

## Maternal Anxiety Associated with Newborn Hearing Screening

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### Abstract

The purpose of this study was to determine if newborn hearing screening increases maternal anxiety. Mothers whose infants were screened for hearing were asked how worried they were prior to hospital discharge and again six weeks later. They were also asked if they were more concerned about their baby's hearing than they were about other aspects of the infant's health and behavior.

Results showed that mothers worried as much or more about many other aspects of their infants' health and behavior as about hearing. Mothers whose infants had a false positive screening result were initially more worried about hearing than other aspects of their infant's health, but this effect disappeared within six weeks. There were no significant differences at Time 1 or Time 2 for maternal anxiety as measured by the STAI between mothers whose infants had a false positive hearing screen compared to mothers of infants who passed their initial hearing screen. Participation in newborn hearing screening is not associated with undue worry among mothers of newborns

**Acronyms:** CDC = Centers for Disease Control and Prevention; CVS = Child Vulnerability Scale; IHCS = Infant Health Concerns Scale; STAI = State-Trait Anxiety Inventory

Over the past twenty years, newborn hearing screening has become the standard of care in the United States (White, 2014), expanding from 3% of newborns in 1993 to 97% in 2013 (Centers for Disease Control and Prevention [CDC], 2015). During this period of expansion, some experts have suggested that participating in newborn hearing screening might create higher levels of parental anxiety, concern, and worry than would be the case if infants were not being screened for hearing (Bess & Paradise, 1994; Clayton & Tharpe, 1998; Mencher & Devoe, 2001; Paradise, 1999).

Subsequent research conducted in response to such suggestions can be divided into two broad categories. The first category is comprised of articles that used a 4 to 5 point Likert-type scale to address the primary question of whether newborn hearing screening leads to high levels of parental worry<sup>1</sup>. These studies reported that 4% to 15% of mothers of all screened infants, and 14% to 25% of mothers of infants who failed the initial hearing screen were *moderately worried* or *very worried* about their infant's hearing. (Barringer & Mauk, 1997; Hergils & Hergils 2000; Clemens, Davis, & Bailey, 2000; de Uzeategui & Yoshinaga-Itano, 1997; Mohd et al., 2011; Van der Ploeg et al., 2008; Vohr, Letourneau, & McDermott, 2001; Weichbold & Welzl-Mueller, 2001).

As discussed in detail by Tueller (2006), most of the existing research on this topic has been of limited value in deciding whether newborn hearing screening is associated with undue levels of parental worry because the studies (a) lacked comparison groups, (b) only asked about worry in the context of the hearing screening result (which may have suggested to mothers that they should be worried), (c) did not collect follow-up data, and (d) had no explicit

basis for comparison (i.e., were parents any more worried about infant hearing than other aspects of infant health and behavior?).

The second category of studies used multi-item scales to measure worry. These studies usually compared mothers of infants who had a false-positive initial hearing screen to mothers of infants who passed the initial screening or to mothers of unscreened infants. All of these studies reported no statistically significant differences between groups on levels of maternal anxiety (Crockett, Baker, Uus, Bamford, & Marteau, 2005; Crockett, Marteau, Uus, & Bamford, 2004; Kennedy, 1999; Suppiej et al., 2013; Watkin, Baldwin, Dison, & Beckman, 1998), as measured by the State-Trait Anxiety Inventory (STAI; Spielberger, 1983) or its short form for state anxiety (Marteau & Bekker, 1992), parental stress (Stuart, Moretz, & Yang, 2000) as measured by the Parenting Stress Index (PSI; Abidin, 1995), or maternal perceptions of child vulnerability (Poulakis, Barker, & Wake, 2003) as measured by the Child Vulnerability Scale (CVS; Forsyth, Horwitz, Leventhal, Burger, & Leaf, 1996). Not only were many of these studies underpowered (see Nelson, Bougatsos, & Nygren, 2008, for further discussion of this issue), but given that these measures assess anxiety, worry, and stress at a very broad level, it is possible that more specific, but important levels of worry caused by newborn hearing screening could have been missed.

To more fully evaluate whether newborn hearing screening is associated with undue levels of worry among mothers, the current study included comparison measures, group comparisons, and follow-up assessments to answer the following questions: (1) Do mothers whose infants were

<sup>1</sup> The term *worry* will be used in the remainder of this article to represent the constructs of worry, concern, anxiety

screened for hearing worry more about their child's hearing than other aspects of infant health and behavior? (2) Do mothers whose infants had a false-positive initial hearing screening worry more about their infant's hearing than mothers whose infants pass the initial hearing screening?

### Patients and Methods

Prior to the initiation of the study, approval was obtained from the Utah State University Institutional Review Board. The approved surveys and questionnaires were distributed to mothers under the direction of newborn hearing screening coordinators in a heterogeneous group of 11 hospitals in Utah. All mothers of infants who failed the inpatient hearing screening and similar numbers of randomly selected mothers whose infants passed the inpatient hearing screening were invited to complete two questionnaires—the first within a week of hospital discharge and the second at approximately six weeks after birth. By the time mothers completed the second questionnaire when the infant was six weeks old, all infants who had failed the inpatient screening and needed an outpatient screening had completed the outpatient screening. At the request of hospital administrators, mothers of Newborn Intensive Care Unit (NICU) babies were not invited to participate in the study. Mothers agreed to the follow-up questionnaire by including their contact information when returning the initial questionnaire. A total of 286 mothers were invited to participate, and 192 completed the Time 1 questionnaire (a 67% response rate). Among those that completed a Time 1 questionnaire, 95 completed the Time 2 questionnaire (49% of the initial responders). The numbers of mothers and percent in each screening result group are presented in Table 1.

The initial questionnaire included the Infant Health Concerns Scale (IHCS, Tueller, 2006) the STAI—short form (Marteau and Bekker, 1992) and demographic questions. The follow-up questionnaire included the STAI, and the IHCS. The IHCS was developed for this study and is comprised of items assessing the respondent's level of worry about 21 aspects of infant health and behavior (e.g., eating habits, sleeping habits, digestion, eyesight, hearing, etc.) on a 4-point Likert type scale (*not at all worried, somewhat worried, moderately worried, or very worried*). One of the items was about hearing and is similar to the items in previously referenced studies that used a single item to assess worry about infant hearing. The STAI was included because it has been used frequently in previous research on this topic. See Table 2 for information about the reliability of the instruments used in the study.

### Results

To answer the question of whether mothers of infants who were screened for hearing are any more worried about hearing than other aspects of their infant's health and/or behavior, the mean level of worry about hearing was compared to each of the 20 other aspects of infant health and behavior measured by the IHCS. As can be seen in Table 3, at Time 1 (i.e., within one week of hospital discharge), the average mother was not very worried about any of the 21 aspects of infant development on the IHCS. The highest average level of worry at Time 1 was 1.65 (on a 4-point scale) for *eating habits* (see Table 3). At Time 1, hearing was the 6th highest worry and was not statistically significantly different from 14 of the other aspects of infant development<sup>2</sup>. Six weeks later at Time 2, hearing was the 8th highest worry and was not statistically significantly different from all 20 of the other aspects of

<sup>2</sup> Results from the IHCS at Time 2 are not included in this article but are available from Tueller (2006).

**Table 1. Number of Participants in Each Screen Result Group**

	<i>n</i>	
	Time 1	Time 2
Passed Initial Hearing Screen (initial pass group)	83	60
Failed Initial Screen/Passed Post-Discharge Screen (fail/pass group)	34	18
Failed Initial Screen/Fail Post-Discharge Screen	9	7
Screen Result Unknown	66	10
<b>Total</b>	<b>192</b>	<b>95</b>

**Table 2. Reliability of Instruments**

Instrument	$\alpha$ in prior development	Current Study		
		Time 1	Time 2	Test-Retest
STAI	$\alpha = 0.82$	$\alpha = 0.79$	$\alpha = 0.81$	$r = 0.39$
IHCS	NA	$\alpha = 0.91$	$\alpha = 0.87$	$r = 0.66$

\* STAI = short form for state anxiety. The correlation between the short form and the 20-item state anxiety subscale of the full form of the STAI is  $r = 0.91$

\* IHCS = short form for Infant Health Concerns Scale

infant development. (Whenever more than two tests of statistical significance were done for the same subjects using different items or subtests, a Bonferroni correction for dependent samples *t*-tests was applied.) As shown in Table 4, among the full sample (i.e., including those babies that passed and those babies that failed the initial screening test), 14.6% of mothers were moderately worried or very worried about their infant's hearing at Time 1, but only 4.3% continued to be worried 6 weeks later.

In the subset of mothers whose infants had a false-positive hearing screen (the fail/pass group), hearing had the highest level of worry among the 21 IHCS items at Time 1, but was not statistically significantly different from 15 of the other IHCS items. At follow-up, hearing had the 8th highest level of worry, and was not statistically significantly different from any of the 20 other IHCS items. Within this subset, 15% of mothers were moderately worried about their infant's hearing at Time 1 and none were very worried. At follow-up, no mothers in this subgroup were moderately worried or very worried about their infant's hearing, although 17% remained somewhat worried.

A second research question was whether mothers whose infants had a false-positive initial hearing screening were more worried about their infant's hearing than mothers

whose infants passed the initial hearing screening. To answer this question, we first examined whether mothers in the two groups varied with respect to overall levels of worry. As shown in Table 5, the average IHCS scores for mothers in the initial pass group were not statistically significantly different than mothers in the fail/pass group at either Time 1 ( $t = .84, p = .40$ ), or Time 2 ( $t = .66, p = .51$ ).

In comparing mothers in the initial screen pass group with those in the fail/pass group on the item, "Please check the box that shows your level of concern about [your baby's] hearing, there were no statistically significant differences at either Time 1 ( $t = 1.7, p = .09, d = .35$ ) or Time 2 ( $t = 1.0, p = .31, d = .27$ ). There were also no statistically significant differences between groups for the STAI at either Time 1 ( $t = .134, p = .89, d = .03$ ) or at follow-up ( $t < .01, p = .99, d < .01$ ).

### Discussion

This study found that 14.6% of mothers of infants from the well baby nursery who were screened for hearing were moderately worried or very worried about their infant's hearing shortly after the time of birth. This finding is consistent with the 4% to 15% reported in earlier articles. However, different from most previous studies, this study

**Table 3. Time 1 Mean Level of Maternal Worry on IHCS Items and Frequencies for Response Options (N = 191\*).**

Aspect of Infant Health	Mean worry (SD)	Percent ‡ (n)			
		Not at all worried	Somewhat worried	Moderately worried	Very Worried
Eating Habits †	1.65 (.83)	53.1 (102)	37.8 (61)	10.4 (20)	4.2 (8)
Getting a major disease †	1.61 (.83)	56.3 (108)	29.7 (57)	8.3 (16)	4.7 (9)
Irritability, crying, or colic †	1.58 (.71)	52.1 (100)	39.1 (75)	6.3 (12)	2.1 (4)
Sleeping habits †	1.55 (.72)	56.8 (109)	31.8 (61)	9.9 (19)	1.0 (2)
Not waking up from sleep †	1.54 (.77)	59.9 (115)	28.1 (54)	7.8 (15)	3.1 (6)
Hearing	1.53 (.82)	64.6 (124)	20.3 (39)	11.5 (22)	3.1 (6)
Getting enough fluid †	1.45 (.71)	65.6 (126)	25.5 (49)	6.3 (12)	2.1 (4)
Digestion †	1.43 (.68)	65.6 (126)	25.5 (49)	6.3 (12)	1.6 (3)
Lungs working right †	1.39 (.76)	74.0 (142)	16.1 (31)	5.7 (11)	3.6 (7)
Heart working right †	1.39 (.77)	73.4 (141)	17.2 (33)	4.7 (9)	4.2 (8)
Weight †	1.37 (.70)	72.4 (139)	19.8 (38)	4.7 (9)	2.6 (5)
Temperament †	1.35 (.45)	70.8 (136)	24.0 (46)	3.6 (7)	1.0 (2)
Eyesight †	1.32 (.64)	75.0 (144)	19.3 (37)	3.1 (6)	2.1 (4)
Intelligence †	1.32 (.70)	76.6 (147)	17.2 (33)	2.1 (4)	3.6 (7)
Physical growth †	1.31 (.65)	76.0 (146)	18.2 (35)	2.6 (5)	2.6 (5)
Bowel movements	1.29 (.58)	75.5 (145)	19.8 (38)	3.1 (6)	1.0 (2)
Ability to pay attention	1.28 (.65)	79.7 (153)	15.1 (29)	1.6 (3)	3.1 (6)
Recognizing you/bonding with you	1.28 (.63)	78.6 (151)	15.6 (30)	3.1 (6)	2.1 (4)
Making Sound	1.20 (.52)	83.9 (161)	12.5 (24)	2.1 (4)	1.0 (2)
Ability to move/grasp	1.16 (.48)	87.5 (168)	9.4 (18)	1.6 (3)	1.0 (2)
Recognizing objects	1.15 (.42)	87.0 (167)	10.9 (21)	1 (2)	0.5 (1)
Average	1.39 (.67)	71.0 (130)	21.0 (39)	5 (9)	2.0 (4)

\* = The number does not total 192 because of missing data

† = *t*-tests with a Bonferroni correction were used to compare the hearing item to all other items; these items were not statistically significantly different from the hearing item.

‡ = Percent of mothers completing a Time 1 questionnaire; percents do not add up to 100 due to rounding

**Table 4. Percent of all Mothers “Moderately Worried” or “Very Worried” About the 21 Aspects of Infant Health Measured by the IHCS at Time 1 and Time 2**

Aspect of Infant Health	Percent worried or very worried (N)			
	Time 1		Time 2	
Eating Habits	14.6	(28)	5.3	(5)
Hearing	14.6	(28)	4.3	(4)
Getting a major disease	13.0	(25)	6.4	(6)
Not waking up from sleep	10.9	(21)	5.3	(5)
Sleeping habits	10.9	(21)	3.2	(3)
Lungs working right	9.3	(18)	1.1	(1)
Heart working right	8.7	(17)	3.2	(3)
Getting enough fluid	8.4	(16)	4.2	(4)
Irritability, crying, or colic	8.4	(16)	11.6	(11)
Digestion	7.9	(15)	9.5	(9)
Weight	7.3	(14)	3.2	(3)
Intelligence	5.7	(11)	3.2	(3)
Eyesight	5.2	(10)	1.1	(1)
Physical growth	5.2	(10)	3.2	(3)
Recognizing you/bonding with you	5.2	(10)	2.1	(2)
Ability to pay attention	4.7	(9)	1.1	(1)
Temperment	4.6	(9)	3.2	(3)
Bowel movements	4.1	(8)	8.5	(8)
Making Sounds	3.1	(6)	1.1	(1)
Ability to move/grasp	2.6	(5)	2.2	(2)
Recognizing objects	1.5	(3)	3.2	(3)
Average	7.4	(14.0)	4.1	(3.8)

\* IHCS = short form for Infant Health Concerns Scale

**Table 5. Differences in IHCS Average Scores for Mothers Whose Babies Passed the Initial Screen Compared to Those Who Failed the Initial Screen and Passed an Outpatient Screen**

	Infants' screening results for each group of mothers	Mean* (n)	Difference of Means	t	df	p
<b>Time 1</b>	Initial Screen: Pass	<b>1.36</b> (83)	0.07	0.84	115	0.40
	Initial Screen: Fail Outpatient Screen: Pass	<b>1.29</b> (34)				
<b>Time 2</b>	Initial Screen: Pass	<b>1.21</b> (60)	0.04	0.66	76	0.51
	Initial Screen: Fail Outpatient Screen: Pass	<b>1.17</b> (18)				

Note. IHCS = short form for Infant Health Concerns Scale

\*The IHCS mean score is the average of scores on 21 four-point likert type items ranging from 1 (*not at all worried*) to 4 (*very worried*).

puts this finding in context by including information about results 6 weeks later and by comparing worry about hearing with worry about other aspects of the infant's health and behavior. At 6 weeks after birth (during which time all of the infants in the sample who failed the inpatient screen received an outpatient hearing screening test after being discharged from the hospital) only 4.3% of the mothers in the initial fail group continued to feel moderately

worried or very worried about their infant's hearing. Thus, newborn hearing screening does not seem to have a persistent negative consequence for more than 95% of mothers. Furthermore, hearing was found to be of no greater concern than many other aspects of infant health and behavior (e.g., eating or sleeping habits, irritability, physical growth, digestion, etc.) about which mothers may be concerned. These data provide convincing evidence that

hearing screening does not lead to higher levels of worry about hearing than is the case for many other aspects of infant health and/or behavior that mothers normally experience.

A major concern of many infant screening programs is whether a parent whose infant has a false-positive result will continue to worry that his/her infant may have a condition despite subsequent screenings or diagnoses indicating that the infant does not have the condition (e.g., Clayton and Tharpe, 1998; Paradise, 1999). In the study reported here, 15% of the mothers whose infants had a false-positive hearing screen (the fail/pass group) were moderately worried or very worried about their infant's hearing at Time 1, which is consistent with the 14% to 25% found in prior studies. However, at the follow-up assessment six weeks later, none of the mothers in the fail/pass group were moderately worried or very worried about their infant's hearing. Shortly after the birth of the baby, mothers in the fail/pass group were worried more about their infant's hearing than any of the 20 other aspects of infant development measured by this study, but most of these concerns had disappeared 6 weeks later.

In comparison to mothers whose infants passed the initial hearing screen, mothers in the fail/pass group did not have significantly higher levels of worry about infant hearing when the baby was about six weeks of age. This indicates that most mothers of infants who had a false-positive hearing screen were initially concerned (which is probably appropriate) about their infant's failed inpatient screen, but that this concern almost always disappeared after their infant passed an outpatient screen following discharge from the hospital. Consistent with prior research, there was no group difference on levels of maternal anxiety as measured by the STAI between mothers whose infants had a false-positive hearing screen and mothers whose infants passed the initial hearing screen at either Time 1 or at the follow-up at Time 2.

### Conclusions

The results of this study provide even stronger evidence than was previously available that newborn hearing screening does not create undue maternal worry. The evidence is stronger because it included an assessment of the degree to which mothers were worried about their infant's hearing compared to other conditions or variables (e.g., sleeping habits, eating habits, vision, etc.) about which mothers may worry. Clearly, a few mothers were worried about their baby's hearing, but it is important to note that fewer mothers worried about hearing than about eating habits, irritability, sleeping habits, not waking up from sleep, and getting a major disease. Furthermore, there were no statistically significant differences shortly after the infant's birth or six weeks later between the number of mothers worried about hearing and those worried about such issues as digestion, lungs working right, weight, temperament, and eyesight. These data suggest that the relatively small number of mothers who worry about

hearing is a function of the normal concerns that mothers have about new babies and is not a negative reaction caused by newborn hearing screening.

Interestingly, even though much of the previous literature refers to parental worry virtually all of that research has been conducted with mothers. It would be good if future research on this topic could also include fathers.

The fact that a significant number of mothers whose infants failed the hospital-based newborn hearing screening are initially worried about hearing may be good because it should increase the motivation for mothers of these infants to follow-up with subsequent screening and diagnostic tests. Of course, the fact that mothers are initially worried underscores the importance of continuing to devote time and effort to parent education to ensure that parents understand why newborn hearing screening is being done and what steps, if any, they should take following screening. Future research on this issue would do well to include measurements of parental understanding of the screening results because misunderstanding may contribute to elevated levels of worry (Arnold et al., 2006). It would also be valuable for future research to examine the effects of providing information about screening results to parents in different ways with different content.

The bottom line is that the results of this study, in combination with previous research on this issue, provide convincing evidence that newborn hearing screening is not creating undue maternal anxiety.

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