

Concurrent Child Health Status and Maternal Recall of Events in Infancy

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Abstract. *Background.* Obtaining information on children's health and health events is heavily dependent on maternal report. Experience as to what factors influence accuracy of reporting varies, and few studies have examined the influence of current child health status on recall.

Methods. A prospective cohort study involving 1833 children who were assessed in infancy and at 8 to 10 years of age was conducted to assess maternal reports of birth weight, gestational age, neonatal transport, length of neonatal hospitalization, and rehospitalizations in the first year compared with data collected in infancy overall, and as a function of concurrent child functional health status, socioemotional health, and ratings of child health.

Results. Maternal recall of neonatal events was accurate but not that of rehospitalizations in the first year. Concurrent child health problems affected accuracy but not sufficiently to make information unusable.

Conclusion. Maternal recall of neonatal events 8 to 10 years later is accurate; however, the influence of current child health status on recall may be important in research on the cognitive processes underlying health questionnaire responses. *Pediatrics* 1999;104:1176-1181; *birth weight, gestational age, hospitalization, survey, recall.*

ABBREVIATIONS. PDA, patent ductus arteriosus; RWJF, Robert Wood Johnson Foundation.

The necessity of continued reliance on lay reports of medical conditions and events to assess the prevalence of health problems and use of medical services has resulted in a lengthy and extensive literature on factors influencing recall and methods of improving accuracy.¹⁻⁴ Of particular concern to those doing research on pregnancy and neonatal risks for later childhood health problems is the accuracy of maternal recall of events during this period, and the factors that influence recall. The existing work indicates that accuracy of recall varies by type of information. Thus,

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The content of this publication does not necessarily reflect the views or policies of the Department of Health and Human Services nor does the mention of trade names, commercial products, or organizations imply endorsement by the US Government.

Received for publication Mar 1, 1999; accepted Jul 20, 1999.

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for example, a high degree of consistency exists between maternal report and medical or vital records for number of pregnancies, number of miscarriages, hospitalization during pregnancy, and birth weight for extended periods after the pregnancy.⁵⁻⁹ Gestational age is remembered less well.⁹ Short-term recall of diet in pregnancy and intrapartum events is moderately good.^{6,10,11} Agreement between maternal recall and recorded data for pregnancy conditions such as threatened abortion, drug and radiograph exposure, and short-term illness is substantially lower.^{5,7,11,12} The recall of infant conditions such as neonatal jaundice, malformations, lower respiratory tract infections, or otitis media appears relatively inaccurate.^{7,11,13,14}

Studies of the factors affecting the accuracy of report have tended to focus on a limited number of sociodemographic characteristics of the women, with greater accuracy of recall with indicators of higher socioeconomic status reported by some authors^{15,16} but not others.¹⁷⁻¹⁹ The effects of other factors, particularly subsequent child and maternal health, have received limited attention. In infancy, mothers of infants with adverse neonatal outcomes have more accurate recall than mothers of control infants in some^{5,20} but not all studies.¹⁷ The hypothesis underlying this observation is that mothers whose infants are born with problems will expend more effort reviewing potentially related events during pregnancy and delivery than mothers with no impetus to do so. Whether subsequent child health status influences maternal recall of neonatal events has, to our knowledge, not been examined. Subsequent child health problems might enhance recall through greater contact with the medical care system and its requirement for medical historical information. Alternatively, parents whose children experienced early health problems may overreport or overestimate the seriousness of child health events, as conceptualized in the vulnerable child syndrome.^{21,22} To address this question, we have examined mother's reports of events in the newborn and infancy periods for children who were 8 to 10 years of age in relation to the child's current health status as assessed across several dimensions of health, using data from a large, multisite study of school-aged children.

METHODS

The data for this analysis were obtained as part of an assessment of the later outcomes of children with varying birth weights. The methods described elsewhere,²³⁻²⁵ will be summarized below.

Study Population

The majority of the very low birth weight (≤ 1500 g) children came from 10 of the 13 centers originally participating in the randomized, controlled trial of indomethacin for the treatment of patent ductus arteriosus (PDA) (NHLBI-H-223121).^{26,27} Neonatal data were collected on all children monitored for the emergence of a PDA, but 1-year follow-up data were obtained only on those children with PDAs entered into the trial. From the entire neonatal cohort were selected all children with birth weights ≤ 1000 g ($n = 395$) and a random sample of children weighing 1001 to 1500 g ($n = 656$) who had been discharged from the intensive care unit alive and were not known to have died subsequently.

To obtain observations on children of similar age but of heavier birth weight, children assessed as infants in the evaluation of the Robert Wood Johnson Foundation (RWJF) National Perinatal Regionalization Demonstration Program^{28,29} were selected from Syracuse, New York; Dallas, Texas; and Cleveland, Ohio. A 75% random sample of all infants with 1-year information was selected for follow-up at school age, yielding a target sample of 1172 low birth weight (≤ 2500 g) and 685 normal birth weight (>2500 g) children.

All children in the study were contacted between April 1986 and November 1988 when the children would have been 8 to 10 years of age. Using a prespecified approach to locating and recruiting families, follow-up information was obtained on 65.1% of the entire sample, or 1889 respondents. When respondents were compared with nonrespondents, the major predictor of nonresponse common to both groups was maternal educational attainment in the child's infancy of less than high school graduation. In both groups, indicators of higher levels of neonatal morbidity were associated with higher response rates (length of neonatal hospital stay >75 th percentile for birth weight in the RWJF cohort and birth weight ≤ 1000 g in the PDA cohort).²³

Data Collection

Infancy Data

For the RWJF cohort, data on birth events were derived from the birth certificate, and data on morbidity in infancy were obtained by a survey relying on maternal report.^{28,30} For the PDA cohort, neonatal data were abstracted in a common format from the hospital record. Infant morbidity data at 1 year of age were obtained from maternal report only for the one-third of subjects who actually entered the trial.²⁶ For both groups, gestational age was available in exact weeks. For the PDA cohort, birth weight was available in exact grams, but for the RWJF cohort, the birth certificate data had been recoded to 500-g intervals to accord with the practice of one of the states. For the PDA cohort, length of hospital stay was calculated from admission and discharge dates, and neonatal transport inferred from status on admission as outborn. For the RWJF cohort, these data were obtained from the mother at 1 year. For both groups, information on subsequent rehospitalizations was obtained at 1 year from maternal

report. Thus, for this variable only, data at 1 year were available only for those PDA children in the trial.

Recall Data

At the subsequent interview when the children were 8 to 10 years of age, information on duration of gestation, length of neonatal hospitalization, birth weight, neonatal transfer, and rehospitalization in infancy was again ascertained, using questions in the same format as the RWJF survey as much as possible. These items were defined and coded as follows:

Duration of Gestation

The question was asked in 2 parts: did the pregnancy last a full term, and, if not, how many weeks early/late was the delivery. The responses were coded as full-term or late, premature, and exact weeks premature or late. This variable was examined both as a categorical variable (premature, term, and late) and as the differences or variance between weeks of gestation in infancy versus those reported at 8 to 10 years of age.

Birth Weight

The response was coded either in grams or pounds/ounces, with the latter being converted to grams; and grouped into 500-g intervals to be consistent with neonatal data.

Duration of Neonatal Hospitalization

This response was defined as the total nights the infant stayed in the hospital before coming home for the first time. This variable was analyzed as the difference between the duration of hospitalization in nights recorded at infancy versus that at 8 to 10 years of age.

Neonatal Transfer

Whether the child stayed in the same hospital until coming home. A "no" answer with the name of the receiving hospital was coded as a neonatal transfer.

Infant Hospitalizations

Hospitalization data were ascertained by asking about hospitalizations in the year before the interview, then any earlier ones. For all episodes, age and date of admission were obtained.

Child Health Status Measures

To assess the effect of child and maternal factors on recall, associations between differences in recalled events versus events recorded in infancy were examined for several child health status measures and maternal characteristics at the time of the interview. These measures are summarized in Table 1.

TABLE 1. Summary of Child Health Status and Maternal Variables

Measures of Child Health Status	Definition
Functional limitations	This assessment included parental report of limitations attributable to health on 16 activities of daily living using a scale developed for the National Health Insurance Study ³¹ modified so that all questions were in a yes or no format with higher scores indicative of worse health. Two questions judged to be duplicative were eliminated.
Affective health	Affective health was measured by the "General Well-being" scale (GWBS) for 5- to 12-year-olds developed for the National Health Insurance Study. ³¹ The scale consists of 10 5-point Likert items with higher scores indicative of positive health.
Behavior problems	Behavioral problems were measured by the index (BPI) developed by Zill ³² and used in the National Health Interview—Child Health Supplement. ³³ The scale consists of 28 items scored 1 to 3 with higher scores indicative of more problems.
Self-competence	Self-competence was measured by the Harter scale. ³⁴ The scale consists of 36 items scored 1 to 4 with higher scores indicative of greater child competence in several domains of activities. ³⁴
Rating of child health	Maternal rating of child health was obtained during the interview using a 6-item health perceptions scale developed for the National Health Insurance Study. ³¹ Responses to items in this scale are along a 5-point Likert scale with all items scored in the direction that higher scores indicate better health.

Statistical Analysis

To address the study question, maternal recall at early school age was compared with data obtained in infancy, using the K statistic³⁵ as the measure of consistency for categorical variables and Pearson's correlation coefficient for interval variables. The respondents were then categorized as "inaccurate" or "accurate" on the categorical responses. To assess the association with current child health status, the mean scores for the child health measures in Table 1 were compared for accurate and inaccurate responders using analyses of variance with Studentized Range Test.³⁶

To assess the effect of maternal educational attainment similar analyses of variance were conducted comparing mean years of educational attainment. Multivariate analyses were then performed to assess any potential modifying effect of maternal education on the effect of current child health status on recall using multiple linear regression with the dependent variable expressed as a dummy (accurate, not accurate), and interval independent variables.

RESULTS

Accuracy of Maternal Recall

In general, maternal recall was quite accurate with values for $K > .85$ for categorical comparisons (Table 2). Where disagreement occurred for birth weight, mothers were likely to recall a lower birth weight. Recall of neonatal transport was quite accurate, but that of hospitalization during the first year less so. For the latter, those whose children were not hospitalized were more accurate than those with hospitalized children, almost half of whom did not recall the event. Because the 1-year data were obtained at ages corrected for duration of gestation, we also examined the hospitalization results for age < 2 years. This procedure reduced the level of inaccuracy somewhat, but this event appeared not to be as well recalled as others. For gestational age, the greatest disagreement was for postdates infants. The correlation in exact weeks for gestational age was .87 with an overall variance between infancy and school-age data of slightly over half a week with the tendency being for mothers to recall the infants as being slightly less mature. Duration of the newborn admission before going home for the first time was well recalled with

a correlation coefficient of .83 although the tendency was to recall it as longer by about 4 days.

Association With Child Health Status Reported at School Age

No significant associations between accuracy of maternal recall and the General Well-being Scale were obtained. The remaining results are summarized in Table 3.

Higher mean scores on the functional limitations indicative of worse current child health were obtained for those who did not recall neonatal transport (16.1 vs 15.6) or infant rehospitalization accurately (16.2 vs 25.5). Lower scores were observed for those not recalling gestational age accurately (15.4 vs 45.7) with no difference in scores for birth weight recall.

The pattern for recall of gestational age, neonatal transport, and infant rehospitalization was repeated for measures of child self-competence and general health rating scores. Lower mean scores (worse health) were observed for those not recalling the latter 2 accurately, but higher mean scores (better health) with less accurate recall of gestational age.

For neonatal transport and rehospitalization in infancy, scores indicating more functional limitations attributable to health, lower child self-competence, and lower general health rating were associated with greater inaccuracies in reporting. For gestational age, these factors were associated with more accurate reporting. Reporting of birth weight was influenced only by behavior problems with inaccurate reporting associated with higher problem scores.

Only ratings of general health were associated with the variances between estimates of gestational age in infancy and at school age, ($r = -.06$, $P < .0001$). The difference in estimates of length of neonatal stay in the 2 time periods was associated with functional limitations ($r = -.05$, $P < .05$) and general health rating ($r = .08$, $P < .001$).

TABLE 2. Maternal Recall of Events in Infancy for Early School-age Child

	Infancy Data	Recall	Measures of Association
Birth weight	<i>n</i> *	% Accurately Recalled	
≤1000	224	94.6	K = .89
1001–1500	336	85.1	
1501–2000	157	83.4	
2001–2500	551	82.9	
2501+	527	98.1	
Neonatal transport			
Yes	310	94.2	K = .94
No	1573	94.5	
Rehospitalized in first year			
Yes	267	53.6	K = .90
No	1277	98.7	
Gestational age (wk)			
<38	953	93.7	K = .85
38–42	723	80.5	
43+	72	20.8	

* Difference between 1989 and sum of *n*'s reflects missing data at one or both ages.

TABLE 3. Association of Maternal Recall of Events in Infancy With Measures of Child's Current Health Status

	Functional Limitations	Child Health Status Measures		General Health Rating
		Mean (Standard Deviation)		
		BPI	Child Self-Competence	
Birth weight (n)		Mean (SD)		
Inaccurate (192)	15.1 (1.6)	13.6 (9.6)*	108.3 (16.5)	22.9 (4.8)
Accurate (1603)	15.6 (1.6)	12.2 (8.9)	108.5 (16.1)	23.4 (4.7)
Gestational age				
Inaccurate (258)	15.4 (1.0)†	12.1 (10.0)	110.5 (15.9)*	24.7 (4.2)¶
Accurate (1490)	15.7 (1.7)	12.5 (9.0)	107.9 (16.2)	23.1 (4.8)
Neonatal transport				
Inaccurate (104)	16.1 (2.2)‡	14.1 (9.8)	104.2 (16.1)**	21.7 (5.0)§
Accurate (1779)	15.6 (1.6)	12.3 (9.1)	108.6 (16.3)	23.4 (4.7)
Rehospitalization in infancy				
Inaccurate (140)	16.2 (2.5)¶	12.8 (9.7)	104.3 (7.8)¶	21.4 (5.0)¶
Accurate (1404)	15.5 (1.3)	12.1 (9.0)	110.0 (15.8)	24.1 (4.5)

* $P < .05$; ** $P < .01$; † $P < .005$; ‡ $P < .001$; § $P < .0005$; ¶ $P < .000$.

We also assessed the effect of years of maternal educational attainment on accuracy of recall (Table 4). Among the categorical variables, maternal education was only associated with reports of recall of neonatal transfer and infant rehospitalizations, but in opposite directions. Higher educational attainment was associated with more accurate recall of infant rehospitalization but less accurate recall of neonatal transfer. Maternal educational attainment was not significantly associated with the variance in the 2 estimates of gestational age or neonatal hospitalization. Controlling for maternal education in multivariate models did not substantially alter the bivariate results.

DISCUSSION

Our results are consistent with other reports that the maternal recall of birth weight and gestational age is accurate. In addition, we have found that mothers can accurately report other neonatal events like neonatal transport and duration of length of hospitalization in the newborn period. Our level of agreement both for birth weight in categories, and gestational age, both in categories and as the actual difference in weeks, is similar to that found by other investigators.^{7,9,15,18,19}

Maternal memory of hospitalization in infancy is less accurate. These results are consistent with the

more general experience that recall of hospitalization is well conserved only for 1 year or less.^{1,2,38} We had anticipated, however, that the rapid growth and developmental changes in the first year might have provided more cues to memory. The direction of the error, an underreporting among those whose children were hospitalized, is what Pless and Pless¹⁸ have found for recall of all hospitalizations, not just those at specific ages, and with other studies suggesting poor recall of even less salient events in infancy.^{16,39}

Of the factors that might affect maternal recall, we have examined child health at 8 to 10 years of age and maternal education. The extent to which poor child health influences maternal report has been examined primarily for recall of prenatal exposures for mothers whose children were born with and without congenital malformations. Many but not all these studies^{5,6,17,20,40-42} have found that mothers of children with malformations recall more exposures, ie, that the presence of the malformation acts as a stimulus to recall. To our knowledge, this is the first study to examine the effect of more general morbidity in older children.

In contrast to the results of the malformation studies, poorer child health status 8 to 10 years after birth is variably related to recall, increasing discrepancies in 3 of the 5 events, but improving recall of gestational and length of neonatal stay. Although statistically significant, the magnitude of the differences is small. Thus, the results, on the whole, suggest maternal reporting is not substantially affected by concurrent child health problems. In our results, maternal education does not affect recall of most events, and higher maternal education does not consistently increase accuracy, and this limited effect is consistent with the variability found in the literature.^{15,18,19}

Our study has incurred some limitations. As noted above, comparison for birth weight is limited to 500-g intervals. Thus, our results may overestimate concordance, although the level of agreement is similar to that reported by others for narrower categories.^{7,18}

Second, the study population is drawn from 2 different cohorts with slight differences in the

TABLE 4. Association of Maternal Recall of Events in Infancy at Early School Age and Educational Attainment

	Maternal Educational Attainment (Years)	
	Mean	(Standard Deviation)
Birth weight		
Inaccurate	12.5	(5.1)
Accurate	12.8	(2.4)
Gestational age		
Inaccurate	13.4	(2.5)
Accurate	12.8	(2.7)
Neonatal transfer		
Inaccurate	13.4	(2.7)
Accurate	12.7	(2.4)*
Rehospitalization in infancy		
Inaccurate	12.2	(2.3)
Accurate	12.8	(2.4)**

* $P < .01$; ** $P < .005$.

sources of information on events in infancy. The differences in sources of information are unlikely to affect the results of this report because of the high degree of overlap, ie, vital statistics data and medical records for the birth. The advantage is that the heavy weighting of very low birth weight children provides a broader range of values over which to compare maternal reports, and to obtain a representative sample of this size would have required a baseline population of >60 000 births. Moreover, having data such as neonatal length of stay prospectively collected would have been unlikely.

Data on rehospitalization for both groups were obtained by maternal report at 1 year corrected for duration of gestation. Lack of a match between maternal recall and infancy data could, therefore, reflect errors in the data at infancy and not maternal inaccuracy, although, as noted above, the earlier reporting interval is consistent with more accurate reporting of hospitalization. In addition, we had to rely on 2 modes of interviewing (telephone and face-to-face) for logistic reasons²²; this factor is unlikely to affect our results, as a substantial body of literature supports the equivalency of these 2 methods of interviewing.^{25,43,44} Finally, we are lacking information on some children because of both cohort attrition^{23,24} and the PDA study protocol in which only those in the actual trial received 1-year assessments, not the entire cohort enrolled.²⁷ As we have previously documented,^{23,24} respondents at school age are more advantaged but also have more health problems so that potential biases attributable to cohort attrition are difficult to estimate. However, such biases are less likely to affect associations among variables⁴⁵ as in the analyses in this report.

Finally, we have relied on a single maternal variable, educational attainment. Other maternal characteristics such as her own mental and physical health and previous experience with health problems might also influence recall. However, the focus of this report is the potential effect of concurrent child health status so that we have chosen to limit the use of maternal characteristics.

CONCLUSION

In summary, we have examined the accuracy of maternal recall for health events in infancy when children have reached early school age. In general, we have found a high degree of agreement for birth events, but poorer recall of rehospitalization in infancy. Although the effects are relatively small, childhood illness at school age is variably related to recall, but the magnitude of the errors is unlikely to influence epidemiologic studies. Nonetheless, the high degree of accuracy for neonatal events, including such related events as neonatal transport and duration of neonatal hospitalization, contrasts sharply with the poor recall of infant rehospitalization. Research on the factors that differentiate between the recall of these 2 events might lead to approaches to improved reporting. In addition, although the effect sizes are small, the fact that poorer concurrent child health status is associated

with decreased accuracy of poorly recalled events may provide some clues for further investigation. For example, children with poorer current health may also have experienced early health problems, and inaccuracy in recall may reflect telescoping or other distortions of memory attributable to frequent health events.⁴⁶ We were unable to assess the reason for hospitalization for this report, but another factor may be the perceived severity of the diagnosis with relatively routine admissions not well conserved. Consideration of incorporating such methodologic research into data-collection efforts such as our study on outcomes related to birth weight enhances both information about methods generally and the productivity of individual projects.

ACKNOWLEDGMENTS

This work was supported by funding from the National Institute of Child Health and Human Development (Grants N01-HD-5-2928 and HD93-08), the Robert Wood Johnson Foundation (Grant 9104), and the William T. Grant Foundation (Grant 86-0401-92).

We wish to acknowledge the contributions of Drs Sarah Friedman, Michael Guilfoyle, Ruby P. Hearn, Marsha Gerdes, Donald McNellis, Alex Nadas, George Peckham, Marcia Sass, Peter Vietze, Susan Weller, Kathryn Workman-Daniels, and Summer Yaffe; Professor Sam Shapiro; and Judith Baker to this project. We are also grateful for the technical assistance of Patrick DiGiacomo, Nancy Ralph, Lorraine Luciano, JoAnna Turner, Alice Morris, Urmi Bhaumik, and Lisa Deal. Finally, we wish to recognize the efforts of the participating sites: Ann Arbor, MI; Atlanta, GA; Baltimore, MD; Boston, MA; Chapel Hill, NC; Charleston, SC; Cleveland, OH; Columbus, OH; Dallas, TX; Lexington, KY; New Haven CT; Philadelphia, PA; and Syracuse, NY.

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Pediatrics 1999;104;1176

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Pediatrics 1999;104;1176

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