Errors in registered birth weight and its implications for mortality statistics

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Abstract

***Background*—Birth weight mortality statistics are important for examining trends and monitoring the outcomes of neonatal care.**

***Aim*—To determine the effects of errors in the registered birth weight on birth weight specific mortality.**

***Methods*—All twins born in England and Wales during 1993–95 comprise the denominator population. For those twins that died, the Office for National Statistics (ONS) provided copies of the death certificates. From the information on the death certificates, the registered birth weight was validated and amended using predetermined rules. The neonatal, postneonatal, and infant mortality rates were recalculated.**

***Results*—In 2.5% of cases the registered birth weight was "not stated" and in others there were miscoding errors. Important differences between published and amended birth weight specific mortality rates especially in <500 g and ⩾3500 g groups were evident.**

***Conclusions*—The bias arising from these errors should be taken into account in interpreting mortality rates and their trends.**

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Keywords: birth weight; miscoding

Statistics published by the Office for National Statistics (ONS) are extensively used for evaluation of health services. Allocation of resources and health service planning are based on these figures and they are used to monitor the effectiveness of service provision. It is appropriate, therefore, that every effort is made to ensure the accuracy of the statistics.

Considerable resources are directed into neonatal care. National trends in, neonatal, postneonatal, and infant mortality rates are used to monitor neonatal care. Low birth weight (<2500 g) infants comprise only 7.4% of all live births but 62.9% of all infant deaths.[1] Similarly very low birth weight (<1500 g) infants comprise only 1.2% of all live births but constitute 47.5% of all infant deaths.[1] For this reason birth weight specific mortality rates have been used to monitor improvements in neonatal care.[2 3]

The ONS compiles data on birth and death registrations. Birth registration, which is a legal obligation of parents, does not require the birth weight to be registered. A birth must be registered within 42 days. Birth notification on the other hand, which includes the recording of birth weight, is the legal obligation of the medical attendant at birth and is transmitted to the health authority. Birth notification is required within 72 hours. Because birth weight is such an important variable, the Registrars of Births, Deaths, and Marriages liaise with the health authorities to obtain the birth weight of infants which are then used by ONS when publishing birth weight specific statistics.

During the course of another study of twins born in England and Wales in 1993–95, our attention was drawn to errors in the registered birth weight that formed the basis of national statistics. The objective of the study reported here is to quantify the errors in registered birth weight data and to determine what effect these errors have on infant mortality rates.

Methods

The ONS provided data on birth weight, sex, and date of birth for all twins born in England and Wales in 1993–95. For those twins that died, ONS also provided copies of the non-confidential section of the death certificate. Information recorded on the death certificate was used to validate the registered birth weight. There is no requirement for mention of gestational age or birth weight on the death certificate; nevertheless these were frequently recorded. Also prematurity, severe prematurity, or extreme prematurity were frequently given among the causes of death. These data on the death certificate were used to provide an estimate of the birth weight. In presenting the data on births and deaths by birth weight, ONS uses the following birth weight groups: "not stated"; <500 g; 500–999 g; 1000–1499 g; 1500–1999 g; 2000–2499 g; 2500–2999 g; 3000–3499 g; ⩾3500 g.

There are two important sources of error in ONS birth weight data, detailed below.

BIRTH WEIGHT "NOT STATED"

This group is biased with a disproportionate number being from the lower birth weight groups.

If the birth weight has not been registered, the infant is classified as birth weight "not stated". For these infants the following hierarchical rules were applied to ascribe them to one of the birth weight groups:

(1) If a birth weight was mentioned in the death certificate, this was used
(2) If gestational age was stated without mention of birth weight, birth weight was allocated as follows:
- gestational age <23 weeks: birth weight <500 g

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Table 1 Reallocation of cases after validation

Registered birth weight (g)	Birthweight amended according to: Birth weight on death certificate	Gestational age on death certificate	"Extreme prematurity" recorded on death certificate	"Prematurity" recorded on death certificate	Birth weight of co-twin
<500	3	8	3	0	1
500–999	7	32	17	4	7
1000–1499	0	6	2	3	1
1500–1999	0	3	0	1	4
⩾2000	0	1	0	0	12
Total	10	50	22	8	25

- gestational age 24–28 weeks: birth weight 500–999 g
- gestational age 29–32 weeks: birth weight 1000–1499 g
- gestational age 33–36 weeks: birth weight 1500–1999 g

(3) If "extreme" or "severe" prematurity was mentioned as a cause of death but there was no mention of gestational age or birth weight, the infant was allocated to the 500–999 g birth weight group

(4) If "prematurity" was mentioned as a cause of death but there was no mention of gestational age or birth weight, the infant was allocated to the 1500–1999 g birth weight group

(5) If no mention was made of birth weight, gestational age, or degree of prematurity but the birth weight of the co-twin was available, the infant was allocated to the same birth weight group as the co-twin.

Validation of hierarchical rules—An attempt was made to validate the hierarchical rules using those death certificates where the registered birth weight and gestational age or degree of prematurity were recorded. The infants were distributed into the birth weight specific groups used by ONS. Where gestational age and birth weight were recorded, using the same four gestational age groups as in the hierarchical rules, the birth weight distribution and their proportion in each group was determined. Similarly where only the degree of prematurity and birth weight were recoded, two prematurity groups as in hierarchical rules were used and birth weight distribution among them and their proportion was determined.

Having made the above allocation, the birth weight obtained from the hierarchical rule estimation was amended according to the proportional distribution obtained through the validation.

MISCODING

In several cases birth weight was recorded as ⩾3000 g but the death certificate mentioned the cause of death as extreme prematurity. Since the recorded weight was incompatible with the maturity stated, the infant was reallocated assuming a tenfold reduction in birth weight, for example, a registered birth weight of 3800 g would be re-coded to a birth weight of 380 g. The validity of such re-coding was frequently supported by the co-twin being of similarly low birth weight.

After reallocating all these infants into appropriate birth weight groups the neonatal, postneonatal, and infant mortality rates were recalculated. The postneonatal mortality rates are calculated per 1000 survivors as a high number of neonatal deaths, particularly in the low birth weight groups, affects the denominator substantially.

Results

ONS published tables for all twins born in England and Wales in 1993–95 show that 2.5% of infants were in birth weight "not stated" group. By applying the above rules, it was possible to allocate 115 (9.4% of not stated group) of these infants into appropriate birth weight groups. The allocation was validated as described by using 932 death certificates where the birth weight and gestational age or degree of prematurity were recorded. Table 1 shows the reallocation of cases after validation. Most of these infants belonged to the <500 and 500–999 g groups.

There were 44 infants whose birth weight was miscoded. Of these, 31 infants registered as ⩾3000 g were reallocated to the <500 g group. The remainder of the infants whose birth weight was miscoded belonged to the ⩾500 g group. Here also the information on the death certificate was incompatible with the registered birth weight, for example, the birth weight was registered as 22 g in a child who died with tricuspid atresia after shunt surgery. The weight of the co-twin was 2230 g. Similarly in a pair of twins the cause of death was reported as extreme prematurity and the registered birth weights were 79 g and 73 g.

Tables 2, 3, and 4 show the published and amended neonatal, postneonatal, and infant mortality rates. The amendments done after validation made only a marginal difference to the mortality rates.

Table 2 Neonatal mortality rate (NMR) 1993–95

Registered birth weight (g)	Live births		Neonatal deaths		NMR	
Total E & W	Published	Amended	Published	Amended	Published	Amended
Not stated	1221	1106	89	8	72.9	7.2
<500	131	183	105	161	801.5	879.8
500–999	1308	1371	563	605	430.4	441.3
1000–1499	2622	2627	185	187	70.6	71.2
1500–1999	6497	6515	66	72	10.2	11.1
2000–2499	14179	14183	47	50	3.3	3.5
2500–2999	16456	16460	37	39	2.2	2.4
3000–3499	6192	6186	17	13	2.7	2.1
3500+	873	848	29	5	33.2	5.9
Total	49479	49479	1138	1140	23.0	23.0

Table 3 Postneonatal mortality rate (PNMR) 1993–95*

Registered birth weight	*Live births*		*Postneonatal deaths*		*PNMR*	
Total E & W	*Published*	*Amended*	*Published*	*Amended*	*Published*	*Amended*
Not stated	1221	1106	8	2	7.1	1.8
<500	131	183	2	3	76.9	136.4
500–999	1308	1371	88	93	118.1	121.4
1000–1499	2622	2627	35	35	14.4	14.3
1500–1999	6497	6515	38	41	5.9	6.4
2000–2499	14179	14183	37	36	2.6	2.5
2500–2999	16456	16460	23	23	1.4	1.4
3000–3499	6192	6186	14	14	2.3	2.3
3500+	873	848	4	2	4.7	2.4
Total	49479	49479	249	249	5.2	5.2

*Per 1000 survivors.

Table 4 Infant mortality rate (IMR) 1993–95

Registered birth weight	*Live births*		*Infant deaths*		*IMR*	
Total E & W	*Published*	*Amended*	*Published*	*Amended*	*Published*	*Amended*
Not stated	1221	1106	97	10	79.4	9.0
<500	131	183	107	164	816.8	896.2
500–999	1308	1371	651	698	497.7	509.1
1000–1499	2622	2627	220	222	83.9	84.5
1500–1999	6497	6515	104	113	16.0	17.3
2000–2499	14179	14183	84	86	5.9	6.1
2500–2999	16456	16460	60	62	3.6	3.8
3000–3499	6192	6186	31	27	5.0	4.4
3500+	873	848	33	7	37.8	8.3
Total	49479	49479	1387	1389	28.0	28.1

These tables show a considerable increase in the mortality rates of the <500 g group. This change occurs because most of the infants in the "not stated" group and those that were miscoded were less than 500 g. There is a reciprocal decrease in the mortality rates of the ⩾3500 g group as most of those miscoded were reallocated to the <500 g group.

There was a discrepancy of two in the total number of neonatal and infant deaths in the published compared with the amended data. This was probably because two sets of conjoined twins provided four death certificates! We had no information on their birth registration.

Discussion

Very low birth weight infants contribute substantially to early deaths and considerable effort has been made to improve their chances of survival. Evidence from national data shows that the mortality rates in these infants have declined particularly over the past three decades.[2–4] These trends are derived from the data provided by ONS. But the ONS data are biased by a large number of infants in birth weight "not stated" group, the majority of whom belong to the very low birth weight group.

In an attempt quantify the effect of this bias on the mortality statistics a set of hierarchical rules were made and validated using death certificates where the necessary information was available. Ideally the validation of the birth weight should have been done from the original obstetric records. However, this was not possible because copies of the death certificates provided by ONS for the study only contained non-confidential information. The names of the children are not provided. Theoretically, an extensive tracing exercise using place of birth and place of death from the death certificate may have enabled us to focus on each appropriate infant. We did not have ethical permission to carry out such a study and, if it had been ethically acceptable, it would have been a very time consuming exercise involving a large number of hospitals and their staff.

It is evident from the study that there is a bias in the ONS data arising as a result of those infants whose birth weight was not notified and registered or from miscoding errors. The observations in this study are limited to twins, but it is likely that similar errors occur in singleton infants. Also the study is limited to those infants who died in infancy. If all the live births in the "not stated" group are reallocated into appropriate birth weight groups and all the miscodings are eliminated it would alter the denominators, leading to changes in mortality rates.

To avoid such bias, birth weights of all live births need to be recorded and standard rules applied to minimise miscoding errors. Most of the inaccuracies in the data arise from failure to record the birth weight when the birth is notified. This is understandable as most of these babies belonged to very premature groups and resuscitation and intensive care procedures have to take precedence over weighing the infant. However, at some point before the birth is notified, birth weight needs to be recorded if national statistics are to be improved. In the most difficult situations at least recording of the weight on which clinical management is based may be helpful in reducing the inaccuracies. Some of the inaccuracies are a result of transcription errors in the transfer of birth weight from the birth notification to the birth registration. These errors will need to be eliminated by quality checks.

National statistics pertaining to very low birth weight infants need to be accurate for the proper evaluation and planning of neonatal services. An awareness of biases in published statistics when interpreting birth weight specific trends in neonatal, postneonatal, and infant mortality rates, is required.

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Long term effect of abuse

The issue of August 2, 2000 of the *Journal of the American Medical Association* is an annual theme issue devoted to the subject of violence and the abuse of human rights. Of most immediate relevance to paediatrics is a paper on stress responses in women who were abused as children (Christine Heim and colleagues. *JAMA* 2000;**284**:592–7).

The authors studied 49 women volunteers (aged 18–45 years) in Atlanta, Georgia. Twelve had no history of childhood physical or sexual abuse and were psychiatrically normal, 13 had been abused in childhood and were currently depressed, 14 had been abused and were not depressed, and 10 were depressed but had not been abused. All underwent a psychosocial stress protocol (10 minutes of preparation and 10 minutes of speaking and performing mental arithmetic in front of an audience) during which heart rate was recorded and blood samples were obtained (from previously inserted catheters) for measurement of plasma concentrations of adrenocorticotropic hormone (ACTH) and cortisol. Women who had been abused and were depressed had significantly higher ACTH, cortisol, and heart rate responses than controls. Those who had been abused but were not depressed had higher ACTH responses than the two non-abused groups but similar cortisol and heart rate responses. Depression without a history of abuse had little effect on response to stress.

Women who have suffered physical or sexual abuse as children have an exaggerated response to psychosocial stress, especially if they are currently depressed. The effects of abuse are longlasting.

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