Estimating conception statistics using gestational age information from NHS Numbers for Babies data

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Conception statistics routinely published for England and Wales include pregnancies that result in one or more live- or stillbirths (a maternity) or an abortion. All live births are assumed to be 38 weeks gestation as information on gestation is not collected at birth registration. For the first time, gestational age information from the National Health Service (NHS) Numbers for Babies (NN4B) data has been used to re-estimate conception statistics for 2005. This shows that 72 per cent of conceptions leading to a maternity in fact have a gestation period that differs from 38 weeks and most of these fall at either 37 or 39 weeks. The age-specific conception rates using this revised method are not significantly different to those produced using the current method.

Introduction

The Office for National Statistics (ONS) (and its predecessors) has produced and published conception statistics for England and Wales since 1969.^{1,2} These data are used to monitor the outcome of pregnancies and also for setting and informing government policies, in particular England's Teenage Pregnancy Strategy.³

ONS estimates conceptions using information from registration of births and notifications of legal abortions for women who are usually resident in England and Wales.

Miscarriages and illegal abortions are, however, not included in conception statistics as data on them are not collected centrally or recorded under any formal registration systems. Therefore, estimates of conceptions from birth registrations and abortion notifications will always under-estimate the true number of conceptions.

In England and Wales, gestation period (average duration of pregnancy from conception) is not recorded at the registration of live births, however, gestation is recorded on the medical certificate of stillbirths and notifications of abortions. Therefore, conceptions are estimated using recorded gestation for abortions and stillbirths, while for live births, the gestation period is assumed to be 38 weeks for all women.^{4,5} Gestational age is, however, known to vary by multiplicity, mother's age and ethnicity.^{6,7,8,9}

A new system introduced in 2002 for allocating NHS numbers at birth (NN4B) provided the opportunity to obtain gestational age information for live births. For all NHS numbers issued from 1 January 2005, ONS has received daily downloads of a subset of the variables received by NN4B, including gestational age. This has made it possible to improve

Box one

Conception statistics include pregnancies that result in:

- one or more live- or stillbirths (a maternity), or
- a legal abortion under the *Abortion Act 1967* (an abortion).

the quality of conception statistics by accurately calculating date of conception for live births by linking NN4B and birth registration data in England and Wales. Gestational age is recorded in the NN4B data in completed weeks of gestation from mother's last menstrual period to baby's date of birth. In relation to conception statistics, the current method used by ONS assumes all live births are born at full term – mothers with preterm births may potentially have later conception dates, while mothers with post term births have earlier conception dates. These differences in the date of conception will affect mother's age at conception when the former is close to the mother's birthday.

Figure 1 shows the measurement of gestational age using preterm, term, and post term categories as defined by the World Health Organisation.¹⁰

In this article conception statistics for 2005 are estimated using linked NN4B-birth registration files for 2005 and 2006. They are then compared to conception statistics for 2005 derived using the current method.

Methods

The analysis examines conception statistics derived using two methods; firstly, following data assumptions currently in use by ONS (current method) and secondly, using gestational age from NN4B data for all live births (revised method).

Current

Date of conception

Date of conception is estimated by subtracting the gestation period from the baby's date of birth or date of termination.

Live births

Conception is assumed to occur 14 days (2 weeks) after the start of the last menstrual period and the time between the last menstrual period and birth is assumed as 40 weeks (referred to as gestational age). Therefore the length of pregnancy from conception to birth is assumed to be 38 weeks (40 weeks minus 2 weeks) for all live births.

Stillbirths

Gestational age is recorded at the registration of a stillbirth. The date of conception is estimated as date of birth minus stated gestational age plus two weeks to allow for time to conceive. On the few records where gestational age is not recorded or available at registration, the length of pregnancy from conception to stillbirth is assumed to be 33 weeks.

Abortions

To produce conception statistics, ONS receives information on abortions from the Department of Health. Gestational age is collected on all notifications of abortions and the vast majority of abortions are performed at under 13 weeks gestation. The date of conception for abortions is estimated as date of termination less the stated gestational age plus 2 weeks to allow for conception. There are however a small proportion of abortion notifications where gestational age is missing and for these records gestation is imputed between 7–10 weeks.¹¹

Age at conception

The mother's age at conception is calculated by subtracting date of conception from mother's date of birth. Where mother's date of birth is not available, a mother's age at birth is then imputed and in these cases the mother's age at conception was calculated from an imputed mother's age at maternity.⁴ Mother's date of birth was not present for less than 1.5 per cent of maternities for 2005 and 2006.

Revised

In the revised method NN4B data linked to birth registration data for 2005 and 2006 are used. Details on the linkage can be found elsewhere.¹² In the linked data, the only data item that is used from the NN4B data is gestational age for live births; all other information required to produce conception statistics is taken from the birth registration record.

Live births

Gestational age on NN4B is recorded from date of mother's last menstrual period to date of birth of baby. Therefore, to allow time for conception, two weeks are subtracted from recorded gestation. Hence, date of conception is estimated by subtracting this gestation period from baby's date of birth.

For live births where gestational age was not stated on the NN4B record or where the birth registration record could not be linked to a NN4B record, the gestation period is assumed to be 38 weeks.

Stillbirths

Information on gestational age for stillbirths is taken from the stillbirth registration record as this was considered to be more complete and accurate. Date of conception is then calculated as with the current method. Therefore, no changes were made to the current method.

Abortions

No changes were made to the current method.

Results

The results for each stage of the process for producing conceptions leading to maternities only (that is not including abortions) using current and revised methods are shown in Figure 2.

Stage 1. Records were identified for 649,371 births occurring in 2005 and 673,069 births occurring in 2006 that were registered in England and Wales.

Stage 2. Birth registration records were then linked to NN4B data. Linkage of birth registrations that occurred in 2006 to NN4B data was carried out using the method used previously for 2005 data.¹² For births occurring in 2005, 648,421 birth registration records were linked to NN4B records giving a linkage rate of 99.8 per cent and for births occurring in 2006, 672,499 birth registration records were linked to NN4B records giving a linkage rate of 99.9 per cent.

Figure 2**Process for producing conceptions leading to maternities data for 2005 using birth registrations linked to NN4B data, 2005–06**

Stage 3. Records for singleton and multiple births were separated in order to produce a maternities dataset.

Stage 4. A maternities file including all singleton births and one record from each set of multiple births was produced for 2005 and 2006.

Stage 5. It was found that recorded gestational age from NN4B was missing on 5,178 maternities for 2005 and 4,873 maternities for 2006 (less than 1 per cent of all maternities for 2005 and 2006); these were either not stated or not available as the NN4B record did not link to a birth registration record.

Stage 6. Table 1 shows the allocation of gestational age to each maternity. Using the current method, 636,420 and 659,388 live births for 2005 and 2006 respectively were assumed to be 38 weeks gestation. At birth registration recorded gestational age was available for 3,206 stillbirths in 2005 and 3,375 stillbirths in 2006, and missing for 55 and 17 stillbirths in 2005 and 2006 respectively.

The revised method uses recorded gestation from NN4B for live births; this was available for 99 per cent of maternities in 2005 and 2006. Gestational age for stillbirths was taken from birth registration data. For live births where gestational age was missing the gestation period was assumed to be 38 weeks (this involved 5,106 live births for 2005 and 4,818 live births for 2006).

Stage 7. Date of conception was estimated by subtracting the gestation period from the baby's date of birth. Table 2 shows the variation in the number of maternities by year of conception using current and revised methods.

Stage 8. In this final stage conceptions occurring in 2005 were selected where dates of conception fell between 1 January 2005 and 31 December 2005. Using the current method there were 655,058 conceptions leading to maternities in 2005 and the revised method gave 654,469 conceptions leading to maternities for 2005.

Data issues

Previous analysis of linked NN4B-birth registration data for 2005 showed there were inconsistencies in the recording of gestational age and birthweight information for babies born under 22 weeks.⁶ There were 88 live births for 2005 and 82 live births for 2006 where gestational age was inconsistent with birthweight and for these records the gestation period was assumed to be 38 weeks.

In contrast to preterm births, there are babies which were born post term (over 42 weeks). Babies with gestational age recorded as 44 weeks and over, (975 maternities in 2005 and 929 maternities in 2006) were assumed to be 38 weeks gestation as pregnancies are unlikely to go beyond 43 weeks. Gestational ages greater than this are most likely to be due to data recording errors.

Table 1**Number of maternities by gestation period using current and revised methods, 2005–06**

England and Wales

Year of birth	Total	Current method			Revised method			
		Gestational age			Gestational age		Gestational age if missing	
		Live birth	Stillbirth		Live birth	Stillbirth	Live birth	Stillbirth
		38 weeks	Recorded gestation minus 2 weeks	Gestation missing and assumed to be 33 weeks	Recorded gestation minus 2 weeks	Recorded gestation minus 2 weeks	38 weeks	33 weeks
			Birth registration		NN4B	Birth registration		
2005	639,681	636,420	3,206	55	631,314	3,206	5,106	55
2006	662,780	659,388	3,375	17	654,570	3,375	4,818	17

Table 2**Number of maternities by year of conception using current and revised methods, 2005–06**

England and Wales

Year of birth	Total	Current method			Revised method		
		Conception year			Conception year		
		2004	2005	2006	2004	2005	2006
Numbers							
2005	639,681	465,973	173,708	–	455,994	183,687	–
2006	662,780	–	481,350	181,430	–	470,782	191,998
Total		655,058			654,469		
Percentages							
2005	100	73	27	–	71	29	–
2006	100	–	73	27	–	71	29

Impact of revised method on conceptions for 2005

Table 2 shows how maternities from 2005 and 2006 contribute to the number of conceptions for 2005. Using the current method, 27 per cent of maternities occurring in 2005 were conceived in 2005. This increased to 29 per cent using the revised method. Of the maternities occurring in 2006, 71 per cent were conceived in 2005 using the revised method compared with 73 per cent using the current method. The revised method gives 10,568 more maternities which were conceived in 2006.

The distribution of 2005 conceptions leading to maternities by gestation using the revised method is shown in Figure 3. Of the 654,469 conceptions leading to maternities for 2005 produced using the revised method, gestation (measured in complete weeks) remained the same (38 weeks) for 28 per cent of conceptions, while gestation for 24 per cent of conceptions was longer (over 38 weeks) and for 48 per cent of the conceptions, gestation was shorter (under 38 weeks). Overall, 42 per cent of conceptions have a gestation period that falls either at 37 or 39 weeks.

For the majority of all conceptions leading to a maternity, woman's age at conception remains the same using the revised method as the current method, as shown in Table 3. Of the remainder, 2 per cent of women are older (13,378) and 0.5 per cent of women are younger (3,554). Women who are older at conception using the revised method have had a pregnancy which is shorter than 38 weeks. Conversely, women who are younger at conception using the revised method have had a pregnancy which is longer than 38 weeks. Of the women who are older, 1,022 (8 per cent) are women aged under 20 while 2,745 (21 per cent) are women aged 35 and over. Of the women who are younger, 385 (11 per cent) are women aged under 20, while 459 (13 per cent) are women aged 35 and over.

Figure 3**Conceptions leading to maternities by gestation using the revised method, 2005**

The numbers and rates of all conceptions for women in England and Wales in 2005 are shown in Table 4. Using the current method there were 842,454 estimated conceptions for all ages for 2005 and using the revised method there were 841,423 conceptions; a difference of 0.12 per cent. The conception rate for all ages remains the same at 76.0 conceptions per 1,000 women using the current or revised method.

There were 102,336 conceptions to mothers aged under 20 using the current method compared with 101,959 conceptions using the revised method, giving rates of 60.1 per 1,000 women aged 15–19 and 59.9 per 1,000 respectively. There are also fewer conceptions for the under 18 age group with 42,344 conceptions produced using the current method compared with 42,134 conceptions using the revised method with rates of 41.5 per 1,000 and 41.2 per 1,000 aged 15–17 respectively. Conception rates for women aged under 20 and 20–24 are slightly lower using the revised method and the rates are identical for women aged 25–29.

However, conception rates for women aged 35–39 and 40 and over are slightly higher using the revised method compared with the current method.

The differences in conception rates between the methods for all age groups, however, are not statistically significant. Conception rates calculated using the revised method fall within the confidence limits of the rates produced using the current method.

Table 3

Age of woman at conception leading to a maternity using the revised method compared with the current method, 2005

England and Wales

Age at conception using revised method	Woman's age comparing revised with current method			
	Younger	Same	Older	Total
Under 18	159	22,003	356	22,518
18	103	17,048	272	17,423
19	123	20,297	394	20,814
20	126	22,438	441	23,005
21	155	23,734	462	24,351
22	127	25,663	506	26,296
23	165	27,205	484	27,854
24	184	29,935	594	30,713
25	188	32,298	656	33,142
26	196	32,706	680	33,582
27	171	32,897	634	33,702
28	208	34,606	679	35,493
29	195	36,356	760	37,311
30	244	37,878	731	38,853
31	198	37,160	771	38,129
32	200	36,239	747	37,186
33	186	34,056	739	34,981
34	167	31,458	727	32,352
35	129	26,423	657	27,209
36	102	21,872	513	22,487
37	84	17,028	440	17,552
38	59	13,044	345	13,448
39	46	9,700	296	10,042
40 and over	39	15,493	494	16,026
Total	3,554	637,537	13,378	654,469
Percentages	0.5	97.4	2.0	100.0

Discussion

The method for producing conception statistics was previously examined in 1999¹ which took into account mother's day of birth and baby's day of conception. However, this is the first time gestational age for live births has been used to produce conception statistics for England and Wales, while it has been possible to do this previously for Scotland.¹³

Using recorded gestational age for live births has shown that nearly three-quarters of conceptions leading to a maternity (72 per cent) have a gestation period that is different to the current method of assuming a 38 week gestation period. However, the majority of these are born either at 37 or 39 weeks gestation. Differences in gestation are more likely to be due to preterm birth (a result of a shorter pregnancy) and this has had an effect on the date of conception, when measured by year of conception, as slightly more maternities are then reported to have been conceived in a later calendar year. The revised method therefore produces fewer conceptions for 2005 compared with the current method. However, as conception statistics are reported by the woman's age at conception, for the vast majority of women, age at conception remains the same using the current or revised method, and where there is a difference, the woman is slightly older. The number of conceptions estimated using the revised method has had a slight impact on conception rates for specific age groups, especially for women aged under 20 and women aged 35 and over. However, overall conception rates at national level by woman's age are not significantly different between the current and revised methods.

The revised method provides a better estimation of date of conception for live births, and in particular for multiple births, and woman's age at conception. However, conceptions leading to a multiple birth account for a small proportion of overall conceptions.

This analysis has used only gestational age from NN4B and all other information from the birth registration record. There are a very small

Figure 4

Differences in conception rates by woman's age – comparing the revised method with the current method, 2005

England and Wales

Table 4

Conceptions (numbers and rates¹) by age of woman at conception, 2005

England and Wales

Age	All conceptions base numbers		Conception rates per 1,000 women					
	Current method	Revised method	Current method	Lower 95 per cent confidence interval	Upper 95 per cent confidence interval	Revised method	Lower 95 per cent confidence interval	Upper 95 per cent confidence interval
Under 14	328	317	1.0	0.9	1.1	0.9	0.8	1.0
14	1,829	1,815	5.4	5.2	5.6	5.3	5.1	5.5
15	5,773	5,730	17.1	16.7	17.5	16.9	16.5	17.3
Under 16	7,930	7,862	7.8	7.6	8.0	7.7	7.5	7.9
16	13,357	13,237	39.5	38.8	40.2	39.1	38.4	39.8
17	21,057	21,035	61.1	60.3	61.9	61.0	60.2	61.8
Under 18	42,344	42,134	41.5	41.1	41.9	41.2	40.8	41.6
18	28,045	27,916	82.5	81.5	83.5	82.1	81.1	83.1
19	31,947	31,909	93.5	92.5	94.5	93.4	92.4	94.4
Under 20	102,336	101,959	60.1	59.7	60.5	59.9	59.5	60.3
20	34,310	34,282	99.5	98.4	100.5	99.4	98.3	100.4
21	35,339	35,255	105.2	104.1	106.3	105.0	103.9	106.1
22	37,019	36,990	111.2	110.1	112.3	111.2	110.0	112.3
23	38,240	38,061	113.1	111.9	114.2	112.6	111.5	113.7
24	40,687	40,625	114.8	113.7	115.9	114.7	113.6	115.8
20-24	185,595	185,213	108.8	108.3	109.3	108.6	108.1	109.1
25	42,612	42,505	120.2	119.0	121.3	119.9	118.8	121.0
26	41,959	41,969	122.8	121.6	124.0	122.8	121.7	124.0
27	41,016	40,904	125.7	124.5	126.9	125.4	124.2	126.6
28	42,096	42,070	129.5	128.3	130.8	129.5	128.3	130.7
29	43,749	43,750	131.6	130.4	132.8	131.7	130.4	132.9
25-29	211,432	211,198	125.8	125.3	126.3	125.8	125.3	126.3
30	44,915	44,934	130.6	129.4	131.8	130.7	129.5	131.9
31	43,850	43,791	124.2	123.0	125.4	124.1	122.9	125.2
32	42,743	42,781	114.6	113.5	115.7	114.8	113.7	115.8
33	40,409	40,224	102.5	101.5	103.5	102.1	101.1	103.1
34	37,412	37,361	92.4	91.4	93.3	92.3	91.4	93.2
30-34	209,329	209,091	112.0	111.5	112.5	111.9	111.4	112.4
35	31,834	31,884	79.7	78.8	80.5	79.9	79.0	80.7
36	26,865	26,866	65.2	64.5	66.0	65.3	64.5	66.1
37	21,483	21,518	52.0	51.3	52.7	52.1	51.4	52.8
38	16,869	16,852	39.9	39.3	40.5	40.0	39.4	40.6
39	13,121	13,086	30.9	30.4	31.4	30.9	30.4	31.4
35-39	110,172	110,206	53.2	52.9	53.5	53.3	53.0	53.6
40 and over	23,590	23,756	11.5	11.4	11.6	11.6	11.5	11.7
All ages	842,454	841,423	76.0	75.8	76.2	76.0	75.8	76.2

1 Rates for women of all ages, under 14, under 16, under 18, under 20 and 40 and over are based on the population of women aged 15–44, 13, 13–15, 15–17, 15–19 and 40–44 respectively.

proportion of records on the birth registration file where mother's date of birth is missing (7,675 maternities for 2005 and 9,883 maternities for 2006). A further stage of this analysis would be to use mother's date of birth where available from NN4B data, to provide a more accurate estimation of mother's age at conception than an imputed value.

Another aspect to explore further is how age-specific conception rates at local authority or ward level differ using current and revised methods. Local variations in the age-specific fertility rates as well as deprivation may have greater impact on age-specific conception rates.

The revised method provides only 2005 conceptions data and adopting this approach means it would not be possible to produce

backdated data for trend analysis as gestational age data are not available prior to 2005. However, the small observed differences between estimates produced by the current and revised methods demonstrate that conception statistics derived from the current method can continue to be used for trend analysis. Therefore to enable monitoring of England's Teenage Pregnancy Strategy target, which covers the period 1998–2010, on a consistent basis, ONS will continue to produce routine conception statistics using the current method until data for 2010 are released.

In the meantime, ONS plans to derive and analyse 2006 and 2007 conception statistics at national level using the revised method and also analyse subnational data for 2005–07.

Key findings

- Using recorded gestational age for live births from NN4B data has shown that 28 per cent of conceptions leading to maternity for 2005 occurred at 38 weeks gestation (same as the current method), while 42 per cent of conceptions occurred either at 37 or 39 weeks gestation
- For the majority of all conceptions leading to a maternity, woman's age at conception remains the same using the revised method as the current method
- Age-specific conception rates produced using the revised method are not significantly different to those produced using the current method. Hence conception statistics derived from the current method can continue to be used for trend analysis

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