title/Abstract] OR "emotional understanding"[Title/Abstract] OR "emotional expression"[Title/Abstract] OR "emotional regulation"[Title/Abstract] OR "social competence"[Title/Abstract] OR "social competencies"[Title/Abstract] OR "emotional development"[Title/Abstract] OR "social development"[Title/Abstract] OR "self management"[Title/Abstract] OR "self awareness"[Title/Abstract] OR "responsible decision making"[Title/Abstract] OR "relationship skills"[Title/Abstract] OR "social awareness"[Title/Abstract] OR Conscientiousness[Title/Abstract] OR "Mental health"[Title/Abstract] OR "anxiety"[Title/Abstract] OR "Emotional intelligence"[Title/Abstract] OR confidence[Title/Abstract] OR "Emotional intelligences"[Title/Abstract] OR "emotional intelligence"[Title/Abstract] OR "emotional stability"[Title/Abstract] OR "Psychological resilience"[Title/Abstract] OR "emotional intelligence"[Title/Abstract] OR Extraversion[Title/Abstract] OR "creative ability"[Title/Abstract] OR "creativity"[Title/Abstract] OR "curiosities"[Title/Abstract]).

In addition, a manual search of the reference lists of the articles finally included was performed. The same search strategy was adapted individually to each of the other databases used in this review.

Eligibility criteria

Studies were eligible for inclusion if they complied with the following criteria: they were population-based cohorts, adjusted to the objective of the study (association between breastfeeding and socio-emotional competencies), and were published in peer-reviewed journals. Language was restricted to English, Spanish, or Portuguese.

Studies were excluded if specific socio-emotional outcome data (e.g., estimates on prosocial behavior factors and peer relationship problems) were not reported. For example, if a study measured the effect that breastfeeding has on the development

of motor skills and socio-emotional competencies and published the overall results without detailing each outcome separately, it was excluded as it would not be possible to determine which proportion of the results refers specifically to the development of socio-emotional competencies, the aim of this review. In addition, studies that only measured psychiatric disorders (anxiety and depression) and behavioral problems (hyperactivity and inattention) were also excluded. Other exclusion criteria include the following: nonhuman, cross-sectional, and case-control studies.

Study selection

The selection of relevant studies was carried out independently by two authors (S.T. and J.M.M.). Duplicates of the studies identified through the electronic bibliographic databases were removed. These two reviewers carried out an initial screening independently based on the title and abstract of the eligible publications. Finally, full articles were retrieved and their reference lists manually screened before being analyzed.

To be able to include a study, it was established that concordance between both authors (Cohen's Kappa) had to be >80%. Any disagreements that occurred under said requirement were resolved by a third reviewer (M.P.-V.) and full consensus with the rest of the authors.

Data extraction

Data were extracted from full-text articles by two reviewers (S.T. and J.M.M.) independently. This information was managed through double-entry tables that allowed errors to be detected and corrections to be made through the original studies.

The studies were arranged according to the variables under review with the aim of organizing and facilitating the understanding of the results, taking into account the following data: the journal and year of publication, the country in which the study was carried out, the main objective of the study and study design, source from which the study population was recruited (clinics and community), inclusion and exclusion criteria, how the exposure variable was categorized, the age at which socio-emotional competencies were measured, and the instrument used (Strengths and Difficulties Questionnaire [SDQ], Rutter's scale) as well as possible confounding variables selected for adjustment or stratified analysis and main results. (Table 1).

Quality assessment

A quality assessment of the studies included (Table 2) was also carried out. For this, a tool ad hoc based on the Newcastle-Ottawa Scale,²¹ the STROBE (Strengthening in reporting of observational studies in epidemiology) statement,²² and the Quality Assessment Tool for Quantitative Studies Dictionary,²³ which adapted to the aim of this review, was used.

The evaluation was performed by two reviewers (S.T. and J.M.M.), and final results were reached by consensus. The quality assessment tool used evaluated the information that should be present in the observational studies that were in the review. This information was divided into four categories: the representativeness of the study (category 1), which con-

sidered whether the population study was representative of the general population (item a), if both groups were selected from the same population (item b), and whether the follow-up rates were acceptable (item c); the exposure variable (category 2), which included the measurement of exposure (item a) and the length of the follow-up (item b); the outcome (category 3), including its measurement (item a), stratification of analysis (item b), consideration of confounding (item c), and the use of an appropriate quantitative measurement of association (item d); and discussion (category 4), which evaluated the discussion of the study's limitations (item a), an overall interpretation of the results (item b), and the source of funding (item c). Each item was scored from 1 to 3 where 1 complies fully with the evaluated item, 2 complies partially, and 3 does not comply or is not reported in the study.

Finally, given the inconsistent results across the included studies, a meta-analysis was rendered difficult and beyond the scope of the current article.

Results

Literature search

With the search strategy used, a total of 3,361 studies were identified through 3 databases (2,011 from Medline, 221 from LILACS, and 1,126 from PsycINFO) and 3 through a manual search of references. After removing duplicates and screening by title and abstract, 23 articles were assessed for eligibility. Of these, after reading the full texts, 13 were finally included in this systematic review (Fig. 1).

Description of included studies

In Table 1, the main descriptive information of the 13 selected articles is shown. All articles were written in English and published between 1995 and 2018. Seven studies²⁴⁻³⁰ (54%) were carried out in Europe, four³¹⁻³⁴ in North America (30%), and one³⁵ in Asia (8%) and Africa (8%).³⁶

The majority (85%) was either longitudinal studies^{28,29,31-34} (6 of the 13 studies, 46%) or birth cohorts^{24,25,27,35} (4 of 13, 30%), while one study³⁶ was an intervention follow-up cohort and the other²⁶ a randomized cluster trial and follow-up. The total sample size ranged between 50 and 30,446.

Socio-emotional competencies

The age at which socio-emotional competencies were measured varied between 12 weeks²⁸ and 34 years.³³ The main instrument used was the SDQ, which measures peer relationship problems and prosocial behavior, and was applied in five studies^{26,27,31,32,36} (38%). The second most commonly used instrument was the Revised Rutter Scale, applied in three studies^{27,30,35} (23%), measuring prosocial behavior and emotional difficulties. The Revised Infant Behavior Questionnaire (IBQ-R) was applied in two studies^{24,34} (15%), which focuses on extraversion, negative affectivity, and regulation. A further 10 other instruments were used: the Self-esteem Inventory,³⁵ Ages and Stages Questionnaire,²⁵ the Rothbart Infant Behavior Questionnaire,²⁸ Infant Characteristics Questionnaire, and Emotionality, Activity and Sociability Scale,²⁹ Early Childhood Behavior Questionnaire,³⁴ 24-Item Malaise Inventory, the British Social Adjustment Guides, and Self-efficacy,³⁰ and the Mini International Personality Item Pool³³ to measure socio-emotional

TABLE 1. MAIN CHARACTERISTICS OF THE INCLUDED STUDIES

References (country)	Design/objective	Population characteristics, setting and follow-up/sample size	Measurement of breastfeeding	Measurement of socio-emotional competencies	Adjusted analysis	Main results
Tumwine et al. ³⁶ (Uganda and Burkina Faso)	Intervention follow-up cohort to assess effect of EBF peer counseling on social-emotional development (peer problems) against control group	Women ≥ 7 months or visibly pregnant in Banfora (Burkina Faso) and Mbale district (Uganda). Children without a malformation that can interfere with breastfeeding. Follow-up: 5–8 years. Sample size: 1,083.	Breastfeeding not measured; divided into two groups; received peer counseling and control group.	SDQ	Socio-economic status, electricity, and duration of kindergarten	No statistically significant difference between both groups.
Lind et al. ³¹ (United States)	Longitudinal study to examine the association of breastfeeding duration with psychosocial development (peer problems and prosocial behavior) at 6 years of age	A nationally distributed consumer opinion panel that included mother-infant pairs in The Infant Feeding Practices Study II (criteria not included in the article). Follow-up: 6 years. Sample size: 1,442.	Never breastfed; breastfed < 6 months; breastfed for ≥ 6 months, but EBF < 3 months; breastfed for ≥ 6 months, EBF ≥ 3 .	SDQ	Race, maternal age, education, prepregnancy BMI, postpartum depression, smoking, marital status, poverty-to-income ratio, postnatal participation in the Special Supplemental Nutrition Program for Women, Infants, and Children, child gender, birth weight, and gestational age at birth	No statistically significant difference between duration and intensity of breastfeeding and peer problems and prosocial behavior.
De Lauzon-Guilain et al. ²⁴ (United Kingdom)	Birth cohort to examine the relationship between breastfeeding and infant temperament at 3 months (extraversion, negative affectivity, and regulation)	Mothers ≥ 16 years old attending single antenatal center in Cambridge, gave informed consent, selected from the Cambridge baby growth study. Children born between January 2006 and February 2009. Follow-up: 3 months. Sample size: 316.	Breastfed; MF; FF milk at 3 months.	IBQ-R	Infant age and the Index of Multiple Deprivation 2007	Breastfed and mixed fed had lower scores in extraversion breastfed 4.0, 95% CI: 3.9–4.1, MF 4.0, 95% CI: 3.8–4.1, FF 4.3, 95% CI: 4.2–4.5, and in regulation: breastfed 4.9, 95% CI: 4.8–5.0, MF 4.9, 95% CI: 4.8–5.1, FF 5.1, 95% CI: 5.0–5.2 compared to FF; breastfed infants had higher scores in negative affectivity, breastfed 3.0, 95% CI: 2.9–3.1 FF 2.8, 95% CI: 2.6–2.9 compared to FF.

(continued)

TABLE 1. (CONTINUED)

<i>References (country)</i>	<i>Design/objective</i>	<i>Population characteristics, setting and follow-up/sample size</i>	<i>Measurement of breastfeeding</i>	<i>Measurement of socio-emotional competencies</i>	<i>Adjusted analysis</i>	<i>Main results</i>
Kwok et al. ³⁵ (China)	Birth Cohort to examine the associations of breast feeding with emotional problems and self-esteem at ~11 years	Recruited at first postnatal visit to any of the 49 Maternal and Child Health Centres in Hong Kong. Children born between April 1, 1997, and May 31, 1997. Follow-up: 11 and 13 years. Sample size: 803.	EBF ≥ 3 months; partially breastfed for any length of time or EBF < 3 months; never breastfed.	Revised Parent's Rutter Scale and Form A of the Culture-free self-esteem inventories	Sex, age, PHQ-9 survey mode, parent's age, education, occupation, household income, mother's birthplace, and child's birth weight for gestational-age, birth order, second-hand smoke exposure	Partial breast feeding for any length of time or EBF < 3 months was associated with lower self-esteem 1.27, 95% CI: 1.06–1.51 compared to never being breastfed, but EBF > 3 months was not.
Belfort et al. ³² (United States)	Longitudinal study to examine associations of breastfeeding duration and exclusivity in infancy with social-emotional development (prosocial behavior) in mid-childhood	Women carrying a singleton gestation, understand English, receive prenatal care by 22 weeks, and not planning to move away selected from 1999 to 2002 at initial prenatal visit at one of eight obstetrical offices of Atrius Health in Massachusetts. Follow-up: 7–10 years. Sample size: 1,037.	Any breastfeeding; EBF; categorized by duration in months.	SDQ	Child age, sex, gestational age, birth weight for gestational age z-score, race and ethnicity, child care, and attendance at 6 months; mother age, parity, smoking status, depressive symptoms at 6 months postpartum, employment, and KBIT-II score; and parental education	Longer breastfeeding duration was not associated with substantially better social-emotional development.

(continued)

TABLE 1. (CONTINUED)

References (country)	Design/objective	Population characteristics, setting and follow-up/sample size	Measurement of breastfeeding	Measurement of socio-emotional competencies	Adjusted analysis	Main results
Jonas et al. ³⁴ (Canada)	Longitudinal study to examine the association between breastfeeding at 3 months and infant temperament (negative affectivity, extraversion, and effortful control) at 18 months and whether this link was affected by the mothers' anxiety and mediated by her sensitivity	Women ≥18 years of age, speak English or French without serious obstetric complications recruited during second trimester at the Women's Health Concerns Clinic. Children born between 2003 and 2004 without extremely low birth weight, prematurity, or any congenital diseases. Follow-up: 18 months. Sample size: 142.	Any breastfeeding; EBF; no breastfeeding.	IBQ-R at 3 and 6 months; Early Childhood Behavior Questionnaire at 18 months	Infant sex, birth weight, maternal age, and family income. Maternal sensitivity and attitudes to breastfeeding at 3 months, STAI at 18 months, total weeks of breastfeeding and early infant temperament at 3 and 6 months	Mothers who breastfed at 3 months showed higher maternal sensitivity at 6 months, which in turn was associated with reduced negative affect at 18 months (-0.065 , 95% CI, $p=0.008$) than those who did not breastfeed at 3 months. No direct effect of 3 months breastfeeding on negative affectivity. This mediation only occurred in women with higher STAI levels (scores ≥ 33.56) at 3 months postpartum.
McCrory and Murray ²⁵ (Ireland)	Birth cohort to examine whether breastfeeding is associated with neurodevelopmental advantages (communication, problem solving, and personal social abilities) at 9 months	Children who would have been 9 months between September 8 and end of April 9 were selected from the CBR, which included all births between December 1, 2007, and June 30, 2008. Follow-up: 9 months. Sample size: 11,134.	Two groups; never and ever breastfed. Duration of breastfeeding in seven subgroups; ≤1 week; 2 weeks to 1 month; 1–3 months; 3–6 months; ≥6 months; EBF 6 months; and EBF ≥6 months.	Ages and Stages Questionnaire	Birth weight, singleton status, and gestational age. Maternal age, ethnicity/racial background, socioeconomic status, household social class, maternal educational attainment, and maternal smoking status at 9 months	Those who were ever breastfed had significantly higher odds of passing the personal-social odds ratio 1.38, 95% CI: 1.23–1.54 and the problem solving component odds ratio 1.20, 95% CI: 1.06–1.36 than those never breastfed. There was little evidence of a dose–response effect.

(continued)

TABLE 1. (CONTINUED)

References (country)	Design/objective	Population characteristics, setting and follow-up/sample size	Measurement of breastfeeding	Measurement of socio-emotional competencies	Adjusted analysis	Main results
Kramer et al. ²⁶ (Belarus)	Randomized cluster trial and follow-up to compare the results of experimental and observational analyses of the association between breastfeeding and behavioral outcome (peer problems and prosocial behavior) data from the same children	Sample selected from 31 maternity hospitals in Belarus and affiliated polyclinics (one per hospital). Infants born healthy and at term in 1996–1997, weighed at least 2,500 g at birth, had 5-minute Apgar scores ≥ 5 , were initially breastfed, and were enrolled during their postpartum stay at the maternity hospital. Follow-up: 6.5 years. Sample size: 13,889.	ITT: received breastfeeding promotion or not; observational: any breastfeeding for <3 , ≥ 3 to <6 , ≥ 6 to <9 , ≥ 9 to <12 , and ≥ 12 months; EBF <3 , ≥ 3 to <6 , and ≥ 6 months.	SDQ	Age, sex, birth weight, geographical location, and parental education	ITT: no differences were observed; observational: no statistically significant association between duration of breastfeeding and peer problems and prosocial behavior.
Borra et al. ²⁷ (United Kingdom)	Birth cohort to investigate the relationship between breastfeeding and children's noncognitive development (prosocial and peer problems)	Children born in the Avon area in the early 1990s. Those recruited had either returned at least one questionnaire or attended a "Children in Focus" clinic by July 19, 1999, and returned at least one post-birth questionnaire. Follow-up: 10 years. Sample size: 12,268.	Two groups: breastfed at 4 weeks; not breastfed at 4 weeks.	Revised Rutter Parent Scale for Children at 42 months. SDQ at 7 and 10 years of age	Pregnancy and birth variables (e.g., mothers age, health, alcohol and smoking during pregnancy, type of delivery ...), child characteristics at birth (sex, birth weight, head circumference, crown-heel length ...), socioeconomic and demographic variables, parental education, breastfeeding attitudes and intentions.	Breastfeeding at 4 weeks is associated with less peer problems in year 3 (-0.077 , 95% CI, $p < 0.05$) than those who are not breastfed at 4 weeks. Prosocial behavior at 42 months shows a significant negative association with breastfeeding (-0.054 95% CI, $p < 0.05$).
Wells and Davies ²⁸ (United Kingdom)	Longitudinal study to compare behavioral activity (fussy, distress, soothability) of 25 FF and 25 breast-fed infants	Healthy term infants were recruited from the Rosie Maternity Hospital in Cambridge, UK. Follow-up: 12 weeks. Sample size: 50.	Two exposure groups: EBF; FF infants.	Two-day activity chart and Rothbart Infant Behavior Questionnaire 1978 version	No adjustments were made.	There were no significant differences between the two groups.

(continued)

TABLE 1. (CONTINUED)

References (country)	Design/objective	Population characteristics, setting and follow-up/sample size	Measurement of breastfeeding	Measurement of socio-emotional competencies	Adjusted analysis	Main results
Niegel et al. ²⁹ (Norway)	Longitudinal study to examine the association between difficult temperament (emotionality, activity and sociability), and breastfeeding at 6 and 18 months	All women who gave birth between 1999 and 2008 in all maternity hospitals (except 2) with >100 births/year in Norway. Follow-up: 6 and 18 months. Sample size: 30,446.	Two groups: fully breastfed for 6 months; not fully breastfed for 6 months.	Six months: 7-item "Fussy/Difficult" subscale of the Infant Characteristics Questionnaire 18 months: Emotionality, Activity and Sociability Scale	Six months: infant sex, gestational age, birth weight, delivery by caesarean section, being in external day care, and maternal parity, age, education, and smoking status 18 months: background variables, temperament, and breastfeeding at 6 months.	At 6 months, children with more difficult temperament were significantly less likely to have been "fully" breastfed (exclusively and predominantly breastfed) for the recommended period of 6 months (-0.15, 95% CI, $p < 0.0000$). At 18 months, there was no longer an association.
Cable et al. ³⁰ (United Kingdom)	Two Birth Cohorts NCDS and BCS70 to examine the role of breastfeeding on childhood psychosocial adjustment and adulthood psychological well-being (emotional distress and self-efficacy)	Recruitment through NCDS and BCS70. Children born with normal birth weight ($\geq 2,500$ g). Follow-up: for BCS70 10 and 30 years. Sample size: 7,304. Follow-up for NCDS: 11 and 33 years. Sample size: 6,205.	Two groups: breastfed ≥ 1 month; breastfed for <1 months; retrospective.	Childhood adjustment: NCDS British Social Adjustment Guides. BCS70 Rutter Child Behavior Scale; Well-being: 24-item Malaise Inventory and Self-efficacy	Maternal age, education, partnership, and parity. Birth order of child and living in a two-parent household.	Significant direct effect of breastfeeding ≥ 1 month on childhood psychosocial adjustment in girls from both cohorts (-0.061 NCDS and -0.203 BCS70 95% CI) $p < 0.05$ compared to those breastfed for <1 month. Breastfeeding ≥ 1 month was significantly associated with better adult psychological well-being in women in BCS70 (-0.09 emotional distress and 0.078 self-efficacy 95% CI), $p < 0.05$ compared to those breastfed <1 month.
Sutin et al. ³³ (United States)	Longitudinal study to examine whether breastfeeding is associated with adult personality (five personality dimensions) and well-being	Nationally representative sample of adolescents in the United States in grades 7-12 during the 1994-1995 school year. Follow-up: 25-34 years. Sample size: 13,007.	Categorized as breastfed for <3, 3-6, 6-9, 9-12, 12-24, >24 months, and not breastfed; retrospective.	Self-reported Mini International Personality Item Pool	Sex, age, education, and race. Birth weight, maternal education and age, household income during childhood, number of children in the family, and birth order.	Breastfeeding was associated with lower scores in neuroticism (-0.06), anxiety (-0.06), and hostility (-0.07) and higher in openness (0.11), agreeableness (0.03), and optimism (0.08) than those not breastfed.

BCS70, 1970 British Cohort Study; BMI, body mass index; CBR, Child Benefit Register; CI, confidence interval; EBF, exclusively breastfed; FF, formula fed; IBQ-R, Revised Infant Behavior Questionnaire; ITT, intention to treat; KBIT-II, Kaufman Brief Intelligence Test; MF, mixed feeding; NCDS, National Child Development Study; PHQ, Patient Health Questionnaire; SDQ, Strengths and Difficulties Questionnaire; STAI, State-Trait Anxiety Inventory.

TABLE 2. METHODOLOGICAL QUALITY OF THE INCLUDED STUDIES

References	Category 1: representativeness				Category 2: exposure			Category 3: outcomes			Category 4: discussion		
	Item a: represents general population?	Item b: similarity between groups?	Item c: follow-up complete?	Item a: measured accurately?	Item b: follow-up long enough?	Item a: outcomes accurately measured?	Item b: stratified according to duration of exposure?	Item c: confounding considered?	Item d: appropriate quantitative measurement of association?	Item a: limitations discussed?	Item b: overall interpretation?	Item c: funding published?	Global rating
Tumwine et al. ³⁶	Yes	Yes	No	No	Yes	Unclear/ somewhat	Yes	Unclear/ somewhat	Yes	Yes	Unclear/ somewhat	Yes	Weak
Lind et al. ³¹	No	Unclear/ somewhat	No	Unclear/ somewhat	Yes	No	Yes	Yes	Yes	Unclear/ somewhat	Yes	Yes	Weak
De Lauzon- Guillain et al. ²⁴	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Weak
Kwok et al. ³⁵	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Moderate
Belfort et al. ³²	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Moderate
Jonas et al. ³⁴	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Strong
McCrory and Murry ²⁵	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Strong
Kramer et al. ²⁶	Unclear/ somewhat	Yes	Yes	Yes	Yes	Yes	Yes	Unclear/ somewhat	Yes	Yes	Yes	Yes	Strong
Borra et al. ²⁷	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Strong
Wells and Davies ²⁸	No	No	Yes	Yes	No	Unclear/ somewhat	No	No	No	Yes	Yes	No	Weak
Niegel et al. ²⁹	No	Unclear/ somewhat	Yes	Unclear/ somewhat	Yes	Yes	Yes	Yes	Unclear/ somewhat	Yes	Yes	Yes	Moderate
Cable et al. ³⁰	Yes	Yes	Yes	No	Yes	Yes	No	Unclear/ somewhat	Yes	Yes	Yes	Yes	Weak
Sutin et al. ³³	Yes	Yes	Yes	No	Yes	Yes	Yes	Unclear/ somewhat	Yes	Yes	Yes	Yes	Moderate

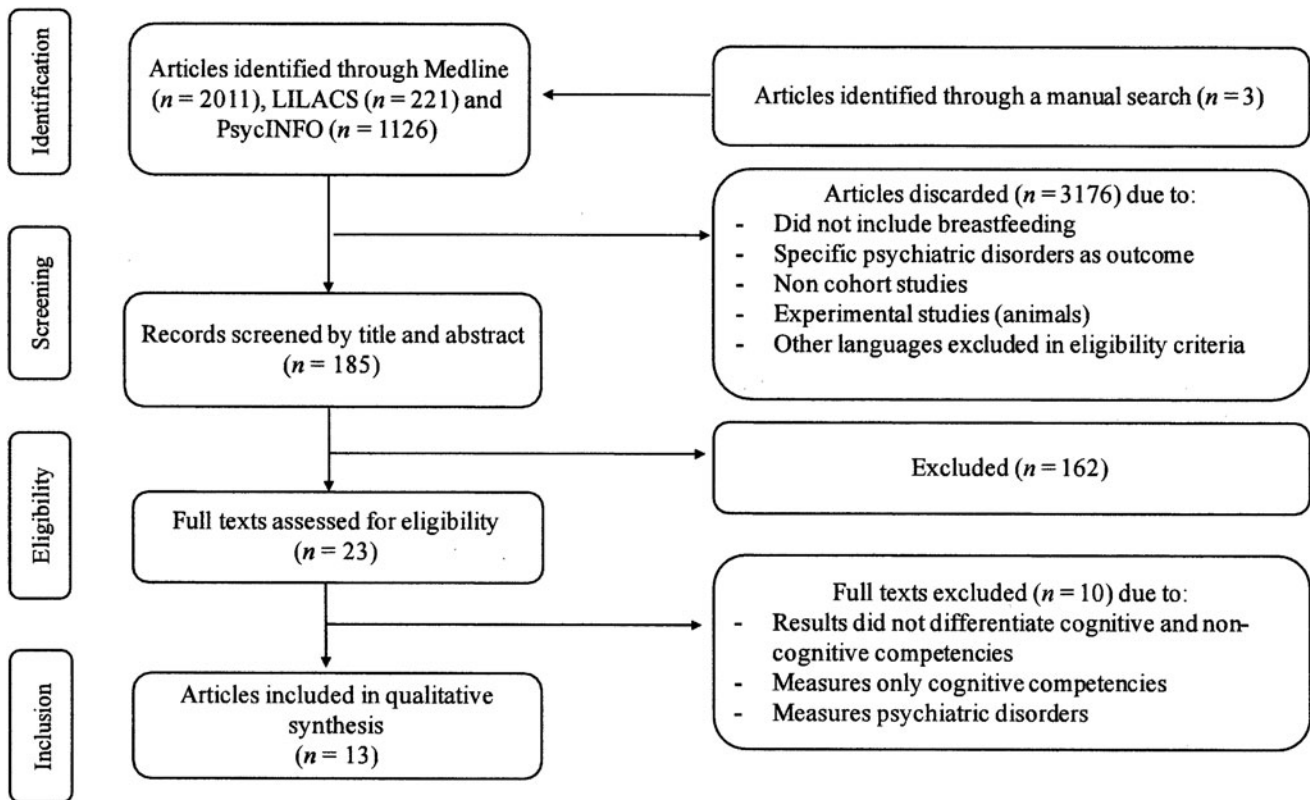


FIG. 1. Flowchart outlining study selection.

competencies such as communication, problem solving, emotional distress, soothability, negative affectivity, and extraversion. In 3 studies, socio-emotional competencies were self-assessed,^{30,33,35} while in 11^{24–29,31,32,34–36} they were reported by parents and 4^{26,27,30,32} by teachers.

Breastfeeding

In the majority of studies,^{24–29,31,32,34,35} breastfeeding information was collected at the time of exposure, while in two studies,^{30,33} it was reported retrospectively. In Tumwine et al.,³⁶ analysis was not stratified by breastfeeding, instead, as an intervention follow-up cohort, it compared a group that had received breastfeeding promotion against a control group. In Kramer et al.,²⁶ two types of analysis were carried out, first between an intervention (breastfeeding promotion) and control group and second depending on actual breastfeeding duration and intensity.

In respect of how exposure was categorized, over half of the studies^{24,27–30,34,35} (54%) established 2 or 3 exposure groups depending on exclusive breastfeeding, no breastfeeding, or any/mixed feeding in a certain amount time, while 5^{25,26,31–33} of the 13 studies (38%) measured the duration of breastfeeding in months.

Adjusted analysis

Adjustment to analysis was made to 12 of the 13 studies. The most frequent covariates that were adjusted for were maternal age, education, and occupation, and child birth weight, gestational age, and sex. Wells and Davies²⁸ was the

only study to not make any adjustment to the analysis. Only two studies^{31,32} took into account maternal mental health as a covariate.

Main results

Table 1 also shows the main results of each study after full adjustment for covariates has been made. In four studies, there was a statistically significant association between breastfeeding and personal-social abilities and problem solving,²⁵ less peer problems,²⁷ lower neuroticism, anxiety and hostility with higher optimism, agreeableness, and openness,³³ and lower negative affectivity.³⁴ Specifically, in Jonas et al.,³⁴ the positive effect was mediated through maternal sensitivity and only occurred in mothers with higher anxiety levels. In Niegel et al.,²⁹ the statistically significant association found between breastfeeding and lower difficult temperament at 6 months no longer existed at 18 months. A positive effect was also seen in Cable et al.³⁰ regarding childhood psychosocial adjustment and adulthood psychological well-being, but only in females. In five studies,^{26,28,31,32,36} no statistically significant association was found between breastfeeding and socio-emotional competencies. In counter position, breastfeeding was found to have a negative impact on socio-emotional competencies in three studies; in De Lauzon-Guillain et al.,²⁴ breastfeeding was associated with lower extraversion and regulation and higher negative affectivity, in Kwok et al.³⁵ the association was with lower self-esteem, and finally, in Borra et al.,²⁷ with less prosocial behavior.

Quality assessment

Details of the quality assessment of the 13 studies included are given in Table 2. In this systematic review, seven^{25,27,30,33–36} studied a sample that was considered representative of the general population, while in one study,²⁶ this was unclear. In the majority of the studies^{25–27,30,32–36} (69%), the exposed and unexposed groups were similar and recruited from the same population, while in 10 studies,^{25–30,32–35} the follow-up was complete or of an acceptable rate with reasons of loss explained. Regarding the exposure variable (breastfeeding), this was measured accurately in less than half of the studies,^{25–28,32,34} but the vast majority^{25–27,29–36} (84%) did have a follow-up long enough for outcomes to occur. In nine studies,^{25–27,29,30,32–35} the outcome was accurately measured, and in eight,^{24,25,27,29,31,32,34,35} potential confounding was considered. Eleven studies^{24–27,29,31–36} stratified the analysis according to the duration of breastfeeding, while only one study²⁸ did not use an appropriate quantitative measurement of association. As for the discussion, 77% described all potential limitations,^{24–27,30,32–36} 11 studies^{24–30,32–35} (84%) reported an overall interpretation of the results taking into consideration relevant evidence, limitations, and possible generalization, and in all, but one,²⁸ the source of funding was published. A global rating was given to each study based on the amount of weak ratings it had; a study was considered strong if it had no weak ratings, moderate if it had one, and weak if it had two or more weak ratings. Only four studies had a strong global rating,^{25–27,34} four had a moderate rating,^{29,32,33,35} while five studies had a weak global rating.^{24,28,30,31,36}

Discussion

This systematic review evaluated the evidence relating the patterns and duration of breastfeeding to offspring's socio-emotional development. Based on the estimates from 13 studies included, a total of 6^{25,27,29,30,33,34} of the 13 studies described a positive association between breastfeeding (duration and intensity varied between studies) and social-emotional competencies such as less peer problems, lower neuroticism, anxiety and negative affectivity, and higher open and agreeableness. However, the quality rating of these studies varied substantially from strong to weak.

A crucial factor that explains the heterogeneity of the included studies is how socio-emotional competencies are defined and which instruments are used to measure them as this differs largely between the different studies. Multiple definitions for socio-emotional competencies have been proposed over the years, of which two have been more prominent; McClelland in 1973 used the term as an alternative to those abilities that are measured through intelligence tests. He defines socio-emotional competencies as a combination of abilities that allow the realization of higher functions.³⁷ Meanwhile, other authors such as Durand define socio-emotional competencies as a coordinated deployment of resources and assets that help to maximize development.³⁸ There is a large variety of instruments that can be used to measure different aspects of socio-emotional competencies, which in turn makes a systematic review of the evidence more difficult. Instruments used to measure temperament include the SDQ, the Child Behavioral

Questionnaire, the Rutter Scale, and Ages and Stages Questionnaire. Meanwhile, instruments such as the Pro-social Behavior Questionnaire focus more on social abilities and The Big Five Inventory on personality traits. Santos and Primi¹² 2014 constructed an instrument specifically to measure socio-emotional competencies in children of different school years and based this on previous instruments considered to be more suitable to evaluate these competencies. Of all the instruments used in the studies in this systematic review, only the SDQ was considered a suitable tool by Santos and Primi based on its predictive power, feasibility, flexibility, and psychometric properties. However, it was concluded that none of the instruments available at that moment in time possessed the ability to measure the wide spectrum of competencies that was required.

There was also a large variation on the age of offspring's socio-emotional assessment, from 12 weeks to 34 years. Rosenblum et al.³⁹ describe the different ages at which social and emotional competencies develop. By 2 months, most infants have developed social smiles and by 3 months, they can transmit positive emotional expressions. Laughter develops typically between 3 and 4 months and, by this time, infants enjoy social interaction. Between 7 and 9 months, infants clearly differentiate their primary caregiver and are wary of strangers. They can also distinguish and understand different emotional expressions. Between 18 and 21 months, there is an increase in self-awareness and emotions associated with this such as embarrassment, pride, and shyness.³⁹ Taking these milestones into account, it is possible that depending on the age of assessment, the findings of each study will vary. This should be taken into consideration when interpreting results of those studies that measured socio-emotional competencies at or below the age of 18 months. For example, De Lauzon-Guillain et al.,²⁴ which found a negative association, evaluates 3-month-old infants using the IBQ-R. This instrument includes an evaluation of fear of the unknown, which generally develops at around 7 months, and laughter, which only begins at around 3–4 months. The same situation occurs in Wells and Davies,²⁸ which found no statistically significant differences of soothability, fussiness, and distress between formula-fed and breastfed infants.

From 13 included articles in this review, only Jonas et al.³⁴ examined potential mechanisms underlying the link between breastfeeding and children's socio-emotional competencies, examining maternal sensitivity as a mediator of this association. Numerous studies have provided evidence of mediators for the association between breastfeeding and a multitude of offspring outcomes, including cognitive development.^{1,40} However, few have yet to analyze the relationship with emotional development.^{8,41} Krol et al.,⁸ 2015a, studied 8-month-old infants to examine whether and how the duration of exclusive breastfeeding impacts neural processing of emotional signals. Their results showed that infants with a higher duration of EBF (5 months or more) had an increased sensitivity to positive emotional information. Krol et al.⁴¹ showed that 7-month-old infants with the CC genotype of the CD38 gene (this genotype results in lower endogenous oxytocin levels) had more sensitivity to happy eyes when they had been exposed to a longer duration of breastfeeding, thus proposing

a role of breastfeeding on the development of emotional sensitivity through an increase of exogenous oxytocin. In addition, other hypothesized pathways that may explain a beneficial socio-emotional development of EBF children are related to nutritional properties of breast milk,⁴² better parenting practices, and infant attachment.⁴³ Future studies should explore the potential mechanisms involved in socio-emotional development of EBF children.

This systematic review poses a number of limitations, including methodological issues related to the included studies. First, of the two studies,^{30,33} in the review that measured the exposure variable retrospectively, neither one recognized this as a limitation, therefore not taking into account a possible recall bias. Breastfeeding measurement varied widely between studies, with some measuring intensity (i.e., Jonas et al.), others duration (i.e., Sutin et al.), and others both (i.e., Kwok et al.). Although the current breastfeeding recommendations by WHO confirm that infants should be EBF for 6 months,³ only 4 of the 13 studies in this review measured the effect of EBF for 6 months on socio-emotional development, of which 2^{25,29} found a positive association and the other 2^{26,32} found no association. This means that, when assessing the remaining nine studies,^{24,27,28,30,31,33–36} explaining their results through current guidelines is limited.

Less than half^{25–28,32,34} (six studies, 46%) measured the exposure variable accurately, that is, using objective and prospective measures to define exposure, which made establishing a comparison between studies difficult.

In addition, only two of the studies in this review used maternal mental health as a covariate.^{31,32} Extensive research has shown the negative effects of poor maternal mental health on adverse socio-emotional development of children.^{44–46} Children from severe and chronic depressive mothers were four times more likely to have peer relationship problems and lower prosocial behavior when compared to those from mothers with low depressive symptomatology.⁴⁷ A delay in emotional development also occurred in children of mothers with low self-efficacy and lower levels of optimism, as well as in those children who experienced less interactive play with their mothers.⁴⁶ These findings could complement those of Jonas et al., which found a significant association between breastfeeding at 3 months and lower negative affectivity at 18 months mediated through maternal sensitivity at 6 months only in those mothers with higher anxiety levels.

Finally, there is no MeSH term for socio-emotional competencies, which means that, although the search strategy was extensive, it is possible that not all the available literature was included in our research. The final sample was small, with only 13 studies included in the review, which could limit the results that were found.

The findings of this review are the result of a thorough, systematic process reviewing a large number of articles. A strength of this systematic review is the development of a specifically designed quality assessment, which was completed by two independent authors. During the initial screening of the literature, studies that only measured psychiatric problems such as offspring hyperactivity, anxiety, and behavior problems were discarded with the aim of avoiding a misconception between socio-emotional compe-

tencies and psychiatric disorders. In addition, studies that only published overall results for both cognitive abilities and socio-emotional competencies were excluded as to avoid the inclusion of the former in our findings. Finally, only longitudinal designed studies were considered with the aim of establishing a proper causal inference of the proposed association.

Conclusion

The vast benefits that breastfeeding has on health and motor and cognitive development have been researched and proven extensively. However, an association between breastfeeding and noncognitive development has been scarcely explored. This systematic review showed that almost half of the studies showed a positive association between breastfeeding and socio-emotional competencies; however, there is a lack of strong evidence to confirm such association. Further research into this issue is required, but more importantly, there is a need for the improvement of methodological rigor of such studies. Accurate breastfeeding assessment, the use of proper instruments for socio-emotional measurement, and unbiased analysis with inclusion of critical covariates such as maternal mental health will enable a better understanding of the relationship between the exposure and the outcome of interest. Such research could strengthen the evidence regarding the benefits of breastfeeding on offspring development and provide more subsidies to policy-makers for breastfeeding incentive policies.

Disclosure Statement

The authors have no conflicts of interest to declare.

Funding Information

J.M.M. is supported by a grant from Sao Paulo Research Foundation (FAPESP; Research Grant No. 2017/22723-5). Dr. Matijasevich was a visiting Professor at the Public Health Department of Miguel Hernández University, supported by a Research and Development Grant 2018 from this University.

References

1. Victora CG, Bahl R, Barros AJ, et al. Breastfeeding in the 21st century: Epidemiology, mechanisms, and lifelong effect. *Lancet* 2016;387:475–490.
2. Dyson L, Renfrew MJ, McFadden A, et al. Policy and public health recommendations to promote the initiation and duration of breast-feeding in developed country settings. *Public Health Nutr* 2010;13(Suppl 1):137–144.
3. Guideline: Counselling of Women to Improve Breastfeeding Practices. Geneva: World Health Organization, 2018, pp. 1–11.
4. Ip S, Chung M, Raman G, et al. Breastfeeding and maternal and infant health outcomes in developed countries. *Evid Rep Technol Assess (Full Rep)* 2007;153:1–186.
5. Horta BL, Victora CG; World Health Organization. Short-Term Effects of Breastfeeding: A Systematic Review of the Benefits of Breastfeeding on Diarrhoea and

- Pneumonia Mortality. Geneva: World Health Organization, 2013.
6. Horta BL, de Mola CL, Victora CG. Long-term consequences of breastfeeding on cholesterol, obesity, systolic blood pressure, and type-2 diabetes: Systematic review and meta-analysis. *Acta Paediatr Suppl* 2015;104:30–37.
 7. Horta BL, de Mola CL, Victora CG. Breastfeeding and intelligence: Systematic review and meta-analysis. *Acta Paediatr Suppl* 2015;104:14–19.
 8. Krol KM, Rajhans P, Missana M, et al. Duration of exclusive breastfeeding is associated with differences in infants' brain responses to emotional body expressions. *Front Behav Neurosci* 2015;8:459.
 9. Brandão HP. Competencies at work: an analysis of Brazilian scientific papers. *Estudos de Psicologia* 2007;12(Suppl 2):149–158.
 10. Gondim SM, Marais FA, Brantes CA. Socio-emotional competences: A key factor on the development of work competences. *Psicol Organ Trab* 2014;14(Suppl 4):394–406.
 11. Heckman J, Kautz T. Hard evidence on soft skills. *J Labour Econ* 2012;19(Suppl 4):451–464.
 12. Santos D, Primi R. Desenvolvimento socioemocional e aprendizado escolar: Uma proposta de mensuração para apropriar políticas públicas. São Paulo: Instituto Ayrton Senna, 2014.
 13. Duckworth AL, Seligman ME. Self-discipline outdoes IQ in predicting academic performance of adolescents. *Psychol Sci* 2005;16(Suppl 12):939–944.
 14. Lleras C. Do skills and behaviours in high school matter? The contribution of noncognitive factors in explaining differences in educational attainment and earnings. *Soc Sci Res* 2008;37:888–902.
 15. DeLisi M, Beaver KM, Vaughn MG, et al. Personality, gender and self-control theory revisited: Results from a sample of institutionalized juvenile delinquents. *Appl Psychol Crim Justice* 2010;6(Suppl 1):5–12.
 16. Roberts BW, Kuncel NR, Shiner R, et al. The power of personality: The comparative validity of personality traits, socioeconomic status, and cognitive ability for predicting important life outcomes. *Perspect Psychol Sci* 2007;2(Suppl 4):313–345.
 17. Miller GE, Cohen S, Rabin BS, et al. Personality and tonic cardiovascular, neuroendocrine, and immune parameters. *Brain Behav Immun* 1999;13:109–123.
 18. Bogg T, Roberts BW. Conscientiousness and health behaviors: A meta-analysis of the leading behavioral contributors to mortality. *Psychol Bull* 2004;130:887–919.
 19. Kenford SL, Smith SS, Wetter DW, et al. Predicting relapse back to smoking: Contrasting affective and physical models of dependence. *J Consult Clin Psychol* 2002;70:216–227.
 20. Moher D, Liberati A, Tetzlaff J, et al.; The PRISMA Group. Preferred reporting items for systematic review and meta-analyses: The PRISMA statement. *PLoS Med* 2009;6(Suppl 7):e1000097.
 21. Wells GA, Shea B, O'Connell D, et al. The Newcastle-Ottawa Scale (NOS) for Assessing the Quality of Nonrandomised Studies in Meta-Analyses. The Ottawa Hospital, 2011. Available at www.ohri.ca/programs/clinical_epidemiology/oxford.asp (accessed April 18, 2019).
 22. Elm EV, Altman DG, Egger M, et al. Strengthening the reporting of observational studies in epidemiology (STROBE) statement: Guidelines for reporting observational studies. *BMJ* 2007;335:806–808.
 23. Effective Public Health Practice Project. Quality assessment tool for quantitative studies. 2009. Available at <https://merst.ca/ephpp> (accessed April 25, 2019).
 24. De Lauzon-Guillain B, Wijndaele K, Clark M, et al. Breastfeeding and infant temperament at age three months. *PLoS One* 2012;7(Suppl 1):e29326.
 25. McCrory C, Murray A. The effect of breastfeeding on neuro-development in infancy. *Matern Child Health J* 2013;17:1680–1688.
 26. Kramer MS, Fombonne E, Matush L, et al. Long term behavioural consequences of infant feeding: The limits of observational studies. *Paediatr Perinat Epidemiol* 2011;25(Suppl 6):500–506.
 27. Borra C, Iacovou M, Sevilla A. The effect of breastfeeding on children's cognitive and noncognitive development. *Labour Econ* 2012;19:496–515.
 28. Wells JCK, Davies PSW. Diet and behavioral activity in 12 week-old infants. *Ann Hum Biol* 1995;22(Suppl 3):207–215.
 29. Niegel S, Ystrom E, Hagtvet KA, et al. Difficult temperament, breastfeeding and their mutual prospective effects: The Norwegian Mother and Child Cohort Study. *J Dev Behav Pediatr* 2008;29:458–462.
 30. Cable N, Bartley M, McMunn A, et al. Gender differences in the effect of breastfeeding on adult psychological well-being. *Eur J Public Health* 2011;22(Suppl 5):1–6.
 31. Lind JN, Li R, Perrine CG, et al. Breastfeeding and later psychosocial development of children at 6 years of age. *Pediatrics* 2014;134(Suppl 1):36–41.
 32. Belfort MB, Rifas-Shiman SL, Kleinman KP, et al. Infant breastfeeding duration and mid-childhood executive function, behavior, and social-emotional development. *J Dev Behav Pediatr* 2016;37(Suppl 1):43–52.
 33. Sutin AR, Stephan Y, Terracciano A. Breastfeeding and adult personality. *Eur J Pers* 2016;30(Suppl 5):484–491.
 34. Jonas W, Atkinson L, Steiner M, et al. Breastfeeding and maternal sensitivity predict early infant temperament. *Acta Paediatr* 2015;104:678–686.
 35. Kwok MK, Leung GM, Schooling CM. Breast feeding and early adolescent behaviour, self-esteem and depression: Hong Kong's "Children of 1997" birth cohort. *Arch Dis Child* 2013;98:887–894.
 36. Tumwine JK, Nankabira V, Abdoulaye Diallo A, et al. Exclusive breastfeeding promotion and neuropsychological outcomes in 5–8 year old children from Uganda and Burkina Faso: Results from the PROMISE EBF cluster randomized trial. *PLoS One* 2018;13(Suppl 2):e0191001.
 37. McClelland DC. Testing for competence rather than for intelligence. *Am Psychol* 1973;28(Suppl 1):1–14.
 38. Durand T. L'alchimie de la compétence. *Revue française de gestion* 2006;160:261–292.
 39. Rosenblum KL, Dayton CJ, Muzik M. Social and emotional milestones. In: Handbook of Infant Mental Health, 4th ed., Zeanah CH, ed. London: The Guilford Press, 2019, pp. 95–104.
 40. Rogers SL, Blissett J. Breastfeeding duration and its relation to weight gain, eating behaviours and positive

- maternal feeding practices in infancy. *Appetite* 2017;108: 399–406.
41. Krol KM, Monakhov M, Lai PS, et al. Genetic variation in CD38 and breastfeeding experience interact to impact infant's attention to social eyes cues. *Proc Natl Acad Sci U S A* 2015;112(Suppl 39):5434–5442.
 42. Koletzko B, Agostoni C, Carlson SE, et al. Long chain polyunsaturated fatty acids (LC-PUFA) and perinatal development. *Acta Paediatr* 2001;90:460–464.
 43. Gibbs BG, Forste R, Lybbert E. Breastfeeding, parenting and infant attachment behaviors. *Matern Child Health J* 2018;22(Suppl 4):579–588.
 44. McDonald SW, Kehler HL, Tough SC. Risk factors for delayed social-emotional development and behaviour problems at age two: Results from the All Our Babies/Families cohort. *Health Sci Rep* 2018;1(Suppl 10):e82.
 45. Goodman SH, Rouse MH, Connell AM, et al. Maternal depression and child psychopathology: A meta-analytic review. *Clin Child Fam Psych* 2011;14:1–27.
 46. Klein DN, Durbin CE, Shankman SA. Personality and mood disorders. In: *Handbook of Depression*, 2nd Edition. Gotlib IH, Hammen CL, eds. New York: The Guilford Press, 2009, pp. 93–112.
 47. Maruyama J, Pastor-Valero M, Santos I, et al. Impact of maternal depression trajectories on offspring socioemotional competences at age 11: 2004 Pelotas birth cohort. *J Affect Disord* 2019;253:8–17.

Address correspondence to:

Samantha Turner, MD

Department of Public Health,

History of Science and Gynecology

Faculty of Medicine

Miguel Hernández University

Campus de San Juan, Ctra. N332, Alicante-Valencia

03550 Sant Joan d'Alacant

Spain

E-mail: samantha.turner@goumh.umh.es