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Title: The Epidemiology of Listeriosis in Pregnant Women and Infants in New Zealand

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Introduction: *Listeria monocytogenes* causes listeriosis, a rare infection that is principally transmitted through the consumption of contaminated food. *L. monocytogenes* has the predilection to affect pregnant women, neonates and those who are immunocompromised. Pregnant women, in particular, are at an approximately 18 times greater risk for infection than the general population, owing to adaptations in immune function during pregnancy.

During pregnancy, listeriosis encompasses maternal, fetal and neonatal disease. Listeriosis most commonly presents in the third trimester of pregnancy (from 28 weeks) and is rarely fatal in the mother; particularly in the absence of other coexisting medical conditions. If transmission to the fetus occurs, infection can lead to miscarriage, pre-term delivery or stillbirth. Pregnancy outcome is strongly impacted by the gestation at which infection occurs; with later infection, particularly that within the third trimester, typically associated with more favourable outcomes than earlier infection. In a recent study of 107 cases of pregnancy-related listeriosis in France, the transmission of infection from the mother to the fetus was 96%, and major fetal or neonatal complications were observed in 83% of infected mothers.

Neonatal listeriosis usually manifests within the first 24-72 hours of life and can present as bacteraemia, respiratory distress, meningitis and, less frequently, pneumonia. Late-onset listeriosis, defined as presenting in infants aged one-to-four weeks, is most often associated with meningitis. Neonatal listeriosis is associated with an overall case fatality rate of 50%, with severe neurological and developmental sequelae observed in 40% of surviving neonates. Due to the severity of the illness, all neonates with suspected infection are treated with antibiotics targeting *L. monocytogenes*.

Listeriosis is rare in healthy children. However, in children who are immunocompromised, infection can present as several clinical syndromes, of which meningitis and bacteraemia are the most common.

The New Zealand Ministry of Health supports a public health campaign aimed at reducing the risk for infection of listeriosis in pregnancy and The Ministry for Primary Industries publish the food safety in pregnancy guidelines. Listeriosis is a notifiable disease in New Zealand. The incidence of *L. monocytogenes* infection is thought to be rare in New Zealand, however this has not been systematically studied, or reported on.

Aim: To describe the epidemiological trends in hospital admissions and disease notifications from listeriosis in pregnant women, infants and children in New Zealand.

Impact: This study provides the first detailed study on the burden of disease due to listeriosis in pregnant women, infants and children in New Zealand. It confirms that the incidence of listeriosis in New Zealand is low and provides insight on the most at-risk population groups and the most common health outcomes associated with infection.

Method: In this population-based descriptive study, hospitalisation and notification rates for listeriosis were analysed for the 20-year period from 1997-2016. Hospitalisation data was sourced from the National Minimum Dataset, and notification data from The Centre for Environmental Science and Research notifiable diseases database from EpiSurv. Pregnant women aged 15 – 45 years and children less than 15 years were considered.

Results:

Hospitalisation: During the 20-year period considered, there were 118 cases of listeriosis that resulted in hospitalisation; 84 cases (71.2%) were pregnant women and 34 cases (28.8%) were children <15 years. The average annual number of hospitalisations (including pregnant women and children) was 5.9 (0.33 per 100,000). Total hospitalisations were highest in 2003 (n=13) and were lowest in 2004 and 2006 (n=2). There was no relationship between total hospitalisations in pregnant women and total hospitalisations in children; peaks and troughs did not correlate (correlation coefficient -0.15). Children <1 year were most likely to be hospitalised when compared to all other age groups (crude rate 1.7 per 100,000) and likelihood for hospitalisation decreased with age. Older children were most likely to present with other risk factors for infections, such as being immunocompromised. There were no changes in hospital admissions or patterns of hospital admission over time. There were no ethnic variations in disease. The commonest outcomes of infection in pregnant women were: intrauterine death (n=8) and early onset delivery (n=24). In children, the commonest outcomes were meningitis (n=26) and preterm infant (n=8).

Notification: There were 144 cases of listeriosis notified; of these, 116 cases (80.6%) were pregnant women, and 28 cases (19.4%) were children <15 years. The average annual number of hospitalisations was 7.2 (0.40 per 100,000). Total notifications peaked in 2009 (n=12) and were lowest in 2004 and 2012 (n=4). In 1999, 2004, 2011 and 2014 there were no notifications in children. Children <1 year were most likely to have a notification due to listeriosis when compared to all other age groups. There were no ethnic variations in disease. There were no changes in patterns of notifications over time, or incidence of notifications observed.

Conclusion: Listeriosis is a rare infection in pregnant women and children in New Zealand. From 1997-2016 there were no changes in total incidence, or patterns of incidence observed.