Medical Record Validation of Maternal Recall of Pregnancy and Birth Events From a Twin Cohort

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This study aims to assess the validity of maternal recall for several perinatal variables 8–10 years after pregnancy in a twin sample. Retrospective information was collected 8–10 years after the delivery event in a cohort of mothers from the University of Southern California Twin Study (N = 611) and compared with medical records for validity analysis. Recall of most variables showed substantial to perfect agreement (κ = 0.60–1.00), with notable exceptions for specific medical problems during pregnancy (κ ≤ 0.40) and substance use when mothers provided continuous data (e.g., number of cigarettes per day; r ≤ 0.24). With the exception of delivery method, neonatal intensive care unit admission, birth weight, neonatal information, and post-delivery complications were also recalled with low accuracy. For mothers of twins, maternal recall is generally a valid measure for perinatal variables 10 years after pregnancy. However, caution should be taken regarding variables such as substance use, medical problems, birth length, and post-delivery complications.

Keywords: twin, maternal recall, recall validity, recall reliability, perinatal pregnancy, birth complication
pregnancy and early life characteristics (D’Souza-Vazirani et al., 2005; Launer et al., 1992; Li et al., 2005; McCormick & Brooks-Gunn, 1999; Olson et al., 1997; Quigley et al., 2007; Reich et al., 2003; Tomeo et al., 1999), evidence still suggests poor to moderate recall for information including lifestyle during pregnancy (Jaspers et al., 2010), complications and disease diagnosis (Coolman et al., 2010; Sou et al., 2006), and procedures during delivery (Quigley et al., 2007). These inconsistencies are in part attributed to the current literature’s varied sample populations, methodology, length of recall, and measures of interest. Importantly, most studies have focused on the recall of one or a few related variables, such as birth weight (Catov et al., 2006; Lumey et al., 1994), and specific procedures or complications during delivery (Coolman et al., 2010; Quigley et al., 2007; Sou et al., 2006). Thus, it is unclear whether inconsistencies in findings actually reflect differences in the accuracy of maternal report for different variables or whether they are due to methodological variations (i.e., sample characteristics, questionnaire wording, measurement). Few studies have looked comprehensively at recall validity for perinatal, prenatal, and postnatal data, and those which have often use small samples (Githens et al., 1993; Rice et al., 2007; Tomeo et al., 1999). Even fewer studies have addressed maternal recall of pregnancy, delivery, or postnatal complications, and those that have often do so very broadly (Tomeo et al., 1999; Yawn et al., 1998). On the other hand, studies which have studied the recall validity for specific complications often leave out other important perinatal factors (Buka et al., 2004; Coolman et al., 2010; Sou et al., 2006). Finally, and importantly, validity has not been assessed in a large sample of mothers of twins who are asked to recall information for both twins simultaneously. To our knowledge, only Reich et al. (2003) have examined maternal recall with a focus on mothers of twins. In their study, mothers were re-interviewed 6–18 months after the initial interview, but comparison to medical records was not available. Thus, while the use of twins allowed for maternal recall to be assessed for reliability, validity of this information was not established.

This study aims to help bridge the gaps in the existing literature by examining the validity of maternal recall in a large twin cohort. Mothers of twins were asked to complete a questionnaire that was developed by the first author and asked mothers to report on pregnancy and birth-related events including maternal history, medical problems during pregnancy, substance and vitamin use, delivery procedures, neonatal information for both twins, and post-delivery complications for both twins. The validity of the data was obtained by comparing questionnaire answers to medical records.

Methods

Study Sample

The subjects were participants in the University of Southern California (USC) Risk Factors for Antisocial Behavior (RFAB) twin study, which is an ongoing prospective longitudinal study of the interplay of genetic, environmental, social, and biological factors on the development of antisocial behavior from childhood to early adulthood. The twins and their parents were recruited from the larger Los Angeles community and the sample is representative of the ethnic and socio-economic diversity of the greater Los Angeles area. On the first assessment (Wave 1), the twins were 9–10 years old (mean age = 9.59, SD = 0.58). On the second assessment (Wave 2), the twins were 11–13 years old (mean age = 11.79, SD = 0.92). On the third assessment (Wave 3), the twins were 14–15 years old (mean age = 14.82, SD = 0.83), and during Wave 4 the twins were 16–18 years old (mean age = 17.22, SD = 1.23). The total sample contains 1,564 subjects (781 twin pairs), including 169 monozygotic (MZ) male, 171 MZ female, 121 dizygotic (DZ) male, 120 DZ female, and 200 DZ opposite-sex twin pairs. Complete details on the procedures and measures can be found elsewhere (Baker et al., 2006, 2007, 2013).

Caregiver participation was primarily by the biological mothers (>90%). Information on prenatal recall was collected from 611 of the twins’ mothers. The mean age of pregnancy among the women in this sample was 29.5 years.

Study Measures

Retrospective birth complications recall questionnaire. Birth complications recall was measured with a retrospective questionnaire developed by the first author who has a master degree in Maternal-Child Health Nursing (see the Appendix). It was developed from the birth complications-medical records instrument (see below), which asked mothers about birth complications on a more general level. The form includes questions regarding three main areas: prenatal (during pregnancy), perinatal (during birth), and postnatal (newborn) complications. Mothers were asked to fill in a computerized version of the birth complications questionnaire at their visit to the USC laboratory.

Birth complications-medical records instrument. We developed the Birth Complications-Medical Records Instrument, which incorporated more detailed birth complications information. This was derived from two well-established instruments: the Lewis–Murray Obstetric Complication Scale (Lewis & Murray, 1987; Lewis et al., 1989) and the McNeil–Sjöström Scale for Obstetric Complications (McNeil & Sjöström, 1995). In this study, we asked for the mother’s permission to obtain the children’s medical records, which were stored at the birth hospitals. We then contacted each hospital and the records were mailed to the laboratory.

Statistical Analyses

Items were grouped into those events occurring prior to the pregnancy of interest (maternal history), during the...
Validity of Maternal Recall in a Twin Sample

This study examined the validity of maternal recall for perinatal variables in a large twin sample 8–10 years after birth. Overall, the data obtained from questionnaires completed by mothers around 9 years after pregnancy showed substantial agreement (κ ≥ 0.60) with medical records for most pre-, peri-, and postnatal variables. Exceptions included poor validity for medical problems during pregnancy (e.g., bleeding, edema, proteinuria), substance and vitamin use, and some neonatal information (e.g., birth length, meconium, respiratory distress, and jaundice).

To our knowledge, these findings are the first that use medical records to demonstrate that maternal recall is a valid method for obtaining neonatal information in twins. Although Reich et al. (2003) looked at reliability and stability of maternal report using a twin sample, this study’s design compared sets of interview responses and did not assess validity through comparison with medical records. The findings for a number of pregnancy and neonatal factors are further discussed below.

Prenatal
The recall validity of medical problems such as bleeding, edema, and nausea and vomiting during pregnancy was mostly poor to moderate. Low rates of recall for antepartum vaginal bleeding and edema have been reported previously (Bryant et al., 1989; Buka et al., 2000; Olson et al., 1997; Sou et al., 2006). Low rates of maternal recall for these particular problems may reflect the fact that these complications may not be severe enough to warrant major actions (i.e., diet change, medications) and are thus less memorable to mothers (Sou et al., 2006). Indeed, the few women whose complications did require them to take medications recalled this information with near-perfect accuracy. The moderate recall of hypertension versus pre-eclampsia in our sample (κ 0.60, 95% CI 0.39–0.80) is in line with previous reports, which have generally promoted more accurate patient–doctor communication in order to address the reduced maternal recall (Coolman et al., 2010; Rice et al., 2007). Previous work has also suggested recall of hypertension to be particularly time-sensitive (Olson et al., 1997).

Our initial findings suggest very poor recall validity and reliability for both smoking and alcohol use. While our findings are in line with existing evidence that maternal recall for alcohol use is poor (Delgado-Rodriguez et al., 1995; Jaspers et al., 2010; Rice et al., 2007), these and other findings have demonstrated accurate recall for smoking (Tomoe et al., 1999; Yawn et al., 1998), which was not observed in our initial analysis. This discrepancy in recall validity for...
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<th>Frequency</th>
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Note: *p < .05. \( \kappa \) is not calculated for this dataset because observed concordance is smaller than mean-chance concordance.

NICU = neonatal intensive care unit.

In the prenatal recall record, seven different illnesses were combined into one variable (0 = none, 1 = respiratory infection, 2 = urinary tract infection, 3 = gall bladder inflammation, 4 = measles, 5 = TB, 6 = epilepsy, 7 = asthma). Due to limited data for some diseases, we only kept respiratory infection, urinary tract infection, and asthma when calculating the \( \kappa \) statistic. Two variables in prenatal record, pre-eclampsia and hypertension, were combined and paired with pre-eclampsia in medical records.
smoking likely reflects the fact that we asked mothers to provide continuous data (e.g., cigarettes per day for overall pregnancy and during each trimester). In contrast to the present study, other studies have generally used dichotomized categories (e.g., 'ever'/'never') when comparing maternal recall data to medical records. Repeating our validity analysis with dichotomous data produced results more in line with the existing evidence with substantial to near perfect agreement for smoking but poor recall of alcohol use.

In addition to poor recall for substance use, we also found very poor recall (κ < 0.20) for the use of prenatal vitamins, iron supplements, and folic acid during pregnancy. To our knowledge, this is the first study that examines maternal recall for vitamin use, but very poor agreement between records and self-report has been reported for prenatal vitamin use even during pregnancy (κ 0.11; Hessol et al., 2004). Due to low frequency of use for the individual vitamins, mothers were asked to report on, answers for prenatal vitamins, iron supplements, and folic acid were all grouped into one category.

Limitations and Implications
Our findings are not without limitations, particularly our use of medical records as the 'gold standard.' These records are not always valid, especially regarding behavioral or lifestyle factors (Hessol et al., 2004; Hewson & Bennett, 1987). Medical records are subject to recording errors and inconsistencies due to varying medical criteria between hospitals (Hewson & Bennett, 1987; Joffe & Grasso, 1985). Recall bias may have also affected our findings and can be caused by factors such as the child's current physical, emotional, mental, or behavioral state. For example, McIntosh et al. (2002) found that the number of obstetric complications recalled by mothers was not related to their own schizophrenic status but was instead related to measures of abnormal child behavior, suggesting that concern for child's behavior may affect retrospective recall. Moreover, it may be possible that pregnancy and related events were more memorable to mothers expecting twins than for those expecting a single child. Additionally, because recall accuracy may be affected by culturally influenced factors, such as the importance of events and awareness and knowledge of conditions (Olson et al., 1997), these findings should be generalized with caution. Furthermore, our sample size is small, which may explain why not all results are significant, specifically regarding more rare medical outcomes. Finally, no information on chorion type was available in the medical birth records.

Perinatal and Postnatal
Our findings add to the existing evidence that birth weight and the method of delivery are among the most accurately recalled perinatal variables (Olson et al., 1997; Sou et al., 2006; Tomeo et al., 1999; Yawn et al., 1998). An accurate and consistent recall of birth weight may reflect high social value and repetition of information to others (Yawn et al., 1998). The lack of such social value could explain the poor recall for birth length in both our samples. We are aware of only one other study that reports recall of birth length, which showed accurate recall but only 6–10 weeks after delivery (Troude et al., 2008). Birth length has been demonstrated to be an independent predictor for various health outcomes (Maimburg et al., 2010; Melved et al., 2000; Sun et al., 2009), and may actually serve as a better indicator of birth size than birth weight (Silva et al., 2008). Thus, while there may be growing interest in obtaining this information, our findings highlight the need for researchers to use caution when relying on maternal reports of birth length.

Recall accuracy was generally poor for neonatal information and post-delivery complications regarding both Twin A and Twin B. Meconium was especially unreliably recalled. Although meconium-stained amniotic fluid has been associated with higher rates of stillbirths, low Apgar scores, and hypoxic ischemic encephalopathy (Carbonne et al., 1997; Starks, 1980; Steer et al., 1989), outcomes are generally good (Balchin et al., 2011) and may explain the underreporting of this complication by mothers. NICU admission tended to be over reported by mothers of the twin samples, while maternal recall of post-delivery complication factors for both twins was the most accurate. This result is similar to previous findings from the United States (Githens et al., 1993).

Despite these limitations, this study makes important contributions to the literature on validity of maternal recall for various perinatal factors. The questionnaire developed and used in this study provides data for medical and behavioral factors that are of interest to researchers, due to their associations with important health outcomes, but have not been examined elsewhere in regard to long-term recall validity. For instance, validity for maternal recall of Apgar scores and birth length has been assessed previously but only 6–10 weeks after delivery (Troude et al., 2008). Recent studies have shown associations between low Apgar scores and a high risk for cerebral palsy in term infants born in Sweden (Thorngren-Jerneck & Herbst, 2006). Our findings suggest that researchers using maternal reports to assess Apgar scores should do so with caution because of the low validity of recall. It could be that parents do not understand the medical terminology, and the information may be unclear to parents when they recall, which in turn may affect validity. Additionally, jaundice has recently been associated with disorders of psychological development (Maimburg et al., 2010), and prenatal vitamin use has been linked to outcomes such as childhood cancers (Goh & Koren, 2008). The present study also informs researchers in the development and use of recall questionnaires. The validity of recall for behavioral factors like smoking was low when mothers were asked to report continuous data within a recall period of almost 10 years. Thus, while the frequency of smoking may be a variable...
of interest to researchers due to its association with many long-term outcomes in offspring (Batty et al., 2006; Brook et al., 2006, 2008; Button et al., 2005; Lambe et al., 2006; Liu et al., 2013), it may be more suitable to present mothers with categorical answers, or ask within a more immediate recall period. Furthermore, since maternal knowledge and perception of the event’s importance may also affect recall validity (Hewson & Bennett, 1987; Mitchell et al., 1986; Olson et al., 1997), as different pre-, peri-, and postnatal events become increasingly associated as risk factors for offsprings health, doctors and nurses should emphasize the importance of this information at or around the time of the delivery event. Healthcare professionals should also improve communication with parents in order to clarify an understanding of how various conditions, procedures, and other factors are defined.

In conclusion, our findings support that maternal recall, even in a twin sample, could be a reliable source for many pregnancy-related variables up to 10 years after the delivery event. However, maternal recall may not be appropriate for obtaining postnatal information, especially regarding twins, aside from the method of delivery, birth weight, and NICU admissions. Furthermore, this study also highlights the need for caution when using maternal report as a sole source of information, especially for information which mothers may not deem socially valuable (e.g., birth length) or events that require little involvement or changes from the mother (e.g., medical problems not requiring medication).

References


Appendix

Retrospective pre/peri/post-natal data Questionnaire*

Twin Name A____________________ B____________________

General information

Mother current name __________________________
Current zip code ________

Mother's full name at the time she gave birth ____________
Zip code during the pregnancy____

The name of the Hospital you gave birth ________________________________

Your age when you gave birth to the twins: _______ years

The age of the father when the twin were born _____years

Your marital status during the pregnancy:

(1) Married ________ (2) not married but living with partner_____
(3) Separated/divorced______ (4) single ________

The year of your education during the pregnancy_____________________

The year of education the father of twins during your pregnancy______________

Your occupation during the pregnancy_______

The occupation of the father of the twins during your pregnancy_______

The total income you and your partner during the pregnancy _____

The family size ________

*This questionnaire was developed by Dr. Jianghong Liu.
Maternal prenatal information

Pregnancy history before the twins:
(1) previous live births (2) abortions (3) miscarriages
(4) premature (5) birth abnormality (6) other

How many antenatal care you received for the twins?
(1) 0 (2) 1-3 (3) 4-6 (4) 7-9 (5) 10+

Did you take prenatal vitamins during the pregnancy? (1) None (2) Yes

Did you take Folic Acid Supplement? (1) None (2) Yes

How much you weighed before pregnancy? _______(LB)

Did you suffer chronic renal disease before the pregnancy? (1) None (2) yes

Did you suffer chronic cardiac disease before the pregnancy? (1) None (2) yes

Did you suffer hepatitis before the pregnancy? (1) None (2) yes

Did you have Diabetes before the pregnancy?
(1) None (2) insulin dependent (3) Non-insulin dependent

Did you experience STD (sexual transmitted disease) before the pregnancy?
(1) None (2) gonorrhea (3) syphilis (4) other

Did you experience/ develop the following illness during pregnancy?

Resp infection (1) None (2) yes
Asthma (1) None (2) yes
Urine infection (1) None (2) yes
Hepatitis (1) None (2) yes
Vulvo infection (1) None (2) yes
Gall bladder (1) None (2) yes
Measles (1) None (2) yes
TB (1) None (2) yes
Epilepsy (1) None (2) yes
Anemia: (1) None (2) yes
Hg level if you remember 1st, 2nd, 3rd
Pregnancy Induced Hypertension: (1) None (2) yes
BP if you remember 1st, 2nd, 3rd
Edema: (1) None (2) yes

Protein in urine: (1) None (2) yes

Gestational Diabetics: (1) None (2) yes

Blood Glucose level if you remember: 1st, 2nd, 3rd

Did you receive insulin treatment? (1) None (2) yes

Pernicious vomiting: (1) None (2) 1st trimester (3) 2nd (4) 3rd

Rubella: (1) None (2) 1st trimester (3) 2nd (4) 3rd

Measles: (1) None (2) 1st trimester (3) 2nd (4) 3rd

Flu during pregnancy: (1) None (2) 1st trimester (3) 2nd (4) 3rd

Fever: (1) None (2) 1st trimester (3) 2nd (4) 3rd

Did you experience abnormal bleeding during the pregnancy?

(1) None (2) 1st trimester (3) 2nd (4) 3rd

Did you experience polyhydramnios (a lot of amniotic fluid)? (1) None (2) yes

Did you experience oligohydramnios (lack of amniotic fluid)? (1) None (2) yes

Any Placental problems (e.g. low position of placenta, placenta rupture) occurred in you pregnancy?

(1) None (2) yes

Did you experience Rh incompatibility? (1) None (2) yes

Other than above, did you experience any other complications? (1) None (2) yes

Did you smoke during the pregnancy? How many cigarettes per day?

(1) None (2) ___/day during 1st trimester (3) ___/day during 2nd (4) ___/day during 3rd

Were you exposure to smoking (partner, co-workers, friends etc)?

(1) 0 (2) 0-1 hr/day (3) 1-2hr/day (4) 2-4hr/day (5) 4+hr/day

Did you use any drugs during the pregnancy?

(1) None (2) Marijuana (3) cocaine (4) other

How much Alcohol did you consume during the pregnancy?

(1) None; (2) 1-2 drink/week; (3) 3-4wk; (4) 1 drink/day; (5) 2+ drink/day

Did you take any Medication during the pregnancy?

(1) None (2) antibiotics (3) antihypertension (4) other

Did you experience any accidents?

(1) None; (2) fall (3) slipped disc; (4) hit in abdomen (5) other
**Labor /deliver information**

Abnormal Fetal heart Rate/rhythm (1) none ____ (2) yes ___ (999) don't know____

Fetal Presentation (which body part came first):

(1) head ___ (2) bottom ____ (3) foot ____ (4) shoulder ____ (999) don't know ___

Premature rupture of membrane (1) none ____ (2) yes ___ (999) don't know ___

Induced labor (use medication such as pitocin) (1) none ____ (2) yes ___ (999) don't know ___

How many hours it took from starting labour (contraction) to birth? ______ Hours (999) don't know ___

Fever during labor (1) none ____ (2) yes ___ (999) don't know ___

Meconium (baby stool) in amniotic fluid: (1) none ____ (2) yes ___ (999) don't know ___

Mother given oxygen: (1) none ____ (2) yes ___ (999) don't know ___

Did you receive any pain medication?

(1) None ____ (2) pain shot ____ (3) epidural ____ (999) don't know

Did you receive any Anesthesia during birth?

(1) None ____ (2) epidural ____ (3) spinal ____ (4) general ______

(5) Cervical ____ (999) don't know

Did you give birth through vaginal delivery?

(1) None ____ (2) Spontaneous ____ (3) forceps______

(4) Vacuum extraction ____ (5) rotation_____

Did you give birth through C-section?

(1) None ____ (2) planned __ (3) emergency __

Any Abnormal bleeding during labor and delivery? (1) None ____ (2) yes ____ (999) don't know __

Were there any placenta infarcts? (1) None ____ (2) yes ____ (999) don't know ____
Newborn information (use separate sheet for each child)

Twin A: name______
Sex: (1) Male___ (2) female____
Born at _____ weeks.
Minutes apart from twin B _____
Birth weight______gram or _______lb _______oz
Length _______cm or ______ inches; HC _______cm;

Did you child have umbilical cord knotted or wrapped around neck upon birth?
(1) None (2) one round___ (3) two rounds____ (999)____

Did you child cry loud/weak at birth (first minutes)?
(1) Good/vigorous cry____ (2) weak/grimace cry (3) no cry ___

What color did your child have at birth (first 1-5 minutes)?
(1) Whole body Pink____ (2) hands/feet blue only____ (3) face blue ___
(4) not blue but face or body pale___

Did you child have active/limp muscle tone at birth (first 1-5 minutes)?
(1) Active____ (2) limp (soft)____ (999) don't know

Did you child experience breathing difficulties at birth (first 1-5 minutes)?
(1) No breathing problem ___ (2) breathing difficult and gave oxyzgeny___
(3) intubation ____ (999) Don't know___

Did you child have Meconium aspiration (baby stool in mouth and nose)?
(1) None ___ (2) yes___ (999) don't know___

Did you child experience Hypoglycemia (low sugar in blood) at birth?
(1) None___ (2) yes ___ (999) don't know____

Did you child have birth injury?
(1) None____ (2) clavicle or brachial born/never injury___ (3) fracture of long born___
(4) Head hemotoma ___ (5) other _____

Did you child have any of the following birth defects?
(1) None____ (2) hydrocephalus____ (3) cleft lip/palate ___ (4) imperforate anus___
(5) Trachoesophageal____ (6) bowel obstrucion___ (7) others____
Was your child sent to NICU (neonatal intensive care unit) after birth?

(1) None  (2) yes, due to premature reason  (3) yes, due to breathing difficulties

(4) Yes, due to fever  (5) yes, due to hypoglycemia  (6) yes, due to other reason

How long was your child in NICU?

______ Days

During the first 6 months did your child have any of the following disorders?

(1) None  (2) Pneumonia  (3) Sepsis (infection in blood)  (4) Fever

(5) Jaundice  (6) Seizure  (7) Other

During the first 18 months of life, for how many days was this child spend in hospital/institutions?

______ days

Feeding information:

What type of feeding method did you chose?

(1) Breast only  (2) Formula only  (3) Mix

For how many months did you breast feed this child?

______ months

For how many months did you formula feed this child?

______ months

What type of formula did you use?

(1) Iron-Fortified Formula  (2) Soy Formula  (3) Hypoallergenic Formula

(4) Other
**Childhood illness:**

Has your child experienced any of the following illness up to present time?

- **Asthma**  
  (1) none _____ (2) mild _____ (3) moderate _____ (4) severe _____

- **Other allergy**  
  (1) none _____ (2) mild _____ (3) moderate _____ (4) severe _____

- **Anemia**  
  (1) none _____ (2) mild _____ (3) moderate _____ (4) severe _____

- **Diabetics**  
  (1) none _____ (2) mild _____ (3) moderate _____ (4) severe _____

- **Cardiac disorder**  
  (1) none _____ (2) mild _____ (3) moderate _____ (4) severe _____

- **Rheumatic fever**  
  (1) none _____ (2) mild _____ (3) moderate _____ (4) severe _____

- **Renal disorder**  
  (1) none _____ (2) mild _____ (3) moderate _____ (4) severe _____

- **Hemophilia**  
  (1) none _____ (2) mild _____ (3) moderate _____ (4) severe _____

- **Cyst fibrosis**  
  (1) none _____ (2) mild _____ (3) moderate _____ (4) severe _____

- **Measles**  
  (1) none _____ (2) yes___

- **Rubella**  
  (1) none______ (2) yes___

- **Chicken Pocks**  
  (1) none_____  (3) yes___

- **Other______**