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A Comparison of Gestational Age Information Derived from the Birth Certificate, 1990 – 1998

An infant's gestational age (length of pregnancy) is important information for public health uses. For example, it is used to calculate the proportion of preterm births and to measure the adequacy of prenatal care. Both these indicators depend on the infant's gestational age. One of the most common sources of gestational age information comes from certificates of live birth. Two types of information on the birth certificate are used to measure gestational age: the date of the last menstrual period (LMP) and the clinically estimated (CE) gestational age.

Using the last menstrual period to calculate gestational age can be problematic, however. Sometimes the last menses date is unknown or incomplete. Other problems of using the LMP date to calculate gestational age are well documented. Recall error, sporadic bleeding during pregnancy, and variations in the menstrual cycle all affect the accuracy of the gestational age calculation.

The clinical estimate of gestation has its own set of problems. Reporting instructions from the National Center for Health Statistics (NCHS) state "this item provides a cross-check with the length of gestation (calculated from the last menses date) based on ultrasound or other techniques." Guidelines for determining the clinically estimated gestational age are not provided, and therefore may reflect a variety of techniques.

The NCHS recommends that the LMP gestational age be used for reporting purposes, unless this calculation is inconsistent with birth weight. Otherwise, the CE gestational age is used, unless it too is missing or inconsistent with birth weight. Currently, the Bureau of Vital Statistics does not calculate the length of pregnancy under NCHS guidelines. The Bureau uses the LMP gestational age if the last menstrual date is reported and the calculated gestation is within a range of 17 to 47 weeks. Otherwise, the CE gestational age is used, provided it is within a range of 17 to 47 weeks. If neither value is within range, the gestational age is reported as unknown.

This newsletter looks at characteristics of the gestational age information collected on birth certificates and compares the distribution of certain risk factors by both gestational age measures.

HIGHLIGHTS

- Using the CE gestational age would produce lower preterm and very preterm birth rates than the LMP gestational age. Currently the LMP gestational age is used for reporting purposes.
- Generally, the more births that occurred in a hospital, the closer the agreement between the CE and LMP gestational age.

On the Lighter Side

Does a full moon have any influence on when a woman goes into labor and gives birth? Find out on page 7.

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METHODS

Birth records from 1990 to 1998 were used for the analysis. The LMP gestational age was based on the completed weeks of gestation between the date of last menses and the birth date. LMP values were not calculated if the last menstrual date was missing or incomplete. Values for gestational age were considered within range if they fell between 20 and 45 weeks. This gestational age range is different from what is currently used by the Bureau (17 to 47 weeks). A gestational age of less than 20 weeks or more than 45 weeks was classified as out of range.

Box and whisker plots were used to identify birth weights that were out of range (outliers) for a given gestational age. Birth weights more than three times the interquartile range [(IQR), the difference between the 75th and 25th percentile] were classified as outliers. All birth records were used to find the within range, out of range, missing or incomplete values for gestational age, and birth weight outliers.

For comparisons between the LMP-based and the CE gestational age, only birth records with both values in a range from 20 to 45 weeks were used. A total of 3,872 birth records were excluded based on this condition. Since the LMP-based method is the preferred estimate of gestational age by the National Center for Health Statistics (NCHS) and the Bureau, this measure was chosen as the standard for comparisons between the LMP and CE estimates.

The difference in gestational age between the CE and the LMP (CE – LMP) was calculated for each birth. Next, the mean difference in gestational age was calculated for each week of gestation (based on the LMP value). The mean difference in gestational age was then examined by the mother's race (Native, non-Native) and period of birth: 1990 to 1994 and 1995 to 1998. These two periods were chosen to see if the relationship between the CE and LMP gestational age has changed over time.

The mean difference in gestational age values was also analyzed by hospital groups. Hospitals were grouped according to the number of births that occurred at each facility. Statistical clustering methods were used to create the groups. Clustering techniques begin by grouping the hospitals that are most similar and then merging these initial groups according to their similarities. Four groups were created using this technique. Due to the large number of births (more than 24% of all births during this period), Providence Alaska Medical Center (PAMC) was considered a group by itself. The other hospitals were grouped according to the following specifications: between 7,000 and 10,000 births; between 2,000 and 6,000 births; and 1,500 or fewer births. Based on these specifications, Fairbanks Memorial, Alaska Regional, Alaska Native Medical Center, Elmendorf USAF, and Bassett Army hospitals comprised the second group (between 7,000 and 10,000 births); Valley, Yukon Kuskokwim, Central Peninsula, Bartlett Memorial, Ketchikan General, and Providence Kodiak Island Medical Center comprised the third group (between 2,000 and 6,000 births); all remaining hospitals comprised the fourth (less than 1,500 births).

Table 1 Characteristics of the LMP and CE Gestational Age Alaska, 1990 - 1998				
Characteristic	LMP Gestational Age		CE Gestational Age	
	Number	Percent	Number	Percent
Within Range (20 - 45 weeks)[1]	93,831	96.5	96,004	98.7
Out of Range (< 20 or > 45 weeks)	1,239	1.3	19	0.0
Birth Weight Outliers[2]	240	0.2	259	0.3
Missing or Incomplete	1,931	2.0	959	1.0
Total	97,241	100.0	97,241	100.0

[1]Excludes birth weight outliers.
[2]As determined in the Methods Section.

Table 2 Gestational Age Distribution by Various Risk Factors, Alaska 1990 - 1998		
Characteristics	LMP Gestational Age	CE Gestational Age
Weeks (mean)	39.06	39.12
Weeks (median)	39	40
5th and 95th percentile	35-42	36-41
Standard deviation	2.41	2.02
Very preterm (< 33 weeks)	1.9%	1.4%
Preterm (< 37 weeks)	9.4%	7.1%
Term (37 - 41 weeks)	81.6%	89.2%
Postterm	9.0%	3.7%
Adequate prenatal care	72.62%	72.62%
Intermediate prenatal care	21.04%	21.04%
Inadequate prenatal care	5.59%	5.59%
Unknown prenatal care	0.75%	0.75%

[1]Excludes births where either the LMP or CE gestational age is <20 or >45 weeks gestation.

RESULTS

A total of 97,241 live births to Alaskan residents occurred from 1990 to 1998. Table 1 shows the proportion of births with within range, out of range, birth weight outliers, and missing or incomplete values for gestational age. The LMP-based calculation had twice as many missing values as the clinically estimated gestational age. The CE measure also showed far fewer out of range values for gestational age.

Characteristics of each gestational age distribution are summarized in Table 2. Both methods produced a similar mean, yet the CE shows a higher median. The LMP gestational calculation has a wider distribution (by two weeks) for the 5th and 95th percentiles and a larger standard deviation. Higher levels of very preterm, preterm, and postterm births was shown by the LMP-based gestation. A clear preference for a gestational age of 40 weeks was shown by the CE measure. More than 1/3 (35.1%) of births had a CE gestational age of 40 weeks. This compares with 23.2% for the LMP-based measure. Overall, the CE measure classified almost 9 of every 10 births as a term birth. Both methods produced identical levels of prenatal care.

Figure 1 shows the mean difference in weeks between the CE and LMP-based-gestational age, grouped by period. As seen in Figure 1, the mean difference in gestational age is greater than zero for births up to 39 weeks gestation. This shows, on average, the CE is larger than the LMP for this gestational age range. After 40 weeks gestation, the relation reverses and the LMP method produces higher gestational values than the CE. By 45 weeks gestation, the LMP method produces an average gestational age that is 5 weeks more than the CE gestational age. Figure 1 also shows that since 1995, births with a gestational age up to 39 weeks show a smaller mean difference in gestational age, compared with births before 1995. With a few exceptions, the mean difference in gestational age for the 1995 to 1998 period was less than two weeks for births up to 39 weeks gestation.

The mean difference in weeks between the CE and LMP gestational age by mother's race is displayed in Figure 2. Births to Native mothers have a larger disparity between the two gestational measures, principally for births with less than 33 weeks gestation (preterm births). Native births with an LMP gestational age of less than 33 weeks will therefore have a CE gestational age that is on average 1 to 3 weeks more than the comparable group of non-Native births. Since the LMP measure is currently the preferred method of reporting gestation, Native mothers will have proportionally higher levels of very preterm and preterm births than if the CE gestational age was

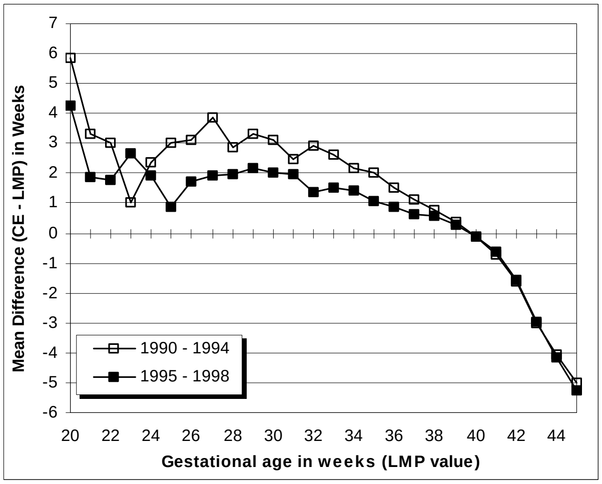


Figure 1. **Mean difference in CE and LMP (CE – LMP) gestational age: Alaska 1990 – 1998**

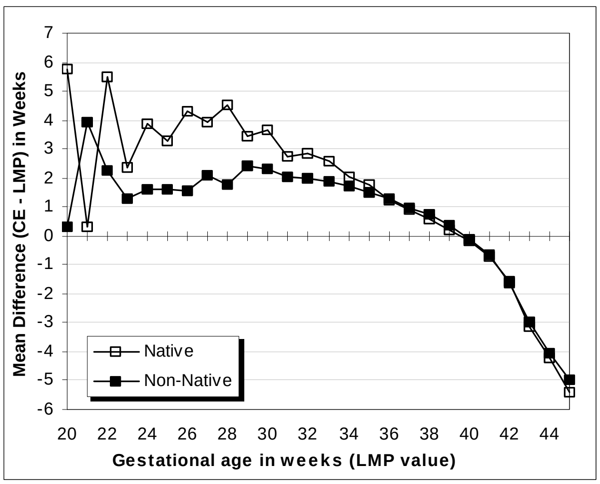


Figure 2. **Mean difference in CE and LMP (CE – LMP) gestational age by mother's race: Alaska 1990 – 1998**

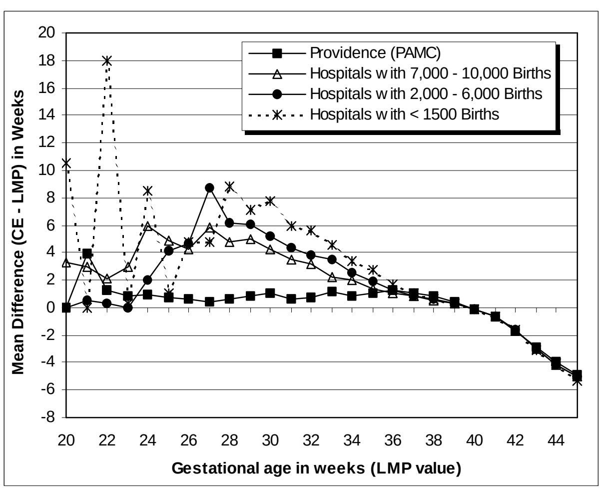


Figure 3. **Mean difference in CE and LMP (CE – LMP) gestational age by hospital group: Alaska 1990 – 1998**

used. For instance, using the LMP gestational age, 2.6% of births to Native mothers were born very preterm during this period. This compares with 1.5% for non-Native mothers. If the CE gestational age had been used, however, Native and non-Native mothers would have had similar levels of very preterm births (.99% and .84%, respectively).

Figure 3 shows the mean difference between the CE and LMP gestational age, by hospital group. For births with less than 36 weeks gestation, Providence (PAMC) shows the closest agreement between the LMP and CE values, with typically a mean difference of one week or less. Generally for births with less than 36 weeks gestation, it appears that the fewer number of births that occur at a hospital, the larger the mean difference between the CE and LMP gestational age. Thus, hospitals with comparatively fewer births will average higher preterm birth rates than if the clinically estimated gestational age was used. All hospitals, no matter how many births occur at the facility, show a similar mean difference for births with 36 weeks or more gestation.

Figure 4 shows a box and whisker plot of the birth weight (in grams) by the LMP-based gestational age. The LMP-based gestational age has a concentration of birth weight outliers from 22 to 27 and 38 to 40 weeks gestation. Proportionally, more outliers occurred between 22 and 27 weeks gestation (57/479) than from 38 to 40 weeks gestation (70/56,985). Figure 4 also shows one problem of using the LMP gestational age estimate. Of the 57 birth weight outliers from 22 to 27 weeks gestation, 45 of these births (79%) had normal birth weight (2500+ grams). If the CE gestational age had been used for these 45 births, 80% (36/45) would have been classified as term births.

The distribution of birth weight (in grams) by the CE gestational age is shown in Figure 5. The distribution of the CE birth weight outliers is more uniform than for the LMP gestational age. Most outliers occurred from 28 to 40 weeks gestation.

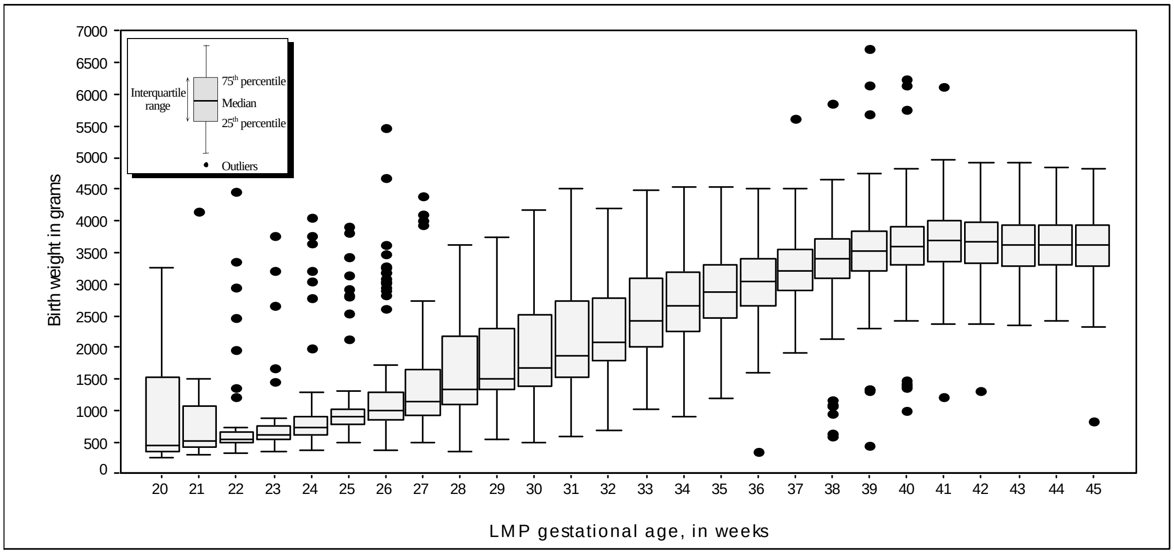


Figure 4. **Box and whisker plot of birth weight by LMP gestational age: Alaska 1990 – 1998**

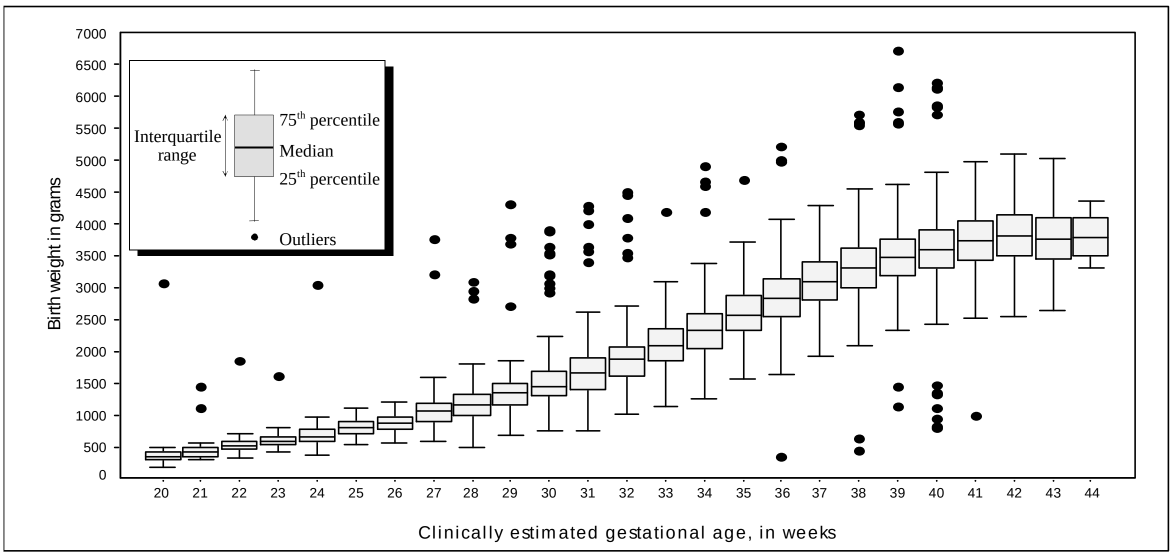


Figure 5. **Box and whisker plot of birth weight by CE gestational age: Alaska 1990 – 1998**

Proportionally, birth weight outliers were more of a problem for births with a CE gestational age of 28 to 32 weeks (31/957) than for births with 33 to 40 weeks gestation (96/76,206). Figure 5 also shows that using the CE gestational age is not without its own set of problems. For births with a CE gestational age of 38 to 40 weeks, 14 births had a birth weight less than 1500 grams, which are classifiable as very low birth weight. Generally, the length of the box plots (the interquartile range) is smaller for the CE than for the LMP gestational age, a visual representation that there is less variation in birth weight by the CE gestational age.

DISCUSSION

Some disparities were noted for the two measures of gestational age. The LMP-based gestational age was more variable, reflecting in part the difficulty of accurately determining the date of last menses. It also had many birth weight outliers for births with a gestational age of less than 28 weeks. In many of these cases the CE gestational age may have more accurately reflected the infant's true gestational age. The higher very preterm and preterm birth rates for the LMP gestational age are at least partially attributable to this apparent misclassification. The CE gestational age tended to show less variation for birth weight by gestational age. Yet this may be partially due to the method(s) used to estimate gestational age. If the infant's birth weight was used to help determine gestational age, then the variation of birth weight by gestational age would decrease.

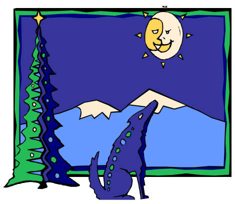
Native infants with a LMP-based gestation of 32 weeks or less showed an average CE gestational age that was from 1 to 3 weeks higher than the comparable group of non-Native infants. If Native infants on average weigh more than non-Native infants, this could partially explain the difference, especially if birth weight was used to help estimate gestation. It could also be that the reported date of last menses is more problematic for Native births. Based on an LMP gestational age of 32 weeks or less, Native infants weigh an average of 392.5 grams (95% CI = 294.9, 490.1) more than non-Native infants. This is more than 3/4 pound, a difference that seems unlikely. For the same group of infants, 51.3% (585/1141) had a CE gestational age that equaled the LMP age. For this subgroup, Native infants only weighed an average of 134.5 grams (95% CI = 39.3, 229.7) more than non-Native infants. These results suggest that birth weight may partially explain the higher CE values for Native infants, but reporting problems with the date of last menses may also play a part.

The mean difference (CE - LMP) in gestational age has lessened during the latter part of this report period. It was also observed that generally, hospitals with more births had a smaller mean difference in gestational age than hospitals with fewer births. Added to the disparities in gestational age noted by mother's race, it is clear these factors could influence the classification of births into risk groups, such as preterm birth. Although the LMP is the preferred measure, the CE gestational age will be used when the LMP is unknown or out of range. Using the CE gestational age in hospitals with fewer births and for Native infants would usually lower the preterm birth rate for these groups of infants.

Adopting the NCHS standards for estimating gestational age would have little effect on indices that use this measure. Applying the NCHS method on birth records from 1990 to 1998, only 0.37% (360/97241) of births would have had a gestational age different from what the Bureau currently reports. The percentage of births born preterm would be the same (9.4%), no matter whose method was used. However, using NCHS standards would eliminate some inconsistencies. For example, it was observed that the LMP-based measure had many birth weight outliers for infants with a gestational age of 22 to 27 weeks. The CE gestational age would have been assigned for most of these births under NCHS guidelines. Using the CE measure would also resolve some of the difference between Native and non-Native birth weight for this gestational age group. Based on the findings in this report, the Bureau has adopted NCHS guidelines for estimating gestational age.

The results from this analysis seem to suggest that using the CE gestational age for births with less than 32 weeks gestation may be the preferred measure for gestational age, at least from a statistical standpoint. Using the CE gestational age for these births would eliminate some apparent gestational age - birth weight inconsistencies. It would also lessen the disparity in birth weight by gestational age distribution between Native and non-Native infants. Unfortunately, the results from this report cannot tell which is the more accurate measure for representing the infant's gestational age. That type of decision would require information that is not available on the birth certificate, such as intrauterine length and head circumference. Nevertheless, the results do show that caution should be taken when using gestational age information from the birth certificate.

On The Lighter Side – The Baby in the Moon?



It is believed by some that a full moon can influence human behavior. For instance, some people think that pregnant women are more likely to go into labor and give birth during a full moon. To test this conjecture, births to Alaskan residents from 1994 to 1998 were investigated. Two hypotheses were tested. The first test compared the average number of births that occurred during a full moon to the average number of births on all other days. The second test looked at the average number of births that occurred during a full moon period to the average number of births on all other days. A full moon period was defined as the day of the full moon plus the day before and the day after.

Sixty full moons occurred from 1994 to 1998. An average of 27.7 (95% CI = 26.4, 29.0) births occurred on days with a full moon, compared with an average of 27.8 births (95% CI = 27.6, 28.1) on days without a full moon. We find that the average number of births that occur during a full moon is essentially the same as the average number of births on days without a full moon. During the same period, an average of 27.5 births (95% CI = 26.8, 28.3) occurred during a full moon period, compared with an average of 27.9 births (95% CI = 27.6, 28.1) that occurred outside a full moon period. Again, no difference between the two averages is observed.

Based on the above evidence, it is clear that a full moon has no effect on when a woman goes into labor and gives birth. However, this does not mean that some days (in particular, days with a full moon) will not have more births than expected. Indeed, 44 births occurred on one of the full moons during this period, which is much higher than the average 28 births per day. This is not unexpected, due to the normal day-to-day variation in the number of births. When this variance occurs during a full moon, more significance can be given to the coincidence. Few will remember the full moon when only 14 births occurred.