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Within-Pair Differences in Newborn Twins: Effects of Gender and Gestational Age on Behavior

Marilyn L. Riese
Department of Pediatrics, University of Louisville School of Medicine, Kentucky

Abstract. The behavior of 120 full term and 160 preterm newborn twins was assessed in several key areas: Irritability, soothability, reactivity, reinforcement value, and activity level. Infants were assessed during various situations so that aggregate, or summary, scores representing each behavioral area could be obtained. Evaluations were made during a feeding period, an active sleep period, an awake alert period during which orienting and interactional behaviors were observed, a quiet period during which reactivity to stress was observed, and any fussy periods during which irritability and soothability were assessed. Significant within-twin-pair concordance of behavior was obtained for each of the areas of behavior, suggesting the influence of constitutional variables on neonatal behavior. Analysis of these data by sex resulted in significant within-pair concordance of behavior for same-sex but not for opposite-sex twins. The actual ratings on these behaviors differentiated between full term and preterm infants. Increased behavioral deviance was observed with increasing prematurity in the areas of soothability and activity level. The results are discussed in terms of increased risk factors for preterm twins.

Key words: Newborn twins, Twin-pair behavior, Preterm twins, Twin behavioral risk, Sex differences

INTRODUCTION

In the present study, various aspects of behavior were evaluated in a group of newborn twins participating in the Louisville Twin Study. The assessment procedure used was designed to examine neonatal behavioral consistency across a variety of situations [13].

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Since twins share their prenatal experiences, as well as genetic factors, examination of newborn twins may provide information on the contribution of familial factors to neonatal behavioral patterns.

The twins were examined during various activities to obtain representative samples of behavior in five categories of behavior: irritability, resistance to soothing, reactivity, reinforcement value, and activity level. Each infant received a rating for several behaviors within each of these categories, and the ratings were then combined into summary scores. A detailed description of the procedures can be found in Riese [12].

An assessment was made of the performance of 140 sets of newborn twin pairs in these behavioral areas, first to examine the degree of similarity of performance on the assessment among the twins within each pair. Zygosity determination for same-sex twins was not available during the newborn period, so it was not possible to look at performance differences based on zygosity.

Since twins are frequently born prematurely, both full term and preterm twins were evaluated. The preterm infant is often at risk for developmental disabilities [2,3,4,10], and medical complications and prolonged hospitalization may limit opportunities for parent-infant interaction. Also, since it is frequently the infant who initiates interaction with its caregivers, any deviant behavioral patterns observed in the preterm infant may affect the caregiver's attitude toward the infant. A family with two preterm infants may be prone to additional stresses not encountered by families with one, or even two, healthy neonates. Thus, a comparison was made of a sample of stable preterm twins with a sample of full term twins on the performance in each of these behavioral categories; that is, the ability of ratings on the behavioral categories to differentiate between the full term and preterm infants was examined.

METHOD

Subjects. The sample included 280 full term and medically stable preterm neonates as follows: There were 120 full term neonates from 47 pairs of same-sex twins (21 female, 26 male), and 13 pairs of opposite-sex twins; and there were 160 preterm infants from 58 pairs of same-sex twins (30 female, 28 male), and 22 pairs of opposite-sex twins.

Procedures. The full term infants were assessed between the first and fourth day of life. The preterm infants or the infants with medical complications were assessed when they were medically stable; in such cases, testing generally occurred shortly before the infant was to be discharged. A summary of the assessment schedule is presented in Table 1.

In brief, the assessment was as follows:

1. Each neonate was fed at its regularly scheduled feeding time. Behavioral ratings included evaluations of the infant's state and irritability around the feeding time, and of the infant's feeding adequacy (that is, rooting, sucking, spitting, etc.).
2. For a 10-minute period during the first active sleep state, 15-second time-sampling recordings were made of spontaneous activity consisting of the number and vigor of limb movements to obtain an index of activity during sleep.
3. Midway between feedings the infant was awakened so that maturational level, sensorimotor status, and orienting behaviors could be assessed [8]. Measures included visual or auditory orienting responses toward a bullseye, rattle, bell, voice, face and voice combined; reflexive responses such as foot withdrawal and Moro reflex; summary measures of alertness, cuddliness, activity level, and reinforcement value of the

infant's behavior; and pattern of irritability and soothability in response to specific items.

4. Ratings were then made of the infant's response to a potentially stressful stimulus. For this procedure, a metal disc was chilled in ice water for three minutes, then placed against the neonate's left thigh and held there for a period of five seconds [1]. The procedure was repeated five times, and after each presentation behavioral responsivity, irritability, and soothability if necessary, were rated.
5. Finally, ratings were made of episodic irritability of the neonate throughout the course of the entire assessment sequence. A standard series of soothing procedures was applied and the level of intervention needed to soothe the neonate after each episode of irritability was rated.

The ratings from these procedures were combined to create the five behavioral categories.

RESULTS AND DISCUSSION

Some of these findings are available elsewhere [14]. They will be outlined here briefly so that additional analyses can be presented. The data were first analyzed for concordance of scores within twin pairs to determine if the average scores of twins within each pair were more similar to one another than to the average scores of twins from other pairs. The resulting correlation coefficients for each of the behavioral categories are presented in Table 2. Significant concordance in the average scores between twins of each pair was obtained in all of the behavioral categories, suggesting a constitutional influence on certain behavioral patterns during the neonatal period. Thus, if one twin of a pair was generally highly irritable, its cotwin was likely to be generally highly irritable. These similarities of behavior may reflect zygosity, prenatal experiences, and other birth experience factors to varying degrees.

One possibility was that the within-pair concordance for average scores on the behavioral categories was related to sex within the twin pairs. Therefore, correlation coefficients were obtained for the twins by sex as follows: all twins of the same sex, opposite sex, female same sex, and male same sex. These within-pair correlations are displayed in Table 3. As can be seen, there was significant concordance in the average scores of same-sex twins in the categories irritability, resistance to soothing, reactivity, and reinforcement value. Significant concordance of scores was not obtained for the opposite-sex twins in any of the behavioral categories. Thus, neonate twins of the same sex appear to be more like each other in these areas of behavior than opposite sex twins. It is important to keep in mind that these findings are compounded by zygosity, which is unknown for this sample. When zygosity is ultimately determined for these twins, it will provide a clearer picture of the contributions of sex and zygosity to the within-pair relationships. This is necessary since tests of significance of the reliability of the difference between the correlation coefficients [7] for the same sex and opposite sex twins resulted in no significant differences between the two groups in any of the categories.

To determine if the significant within-pair correlations observed for the same-sex twins may have been different for males and females, the same analysis was performed separately for same-sex female and same-sex male pairs. The results, also displayed in Table 3, indicated that within-pair concordance was observed for both the male and female groups in all of the behavioral categories except reactivity, which did not reach significance in the same-sex male group. However, since the male-male reactivity cor-

relation coefficient did approach significance ($P < 0.10$), it is not possible to conclude that there are differences in this behavioral area based on sex for same-sex twins. Again, further research, including zygosity determination, may account for this finding. In addition, there were no significant differences between any of the correlation coefficients for the two same-sex groups.

It is also evident from Table 3 that the within-pair concordance of scores in the activity level category was not significant for any of the groups. This finding is not surprising in view of the low (0.16), although significant, correlation coefficient for the entire sample combined. In addition, although satisfactory individual consistency was observed for both full term and preterm infants in the scores within each of the first four behavioral categories, the internal consistency coefficient for activity level was very low [13]. This suggested that the levels of activity during sleep and while awake are independent, so that in future analyses these two activity level scores were treated separately.

Differences between full term and preterm singleton infants have been described by other investigators in several areas of behavior; eg, in the ability to maintain a high level of arousal [11], in orienting responses [8], in the amunt of crying during a brief examination [5,9,11,15,16], and in the organization of active sleep [6]. To examine possible differences between full term and preterm infant twins, the infants in this sample were first divided into three groups: (a) full term infants of 38-41 weeks gestation; (b) preterm infants born between 35 and 37 weeks gestation; and (c) preterm infants born between 29 and 34 weeks gestation. To determine if the ratings on these items detected differences associated with prematurity, a stepwise discriminant analysis was performed on the behavioral category scores for the infants in the full term and two preterm groups [BMDP Biomedical Computer Programs, P-Series, 1979 (Health Sciences Center,UCLA)]. Table 4 displays the means and standard deviations for the three groups by gestional age, together with the results of the discriminant analysis. The results indicated that the behavioral category resistance to soothing best discriminated between the three groups, with the more mature neonates being more difficult to soothe. In addition, the full term infants were more irritable and more reactive than the preterm infants.

However, one consideration in the breakdown of the preterm group into two separate groups is the acknowledgment that early behavior may be influenced by the degree of prematurity. Therefore, additional stepwise discriminant analyses were performed to determine if the ratings differentiated between the full term and two preterm groups, and/or between the two preterm groups. The results indicated that (a) the later preterm infants (35-37 weeks) were more resistant to soothing ($P < 0.005$) and less active when awake ($P < 0.05$) than the earlier preterm infants (29-34 weeks); (b) the full term infants were more irritable and more reactive than both groups of preterm infants ($P < 0.001$ and $P < 0.05$; $P < 0.025$ and $P < 0.01$, respectively); (c) the full term infants were more resistant to soothing ($P < 0.001$) and less active during the active sleep period ($P < 0.05$) than the earlier preterm infants. There were no differences among the groups in ratings received for reinforcement value of behavior. These findings demonstrate increased risk, or behavioral deviance, in certain behavioral areas (ie, resistance to soothing, activity while awake and during active sleep) with increased prematurity. They also suggest that behavioral differences found in the present study between full term and preterm infant twins are comparable to those found by other investigators between full term and preterm singleton infants.

TABLE 1 - Assessment Schedule

I. Feeding
II. Observation of spontaneous behaviors during active sleep
III. Assessment of maturational level, sensori-motor status, and orienting behaviors
IV. Reactivity to stress (cold disc)
V. Evaluation of spontaneous irritability and soothability

TABLE 2 - Within-Pair Correlations for Scores on Behavioral Categories

	Within-pair correlation	No. of pairs
Irritability	0.45 ***	132
Resistance to soothing	0.33 ***	130
Reactivity	0.22 **	128
Reinforcement value	0.35 ***	130
Activity level	0.16 *	132

* $P < 0.05$; ** $P < 0.01$; *** $P < 0.005$

TABLE 3 - Within-Pair Correlations for Scores on Behavioral Categories by Sex

Behavioral category	Same sex All	No. of pairs	Opposite sex	No. of pairs	Same sex Female	No. of pairs	Same sex Male	No. of pairs
Irritability	0.50***	99	0.28	34	0.53***	47	0.46***	52
Resistance to soothing	0.43***	98	0.13	33	0.35*	47	0.45**	51
Reactivity	0.30**	97	0.02	32	0.41**	46	0.21(*)	51
Reinforcement value	0.41***	99	0.14	32	0.39**	47	0.40**	52
Activity level	0.14	98	0.24	33	0.20	47	0.09	51

(*) $P < 0.10$; *$P < 0.01$; **$P < 0.005$; ***$P < 0.0005$.

TABLE 4 - Means and Standard Deviations of Scores on the Behavioral Variables by Gestional Age at Birth

Variable	38-41 weeks (N = 108)		35-37 weeks (N = 83)		39-34 weeks (N = 70)		F to Enter
	Mean	SD	Mean	SD	Mean	SD	
Irritability[b,c]	2.66	0.93	2.18	0.75	1.95	0.70	3.31*
Resistance to soothing[a,c]	3.44	1.06	2.94	0.96	2.47	1.02	19.71**
Reactivity[b,c]	2.99	0.79	2.91	0.74	2.87	0.70	3.96*
Reinforcement value	2.56	1.17	2.87	0.98	2.94	0.85	1.08
Activity (Awake)[a]	3.73	1.03	3.39	0.99	3.43	1.07	1.72
Activity (Sleep)[c]	2.78	1.09	2.93	1.18	3.01	1.16	1.06

*$P < 0.05$; **$P < 0.001$.

[a] Significant difference between 35-37 and 29-34 weeks.

[b] Significant difference between 38-41 and 35-37 weeks.

[c] Significant difference between 38-41 and 29-34 weeks.

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From a clinical perspective, these findings point to the importance of an awareness of differences in behavioral patterns with increasing prematurity, especially when promoting interaction between parents and infants. Parents of preterm twins are presented with two infants who are not only at high medical risk, but with whom interaction will be less than optimal due to basic differences in behavior in addition to fewer opportunities for interaction with each infant individually.

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Correspondence: Marilyn L. Riese, Ph.D., Child Development Unit, Department of Pediatrics, Health Sciences Center, University of Louisville, Louisville, KY 40292, USA.