

RESEARCH PAPER



Determinants of vaccine hesitancy in Quebec: a large population-based survey

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ABSTRACT

Objectives: Vaccine hesitancy is a global phenomenon that needs to be measured and addressed. This study aimed to identify the determinants of vaccine hesitancy among a large regional population.

Methods: A structured telephone survey was administered to a random digit sample in Quebec's Eastern Townships region. In addition to socioeconomic information, respondents were asked questions on several health topics such as knowledge and beliefs about immunization, medical consultations, health status, and life habits. Data were weighted according to age, sex, and territories. Statistically significant variables in the univariate analysis were introduced into a multivariate logistic regression model to determine independent factors for vaccine hesitancy (adjusted odds ratios [aOR] and 95% confidence intervals).

Results: A total of 8,737 interviews were conducted (participation rate 48.3%). Among all respondents, 32.2% were vaccine-hesitant. Several beliefs were significantly associated with vaccine hesitancy: belief that children receive too many vaccines (aOR = 2.72; 2.32–3.18), belief that a healthy lifestyle can eliminate the need for vaccination (aOR = 2.48; 2.09–2.93), and belief that the use of alternative medicine practices can eliminate the need for vaccination (aOR = 1.39; 1.16–1.68). Other determinants associated with vaccine hesitancy were having consulted a massage therapist (aOR = 2.34; 1.46–3.75), not being vaccinated against influenza (aOR = 1.80; 1.49–2.16), having a low (<\$30,000) (aOR = 1.58; 1.24–2.02) or moderate (\$30,000–\$79,000) (aOR = 1.37; 1.12–1.67) household income, distrust in public health authorities (aOR = 1.40; 1.21–1.63), perceived insufficient knowledge about immunization (aOR = 1.26; 1.04–1.51), and smoking (aOR = 1.22; 1.01–1.47).

Conclusions: Many determinants are related to vaccine hesitancy. These determinants should be taken into account when health professionals engage with vaccine-hesitant individuals.

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Introduction

Several vaccine-preventable diseases (VPD) were eliminated or controlled with vaccination. However, over the last decade, clusters of under-immunized individuals have led to community outbreaks by increasing transmission of VPD,¹ as observed with measles outbreaks in the USA, Canada, and Europe.^{1–4} This phenomenon, called “vaccine hesitancy”, is a growing issue that needs to be measured and addressed, according to the World Health Organization.⁵ Vaccine hesitancy refers to delays in acceptance or refusal of vaccination despite the availability of vaccination services.⁶ Although vaccine hesitancy is a global issue, it is considered context specific, i.e., it can vary across time, from one location to another, and according to the vaccine in question.⁶

To avoid outbreaks of VPD, high vaccine coverage needs to be reached and maintained. In Quebec (Canada), all vaccines recommended by the provincial immunization program are provided free of charge in public health clinics, hospitals, and physicians' offices.⁷ Unfortunately, only 71% of 2-y-olds are fully immunized against VPD (85% if excluding rotavirus

vaccine) in Quebec.⁷ An increasing number of individuals refusing or delaying vaccination for their children have been observed over the last few years.^{1,8,9} Among the general Quebec population, 31% of the adults ≥60 y, 44% of the adults <60 y with a chronic condition, and 55% of the health-care providers reported some hesitation to receive one or several vaccines for themselves.¹⁰ In the same study, 37% of the parents of children aged between 2 months and 17 y reported having hesitated to vaccinate their child.¹⁰ Vaccine-hesitant individuals are concerned about the need for and the safety of vaccines.^{11,12} Trying to convince vaccine-hesitant individuals by giving them a lot of facts and information generally backfires and makes them even more hesitant.¹³ The need for effective strategies to tackle vaccine hesitancy is, therefore, required.^{14,15}

Since vaccine hesitancy varies across settings, local assessments are needed to develop appropriate strategies.¹⁶ To our knowledge, only a few studies have assessed vaccine hesitancy and its determinants on a population basis.¹⁷ This study aimed to identify the determinants of vaccine hesitancy among a large regional population.

Results

A total of 8,737 individuals completed the questionnaire, for a participation rate of 48.3%. Among these, 7,205 (82.5%), 820 (9.4%), and 712 (8.1%) answered the questionnaire via a phone, the Internet, and a cellphone, respectively. Participants were aged 18–95 y old, with 59.5% of the respondents aged between 30 and 64 (Table 1). More than half of the respondents (55.4%) lived in the region's main city, Sherbrooke, and most of them (93.1%) spoke French at home.

Among all respondents, 32.2% were identified as vaccine-hesitant, with 13.3% and 18.9% identified as totally and somewhat vaccine-hesitant, respectively.

Compared to non-vaccine-hesitant respondents, vaccine-hesitant people were less likely to reside in the region's main metropolitan area (51.0% vs. 57.5%, $p < 0.001$) and lived with a partner (57.0% vs. 63.5%, $p < 0.001$). In the vaccine-hesitant group, people were more likely to have a lower education level (42.8% vs. 29.6%, $p < 0.001$), to have a lower household income (35.1% vs. 23.2%, $p < 0.001$), and to speak French at home (95.9% vs. 91.7%, $p < 0.001$).

Several variables pertaining to immunization were independently associated with vaccine hesitancy: belief that children receive too many vaccines (adjusted odds ratios [aOR] = 2.72; 2.32–3.18), belief that a healthy lifestyle can eliminate the need for vaccination (aOR = 2.48; 2.09–2.93), belief that the use of alternative medicine practices can eliminate the need for vaccination (aOR = 1.39; 1.16–1.68), and perceived insufficient knowledge about immunization (aOR = 1.26; 1.04–1.51) (Table 2). As for specific Health Belief Model (HBM) items, perceived vulnerability, vaccine benefits (flu vaccine can cause the flu and does not prevent flu transmission to family members and relatives), and one item of vaccine risks presented significant aOR.

Some health-care professional consultation habits were significantly linked to vaccine hesitancy, such as having consulted a massage therapist (aOR = 2.34; 1.46–3.75) or not having consulted a medical specialist over the last 12 months

(aOR = 1.26; 1.08–1.48) (Table 3). Those who did not vaccinate against influenza in the previous (2013–2014) season were nearly two times as likely to be vaccine hesitant than those who were vaccinated against influenza in the previous season (aOR = 1.80; 1.49–2.16). Smoking cigarettes was also independently associated with vaccine hesitancy (aOR = 1.22; 1.01–1.47). Participants who did not agree with the fluoridation of drinking water were also significantly more vaccine-hesitant compared to participants who did (aOR = 1.40; 1.21–1.63).

Some demographic and socioeconomic characteristics were also identified as independent determinants of vaccine hesitancy: having a low (<\$30,000) (aOR = 1.58; 1.24–2.02) or moderate (\$30,000–\$79,000) (aOR = 1.37; 1.12–1.67) household income, speaking French at home (aOR = 1.48; 1.09–2.02), and not living with a child less than 5 y of age (aOR = 1.26; 1.02–1.57) (Table 4).

Discussion

This study aimed to identify determinants of vaccine hesitancy among a large sample of the population residing in the Eastern Townships region because many health practitioners in the region were concerned about vaccine hesitancy. No regional data regarding vaccine hesitancy were available, but a previous study showed that this phenomenon existed in the Eastern Townships.¹⁸ This region contains some anti-vaccination groups explaining why the proportion of children who received no vaccine is slightly higher in the Eastern Townships (4–5%) compared to the rest of the Province of Quebec (1%).¹⁹ Population-based measurement of the level of vaccine hesitancy and its determinants is important in order to implement specific promotion and communication strategies among specific target subgroups¹⁶ and support training of immunization providers with strategies such as motivational interviewing. The present study was conducted among a large

Table 1. Demographic and socioeconomic characteristics of respondents according to vaccine hesitancy, Eastern Townships, 2014.

	Total (<i>n</i> = 8,737), <i>n</i> (%)	Vaccine-hesitant (<i>n</i> = 2,772), <i>n</i> (%)	Non-vaccine-hesitant (<i>n</i> = 5,840), <i>n</i> (%)	<i>p</i> -Value
Sex (<i>n</i> = 8,737)				
Male	4,275 (48.9)	1,381 (49.8)	2,843 (48.7)	0.327
Age (<i>n</i> = 8,620)				
18–29 y	1,650 (19.1)	513 (18.8)	1,130 (19.6)	
30–49 y	2,494 (28.9)	751 (27.6)	1,712 (29.6)	
50–64 y	2,637 (30.6)	857 (31.5)	1,734 (30.0)	
≥65 y	1,840 (21.3)	601 (22.1)	1,203 (20.8)	0.120
Place of residence (<i>n</i> = 8,737)				
Sherbrooke	4,840 (55.4)	1,413 (51.0)	3,357 (57.5)	<0.001
Education level (<i>n</i> = 8,697)				
High school or less	2,951 (33.9)	1,180 (42.8)	1,723 (29.6)	
College	2,802 (32.2)	887 (32.1)	1,879 (32.3)	
University	2,944 (33.9)	693 (25.1)	2,211 (38.0)	<0.001
Annual household income (before income taxes) (<i>n</i> = 8,329)				
<\$30,000	2,257 (27.1)	928 (35.1)	1,295 (23.2)	
\$30,000–\$79,000	3,908 (46.9)	1,230 (46.5)	2,623 (47.0)	
≥\$80,000	2,163 (26.0)	485 (18.4)	1,660 (29.8)	<0.001
Language spoken at home (<i>n</i> = 8,737)				
French	8,134 (93.1)	2,659 (95.9)	5,353 (91.7)	<0.001
Household composition (<i>n</i> = 8,716)				
Couple (with or without children)	5,345 (61.3)	1,572 (57.0)	3,705 (63.5)	
Person living alone	2,076 (23.8)	741 (26.8)	1,288 (22.1)	
Other (single-parent family, multiple families, and roommates)	1,295 (14.9)	447 (16.2)	840 (14.4)	<0.001

Table 2. Determinants of vaccine hesitancy, Eastern Townships, 2014 (Part 1 – HBM items).

(n = 4,954)	Multivariate regression
	aOR [95% CI]
Perceived knowledge about general vaccination	
Perceived insufficient knowledge about vaccination in general	1.26 [1.04–1.51]*
Perceived necessity of general vaccination	
Belief that a healthy lifestyle can eliminate the need for vaccination	2.48 [2.09–2.93]***
Belief that the use of alternative medicine practices can eliminate the need for vaccination	1.39 [1.16–1.68]***
Belief that children receive too many vaccines	2.72 [2.32–3.18]***
Perceived vulnerability to the flu	
Belief about the risk of catching the flu	1.57 [1.36–1.83]***
Perceived severity of the flu	
Belief that catching the flu does not cause severe health complications	1.09 [0.92–1.28]
Belief that catching the flu does not prevent daily activities	1.16 [0.97–1.39]
Perceived risks of the flu vaccine	
Belief that the influenza vaccine causes side effects	1.34 [1.14–1.57]***
Belief that people vaccinated against the flu have a risk of getting this disease	1.18 [1.00–1.39]
Perceived benefits of the flu vaccine	
Belief that the influenza vaccine can cause the flu	1.40 [1.20–1.63]***
Belief that getting vaccinated against the flu does not prevent its transmission to family members and relatives	1.19 [1.01–1.40]*
Subjective norm about the flu vaccine	
Not having received a recommendation from a health-care professional to get vaccinated against the flu	0.95 [0.81–1.12]

* $p < 0.05$, *** $p < 0.001$, bold value = $p < 0.05$.

sample of residents aged between 18 and 95 y and not only among parents of young children as was the case in prior studies.^{20–22}

According to our findings, 32% of our population were vaccine-hesitant according to the general question that was asked. This proportion is consistent with the findings from other studies that also reported an approximate rate of one-in-three vaccine-hesitant individuals among their study population.^{10,17,20–22}

Several items based on the HBM were significantly associated with vaccine hesitancy. For practical reasons, HBM items were related to influenza vaccination because this vaccine is largely recommended and has received many criticisms. Respondents that considered themselves not at risk of catching the flu and believed that the influenza vaccine could cause the flu or side effects were significantly more likely to be vaccine-hesitant after adjusting for all variables. In Canada and in the USA, a lack of belief in disease susceptibility and severity was strongly associated with partial immunization.^{11,23} Several studies also found an independent link between parental concerns about vaccine safety and under-immunization.^{11,17,20,23} “Perceived severity of influenza” was the only component that was not identified in our study as an independent determinant of vaccine hesitancy.

Other determinants strongly associated with vaccine hesitancy were the belief that a healthy lifestyle and alternative medicine practices could eliminate the need for vaccination.

Table 3. Determinants of vaccine hesitancy, Eastern Townships, 2014 (Part 2 – Health-care consultations and life habits).

(n = 4,954)	Multivariate regression
	aOR [95% CI]
Health-care professional consultations (over the last 12 months) – Conventional medicine	
Not having consulted a family doctor	0.99 [0.84–1.17]
Not having consulted a specialist	1.26 [1.08–1.48]**
Not having consulted a nurse	1.04 [0.88–1.22]
Not having consulted a pharmacist	0.96 [0.81–1.13]
Health-care professional consultations (over the last 12 months) – Alternative medicine	
Having consulted a massage therapist	2.34 [1.46–3.75]***
Having consulted a naturopath	1.01 [0.37–2.74]
Having consulted an osteopath	1.31 [0.91–1.89]
Health status/life habits	
BMI <30 kg/m ²	0.99 [0.82–1.20]
Self-perceived poor health status	1.07 [0.85–1.34]
Not being vaccinated against influenza	1.80 [1.49–2.16]***
Eating <5 daily servings of fruits or vegetables	0.99 [0.86–1.16]
Consuming ≥5 alcoholic drinks on one occasion per week	1.16 [0.92–1.46]
Smoking cigarettes	1.22 [1.01–1.47]*
Distrust in public health authorities	
Not agree with the fluoridation of drinking water	1.40 [1.21–1.63]***

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, bold value = $p < 0.05$.

Table 4. Determinants of vaccine hesitancy, Eastern Townships, 2014 (Part 3 – Demographic and socioeconomic variables).

(n = 4,954)	Multivariate regression
	aOR [95% CI]
Demographic and socioeconomic variables	
Place of residence: Sherbrooke	0.98 [0.84–1.14]
Education level: University	1.00
College	0.95 [0.78–1.15]
High school or less	1.17 [0.95–1.43]
Annual household income: ≥\$80,000	1.00
\$30,000–\$79,000	1.37 [1.12–1.67]**
<\$30,000	1.58 [1.24–2.02]***
Language spoken at home: French	1.48 [1.09–2.02]*
Household composition: Couple (with or without children)	1.00
Other (single-parent family, multiple families, and roommates)	0.87 [0.71–1.06]
Person living alone	0.90 [0.71–1.13]
Not living with a child aged <5 y old	1.26 [1.02–1.57]*
Not being a health-care professional	0.89 [0.64–1.22]

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, bold value = $p < 0.05$.

Indeed, others found similar results and showed that parents concerned with the utility or the necessity of vaccines were more likely to intend to follow an alternative immunization schedule for their children.²⁰ According to qualitative studies, vaccine-hesitant parents believed they could protect their child's life from infectious diseases through good nutrition, physical activity, handwashing, high air quality, and limited contact with other children (e.g., by avoiding daycare), rather than through immunization.^{11,18}

Respondents who felt that children receive too many vaccines were also more likely to be vaccine-hesitant, regardless of other confounding variables. Indeed, some vaccine-hesitant individuals may be preoccupied about the number of vaccines perceived to be given too early to their children and during a too short time window.¹¹ In a Canadian study, parents who believed that too many shots were administered at one time were less likely to complete their children's immunization schedule.²³ Moreover, people who feel they had insufficient knowledge about vaccination were more likely to be vaccine-hesitant. Several studies demonstrated the association between the perceived lack of information and negative attitudes about immunization.^{11,24}

Health professional consultation habits were also identified as a vaccine hesitancy determinant. For instance, having consulted a massage therapist was significantly associated with vaccine hesitancy. This result is consistent with the belief that the use of alternative medicine practices can eliminate the need for vaccination, also identified in the study as an independent determinant of vaccine hesitancy. A similar finding was demonstrated in a UK study where parents who chose to delay their children's vaccination were significantly more likely to have visited a homeopath.²⁵ The use of alternative medicine resources such as chiropractors, naturopaths, and midwives was reported by mothers of under-immunized children in a study conducted in the Eastern Townships region.¹⁸ This study also showed a significant association between midwife-assisted birth and an incomplete vaccine status for the child,¹⁸ meaning that mothers giving birth with a midwife are usually more vaccine-hesitant and did not give their child all the recommended vaccines.

We also found that smoking is significantly linked to vaccine hesitancy. Although it may be a coincidence, this result is supported by other studies who also found a similar association.^{26,27} This may suggest that vaccine-hesitant individuals appear to have less healthy living habits than non-vaccine-hesitant people. In a US study, smokers were more likely to be unvaccinated against the flu, suggesting that these individuals may be less concerned with health issues such as immunization.²⁶ This association was also found in Turkey where maternal cigarette smoking was significantly linked to an incomplete vaccination status in children <3 y of age.²⁷

Distrust in public health authorities regarding the addition of fluoride in municipal drinking water was identified as an independent determinant of vaccine hesitancy. Parents who refused or delayed their children's vaccinations are more likely to distrust the government and to be suspicious of the influence of pharmaceutical companies.^{25,28} They typically present issues of trust in the government's role in protecting the population from health risks, which could, therefore,

apply to a publicly funded government program such as vaccination.

Some socioeconomic factors were also significantly associated with vaccine hesitancy. In many countries, studies demonstrated opposite results: vaccine hesitancy has been associated with both high and low socioeconomic status.²⁹ In our study, respondents with low and moderate household income were significantly more vaccine-hesitant than people having an annual income of \geq \$80,000. Although Canadian and US studies showed an association between vaccine hesitancy and both high and low income,^{12,17,30-35} our result is supported by another study who demonstrated that US mothers with an income <\$40,000 were less trusting with regard to vaccines compared to mothers having a higher income.³⁶ The authors suggested that lower socioeconomic status in the USA was linked to a mistrust of the health-care provider, which could, therefore, explain the association between low income and vaccine hesitancy. In our study, trust in the health provider was not assessed, but distrust in public health authorities was identified as a factor increasing vaccine hesitancy. Socioeconomic factors should be further explored in future studies since household income influences vaccine hesitancy even in a setting that benefits from a universal health-care system and where vaccines are publicly funded and available for free. People with low household income may have less access to health care and may thus benefit from fewer recommendations about vaccination.

Speaking French at home was also associated with vaccine hesitancy. This result supports the fact that some cultural factors may be related to vaccine hesitancy.

Finally, not living with a child less than 5 y old was associated with vaccine hesitancy. People living with young children may have more knowledge about vaccines since they likely had to make a decision regarding their children's vaccination compared to persons not living with young children. This may explain why people not living with young children were more vaccine-hesitant. This last observation is also coherent with the fact that people who reported having insufficient knowledge about vaccination were also more likely to be vaccine-hesitant.

A major strength in this study was the analysis of many variables related to several health-related topics such as physician consultations, perceived health status, life habits, or sociodemographic characteristics. A further strength was the large sample size that made it possible to include many variables in the regression analysis. In studies using telephone surveys, people with no home phone are usually not reached. However, in our study, people with only cell phones and no phone at home were also contacted, which reduced the inherent selection bias generated by this type of study. An online survey was also available to reach more participants.

However, some limits in this study need to be addressed. First, because of the cross-sectional study design, it was not possible to establish a straight cause-effect relationship between vaccine hesitancy and the observed determinants. Furthermore, other studies used between one and three items to measure vaccine hesitancy,^{10,17,20} whereas vaccine hesitancy was measured using only one item in the present study. The validated 15-item tool developed by Opel *et al.*

was not used since this survey only targets parents of young children.²² In spite of the recruitment procedure that implied first calling the participant to make an appointment and then later answering the survey at the agreed time, our participation rate was quite substantial. However, as with most studies, our sampling may have been affected by a potential selection bias, which means that nonrespondents could have different opinions about immunization compared to respondents. However, weighting methods and the fact that the survey was about health, not only about immunization, partially reduce this nonresponse bias. Weighted data were used in all analyses to ensure a better representation of the population of the Eastern Townships, which allowed for a generalization of the results in the entire region.

Conclusions

This study determined several independent factors influencing vaccine hesitancy among a large population-based sample of individuals residing in the Eastern Townships region. People who consult alternative health-care professionals, smoke cigarettes, have issues of trust with public health authorities, or have a low household income should be particularly targeted by health professionals during immunization counseling. Future strategies to tackle vaccine hesitancy should take into account these determinants.

Methods

Design and sample

A cross-sectional study was conducted between June and October 2014 in the Eastern Townships, a southern region of Quebec (Canada) with 320,000 residents in 2014 (4% of Quebec population).³⁷ A phone survey was administered over a large random digit sample by trained interviewing staff targeting 8,700 adults living in the region. The sample was stratified according to the territory of residence, with half of the sample ($n = 3,900$) living in Sherbrooke, the main city of the region, and 800 residents from each of the other six territories ($n = 4,800$). Adults 18 y old and over, living in private households and speaking French or English, were eligible to participate in the study. During the study period, a total of 148 trained interviewers made phone calls between 10:00 am and 9:00 pm on weekdays and 3:00 pm and 9:00 pm on Sundays to check respondent's eligibility, obtain verbal consent to participate, and schedule appointments for answering the survey. Interviewers then conducted computer-assisted telephone interviews at the agreed appointment based on a structured questionnaire during weekdays between 8:30 am and 5:00 pm. An online version of the survey was also available to respondents if they preferred or were not available for the appointment.

Survey questionnaire

A questionnaire was developed to assess several health topics among the population. Questions were mostly based on

validated questionnaires and were determined with the collaboration of university researchers of the Eastern Townships Health Authority. In this case, relevant items, such as questions about physician consultations, perceived health status, life habits, and socioeconomic situation, were considered in this analysis in order to identify independent determinants of vaccine hesitancy.

Items pertaining to immunization knowledge, attitudes, and beliefs were based on the HBM, an established theoretical framework used to examine patient motivations for adopting a preventive health-related behavior,³⁸ and were developed by immunization experts from the Eastern Townships Public Health Department. The HBM has been used before in several studies to assess immunization beliefs and behaviors.^{39–41} Based on this model, four components were assessed in the present study: perceived susceptibility (i.e., respondent's beliefs about their risk of getting a condition), perceived severity (i.e., respondent's concerns about the seriousness of a condition and its consequences), perceived vaccine benefits, and perceived vaccine risks. These four components concerned influenza immunization since this vaccine is indicated for everyone, and as it is recommended every year, participants should remember more easily the reasons for accepting or not receiving it. The other items (perceived knowledge and perceived necessity) concerned general vaccination. Vaccine hesitancy, the main outcome measure in this study, was assessed by one item: "Do you agree with this statement: I am not in favor of vaccination in general".

Items mainly used a 4-point Likert scale, and the questionnaire was pre-tested in the beginning of June 2014. The study was approved by the CSSS-IUGS Research Ethics Board.

Statistical analyses

Data were weighted according to age, sex, and territory of residence using an iterative method in order to better represent the population of the Eastern Townships. Likert-scaled responses were analyzed as dichotomous variables indicating the respondent's agreement or lack of agreement with the item (e.g., totally/somewhat agree vs. totally/somewhat disagree). Chi-square tests were performed to explore differences in responses between vaccine-hesitant and non-vaccine-hesitant respondents. Responses "I don't know" or "Preferred to not answer" for some variables, representing between 0 and 4.7% of all responses, were excluded only in the specific analyses involving those variables.

Univariate logistic regressions were first performed in order to examine each variable individually without adjusting for the effects of others. All statistically significant variables associated with vaccine hesitancy for a significance level set at 0.05 were then introduced into a multivariate model in order to identify independent determinants of vaccine hesitancy. Adjusted odds ratios (aOR) and their respective 95% confidence intervals were calculated. All analyses were conducted using SPSS version 20.0.

Abbreviations

AOR Adjusted odds ratio
CI Confidence intervals

HBM Health Belief Model
VPD vaccine-preventable diseases

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No potential conflicts of interest were disclosed.

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