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A survey of acute self-reported infections in pregnancy

Samantha J Lain,[1] Christine L Roberts,[1] Julia Warning,[1] Josephine Vivian-Taylor,[2] Jane B Ford[1]

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[1]Department of Perinatal Research, Kolling Institute of Medical Research, University of Sydney, Sydney, Australia
[2]Department of Obstetrics and Gynaecology, University of Sydney, Sydney, Australia

Correspondence to
Samantha J Lain; samantha.lain@sydney.edu.au

ABSTRACT

Objective: The objective of this study was to estimate the weekly prevalence of self-reported recently acquired infections in women at least 20 weeks pregnant.

Design: We conducted a cross-sectional survey of pregnant women in a hospital antenatal clinic in Sydney, Australia between August 2008 and April 2009. Women were asked to report whether they had onset of a new infection in the 7 days before completing the questionnaire, and were asked for details of symptoms and medication taken.

Results: 737 women at least 20 weeks pregnant completed the survey (94% of women approached). Five per cent of the completed questionnaires reported the onset of an infection in the 7 days prior to survey completion. When symptoms were analysed, 3.5% of women were classified as having a moderate or severe infection in the past 7 days. The most common infection reported was a cold/upper respiratory tract infection followed by gastroenteritis. Women pregnant with their first child had a lower rate of self-reported infection than women who had other children (2.9% vs 7.2%).

Conclusions: These results can be used to inform future research examining acute infection as a trigger for pregnancy complications.

ARTICLE SUMMARY

Article focus

- This was a survey to ascertain the period prevalence of self-reported new infections in any 7-day period during the second half of pregnancy.
- Information regarding the type of infection and medication taken to treat the infection was also collected.

Key messages

- Five per cent of women at least 20 weeks pregnant reported the onset of a new infection in the previous 7 days and 3.5% of these women had a moderate or severe infection.
- Only 21% of women reporting an infection sought medical care, while 65% took medication to treat the infection.
- This information can be used to inform future research into acute infections as a possible trigger for pregnancy complications such as pre-eclampsia.

Strengths and limitations of this study

- Strengths include the prevalence estimate of infection in a short period of time rather than at any time during pregnancy to inform research into acute triggers of pregnancy complications, and the use of information regarding symptoms and medication taken to distinguish between mild and more severe infections.
- Limitations include the use of self-reported infection; however, this method has previously been used to report infection in a number of populations.

BACKGROUND

Acute infections during pregnancy are associated with adverse outcomes including miscarriage, preterm prelabour rupture of membranes, preterm birth and stillbirth.[1–3] Epidemiological evidence suggests that maternal infections may precipitate other complications of pregnancy including pre-eclampsia.[4] Early pregnancy evokes a mild and limited systemic inflammatory response with increased levels of pro-inflammatory mediators such as prostaglandin E_2 (PGE_2), tumour necrosis factor (TNF)-α,[5] and interleukins 1 and 6.[6 7] These inflammatory mediators promote vascular remodelling and placental invasion, necessary in early pregnancy to ensure adequate fetal growth. The placenta reaches its full size by about 20 weeks, by which time vascular remodelling is complete and a concurrent decrease in circulating inflammatory markers has been observed.[8–10] In clinically normal pregnancies, maternal inflammation remains subdued until the onset of labour, when PGE_2 and proinflammatory cytokines mediate the ripening of the cervix, rupture of membranes and myometrial contractility.[11 12] Therefore, acute infection may trigger perturbations in the temporal control of maternal inflammation, causing adverse pregnancy outcomes.[13 14] The maternal immune

response to such an infection could mimic the cytokine milieu involved in the onset of labour.

Previous studies on pregnancy have centred on specific infections such as urinary tract infection and periodontal disease rather than investigating the prevalence of all acute infections which may evoke an inflammatory response. Acute infectious episodes are known to increase the risk of cardiovascular diseases, including the risk of first-time myocardial infarction and stroke. Studies of these diseases suggest the effect of infection may be generic and not linked to specific types of infection.[15] The current study arose out of the design phase of a similar study among pregnant women investigating the possible role of infection and other acute triggers in the onset of pre-eclampsia, an acute hypertensive disorder of pregnancy. An accurate estimate of the prevalence rate of infections during the second half of pregnancy (when women are at risk of pre-eclampsia) is necessary to calculate the study sample size; a simple overall infection rate will not suffice when assessing acute triggers. Few studies have assessed the prevalence of acute infections during pregnancy and none have addressed the specific issue of timing during pregnancy.[4] Studies using the prevalence of infection at any time during pregnancy may result in systematic misclassification of exposure and dilution of the true risk of complications occurring later in pregnancy. The aim of this current study is to ascertain the period prevalence of self-reported new acute infections in any 7-day period during the second half of pregnancy.

METHODS

This cross-sectional study was conducted in the antenatal clinic of a teaching hospital with tertiary obstetric and neonatal care facilities in Sydney, Australia between August 2008 and April 2009. Methods have been described in detail previously in a separate report of recent maternal activities during pregnancy.[16] Briefly, women who were at least 20 weeks pregnant and able to complete the questionnaire in English were eligible for participation. Women were approached in the antenatal clinic by a trained researcher not involved in their medical care and completed a short questionnaire after giving informed consent. The questionnaire was developed after review of the literature and discussion with clinical staff and was piloted prior to study commencement.

The questionnaire asked women about demographic characteristics and whether they had an infection during their pregnancy. Other studies have similarly identified recent infections using self-report[17–21] and concordance studies find this method to be reliable.[22–25] In the questionnaire, infection was defined as 'symptoms lasting more than 24 h that you think were caused by an infection' and onset of the most recent infection was identified as in the last 7, 8–14 or >14 days. Detailed information was only asked for new infections in the last 7 days. Participants were also prompted with a list of examples such as a cold or flu, urinary tract infection, thrush, tooth abscess or an infected wound, when considering if they had an infection in the past 7 days. The questionnaire sought information about infection in the 7 days prior to its completion, so women were eligible to complete the survey more than once, providing there were at least 14 days between each questionnaire. If the women responded that they had an infection in the last 7 days, they were asked to record the perceived severity (mild, moderate or severe) of symptoms from a provided list (see box 1). Details were also collected regarding medical advice sought, tests performed and medication taken for their infection. Details of symptoms and medication were used to analyse severity of infections. Women who had taken antibiotics or had three or more symptoms that they rated as moderate or severe were classified as having

Box 1 List of symptoms, the severity (none, mild, moderate or severe) of which participants reporting having an infection were asked about

General symptoms for infection
- Fever
- Night sweats/chills
- Fatigue/weakness

Upper respiratory tract infection (eg, a cold, influenza, tonsillitis)
- Runny nose or blocked nose
- Sneezing
- Headache, sinus/face pain
- Swollen glands

Lower respiratory tract infection (eg, pneumonia, bronchitis)
- Dry cough
- Productive cough (coughing up phlegm or mucous)
- Shortness of breath
- Chest pain
- Pain when breathing

Urinary tract infection (eg, bladder or kidney infections)
- Burning sensation when urinating
- Cloudy or foul-smelling urine
- Pus or blood in urine
- Frequent urination
- Urgency, pressure or pain in bladder

Genital tract infection (eg, thrush)
- Abnormal vaginal discharge with an unpleasant smell
- Intense itching, swelling and irritation

Gastro-intestinal infection (eg, food poisoning)
- Nausea, vomiting (other than morning sickness)
- Diarrhoea
- Stomach pain

Other infections
- Tooth abscess
- Infected cut or scratch/wound infection
- Skin infection/boils

a 'moderate/severe' infection. As the timing of the onset of infection was important, women were given a calendar to help prompt them with the date of onset of infection and were also asked how confident they were of the date the infection first appeared.

Survey data were analysed using frequency tabulations and contingency table analyses. Stratified analysis, using χ^2 tests, examined the impact of gestational age, parity, plurality, maternal education and other medical conditions on the prevalence of infection. This study was approved by the Northern Sydney and Central Coast Human Research Ethics Committee.

RESULTS

Among women who were at least 20 weeks pregnant approached to complete the survey, 738 (94%) agreed to participate; 97% when approached for the first time and 87% when approached to complete the survey for a subsequent time. A total of 737 surveys were completed, and 161 women completed the survey more than once. Factors that significantly differed between women completing the survey more than once and those who only completed one survey were increased gestational age, women with multiple pregnancies and women with university degrees.[16] The majority of the women who completed the survey were over 30 years of age, had a university degree, and were having their first baby (see table 1).

Forty per cent of women surveyed said that they had had an infection at some stage during their pregnancy. Five per cent of the completed surveys reported the onset of an infection in the 7 days prior to survey completion (see table 2) and 5.7% reported the onset of an infection 7–14 days before completing the survey. For women who reported an infection in the 7 days prior to completing the survey, the most common infection was a cold/upper respiratory tract infection (with an prevalence rate of 2.6%), followed by gastroenteritis or vomiting (0.7%), influenza (0.5%), candidiasis (0.4%) and urinary tract infection (0.4%). When only 'moderate/severe' infections were examined, the weekly prevalence of any new infection decreased to 3.5% and the prevalence of a cold/upper respiratory tract infection in the 7 days prior to survey completion decreased to 1.2%.

Table 2 shows the weekly prevalence of infections by demographic and pregnancy variables. The prevalence of infection differed significantly by parity, plurality and for women who had high blood pressure. Less women who were pregnant for the first time reported the onset of an infection compared to women who were pregnant for a second or subsequent time (2.9% vs 7.2%, p=0.008). Women who were pregnant with twins reported a higher prevalence of infection than women pregnant with a singleton (16.1% vs 4.5%, p=0.004); however, there was no difference between groups in the prevalence of moderate/severe infection. Women who reported having a hypertensive disorder of pregnancy reported more infection than women without a medical condition (15.3% vs 4.6%, p=0.01).

Table 1 Characteristics of the women surveyed

	N (%)
Total questionnaires completed	737
Women who completed the survey only once	576 (78.2)
Maternal age (years)	
<25	55 (7.5)
25–34	430 (58.3)
≥35	247 (33.5)
Gestational age (weeks)	
20–28	241 (32.7)
29–34	172 (23.3)
35–42	324 (44.0)
Plurality	
Singleton	705 (95.7)
Twins/triplets	31 (4.2)
Parity	
Nulliparous	376 (51.0)
Multiparous	360 (48.8)
Highest level of education completed	
Without university degree	313 (42.5)
With university degree	422 (57.3)
Medical conditions (pre-existing or pregnancy related)	
No medical conditions	564 (76.5)
Asthma	69 (9.4)
High blood pressure	25 (3.4)
Diabetes	46 (6.2)
Other	32 (4.3)
Smoking status	
Did not smoke during pregnancy	708 (96.1)
Smoked cigarettes during pregnancy	29 (3.9)

Of those women reporting an infection in the 7 days prior to survey completion, the proportions who sought medical advice or took medication are given in table 3. Overall, 21% of women with an infection saw a health-care professional and 65% took some type of medication to treat the infection. Paracetamol/acetaminophen was most commonly taken, followed by antibiotics and 5% of women with an infection reported taking aspirin. Just over 50% of women reporting an infection stated that they had a fever and a third of these women reported having their temperature taken. The two women who reported having an investigative test performed, had urine samples taken for urinary tract infections. The highest prevalence of infection in the 7 days prior to the survey was in the southern hemisphere winter month of August (11.5%), while January (summer) had the lowest infection rate (0.6%). Most women (92%) were confident or very confident of the date when symptoms of infection had first appeared.

DISCUSSION

This is the first study to look at the prevalence of infection in a 7-day window in pregnant women. There are a number of studies that report the rate of selected infections at any time during pregnancy and it is necessary to estimate weekly rates

Table 2 Characteristics of women with a self-reported infection, and the weekly prevalence rate, per 100 questionnaires, of infection in the 7 days prior to completing the survey

	Women with self-reported infection, N	Weekly prevalence of self-reported infection, % (95% CI)
Total questionnaires completed	37	5.0 (3.4 to 6.6)
Women who completed the survey only once	28	4.8 (3.1 to 6.6)
Maternal age (years)		
<25	3	5.5 (0.0 to 10.7)
25–34	18	4.2 (2.3 to 6.1)
≥35	16	6.5 (3.4 to 9.6)
Gestational age (weeks)		
20–28	10	4.2 (1.6 to 6.7)
29–34	9	5.2 (1.9 to 8.6)
35–42	18	5.6 (3.0 to 8.1)
Plurality		
Singleton	32	4.5 (3.0 to 6.1)
Twins/triplets	5	16.1 (2.4 to 29.8)
Parity		
Nulliparous	11	2.9 (1.2 to 4.6)
Multiparous	26	7.2 (4.5 to 9.9)
Highest level of education completed		
Without university degree	14	4.5 (2.2 to 6.8)
With university degree	23	5.5 (3.3 to 7.6)
Medical conditions (pre-existing or pregnancy related)		
No medical conditions	26	4.6 (2.9 to 6.3)
Asthma	4	5.8 (0.1 to 11.5)
High blood pressure	4	15.3 (0.5 to 30.2)
Diabetes	3	6.5 (0.0 to 13.9)
Other	0	0.0
Smoking status		
Did not smoke during pregnancy	36	5.1 (3.5 to 6.7)
Smoked cigarettes during pregnancy	1	3.4 (0.0 to 10.5)

for comparison with these studies, assuming a constant rate of infection by week of gestation. Our study found a lower rate of self-reported infection during the entire pregnancy (40%) than Collier *et al*[17] (64%), but they included the first trimester. Weekly rates for specific infections in pregnancy reported in other studies include: urinary tract infection 0.2–0.5%[17 26 27] (similar to the 0.4% reported in our study), gastroenteritis 0.8%[20] (0.7% in this study), influenza 0.1%[27] (0.5% in this study), acute respiratory infectious disease 0.2%[28] and the common cold 0.4%[29] (compared to 1.2% for moderate/severe upper respiratory tract infections reported in this study). Our study has a higher prevalence rate for the common cold, however a population-based cohort study in Canada found that the weekly rate of acute respiratory illness severe enough to require a physician visit ranged from 1.1% to 1.9%,[30] similar to the prevalence rate of severe colds observed in this study. As each completed questionnaire was anonymous, we could not determine whether any of the infections were recurrent and it is possible that some of the reported infections were chronic rather than acute.

Table 3 Medication taken or health advice sought by women with self-reported infection

	N (%)
Medication taken	37
Paracetamol/acetaminophen	12 (32.4)
Aspirin	2 (5.4)
Antibiotics	7 (18.9)
None	3 (8.1)
Other*	13 (35.1)
Medical care	
Advice sought from doctor	8 (21.6)
Medical test/investigation performed	2 (5.4)
Temperature taken	7 (18.9)

*Includes antifungal cream, antibacterial throat lozenges and gargle.

We found the prevalence of acute infections was higher for women who had previously been pregnant and, for mild infections, women with twin pregnancies. Children are prone to developing infections[20] which could be easily transferred to the mother. Women pregnant with multi-fetal pregnancies may have increased antenatal visits and surveillance by clinicians, and this may lead to an increase in the reporting of infections. An unexpected yet interesting finding from the survey was the increased prevalence of infection in women with a hypertensive disorder of pregnancy, although this rate is based on small numbers and the confidence intervals around the prevalence estimate are very wide. This result is of particular interest because the

estimate of prevalence of infection in pregnant women from this survey is to inform future research about infection and pre-eclampsia. The authors propose using the prevalence estimates of infection obtained from the current research for a case–crossover study investigating the role of acute infection and other acute triggers in the onset of pre-eclampsia. The current study, however, was not designed to examine infection rates in pregnant women with hypertension. In this cross-sectional survey it was not possible to establish whether the hypertension or the infection occurred first.

The reliance upon self-report of infection is a potential limitation of the study, with only 21% of women reporting an infection seeking medical attention; however, mild infections that do not come to medical attention may still be a risk for pregnancy complications.[17] Self-report of infection has been used to estimate the rates of gastroenteritis,[20] influenza and fever,[19 21] and genitourinary infections[18] in pregnant women. Banhidy *et al* collected information about infection from both prospectively collected medical data and self-report from women in a post-natal questionnaire.[25 28] They found that 74% of women reporting an acute respiratory disease during pregnancy had the disease recorded in their medical records[28] and 95% of women with a medically recorded urinary tract infection self-reported the infection.[25] Our study also collected information about the severity of symptoms experienced and medication taken, which helped to distinguish between mild and more severe infections. This stratified analysis of reported infections increases the certainty that women who experienced a severe infection truly did have an infection.

The use of self-reported data may be affected by recall bias. One study using self-report of any infection during pregnancy recommended "future studies should emphasise the importance of interviewing women as early as possible"[17] as mothers tend to under-report infection when recalling information after birth.[31] The short window of time to recall details of infection in our study (7 days) minimises this recall bias.

A further limitation of this study is that the study population is older than the general population of pregnant women in Australia,[32] is highly educated and was restricted to English speaking participants. Although this may impact the generalisability of the results, such characteristics are representative of the women who attend this hospital. Notably, age or educational level did not have a significant effect on the total infection rate, although a larger sample size may show an association between these factors and sexually transmitted infections. Strengths of this paper include the investigation of any infection rather than being limited to single infections, and the investigation of acute rather than chronic infections which may be over-estimated if weekly prevalence rates rather than date of infection onset are used.

Conclusions

This survey is the first study to estimate the weekly prevalence of recently acquired acute infections in a population of pregnant women. The results of this study will be used to inform future research examining the association between acute infection and pregnancy complications such as pre-eclampsia. This study also informs clinicians about the types of infections and medication pregnant women are exposed to.

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Competing interests None.

Ethics approval This study was approved by the Northern Sydney and Central Coast Human Research Ethics Committee.

Contributors SJL designed and administered the survey, analysed the data and drafted the manuscript. CLR and JBF developed the study and helped design the survey. CLR, JBF, JVT and JW contributed to data analysis and interpretation. All authors edited the manuscript and gave final approval of the version to be published.

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