

ORIGINAL ARTICLE

Perinatal and Early-Life Determinants of Infantile Colic and Non-Colic Excessive Crying

SIRAJ NABI¹, JAVID IQBAL², FARHEEN NASEEM³, SABA WAMIQ⁴, MOHAMMAD SHAHID IQBAL⁵¹Lecturer Department of Forensic Medicine & Toxicology People's University of Medical and Health Sciences Nawabshah²Médico de familia en función Pediatra Department Pediatría Servicio andaluz de salud Almería Spain³senior medical officer Department of Paeds emergency The Indus hospital and Health network Karachi⁴Assistant professor Department of pediatric medicine, multan medical and dental college /ibn-e- siena hospital and research Institue Multan, Pakistan⁵Medical officer, children ward THQ hospital Kotli sattian, MurreeCorrespondence to: Siraj Nabi, Email: sirajnabidepar@gmail.com

ABSTRACT

Background: Excessive crying during infancy, including infantile colic and non-colic excessive crying, is a common concern among caregivers and a frequent cause of pediatric consultations.

Objectives: To investigate the perinatal and early-life risk factors associated with infantile colic and non-colic excessive crying in term infants during the first three months of life.

Methods: This prospective observational cohort study was conducted at ibn-e- siena hospital and research Institue Multan during January 2022 to November 2022. A total of 380 infants and their primary caregivers were enrolled in the study. Infants born at term (gestational age ≥ 37 weeks), singleton births, and the absence of major congenital anomalies or chronic illnesses were included in the study. Participants comprised of premature birth, significant perinatal asphyxia, known genetic syndromes, and parents with major psychiatric disorders that could impede reliable reporting were excluded.

Results: Infantile colic was observed in 17.6% of infants and non-colic excessive crying in 22.4%, with a combined prevalence of 40%. Cesarean delivery (AOR = 2.14; 95% CI: 1.23–3.71), formula feeding (AOR = 2.89; 95% CI: 1.65–5.06), high maternal prenatal stress (AOR = 1.78; 95% CI: 1.01–3.12), and passive smoking (AOR = 1.94; 95% CI: 1.05–3.59) were significant predictors of infantile colic. Non-colic excessive crying was independently associated with maternal postnatal depression (AOR = 2.37; 95% CI: 1.31–4.31), low maternal-infant bonding (AOR = 1.88; 95% CI: 1.06–3.31), and lower household income (AOR = 1.65; 95% CI: 1.01–2.69).

Conclusion: It is concluded that both infantile colic and non-colic excessive crying are influenced by distinct but overlapping perinatal and psychosocial factors. While infantile colic is more strongly associated with biological and environmental exposures, non-colic crying is linked to caregiver mental health and socioeconomic stress.

Keywords: Perinatal, Early life risk factor, colic, non colic, excessive crying

INTRODUCTION

Excessive crying during infancy is a significant concern for caregivers and healthcare providers, often prompting clinical attention and causing considerable familial stress. Early crying disturbances include infantile colic which remains the most extensively studied yet poorly understood case according to Wessel's criteria¹. Non-colic excessive crying stands as a problematic condition among infants that does not fulfill diagnostic requirements yet severely affects their health alongside that of their parents. The latest research demonstrates that both pre-birth factors along with infancy environment play crucial roles in creating these disorders². During the first thousand days from the gestational period through to infancy lies a crucial developmental stage that shapes future pathways because disturbances at this time might create a risk for infant regulatory problems such as crying indefinitely. Infant regulatory behaviors are shaped by multiple biological factors through their brain development processes alongside the complex interactions between the gut microbiome and psychological connections between care providers and their offspring³.

Proofs continue to establish that the conditions faced by a fetus during birth determine essential neurobehavioral development outcomes. Research indicates maternal pregnancy stress leads to hypothalamic-pituitary-adrenal axis disturbances in offspring which increases infant irritability while compromising their ability to self-calm⁴. Multiple perinatal exposures including smoking and maternal obesity with gestational diabetes and particular medications result in inflammation along with neurodevelopmental changes which produce underlying causes of crying disorders⁵. Research on the gut-brain axis in colic considers the different microbial populations infants acquire through vaginal or cesarean delivery since gut-brain communication potentially differs between these birth methods. The initial months of life depend heavily on the care patterns of feeding and the state of gut health⁶. Studies have demonstrated that breastfeeding lowers the probability of colic development by bringing beneficial differences between human milk constituents and the natural gut microbial makeup.

The introduction of formula milk or early consumption of cow milk proteins together with gastrointestinal dysbiosis are potential causes that lead to excessive crying syndromes⁷. Premature gut microbiota directly shapes gastrointestinal symptoms while scientists recognize their important influence on emotional and stress-related behavior which establishes a potential mechanism linking early microbial exposures to infant crying behavior. All psychosocial elements in combination with environmental factors remain significant⁸. The excessive crying patterns result from the interaction between maternal depression and anxiety parental coping methods and family stress elements and infant tolerance traits. A non-responsive caregiving environment combined with parental stress makes infants cry longer than normally seen regardless of their biological tendencies because they lack successful caregiver relationships⁹. A biopsychosocial model presents the most accurate understanding of infantile colic and non-colic excessive crying by combining biological susceptibility with environmental influences¹⁰.

Objective: To investigate the perinatal and early-life risk factors associated with infantile colic and non-colic excessive crying in term infants during the first three months of life.

METHODOLOGY

This prospective observational cohort study was conducted at ibn-e- siena hospital and research Institue Multan during January 2022 to November 2022. A total of 380 infants and their primary caregivers were enrolled in the study. Infants born at term (gestational age ≥ 37 weeks), singleton births, and the absence of major congenital anomalies or chronic illnesses were included in the study. Participants comprised of premature birth, significant perinatal asphyxia, known genetic syndromes, and parents with major psychiatric disorders that could impede reliable reporting were excluded.

Data Collection: Data were collected in three domains: perinatal exposures, early-life environmental factors, and infant crying outcomes. Perinatal data included maternal demographic characteristics (age, education, socioeconomic status), obstetric

history (parity, delivery mode, pregnancy complications), and maternal prenatal stress, which was measured using the Prenatal Stress Questionnaire. Additional information on maternal behaviors during pregnancy, including tobacco or alcohol use, as well as mental health status, was recorded using validated tools such as the Edinburgh Postnatal Depression Scale. The assessment included feeding methods (exclusive breastfeeding versus formula feeding and mixed feeding), sleep timetable management and tobacco exposure at home, early childhood illnesses, together with evaluations of residence conditions. The researchers obtained this information by using structured caregiver questionnaires during the first three and sixth months after birth. Research assessors measured infant outcomes through documentation of parent-reported crying patterns from daily reports and standardized tests such as the Infant Colic Scale and Crying Pattern Questionnaire. The pediatrician confirmed infantile colic diagnosis based on Wessel's modified criteria that established excessive crying periods exceeding three hours daily for three days per week during three weeks. Medical professionals diagnosed children with non-colicky excessive crying when they showed persistent and intense crying patterns that fell short of complete colic symptoms. Routine pediatric visits included clinical examinations to verify parent-reported data and eliminate medical factors that could cause extended crying in children.

Statistical Analysis: Data were analyzed using SPSS v17. Descriptive statistics were used to summarize baseline demographic and clinical characteristics of the participants. Continuous variables were reported as means with standard deviations or as medians with interquartile ranges, depending on their distribution. Statistical significance was defined as $p < 0.05$.

RESULTS

Data were collected from 380 infants, with male (192) and female (188) participants. The mean gestational age was 39.1 ± 1.2 weeks, and the average birth weight was 3.3 ± 0.4 kg. Most mothers (62.6%) were between 25 and 34 years old, and 68.9% had attained at least secondary education. Regarding delivery mode, 62.4% of infants were delivered vaginally, while 37.6% were

born via cesarean section. 58.2% of mothers reported experiencing moderate to high levels of prenatal stress, and 21.3% screened positive for postnatal depression.

Table 1: Baseline Characteristics of the Study Population (N = 380)

Variable	Value
Total participants	380
Male infants	192
Female infants	188
Mean gestational age (weeks)	39.1 ± 1.2
Mean birth weight (kg)	3.3 ± 0.4
Maternal age 25–34	62.6%
Secondary education or higher	68.9%
Vaginal delivery	62.4%
Cesarean delivery	37.6%
Moderate/high prenatal stress	58.2%
Postnatal depression	21.3%

67 (17.6%) met the criteria for infantile colic, while 85 (22.4%) experienced non-colic excessive crying. This brings the total prevalence of excessive crying behaviors during the first three months of life to 152 infants, accounting for 40.0% of the sample.

Table 2: Prevalence of Infantile Colic and Non-Colic Excessive Crying

Crying Category	Number of Infants	Prevalence (%)
Infantile Colic	67	17.6%
Non-Colic Excessive Crying	85	22.4%
Total Excessive Crying	152	40.0%

Infantile colic was significantly associated with cesarean delivery (AOR = 2.14, 95% CI: 1.23–3.71, $p = 0.006$), formula feeding (AOR = 2.89, 95% CI: 1.65–5.06, $p < 0.001$), high maternal prenatal stress (AOR = 1.78, 95% CI: 1.01–3.12, $p = 0.04$), and exposure to passive smoking (AOR = 1.94, 95% CI: 1.05–3.59, $p = 0.03$). In contrast, non-colic excessive crying was independently predicted by maternal postnatal depression (AOR = 2.37, 95% CI: 1.31–4.31, $p = 0.004$), low maternal-infant bonding (AOR = 1.88, 95% CI: 1.06–3.31, $p = 0.03$), and low household income (AOR = 1.65, 95% CI: 1.01–2.69, $p = 0.045$).

Table 3: Multivariate Logistic Regression Analysis for Colic and Non-Colic Crying

Variable	AOR (Colic)	95% CI (Colic)	p-value (Colic)	AOR (Non-Colic)	95% CI (Non-Colic)	p-value (Non-Colic)
Cesarean Delivery	2.14	1.23–3.71	0.006	-	-	-
Formula Feeding	2.89	1.65–5.06	<0.001	-	-	-
High Prenatal Stress	1.78	1.01–3.12	0.04	-	-	-
Passive Smoking	1.94	1.05–3.59	0.03	-	-	-
Postnatal Depression	-	-	-	2.37	1.31–4.31	0.004
Low Bonding Score	-	-	-	1.88	1.06–3.31	0.03
Low Income	-	-	-	1.65	1.01–2.69	0.045

Infants who were exclusively breastfed had the lowest prevalence of colic (11.4%) and non-colic crying (14.1%). The prevalence increased among those receiving mixed feeding, with 18.7% experiencing colic and 20.5% non-colic crying. The highest rates were observed in formula-fed infants, with 32.8% affected by colic and 28.2% by non-colic crying.

Table 4: Feeding Type Distribution by Crying Category

Feeding Type	Infantile Colic (%)	Non-Colic Crying (%)
Exclusive Breastfeeding	11.4	14.1
Mixed Feeding	18.7	20.5
Formula Feeding	32.8	28.2

Exposure to passive smoking was associated with the highest risk of infantile colic (24.6%) and also elevated non-colic crying risk (18.7%). In contrast, low household income was more strongly linked to non-colic crying (25.4%) than to colic (16.3%), indicating a possible psychosocial influence. Crowded living conditions showed a moderate association with both outcomes, with 12.1% of infants experiencing colic and 20.2% showing non-colic excessive crying.

Table 5: Environmental Risk Factors and Crying Outcomes

Environmental Factor	Colic Risk (%)	Non-Colic Crying Risk (%)
Passive Smoking	24.6	18.7
Low Household Income	16.3	25.4
Crowded Living Conditions	12.1	20.2

DISCUSSION

This study examined perinatal and early-life determinants of infantile colic and non-colic excessive crying in a cohort of 380 term infants. The findings indicate that excessive crying in infancy, whether classified as colic or non-colic, is influenced by a complex interplay of biological, environmental, and psychosocial factors. The overall prevalence of excessive crying was 40%, with 17.6% meeting criteria for infantile colic and 22.4% experiencing non-colic excessive crying, highlighting the substantial burden these conditions impose on early childhood development and parental well-being. Our analysis identified several independent predictors of infantile colic¹¹. Cesarean delivery was significantly associated with increased odds of colic, which aligns with earlier studies suggesting that altered gut microbiota colonization due to bypassing the vaginal birth canal may play a role in the

pathogenesis of colic¹². Formula feeding also emerged as a strong risk factor, consistent with prior research indicating differences in digestibility, microbiota diversity, and inflammatory responses between formula-fed and breastfed infants¹³. High levels of maternal prenatal stress and postnatal exposure to household tobacco smoke were also linked to increased risk, reinforcing the hypothesis that both in-utero stress exposure and early environmental irritants may disrupt neurobehavioral regulation and gut-brain axis development¹⁴. Excessive crying outside the realm of colic shows both unique and comparable risk factors with its infantile counterpart. Observations show maternal postnatal depression functioned as a leading independent risk factor thus supporting existing studies about infant emotional regulation based on maternal mental health. The analysis revealed low maternal-infant bonding together with lower household income as major risk factors indicating non-colic crying develops through stressors of caregiving relationships more than physiological disturbances¹⁵. Early crying disorders should be studied using the biopsychosocial model framework because these findings demonstrate its vital importance. Although the distinction between colic crying and other cases of excessive crying exists as an artificial separation it remains clinically important¹⁶. The research indicates biological factors together with feeding issues link to colic but non-colic excessive crying seems to carry environmental influences beyond basic physical causes. The distinct groupings between infantile colic and non-colic excessive crying might facilitate identification of appropriate treatment approaches¹⁷.

The study outcomes recognize various manageable elements behind this condition. The combination of supporting breastfeeding practices alongside stress reduction during pregnancy and postpartum maternal mental health treatment helps minimize excessive cry behaviors from occurring. Additional public health campaigns along with preventive measures must address early environmental exposures because these create significant health risks. Several limitations must be acknowledged. The diagnostic process for colic and excessive crying depended on parental assessment yet this practice contains both memory distortion factors and parent-related perception and stress influences. The investigation adjusted for different confounders but unaccounted paternal mental health state and individual infant temperament traits could impact the study results.

CONCLUSION

It is concluded that excessive crying in infancy, including both infantile colic and non-colic excessive crying, is significantly influenced by a combination of perinatal and early-life factors. Infantile colic was independently associated with cesarean delivery, formula feeding, maternal prenatal stress, and exposure to household tobacco smoke, indicating a strong link with physiological and environmental conditions during and shortly after birth. In contrast, non-colic excessive crying was more closely related to psychosocial factors, particularly maternal postnatal

depression, low maternal-infant bonding, and lower socioeconomic status.

REFERENCES

1. Zeevenhooven J, Koppen IJN, Benninga MA. The new Rome IV criteria for functional gastrointestinal disorders in infants and toddlers. *Pediatr Gastroenterol Hepatol Nutr*. 2017;20(1):1–13.
2. Sarasu JM, Narang M, Shah D. Infantile colic: an update. *Indian Pediatr*. 2018;55(11):979–87.
3. Savino F, Cordisco L, Tarasco V, et al. A prospective 10-year study on children who had severe infantile colic. *Acta Paediatr Suppl*. 2005;94(449):129–32.
4. Mai T, Fatheree NY, Gleason W, Liu Y, Rhoads JM. Infantile colic: new insights into an old problem. *Gastroenterol Clin North Am*. 2018;47(4):829–44.
5. Johnson JM, Adams ED. The gastrointestinal microbiome in infant colic: a scoping review. *MCN Am J Matern Child Nurs*. 2022;47(3):195–206.
6. Ouald Chaib A, Levy EI, Ouald Chaib M, Vandenplas Y. The influence of the gastrointestinal microbiome on infant colic. *Expert Rev Gastroenterol Hepatol*. 2020;14(11):919–32.
7. Hjern A, Lindblom K, Reuter A, Silfverdal SA. A systematic review of prevention and treatment of infantile colic. *Acta Paediatr*. 2020;109(9):1733–44.
8. Bell G, Hiscock H, Tobin S, Cook F, Sung V. Behavioral outcomes of infant colic in toddlerhood: a longitudinal study. *J Pediatr*. 2018;201:154–9.
9. Oken E, Huh SY, Taveras EM, et al. Sex-specific associations of maternal gestational glycemia with hormones in umbilical cord blood at delivery. *Am J Perinatol*. 2016;33(13):1273–81.
10. Cheng ER, Rifas-Shiman SL, Perkins ME, et al. The influence of antenatal partner support on pregnancy outcomes. *J Womens Health (Larchmt)*. 2016;25(7):672–9.
11. Levis B, Negeri Z, Sun Y, et al. Accuracy of the Edinburgh Postnatal Depression Scale (EPDS) for screening to detect major depression among pregnant and postpartum women: systematic review and meta-analysis of individual participant data. *BMJ*. 2020;371:m4022.
12. Phelan AL, DiBenedetto MR, Paul IM, Zhu J, Kjerulff KH. Psychosocial stress during first pregnancy predicts infant health outcomes in the first postnatal year. *Matern Child Health J*. 2015;19(11):2587–95.
13. Gardner FC, Adkins CS, Hart SE, Travaglini RA, Doheny KK. Preterm stress behaviors, autonomic indices, and maternal perceptions of infant colic. *Adv Neonatal Care*. 2018;18(1):49–57.
14. Pärtty A, Kalliomäki M, Salminen S, Isolauri E. Infantile colic is associated with low-grade systemic inflammation. *J Pediatr Gastroenterol Nutr*. 2017;64(5):691–5.
15. Salvatore S, Baldassarre ME, Di Mauro A, et al. Neonatal antibiotics and prematurity are associated with increased risk of functional gastrointestinal disorders in the first year of life. *J Pediatr*. 2019;212:44–51.
16. Fazil M. Prevalence and risk factors for infantile colic in District Mansehra. *J Ayub Med Coll Abbottabad*. 2011;23(4):115–7.
17. Elwenspoek MM, Thom H, Sheppard AL, Keeney E, O'Donnell R, Jackson J, Roadevin C, Dawson S, Lane D, Stubbs J, Everitt H, Watson JC, Hay AD, Gillett P, Robins G, Jones HE, Mallett S, Whiting PF. Defining the optimum strategy for identifying adults and children with coeliac disease: systematic review and economic modelling. *Health Technol Assess*. 2022 Oct;26(44):1–310. doi: 10.3310/ZUCE8371. PMID: 36321689; PMCID: PMC9638887.