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**Predicting date of birth: the best time to date a pregnancy?**

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**ABSTRACT**

**Objective:** To compare the estimated date of birth calculations from last menstrual period (LMP) and ultrasounds at varying gestations (<$7^0$, $7^0$-$10^6$, $11^0$-$14^0$, $14^1$-$19^6$ and $20^0$-$27^6$) against the actual date of birth (DOB).

**Methods:** This cohort study in a single local health district, Australia included 18,708 women with spontaneous labor who gave birth to a single live born infant without major anomalies between 2007 and 2011. Data were sourced from a computerized population birth database. The outcome of interest was duration of pregnancy expressed as total days, and the difference between actual DOB and estimated date of birth by dating method.

**Results:** Only 5% of births occurred on the estimated date of birth regardless of the timing of the estimate. Approximately 66% of births occurred +/-7 days of the estimated date of birth, and there was little difference between ultrasound gestational week bands. The $11^0$-$14^0$ weeks of gestation ultrasound performed as well if not better than ultrasounds conducted at other gestations. Maternal factors such as ethnicity and smoking status during pregnancy influenced duration of pregnancy; however, their explanatory power was too low to support incorporating these characteristics in dating estimations.

**Conclusion:** An early dating scan (10 weeks or earlier) is unnecessary if LMP is reliable.

## INTRODUCTION

Determination of the expected date of birth (EDB) has a direct effect on determination of gestational age, which in turn has a critical impact on the timing of prenatal tests, diagnosis of preterm labor and post-term pregnancies, interventions for poor fetal growth, induction of labor and tocolytic treatment.[1] Prediction of the delivery date also has social and personal ramifications for the pregnant woman and her family as they prepare for the arrival of their newborn child, including household preparations, timing of cultural rituals, travel arrangements for family visitors from afar and initiation of parental leave.

Current methods for determining the length of human gestation are based on last menstrual period (LMP) and/or ultrasound scanning. Using LMP, length of gestation is calculated as 280 days from the first day of the last menstrual period (LMP) or 266 days from ovulation to delivery, assuming that the woman has a 28 day cycle and ovulates on the 14th day.[2] Limitations of LMP include recall bias, irregular menstrual cycles, oral contraceptive use and bleeding in early pregnancy.[3] Ultrasound dating relies on a variety of fetal size measurements such as crown-rump length (CRL), biparietal diameter, head circumference, abdominal circumference, femur length and transverse cerebellar diameter.[4] A criticism of ultrasound dating is that fetal measurements are compared with fetal size references which do not account for normal variability.[5] An implicit assumption in ultrasound assessment is that all fetal size variability is due only to gestational age below a certain gestational age,[6] which may systematically result in the assignment of incorrect lower gestational age estimates for smaller infants.[6, 7]

Compared to menstrual dating, ultrasonography before 20 weeks' gestation is generally viewed as a more accurate method of estimating gestational age.[8-11] In practice, the use of both methods is intertwined. LMP estimates are used as a benchmark for booking the timing of the ultrasound; therefore, influencing the calibration and acceptance of the gestational age resulting from ultrasound information. When LMP is uncertain, gestational age estimates are based on early ultrasound (<20 weeks) or other factors.[12] When there is disagreement between the two methods non-standardised or universal rules are used to decide whether to substitute ultrasound-based gestational age estimates for LMP-based estimates.[10]

While there is a prevailing belief that the earlier in pregnancy an ultrasound is conducted the greater accuracy it has,[12] there are no studies to support this claim. The obstetric literature strongly suggests CRL measurement between 6.5–10 weeks of gestation is the single most accurate method of pregnancy dating.[13, 14] However, Gezer and colleagues found that CRL measurements changed the gestational age estimation in a great proportion of cases.[14] As more pregnancies undergo nuchal translucency screening, it remains to be seen whether such ultrasounds, commonly done at 11-13 weeks of gestation, will provide adequate dating. Another unknown is whether maternal factors that are easily assessed in early pregnancy, such as age, parity,ethnicity, body mass index (BMI), and smoking should be considered when estimating EDB. Previous studies comparing dates of delivery predicted by LMP or ultrasounds have been limited by lack of information on the actual date of delivery,[3, 6, 9, 12, 15, 16] selective and non-generalizable study populations,[10] and comparisons between LMP and a single ultrasounds estimation.[7, 17]

The aim of the present study was to compare the EDB calculations from LMP and ultrasounds at varying gestations against the actual date of birth (DOB). We also examined whether maternal factors that are clinically identifiable at the time of pregnancy dating influence pregnancy duration.

## METHODS

The study population included all women with spontaneous labor who gave birth to a singleton infant without major anomalies in the Northern Sydney Central Coast Health Area between 1 January 2007 and 31 October 2011. These births represent 51.7% of all births during the study period (n=37,089). Within this population there is a high uptake of nuchal translucency screening and fetal anomaly ultrasounds. Other ultrasound examinations are performed at the discretion of the caregiver according to clinical circumstances. Women undergo ultrasound scans in dedicated public or private obstetric ultrasound services staffed with accredited obstetric sonographers, obstetricians with ultrasound sub-speciality training or maternal-fetal medicine specialists using accredited equipment. Generally women book into hospital in the first 16 weeks and have available ultrasound results recorded at that time such that ultrasounds after this booking visit may not be captured.

De-identified population health data were sourced from ObstetriX, a computerized birth database, which includes all births of at least 400 grams birth weight or ≥20 weeks of gestation. Information on maternal characteristics, pregnancy, labor and delivery and infant outcomes were entered into the electronic database by the attending midwife or doctor as they occurred during pregnancy and birth. Validation studies show ObstetriX has low rates of missing data and generally high levels of agreement when compared with information obtained directly from the medical record.[18] The study received ethics approval from the Human Research Ethics Committee (HREC) of Northern Sydney Central Coast Health, Australia.

The outcome of interest was duration of pregnancy expressed as both the total number of days and the difference between actual DOB and estimated date of birth (EDB), by type of dating method. Outcomes were calculated using the following variables: date of last menstrual period (LMP), cycle length, the dates and gestational age estimates for individual ultrasounds taken during pregnancy and the actual DOB.  Duration of pregnancy is reported in days and calculated as: 280+ (DOB-EDB).  EDB estimates were calculated using available information on LMP (LMP date+280+ (cycle length-28) and ultrasound (ultrasound date - days gestation at ultrasound+280).  LMP dates were only recorded when ‘reliable’ (including a reliable date, regular menstrual cycle prior to pregnancy and cycle length between 21 and 35 days). Ultrasounds were categorized into five gestational bands: $<7^0$ weeks, $7^0$-$10^6$ weeks, $11^0$-$14^0$ weeks, $14^1$-$19^6$ weeks and $20^0$-$27^6$ weeks.   There are no standard international guidelines for the number of recommended ultrasounds during routine prenatal care, thus categories were based on the most common medical indications for performing ultrasounds in most industrialized countries.[19, 20]  In broad terms, these include early first trimester ultrasounds ($<7^0$ or $7^0$-$10^6$ weeks gestation) to confirm heartbeat, viable, molar or ectopic pregnancies, measure CRL and assess gestational age; the $11^0$-$14^0$ week ultrasound to assess risk of trisomy, the mid-pregnancy ultrasound ($14^1$-$19^6$ weeks gestation) for systematic investigation of fetal morphology and the $20^0$-$27^6$ weeks ultrasound to identify placental location, observe fetal presentation and movements, identify uterine or pelvic abnormalities of the mother or confirm intrauterine death. For women with more than one ultrasound in a specific gestational band (n=928), estimates from the earliest ultrasound in the band were used. Explanatory variables included: maternal age, parity, pre-pregnancy body mass index (BMI), smoking during pregnancy, hypertension (pre-existing, gestational and pre-eclampsia), diabetes (pre-existing and gestational) and model of care (including midwife, hospital-based or private obstetrician). Using international standards, BMI measurements were used to categorise women as underweight (BMI $< 18.5$ kg/m$^2$), normal weight (BMI 18.5 to 24.9 kg/m$^2$), overweight (BMI 25.0 to 29.9 kg/m$^2$), or obese (BMI $\geq 30$ kg/m$^2$).[21] Age was categorised as <20, 20-24, 25-29, 30-34, 35-39 and 40 years or more.

The paired difference between DOB and EDB (DOB minus EDB) was calculated for each non-missing LMP/ultrasound band for each woman. Descriptive analyses using frequency tables for categorical outcomes and means (standard deviations), medians (25$^{th}$ and 75$^{th}$ percentile ranges) and modes for continuous variables were performed to examine general characteristics of the study population and to describe the distributional spread of duration of pregnancy in days and the paired DOB-EDB differences by method of EDB estimation. Frequency tables were used to examine the proportion of births where the EDB was within 0 (same day), ±3, ±7, ±14 and ±21 days of the actual date of birth using different sources of dating measurements.

Multivariable analysis was performed using linear regression. The dependent variable was the difference between DOB and EDB. Separate models were performed for the difference between DOB and EDB based on LMP-estimates and for each of the ultrasound band estimates. Independent variables included maternal age, parity, country of birth, BMI and maternal smoking status during pregnancy. Results are presented as parameter estimates and 95% confidence intervals (95%CI). Analyses were conducted using SAS, version 9.2 (SAS Institute, Cary, NC, USA).

**RESULTS**

During the study period, there were 19,191 women with spontaneous labor who gave birth to a singleton infant. After excluding women that were missing dating information for both LMP- and ultrasound-based methods (n=483, 2.5%), the study population consisted of 18,708 births. The mean (±SD) maternal age was 30.3 (± 5.5) years and 23.2% were aged 35 years of more (**Table 1**), while 26.2% were overweight or obese. As women with planned births (labor induction and prelabor cesarean section) were excluded, the rates of hypertension and diabetes are low. Of the 10,243 (55%) women with a reliable LMP, 88.3% had a cycle of 26-30 days, 3.3% a cycle of 21-25 days and 8.4% had 31-35 day cycles. Smokers were less likely to report a reliable LMP than non-smokers (31.1% vs 56.5%) Ninety-five percent of women had at least one ultrasound result and 1.7% had four or more.The most frequently reported ultrasound result (65.1%) was at $11^0$-$14^0$ weeks (**Table 2**).

Based on calculations using the actual DOB, the mean (±SD) duration of pregnancy based on LMP-estimates was 277.7 (±13.1) days (**Table 2**). Duration of pregnancy based on estimates from different ultrasound bands showed mean estimates ranging from 275.7 to 278.7 days and medians from 278 to 281 days. EDB based on ultrasounds performed at $11^0$-$14^0$ weeks showed the least amount of dispersion around the mean (standard deviation (SD)=11.2 days) compared to greater dispersion or variability when using the LMP-based estimate (SD=13.1) or the commonly preferred dating ultrasound between $7^0$ and $10^6$ weeks (SD=12.8). The difference between the overall mean EDB's for the $7^0$-$10^6$ and $11^0$-$14^0$ ultrasounds was small (2.0 days) compared to the natural variability around the EDB (≥10 days between the $25^{th}$ and $75^{th}$ percentile).

Across all methods for estimating EDB, approximately 5% (range 4.9-5.5%) of EDBs correctly predicted the actual DOB and approximately 66% (range 60.8-67.9%) occurred within a week (± 7 days) of the EDB (**Table 2**). EDB using the LMP and the $20^0$-$27^6$ ultrasounds led to a higher proportion of post-term births (1.6% and 1.8%, respectively) in comparison to the other ultrasound bands. EDB based on the $11^0$-$14^0$ and $14^1$-$19^6$ ultrasound bands led to the lowest proportion of preterm births (3.8 and 4.3%, respectively) compared to the other methods. Ultrasounds performed at <$7^0$ weeks had more births occur before the EDB (58.9%), which is visually represented by a left shift in the histogram showing the distribution in the difference in days between the actual DOB and EDB (**Figure 1**). In contrast, the $11^0$-$14^0$ ultrasound showed a slight shift to the right, suggesting more births occurred after the EDB. The subgroup of Asian-born women had a leftward shift (shorter pregnancy duration) at all ultrasound bands; for the $11^0$-$14^0$ weeks ultrasound their median DOB-EDB difference was -2 days. For all gestational bands, the distribution of DOB-EDB differences necessarily had a longer tail to the left (skewness = -3.8) due to the occurrence of very preterm births.

Results of multivariable analyses examining the influence of maternal characteristics on the duration of pregnancy for EDB estimates based on LMP and ultrasound bands indicate that Asian-born women and smokers had shorter lengths of gestation (**Table 3**). Based on LMP and ultrasound at $7^0$-$10^6$, $11^0$-$14^0$, and $14^1$-$19^6$, the duration of pregnancy was shorter for Asian-born women by 2.54, 1.90, 2.36 and 2.05 days, respectively, and for women who smoked during pregnancy by 2.76, 5.74, 3.75 and 3.84 days, respectively. The low explanatory power of the models (adjusted R- squareds ranged from 0.01 to 0.02 using the different ultrasound bands) reflects the large natural variability in the duration of pregnancy which was not explained by the maternal characteristics that were examined.

## DISCUSSION

Key findings from this comparison of EDB calculations from LMP and ultrasounds at varying gestations are as follows: few births occur on the expected due date, the difference between EDB and actual DOB are similar regardless of which method is used to calculate EDB and very little of the variability in pregnancy duration is explained by maternal factors such as age, parity, BMI and smoking status.

While it has been suggested that a very small proportion of births occur on the EDB,[11, 22] this study uses a population-based sample and data on actual date of birth to support this claim. Results show that 1 in 20 births occur on the EDB and approximately 66% of births occur within a week (+/- 7 days) of the EDB. Most clinical decisions during pregnancy are influenced by the presumed gestational age of the fetus at the time that decisions are made. Therefore, better prediction of the timing of birth will improve monitoring of fetal growth and assist in providing optimal management for preterm and postterm deliveries.[23]

Results of this study also found that compared to the large natural variability around DOB, there was little practical difference at the individual patient level between the various dating scans. The small amount of difference between dating methods suggests that revisions to EDB during pregnancy are unwarranted. Older studies have claimed that EDB estimation using "early" ultrasound scanning (before 20 weeks) instead of LMP has contributed to higher rates of preterm delivery rate (<37 completed weeks).[24, 25] The present study found that reliance on a dating scan before 11 weeks would have resulted in a higher apparent preterm rate for the cohort (5.1% based upon the $7^0$-$10^6$ scan) compared to reliance upon later scans (3.8% at $11^0$-$14^0$, 4.3% at $14^1$-$19^6$). These rates are lower than for the entire Health Area (6.3%)[26], which is unsurprising given the cohort only includes women who spontaneously laboured and does not include high risk transfers from rural areas.

Previous studies have reported lower rates of post-term births for women with EDB based on first trimester ultrasound assessments compared to second trimester ultrasound assessments[27] and compared to LMP;[15, 28] however, these studies were unable to distinguish between first and second trimester ultrasounds at varying gestations. In this study, there were fewer post-term births for earlier ultrasounds performed at $<7^0$ -$10^6$ weeks compared to ultrasounds at $11^0$-$14^0$ or $14^1$-$19^6$ weeks. Both the $11^0$-$14^0$ and $14^1$-$19^6$ ultrasound showed a slight shift to the right in the DOB-EDB difference (post-term advanced by 1-2 days). Except for the $20^0$-$27^6$ ultrasound, all of the other ultrasounds resulted in fewer or equivalent post-term births compared to LMP.

While no single gestational ultrasound band stands out as the best, the nuchal translucency and anomaly ultrasounds which are already routinely performed appear to have the least amount of dispersion around the mean. Our results lend support to international guidelines that recommend[19] using either ultrasound ($11^0$-$14^0$ or $14^1$-$19^6$) for dating purposes, which would lead to reduced costs (if $7^0$-$10^6$ week dating scans are in widespread use) and greater consistency in gestational age assessment. While ultrasounds prior to 10 weeks gestation may provide the opportunity for early detection of nonviable and ectopic pregnancies, our results suggest that their use for dating purposes could be limited to when LMP is unknown or unreliable and determination of gestational age is required for accurate booking of a nuchal tranclucency ultrasound.

The present study found that although maternal factors such as ethnicity and smoking status influence duration of pregnancy, the explanatory power of such predictors for estimating

EDB are low. Overall results indicate that sociodemographic information will not greatly improve individual estimates of the expected date of birth.

In terms of implications, expectant mothers should be informed that there is only a 35% chance that they will actually go into labor during the week of their EDB (+/-3 days). While the practice of supplying women with a single day on which to expect their birth has long been the norm, it has been suggested that anxiety may be alleviated if a range of dates (for example 38-42 weeks) was substituted for a specific date of delivery.[29] However, information on women's preferences for how the timing of their birth is communicated is lacking

The strengths of this study include the use of reliable measures of maternal characteristics, LMP dates are only used when reported to be reliable, and pregnancies with prelabor interventions (induction or prelabor cesarean section) were excluded to eliminate the introduction of bias from the artificial shortening of the biological span of pregnancy. Furthermore, this study used a population-based cohort with data on actual date of birth and was able to express duration of pregnancy in days and not just weeks. EDBs were determined prior to, and unbiased by, the actual date of birth. Consequently, these data also describe the natural duration of singleton pregnancies. Study limitations include the possibility that the study sample is not generalizable to all pregnant women including those with multiple pregnancies. Our study population has a greater proportion of older and more educated women compared to national estimates.[30] Another possible limitation is that many of the women did not have a record of EDB assessment in all gestational bands. If those not attending for a particular EDB were systematically different from those who did, this could introduce bias into comparisons of EDB at different gestational bands. However, the differences between the EDB estimates by band were relatively small, suggesting a limited effect to any such potential bias. The lack of complete data on ultrasound results from the 14-19 week morphology ultrasound is because this examination usually occurs after the antenatal booking appointment and dating results may not always be sent to the attending midwife or doctor who enters medical information into the electronic database. Finally, data were not available on which fetal measurements were used at various ultrasounds nor on details relating to providers, training and equipment, and it is not possible to determine whether the LMP estimation of gestational age based on women's self-reported dates influenced ultrasound measurements or results.

In summary, regardless of which dating method is used, current methods used in clinical settings for estimating the duration of pregnancy from conception to spontaneous birth are only able to predict actual date of birth for 1 in 20 births. While no single dating method stands out, our results support use of an ultrasound between 11-14 weeks-for determining gestational age.[19]

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**Table 1** Maternal characteristics by method of Estimated Date of Birth assessment (Last Menstrual Period and timing of ultrasound)

| | **Entire Study Population N=18,708 n (%)** | **Reliable Last Menstrual Period n=10,243 n (%)** | **Ultrasound Bands (Weeks of Gestation)** | | | | |
|---|---|---|---|---|---|---|---|
| | | | **$<7^0$ n=1,999 n (%)** | **$7^0$-$10^6$ n=521 n (%)** | **$11^0$-$14^0$ n=12,184 n (%)** | **$14^1$-$19^6$ n=6,919 n (%)** | **$20^0$-$27^6$ n=2,234 n (%)** |
| **Maternal age, years** | | | | | | | |
| Younger than 20 | 61 (3.3) | 148 (1.4) | 73 (3.7) | 164 (3.6) | 273 (2.2) | 206 (3.0) | 121 (5.4) |
| 20-24 | 2 315 (12.4) | 903 (8.8) | 287 (14.4) | 628 (13.9) | 1218 (10.0) | 851 (12.3) | 334 (15.0) |
| 25-29 | 5 073 (27.1) | 2644 (25.8) | 625 (31.3) | 1265 (28.0) | 3131 (25.7) | 1841 (26.6) | 617 (27.6) |
| 30-34 | 6 376 (34.1) | 3848 (37.6) | 668 (33.4) | 1470 (32.5) | 4466 (36.7) | 2431 (35.1) | 699 (31.3) |
| 35-39 | 3 684 (19.7) | 2291 (22.4) | 288 (14.4) | 829 (18.3) | 2666 (21.9) | 1345 (19.4) | 383 (17.1) |
| 40 or older | 649 (3.5) | 409 (4.0) | 58 (2.9) | 165 (3.7) | 430 (3.5) | 245 (3.5) | 80 (3.6) |
| **Country of birth** | | | | | | | |
| Australia | 11 491 (61.7) | 5734 (56.0) | 1221 (61.5) | 2874 (63.8) | 7516 (61.7) | 3947 (57.4) | 1234 (55.5) |
| Asian region | 3165 (17.0) | 2042 (19.9) | 380 (19.1) | 747 (16.6) | 1884 (15.5) | 1498 (21.8) | 510 (22.9) |
| Other | 3972 (21.3) | 2415 (23.6) | 385 (19.4) | 884 (19.6) | 2727 (22.4) | 1437 (20.9) | 479 (21.6) |
| **Nulliparous** | 8211 (43.9) | 4549 (44.4) | 1048 (52.4) | 2106 (46.6) | 5513 (45.3) | 3147 (45.5) | 1014 (45.4) |
| **Body mass index ($kg/m^2$)** | | | | | | | |
| Underweight | 1 361 (7.5) | 699 (7.0) | 153 (7.8) | 369 (8.4) | 802 (6.8) | 546 (8.1) | 170 (7.9) |
| Normal weight | 11 969 (66.3) | 6733 (67.9) | 1267 (64.4) | 2824 (64.2) | 7943 (67.2) | 4513 (67.2) | 1371 (63.9) |
| Overweight | 3 283 (18.2) | 1767 (17.8) | 390 (19.8) | 815 (18.5) | 2178 (18.4) | 1177 (17.5) | 390 (18.2) |
| Obese | 1 452 (8.0) | 721 (7.3) | 158 (8.0) | 391 (8.9) | 896 (7.6) | 481 (7.2) | 213 (9.9) |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Model of prenatal care** | | | | | | | |
| Midwife | 14 554 (77.8) | 7871 (77.8) | 1571 (78.6) | 3513 (77.7) | 9677 (79.4) | 5466 (79.0) | 1708 (76.8) |
| Hospital-based medical | 2 515 (13.4) | 1280 (12.5) | 278 (13.9) | 658 (14.6) | 1524 (12.5) | 855 (12.4) | 365 (16.4) |
| Shared | 1 089 (5.8) | 634 (6.2) | 129 (6.5) | 283 (6.3) | 705 (5.8) | 475 (6.9) | 119 (5.4) |
| Private obstetrician | 529 (2.8) | 349 (3.4) | 21 (1.1) | 66 (1.5) | 277 (2.3) | 121 (1.8) | 33 (1.5) |
| **Smoked in pregnancy** | 1835 (9.8) | 579 (5.7) | 204 (10.2) | 527 (11.7) | 916 (7.5) | 611 (8.8) | 296 (13.3) |
| **Diabetes** | | | | | | | |
| None | 17 889 (95.6) | 9758 (95.6) | 1895 (94.8) | 4337 (96.3) | 11 719 (96.2) | 6562 (95.2) | 2121 (95.7) |
| Pre-existing | 16 (0.1) | 11 (0.1) | 2 (0.1) | 4 (0.1) | 9 (0.1) | 6 (0.1) | 4 (0.2) |
| Gestational | 715 (3.8) | 437 (4.3) | 102 (5.1) | 164 (3.6) | 455 (3.7) | 326 (4.7) | 92 (4.2) |
| **Hypertension** | | | | | | | |
| None | 18 341 (98.0) | 10 052 (98.3) | 1952 (97.8) | 4435 (98.2) | 11 947 (98.1) | 6798 (98.3) | 2197 (98.3) |
| Pre-existing | 34 (0.2) | 16 (0.2) | 4 (0.2) | 7 (0.2) | 19 (0.2) | 7 (0.1) | 2 (0.1) |
| Pregnancy | 307 (1.7) | 162 (1.6) | 39 (2.0) | 75 (1.6) | 208 (1.7) | 106 (1.5) | 31 (1.4) |

Reliable last menstural period  defined as regular menstrual cycle prior to pregnancy and cycle length between 21 and 35 days.

Subgroup totals may be less than column total N because of missing data.

**Table 2** Proportion of births where estimated date of birth was the same as the actual date of birth and within specified ranges by source of estimated date of birth

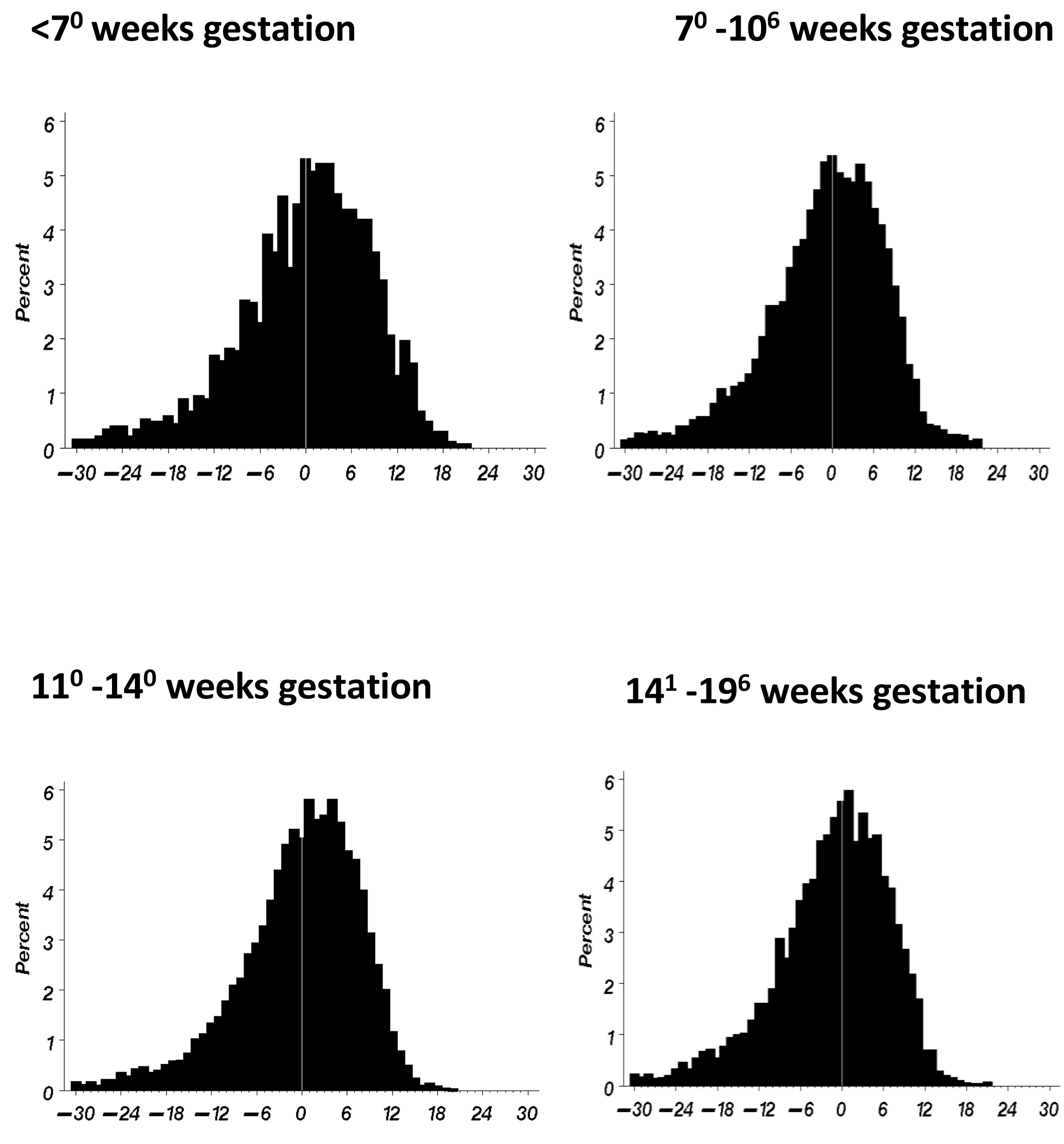
| Duration of pregnancy | | Reliable Last Menstrual Period | Gestation of Ultrasound (Weeks) | | | | |
|---|---|---|---|---|---|---|---|
| | | | $<7^0$ | $7^0$-$10^6$ | $11^0$-$14^0$ | $14^1$-$19^6$ | $20^0$-$27^6$ |
| **Total number of women** | | 10,243 | 1,999 | 4,521 | 12,184 | 6,919 | 2,234 |
| **Proportion of women (%)** | | 54.8 | 10.7 | 24.2 | 65.1 | 37.0 | 11.9 |
| **Mean duration (±SD)** [2,3] | | 277.7 ± 13.1 | 275.7 ± 11.9 | 276.7 ± 12.8 | 278.7 ± 11.2 | 277.3 ± 12.5 | 277.8 ± 15.2 |
| **Median duration (interquartile range)** [2,3] | | 280 (11) | 278 (11) | 279 (11) | 281 (10) | 279 (10) | 281 (12) |
| **Mode of duration ($25^{th}$, $75^{th}$ percentiles)** [2,3] | | 280 (274, 285) | 282 (272, 283) | 279 (273, 284) | 281 (275, 285) | 281 (274, 284) | 280 (274, 286) |
| **Difference between DOB and Estimated Date of Birth (days)** | | | | | | | |
| **DOB before EDB** | **22 or more (preterm)** | 4.7 | 5.3 | 5.1 | 3.8 | 4.3 | 5.6 |
| | **15-21** | 4.6 | 6.6 | 5.0 | 3.5 | 4.9 | 3.8 |
| | **8-14** | 12.1 | 15.2 | 13.0 | 10.7 | 12.4 | 10.9 |
| | **4-7** | 13.1 | 16.8 | 14.2 | 12.4 | 14.3 | 12.0 |
| | **1-3** | 13.9 | 15.0 | 14.8 | 14.2 | 14.6 | 11.9 |
| **DOB on the EDB** | **0** | 5.2 | 5.4 | 5.5 | 4.9 | 5.4 | 5.1 |
| **DOB after EDB** | **1-3** | 14.4 | 14.8 | 15.5 | 16.3 | 15.5 | 14.9 |
| | **4-7** | 18.0 | 14.1 | 17.5 | 20.1 | 17.2 | 16.9 |
| | **8-14** | 12.4 | 6.8 | 9.1 | 13.7 | 11.0 | 17.0 |
| | **15 or more (postterm )** | 1.6 | 0.1 | 0.2 | 0.5 | 0.5 | 1.8 |

**Table 3**

Factors associated with the difference in days between actual date of birth and estimated date of birth for selected ultrasound bands

| | **Last Menstrual Period** | **Ultrasound bands (weeks gestation)** | | |
|---|---|---|---|---|
| | | **$7^0$-$10^6$** | **$11^0$-$14^0$** | **$14^1$-$19^6$** |
| | **DOB-Estimated Date of Birth (days) (95% CI)** | **DOB- Estimated Date of Birth (days) (95% CI)** | **DOB-E Estimated Date of Birth (days) (95% CI)** | **DOB- Estimated Date of Birth (days) (95% CI)** |
| **Age, years** | | | | |
| Younger than 20 | -1.12 (-3.34, 1.10) | 0.25 (-1.84, 2.34) | -.64 (-2.05, 0.77) | -0.85 (-2.72, 1.02) |
| 20-24 | 0.72 (-0.29, 1.73) | 0.94 (-0.28, 2.16) | 0.36 (-0.39, 1.11) | 0.35 (-0.70, 1.41) |
| 25-29 | Reference | Reference | Reference | Reference |
| 30-34 | -0.43 (-1.09, 0.24) | -0.17 (-1.13, 0.78) | 0.51 (-0.01, 1.02) | 0.16 (-0.62, 0.94) |
| 35-39 | -1.61 (-2.37, -0.84) | -0.48 (-1.60, 0.65) | 0.30 (-0.29, 0.89) | 0.16 (-0.76, 1.07) |
| 40 or older | -2.47 (-3.87, -1.07) | -1.22 (-3.27, 0.84) | -0.69 (-1.83, 0.45) | -0.11 (-1.83, 1.61) |
| **Nulliparous** | 0.04 (-0.50, 0.59) | 0.04 (-0.75, 0.82) | 0.23 (-0.19, 0.65) | 0.83 (0.19, 1.48) |
| **Asian country of birth** | -2.54 (-3.20, -1.87) | -1.90 (-2.92, -0.87) | -2.36 (-2.92, -1.79) | -2.05 (-2.81, -1.29) |
| **Body mass index** | | | | |
| Underweight | -0.73 (-1.77, 0.32) | -0.70 (-2.07, 0.68) | -0.96 (-1.78, -0.15) | -0.78 (-1.92, 0.36) |
| Normal weight | Reference | Reference | Reference | Reference |
| Overweight | -0.05 (-0.75, 0.65) | 0.28 (-0.71, 1.26) | 0.72 (0.19, 1.25) | 0.64 (-0.19, 1.46) |
| Obese | 0.06 (-0.97, 1.09) | -0.14 (-1.48, 1.20) | -0.44 (-1.22, 0.34) | -0.14 (-1.35, 1.07) |
| **Smoker** | -2.76 (-3.91, -1.62) | -5.74 (-6.93, -4.55) | -3.75 (-4.52, -2.97) | -3.84 (-4.94, -2.74) |
| **Adjusted R-squared** | 0.010 | 0.020 | 0.011 | 0.014 |

**Figure 1.**


$<7^0$ weeks gestation
$7^0$ -$10^6$ weeks gestation
$11^0$ -$14^0$ weeks gestation
$14^1$ -$19^6$ weeks gestation
Percent
0
1
2
3
4
5
6
−30 −24 −18 −12 −6 0 6 12 18 24 30

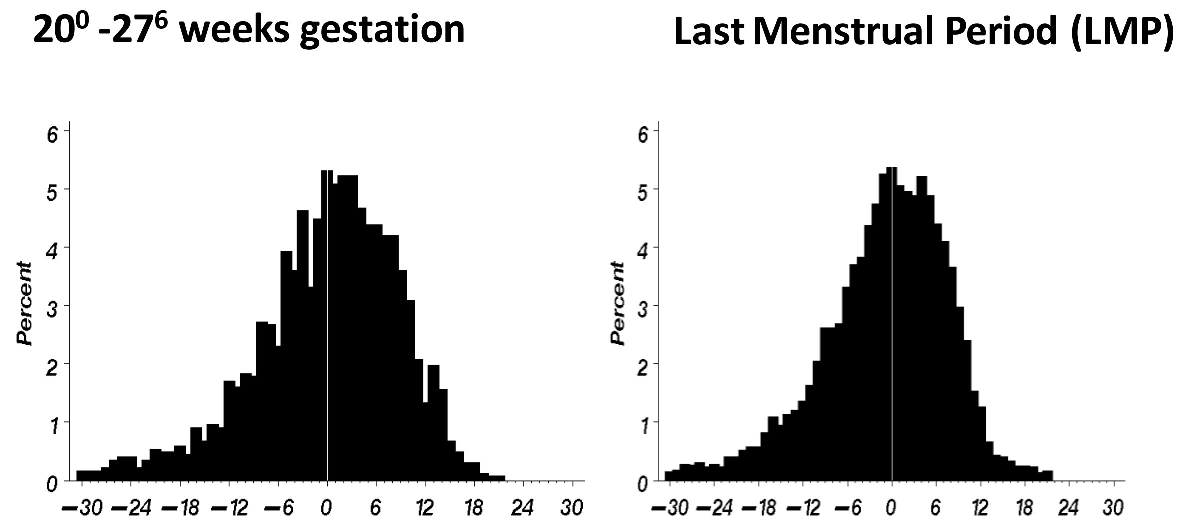



**Figure Legend**

Histogram of the difference in number of days between actual date of birth and estimated date of birth using last menstrual period and ultrasonography estimates categorized by gestational age at ultrasonogram. A, less than 7 weeks of gestation; B, 7–10 6/7 weeks of gestation; C, 11–14 weeks of gestation; D, 14 1/7–19 6/7 weeks of gestation; E, 20–27 6/7; F, last menstrual period.