

Self-Reported Protective Behaviour Against West Nile Virus Among Pregnant Women in Toronto

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Abstract

Objective: West Nile virus (WNV) is an emerging infection that can lead to substantial morbidity and mortality. Although data are limited with respect to the risk to the fetus and neonate, this risk is not inconsequential. Methods to reduce the risk of mosquito bites and WNV transmission are simple, economical, and effective in the non-pregnant population. The objective of this descriptive cross-sectional study was to assess adherence to protective behaviours against WNV in pregnant women and to determine predictors for such adherence.

Methods: A questionnaire was administered to all consenting pregnant women at two Toronto university hospitals.

Results: The majority of women reported practising behaviours that reduce the risk of mosquito bites and potentially of WNV infection. In this survey, between 40% and 80% of pregnant women avoided the outdoors, avoided areas with mosquitoes, and reported practising two or more personal protection behaviours. However, only 33% of pregnant women reported wearing mosquito repellent, with the majority expressing concern about the safety of repellent use during pregnancy. The majority of pregnant women cited the media or the Internet as a source of their knowledge about WNV; only 12% reported their physician as a source of such knowledge.

Conclusion: The majority of pregnant women are aware of WNV and practise protective behaviours that reduce the risk of transmission. However, they have unjustified fetal safety concerns about the use of mosquito repellent and are thus less likely to use it.

Résumé

Objectif : Le virus du Nil occidental (VNO) est une nouvelle infection pouvant mener à une morbidité et à une mortalité substantielles. Bien que les données soient limitées en ce qui concerne le risque

envers le fœtus et le nouveau-né, ce risque n'est pas sans conséquence. Les méthodes visant à réduire le risque de piqûres de moustique et de transmission du VNO chez la population non enceinte sont simples, économiques et efficaces. L'objectif de cette étude transversale descriptive était d'évaluer l'observance des comportements protecteurs contre le VNO chez les femmes enceintes et de déterminer les prédicteurs d'une telle observance.

Méthodes : Un questionnaire a été administré à toutes les femmes enceintes consentantes au sein de deux hôpitaux universitaires torontois.

Résultats : La majorité des femmes ont affirmé qu'elles adoptaient des comportements qui réduisaient le risque de piqûres de moustique et, potentiellement, d'infection au VNO. Dans le cadre de ce sondage, entre 40 % et 80 % des femmes enceintes évitaient les activités en plein air, évitaient les régions attirant les moustiques et affirmaient avoir adopté deux comportements de protection personnelle ou plus. Cependant, seulement 33 % des femmes enceintes affirmaient utiliser un insectifuge, la plupart des femmes enceintes exprimant des préoccupations au sujet de l'innocuité de l'utilisation d'un tel produit pendant la grossesse. La majorité des femmes enceintes citaient les médias ou Internet en tant que sources de leurs connaissances au sujet du VNO; seulement 12 % de ces femmes ont cité leur médecin en tant que source de ces connaissances.

Conclusion : La majorité des femmes enceintes connaissent le VNO et adoptent des comportements protecteurs qui réduisent le risque de transmission. Cependant, elles présentent des préoccupations injustifiées quant à la sécurité fœtale en ce qui concerne l'utilisation d'un insectifuge; elles sont ainsi moins susceptibles d'en utiliser un.

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INTRODUCTION

The prevalence of West Nile virus (WNV) infection in the population has varied from 2.6% to almost 10%.^{1–3} The virus is transmitted by infected *Culex* mosquitoes between birds of the Corvidae family (crows, jays, etc.);

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humans and other mammals are an incidental dead end.⁴ Outbreaks of WNV infection peak in late summer and early fall and are correlated with increased mosquito populations and increased outdoor activity.⁴ The majority of people infected with WNV are asymptomatic; 20% of those infected present with fever and flu-like symptoms that last three to six days and are collectively identified as West Nile fever. Patients may also have headache, nausea, vomiting, fatigue, malaise, skin rash, lymphadenopathy, eye pain, arthralgia, myalgia, and gastrointestinal symptoms. One in 150 to 300 patients develops severe neurologic sequelae, which progress to encephalitis, meningitis, meningoencephalitis, or acute flaccid paralysis.^{1,4,5} Patients who are over 50 years of age or who are immunocompromised are at higher risk for neurologic involvement, whereas children tend to have asymptomatic or mild symptomatic infection. Overall mortality is low. However, for those who develop neurologic sequelae, mortality rates range from 11% to 14%.⁵⁻⁷

Other than mosquito bites, potential routes of WNV transmission include organ and blood donations, breast milk, and intrauterine transmission.⁸⁻¹¹ To date there has been only one case of WNV infection with possible fetal sequelae reported.¹¹ A pregnant woman developed WNV meningoencephalitis in the third trimester of pregnancy. She had presented with fever, headache, blurred vision, abdominal pain, back pain, and vomiting. Four days later her fever resolved and she developed lower limb weakness and hyporeflexia in all extremities. Fetal monitoring continued to be normal throughout the WNV illness and until delivery. Her infant had bilateral chorioretinitis, severe bilateral white-matter loss in the temporal and occipital lobes of the brain, and cystic cerebral tissue destruction in one temporal lobe. Cord blood and infant's serum obtained by heel-stick were positive for WNV-specific IgM and neutralizing antibodies, and cerebrospinal fluid samples contained WNV-specific IgM indicating intrauterine infection with WNV. Since publication of this case report, another case of WNV infection during pregnancy has been described; however, the infant in this case demonstrated no obvious neurologic or other sequelae following delivery.¹² To monitor congenital WNV infection, the Centers for Disease Control and Prevention in the United States established a registry for pregnant women who develop WNV illness. O'Leary et al. summarized the results of surveillance, from 2003 to 2004, in which infants were followed until 12 months of age.¹³ These authors concluded that, despite negative laboratory evidence, congenital WNV infection cannot be ruled out with certainty.

Transmission of WNV via breast milk has been described.¹⁰ A pregnant woman acquired WNV infection from a blood transfusion she received shortly after delivery. She began

breastfeeding on the day of delivery, and her breast milk tested positive for WNV by polymerase chain reaction and for WNV-specific IgM and IgG antibodies. The infant remained healthy, even though the infant's serum tested positive for WNV-specific IgM antibody (suggesting asymptomatic WNV infection). Transmission of WNV through breast milk is biologically plausible, although a report of WNV surveillance observed that it is rare.¹⁴ Currently, there are no recommendations regarding breastfeeding practices in women who test positive for WNV.

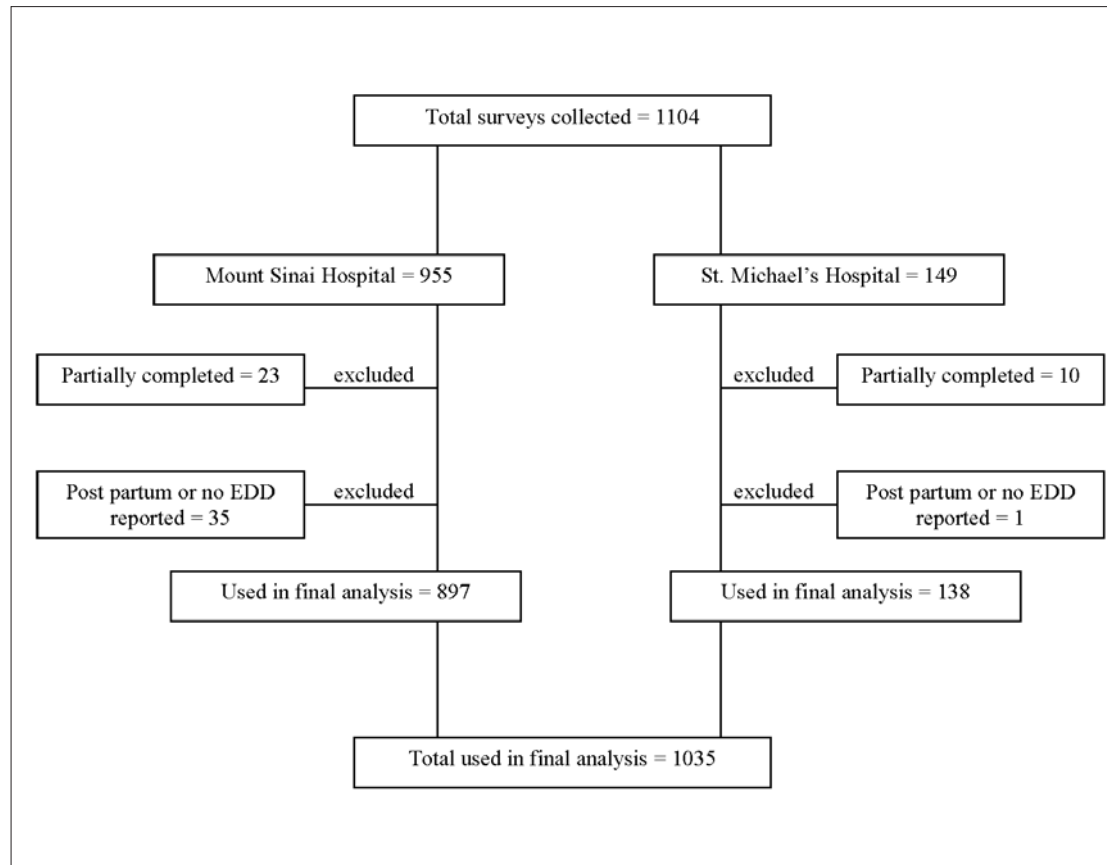
Given the lack of information regarding transplacental and breast milk transmission of WNV, the lack of understanding of neonatal sequelae of WNV infection, and the fact that there is no treatment for it, screening of asymptomatic pregnant women for WNV is not recommended.¹⁵ At present, the only effective method of dealing with WNV infection is primary prevention; therefore, this should be the focus of prenatal counselling about WNV infection. However, at this time pregnant women are not routinely counselled regarding protective behaviours against WNV. Three groups of investigators have assessed protective behaviours against WNV infection in the general population.^{2,3,16} In 2005, Loeb et al. demonstrated that those who practise two or more personal protective behaviours to avoid mosquito bites reduce their risk of acquiring WNV infection.² However, little is known about protective behaviours in pregnant women. The objective of this descriptive cross-sectional study was to assess adherence to protective behaviours against WNV in pregnant women and to determine predictors for such adherence.

MATERIALS AND METHODS

We conducted a cross-sectional study in the outpatient obstetric clinics of two tertiary care hospitals (Mount Sinai Hospital and St Michael's Hospital) between July 5 and August 31, 2006. Both hospitals are located in the downtown area of Toronto and serve the population of the city as well as commuters from the Greater Toronto area. In addition, Mount Sinai Hospital has a high-risk clinic that accepts patients from outside the city. There are 6500 deliveries per year in Mount Sinai Hospital and 3000 in St. Michael's Hospital.

Women of any gestational age were eligible to participate. The women were approached by office staff at the time of appointment check-in, the questionnaire was explained, and verbal consent was obtained. The two-page questionnaire contained 18 questions. No information about WNV was given to women before they answered the questionnaire. After completion, women were given a thank-you bookmark, containing information about WNV and protective behaviours against mosquito bites.

Study profile



EDD: estimated date of delivery

The questionnaire assessed the frequency (always, sometimes, rarely, or never) with which women reported practising source reduction behaviours (drain or remove objects that may collect water, check and clean gutters, check and repair screens, use bug lamps or bug zappers) and personal protective behaviours (avoid areas where mosquitoes are likely to be a problem, avoid outdoors, wear long sleeves or long pants when outdoors, wear mosquito repellent when outdoors for 30 minutes or longer). We also asked how often mosquitoes were seen indoors and how much time the women spent outdoors. In addition, the survey contained questions about demographics, the women's concerns related to WNV in pregnancy, and the sources of their knowledge about WNV.

Data were analyzed using SPSS, for Windows, (Version 15.0, Chicago, IL). We assessed factors associated with adherence (age, education level, area of residence, concern over using mosquito repellent, and concern over contracting WNV) using a chi-square test for binary variables and student *t* test for continuous variables.

Ethics approval for the study was obtained from the ethics review boards of Mount Sinai Hospital and St. Michael's Hospital.

RESULTS

A total of 1104 women, 955 from Mount Sinai Hospital and 149 from St. Michael's Hospital, completed surveys (Figure). Over 99% of women agreed to participate. Surveys that were completed partially (half of the survey or less) were excluded. Also, women whose surveys had a missing estimated date of delivery or who were post partum were excluded. A total of 1035 surveys were used for analysis.

Population demographics are shown in Table 1 (urban area is defined as having a population of 10 000 or more¹⁷). Overall mosquito exposure and protective behaviours practised by the women participating in the survey are shown in Table 2. Over 60% reported practising two or more source reduction behaviours and two or more personal protective behaviours.

The likelihood of performing source reduction and personal protection behaviours as a function of area of residence (urban vs. rural) and education is shown in Tables 3

Table 1. Demographics of survey respondents

	Mean	SD	Min	Max
Age in years	32.3	5.0	16	46
Gestational age in weeks	28.0	8.3	7	41
Education	n (%) (N = 1035)*			
< High school	27 (2.6)			
High school	88 (8.5)			
College	222 (21.5)			
Undergraduate	497 (48.0)			
Graduate/professional	195 (18.8)			
Residency	n (%) (N = 1035)*			
Rural	31 (3.0)			
Urban	973 (94.0)			
Home description	n (%) (N = 1035)			
Air conditioner	892 (86.2)			
Open deck or unscreened porch	641 (61.9)			
Screens on all doors and windows	738 (71.3)			
Tears in screens	174 (16.8)			

* Totals do not add up because of missing data

Table 2. Overall mosquito exposure and protective behaviours against West Nile virus

	n (%) (N = 1035)
Mosquitoes in home \geq 1x/week	132 (12.8)
Outdoor exposure	824 (79.6)
\geq 1 hr spent outside at dusk or dawn on a work day	494 (47.7)
\geq 1 hr spent outside at dusk or dawn on a nonwork day	714 (69.0)
Source reduction behaviours	
Drain objects that may collect water	634 (61.3)
Check and clean gutters	479 (46.3)
Check and repair screens if necessary	704 (68.0)
Use bug lamps/bug zappers	92 (8.9)
\geq 2 source reduction behaviours	636 (61.5)
Personal protective behaviours	
Always or sometimes avoid areas where mosquitoes are likely to be a problem	824 (79.6)
Always or sometimes avoid outdoors	404 (39.0)
Always or sometimes wear long sleeves or long pants when outdoors	556 (53.7)
Always or sometimes wear mosquito repellent when outdoors \geq 30 min	345 (33.3)
\geq 2 personal protection behaviours	683 (66.0)

and 4. The likelihood of these behaviours was similar for rural and urban women and for those with less than or greater than a high school education.

Tables 5 and 6 show the likelihood of women performing source reduction and personal protective behaviours depending upon whether they are worried about wearing mosquito repellent or whether they are worried about contracting WNV. Significantly more women who were worried about mosquito repellent reported wearing long sleeves and pants when outdoors than women who were not worried. In contrast, significantly fewer women who were worried about mosquito repellent reported wearing the repellent when outdoors for 30 minutes or more. Significantly more women who were worried about WNV reported checking screens and repairing them if necessary, using bug lamps or zappers, avoiding areas where mosquitoes are likely to be a problem, avoiding outdoors, wearing long sleeves or pants when outdoors, and practising two or more personal protection behaviours.

Finally, we investigated whether age affected the probability of engaging in protective behaviours. Source reduction behaviours such as draining objects that may collect water (correlation coefficient 0.064, standard error 0.035) and checking and cleaning gutters (0.076, standard error 0.030) as well as practising two or more source reduction behaviours (0.097, standard error 0.031) were significantly correlated with age.

Ninety-seven percent of pregnant women had prior knowledge about WNV, and 93% knew that it is transmitted by mosquitoes. With respect to the source of their knowledge, 92.7% reported learning about it from the media or Internet, 27.3% from their family or friends, 10.1% from their family or other doctor, 1.8% at work, 1.5% from their obstetrician, 0.8% from research, and 0.7% from public health.

Regarding concerns during pregnancy, 63.4% of women reported being worried about use of mosquito repellent. Of these, 60.0% were concerned about harm for their baby, 13.2% reporting concern about becoming sick from it, and 10.5% reported both. Of note, 63.7% reported concern about contracting WNV. When asked what was the most worrisome, almost two-thirds (64.7%) said they were concerned about mosquito repellent or the possibility of acquiring WNV in pregnancy, 20.3% reported WNV, 9.3% reported mosquito repellent, and 1.1% neither.

DISCUSSION

We found that the majority of women surveyed were well aware of WNV and its route of transmission. Most pregnant women, 61.5%, reported practising two or more source reduction behaviours. This result is similar to the

Table 3. Area of residence (rural vs. urban) and protective behaviours against West Nile virus

	Rural, n (%)	Urban, n (%)	OR (95% CI)	P
Source reduction behaviours				
Drain objects that may collect water (n = 944)	22 (78.6)	599 (65.4)	0.52 (0.21–1.28)	0.148
Check and clean gutters (n = 877)	19 (63.3)	449 (53.0)	0.65 (0.31–1.39)	0.265
Check and repair screens if necessary (n = 954)	28 (90.3)	656 (71.1)	0.26 (0.08–0.87)	0.019
Use bug lamps/bug zappers (n = 978)	4 (12.9)	86 (9.1)	0.67 (0.23–1.97)	0.469
≥ 2 source reduction behaviours (n = 1004)	24 (77.4)	599 (61.6)	2.14 (0.91–5.02)	0.073
Personal protective behaviours				
Always or sometimes avoid areas where mosquitoes are likely to be a problem (n = 1001)	20 (64.5)	782 (80.6)	0.44 (0.21–0.93)	0.027
Always or sometimes avoid outdoors (n = 998)	13 (41.9)	380 (39.3)	1.12 (0.54–2.30)	0.767
Always or sometimes wear long sleeves or long pants when outdoors (n = 1002)	16 (51.6)	523 (53.9)	0.91 (0.45–1.87)	0.805
Always or sometimes wear mosquito repellent when outdoors ≥ 30 min (n = 999)	12 (38.7)	324 (33.5)	1.26 (0.60–2.62)	0.543
≥ 2 personal protection behaviours (n = 1004)	22 (71.0)	643 (66.1)	1.26 (0.57–2.76)	0.571

Table 4. Education level and protective behaviours against West Nile virus

	≤ High school, n (%)	> High school, n (%)	OR (95% CI)	P
Source reduction behaviours				
Drain objects that may collect water (n = 966)	66 (59.5)	565 (66.1)	1.33 (0.89–1.99)	0.168
Check and clean gutters (n = 899)	56 (57.7)	421 (52.5)	0.81 (0.53–1.24)	0.329
Check and repair screens if necessary (n = 979)	85 (79.4)	616 (70.6)	0.62 (0.38–1.02)	0.057
Use bug lamps/bug zappers (n = 1001)	23 (21.5)	69 (7.7)	0.31 (0.18–0.52)	0.000
≥ 2 source reduction behaviours (n = 1029)	70 (60.9)	563 (61.6)	0.97 (0.65–1.44)	0.880
Personal protective behaviours				
Always or sometimes avoid areas where mosquitoes are likely to be a problem (n = 1026)	94 (81.7)	725 (79.6)	1.15 (0.70–1.89)	0.587
Always or sometimes avoid outdoors (n = 1023)	53 (46.1)	347 (38.2)	1.38 (0.94–2.04)	0.103
Always or sometimes wear long sleeves or long pants when outdoors (n = 1027)	75 (65.2)	478 (52.4)	1.70 (1.14–2.55)	0.009
Always or sometimes wear mosquito repellent when outdoors ≥ 30 min (n = 1024)	42 (37.2)	301 (33.0)	1.20 (0.80–1.80)	0.381
≥ 2 personal protection behaviours (n = 1029)	85 (73.9)	594 (65.0)	1.53 (0.99–2.37)	0.057

71% source reduction behaviour reported in an Ontario survey of the general population.² The majority of pregnant women in this survey reported practising personal protective behaviours to reduce the risk of mosquito bites. Compared with studies in the general population, more pregnant women avoided areas where mosquitoes are likely to be a problem (79.6% vs. 38–62%) and more women avoided outdoors (39% vs. up to 34%), but the numbers were similar in terms of wearing protective clothing to prevent mosquito bites.^{2,3,16,18} More pregnant women reported practising two or more personal protection behaviours than did the general population (66% vs. up to 61%).^{2,3} This is in keeping with the finding that women practise more

protection behaviours than men.¹⁶ In addition, women who are pregnant tend to take better care of themselves than non-pregnant women.^{19,20} However, despite being more health-conscious during pregnancy, in this survey fewer women reported wearing mosquito repellent (33.3% vs. 36–56% reported in the general population).^{2,3,16,18} Of women who completed the survey, 63% reported concern about using the repellent, which is a greater level of concern than that reported in other studies (40–55%).^{16,18} Furthermore, the majority of pregnant women reported worry that the use of mosquito repellent could harm their baby. Pregnant women continue to express concern despite a recently published study demonstrating that DEET is not associated

Table 5. Concern over using mosquito repellent in pregnancy and protective behaviours against West Nile virus

	Worried, n (%)	Not worried, n (%)	OR (95% CI)	P
Source reduction behaviours				
Drain objects that may collect water (n = 838)	421 (68.7)	140 (62.2)	0.75 (0.55–1.03)	0.078
Check and clean gutters (n = 779)	322 (56.1)	107 (52.2)	0.85 (0.62–1.18)	0.335
Check and repair screens if necessary (n = 848)	456 (73.0)	161 (72.2)	0.96 (0.68–1.36)	0.826
Use bug lamps/bug zappers (n = 866)	58 (9.1)	26 (11.3)	1.27 (0.78–2.07)	0.337
≥ 2 source reduction behaviours (n = 891)	428 (65.2)	143 (60.9)	1.21 (0.89–1.64)	0.228
Personal protective behaviours				
Always or sometimes avoid areas where mosquitoes are likely to be a problem (n = 888)	537 (82.2)	184 (78.3)	1.28 (0.89–1.86)	0.185
Always or sometimes avoid outdoors (n = 885)	268 (41.2)	85 (36.3)	1.23 (0.90–1.67)	0.194
Always or sometimes wear long sleeves or long pants when outdoors (n = 889)	375 (57.3)	115 (48.9)	1.40 (1.04–1.89)	0.026
Always or sometimes wear mosquito repellent when outdoors ≥ 30 min (n = 886)	207 (31.8)	110 (46.8)	0.53 (0.39–0.72)	0.000
≥ 2 personal protection behaviours (n = 891)	445 (67.8)	156 (66.4)	1.07 (0.78–1.47)	0.683

Table 6. Concern over contracting WNV infection and protective behaviours against West Nile virus

	Worried, n (%)	Not worried, n (%)	OR (95% CI)	P
Source reduction behaviours				
Drain objects that may collect water (n = 926)	402 (64.8)	207 (67.6)	1.13 (0.85–1.52)	0.397
Check and clean gutters (n = 864)	316 (55.1)	145 (50.0)	0.82 (0.62–1.08)	0.160
Check and repair screens if necessary (n = 941)	468 (74.5)	207 (66.1)	0.67 (0.50–0.90)	0.007
Use bug lamps/bug zappers (n = 962)	70 (11.0)	20 (6.2)	0.54 (0.32–0.90)	0.017
≥ 2 source reduction behaviours (n = 988)	417 (63.3)	195 (59.3)	1.18 (0.90–1.55)	0.221
Personal protective behaviours				
Always or sometimes avoid areas where mosquitoes are likely to be a problem (n = 985)	566 (86.3)	222 (67.5)	3.03 (2.20–4.18)	0.000
Always or sometimes avoid outdoors (n = 982)	298 (45.5)	87 (26.6)	2.30 (1.72–3.08)	0.000
Always or sometimes wear long sleeves or long pants when outdoors (n = 986)	369 (56.1)	158 (48.2)	1.37 (1.05–1.79)	0.019
Always or sometimes wear mosquito repellent when outdoors ≥ 30 min (n = 984)	235 (35.9)	103 (31.3)	1.23 (0.93–1.63)	0.154
≥ 2 personal protection behaviours (n = 988)	480 (72.8)	172 (52.3)	2.45 (1.86–3.23)	0.000

with adverse effects to the fetus when used as indicated, and despite the fact that DEET-containing repellents provide a longer period of protection than any other kind of repellent.²¹ The important message that DEET is effective and harmless does not appear to be reaching pregnant women.

Equal numbers of women expressed concerns about using mosquito repellent and about contracting WNV infection during pregnancy. Concern about WNV infection found in this study was similar to that reported among the general population, whereas anxiety about using mosquito repellent was higher.¹⁶ When women were asked to choose what worries them most in pregnancy, the majority answered that both WNV infection and the use of mosquito repellent in

pregnancy were worrying, whereas contracting WNV was the most worrisome among the general population.¹⁶ Women who were worried about mosquito repellent use were more cautious overall and reported practising slightly more source reduction and personal protective behaviours, especially wearing long sleeves and pants. As expected, they were less likely to use mosquito repellent. Concern over WNV seemed to be the best motivator, because women who reported being worried about WNV were significantly better at practising most of the protective behaviours. Age was positively correlated with source reduction behaviours but not with personal protection behaviours. Source reduction behaviours, especially “checking and cleaning gutters”

and “draining objects that may collect water,” are somewhat more applicable to women who live in single family homes. Therefore, this difference in behaviour may be explained by the fact that older women are more likely to live in single family homes.

Some limitations of our study must be acknowledged. All information was based on self-report only, with no methods available for corroboration. The study population consisted of well-educated women living in urban areas, and our findings may not be generalizable to pregnant women with fewer years of education or those living in rural areas. The comparison between rural and urban women is also limited by the small number of women from rural areas who participated in the survey. Finally, we compared our results to the published literature and did not assess a non-pregnant population of our own. Publications on this topic are limited and additional research is required.

CONCLUSION

In this descriptive cross-sectional study, pregnant women are shown to practise protective behaviours against West Nile virus as well as, or better than, the general population. However, they have fears and are less likely to use mosquito repellent, despite the evidence demonstrating its safety in pregnancy. Fear of contracting WNV seems to be the best motivator of protective behaviours. Health care professionals need to disseminate information to protect pregnant women and to dispel myths surrounding the use of mosquito repellents. Although there is hope for successful treatment in the future, currently the best way to avoid WNV infection is by the use of primary prevention measures.

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