Demographic, clinical and microbiological characteristics of maternity patients: A Canadian clinical cohort study

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OBJECTIVE: To determine the demographic, clinical and microbiological characteristics of a representative Canadian obstetrical population.

DESIGN: A one-year cohort study of all maternity patients who were followed to delivery, using detailed patient questionnaires containing more than 60 demographic and clinical variables, and three microbiological evaluations during gestation – first trimester, 26 to 30 weeks, and labour and delivery. Outcome measurements included birth weight and gestational age.

SETTING: Labour and delivery suites of all office obstetrical practices affiliated with a single hospital.

POPULATION STUDIED: A consecutive sample of pregnant women in the study practices during one year were eligible for enrolment; 2237 consecutive patients were approached for consent, 2047 enrolled and 1811 completed the study through delivery.

RESULTS: The average patient was white, married and 29 years of age. Slightly more than half of the patients had postsecondary education, but 10% fell below the national poverty line for income. Frequency of factors linked to adverse pregnancy outcomes included cigarette smoking (19%), alcohol ingestion (18%), previously having had a premature infant (7%), and maternal diabetes (2%). Overall prevalence of genital microbes variously implicated in prematurity was 37% for ureaplasma, 11% for group B streptococcus and 4% for Mycoplasma hominis. Prevalence of bacterial vaginosis was 14%. The median gestational age for the cohort was 39 weeks, with 7% of infants born less than 37 weeks' gestation. Mean birth weight was 3415 g.

CONCLUSIONS: The present clinical cohort represents demographic and medical characteristics of the Canadian obstetrical population. The birth outcomes are consistent with national data. This database provides valuable information about a general obstetrical population that is managed by a universal health care system.

Key Words: Genital tract infections; Prematurity; Risk factors

Résumé à la page suivante
Caractéristiques démographiques, cliniques et microbiologiques des patientes de maternité: Étude clinique sur une cohorte canadienne

**OBJECTIF**: Déterminer les caractéristiques démographiques, cliniques et microbiologiques d'une population obstétricale canadienne représentative.

**MODÈLE**: Étude de cohorte d'une durée d'un an portant sur toutes les patientes de maternité qui ont été suivies jusqu'à l'accouchement à l'aide de questionnaires détaillés incluant plus de 60 variables démographiques et cliniques et trois évaluations microbiologiques, durant la gestation: premier trimestre, 26 à 30 semaines, puis travail et accouchement. Les mesures concernant l'issue de la grossesse incluaient le poids à la naissance et l'âge gestationnel.

**CONTEXTE**: Salles de travail et salles d'accouchement de toutes les pratiques obstétricales affiliées à un seul hôpital.

**POPULATION ÉTUDIÉE**: Un échantillon de femmes enceintes consécutives suivies par les cabinets d'obstétrique participant à l'étude au cours d'un an a été jugé admissible pour inscription. Deux mille deux cent trente-sept patientes consécutives ont été abordées pour donner leur consentement; 2 047 se sont inscrites et 1 811 le sont restées jusqu'au moment de l'accouchement.

**RÉSULTATS**: En général, les patientes étaient de race blanche, mariées et âgées de 29 ans. Un peu plus de la moitié des patientes détenaient un diplôme post-secondaire, mais 10 % se trouvaient sous le seuil de pauvreté national sur le plan du revenu. La fréquence des facteurs reliés à des complications de la grossesse incluait le tabagisme (19 %), l'alcoolisme (18 %), des antécédents d'accouchement prématuré (7 %) et le diabète de grossesse (2 %). La prévalence globale des agents pathogènes génitaux impliqués dans la prématuration a été de 37 % pour l'uréaplasme, de 14 % pour la vaginose bactérienne, de 11 % pour le streptocoque du groupe B et de 4 % pour Mycoplasma hominis. L'âge gestationnel médian pour la cohorte a été de 39 semaines, 7 % des nourrissons étant nés après moins de 37 semaines de gestation. Le poids moyen à la naissance était de 3 415 grammes.

**CONCLUSION**: La cohorte clinique actuelle représente les caractéristiques démographiques et médicales de la population obstétricale canadienne. L'issue sur le plan des naissances concorde avec les données nationales. Cette base de données procure des renseignements utiles sur la population obstétricale générale prise en charge par le système de santé universel.

**DATA AND METHODS**

**Facilities**

The present study was conducted at three private obstetrical offices, one hospital-based office, and the University of Alberta Hospital (UAH), Edmonton, Alberta. The four offices comprised 10 obstetricians who each enrolled between 108 and 382 patients (one primarily administratetive physician enrolled two patients). All patients who were due for delivery over a 12-month consecutive period between 1994 and 1995 were asked to participate. All microbiological testing was performed on site; Gram stains and bacterial cultures were performed at the UAH laboratories; and serology, chlamydial and mycoplasma cultures were performed at the Provincial Laboratory of Public Health for Northern Alberta. Both laboratories are housed within the UAH complex.

**Enrolment and data collection**

The study was approved by the ethics committee, Faculty of Medicine, University of Alberta. All prenatal patients who were seen for a first visit before 20 weeks' gestation at each one of the four obstetrical offices associated with UAH were asked to provide informed consent and to enrol in the study. The obstetrical risk questionnaire was developed, tested and finalized. A pilot project using the questionnaire was conducted to elicit feedback from patients, staff and methodologists before the study onset. Patients were introduced to the study by the research nurse, who explained the questionnaire in the physician's office before the patient was seen by the obstetrician. The same research nurse enrolled in excess of 90% of all study patients, while the remainder were enrolled by one other nurse.

Sealed boxes were left in each obstetrician's office to allow patients to deposit their completed questionnaires. Each envelope accompanying the questionnaire was numbered, and a master list containing the number and name of the patient was checked. If the questionnaire was not received, a maximum of three follow-up telephone calls were made to remind the patient to bring it to the office. If the original questionnaire was misplaced by the patient, another was mailed to her for completion and she was asked to deposit it in the box at the next prenatal office visit.
The study nurse then contacted and interviewed each patient with regard to obstetrical risk factors. Demographic and obstetrical variables associated with PB from previous studies included maternal age, race, parity, marital status, welfare status, cigarette smoking, alcohol and other drug consumption, previous preterm delivery, urinary and genital tract infections, and nutritional status. Clinical variables such as underlying medical conditions, medications, reproductive history and obstetrical data were collected. Questionnaires took from 10 to 40 min to complete. Additional information was taken from the obstetrical charts and completed by the study nurse. More than 60 variables, many of which had numerous categories, were documented in the database. Standardization of the questionnaire was ascertained by mailing 50 repeat questionnaires to enrolled patients to compare responses to those given at their first visit.

All data were entered into an SPSS (SPSS Inc, USA) file and verified with sample checks that were conducted to ensure a minimization of coding and validity errors. Descriptive statistics were calculated for each variable at each time period with appropriate adjustments made for incomplete cases.

Microbiology

Each patient enrolled in the study had three speculum examinations, and microbiological investigations were performed on the specimens that were collected. The first examination occurred at the initial visit to the obstetrician’s office during the first trimester. At that time, urine culture and serology for syphilis, hepatitis B and rubella were performed. Genital cultures for Neisseria gonorrhoeae, Chlamydia trachomatis, group B streptococcus, Mycoplasma hominis and Ureaplasma urealyticum, and Gram stains for bacterial vaginosis, trichomonas-like organisms and yeast were performed. The second examination took place in the obstetrician’s office between 26 and 30 weeks’ gestation. At this visit, cultures were done for C trachomatis, group B streptococcus, M hominis and U urealyticum, and a Gram stain was performed for the purposes noted above. The third examination took place in the hospital at the time of labour and delivery; the specimens that were collected and the microbiology that was performed were the same as those of the second examination. All specimens were delivered to the laboratory within 2 h of collection. Bacterial cultures were plated when received, chlamydia cultures were set up within 8 h of receipt and mycoplasma cultures were set up within 24 h of receipt.

For gonococcal cultures, endocervical swabs were placed in charcoal transport medium and inoculated onto modified Thayer-Martin split plates and incubated in carbon dioxide at 35°C. Isolates were identified by standard methods, including Gram smear, oxidase reactivity, direct fluorescent antigen identification (SYVA reagent [Syva Diagnostics, USA]) and the presence of beta lactamase. Equivocal or fluorescent antigen-negative isolates were then selected on cysteine trypticase agar (glucose, maltose, sucrose), ortho-

Characteristics of Canadian maternity patients

Principal occupations were skilled (31%), professional

nitrophenol-beta-galactopyranoside and catalase. Cervico-vaginal swabs for isolation of group B streptococcus were placed in charcoal transport medium and inoculated onto 5% blood agar plates for identification by standard methods, including Gram smear and grouping (PathoDx Streptococcus grouping kit, Diagnostic Products Corporation, USA). Endocervical specimens were collected using a rayon fibre swab for C trachomatis, M hominis and U urealyticum, and were placed into sucrose-phosphate-glutamate transport medium. C trachomatis cultures were set up within 8 h of receipt by the laboratory. Samples were inoculated onto cycloheximide-treated McCoy cell monolayers in shell vials and incubated in carbon dioxide at 37°C. After 48 h, the monolayers were stained with fluorescein-conjugated antichlamydial monoclonal antibody (Kallestad Laboratories Inc, USA), and inclusions were identified by fluorescent microscopy.

For the isolation of M hominis and U urealyticum, the specimens were inoculated onto both genital mycoplasma agar plates and bromothymol blue broth. The plates were incubated for 48 h (in 5% carbon dioxide for agar) at 37°C and the broths at 37°C in air for the same period. The bromothymol blue broth comprised pleuropneumonia-like organisms broth yeast extract, bromothymol blue solution 0.4%, donor horse serum, urea solution 10% and tripeptide, and was supplemented with penicillin and nystatin. The agar plates contained the same ingredients in addition to agar. U urealyticum colonies were identified with urease spot test reagent. M hominis was identified by colonial morphology and substrate utilization, the latter by subculturing bromothymol blue broth into glucose/arginine subcultures (M hominis hydrolyzes arginine [colour changes in arginine broth], but does not ferment glucose).

A vaginal swab for Gram stain was smeared on a glass slide and immediately air dried unfixed. The slide was stained and assessed for trichomonas-like organisms, clue cells, yeast-like organisms and Nugent’s (22) criteria for bacterial vaginosis.

RESULTS

A total of 2237 consecutive patients were asked by the research nurse to participate in the study and were provided questionnaires. Questionnaires were not returned by 188 patients at the enrolment stage, and two women consented to be in the study but did not hand in the questionnaire, which left 2047 (91.5%) women with some questionnaire information. Fifty-four women moved away from the area during their pregnancies, and nine either refused to continue in the study or could not be contacted following enrolment. For some variables, missing data were not included in the denominator, and totals in the tables may vary according to the level of information that was available.

Demographic characteristics of the 2047 women who completed the questionnaire are shown in Table 1. Age was 29.1 years (±5.1), and the majority of women were married (81%), white (78%) and had attended college (52%). Principal occupations were skilled (31%), professional
(29%) and homemaker (19%). Forty-two per cent reported more than $50,000 household income/year and 10% fell below the national poverty line.

No single medical condition was noted in more than 4% of the study group (Table 2). High blood pressure and high cholesterol were described by 3.6% of participants. There were 46 patients with diabetes, of whom 54% were taking insulin. Nearly 2% of all subjects were taking antibiotics.

Table 3 shows cigarette and drug consumption, including alcohol, during the current pregnancy – 14% smoked cigarettes daily and nearly 5% smoked occasionally. Since becoming aware that they were pregnant, 18% of women had ingested alcohol. Although 18% of the women in the study reported having used street drugs at one point, fewer than 1% still used these drugs.

Nutrition and exercise information is shown in Table 4. Meal consumption patterns revealed that supper was the most likely meal of the day (98%), and breakfast was the least likely (83%). Daily exercise before the current preg-
The reproductive information in Table 5 indicates that the current pregnancy was the first pregnancy for 31% of the patients. Of those who had been pregnant previously, the number of pregnancies ranged from one (47%) to five or more (5%). The patient's age at first pregnancy was reported to be older than 20 years by 80% of respondents, and between 15 and 19 years by 20% of respondents. The mean age at first intercourse was 18 years. The number of lifetime sexual partners ranged from one (37%) to more than 20 (3%). Fewer than 2% of patients reported having more than one sexual partner during the current pregnancy. The majority (87%) had used birth control within the six months before the current pregnancy, with oral contraceptives (48%) and condoms (53%) being the most commonly reported methods. Most women were able to conceive the current pregnancy in fewer than six months (74%) or between six and 12 months (11%). One-hundred-forty-three women (7%) underwent investigations for infertility, and 114 (5.6%) took fertility drugs to conceive the present pregnancy.
Table 6 shows the obstetrical histories of patients who were enrolled in the study. Approximately 12% reported having previously had a premature baby, and 22% reported having a close female relative who had a premature infant. There was a history of twins or triplets in nearly 2% of the patients. Previous pregnancies had been complicated by vaginal bleeding in 36% of patients and caesarean sections were performed in 15%. An incompetent cervix or suture in the cervix during an earlier pregnancy was reported by 2.5% of patients.

Obstetrical data from the current pregnancy are presented in Table 7. At the time of the questionnaire, 38% of women had undergone an ultrasound. Vaginal bleeding was reported by 18% and an incompetent cervix or cervical suture was reported by 1% of patients during the current pregnancy.

Microbiology data from the three speculum examinations conducted during the current pregnancies are displayed in Table 8. The principal organisms that were isolated, group B streptococcus, U urealyticum and M hominis, occurred throughout pregnancy in 11%, 37% and 4% of patients, respectively. Bacterial vaginosis diagnosed by Gram stain criteria appeared to decrease slightly during gestation and was present in 17% of women at the first examination, 14% at the second examination and 12% at the time of labour and delivery. Only one patient had N gonorrhoeae, which was isolated at the first prenatal visit. C trachomatis was also an uncommon isolate, detected in less than 1% of patients at any examination. Yeast-like organisms were observed on Gram stain in less than 10% of patients at any examination.

Finally, pregnancy outcomes are shown in Table 9, with a mean gestational age of 38.9 weeks (±2.1), median 39 weeks; mean birth weight of 3384 g (±583), median birth weight 3415 g. Overall, 127 (7%) infants were born prematurely. Caesarean section occurred in 16% of births, and 15% of infants were delivered with the assistance of forceps. Fetal distress occurred in 6% of cases and 7% of infants were admitted to the neonatal intensive care unit.

**DISCUSSION**

The goal of the present study was to enrol and track pregnant women prospectively, as a mechanism to determine the prevalence of demographic, clinical and microbiological factors. This approach has value relative to examining the importance of PB and the inconclusive information that has been available on its causation. PB is a significant and growing problem (3,4,6). Infections represent one factor that is linked to adverse pregnancy outcome, and a preponderance of reports support an association between at least some microbes and PB. However, various studies have yielded conflicting results, even with syndromes such as bacterial vaginosis, which is most closely associated with prematurity (15,18,20,21).

Most earlier North American studies enrolled lower socioeconomic and/or ethnically nonrepresentative populations. In addition, most were performed at publicly funded obstetrical clinics rather than at private practices and, thus, were unlikely to reflect a general obstetrical population. This has been the case even with larger multicentre studies. Therefore, we sought to assess a general Canadian obstetrical population by enrolling consecutive patients in the practices of a group (private and academic) comprising all obstetricians affiliated with a single hospital for infant care.

**TABLE 6**

| Obstetrical history                        | Number of participants | Percentage |
|-------------------------------------------|------------------------|------------|
| Mother or sister had premature baby       | 385                    | 22.0       |
| Previous twins or triplets               | 23                     | 1.7        |
| Previous vaginal bleeding                | 493                    | 35.6       |
| Cause of bleeding                         |                        |            |
| Placenta previa                           | 22                     | 4.5        |
| Abruption of the placenta                | 18                     | 3.7        |
| Other                                    | 142                    | 28.8       |
| Don’t know                               | 311                    | 63.1       |
| Incompetent cervix or cervical suture in previous pregnancy | 35 | 2.5 |
| Previous caesarean section               | 201                    | 14.5       |

**TABLE 7**

| Obstetrical data                        | Number of participants | Percentage |
|-----------------------------------------|------------------------|------------|
| Ultrasound in this pregnancy (yes/no)   | 753/1226               | 37.7/61.5  |
| Twins or triplets expected (yes/no/do not know) | 22/907/504 | 1.5/63.3/35.2 |
| Vaginal bleeding (yes/no)               | 353/1597               | 18.1/81.9  |
| Cause and/or timing of bleeding (categories may overlap) |     |           |
| After intercourse                       | 43                     | 12.2       |
| After pelvic examination                | 22                     | 6.2        |
| Placenta previa                         | 4                      | 1.1        |
| Abruption of placenta                   | 4                      | 1.1        |
| Other                                   | 60                     | 17.0       |
| Don’t know                              | 226                    | 64.0       |
| Incompetent cervix or cervical suture   | 19/1801                | 1.0/99.0   |

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The patient group in the study demonstrated several differences with published North American studies. The patient group in the present study reflected the racial and ethnic composition of both Edmonton and Canada in general. The 1996 census data identified 9.8% of the female population of Edmonton and 5.0% of the female population of Canada to be of Chinese, Vietnamese, Laotian, Cambodian, Japanese, Korean or Filipino ethnicity (24). The patients in the present study identified themselves as Oriental in 9.2% of instances, a proportion that was very similar to that of the census statistics. The census data reported that 3.6% of the female population of Edmonton was of South Asian (India and Pakistan) origin, 1.6% black (Africa or Caribbean) and 4.3% Aboriginal. The study cohort reported 3.1%, 1.7% and 3.7%, respectively in the same groups. Because racial and/or ethnic information is not part of hospital admission or birth statistics, the census data best reflect the diversity of the obstetrical population in the present study. Most North American studies, including all large multicentre studies (17,19,21,26-29), enrolled a predominance of ‘minority’ patients. In studies published since 1995, McGregor et al (27) reported a 66% black or Hispanic population, Meis et al (29) reported a 63% black population, Hauth et al (20) reported a greater than 70% black population, and Carey et al (21) reported an 85% black or Hispanic population. The few studies in which the majority of patients were white (14,15,30) had a small enrolment and were single centre studies in which the majority of women were from low socioeconomic groups. For example, in one study (15) all patients attended publicly financed clinics, and in another study (30), 70% of patients received public assistance. Fewer than 50% of the subjects were married in all studies. In addition, several studies represented high risk obstetrical populations in which patients had a higher than average number of previous premature infants (20,29).

Thus, the present study comprised a population with characteristics that were quite representative of the general Canadian obstetrical population in terms of race, ethnicity and obstetrical risk factors. One unique feature of the present study was that it offered a vehicle with which to assess the impact of universal medical insurance on PBs and related issues. In general, patients who are cared for under a public insurance plan are more likely to attend public hospitals and undergo public assisted deliveries. Patients routinely refer themselves to obstetricians, and the majority of maternal care in Edmonton is provided by specialists. In 1994 and 1995, obstetricians assisted in 10,337 deliveries, family practitioners assisted in 2876 and ‘others’, including midwives, assisted in 10 of the 13,223 births in the Edmonton region (23). The Perinatal Infections Group represented approximately 25% of obstetricians in Edmonton at the time of the study. The study was designed to follow patients throughout pregnancy from initial enrolment, usually early in the first trimester, through delivery. An extensive laboratory evaluation was conducted in terms of the number of analyses and longitudinal sampling during the first trimester, second trimester and finally, labour and delivery. The present study also assessed other potential cofactors and confounding factors, including traits that are strongly linked to PB, such as smoking and diabetes, and detailed information on nutrition, exercise and reproductive history.

Compared with the general population of Edmonton (24), the patient cohort in the present study was representative of the age distribution for pregnancy in this city. It was, however, a group with a higher educational achievement and economic level than that of the city of Edmonton or the Canadian population (24). Compared with data from other Canadian provinces, it appears that the prevalence of known risk factors in the study population was representative of that in the other provinces. For example, the occurrence of smoking, alcohol ingestion and diabetes during pregnancy was highly similar in the group in the present study and in Manitoba (25). The patient group in the study demonstrated several differences with published North American studies. The patient group in the present study reflected the racial and ethnic composition of both Edmonton and Canada in general. The 1996 census data identified 9.8% of the female population of Edmonton and 5.0% of the female population

| Microbiology finding          | Visit 1 (Number/%) | Visit 2 (Number/%) | Visit 3 (Number/%) |
|------------------------------|--------------------|--------------------|--------------------|
| Group B streptococcus        | 107/5.4            | 142/7.8            | 179/10.3           |
| *Chlamydia trachomatis*      | 1/0.05             | 2/0.1              | 6/0.4              |
| *Ureaplasma urealyticum*     | 618/36.9           | 119/6.9            | 586/36.8           |
| *Mycoplasma hominis*         | 734/36.7           | 119/6.9            | 71/4.5             |
| Bacterial vaginosis          | 66/3.9             | 234/13.8           | 194/12.2           |
| *Trichomonas* (Gram stain)   | 3/0.1              | 2/0.1              | 0/0                |
| *Neisseria gonorrhoeae*      | 66/3.9             | 0/0                | 0/0                |
| Yeast (Gram stain)           | 125/6.6            | 103/6.1            | 62/3.9             |

TABLE 8 Prevalence of microbiology findings at different visits in the Edmonton Perinatal Study

**TABLE 9**

Pregnancy outcomes of participants in the Edmonton Perinatal Study

| Pregnancy outcome               | Number of participants | Percent |
|---------------------------------|------------------------|---------|
| Complications                   |                        |         |
| Caesarean                       | 296                    | 16.3    |
| Forceps, etc                    | 267                    | 14.7    |
| Fetal distress                  | 109                    | 6.0     |
| Bleeding                        | 143                    | 7.9     |
| Baby in neonatal intensive care unit (yes/no) | 125/1686 | 6.9/93.1 |

Mean total gestational age of 1814 participants was 38.9 weeks, SD±2.1 weeks; Mean total birth weight of 1811 participants was 3384 g, SD ±583 g.
and involvement of every obstetrician who provided care at a single hospital. It included a subset of patients with known high risk pregnancies because UAH was the tertiary obstetrical facility in northern Alberta at the time of the study. All of these characteristics, plus detailed histories, extensive microbiology, and comprehensive follow-up generated a substantial database that is being analyzed to evaluate the role(s) of multiple variables in determining birth weight and gestational age.

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