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Original Article

Investigation of the Relationships Among Maternal Anxiety, Infantile Colic and Sociodemographic Characteristics of the Family

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Abstract

Introduction: Infantile colic (IC) is a functional gastrointestinal disorder characterised by excessive crying episodes during the first months of life with an unknown aetiology. Despite the absence of identifiable organic pathology, IC may lead to psychological problems such as anxiety and depression, particularly in mothers, and can adversely affect parent-infant interactions. This study aimed to investigate the associations between maternal anxiety levels during pregnancy and the development of infantile colic, as well as the potential influence of certain paternal risk factors. ***Methodology:*** In this prospective observational study, a total of 210 mother-infant pairs were evaluated. Maternal gestational age and sociodemographic characteristics were recorded, and the Beck Anxiety Inventory (BAI) was administered during pregnancy. Between the 5th and 8th weeks postpartum, mothers were contacted via telephone to assess signs of infantile colic in their babies. For suspected IC cases, parents were asked to keep a crying diary, and the infants were invited to the clinic for physical examination and laboratory evaluation. Infants meeting Wessel's criteria were diagnosed with IC. ***Results:*** Infantile colic was significantly more prevalent among infants whose mothers experienced high levels of anxiety during pregnancy. Furthermore, the incidence of IC was greater in infants whose fathers smoked or consumed alcohol. Mothers who had previously had a child diagnosed with IC reported higher anxiety scores. Cesarean delivery rates were also elevated among mothers with high anxiety levels. ***Conclusion:*** This study suggests that maternal anxiety during pregnancy may be a significant risk factor for the development of infantile colic. Additionally, environmental and behavioral factors related to the father may also contribute to the aetiology of IC. These findings highlight the importance of psychosocial interventions targeting both maternal and paternal factors.

Key words Beck Anxiety Inventory; Crying baby; Infantile colic; Prenatal anxiety; Rome IV criteria

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Introduction

Functional gastrointestinal disorders are chronic, recurrent conditions that originate from the gastrointestinal tract but lack identifiable organic pathology. Among these, infantile colic (IC) was first described by Wessel using the "Rule of Threes": crying episodes lasting at least 3 hours per day, occurring at least 3 days per week, and persisting for at least 3 weeks.[1] Common symptoms of IC include abdominal contractions, pulling the legs toward the abdomen, difficulty with defecation, arching of the back, and kicking movements.[2] Currently, diagnosis is based on

symptom-driven Rome criteria, most recently updated in 2016 (Rome IV), which define IC as recurrent episodes of prolonged crying, fussiness, or irritability that begin and end within the first five months of life. These episodes are perceived as excessive by caregivers, and infants are typically difficult to soothe. Importantly, there is no evidence of underlying organic disease or growth failure. The frequency of these episodes (≥3 hours per day, ≥3 days per week) must be confirmed by a clinician, with the crying diary being the most reliable tool for validation.[3-5] The reported prevalence rates of IC vary widely, ranging from 2% to 73%, with a median of approximately 17.7%.[6]

Although IC generally resolves spontaneously within the first six months of life, the condition can lead to frequent medical consultations, increased parental anxiety, postpartum depression, fatigue, sleep disturbances, and difficulties in mother-infant bonding. Excessive crying has also been linked to serious outcomes such as shaken baby syndrome resulting from the loss of caregiver control.[7,8]

The pathophysiology of IC remains unclear. The proposed mechanisms include psychosocial stressors, feeding difficulties (particularly food allergies), delayed gastrointestinal maturation, motility disorders, excessive gas, and imbalances in the gut microbiota.[9] The relationship between IC and maternal anxiety is considered bidirectional: while IC may exacerbate maternal anxiety and depression, maternal anxiety during pregnancy may also increase the risk of IC in infants.[10]

The first-line treatment for IC is caregiver education. Although probiotics and simethicone are frequently used, their efficacy remains inconclusive. Some evidence supports the use of herbal agents such as cumin and fennel. Traditional methods — such as massage, swaddling, rhythmic rocking, reflexology, and white noise — have been reported in some studies to be more effective than pharmacological treatments.[11-14]

The aim of this study was to investigate the relationships among infantile colic, maternal anxiety levels during the third trimester, and family sociodemographic characteristics. Additionally, this study sought to evaluate the relative effectiveness of various treatments employed for IC.

Materials and Methods

This prospective study included a total of 210 mother-infant pairs. Maternal gestational age and sociodemographic characteristics were recorded. Structured questionnaires were used to collect data from both parents on cigarette and alcohol use, maternal dietary and exercise habits during pregnancy, folic acid supplementation, birth order, and any history of infantile colic in previous children. The Beck Anxiety Inventory (BAI) was administered to all mothers during pregnancy.

Between the 5th and 8th weeks postpartum, mothers were contacted by phone to obtain information regarding the infant's sex, gestational age at birth, birth weight, mode of delivery, and signs of infantile colic. In cases with suspected IC, mothers were asked to maintain a crying diary. The infants were then invited for clinical evaluation, including physical examination and laboratory tests (urinalysis). Infants with no identifiable pathology and who met the Rome IV criteria were diagnosed with IC and included in the study group.

Infants born prematurely, those with intrauterine growth restriction, those classified as small or large for gestational age, and those with identifiable organic conditions (e.g., otitis media or urinary tract infections) were excluded from the study.

Statistical Analysis

Descriptive statistics are presented as the means and standard deviations for continuous variables and as counts and percentages for categorical variables. The distribution of continuous data was evaluated via histogram plots. For comparisons of continuous variables between two groups, Student's t test or the Mann–Whitney U test was used depending on the data distribution. Correlations between continuous variables were assessed via Pearson's correlation coefficient. A p value of <0.05 was considered to indicate statistical significance. All the statistical analyses were performed via SPSS version 23.0.

Results

A total of 210 mothers were included in the study. The mean age of the participants was 27.95±5.31 years. The majority of the mothers had completed high school, university, or higher education. A large proportion (68.57%, n=144) were homemakers. During pregnancy, 10% (n=21) reported smoking, and one participant reported alcohol consumption. The sociodemographic characteristics of the participants are presented in Table 1.

Information regarding pregnancy-related behaviors, the presence of IC, and the treatment methods used for IC is provided in Table 2. Twenty-six mothers reported not

using folic acid during pregnancy, whereas 78 indicated that they exercised regularly. One of the study's primary outcome variables, the presence of IC, was identified in 31.91% (n=67) of the infants.

Ninety-five percent of families reported using traditional methods for managing IC, and 89% of them stated that these methods were beneficial. Pharmaceutical treatment was used by 92% of the participants, with the most commonly used agents being probiotic drops containing *Lactobacillus reuteri* and preparations containing simethicone. Among these, 65% reported treatment benefits. Additionally, 56% used herbal remedies — particularly cumin and fennel — with 57% of this group reporting perceived benefits.

The mean parity among mothers was 1.98±1.19, and the mean BAI score was 11.40±8.13. Maternal age and parity did not have a statistically significant effect on the presence of IC. However, mothers of infants diagnosed

Table 1 Sociodemographic characteristics of the parents of the cases included in the study

		n	%
Education	Primary school	13	6.19
	Secondary school	44	20.95
	High school	90	42.86
	University and above	63	30.00
Occupation	Working	66	31.43
	Housewife	144	68.57
Maternal smoking	Yes	21	10.00
Paternal smoking	Yes	125	59.52
Maternal drinking	Yes	1	0.48
Paternal drinking	Yes	18	8.57
Maternal diet	Yes	32	15.24
Which diet	Vegetarian	0	0.00
	Vegan	1	3.13
	Weight loss diet	10	31.25
	Doctor diet	21	65.63

Table 2 Other investigated characteristics potentially associated with infantile colic

		n	%
Folic acid use during pregnancy	Yes	184	87.62
Exercise during pregnancy	Yes	78	37.14
IC in siblings	Yes	19	16.81
IC presence	Yes	67	31.91
Drug use	Yes	61	92.42
Drug benefit	Yes	40	65.57
Traditional method use	Yes	64	95.45
Traditional method benefit	Yes	57	89.06
Herbal method use	Yes	38	56.06
Herbal method benefit	Yes	22	57.89
Type of birth	C/S	133	63.33
	NSVB	77	36.67
Gender	Boy	103	49.05
	Girl	107	50.95

IC: Infantile colic; C/S: Caesarean section; NSVB:Normal spontaneous vaginal birth

with IC had significantly higher mean BAI scores during the third trimester (p=0.002) (Table 3).

Paternal smoking (p=0.014) and alcohol consumption (p=0.024) were found to significantly increase the likelihood of IC. No other sociodemographic or pregnancy-related variables were significantly associated with the presence of IC (Table 4).

Correlation analysis between BAI scores and gestational age, maternal age, and parity revealed no significant relationships (p>0.05). However, mothers who had a previous child with IC and those who delivered via cesarean section had significantly higher BAI scores (p=0.011 and p=0.009, respectively). No other significant associations were observed between BAI scores and sociodemographic or pregnancy-related variables (Table 5).

Table 3 The effects of maternal age, parity and maternal anxiety levels on the presence of IC

	IC Presence				
	Yes (n=67)		No (n=143)		
	Mean	SS	Mean	SS	p
Maternal age	27.70	5.65	28.06	5.16	0.647
Parity	1.91	1.23	2.01	1.18	0.502
BAI score	13.97	8.60	10.20	7.64	**0.002**

BAI: Beck Anxiety Inventory; IC: Infantile colic

Table 4 Relationships between sociodemographic characteristics and pregnancy-related characteristics with IC

		IC Presence				
		Yes		No		
		n	%	n	%	p
Education	Primary school	6	8.96	7	4.90	
	Secondary school	15	22.39	29	20.28	
	High school	25	37.31	65	45.45	
	University and above	21	31.34	42	29.37	
Occupation	Working	21	31.34	45	31.47	0.985
	Housewife	46	68.66	98	68.53	
Maternal smoking	Yes	8	11.94	13	9.09	0.521
Paternal smoking	Yes	48	71.64	77	53.85	**0.014**
Maternal drinking	Yes	1	1.49	0	0.00	
Paternal drinking	Yes	10	14.93	8	5.59	**0.024**
Maternal diet	Yes	9	13.43	23	16.08	0.618
Which diet	Vegetarian	0	0.00	0	0.00	0.607
	Vegan	0	0.00	1	4.35	
	Weight loss diet	2	22.22	8	34.78	
	Doctor diet	7	77.78	14	60.87	
Folic acid use during pregnancy	Yes	58	86.57	126	88.11	0.751
Exercise during pregnancy	Yes	23	34.33	55	38.46	0.563
IC in siblings	Yes	4	11.43	15	19.23	0.305
Type of birth	C/S	40	59.70	93	65.03	0.455
	NSVB	27	40.30	50	34.97	
Gender	Boy	36	53.73	67	46.85	0.353
	Girl	31	46.27	76	53.15	

IC: Infantile colic; C/S: Caesarean section; NSVB: Normal spontaneous vaginal birth

Discussion

In our study, we found that infants born to mothers with high BAI scores presented a significantly greater incidence of IC. Furthermore, mothers with a history of IC in previous children had significantly higher anxiety levels, and cesarean section delivery was more common among mothers with high BAI scores. One notable finding of our study was the impact of paternal smoking and alcohol consumption on infantile colic. The data revealed that the rates of smoking and/or alcohol use were significantly higher among the fathers of infants diagnosed with colic. This association may be attributed to increased maternal exposure to secondhand smoke or heightened stress levels during the prenatal period, as well as potential direct or indirect effects on the infant in the postnatal period. Furthermore, paternal smoking and alcohol use may negatively influence family dynamics, potentially compromising maternal mental health and thereby increasing the risk of colic. These findings suggest that the development of infantile colic may be influenced not only by maternal factors but also by paternal lifestyle and habits.

BAI was preferred in this study for evaluating anxiety levels. Although the State-Trait Anxiety Inventory (STAI) is also frequently used to assess anxiety during pregnancy,[15] the BAI offers a shorter, more practical tool that specifically evaluates somatic and cognitive symptoms of anxiety. In contrast, the STAI covers more general emotional states and includes items that may overlap with depressive symptoms.[16]

Petzold et al assessed 306 mothers for anxiety and depression during early pregnancy and followed them up until the 16th postnatal month. It has been reported that maternal anxiety significantly increases the risk of IC in infants.[10] Similarly, Krause et al demonstrated that maternal anxiety disorders were associated with an increased risk of IC.[17] Consistent with these findings, our study also revealed a higher prevalence of IC in infants of mothers with elevated BAI scores.

Table 5 Relationships between sociodemographic characteristics and several pregnancy-related characteristics and BAI scores

		BAI score			
		n	**Mean**	**SD**	**p**
Education	Primary school	13	14.46	9.80	0.577
	Secondary school	44	11.55	9.96	
	High school	90	11.57	7.79	
	University and above	63	10.44	6.75	
Occupation	Working	66	11.88	9.61	0.968
	Housewife	144	11.19	7.38	
Maternal smoking	Yes	21	13.95	7.43	0.055
Paternal smoking	Yes	125	12.06	8.36	0.182
Maternal drinking	Yes	1	4.00	–	0.352
Paternal drinking	Yes	18	11.78	7.49	0.670
Maternal diet	Yes	32	10.34	7.84	0.398
Which diet	Vegetarian	0	–	–	0.398
	Vegan	1	12.00	–	
	Weight loss diet	10	13.40	9.38	
	Doctor diet	21	8.81	6.95	
Folic acid use during pregnancy	Yes	184	11.47	8.32	0.985
Exercise during pregnancy	Yes	78	10.42	7.52	0.172
IC in siblings	Yes	19	16.42	9.97	**0.011**
Type of birth	C/S	133	12.63	8.73	**0.009**
	NSVB	77	9.29	6.51	
Gender	Boy	103	10.50	7.15	0.214
	Girl	107	12.28	8.93	

BAI: Beck Anxiety Inventory; IC: Infantile colic; C/S: Caesarean section; NSVB:Normal spontaneous vaginal birth

Canivet et al reported a strong association between maternal anxiety and IC, noting that the most significant anxiety-inducing factor was the mother's separation from the baby's father.[18] In our study, all participating mothers were married and living with their partners, which may be a protective factor for both mothers and infants, possibly reflecting sociocultural characteristics specific to our population.

Canivet et al reported that younger mothers and those with lower education levels experienced greater anxiety, leading to increased IC risk in their infants.[18] Paradise et al reported a significant relationship between maternal education level and IC, whereas no such association was observed with maternal age or birth order.[19] Conversely, Suklert et al reported no significant relationships between IC and maternal age, education, or birth order.[20] Similarly, our study did not identify any significant relationships between IC and maternal age, education, or birth order. This may suggest that, independent of maternal demographics, modern communication tools and internet access enable mothers to obtain reliable health information and connect with healthcare professionals or peers, as supported by previous studies.[21]

Although some studies have reported no significant relationship between mode of delivery and IC.[22] Simbar et al reported a higher incidence of IC among infants born via cesarean section.[23] While delivery mode is known to significantly influence the infant gut microbiota — and gut dysbiosis has been proposed as a factor in IC aetiology — our study did not find a statistically significant association between mode of delivery and IC.[24]

Canivet et al also reported a significant association between maternal smoking and IC.[25] Similarly, Radwan et al reported an increased risk of IC in infants exposed to secondhand smoke.[26] However, other studies, such as that conducted by Mai et al, did not find evidence supporting this association.[27] In our sample, the maternal smoking rate was 10% (n=21), which is considerably lower than the general population average. No statistically significant relationship was found between maternal smoking and IC in our study (p=0.521) (Table 4). This may indicate growing awareness among pregnant women regarding the harmful effects of smoking on fetal health, resulting in reduced tobacco use during pregnancy. In support of this, the literature suggests that prenatal education regarding the harms of smoking can lead to significant reductions in smoking among pregnant women.[28]

Paternal factors have rarely been investigated in IC studies. Sondergaard et al reported no significant association between paternal smoking and IC.[26] Although paternal smoking was found to be significantly associated with infantile colic in our study, this relationship may not necessarily be causal. It is possible that paternal smoking indirectly contributes to the development of colic by increasing maternal anxiety levels during pregnancy, rather than exerting a direct physiological effect on the infant. Therefore, paternal smoking may act as a *confounding variable* rather than an independent risk factor. Since our analysis did not include a multivariate model controlling for maternal anxiety, we cannot fully exclude this confounding effect. Future studies employing multivariate analyses are warranted to clarify whether the observed association between paternal smoking and infantile colic remains significant after adjusting for maternal anxiety. Indeed, Alibekova et al reported that paternal smoking was associated with increased maternal anxiety levels.[29]

Ayaz et al, in a study conducted in Turkey, reported no significant relationship between maternal employment status and anxiety levels.[30] In contrast, Khalesi et al reported that 78% of housewives experienced high anxiety levels during pregnancy.[31] In alignment with Ayaz et al's findings, our study also revealed no statistically significant relationship between maternal employment status and BAI scores. This result may reflect the cultural diversity of our study population. In some cultures, homemakers may bear greater childcare and household responsibilities, contributing to elevated anxiety levels during pregnancy.

Anxiety can trigger fear of childbirth,[32] and both anxiety and childbirth fear are influential factors in the preference for cesarean section.[33,34] In our study, mothers with higher BAI scores were more likely to opt for cesarean delivery.

While numerous studies have demonstrated a strong relationship between prenatal anxiety and IC, we did not find studies that examined anxiety levels in mothers who previously had infants with IC. In our study, mothers with a history of IC in previous children had significantly higher BAI scores during subsequent pregnancies.

IC has been linked to a range of psychological and emotional difficulties, including postpartum depression, anxiety, feelings of inadequacy, sleep disturbances, intrusive thoughts of harm to the infant, and mother–infant bonding issues.[7,35] Thus, anxiety experienced during subsequent pregnancies may stem from concerns about encountering similar challenges with a new baby.

A comparison of our study findings with those in the literature is presented in Table 6.

Conclusion

This study revealed that infants born to mothers with high levels of anxiety during the third trimester had an increased risk of developing IC. A particularly noteworthy finding is the potential role of paternal factors in the development of IC. Infants whose fathers smoked or consumed alcohol presented a significantly higher incidence of IC. These results highlight the importance of adopting a multidimensional approach to the aetiology of IC, as paternal lifestyle and habits — often overlooked in the literature — may also be influential. Moreover, the higher anxiety levels observed in mothers with a prior history of IC and the increased rates of cesarean deliveries in subsequent pregnancies among these mothers emphasize that IC is not solely a neonatal condition but also impacts the entire family unit. Therefore, conducting comprehensive psychosocial assessments for both mothers and fathers during pregnancy may be a critical step toward reducing the risk of IC and promoting overall family well-being.

Limitations

This study has several limitations. This study was conducted in a single centre, which may limit the generalisability of the findings to other populations. Maternal anxiety was assessed only during the third trimester via a self-report scale, which may be subject to reporting bias. The diagnosis of IC was based on parental reporting and thus may include subjective elements. Paternal psychosocial status was not evaluated in detail; only smoking and alcohol use were assessed. Additionally, the follow-up period for infants was short, and the effectiveness of treatment approaches was not objectively measured.

Declaration

Author Contributions

Conceptualisation, F.K., C.T. and A.K.; methodology, F.K. and C.T.; software, F.K. and A.K.; validation, C.T. and A.K.; formal analysis, F.K. and C.T.; investigation, F.K. and C.T.; resources, F.K. and A.K.; data curation, F.K. and A.K.; writing original draft preparation, F.K., C.T. and A.K.; project administration, F.K. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement

The study was conducted in accordance with the Declaration of Helsinki and approved by the Düzce University Faculty of Medicine Ethics Committee (Decision no: 22/79 Approval Date: 25.04.2022).

Table 6 Comparison of the study's findings with those in the literature

Risk factor	Findings of the study	Literature	Comparison/commentary
High maternal anxiety	Significantly associated with increased incidence of IC	Petzold (2014)[10]; Krause (2017)[17]: Higher rates of IC in infants of anxious mothers	Consistent with previous studies; reinforces the role of maternal anxiety as a key risk factor in IC development.
Paternal smoking	Significantly associated with increased incidence of IC	Søndergaard (2001)[36]: No significant association	Contradicts earlier findings; may suggest changing sociocultural factors or methodological differences warrant further investigation.
High maternal anxiety and Cesarean delivery	Mothers with higher anxiety were more likely to undergo cesarean section	Salomonsson (2013)[33]; Shakarami (2021)[34]: Higher anxiety associated with more frequent cesarean deliveries	In line with previous research; supports the link between prenatal anxiety and delivery mode.

IC: Infantile colic

Informed Consent Statement

Informed consent was obtained from all the subjects involved in the study.

Data Availability Statement

Study data will be shared if requested.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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