

# Sequelae of Infant Colic

## Evidence of Transient Infant Distress and Absence of Lasting Effects on Maternal Mental Health

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**Background:** Colic is widely believed to remit by 3 months of age, with little lasting effect on the infant or the family.

**Objectives:** To determine the prevalence of colic at 3 months and the proportion of cases of colic (identified at 6 weeks) that remitted by 3 months; to identify the factors predictive of colic's remission; and to explore the potential lasting effects of colic on maternal mental health.

**Design:** Prospective cohort study of 856 mother-infant dyads. Self-administered questionnaires were mailed to mothers at 1 and 6 weeks and 3 and 6 months post partum. Standardized instruments were incorporated into the first and last questionnaires to assess maternal anxiety, postnatal depression, and social support. At 6 weeks and at 3 months, mothers completed the Barr diary and/or the Ames Cry Score.

**Results:** Data from 547 dyads were available for analysis. The prevalence of colic at 3 months was 6.4%. More than 85% of cases of colic had remitted by 3 months of age. These infants were more likely to be female, whereas the mothers of these infants were more likely to have received pain relief during labor/delivery and to have been employed during pregnancy. Reductions in scores for trait anxiety and postnatal depression, although smaller for mothers whose infants were colicky at 6 weeks of age, were not significantly different from those of mothers whose infants were never colicky.

**Conclusion:** This study provides support for the belief that, in most cases, colic is self-limiting and does not result in lasting effects to maternal mental health.

*Arch Pediatr Adolesc Med.* 2002;156:1183-1188

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**D**ESPITE UNCERTAINTY as to its etiology, the prevalence of colic has been estimated to range from 5% to 28% when assessed in prospective studies of relatively high quality.<sup>1</sup> Colic is characterized by excessive and inconsolable crying, hypertonicity, and wakefulness that cluster in the evening hours. The onset usually occurs during the second to the sixth weeks of life. The most widely cited criterion for colic, known as the "rule of threes," defines a fussy infant as one who, "otherwise healthy and well fed, [has] paroxysms of irritability, fussing or crying lasting for a total of 3 hours per day and occurring more than 3 days in any 1 week."<sup>2</sup> The term 3-month colic was coined by Illingworth<sup>3</sup> after noting that 85% of cases of colic remitted by 3 months of age.

Although colic is believed to be self-limiting, the absence of a fail-safe cure<sup>4</sup> can translate into a number of weeks that can be overwhelming for parents.<sup>5,6</sup> Concomitant changes to the parent-child relationship<sup>7,8</sup> may result in long-term deficits to the infant's mental and social develop-

ment,<sup>9,10</sup> whereas an episode of colic may adversely affect family life, even after it has resolved.<sup>11-17</sup>

The potential sequelae of colic underline the importance of continued research. Although previous works have examined the natural history of colic and its

*For editorial comment  
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effects on the family, methodological issues such as nonstandard or inconsistent definitions of colic<sup>6,11,14,17</sup> and the use of clinically referred populations<sup>6,12,16</sup> and retrospective assessments<sup>7,9,11,12,17</sup> have restricted the interpretation of study findings. Thus, prospective methods are needed to determine whether colic is truly self-limiting and benign.

Building on an earlier examination of colic,<sup>18</sup> this work used prospective methods in a population-based sample to determine the prevalence of colic at 3 months of age and the proportion of cases of colic (identified at 6 weeks of age) that remitted by 3 months and to identify factors predictive of colic's remission. In addition, we

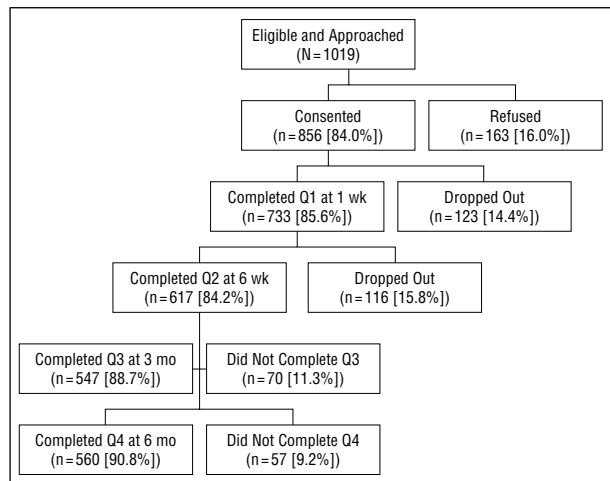


Figure 1. Study hierarchy. Q indicates questionnaire.

explored the potential for an episode of colic to result in lasting maternal distress by examining levels of maternal trait anxiety and depression at 6 months post partum, after controlling for earlier (ie, precolic) levels of maternal distress.

## METHODS

Approval for this study was granted by the Review Board for Health Sciences Research Involving Human Subjects of the University of Western Ontario, London. The prospective cohort included 856 mothers who were identified after giving birth in London. Eligible mothers were approached between January 15 and September 16, 1999, before their discharge from the hospital. Those who wished to participate provided written consent and an address to which surveys could be mailed. A detailed description of the study design is presented elsewhere.<sup>18</sup>

Briefly, baseline data were collected from eligible consenting women by means of a self-administered questionnaire that was mailed to their homes approximately 1 week after their discharge from the postpartum ward. This baseline questionnaire requested information on the current source of infant nutrition, prenatal and postnatal health behaviors, and demographic and biological factors. Standardized instruments assessing maternal anxiety (the State-Trait Anxiety Inventory),<sup>19</sup> postnatal depression (the Edinburgh Postnatal Depression Scale),<sup>20</sup> and social support (the Social Behaviours Inventory)<sup>21</sup> were incorporated into this questionnaire. At 6 weeks and 3 months post partum, mothers were asked to complete a shortened version of the postpartum questionnaire (ie, identical to the original postpartum questionnaire except the standardized measures of anxiety, depression, and social support were excluded) and, by completing the Barr Baby's Day Diary<sup>22</sup> and/or the Ames Cry Score,<sup>15,23</sup> to provide details regarding their infants' crying behaviors. The strengths and limitations of each cry/fuss instrument are discussed elsewhere (T.J.C., M.K.C., K.N.S., and F.G., unpublished data, March 2000).

The final stage of data collection, at 6 months post partum, asked mothers to complete a questionnaire that included the standardized measures of anxiety<sup>19</sup> and depression.<sup>20</sup> All data collection was performed by mail. Reminder postcards were sent to all participants, and follow-up mailings were used, if necessary, as per the Total Design Survey Method of Dillman.<sup>24</sup>

Data were analyzed by means of the statistical program SPSS 9.0 for Windows (SPSS Inc, Chicago, Ill). All variables were categorical, with the exceptions of labor support, social support, maternal anxiety, and postnatal depression, which were mea-

sured on continuous scales. The prevalence of colic at 3 months was estimated on the basis of the application of a modified rule of threes to data recorded in the Barr diary. For this study, a colicky infant was defined as one who was "otherwise healthy and well fed but who had paroxysms of irritability, fussing, or crying lasting for 3 or more hours in any 1 day and occurring on 3 or more days in any 1 week." If a diary was not completed, analysis of responses on the Ames Cry Score, whereby a total cry score of 3 or greater was interpreted to indicate colic, provided estimates of colic's prevalence. Similar approaches were used to determine the proportions of cases of colic that remitted by 3 months, persistent cases of colic, and infants in whom latent distress developed (ie, infants who were not colicky at 6 weeks but whose behaviors rendered them colicky at 3 months of age).

To identify predictors of colic's remission, analyses were restricted to those with colic at 6 weeks of age. For univariable analyses, we used the 2-sample *t* test, Mantel-Haenszel  $\chi^2$  test, and Fisher exact test, where appropriate, to analyze group differences. A multivariable model predictive of colic's remission or persistence at 3 months of age could not be developed because a limited number of cases of colic persisted that long.

To determine whether changes in maternal trait anxiety and depression scores were associated with the presence or absence of colic at 6 weeks of age, a 1-way analysis of variance was performed. Change scores, calculated separately for trait anxiety and depression, were derived by subtracting scores reported on the first questionnaire (1 week) from those reported on the final questionnaire (6 months).

## RESULTS

A total of 1019 eligible mothers were approached from January 15 through September 16, 1999. Consent was received from 856 mothers (84.0%). Response rates were above 80% at each stage of data collection (Figure 1), with 65.4% of those who consented to participate returning a completed study package at 6 months post partum.

The 617 participants who completed the second (6-week) questionnaire were eligible to participate at the third (3-month) stage of data collection. Of these, 588 (95.3%) were married or living with a common-law partner; 517 (83.8%) delivered vaginally; and 511 (82.8%) were aged 20 to 34 years. The 547 mothers who participated at 3 months post partum were more likely to be married, to have completed more formal education, and to have higher household incomes than those who did not (Table 1). Participants were also more likely to be nonsmokers, to reside in a nonsmoking household, to breastfeed, and to have higher levels of social support and lower levels of anxiety and depression (as assessed at 1 week post partum) than those who did not complete the 3-month questionnaire.

Of the 547 mother-infant dyads who participated at 3 months, 35 infants (6.4%) had colic at 3 months. When examined in closer detail, 131 had colic at 6 weeks. Of these, 18 (13.7%) still had colic at 3 months. This means that 113 (86.3%) of the 131 cases of colic that had been identified at 6 weeks of age had remitted by 3 months. However, 17 infants had crying behaviors at 3 months of age that fulfilled our modified rule of threes and thus, were classified as colicky, although they had not been identified as colicky at 6 weeks of age. In other words, of the 35 cases of colic identified at 3 months of age, an

**Table 1. Characteristics of Those Eligible for Participation at 3 Months\***

Variable	Participants (n = 547)	Nonparticipants (n = 70)	P Value
Hospital of delivery			
1	303 (55.4)	49 (70.0)	.02
2	244 (44.6)	21 (30.0)	
Marital status			
Single	20 (3.7)	9 (12.9)	.003
Partner	527 (96.3)	61 (87.1)	
Prenatal classes			
No	219 (40.0)	38 (54.3)	.03
Yes	328 (60.0)	32 (45.7)	
Smoking in pregnancy†			
None	484 (88.8)	53 (75.7)	.004
Some	61 (11.2)	17 (24.3)	
Smoker in home†			
None	439 (80.4)	41 (58.6)	<.001
Some	107 (19.6)	29 (41.4)	
Caffeine in pregnancy†			
None	116 (21.3)	7 (10.0)	.03
Some	429 (78.7)	63 (90.0)	
Employment status 2 mo before delivery			
Homemaker	82 (15.0)	17 (24.3)	<.001
Student	9 (1.6)	7 (10.0)	
Unemployed	13 (2.4)	4 (5.7)	
Full-time job	332 (60.7)	31 (44.3)	
Part-time job	111 (20.3)	11 (15.7)	
Maternal education‡			
<High school	9 (1.7)	5 (7.1)	.006
High school	109 (20.0)	18 (25.7)	
Postsecondary	331 (60.7)	41 (58.6)	
Postgraduate	96 (17.6)	6 (8.6)	
Household income, Can \$/yr			
<\$10 000	7 (1.4)	6 (9.4)	.001
10 000-14 999	15 (2.9)	3 (4.7)	
15 000-19 999	19 (3.7)	2 (3.1)	
20 000-29 999	46 (9.0)	7 (10.9)	
30 000-39 999	49 (9.6)	9 (14.1)	
40 000-49 999	53 (10.3)	11 (17.2)	
50 000-59 999	78 (15.2)	7 (10.9)	
60 000-69 999	73 (14.2)	8 (12.5)	
≥70 000	173 (33.7)	11 (17.2)	
Source of infant nutrition at 6 wk			
Breast milk‡	325 (59.4)	28 (40.0)	.004
Formula	151 (27.6)	32 (45.7)	
Breastmilk and formula	71 (13.0)	10 (14.3)	
Pacifier use at 6 wk			
No	264 (48.3)	23 (32.9)	.02
Yes	283 (51.7)	47 (67.1)	
Maternal smoking at 6 wk			
None	474 (86.7)	51 (72.9)	.004
Some	73 (13.3)	19 (27.1)	
Maternal trait anxiety, mean (SD)§	35.45 (8.55)	38.66 (8.63)	.003
Social support, mean (SD)	10.58 (1.28)	10.24 (1.76)	.05
Maternal state anxiety, mean (SD)§	33.30 (9.81)	36.76 (10.77)	.006
Postnatal depression, mean (SD)¶	6.95 (4.68)	8.70 (5.39)	.004

\*Unless otherwise indicated, data are given as number (percentage) of dyads.

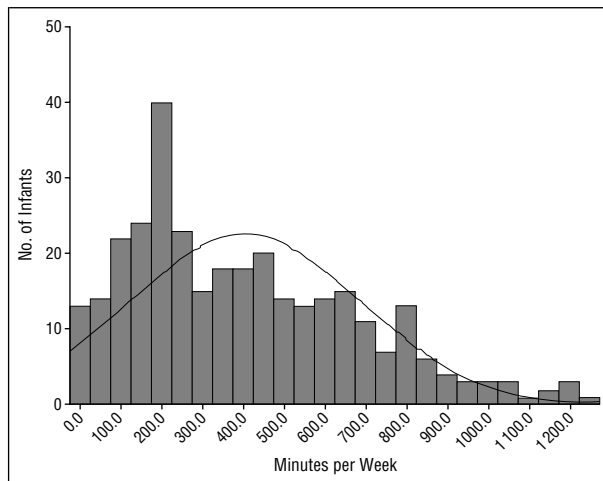
†Numbers may not total 617 owing to missing data.

‡Includes those exclusively breastfed and those receiving expressed breast milk exclusively.

§Determined by means of the State-Trait Anxiety Inventory.<sup>19</sup>

||Determined by means of the Social Behaviours Inventory.<sup>21</sup>

¶Determined by means of the Edinburgh Postnatal Depression Scale.<sup>20</sup>



**Figure 2.** Cry/fuss distribution at 3 months of age for 320 infants. Minutes per week represent total minutes of crying and fussing during the 12th week of life (mean, 280.6 minutes; SD, 400.5 minutes).

almost equitable split was found between persistent (n = 18) and latent (n = 17) cases.

The cry/fuss distribution (**Figure 2**) was derived from detailed examination of the 320 diaries that were returned. From this analysis, the mean amount of crying/fussing recorded during an infant's 12th week of life was less than 6.7 hours (SD, 4.7 hours). Although this is an average of less than 1 hr/d, the cry/fuss behavior of some infants was truly excessive, with 1 mother recording that her infant cried/fussed for 21 hours during that week.

**Table 2** presents factors identified, in univariable analyses, to be significantly associated with the remission/persistence of colic at 3 months of age. Infants with colic that remitted by 3 months of age were more likely to be female, whereas the mothers of these infants were more likely to have received obstetric anesthesia or analgesia during labor and/or delivery, to have been employed outside the home during pregnancy, and to have consumed alcohol or caffeine in the postpartum period. Although household income also reached statistical significance in univariable analyses, interpretation of this association is complicated by small-cell counts in certain income categories. Since only 18 cases of colic persisted to 3 months of age, it was not possible to develop a multivariable model in which the dependent variable was defined according to the persistence or remission of colic at 3 months.

Results of the 1-way analysis of variance examining changes in maternal trait anxiety and depression are presented in **Table 3**. Between the first (1 week post partum) and final (6 months post partum) stages of data collection, scores fell by an average of 2.4 and 1.7 points for trait anxiety and depression, respectively. Reductions in scores for trait anxiety and postnatal depression were smaller for mothers whose infants were colicky at 6 weeks of age than for those whose infants were never colicky, but the difference was not statistically significant.

#### COMMENT

This study used prospective methods in a relatively large population-based sample to provide evidence that most

**Table 2. Factors Associated With Remission of Colic at 3 Months\***

Variable†	Colic Persisted (n = 18 [13.7%])	Colic Remitted (n = 113 [86.3%])	P Value
Infant's sex			
Male	15 (83.3)	51 (45.1)	.004
Female	3 (16.7)	62 (54.9)	
Obstetric anesthesia or analgesia‡			
None	8 (44.4)	14 (12.8)	.005
Epidural	9 (50.0)	85 (78.0)	
Other	1 (5.6)	10 (9)	
Employment in pregnancy			
Homemaker	6 (33.3)	11 (9.7)	.02
Student	0	1 (0.9)	
Unemployed	2 (11.1)	3 (2.7)	
Full-time job	7 (38.9)	65 (57.5)	
Part-time job	3 (16.7)	33 (29.2)	
Household income, Can \$/yr‡§			
<10 000	2 (12.5)	2 (1.8)	.03
10 000-14 999	0	3 (2.8)	
15 000-19 999	0	5 (4.6)	
20 000-29 999	2 (12.5)	8 (7.3)	
30 000-39 999	0	14 (12.8)	
40 000-49 999	4 (25.0)	5 (4.6)	
50 000-59 999	2 (12.5)	20 (18.3)	
60 000-69 999	2 (12.5)	14 (12.8)	
≥70 000	4 (25.0)	38 (34.9)	
Alcohol at 6 wk			
None	16 (88.9)	57 (50.4)	.002
Some	2 (11.1)	56 (49.6)	
Caffeine at 6 wk‡			
None	6 (33.3)	8 (7.1)	.005
Some	12 (66.7)	104 (92.9)	
Alcohol at 3 mo‡			
None	14 (77.8)	45 (40.2)	.004
Some	4 (22.2)	67 (59.8)	
Caffeine at 3 mo§			
None	4 (22.2)	7 (6.2)	.046
Some	14 (77.8)	105 (93.8)	

\*Data are given as number (percentage) of dyads, restricted to the 131 infants with colic at 6 weeks of age.

†Other variables not found to be significantly associated with persistence or remission of colic at 3 months included hospital of delivery, mode of delivery, parity, maternal age, marital status, attendance at prenatal classes, rooming in, family history of atopy, source of infant nutrition, maternal smoking during pregnancy and post partum, residing with a smoker, maternal alcohol use during pregnancy and post partum, maternal caffeine consumption during pregnancy and post partum, anticipated return to work, maternal education, pacifier use, social support, labor support, and postnatal depression.

‡Numbers may not total 131 owing to missing data.

§Percentages have been rounded and may not total 100.

cases of colic remit by 3 months of age with little lasting impact on levels of maternal anxiety or depression. We ascertained the outcome of interest, colic, objectively by applying a modified rule of threes to data collected by means of instruments specifically designed for this purpose. Unlike earlier studies, potential etiologic agents, including the source of infant nutrition and levels of maternal distress, were assessed before the development of colic, allowing for the exploration of temporal relationships. Moreover, we examined the potential for an episode of colic to adversely affect maternal mental health

after controlling for earlier (ie, precolic) levels of anxiety and depression.

This study's finding that more than 85% of colic cases remit by 3 months of age is in keeping with the observations of others<sup>2,25-29</sup> and should provide some relief to parents who find themselves caring for a colicky infant. Additional relief can be derived from the fact that, by the twelfth week of life, the total duration of crying and fussing had fallen to an average of 1 h/d, which is about half that seen at 6 weeks of age. This finding is in concordance with the patterns depicted by the normal crying curve, which peaks around 6 weeks of age and decreases to a baseline level around the third month of life.<sup>2,26,29-37</sup> That the normal crying curve has been found to be robust across time and place and to persist despite optimal caregiving practices<sup>38,39</sup> suggests that early crying patterns reflect a process of normal maturation.<sup>33,40</sup>

Excessive crying persisted beyond 3 months of age in almost 14% of cases. This phenomenon, too, appears to be robust across time, place, and study design.<sup>2,32,35,36,39,41-44</sup> This observation suggests that a number of meaningful subgroups may exist within the constellation of colic complaints<sup>44</sup>: one subgroup exhibits typical 3-month colic, whereas in another, colic persists beyond 3 months, perhaps stemming from a persistent mother-infant distress syndrome.<sup>16</sup> As in the study by Wurmser et al,<sup>43</sup> we found no significant relationships between persistent cases of colic and birth order, source of infant nutrition, parental education, or maternal age. A number of factors, including the infant's sex, administration of obstetric anesthesia or analgesia during labor and/or delivery, maternal employment status during pregnancy, household income, and postpartum maternal health behaviors, were identified in univariable analyses to differentiate between colic that remitted and colic that persisted. Because of the potential development of persistent mother-infant distress syndrome,<sup>16</sup> mother-infant dyads who fall into this latter category deserve special attention by future research.

A third subgroup of infants experienced latent distress. These infants did not demonstrate colicky behavior at 6 weeks of age, but did at 3 months of age. Therefore, future studies should look beyond rigid definitions of colic to provide parents with an accurate description of age-appropriate crying behaviors.

Although previous studies that relied on subjective assessments found mothers of formerly colicky infants to be more bothered by their child's behavior,<sup>12,16,17</sup> no such differences were seen in studies that used objective measures.<sup>11,12,16</sup> Along with the findings of this study, those findings suggest that once colic resolves, the residual effects on levels of maternal distress are negligible. Perhaps, once colic resolves, parents then turn their attention to the positive aspects of their child's development. This finding should provide additional reassurance to parents with indications that, for most infants, colic is self-limiting and benign.

Limitations of this study include the possibility that the experiences of this study population may not generalize to postpartum populations with different access to resources that may ease the burden of caring for a fussy infant. Mothers were not asked about their use of interventions and/or health care services in response to their

**Table 3. Change in Maternal Trait Anxiety and Depression Scores, Relative to Infant's Colic Status\***

Score, Colic Status	Range of Change	Mean (SD) Change Score	95% CI for Mean Change	P Value
Trait anxiety†				
No colic	-35 to +25	-2.60 (7.58)	-3.32 to -1.87 ]	.32
Colic at 6 wk	-18 to +17	-1.80 (8.95)		
Postnatal depression‡				
No colic	-20 to +11	-1.82 (4.45)	-2.25 to -1.40 ]	.12
Colic at 6 wk	-14 to +7	-1.12 (4.78)		

\*Change score is measured as the difference between the score at 6 months post partum and the score at 1 week post partum.

†Measured by means of the State-Trait Anxiety Inventory.<sup>19</sup>

‡Measured by means of the Edinburgh Postnatal Depression Scale.<sup>20</sup>

### What This Study Adds

Colic is a relatively common condition of early infancy, characterized by excessive and inconsolable crying. Although the absence of a fail-safe cure for colic can translate into a number of weeks that can be overwhelming for parents, colic is widely believed to be self-limiting and benign. Methodological shortcomings of existing studies, however, have limited our ability to make definitive conclusions.

This study used prospective methods in a community sample of infants to provide evidence that, for most infants, colic remits by 3 months of age with no evidence of deleterious lasting effects on levels of maternal anxiety or depression, as measured by standardized assessments. Because this population has universal access to health care and because most mothers were married, well-educated, and financially secure, future research may wish to examine these findings in populations that differ in their socioeconomic profile and/or access to care.

infant's crying or if they were able to seek respite when they felt overwhelmed. The observation that most mothers in this study were married and financially secure, along with the relative universality of health care in Canada, suggests that the families in this study would have adequate resources to buffer the effects of their infants' colic.<sup>6,15</sup> Moreover, the attrition seen in this study's 4 stages of data collection was not uniform; ie, the manner in which participants differed from nonparticipants translated to a study population that was not necessarily representative of the entire postpartum population. Although such differential participation in postal surveys of this population is not unique,<sup>45,46</sup> the absence of noted effects on levels of maternal anxiety and depression may be due to the relative uniformity of the study sample. Replication of this study in populations that are more heterogeneous could address this issue. In addition, this study did not assess the possibility that parental perceptions of their infants (ie, his or her vulnerability and/or temperament) were altered by the colicky behavior. This will be addressed in a follow-up study of this cohort.

### CONCLUSIONS

This study represents an important contribution to furthering society's understanding of infant colic. Parents

can be reassured that, for most infants, colic is confined to the first 3 months of life, with little lasting effect on levels of maternal distress. These observations should not justify the abandonment of research. Rather, the absence of definitive conclusions regarding colic's etiology, along with its relatively frequent occurrence, the feelings of despair it can evoke, and, in a few cases, its persistence, underlines the importance of continued research that examines the many subgroups of excessive infant crying. In the meantime, we should provide parents with education and support that enable them to cope during this potentially difficult time.

Accepted for publication June 25, 2002.

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