Secular Trends in Preterm Birth
A Hospital-Based Cohort Study

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Context.—Canada and the United States have reported a recent increase in the incidence of preterm birth, but the reasons for this increase are unknown.

Objective.—To assess secular trends in preterm birth and its potential determinants.

Design.—Hospital-based cohort study.


Participants.—A total of 65,574 nonreferred live births and stillbirths.

Main Outcome Measures.—Changes in occurrence of preterm birth, before and after adjustment for changes in method of gestational age assessment, obstetric intervention, registration of births weighing less than 500 g, and sociodemographic, behavioral, and clinical determinants.

Results.—A crude secular increase in preterm births was seen for births less than 37, 34, and 32 completed weeks, and increases reported in population-based national studies from the United States and Canada. This trend appears largely attributable to the increasing use of early ultrasound dating. The residual trend was eliminated after controlling for secular increases in unmarried status and the proportion of women aged 35 years or older. These factors, combined with a decrease in alcohol consumption and increases in histological chorioamnionitis and cocaine use, appear to have counteracted a reduction in preterm birth since the mid-1980s that otherwise would have been observed.

Conclusions.—This hospital’s increase in preterm births since 1978 parallels increases reported in population-based national studies from the United States and Canada. This trend appears largely attributable to the increasing use of early ultrasound dating, preterm induction and preterm cesarean delivery without labor, and changes in sociodemographic and behavioral factors.

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PRETERM BIRTH is arguably the most important maternal and child health problem in developed societies. It is the leading cause of infant mortality and is associated with major long-term neurocognitive, respiratory, and ophthalmologic morbidity. Moreover, provision of intensive care for extremely preterm newborns is expensive and giving birth to an infant requiring such care is traumatic for parents and families. Dramatic reductions in perinatal and infant mortality have occurred during the last several decades, virtually all of which are attributable to improved access to and quality of high-risk obstetric and neonatal care. The major consequence has been a reduction in mortality of preterm newborns, rather than prevention of preterm birth.

With the exception of France and Finland, no country (to our knowledge) has reported a reduction in incidence in preterm birth. In fact, the United States has experienced a small but steady increase since the early 1980s and recent Canadian data also suggest an increase. Does this disappointing secular trend reflect a total failure to prevent preterm delivery, or is it due to the countervailing effects of increased use of early ultrasound estimation of gestational age, early delivery for extreme fetal growth retardation or severe preeclampsia, multiple gestation (due to infertility treatment), registration of fetuses and newborns near the borderline of viability, or changes in sociodemographic or behavioral determinants of preterm birth? The answer to this question is important for both clinical practice and public health policy. In this article, we attempt to provide such an answer by analyzing the secular trend in preterm birth from 1978 to 1996 and the potential determinants of that trend, using a computerized hospital database.

METHODS

Our analysis is based on all 65,574 inborn infants (whether live-born or stillborn, but excluding antenatal referrals) delivered at the Royal Victoria Hospital, a tertiary care general and maternity hospital affiliated with McGill University, Montreal, Quebec. Data on these births are collected in the McGill Obstetric and Neonatal Database, which has been in its current version since 1978. The principal outcomes under study are delivery prior to 37, 34, or 32 completed weeks of gestation (259, 238, and 224 days, respectively). Gestational age was assessed in 3 ways: (1) time since the first day of the last normal menstrual period (LNMP), (2) early (usually 16-18 weeks) ultrasound estimate used in all other cases. Period effects were considered in 3 ways: (1) as a yearly (linear) trend, (2) 9 intervals of 2 years each, and (3) 3 intervals of 6 years each (1978-1983, 1984-1989, and 1990-1996). Data from 1996 were complete only through March 31 of that year; these data were therefore included with the 1994-1995 2-year interval and with the 1990-1995 6-year interval.

Independent variables considered as either potential determinants or confounders of the secular trend in preterm birth
included stillbirth vs live birth; singleton vs multiple gestation; preterm induction of labor; preterm cesarean delivery without labor; birth weight less than 500 g or 500 to 749 g; maternal age, parity, education, and marital status; cigarette smoking; any alcohol, cannabis, or cocaine use during pregnancy; prepregnancy hypertension; severe pregnancy-induced hypertension (PIH); and histological chorioamnionitis. Data on smoking, alcohol, cannabis, cocaine, education, and marital status were obtained by maternal self-report. No information was collected on the family income or racial-ethnic origin of the mother. Women were classified as “unmarried” if they were legally single, widowed, or divorced. Severe PIH was defined as the specific mention of “severe preeclampsia” on the discharge sheet completed by the attending obstetrician or on documented evidence of frank eclampsia. We restricted our analysis of PIH to severe cases to minimize the effects of misclassification and temporal variations in diagnosis of milder cases. Chorioamnionitis was considered present if the perinatal pathologist noted definite or severe leukocytic infiltration of the placental membranes or umbilical cord.

Statistical techniques included ordinary chi-square tests and chi-square tests for linear trend for bivariate analyses and multiple logistic regression. All statistical analyses were carried out using SAS-PC for Windows (SAS Institute Inc, Cary, NC). Because linear time trends are expressed on a per-year basis, which reflect small yearly changes during the study period, all odds ratios (ORs) are reported to 3 decimal places.

RESULTS

Figure 1 shows the secular trend in preterm birth by 2-year intervals using all 3 definitions of gestational age. Three levels (cutoffs) for gestational age are shown in Figure 1: all preterm births (<37 completed weeks), earlier preterm births (<34 completed weeks), and extremely preterm births (<32 completed weeks). Based on the algorithm-derived gestational age estimates, rates increased from 6.6% to 9.8% for births before 37 weeks, 1.7% to 2.3% before 34 weeks, and 1.0% to 1.2% before 32 weeks. After the first 2 intervals, the curves corresponding to the 3 gestational age definitions are reasonably parallel, with the highest rates using the early ultrasound estimate, the lowest rates using the LNMP definition, and intermediate rates for the algorithm. Complementing the rise in preterm birth rates was a marked reduction in postterm birth (≥42 completed weeks); algorithm-based rates of postterm birth decreased from 5.8% in 1978-1979 to 1.6% in 1994-1996.

Figure 2 shows the change in distribution of gestational age assessment information during the study period. The proportion of births missing both LNMP and ultrasound estimates decreased substantially, as did the proportion of births missing ultrasound estimates only. The proportion missing only LNMP estimates was low and remained low during the study period, whereas the proportions of births with concordant (within 7 days) and discordant (and hence ultrasound-derived) estimates both increased.

Table 1 shows the corresponding secular trends in other potential determinants. Unlike Canadian population-based
trends, no significant change was noted in the rate of multiple births. Significant increases were noted for both preterm induction and preterm cesarean delivery without labor. Although no significant increase in preterm inductions was seen for any indication prior to 32 weeks or at 32 to 33 weeks, significant increases were observed for inductions at 34 to 36 weeks, for both intrapartum growth retardation ($P = .02$ by $x^2$ test for linear trend) and prelabour rupture of membranes ($P < .001$). For preterm cesarean delivery without labor, significant increases were observed for breech presentation before 32 weeks ($P = .02$) and 32 to 33 weeks ($P = .04$) and for abruptio placenta or placenta previa before 32 weeks ($P = .002$), 32 to 33 weeks ($P = .02$), and 34 to 36 weeks ($P < .001$). Many of these cesarean deliveries, especially those for breech presentation, were likely to have additional (uncoded) indications, such as intrapartum growth retardation, preeclampsia, or fetal distress. Fetal heart rate monitoring was routinely used throughout the study period, and no significant secular trend was noted in preterm cesarean delivery without labor for a primary indication of fetal distress. The increases in preterm inductions and preterm cesarean delivery without labor were observed among women aged 20 to 34 years, as well as those 35 years or older. Maternal age of 35 years or older, unmarried status, cocaine use, and histological chorioamnionitis also increased significantly during the study period. Stillbirths, prepregnancy hypertension, severe PIH, cigarette smoking, alcohol use, and low maternal education ($= 12$ completed years), on the other hand, showed a significant decrease. The secular trend in maternal education parallels the population-based trend observed for the province of Quebec as a whole (Margaret Cyr, Statistics Canada, written communication, July 7, 1998).

Because the patterns shown in Figure 1 were virtually identical when restricted to live births, all subsequent analyses are based on total births (stillbirths plus live births). Figure 3 shows the algorithm-based rates of delivery before 37, 34, and 32 weeks after elimination of births of newborns weighing less than 500 g and those with induction or preterm cesarean delivery without labor before each of those corresponding gestational age cutoffs. Because of the extremely low rates of births of newborns weighing less than 500 g, these eliminations primarily reflect the contributions of preterm inductions and preterm cesarean deliveries without labor. Compared with Figure 1, the increase

![Figure 2.—Secular trends in gestational age assessment information. LNMP indicates last normal menstrual period; US, ultrasound.](image-url)

### Table 1.—Secular Trends in Potential Determinants of Preterm Births, 1978-1996

<table>
<thead>
<tr>
<th>Determinant</th>
<th>Percentage of All Births</th>
<th>$P$ Value*</th>
<th>Total Births</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stillbirths</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1978-1979</td>
<td>0.54</td>
<td>0.56</td>
<td>0.59</td>
</tr>
<tr>
<td>1980-1981</td>
<td>0.49</td>
<td>0.49</td>
<td>0.40</td>
</tr>
<tr>
<td>1982-1983</td>
<td>0.42</td>
<td>0.36</td>
<td>0.29</td>
</tr>
<tr>
<td>1984-1985</td>
<td>0.42</td>
<td>0.36</td>
<td>0.29</td>
</tr>
<tr>
<td>1986-1987</td>
<td>0.41</td>
<td>0.35</td>
<td>0.29</td>
</tr>
<tr>
<td>1988-1989</td>
<td>0.41</td>
<td>0.36</td>
<td>0.29</td>
</tr>
<tr>
<td>1990-1991</td>
<td>0.41</td>
<td>0.35</td>
<td>0.29</td>
</tr>
<tr>
<td>1992-1993</td>
<td>0.41</td>
<td>0.35</td>
<td>0.29</td>
</tr>
<tr>
<td>1994-1996</td>
<td>0.41</td>
<td>0.35</td>
<td>0.29</td>
</tr>
<tr>
<td>Birth weight &lt;500 g</td>
<td>0.00</td>
<td>0.02</td>
<td>0.00</td>
</tr>
<tr>
<td>Birth weight 500-750 g</td>
<td>0.3</td>
<td>0.2</td>
<td>0.3</td>
</tr>
<tr>
<td>Preterm induction</td>
<td>1.0</td>
<td>1.0</td>
<td>0.8</td>
</tr>
<tr>
<td>Preterm cesarean delivery without labor</td>
<td>0.6</td>
<td>1.0</td>
<td>0.3</td>
</tr>
<tr>
<td>Maternal age, y</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;20</td>
<td>4.7</td>
<td>3.9</td>
<td>2.3</td>
</tr>
<tr>
<td>20-34</td>
<td>87.5</td>
<td>87.2</td>
<td>87.2</td>
</tr>
<tr>
<td>&gt;35</td>
<td>7.8</td>
<td>8.9</td>
<td>10.5</td>
</tr>
<tr>
<td>Primiparity</td>
<td>47.5</td>
<td>46.5</td>
<td>47.4</td>
</tr>
<tr>
<td>Maternal education ≤12 y</td>
<td>54.3</td>
<td>50.1</td>
<td>44.9</td>
</tr>
<tr>
<td>Unmarried status</td>
<td>4.8</td>
<td>8.5</td>
<td>11.0</td>
</tr>
<tr>
<td>Multiple birth</td>
<td>2.3</td>
<td>2.3</td>
<td>2.0</td>
</tr>
<tr>
<td>Prepregnancy hypertension</td>
<td>0.49</td>
<td>0.50</td>
<td>0.26</td>
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<tr>
<td>Severe pregnancy-induced hypertension</td>
<td>0.60</td>
<td>1.59</td>
<td>0.90</td>
</tr>
<tr>
<td>Smoking, cigarettes per day</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>78.4</td>
<td>77.6</td>
<td>79.4</td>
</tr>
<tr>
<td>1-10</td>
<td>8.6</td>
<td>9.5</td>
<td>8.6</td>
</tr>
<tr>
<td>&gt;10</td>
<td>13.0</td>
<td>12.9</td>
<td>12.1</td>
</tr>
<tr>
<td>Alcohol use</td>
<td>29.3</td>
<td>34.1</td>
<td>32.2</td>
</tr>
<tr>
<td>Cannabis use</td>
<td>0.2</td>
<td>0.3</td>
<td>0.5</td>
</tr>
<tr>
<td>Cocaine use</td>
<td>2.5</td>
<td>3.5</td>
<td>1.6</td>
</tr>
</tbody>
</table>

* $P$ values are based on $x^2$ test for linear trend.
† These $P$ values are based on the overall linear trend for the 3 categories of age and cigarette smoking.
‡ Large proportions of values are missing for these years.
for births before 37 weeks, though still evident, is considerably attenuated and less regular. No increase is evident for births before 34 or 32 weeks. Data (not shown) based on the ultrasound or LNMP definitions of gestational age show an identical pattern for all 3 preterm cutoffs. These results suggest that the crude trends shown in Figure 1 are largely attributable to an increasing tendency toward preterm inductions and preterm cesarean deliveries without labor. The crude yearly OR (and 95% confidence interval) for the increase in algorithm-based births before 37 weeks before eliminating preterm inductions, preterm cesarean deliveries without labor, and births of newborns weighing less than 500 g was 1.023 (1.017-1.029), indicating an average increase of 2.3% per year in the rate of preterm birth. When the overall study period was divided into three 6-year intervals (1978-1983, 1984-1989, and 1990-1996), the crude ORs for the latter 2 intervals (relative to the first interval) were 1.211 (1.125-1.303) and 1.336 (1.245-1.434), respectively, ie, a significant increase in both the second and third intervals. After eliminating preterm inductions, preterm cesarean deliveries without labor, and births weighing less than 500 g, the yearly OR decreased to 1.015 (1.008-1.021), while the interval ORs decreased to 1.153 (1.061-1.253) for 1984-1989 and 1.165 (1.074-1.264) for 1990-1996, indicating that the eliminated factors were responsible for about one third of the crude overall increase before 37 weeks and most of the increase since 1990. When gestational age assessment method (ultrasound-based vs LNMP-based) was added to these logistic models, the association between an ultrasound-based method and preterm birth was substantial (OR, 1.645 [1.535-1.763] in the yearly model), and the yearly OR decreased to 1.009 (1.003-1.016), while the interval ORs decreased to 1.084 (0.997-1.179) for 1984-1989 and 1.092 (1.006-1.186) for 1990-1996. These results indicate that the secular trend toward ultrasound-based estimates of gestational age accounted for nearly half of the (apparent) residual increase in births before 37 weeks during the study period.

As shown in the top part of Table 2, when maternal age, parity, unmarried status, multiple births, smoking, prepregnancy hypertension, and severe PIH were added to the logistic regression model, the secular increase in algorithm-derived births before 37 weeks was markedly reduced and statistically nonsignificant (OR, 1.057 [0.996-1.157] for 1984-1989 and OR, 1.004 [0.918-1.098] for 1990-1996). Including maternal education in the model resulted in virtually identical effects for the secular trend and the other covariates but reduced the sample size because of missing values for maternal education. A similar reduction was noted in the average yearly trend (OR, 1.003 [0.996-1.010]). As shown in the bottom of Table 2, most of the additional reduction was due to unmarried status and maternal age. These results suggest that the secular increases in unmarried status and older maternal age over the study period were responsible for most of the residual (ie, after controlling for ultrasound-based gestational age estimates) increase in births before 37 weeks. Multiple birth was strongly associated with preterm birth (adjusted OR, 13.413 [11.824-15.215]) but had little effect on the yearly or interval changes because multiple birth rates did not increase significantly during the study period (Table 1).
Because the majority of study subjects had missing values for cocaine and alcohol use from 1978-1981, and for histological chorioamnionitis for 1978-1983, analyses for the effects of these potential determinants were restricted to the years 1984-1996. After eliminating preterm inductions, preterm cesarean deliveries without labor, and births weighing less than 500 g, no significant interval (OR, 1.010 [0.935-1.091] for 1990-1996 vs 1984-1989) or yearly (OR, 1.006 [0.995-1.017] for yearly trend) was observed during these study years. These trend effects remained essentially unchanged after controlling for gestational age assessment method (OR, 1.008 [0.953-1.068] for 1990-1996 vs 1984-1989 and OR, 1.065 [0.995-1.017] for yearly trend). After controlling for maternal age, parity, unmarried status, multiple birth, cigarette smoking, alcohol and cocaine use, prepregnancy hypertension, severe PIH, and histological chorioamnionitis, however, the secular trend was actually reversed (top of Table 3). The corresponding yearly trend was also reversed (OR, 0.986 [0.973-0.999]). As shown in the bottom of Table 3, sequential logistic regression models indicated that a decrease in alcohol consumption and increase in chorioamnionitis were responsible for about half this reversal for both the yearly and interval effects; increases in unmarried status and cocaine use also accounted for a sizeable portion.

Inclusion of low maternal education in these models resulted in nearly identical point estimates but somewhat wider confidence intervals (data not shown), because of the large number of missing values for maternal education. These results suggest that the secular decrease in alcohol use and the secular increase in histological chorioamnionitis, unmarried status, and cocaine use since 1984 may have actually prevented a reduction in preterm birth, ie, a reduction would have been observed if those changes had not occurred.

**COMMENT**

The results of this large, hospital-based cohort study confirm recent Canadian population-based data indicating an increase in preterm birth during the last 2 decades.12,13 The availability of separate gestational age estimates based on early ultrasound, LNMP, and an algorithmic combination of the 2 permit a quantitative estimate of the extent to which the increasing use of early ultrasound dating explains the observed trend, at least at the study hospital. Our results indicate that the overall secular increase is partly an artifact of changing methods of gestational age estimation. Nonetheless, our results also demonstrate that early ultrasound dating cannot explain all of the observed increase during the study period.

We deliberately excluded antenatal referrals so as not to bias our results by secular changes in referral patterns. Nonetheless, we were surprised to observe that in contrast to recently reported national trends from Canada,17 the United States,18 and Denmark,19 the study hospital saw no increase in the rate of multiple births during the study period (approximately 2.3% of births or 1 in 87 pregnancies). As in Canada overall,17 the study hospital had a slight increase in births weighing less than 500 g, which were recorded in the database only for newborns admitted to the hospital’s neonatal intensive care unit. Such admissions have increased somewhat in recent years, probably because physicians are aware that newborns weighing less than 500 g are more likely to survive than in the past. Nonetheless, this increase had a very small impact on the overall secular trend in preterm birth.

A major factor contributing to the secular increase in preterm birth at this hospital was the increasing use of preterm induction and preterm cesarean delivery without labor, which appear to account for all of the secular increase in births before 34 and 32 weeks and a major portion of the trend before 37 weeks. The fact that this trend was accompanied by a decline in the hospital’s stillbirth rate and in-hospital neonatal death rate suggests that the increased obstetric intervention may well be justified. Earlier obstetric intervention for pregnancies complicated by severe pre-eclampsia, fetal growth retardation, prolonged prelabor rupture of membranes, and other indications has been well documented in several settings. In the study by Goldenberg et al,18 the secular increases in these interventions accounted for only a small fraction of the observed increase in preterm delivery. In the study by Bréart et al,4 increasing trends toward preterm inductions and preterm cesarean deliveries in France were observed despite a secular trend of decreasing preterm birth rates in France. The latter pattern suggests that recent trends toward early obstetric intervention in pathologic pregnancies may have resulted primarily in a shift toward earlier preterm delivery of infants who would otherwise have been born before 37 weeks.

After eliminating preterm inductions and preterm cesarean deliveries without labor, we observed a persistent, albeit at-

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**Table 3.—Multiple Logistic Regression Analysis for Secular Trend in Preterm Birth, 1984-1996**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Adjusted OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interval. 1990-1996 (vs 1984-1989)</td>
<td>0.883 (0.807-0.965)</td>
</tr>
<tr>
<td>Ultrasound-based gestational age assessment</td>
<td>1.790 (1.638-1.957)</td>
</tr>
<tr>
<td>Maternal age, y</td>
<td></td>
</tr>
<tr>
<td>&lt;20</td>
<td>0.989 (0.702-1.395)</td>
</tr>
<tr>
<td>≥35</td>
<td>1.324 (1.186-1.479)</td>
</tr>
<tr>
<td>Primiparity</td>
<td>1.038 (0.949-1.135)</td>
</tr>
<tr>
<td>Unmarried status</td>
<td>1.510 (1.355-1.683)</td>
</tr>
<tr>
<td>Multiple birth</td>
<td>14.782 (12.517-17.458)</td>
</tr>
<tr>
<td>Smoking, cigarettes per day</td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>1.000 (Reference)</td>
</tr>
<tr>
<td>1-10</td>
<td>0.982 (0.834-1.156)</td>
</tr>
<tr>
<td>&gt;10</td>
<td>1.174 (1.029-1.350)</td>
</tr>
<tr>
<td>Alcohol use</td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>1.000 (Reference)</td>
</tr>
<tr>
<td>0.01-0.15</td>
<td>0.802 (0.716-0.899)</td>
</tr>
<tr>
<td>≥1.06</td>
<td>2.526 (1.497-4.262)</td>
</tr>
<tr>
<td>Cocaine use</td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>1.000 (Reference)</td>
</tr>
<tr>
<td>0.01-0.15</td>
<td>1.260 (0.874-1.826)</td>
</tr>
<tr>
<td>≥1.06</td>
<td>2.526 (1.497-4.262)</td>
</tr>
<tr>
<td>Prepregnancy hypertension</td>
<td>2.163 (1.084-4.318)</td>
</tr>
<tr>
<td>Severe PIH</td>
<td>2.397 (1.383-4.154)</td>
</tr>
<tr>
<td>Histological chorioamnionitis</td>
<td>4.402 (3.762-5.150)</td>
</tr>
</tbody>
</table>

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**Table 3.—Multiple Logistic Regression Analysis for Secular Trend in Preterm Birth, 1984-1996**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Per Year</th>
<th>1990-1996 Interval vs 1984-1989</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude OR (95% CI)</td>
<td>1.006 (0.995-1.016)</td>
<td>1.010 (0.935-1.091)</td>
</tr>
<tr>
<td>Adjusted OR</td>
<td>1.006 (0.995-1.017)</td>
<td>1.008 (0.933-1.086)</td>
</tr>
<tr>
<td>Plus pregnancy hypertension, severe PIH, and smoking</td>
<td>1.002 (0.990-1.013)</td>
<td>0.975 (0.900-1.057)</td>
</tr>
<tr>
<td>Plus multiple births</td>
<td>1.001 (0.989-1.013)</td>
<td>0.973 (0.896-1.057)</td>
</tr>
<tr>
<td>Plus maternal age</td>
<td>1.000 (0.988-1.012)</td>
<td>0.970 (0.893-1.053)</td>
</tr>
<tr>
<td>Plus primiparity</td>
<td>1.000 (0.988-1.012)</td>
<td>0.969 (0.892-1.052)</td>
</tr>
<tr>
<td>Plus unmarried status</td>
<td>0.997 (0.985-1.009)</td>
<td>0.951 (0.876-1.033)</td>
</tr>
<tr>
<td>Plus alcohol use</td>
<td>0.991 (0.979-1.004)</td>
<td>0.913 (0.838-0.993)</td>
</tr>
<tr>
<td>Plus cocaine use</td>
<td>0.990 (0.978-1.002)</td>
<td>0.905 (0.831-0.986)</td>
</tr>
<tr>
<td>Plus histological chorioamnionitis</td>
<td>0.986 (0.973-0.999)</td>
<td>0.883 (0.807-0.965)</td>
</tr>
</tbody>
</table>

*After eliminating preterm inductions, preterm cesarean deliveries without labor, and births weighing less than 500 g. OR indicates odds ratio; CI, confidence interval; and PIH, pregnancy-induced hypertension.
tematuated, secular increase in births be-
fore 37 weeks. Nearly half this residual in-
crease can be attributed to the increasing
use of early ultrasound dating of ges-
tational age. This is consistent with pre-
vious reports18,19 indicating that early ultra-
sound dating shifts the overall gestational
age distribution to the left and systemati-
cally increases the proportion of births clas-
sified as preterm. This shift probably re-
flects a correction for delayed ovulation
(and hence delayed conception) and missed
spontaneous abortion (with ultrasound-
based gestational age reflecting the sec-
ond, ie, nonaborted conception), rather than
systematic underestimates in wom-
en’s recollection of the date of their LNMP.
It could, however, reflect an error in the
ultrasound-based gestational error esti-
mates, since even a small systematic bias
in the formula (based on the biparietal
diameter) could lead to a substantial in-
crease in apparent preterm birth rates.

Even after accounting for the artifac-
tual increase in births before 37 weeks due
to early ultrasound dating, a significant
secular increase remained. Much of the re-
sidual increase appears attributable to a
secular increase in the proportions of de-
liveries to unmarried women and women
aged 35 years or older, because these pro-
portions were substantial and increased 4-
fold and 2.5-fold, respectively, during the
study period. In addition, since 1984, the
decreased use of (any) alcohol and in-
creases in the prevalence of histological
chorioamnionitis (which presumably re-
fects colonization and/or infection of the
upper genital tract during pregnancy) and
in cocaine use may have prevented a secu-
lar decrease in rate of preterm delivery
that would have otherwise been aparent.
Thus, overall, our results suggest that
observed crude increases in delivery be-
fore 32 and 34 completed weeks are largely
attributable to changes in obstetric prac-
tice, while sociodemographic and behav-
ioral changes may have been responsible
for a substantial part of the remaining true
(i.e., not due to gestational age assessment
method) increase and for a failure to ob-
serve a decrease in deliveries between 34
and 36 weeks of gestation.

Caution is advised in interpreting our
findings concerning several of the poten-
tial determinants we investigated. Al-
though women delivering at the study
hospital did not have routine vaginal
or cervical cultures, and although the results
of those who did have such cultures are not
contained in the computerized data-
base, genital tract colonization does not
necessarily denote infection. We were for-
tunate to have pathological examination
of placenta (as of 1984), which provides
histological evidence about the presence
of chorioamnionitis, although placental in-
flammation can have causes other than
genital tract infection. Assortment of cigarettte smoking and use of alcohol, can-
navis, and cocaine during pregnancy were
all based on the mother’s self report. In the
absence of biological markers of these ex-
posures, it is probably safe to assume that
all were underreported. We have no rea-
son to suspect different degrees of under-
reporting over time among mothers who
delivered preterm vs at term, however, and
such nondifferential underreporting
should therefore reduce the effects of secu-
lar trends in these exposures on the cor-
responding trends in preterm birth.

Study mothers who consumed alcohol
during pregnancy were at reduced risk for
preterm birth. High alcohol consumption
(>2 drinks per day) is known to be asso-
ciated with deficits in fetal growth but is
not a recognized determinant of preterm
birth.20 As previously reported from this
study hospital, only about 0.3% of our study
mothers report drinking even 1 or more
drinks per day.21 Thus the high rates of any
alcohol consumption observed in this study
essentially reflect occasional alcohol use
(<1 drink per day). Despite the known to-
colytic effect of alcohol, our results do not
necessarily indicate that this low level of
consumption has a true, biological protec-
tive effect. We speculate that it may be a
marker for low stress, high self-confi-
dence, or other unmeasured behavioral
traits that might reduce the risk of pre-
term birth, but the possibility of a true pro-
tective effect merits further study.

Our results require confirmation in
other settings, both because of the numer-
sous etiologic hypotheses we tested (ie,
multiple comparisons) and because of the
hospital-based provenance of the study.
In particular, population-based studies
have indicated a substantial secular in-
crease in multiple births21,22,23 (caused
largely by treatment for infertility). Mul-
tiple births may therefore play a larger role
in the observed secular increase in pre-
term birth observed in large population-
based studies. Apart from this difference
relating to multiple births, the findings
from this hospital are consistent with those
from our recent population-based study of
Canadian births from 1981 to 1994,24 even
though obstetric intervention and ultra-
sound dating in the latter study were based
on proxy ecological variables rather than
individual-level measurement. Unfortu-
nately, large population-based studies
rarely contain detailed, individual-level in-
formation on the source of gestational age
estimates (eg, the use of early ultrasound
dating), obstetric interventions, sub-
stance abuse, and markers for genital tract
infection, and are based on mother’s self data on
maternal smoking. Thus, further study using
large, computerized clinical databases from
other settings would be useful in confirm-
ning our findings. Regardless of the re-
results of future studies, however, the avail-
able evidence to date is clear in showing
no observable secular reduction in pre-
term birth. Part of our in-
crease appears to be an artifact of the in-
creasing use of early ultrasound-based
estimates of gestational age, and part can
be explained by clinically justified changes
in obstetric intervention. Nonetheless, the
failure to reduce (true) preterm delivery
among those births without such inter-
vention underlines the need for new etio-
logic hypotheses and further basic and epi-
demiologic research in advancing our
understanding about the causes and pre-
vention of preterm birth.

Dr Kramer is a Distinguished Scientist of the
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Maternal nutrition and spontaneous preterm birth.
Diagnosing Myocardial Infarction: Should Patients Carry a Copy of Their ECG?

To the Editor: While the article by Dr Panju and colleagues1 on diagnosing myocardial infarction (MI) was excellent, patients with cardiac conditions should be reminded to carry a copy of their electrocardiogram (ECG). In our splintered current health care system, this step would save much time and effort and permit appropriate therapy to be instituted more quickly.

Neil L. Kao, MD
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In Reply: We thank Dr Kao for his thoughtful comments and agree that the ECG, and specifically the presence of new ST-segment elevation and new Q waves, plays an important role in aiding the diagnosis of MI. In particular in our review we found that the presence of a new ST-segment elevation was associated with likelihood ratios of 5.7 to 53.9, while the presence of any ST-segment elevation (which by definition includes ST-segment elevation that may have been present on a prior ECG) was associated with a likelihood ratio of only 11.2. Similarly, new Q waves, as opposed to any Q waves, also were associated with higher likelihood ratios and therefore more likely to occur in patients with, as opposed to those without, MI.

The clinical impact of a prior ECG on the triage of patients with acute chest pain also was studied by Lee et al.1 In this prospective study of 5673 patients who presented to the emergency department with acute chest pain, the availability of a prior ECG did not change the sensitivity of admission to the hospital or critical care unit in patients with MI. However, patients who did have MI but had prior ECGs available were less likely to be admitted to the critical care unit than were patients without MI who did not have prior ECGs. This increased diagnostic specificity was most marked in patients with current ECG changes consistent with ischemia or infarction, suggesting that prior ECG tracings may help avoid unnecessary admissions. Prior ECGs often are not available in the emergency department setting and Kao’s suggestion that patients assume the responsibility of carrying a copy of their ECG may be one approach to overcoming this obstacle.

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CORRECTION

Incorrect Figure: In the Original Contribution entitled “Secular Trends in Preterm Birth: A Hospital-Based Cohort Study,” published in the December 2, 1998, issue of The Journal, (1998;280:1849-1854), the interval 1992-1993 of Figure 2 on page 1851 was presented incorrectly. The correct figure appears below.

Secular trends in gestational age assessment information. LNMP indicates last normal menstrual period; US, ultrasound.