

Listeriosis Awareness among Pregnant Women in the Loddon-Mallee Region of Victoria**Paul Jackson¹, Maria Sheldon², and Dianne Katscherian³****¹Department of Health & Environment, La Trobe University,****²Faculty of Education, La Trobe University &****³Divisions of Science & Engineering, Murdoch University**

Listeriosis is a rare but serious food-borne illness with particular implications for pregnant women. The study investigated the understanding of listeriosis among recent mothers in the Loddon-Mallee region of Victoria, Australia, and examined the effectiveness of listeriosis educational material. A postal survey was undertaken of all women in the Loddon-Mallee region who gave birth in the month of June 2003. Of the 303 women who had live singleton births in the region in June 2003, 129 consented to be contacted and 83 responded. Nineteen women had never heard of listeria and seven had done so only after their pregnancy. The study found that pregnant and post-partum women in the region had poor knowledge and awareness of listeriosis and its consequences. Awareness of the mild, flu-like symptoms that can affect pregnant women was particularly lacking. The listeriosis pamphlets currently available were neither effectively distributed nor well known. Further research across larger areas and including women from culturally and linguistically diverse (CALD) backgrounds is recommended. The results indicate a need for a new approach to the dissemination of listeriosis information to this high risk group.

Key words: *Listeria; Listeriosis; Pregnancy; Food-borne Infection; Loddon-Mallee; Awareness*

Listeriosis is a rare, food-borne disease, but one with high public health significance. Listeriosis is caused by ingestion of the *Listeria monocytogenes* bacterium and is a serious disease to which neonates, pregnant women, the immunocompromised and the elderly are particularly susceptible (Altekruse et al. 1997; Wing & Gregory 2002). Infection during pregnancy can be transmitted to the foetus. Affected infants may be stillborn, born with septicaemia, and/or develop meningitis in the neonatal period (Roche et al. 2001). As a food-borne disease, listeriosis is a relatively new and emerging condition, which has not yet achieved high community recognition or understanding (Torvaldsen et al. 1999).

**Characteristics of
*Listeria Monocytogenes***

Listeria monocytogenes historically has been one of the most important but least recognised microorganisms transmitted by food. The microorganism is ubiquitous in soil and water. It is commonly found in the gastrointestinal tracts of animals and up to 5% of healthy human adults (Wing & Gregory 2002). Despite the organism being widespread, most listeria infections result from eating contaminated foods (US Department of Health and Human Services and Department of Agriculture [USDHHS & DA] 2001). Two unusual features of the organism are its ability to multiply between 1°C and 45°C and at relatively high salt concentrations (Chin 2000; Wing & Gregory 2002). Hence *L. monocytogenes* can

grow well at refrigeration temperatures and in foods that are preserved in brine, such as soft cheeses and ready-to-eat foods. These foods therefore have the potential to be the vehicles for listeria infection.

Reservoir and sources

Listeria monocytogenes is ubiquitous in the environment, and human exposure is frequent. The organism is commonly isolated from sewage, silage, sludge, birds, and wild and domestic animals (Department of Human Services [DHS] 1996, 2001b). Fresh produce such as cabbage, potatoes, asparagus, broccoli, cauliflower, corn, green beans, lettuce, and radishes have been shown to be sources of *L. monocytogenes*, and products upon which the organism can grow and proliferate (Bell & Kyriakides 1998).

Mortality rates

In Western countries, listeriosis has the highest mortality rate of any food-borne pathogen. The US Department of Health and Human Services and the Department of Agriculture recently projected that there would be 2500 serious cases of listeriosis, with 500 deaths, in the United States each year (USDHHS & DA 2001). This equates to a mortality rate of 20%. By comparison, *Salmonella enteritidis* infections have a mortality rate of 0.38% (Mishu et al. 1994), *Campylobacter* species infections range from 0.02% to 0.1%, and mortality rates for infections from *Vibrio* species range from 0.005% to 0.01% (Altekruse et al. 1997).

Outbreaks of listeriosis

Most human cases of listeriosis are not outbreak related, but occur rather as a sporadic illness confined to a single individual (McLauchlin 1990). However, most of our knowledge comes from the study of outbreaks. Although long suspected, food was not strongly implicated in the transmission of *L. monocytogenes* until a 1981 Canadian outbreak in which coleslaw

was shown to be the vehicle responsible (Bell & Kyriakides 1998; Donnelly 2001). Many subsequent outbreaks, including one in Massachusetts (1983), and another in Los Angeles (1985), relating to pasteurised milk and Mexican-style soft cheese respectively, confirmed the risk of ingesting contaminated foods (Fleming et al. 1985; Linnan et al. 1988). In December 1998, an outbreak of invasive listeriosis was identified in which *L. monocytogenes* was spread by hot dogs and processed meats produced by Sara Lee Foods in the United States. Over 100 people became ill during the outbreak and 21 people died, including five miscarriages or stillbirths (Centers for Disease Control and Prevention 1999; Jacobsen 2000).

Outbreaks continue to be reported around the world but are relatively uncommon in Australia. In 1990, a listeriosis outbreak involving ten pregnant women and resulting in six stillbirths was reported in Western Australia (Watson & Ott 1990). During the 1990s small outbreaks continued to occur in Australia and in the period 1998-2000, there were five outbreaks, three in healthcare settings (Kirk et al. 2003). The mean rate of listeriosis in Australia for the 1997-2000 was 3.0/106 cases, and the mean rate for non-pregnancy related listeriosis infections was 2.4/106 cases. In Victoria, the number of materno-foetal cases in 1997-2001 decreased 50% when compared to 1991-1996 (Kirk et al. 2003).

When compared to countries such as the United States, England and France, the number of listeriosis cases in Australia has been relatively low for many years (DHS 2001a; McLauchlin 1990; Roche et al. 2001; Wing & Gregory 2002). There is some evidence that it has even been declining in recent years (Kirk et al. 2003). Whether this is due to the success of educational and awareness programs, or to higher standards in food processing industries leading to reduced exposures, or both, or to other reasons is difficult to ascertain. One factor that could be impacting upon the number of listeriosis cases is the use of convenience

foods. Usage of pre-cooked, chilled foods is lower in Australia than many other countries and it is these foods that are very often implicated in major outbreaks overseas. If this is correct, and should the usage of these types of foods grow in Australia we might see an increase in the number of listeria cases in years to come. When this is combined with the increase of listeriosis among other risk groups such as the elderly and the immunocompromised in the period 2000-2003 (Gregory, J. 24 October 2003, personal communication; Kirk, M. 27 October 2003, personal communication), it would seem imperative for agencies, such as the Victorian Department of Human Services (DHS), to increase their role in the promotion of listeria awareness and in being more proactive in delivering the message to the public in general and to high risk populations in particular.

Occurrence and public health significance

Listeriosis is an uncommon disease in humans. Estimates of four cases per million in the UK, and of 7.1 cases per million population in the USA have been reported (DHS 1996). Mean rates in Australia for 1998-2000 were three per million (Kirk et al. 2003). Listeriosis notifications in Australia have steadily increased from 1984 until 1999 when there were 63 cases reported (DHS 2000).

In Victoria in 1999, there were 12 notifications of listeriosis, consisting of five materno-foetal cases and seven notifications in other at-risk persons. No clusters were identified in 1999, and notifications were received throughout the year. Of these, five were materno-foetal cases that resulted in only two live births, but there were no maternal deaths (DHS 2000).

In 2000, in Victoria there were 11 reported cases of listeriosis, consisting of two materno-foetal cases and nine notifications of other at-risk people. The notifications were spread throughout the year (DHS

2001a). The two materno-foetal cases resulted in two live births, but one neonate died 36 hours after delivery. There were no maternal deaths. Both cases occurred in the metropolitan area (DHS 2001a). There were no outbreaks identified in 2000. Table 1 summarises the listeriosis notifications and deaths from 1996 to 2000.

Table 1: Listeriosis notifications and deaths, by category, Victoria, 1996-2000

Year	Materno-foetal cases		Other Cases		Total cases	
	Notifications (Deaths) ^a	Case fatality rate %	Notifications (Deaths)	Case fatality rate %	Notifications (Deaths)	Case fatality rate %
1996	3 (1)	33	17 (9)	53	20 (10)	50
1997	4 (1)	25	11 (3)	27	15 (4)	27
1998	5 (4)	80	10 (3)	30	15 (7)	47
1999	5 (3)	60	7 (1)	14	12 (4)	33
2000	2 (1)	50	9 (6)	66	11 (7)	64
Total	19 (10)	53	54 (22)	41	73 (32)	44

^a Materno-foetal deaths include stillbirths, neonatal deaths and miscarriages.

Source: Victorian Perinatal Data Collection Unit 2001

Listeria during pregnancy

Pregnant women have 20 times the risk of acquiring listeriosis when compared with the wider population (Donnelly 2001). Listeriosis occurs most often during the third trimester of pregnancy, resulting in one of three outcomes: an asymptomatic maternal infection and an infected infant; a severely ill mother who enters labour prematurely and delivers a stillborn or severely ill infant; or an unaffected foetus but the mother usually dies (Donnelly 2001). In most cases of perinatal listeriosis, the mother is mildly affected, exhibiting flu-like symptoms, but neonatal mortality is common (Donnelly 2001).

Listeriosis generally manifests as meningoencephalitis and/or septicaemia in newborns and adults and abortion in pregnant women (Chin 2000). However, Mylonakis et al. (2002) also reported that maternal listeriosis often resulted in a non-specific febrile illness that was seldom diagnosed pre-partum. Serious illness was

rarely noted in a studied group of 222 pregnant women. Infection, however, often resulted in spontaneous abortion, stillbirth, death of the newborn within hours after birth, or neonatal sepsis (Mylonakis et al. 2002). Although listeria infections occur most commonly in the third trimester, the prognosis is worst if the infection occurs in early pregnancy. Of the surviving infants born to listeria-infected mothers, about two-thirds develop neonatal sepsis (Wing & Gregory 2002). Pregnancy related cases in Victoria between 1996 and 2000 had fatality rates ranging from 25-80% (Victorian Perinatal Data Collection Unit 2001).

Listeria awareness

The symptoms of listeriosis generally take a few days or even weeks to appear and can be mild, thus pregnant women might not even know they have it (Chin 2000). Therefore, it is very important to take appropriate dietary and food safety precautions during pregnancy. It is vital that pregnant women become appraised of the dangers of listeria infection and the precautions that should be taken as early as possible during the pregnancy or, preferably, before becoming pregnant. The main forms of education in Australia are provision of information in pamphlets and use of on-line material. In an American study, Woteki (2001) reported that many women are not properly advised about the risks of listeria infection, even when they have specifically asked their health care provider for information. Only Torvaldsen et al. (1999) in their study in Western Australia have made any assessment of the understanding of pregnant women of the issues associated with listeriosis and the effectiveness of the awareness campaigns. Torvaldsen et al. concluded that rural women were less likely to have heard of listeria, less likely to have knowledge of listeria, and less likely to initiate appropriate dietary changes during pregnancy. Exploration of this conclusion in relation to rural women formed, in part,

the motivation for this study of women in regional Victoria.

Australian health agencies have sought to increase listeriosis awareness through public awareness campaigns but the effectiveness of these campaigns and the levels of awareness have not been well examined (Kirk et al. 2003). While there is some evidence of falling rates of listeriosis in Victoria, reasons for the decline are not clear (Kirk et al.). Only one study (Torvaldsen et al. 1999) has examined the sources of information about listeriosis used by pregnant women and it concluded that:

The listeria pamphlet is an effective medium for educating pregnant women about listeria. Rural, young, single and non-English speaking background women may require a different or supplementary approach (Torvaldsen et al. 1999, p. 362).

Torvaldsen et al. (1999) also reported that 11% of the study population had not heard of listeria and that this group had lower odds of correctly identifying risk foods.

Aim

The principal aim of this project was to assess awareness and knowledge relating to listeriosis among recent mothers (8-12 weeks post-partum) in the Loddon-Mallee region of Victoria and to test the hypotheses that listeriosis is not well understood by pregnant women. Subordinate objectives were to ascertain from which sources pregnant women obtain information about listeriosis; to compare results with previous research into the area of listeriosis awareness; to assess whether women who report having received advice on listeriosis had better knowledge of the associated risks.

Method

A quantitative, cross-sectional study of women was undertaken 12 weeks post-partum. A questionnaire was developed by selecting questions relating to listeria previously used in the Western Australian Pregnancy and Infancy Survey 1997-98 (Torvaldsen et al. 1999). The five-page, self-

reported, pen and paper questionnaire consisted of 24 questions to gather quantitative data about knowledge, events and behaviours relating to listeriosis awareness during pregnancy.

Sample

The study examined a small, cross-sectional cohort of women in the Loddon-Mallee region of Victoria. The 303 women who gave birth to live singleton infants in the region during June 2003 were approached to participate. In total, 129 women gave consent and 83 (27%) completed the questionnaire. The study sample was recruited through each of the 11 regional hospitals with maternity facilities or wards. Midwifery staff sought agreement to participate from each new mother before she left the hospital. At that time, mothers were advised of the general nature of the interview and asked to participate in two to three month's time. Every new mother who met the study criteria was approached to participate. Women were approached for recruitment shortly after delivery, but while still in hospital. They were asked at this time for their name and address and consent to participate in the study. Ethics approval was obtained from each of the participating hospitals in accordance with National Health & Medical Research Council guidelines.

Results

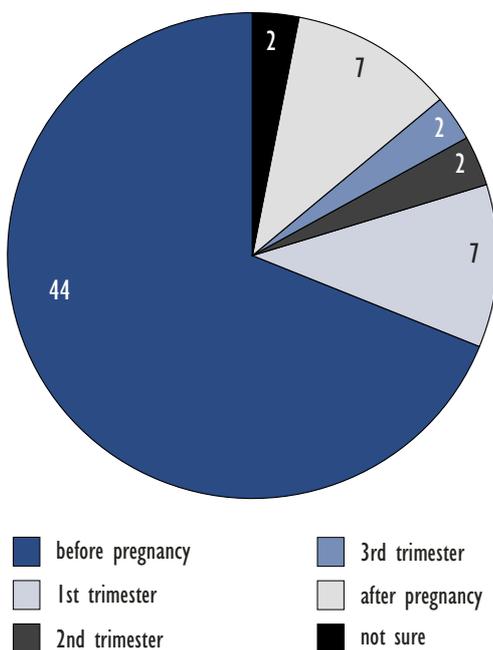
The 83 women who responded, were all aged 18-42 with a median age of 31 years. All reported English as the language normally spoken at home and only one reported having been born overseas.

Listeria awareness among respondents

Of the 83 respondents, 19 (23%) had not heard of listeria. Of the remaining 64 who had heard of listeria, 7 (13%) heard about it only after their pregnancy. Of the 64 respondents who had heard about listeria, most (69%) had heard about listeria prior

to their pregnancy. Others received the information at diverse times throughout the pregnancy. Two women could not recall when they had first heard of listeria. The information in Figure 1 shows details of the results.

Figure 1: Number of women who had heard of listeria and the time in pregnancy at which the mother first heard of listeria



To assess which risk factors might influence women being aware of listeria, their age, marital status and education levels were examined (Table 2). No significant differences were found in knowledge of listeria among women who were married, single, divorced, or in de facto relationships. However, women who had not heard of listeria were significantly more likely to be younger and less well educated. When compared to the reference group (i.e. women over 29), women under 25 were less likely to have heard about listeria (OR 5.6; 95% CI 1.2-27.1). Women who had not completed tertiary studies were less likely to have heard of listeria than those who had (OR 4.4; 95% CI 1.1-17.6).

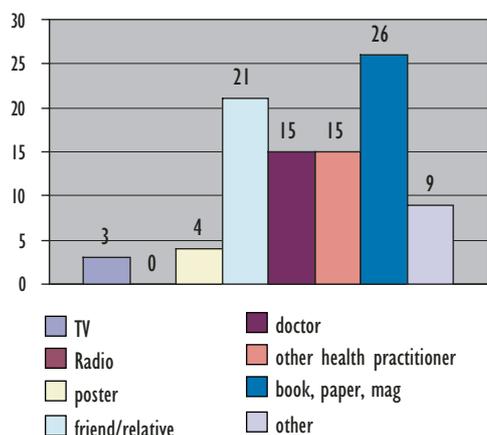
Table 2: Factors potentially influencing whether women had heard about listeria

Potential influencing factors	N(%) of those who had not heard of listeria (n=19)	N(%) of those who had heard of listeria (n=64)	Unadjusted odds ratio for not having heard of listeria (95% CI)
Single/separated/de facto	8 (42)	15 (23)	2.4 (0.7-8.0)
Education			
Tertiary degree or diploma	6 (32)	38 (59)	1 (referent group)
High school or other	9 (47)	13 (20)	4.4 (1.1-17.6)
Not completed high school	4 (21)	13 (20)	2.0 (0.4-9.7)
Age			
>29	7 (37)	46 (72)	1 (referent group)
25-29	6 (32)	11 (17)	3.6 (0.9-15.4)
<25	6 (32)	7 (11)	5.6 (1.2-27.1)

Sources of information about listeria

Survey respondents who had heard of listeria were asked about their sources (Figure 2). There were 33% of the women who reported having heard about listeria from relatives or friends while 40% obtained their information from magazines, books, or newspapers. The various other sources mentioned included pamphlets (4), the Internet, antenatal sessions, and hospital maternity admission information kits.

Figure 2: Sources of listeria information



Awareness of listeria pamphlets

Respondents who reported having heard about listeria were then asked specifically whether or not they had seen any pamphlets relating to information about listeria during pregnancy. Those who had seen the pamphlets were further asked where they saw

or obtained them. Of the 64 women who had heard of listeria, 36 (56%) had not seen any pamphlets. The 28 (44%) who now reported having seen a pamphlet, had obtained it from doctors (10), other health practitioners (8), health centres (7) and ‘others’ (9). Women were able to report more than one source. The ‘other’ sources included almost exclusively the information kits supplied by the hospitals upon booking for the birth.

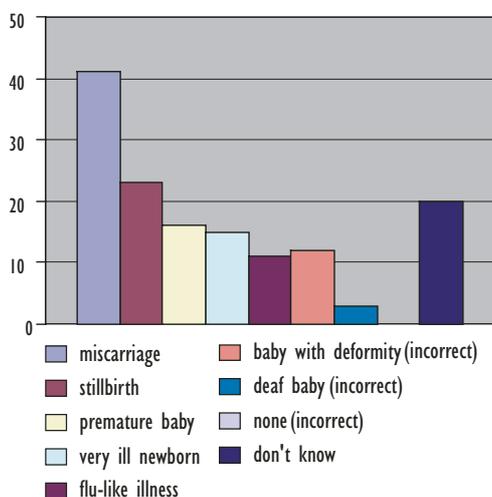
Of the 28 women who reported having seen a pamphlet, 25 found it very useful or useful. Two women found it neither helpful nor unhelpful and one woman could not remember. When asked to comment on what further information could be included in the listeria pamphlet, five women commented that they would like more information on topics such as risk foods, food preparation, symptoms in the mother, symptoms and illness in the foetus, and infection transmission times.

Knowledge of outcomes and transmission of listeria infection

Survey respondents who reported having heard of listeria were asked to identify the possible outcomes of listeria infection during pregnancy. Respondents were offered five correct responses (a stillbirth, a very ill newborn baby, premature birth, miscarriage and flu-like illness) and three incorrect ones (a baby with deformity, a deaf baby and no effect). Only two of 64 respondents (3%) correctly identified all five correct responses

and no incorrect ones. Twenty respondents (31%) indicated that they did not know and 42 (66%) answered incorrectly or partially correctly (see Figure 3). Of those who ticked one or more symptoms, all correctly identified miscarriage as an outcome, but 45% failed to identify stillbirth, 64% failed to identify premature birth, 67% failed to identify very ill newborn baby and 73% failed to identify flu-like symptoms.

Figure 3: Knowledge of symptoms caused by listeria



When asked to identify the stage in pregnancy at which listeria infection could be transmitted from mother to child, only 18 (29%) of survey respondents correctly identified that transmission could occur at any time during pregnancy. Five women (8%) said the first trimester, one (2%) said third trimester, two (3%) said never, and 36 (58%) said they did not know. No one selected the second trimester as a time during which transmission could occur.

Discussion

Awareness of listeria

Almost one quarter (23%) of the women surveyed had never heard of listeria. This contrasts with the findings of Torvaldsen et al. (1999) that only 11% of new mothers in Western Australia were unaware of listeria.

Results of this study, however, support Torvaldsen's conclusion that rural women are less likely to have heard of listeria (OR 4.6, 95% CI 2.5-8.6). The high percentage (23%) of respondents who had not heard of listeria points to the need for education programs to be improved and revised particularly in rural areas. Torvaldsen et al. also hypothesised that the low rates of knowledge among rural women were due to their relatively poor access to health promotion materials compared with metropolitan-based women. Medical providers and services such as private hospitals and other alternative birthing centres or practitioners are also notably fewer in regional areas (Duckett & Kenny 2000; Wilkinson & Symon 2000). This is of importance given that these services are often the source of information about conditions such as listeriosis.

Younger women and women with lower education levels were found to be less likely to have heard of listeria. In particular women under 25, when compared with the reference group of women over 29, were almost six times less likely to have heard of listeria. This has important consequences as these women are therefore less likely to control dietary risks associated with listeria infection. There are also higher rates of early motherhood in rural districts compared to metropolitan areas (Victorian Perinatal Data Collection Unit 2001). Although most respondents (69%) heard of listeriosis before their pregnancy, there is still a significant group who are receiving their information at stages which might be too late.

Sources of information

Doctors and other health professionals were equally significant sources of information for respondents who had heard about listeria. The role of other health care professionals should therefore not be underestimated when developing strategies for listeria awareness campaigns or programs. Nevertheless, a significant number of women obtained information about listeria

from areas and sources other than health professionals. These included books, papers and magazines (reported by 40%), friends and relatives (reported by 33%), and a range of other sources (reported by 14%). It is encouraging to note a diversity of information sources regarding listeria risks and infection to women. Nevertheless, there is a need to ensure that information is accurate, reliable and up-to-date.

Information gained from a listeria pamphlet

Torvaldsen et al. (1999) reported that 86% of their survey respondents had seen a listeria pamphlet. However, of the respondents in this current study who had heard of listeria, only 28 (44%) reported having done so. Furthermore, 19 respondents had never heard of listeria, implying that only 35% of all the participants in this current study had actually seen a listeria pamphlet. Although the Victorian DHS sends the listeria pamphlet regularly to its offices throughout the state and to local councils, no respondent cited councils or government agencies as a source of the pamphlet. Further examination of the distribution of the pamphlet should be undertaken.

It was encouraging to note that the majority of those women who had seen the pamphlet regarded it as being useful or very useful. However, revision and expansion of the pamphlet in the areas such as risk foods, food preparation, symptoms in the mother, symptoms and illness in the foetus, and infection transmission times should be considered.

Knowledge of listeria transmission during pregnancy

Overall, the survey respondents displayed a poor knowledge of the stages of pregnancy during which transmission of listeria infection can occur. Over half of the new mothers ticked "don't know" to this question and a further 13% answered

incorrectly. This is of particular concern as a sound knowledge of transmission risks is vital to the prevention of infection in this high-risk group.

The levels of knowledge indicated were in contrast to the findings of Torvaldsen et al. (1999) that 83% of new mothers from metropolitan areas knew that transmission could occur at any time during pregnancy. This suggests that future campaigns in rural areas should emphasise the importance of avoiding the consumption of high risk foods during pregnancy. It is possible that this lack of knowledge may be related to the preferred information sources utilised by this group. Magazines, newspapers, friends, and relatives might focus more on the often dramatic outcomes of listeria infection than on the less newsworthy aspects such as transmission times.

Knowledge of symptoms and outcomes of listeria infection

Only two survey respondents were able correctly to identify all possible outcomes of listeria infection in pregnancy while not ticking any of the incorrect ones. However, all respondents who attempted this question were able to nominate at least one of the correct symptoms. This is critical as far as the public health and behaviour implications are concerned. Although 20 of the respondents indicated that they were unaware of the symptoms of listeria infection during pregnancy, it was encouraging that the remaining 44 (69%) recognised miscarriage as an outcome. Of some concern, however, is that 73% failed to recognise that flu-like symptoms in a pregnant woman could be a sign of listeria infection. As this is often the only noticeable indication of listeria infection for a pregnant woman, it is important for them to be able to recognise and report it to their medical practitioner (Donnelly 2001; Mylonakis et al. 2002). This is a key issue, which needs to be addressed by listeriosis educators.

Demographics and recruitment

Reasons for the overall low involvement rate (23%) might be related to the poor cooperation of hospitals and their participating staff. There was a particular lack of involvement from two of the hospitals that had given ethics approval. It is also possible that the chosen time of recruitment, that is 1-2 days after birth, had a negative impact upon the willingness of new mothers to participate. It is likely that many women were still recovering from the emotional and physical impact of birth and feeling the burden of responsibility of caring for a newborn infant. Midwifery personnel are also often under work pressures during the early post-natal periods, which might have made it difficult for them to recruit participants.

It may also be possible that the recruitment method was subject to influence. It was the role of individual nurses in the midwifery wards to give information to new mothers and discuss the research with them. It is feasible that some nurses thought that, with the other pressures of work, it was too difficult to approach women who had poor English skills. It might also have been that those mothers from non-English speaking backgrounds found the information or the questionnaire too difficult and did not agree to participate or did not complete the questionnaire.

Conclusion

The hypothesis that listeria is not well understood by young mothers in rural areas has been supported by this research, in so far as the results indicate a notable lack of understanding by this group of a number of key factors pertinent to the risks and consequences of listeria infection in pregnancy.

The results of this study did not confirm the findings of Torvaldsen et al. (1999) in

relation to general listeria awareness among new mothers. Whereas Torvaldsen et al. reported awareness levels of 89%, this figure was only 77% in the Loddon-Mallee region. Nor could we confirm the findings of Torvaldsen et al. that over 80% of women were able to identify correctly the stages of pregnancy when infection transmission could occur, with only 29% of mothers correctly answering this question. While our results support findings by Torvaldsen et al. that listeria information pamphlets are useful if used, the DHS strategy on listeriosis awareness at the time focused on the distribution of the pamphlet *Listeria: The Facts* to hospitals and other health agencies and our results indicate that these pamphlets were under-utilised.

Torvaldsen et al. (1999) reported that pamphlets are an effective medium for educating women about listeria. That finding was not fully supported by this research as the majority of women who had heard of listeria could not recall having ever seen a listeria pamphlet.

Recommendations

Future studies should include non-English speaking women and women born overseas. This could be facilitated by the development of information sheets, consent forms and questionnaires in languages other than English.

It would seem that a reorientation of official information into sources such as books, papers and magazines would be beneficial and successful in reaching a greater percentage of women. Education strategies need to focus the awareness campaigns to reach women before they become pregnant. Future studies should have a specific emphasis placed upon assessing rural women's access to education programs, sources of information about listeria, and the availability of medical practitioners and other health service providers.

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