

Excessive Infant Crying: The Impact of Varying Definitions

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ABSTRACT. *Objective.* To assess the impact of varying definitions of excessive crying and infantile colic on prevalence estimates and to assess to what extent these definitions comprise the same children.

Methods. Parents of 3345 infants aged 1, 3, and 6 months (response: 96.5%) were interviewed on the crying behavior of their infant in a Dutch cross-sectional national population-based study. We computed the prevalence of excessive crying according to 10 published definitions regarding parent-reported duration of infant crying and the parents' experience. We measured concordance between pairs of definitions by Cohen's κ (agreement adjusted for chance agreement).

Results. Overall prevalence rates of excessive crying varied strongly between definitions, from 1.5% to 11.9%. They were always highest in 1-month-old infants. Concordance between definitions was only excellent ($\kappa > 0.75$) if they were closely related, such as crying for >3 hours/day for >3 days/week for the preceding 2 or 3 weeks. Concordance between less closely related definitions was much weaker. Concordance between definitions that were based on duration and on parental experience was mostly poor (κ : 0.17–0.53 for infants aged 1 and 3 months).

Conclusions. Different definitions of excessive crying lead to the inclusion of very dissimilar groups of infants. We recommend presenting study results using clearly described definitions, preferably concerning both duration of crying and parental distress. This may improve the comparability of studies on the cause and treatment of excessive infant crying. The impact of the method of data collection on this comparability needs additional study. *Pediatrics* 2001;108:893–897; *colic, preventive child health care, prevention, infancy.*

Excessive crying of young infants is a common and often serious problem for parents.^{1,2} As such, it may affect parental feelings negatively and may cause the infant to be regarded as vulnerable or difficult.^{1,3,4} It also may distort the future relationship between parent and child,⁵ although evidence pointing this way is not conclusive.^{1,6} Furthermore, parents may undertake all kinds of actions to stop excessive infant crying. Some of these may be detrimental to the infant's health^{1,7} such as slapping or shaking the child.⁸

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Despite its potentially substantial negative health consequences, no consensus has been reached on the definition of excessive crying, often called "infantile colic."^{1,4} The available definitions mostly concern the duration of infant crying or its effect on the parents. Regarding duration, an often-cited definition is that of Wessel et al, published in 1954,⁹ which distinguishes between "fussy" and "seriously fussy" children:

"A 'fussy' infant was defined as one who, otherwise healthy and well-fed, had paroxysms of irritability, fussing or crying lasting for a total of more than three hours a day and occurring on more than three days in any one week." (pp. 425–426)

"'Seriously fussy,' in that their paroxysms continued to recur for more than 3 weeks, or became so severe that the pediatrician felt that medication was indicated (footnote: It is the authors' opinion that these 'seriously fussy' infants would be classified as 'colicky' by most pediatric observers)." (p. 427)

This Wessel definition often is used^{1,10–14} but regularly with modifications that may lead to different findings.^{10,11} Lehtonen and Korvenranta,¹¹ for instance, operationalize it as "paroxysms of crying for 3 or more hours per day for 3 days or more per week during a period of at least 3 weeks" (p. 534). Although any cutoff point is arbitrary,¹ the use of "3 or more" in 2 instances instead of "more than 3" probably will lead to the inclusion of a larger group of children. Other (combinations of) cutoff points regarding the duration of crying also have been used.^{5,7,10,13,15–22}

Regarding the effect of infant crying on parents, a similar variety of definitions has been used, such as to what extent parents are able to console their child,^{7,23} think that their child is colicky^{11,24} or cries a lot,⁷ seek professional help,^{10,25–27} or experience the crying of their infant as problematic.¹⁹

For a proper interpretation of the various studies on the occurrence, cause, and treatment of excessive crying and infantile colic, information is needed to establish to what extent these various definitions comprise the same children. Unfortunately, little is known on this subject. A few studies provide prevalence rates based on several definitions,^{7,19,27} but only 1 shows the degree to which various definitions comprise the same children.¹⁹ The aim of this study was to assess the impact of the definition on estimates of the prevalence of excessive crying and to assess to what extent various definitions comprise the same children.

METHODS

Sample and Procedure

Trained child health professionals (physicians and nurses) interviewed a national sample of parents on their infants' crying behavior and on background characteristics, from October 1997 to June 1998. The sample was obtained using a 2-step procedure. In the first step, a random sample of 16 of 65 Well Infant Clinics was drawn, after stratification by region and degree of urbanization of their district. In the second step, each clinic provided a random sample of 75 infants for 3 age groups (variation allowed between brackets): 4 (± 1), 13 (± 2), and 26 (± 4) weeks, further called 1, 3, and 6 months. Of the 3467 eligible children, 96.5% ($n = 3345$) participated. The main reason for nonresponse was lack of interest in the object of study. The sample was representative of the entire Dutch population, except that infants who lived in big cities were relatively underrepresented as a result of the sampling procedure.

The data were collected in a standardized way as part of the preventive health assessments to which all Dutch children are invited regularly. Before the assessment, information on the study and a questionnaire on parental actions regarding crying were mailed to all parents. The design of the study was approved by the Medical Ethical Committee.

Data and Measures

All questions on crying referred to infant crying in the period just before the interview: mean duration per day during the last week (=7 days), number of days during the last week in which the crying lasted longer than 3 hours, number of successive preceding weeks in which the duration of crying exceeded 3 hours, parental opinion on crying at present (cries a lot: yes/no; if yes, to what extent is it a problem: never/at least sometimes), consolability if crying (easy or difficult), and consultation of a health professional for the crying of this infant (yes or no). On the basis of this, 10 definitions that had been used in previous studies were operationalized (see Table 1). All definitions regarding duration were applied only to crying and not to fussing,¹ as differences between definitions regarding this would confound our results.

Data Analysis

We first computed the prevalence rates of excessive crying according to the various definitions and the mean number of hours of crying per day during the preceding week by children who met the criteria of that definition. Next, in a pair-wise analysis, we compared the definitions regarding the percentages of all infants that were comprised by them. We then computed Cohen's κ statistics (agreement adjusted for chance agreement)²⁸⁻³¹ to measure concordance between pairs of definitions. Fleiss characterized κ of 0.75 and over as excellent, below 0.40 as poor, and those in between as reasonable to good.²⁸ We computed κ for the 1- and 3-month age group and for the 6-month age group separately because infants with persistent excessive crying beyond 4 months of age may constitute a different clinical entity.^{1,4,32} Finally, we assessed the impact of differences in prevalence between raters (ie, definitions) and of a low overall prevalence,^{33,34} as both may influence the values of κ .^{29,34,35}

RESULTS

Overall prevalence rates of excessive crying differed strongly between definitions, although, in general, they were highest among 1-month-old infants (Table 2). Infants who met the criteria of a definition always cried more hours per day than the other infants with statistical significance.

As was expected, concordance between definitions was excellent ($\kappa > 0.75$) when it concerned closely related definitions, such as crying >3 hours/day on >3 days/week for at least 3 weeks and for >3 weeks. However, concordances between duration-based definitions on the one hand and parental experience-based definitions on the other hand were, at best, reasonable but often poor. Furthermore, the mutual concordance between duration-based definitions decreased rapidly when they were less closely related.

TABLE 1. Definitions of Excessive Crying Used in This Study

Operationalization in This Study	Original Publication	Description in Original Study
A: Crying >3 h/d on >3 d/wk, >3 wk	Wessel et al, ⁹ 1954, p. 427	"Seriously fussy," in that their paroxysms continued to recur for >3 wk, or became so severe that the pediatrician felt that medication was indicated."
B: Crying >3 h/d on >3 d/wk, ≥ 3 wk	Zeskind & Barr, ²² 1997, p. 396	"Paroxysms (sudden onset) of crying that last for a total of >3 h/d on more than >3 d/wk for at least 3 wk during the first months of life."*
C: Crying >3 h/d on >3 d/wk, ≥ 2 wk	Estep & Kulczycki, ²¹ 2000, p. 22	"Having a duration of total cry and fuss behavior of at least 3 h per d, for at least 4 d/wk, and for at least 2 wk."†
D: Crying >3 h/d on >3 d/wk, 1 wk	Wessel et al, ⁹ 1954, pp. 425-6	"A 'fussy' infant was defined as one who, otherwise healthy and well-fed, had paroxysms of irritability, fussing or crying lasting for a total of >3 h a day and occurring on >3 d in any 1 wk."
E: Crying >3 h/d on ≥ 3 d/wk, 1 wk	Barr et al, ¹⁰ 1992, p. 16	"Number of days of crying/fussing totaling more than 3 h/d in 1 wk. Colic infants with ≥ 3 such days."‡
F: Average crying ≥ 4 h/d, 1 wk	St. James-Roberts & Halil, ²⁷ 1991, pp. 961, 953	"24-hour crying ≥ 4 h . . . in the previous wk."
G: Average crying ≥ 3 h/d, 1 wk	St. James-Roberts & Halil, ²⁷ 1991, pp. 961, 953	"24-hour crying ≥ 4 h . . . in the previous wk."
H: Inconsolable crying	Evans et al, ²³ 1995, p. 850	"Infant had episodes of inconsolable crying, thought to be due to abdominal pain and requiring medication or medical advice."
I: Problematic crying (at least sometimes)	Canivet et al, ¹⁹ 1996, p. 454	"Do you find that your baby's crying has been a problem to you or your family? . . . 'No,' 'yes, a little,' 'yes, quite a lot,' and 'yes, very much.'"
J: Cries a lot	Van der Wal et al, ⁷ 1998, p. 313	"Mothers were also asked whether their baby cries a lot."

* Although this definition is mentioned in the text of this article, the infants included in this study are the same as those described by Barr et al,⁷ and they meet the criteria mentioned in the definition of Barr et al¹⁰ in this table.

† In our data, we can only operationalize "over 3 hours/day," whereas Estep and Kulczycki²¹ used "at least 3 hours/day." Furthermore, the authors used additional criteria regarding infant age, age at onset of symptoms, and infant health that we did not apply.

‡ In the original publication, this applies to parents who sought care because of infant crying.

TABLE 2. Prevalence Rates of Excessive Crying According to 10 Definitions* and Mean Number (SEM) of Hours of Crying Per Day During Preceding Week Among the Identified Excessive Criers, by Age Group (1, 3, and 6 Months)†

Definition	1 Month (n = 1128)		3 Months (n = 1090)		6 Months (n = 1127)		Overall (n = 3345)	
	Rate (%)	Mean (SEM)	Rate (%)	Mean (SEM)	Rate (%)	Mean (SEM)	Rate (%)	Mean (SEM)
A: Crying >3 h/d on >3 d/wk, >3 wk	2.2	3.78 (0.24)	2.0	4.03 (0.43)	0.3	10.92 (5.58)	1.5	4.33 (0.43)
B: Crying >3 h/d on >3 d/wk, ≥3 wk	4.0	4.27 (0.27)	2.0	4.03 (0.43)	0.3	10.92 (5.58)	2.1	4.49 (0.34)
C: Crying >3 h/d on >3 d/wk, ≥2 wk	6.3	4.35 (0.21)	2.4	4.30 (0.40)	0.5	6.83 (3.12)	3.1	4.48 (0.25)
D: Crying >3 h/d on >3 d/wk, 1 wk	9.0	4.40 (0.18)	3.7	3.93 (0.30)	1.3	5.28 (1.31)	4.7	4.36 (0.19)
E: Crying >3 h/d on ≥3 d/wk, 1 wk	12.7	3.81 (0.16)	4.6	3.87 (0.30)	2.0	5.58 (1.30)	6.4	4.01 (0.18)
F: Average crying ≥4 h/d, 1 wk	7.3	5.44 (0.21)	2.8	5.80 (0.46)	1.8	7.50 (1.46)	3.9	5.80 (0.26)
G: Average crying ≥3 h/d, 1 wk	11.2	4.65 (0.17)	4.9	4.62 (0.32)	2.1	6.37 (1.15)	6.2	4.84 (0.19)
H: Inconsolable crying	8.6	3.36 (0.23)	7.3	2.34 (0.24)	3.9	1.96 (0.59)	6.6	2.72 (0.18)
I: Problematic crying	14.3	3.13 (0.16)	6.4	2.88 (0.29)	4.4	2.56 (0.55)	8.4	2.97 (0.15)
J: Cries a lot	17.8	3.00 (0.15)	9.9	2.37 (0.21)	7.7	2.19 (0.41)	11.9	2.66 (0.13)
All infants		1.49 (0.04)		1.01 (0.03)		0.71 (0.04)		1.07 (0.02)

SEM indicates standard error of the mean.

* For all definitions, prevalence rates differ between age groups with statistical significance ($P < .001$; χ^2 tests).

† For all children and for children in the separate age groups, the mean number of hours of crying in the identified group differed from the rest with $P < .001$ (t tests).

Finally, the concordance between a definition that was based on the consolability of the infant and all other definitions generally was poor.

The additional analyses regarding the 6-month age group showed that almost all κ were much lower for this group than for the 1- and 3-month age groups combined, indicating poor concordance, except for the aforementioned closely related definitions. Therefore, in Table 3 we present κ for the combined 1- and 3-month age group only and mainly for definitions for which high κ cannot a priori be expected. Because of the low prevalence of excessive crying at the age of 6 months, κ were only slightly different when we also included the 6-month age group.

The impact of differences in prevalence on the values of κ was small; absolute values of Byrt's bias index³⁴ was always 0.12 or less. The impact of a low overall prevalence, however, seems to be larger; absolute values of Byrt's prevalence index³⁴ varied from 0.76 to 0.95. As a solution for this, Cicchetti and Feinstein³³ proposed using the proportion of positive and negative agreement. The latter is of little interest for this analysis, because most infants are not excessive criers. (This is reflected by high proportions of negative agreements, from 0.92 to 1.00.) Resulting proportions of positive agreement are on average

0.04 higher than values of κ , without affecting our findings. Again, results hardly change when the 6-month-old group is included (not shown).

DISCUSSION

Our results show that the overall prevalence rates of excessive crying vary 8-fold depending on the definition used. Relatively small differences between definitions seem to cause large changes in prevalence rates. Furthermore, definitions seem to comprise different groups of infants as is shown by generally low κ statistics, except when these definitions are closely related.

Bias can hardly explain our findings. First, our sample was representative for almost all Dutch infants and response rates were very high (96.5%). Second, information regarding all definitions was obtained in a similar way. Thus, although retrospective parental report may give other estimates of infant crying than prospective parental report (eg, diaries) or tape registration,^{17,36-38} this will hardly affect the comparison between the various way of measuring duration. Regarding our comparison of duration and parental experiences, however, we expect some overestimation of concordance, as parental feelings will influence both factors. This suggests

TABLE 3. Agreement Between the Groups Identified by All Definitions*

	B	C	D	E	F
A: Crying >3 h/d on >3 d/wk, >3 wk	0.50 (2.1/-/3.9)	0.38 (2.1/-/6.3)	0.34 (1.8/0.4/6.0)	0.17 (1.0/1.1/6.6)	0.19 (1.3/0.8/9.0)
B: Crying >3 h/d on >3 d/wk, 1 wk	—	0.83 (6.4/-/2.4)	0.77 (5.6/0.8/2.3)	0.34 (2.7/3.6/5.0)	0.46 (4.2/2.1/6.2)
C: Crying >3 h/d on ≥3 d/wk, 1 wk		—	0.74 (6.3/2.5/1.6)	0.38 (3.5/5.1/4.3)	0.53 (5.5/3.1/4.9)
D: Average crying ≥3 h/d, 1 wk			—	0.37 (3.4/4.7/4.6)	0.47 (4.9/3.2/5.7)
E: Inconsolable crying				—	0.34 (3.6/4.3/6.7)
F: Problematic crying					—

Data are presented as Cohen's κ (Percentage identified by both definitions, only by row definition, and only by column definition) regarding infants aged 1 and 3 months ($n = 2218$). Combined with the percentage of children that meet neither definition, these percentages add up to 100.

* In all cases, κ differed from 0 with high statistical significance ($P < .001$, t tests).

that the actual κ might even be lower than the already low ones that we found; this topic deserves additional study. Finally, neither the differences in prevalence rates on the basis of the various definitions nor the overall low prevalence rates affected our results in a systematic way.

As to prevalence rates, our results show that even small changes in the definition of excessive crying have considerable consequences. For instance, regarding the duration of crying, application of the exact Wessel definition of colic (crying >3 hours/day on >3 days/week for >3 preceding weeks)⁹ yields a prevalence rate of 1.5%. When the last part of this definition is relaxed to "for 3 or more preceding weeks,"²² to "for 2 or more preceding weeks,"²¹ or to "during the preceding week,"⁹ this adds 0.6%, 1.0%, and 2.6%, respectively, to the prevalence rate. When the second part of the definition also is slightly relaxed, from ">3 days/week" to " \geq 3 days/week"¹⁰ this again adds 1.7%. In total, this more than quadruples prevalence rates (from 1.5% to 6.4%). Prevalence rates thus can be compared only when the definitions that were used are completely comparable.

Our combined data on prevalence rates and concordance show that different definitions often yield different prevalence rates and that even if prevalence rates are similar, they may concern different children. As such, our study provides a quantification of a problem already noted by other authors.^{1,4,7,19,27} For instance, the definitions "crying for >3 hours/day on 3 or more days during the preceding week," "crying on average 3 or more hours/day during the preceding week," and "inconsolable crying" yield similar prevalence rates for infants aged 1 and 3 months (8.8%, 8.1%, and 8.0%, respectively). However, only the first 2 definitions comprised mainly the same children (10.4% of all infants are comprised by at least either of them, 6.3% by both). The other 2 combinations of definitions jointly comprised only approximately 1 quarter of the infants that were comprised by either of them (which was reflected by a very low κ). When 6-month-old infants also were taken into account, results were even worse (not shown).

Thus, the results of studies that use different definitions cannot be compared because they mostly concern different infants. This is relevant for both etiologic studies and studies on the effectiveness of treatments. For instance, the varying results of trials on various behavioral interventions^{25,26,39–41} may be due, at least partially, to differences in the kind of crying infants that were included.⁴⁰ Our results further support previous reports that infants who cry excessively beyond 4 months of age may constitute a different group.^{1,4,32}

CONCLUSION

The results of our study emphasize the necessity to use better comparable definitions in studies on excessive crying and colic. A presentation of results using several clearly described definitions might serve this purpose. It remains to be decided which definitions one should use. We presented results on

10 definitions, but many more could be extracted from the literature. Preferably, studies should use both a definition regarding the duration of crying and fussing per day and one regarding the resulting parental distress. Regarding duration, adherence to the original definitions made by Wessel et al may be useful. These are very widely known^{1,14} and enable a discrimination between crying a lot (crying >3 hours/day on >3 days, ie, at least 4, in the preceding week)⁹ and excessive crying (meeting this criterion for >3 successive weeks).⁹

Second, inclusion of a definition that concerns parental distress is important, as this is a main impetus for seeking professional care,⁴ like that on problematic crying as defined by Canivet et al.¹⁹ Many additional factors influence the composition of this group, however, such as parental background^{12,42} and kind of care setting (eg, community care vs specialist referral care).^{1,4,43} In a clinical setting, diaries^{27,36,38} are necessary when interventions are considered. In that case, the second Wessel definition may be of less interest, as parents or clinicians may not be willing to wait for 3 weeks.¹

Finally, in all cases, a clear description of the applied definition is very important as even minor deviations may lead to the inclusion of different groups of infants. The same holds true for the way in which data are collected (eg, diaries, retrospective self-report, audiotapes).^{27,36–38} We hope that this advice will be a step toward more insight into the causes and treatment of excessive infant crying.

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A WEBSITE AT BIRTH

"Children, it goes without saying, should be initiated as early as possible into the world of computers and the Internet.

So, let's welcome the pilot project running at the Sequoia Hospital in Redwood City, California.

Newborn babies at the hospital are routinely sent home with a birth certificate, a box of toys, and nappies. But now this baby starter kit includes a novel addition—the baby's very own website domain name. In collaboration with domain name provider Namezero.com, the hospital invites new parents to register their infants online with a special password. The first year is free, and after that it costs \$29.95 a year to maintain the site."

New Scientist. June 30, 2001

Noted by JFL, MD

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Sijmen A. Reijneveld, Emily Brugman and Remy A. Hirasing

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