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Assessing knowledge, attitudes, willingness, and barriers to Pneumococcal vaccination among Canadian older adults: a cross-sectional survey

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Abstract

Background Pneumococcal disease is a leading cause of morbidity and mortality worldwide, with older adults aged 65 and above at particularly high risk for invasive pneumococcal infections. In Canada, pneumococcal vaccination has been recommended for this age group since 1989, yet coverage remains below national targets. Currently, only about 55% of older adults report being vaccinated, falling short of the 80% target. This study assessed knowledge, attitudes, willingness, and barriers to pneumococcal vaccination among unvaccinated older adults.

Methods We used baseline data from a randomized controlled trial conducted as a cross-sectional survey among community-dwelling adults aged 65 years and older, residing in any of the ten Canadian provinces, and who self-identified as unvaccinated against pneumococcal disease. The survey was administered online using a tailored web-based electronic data capture system. Data were collected between June 20, 2024, and December 12, 2024, capturing data on participants' knowledge, attitudes, and willingness to receive the vaccine, along with perceived barriers. Ordinal logistic regression was used to identify factors associated with willingness to be vaccinated, categorized as "willing", "not willing", and "I don't know".

Results A total of 720 participants completed the baseline survey. Ninety percent of the respondents had moderate to good knowledge, and 47% reported positive attitudes toward the vaccine. 59% of respondents reported willingness to be vaccinated, 20% were unwilling, and 21% were unsure. We also found that positive attitudes were the strongest predictor of willingness to be vaccinated (aOR 14.8, 95% CI: 9.2-23.9), followed by good knowledge of pneumococcal vaccines and pneumococcal disease (aOR 2.6, 95% CI: 1.4-5.0). Regional differences emerged, with significantly higher willingness among those residing in the Prairies versus Ontario. Commonly reported barriers included affordability concerns and lack of awareness about where to get vaccinated.

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Conclusion Our findings underscore the need to address attitudes alongside knowledge in public health efforts to improve pneumococcal vaccine uptake among older adults. Tailored interventions that reduce logistical and informational barriers may help close the coverage gap and support national immunization goals.

Keywords Pneumococcal vaccination, Older adults, Vaccine uptake, Barriers to vaccination

Introduction

Streptococcus pneumoniae causes illnesses ranging from non-invasive conditions, such as non-bacteremic pneumonia, otitis media, and rhinosinusitis, to invasive pneumococcal disease (IPD), which can present as bacteremic pneumonia, sepsis, or meningitis. It remains a prominent source of morbidity and mortality globally, particularly among young children, older adults, and immunocompromised individuals [1]. In 2016, the overall incidence was 26.7 per 1,000, rising to about 71 per 1,000 in children under five and adults over 70 [2, 3]. In Canada, the annual incidence of IPD remained stable between 2009 and 2019, ranging from 9.8 to 10.1 cases per 100,000 population, but – according to the most recent estimates – declined to below six cases per 100,000 in 2020 and 2021 [4]. Despite this decline, older adults continue to bear a disproportionate burden. Between 2011 and 2017, the annual incidence of IPD among adults aged 65 years and older was approximately 24 per 100,000 [5] In 2020; this age group accounted for 34.1% of all identified IPD isolates in Canada [5].

To mitigate this burden, the National Advisory Committee on Immunization (NACI) has recommended pneumococcal vaccination for all adults aged 65 years and older since 1989, initially with a single lifetime dose of the 23-valent polysaccharide-based pneumococcal vaccine (PPV-23) [6]. Since 2001, all Canadian provinces and territories have publicly funded PPV-23 for this age group, though delivery channels and communication strategies vary by province. In most provinces, vaccination is offered through primary care providers, public health clinics, and pharmacies. In 2024, NACI updated its guidance to recommend a single dose of either the 20-valent (Pneu-C-20) or 21-valent (Pneu-C-21) pneumococcal conjugate vaccine, allowing broader serotype coverage for adults aged 65 and older and for high-risk individuals aged 50–64, regardless of prior vaccination history [7].

Despite ongoing efforts to improve pneumococcal vaccine uptake and reduce disease burden, current coverage rates remain suboptimal. The 2020–2021 Seasonal Influenza Vaccination Coverage Survey carried out by the Public Health Agency of Canada (PHAC) found that among 2,739 Canadian adults surveyed only 55% of those aged 65 and older reported having received a pneumococcal vaccine, with higher coverage among females (60%) than males (48%) [8]. This remains well below the national target of 80% set to be achieved by 2025 [8].

Our previous work using data from the Canadian Longitudinal Study on Aging (CLSA) [9] found similar results: only 54.2% of 22,246 CLSA participants aged 65 and older surveyed between 2015 and 2018 reported ever receiving a pneumococcal vaccine [9]. We also identified several sociodemographic factors associated with higher likelihood of not receiving a pneumococcal vaccine, including male sex (aOR [adjusted odds ratio] = 1.34; 95% CI: 1.26–1.42), self- identifying as any race other than white (aOR = 1.23; 95% CI: 1.05–1.44), being divorced or separated (aOR = 1.17; 95% CI: 1.02–1.34), living in rural areas (aOR = 1.13; 95% CI: 1.04–1.23), and residing in the Atlantic provinces (especially Newfoundland: aOR = 2.33; 95% CI: 2.04–2.66) compared to Ontario [9]. Additionally, our findings revealed that missed opportunities for pneumococcal vaccination are frequent among older adults in Canada. Among CLSA participants age-eligible for pneumococcal vaccine who had received an influenza vaccine or seen a family physician in the previous year, 32.6% (95% CI: 31.9–33.4) and 44.8% (95% CI: 44.1–45.5), respectively, had not received a pneumococcal vaccine [9].

A 2020–2021 PHAC survey found that among 365 adults aged 65 and older who did not receive a pneumococcal vaccine, 32% believed the vaccine was unnecessary, and 17.5% had never heard of it [8]. These findings suggest that knowledge gaps and misperceptions about risk may contribute to the persistently low pneumococcal vaccine coverage among older Canadians. However, a comprehensive assessment of the factors leading to non-vaccination is lacking. Addressing this gap is essential for developing effective interventions to increase vaccine coverage among this high-risk population.

This study aimed to (1) assess knowledge, attitudes, and willingness to receive the pneumococcal vaccine among Canadian adults aged 65 years and older who reported not being vaccinated for pneumococcal disease, and (2) identify factors associated with lack of willingness to receive a pneumococcal vaccine.

Methods

Study design

This study reports baseline survey data from participants enrolled in a randomized controlled trial (RCT) registered in ClinicalTrials.gov [NCT06234683] on January 22, 2024, which aims to improve the knowledge, attitudes, willingness, and actual uptake of pneumococcal vaccines among community-dwelling older adults. The

findings presented in this paper pertain to the initial cross-sectional component of the study, conducted prior to the implementation of a web-based educational intervention; thus, the present analysis does not evaluate the effectiveness of the intervention. The baseline survey was designed to assess participants' knowledge, attitudes, and willingness to receive the pneumococcal vaccine and associated barriers related to lack of vaccination willingness before any study interventions (either tailored educational video plus a reminder to get vaccinated or reminder only) were administered.

Sample size

The sample size for this study was pre-determined based on the primary outcomes of the larger RCT (i.e., estimating the effectiveness of the intervention), rather than the baseline survey alone. The target sample size for the RCT was 786 participants spread equally across two study arms. This survey was administered at baseline before the trial intervention was administered.

Study population

Eligible participants were community-dwelling individuals aged 65 years or older, residing in any of the ten Canadian provinces, and reporting not having received the pneumococcal vaccination. Eligibility was assessed through a screening questionnaire. We initially planned to recruit participants through various channels, e.g., social media platforms and electronic newsletters, in collaboration with organizations that work with and for older adults across the country. We reached out to 95 organizations across Canada. Of those, 39 responded, and only 22 agreed to share the study invitation through their communication channels. After two months, just 9 participants had enrolled. Because the response was much lower than expected, we decided to change our recruitment approach. Consequently, we partnered with the Canadian Hub for Applied and Social Research (CHASR) at the University of Saskatchewan, which assisted us in recruiting participants through third-party online panel providers Zamplia that maintains a proprietary database of individuals who have opted in to participate in research studies, recruited through digital outreach and incentivized through rewards programs (loyalty points). The CHASR used Zamplia by submitting a detailed recruitment request, specifying the target population parameters, required sample size, and inclusion and exclusion criteria. The panel provider identified potentially eligible individuals from its existing pool of profiled panelists and managed all recruitment and communication. The research team and CHASR did not have direct contact with participants or access to any personally identifying information at any stage of the recruitment process.

Data collection

A tailored web-based electronic data capture system (web-EDCS) was developed by the Ottawa Methods Centre (OMC) to host and administer both the electronic consent form and survey, which were offered in both English and French. We piloted the survey with a convenient sample of 25 older adults who provided feedback on the readability, accessibility, and ease of completion of the survey. The survey questionnaire included a combination of closed-ended, multiple-choice, and Likert-type questions. All study materials were first developed in English and were translated to French using an online tool and reviewed by a native French speaker. The questionnaire was structured based on the World Health Organization's Behavioural and Social Drivers (BeSD) Framework [10] and focused on factors that have been found to influence vaccination willingness among older adults based on the scientific literature [11] and our team's prior experience [9, 12]. The questionnaire is available in Appendix 1.

The survey included an option allowing for proxy responses in cases where the intended respondent was unable to complete the survey themselves due to any limitations. Moreover, it was instructed in the screening section that all proxies had to answer based on the participant's situation and perspective. Upon confirmation of eligibility through a screening questionnaire, consenting participants were asked a range of questions to assess their knowledge of pneumococcal vaccines and the recommendation for older adults, to explore reasons for non-vaccination, to document their immunization history (e.g., prior receipt of other age-recommended vaccines), and to evaluate attitudes towards vaccines in general and pneumococcal vaccines in particular. Additional questions addressed healthcare utilization, barriers to accessing care, facilitators to access (e.g., transportation, clinic location, etc.), and preferred channels for accessing immunization services. Basic sociodemographic data and personal health information were collected as well.

Outcomes and data analysis

We used descriptive methods to analyze participants' responses to survey questions, reporting counts, proportions, and 95% confidence intervals (CIs). Composite scores were constructed separately for knowledge and attitudes by summing responses to relevant survey questions. Specifically, for knowledge questions with binary yes/no responses, a score of 1 was assigned to "yes" (indicating correct or informed responses) and 0 to "no". For attitude items, Likert-type questions with six response options (strongly disagree, disagree, neutral, agree, strongly agree and prefer not to answer), were scored such that only responses of "agree" or "strongly agree" were scored as 1, while all other responses were scored

as 0. This dichotomization was chosen to emphasize clear positive attitudes and to avoid misclassifying neutral responses as positive, thereby ensuring consistency across items and participants. The total score for each participant was then converted into a percentage. Based on these percentage scores, participants were categorized into three levels: poor (≤ 49%), moderate (50–79%), or good knowledge (≥ 80%). This classification approach aligns with methods used in previous knowledge-based assessment studies that apply similar percentage thresholds for categorizing knowledge levels [13, 14]. A similar categorization approach was applied to attitude-related items, resulting in participants being categorized as having a negative (≤ 49%), neutral (50–79%), or positive attitude (≥ 80%). Internal consistency was assessed using Cronbach's alpha for the Likert items (α = 0.85), indicating strong reliability. Binary knowledge items were not included in this analysis, as they were designed to capture factual responses rather than graded ones. We also stratified baseline characteristics by willingness to receive the pneumococcal vaccine.

To estimate associations between participants' knowledge of and attitudes towards pneumococcal vaccines (both measured using composite scores), and their willingness to receive the vaccine, we utilized ordinal logistic regression models with willingness to receive the vaccine ("yes", "no", "I don't know") as the outcome variable and reported adjusted odds ratios (aORs) and 95% confidence intervals (CIs). The models were adjusted for sociodemographic characteristics (sex and province of residence) and health-related factors (having one or more chronic medical conditions, and indicators of healthcare utilization). All three response categories for the outcome variable were included to reflect meaningful distinctions in vaccine decision-making: "I don't know" was treated as a distinct expression of uncertainty, rather than grouped with acceptance or refusal. We also assessed the correlation between knowledge and willingness, and between attitude and willingness, using Spearman's rank correlation. Although the proportional odds assumption was formally tested using the likelihood ratio test and found to be violated, we retained the ordinal logistic regression model in the main analysis for simplicity and interpretability. To validate our findings, we also fitted a generalized ordered logistic regression model using the user-written gologit2 command in Stata, which relaxes the proportional odds assumption for the variables that violated the assumption (attitude and frequency of visit to provider) [15]. Additionally, subgroup analyses by sex were performed to explore sex-specific differences in these associations. All analyses were conducted using Stata version 18.0 (Stata-Corp, College Station, TX, USA) [16].

Results

A total of 2069 participants consented and were screened. Among these, 764 met the eligibility criteria, and 720 participants completed the baseline survey between June 20, 2024, and December 12, 2024. Of these, 714 participants responded to the survey in English and 6 in French. Most participants completed the survey by themselves; however, 73/720 responses were given by a proxy responder (e.g., a caregiver). The main socio-demographic characteristics and healthcare utilization patterns of survey respondents are presented in Table 1. There was an almost even split between male and female participants. Nearly half of the respondents were from Ontario (43.1%, 95% CI: 39.6–46.8), followed by the Prairie Provinces (25.1%, 95% CI: 22.0-28.4) and British Columbia (17.2%, 95% CI: 14.6–20.1).

In terms of healthcare utilization, 48.4% (95% CI: 44.8–52.1) reported visiting their healthcare provider more than once per year, while 25.2% (95% CI: 22.2–28.5) reported one visit annually. Most participants (71.3%) reported having received an influenza vaccine at least once (i.e., every year, occasionally, or once), and among them, 68.7% (95% CI: 64.5–72.5) had received it in the previous 12 months. Additionally, 83.3% (95% CI: 80.4–85.9) reported having received a COVID-19 vaccine, and 53.4% (95% CI: 49.8–57.0) reported having an underlying health condition.

Approximately three quarters of participants had heard of the pneumococcal vaccine (Table 1). Based on composite scores, approximately nine participants out of ten had reported moderate to good knowledge about pneumococcal vaccination (Table 2). Specifically, 70.2% were aware that the pneumococcal vaccine is recommended for adults aged 65 years and older, and 53% were familiar with its potential benefits for their age group. Regarding attitudes, 64.3% of participants demonstrated neutral to positive attitudes toward the pneumococcal vaccine (Table 3). Notably, 60.2% agreed that the pneumococcal vaccine is important for their health (Table 3).

Of the 715 participants, 59% (423) expressed willingness to receive a pneumococcal vaccine, while 143 (20%) indicated they were not willing and 149 (21%) reported being unsure or responded, "I don't know." Five participants from the total sample of 720 selected 'prefer not to answer' for the willingness question and were excluded from this analysis. This exclusion represented < 1% of the sample and did not impact findings (Table 1). Stratified analyses showed overlapping confidence intervals between willing and unwilling participants for several variables, including sex, gender, participation of other household members, province of residence, and whether they had an underlying health condition. However, participants who were willing to be vaccinated were more likely to report: visiting their healthcare provider more

Table 1 Sociodemographic, health status, and healthcare utilization characteristics of survey participants stratified by willingness to get Pneumococcal vaccine

Characteristics	Overall (*N* = 720)		Willing (*N* = 423)		Not willing (*N* = 143)		Don't know (*N* = 149)	
	n	% (95% CI)	*n*	% (95% CI)	*n*	% (95% CI)	*n*	% (95% CI)
Sex								
Male	371	51.53 (47.86–55.16)	216	51.06 (46.29–55.81)	72	50.35 (42.20-58.47)	82	55.03 (46.97–62.83)
Female	348	48.33 (44.69–51.99)	207	48.94 (44.18–53.70)	71	49.65 (41.52–57.79)	67	44.97 (37.16–53.02)
Prefer not to answer	1	0.14 (0.01–0.98)	0	0.00 (N/A)	0	0.00 (N/A)	0	0.00 (N/A)
Gender								
Man	369	51.25 (47.59–54.89)	215	50.83 (46.06–55.57)	71	49.65 (41.52–57.79)	82	55.03 (46.97–62.83)
Woman	347	48.19 (44.55–51.85)	207	48.94 (44.18–53.70)	71	49.65 (41.52–57.79)	66	44.30 (36.51–52.36)
Other	4	0.55 (0.20–1.47)	1	0.23 (0.03–1.66)	1	0.69 (0.09–4.80)	1	0.67 (0.09–4.62)
Prefer not to answer	1	0.14 (0.01–0.98)	0	0.00 (N/A)	1	0.70 (0.09–4.80)	0	0.00 (N/A)
Someone else from the household participated								
Yes	51	7.08 (5.42–9.20)	37	8.75 (6.39–11.84)	14	9.79 (5.87–15.86)	0	0.00 (N/A)
No	660	91.67 (89.40-93.47)	381	90.07 (86.82–92.58)	129	90.21 (84.13–94.12)	146	97.99 (93.93–99.35)
I don't know	8	1.11 (0.55–2.20)	5	1.18 (0.49–2.81)	0	0.00 (N/A)	3	2.01 (0.64–6.06)
Prefer not to answer	1	0.14 (0.01–0.98)	0	0.00 (N/A)	0	0.00 (N/A)	0	0.00 (N/A)
Province of residence								
British Columbia	124	17.22 (14.63–20.16)	71	16.78 (13.51- 20.66)	19	13.29 (8.63–19.90)	32	21.48 (15.60–28.80)
Ontario	311	43.19 (39.61–46.84)	183	43.26 (38.60-48.03)	71	49.65 (41.52–57.79)	54	36.24 (28.91–44.26)
Quebec	50	6.94 (5.29–9.05)	26	6.15 (4.21–8.87)	10	6.99 (3.79–12.52)	14	9.40 (5.63–15.25)
Newfoundland and Labrador	14	1.94 (1.15–3.25)	9	2.13 (1.10–4.04)	1	0.70 (0.09–4.80)	4	2.68 (1.0-6.94)
Maritime Provinces	40	5.56 (4.09–7.48)	20	4.73 (3.06–7.21)	5	3.50 (1.46–8.13)	15	10.07 (6.15–16.04)
Prairie Provinces	181	25.14 (22.09–28.44)	114	26.95 (22.92–31.38)	37	25.87 (19.35–33.67)	30	20.13 (14.44–27.35)
Frequency of provider visit								
More than 1 visit a year	349	48.47 (44.83–52.13)	221	52.25 (47.47–56.97)	48	33.57 (26.30–41.70)	80	53.69 (45.64–61.54)
1 visit a year	181	25.27 (22.23–28.58)	105	24.82 (20.93–29.17)	43	30.07 (23.11–38.08)	33	22.15 (16.18–29.53)
Less than 1 visit a year	114	16.25 (13.72–19.13)	63	14.89 (11.80-18.62)	34	23.78 (17.49–31.44)	19	12.75 (8.27–19.14)
Don't have a primary healthcare provider	56	7.77 (6.03–9.97)	22	5.20 (3.44–7.77)	15	10.49 (6.41–16.68)	18	12.08 (7.73–18.37)
Prefer not to answer	2	0.28 (0.06–1.10)	1	0.24 (0.03–1.66)	0	0.00 (N/A)	0	0.00 (N/A)
Invalid Response	15	2.08 (1.17–3.41)	0	0.00 (N/A)	0	0.00 (N/A)	0	0.00 (N/A)
Missing	3	0.41 (0.09–0.92)	0	0.00 (N/A)	0	0.00 (N/A)	0	0.00 (N/A)
Underlying health condition								
Yes	385	53.47 (49.81–57.09)	238	56.26 (51.48–60.92)	71	49.65 (41.52–57.79)	75	50.34 (42.35–58.30)
No	306	42.50 (38.92–46.15)	170	40.19 (35.61–44.94)	68	47.55 (39.49–55.74)	66	44.30 (36.51–52.36)
I don't know	22	3.06 (2.01–4.59)	12	2.84 (1.61–4.93)	4	2.80 (1.05–7.22)	6	4.03 (1.81–8.68)
Prefer not to answer	7	0.97 (0.46–2.02)	3	0.71 (0.22–2.17)	0	0.00 (N/A)	2	1.34 (0.33–5.21)
Heard of the pneumococcal vaccine								
Yes	539	74.86 (71.55–77.90)	343	81.09 (77.06–84.54)	97	67.83 (59.73–74.97)	96	64.43 (56.41–71.70)
No	154	21.39 (18.54–24.54)	67	15.84 (12.65–19.64)	42	29.37 (22.47–37.35)	45	30.20 (23.36–38.05)
I don't know	25	3.47 (2.35–5.09)	13	3.07 (1.79–5.22)	4	2.80 (1.05–7.22)	8	5.37 (2.70-10.37)
Prefer not to answer	2	0.28 (0.06–1.10)	0	0.00	0	0.00	0	0.00
Ever received influenza vaccine								
Yes, every year	318	44.17 (40.57–47.82)	254	60.05 (55.29–64.61)	16	11.19 (6.96–17.49)	46	30.87 (23.97–38.74)
Yes, occasionally	124	17.22 (14.63–20.16)	63	14.89 (11.80-18.62)	23	16.08 (10.92–23.05)	37	24.83 (18.54–32.40)
Yes, once	72	10 (8.0-12.4)	29	6.86 (4.80–9.69)	21	14.69 (9.76–21.48)	22	14.77 (9.91–21.42)
Never	172	23.89 (20.90-27.14)	47	11.11 (8.44–14.48)	82	57.34 (49.09–65.19)	42	28.19 (21.54–35.94)
I do not know	33	4.58 (3.27–6.38)	30	7.09 (4.99–9.96)	1	0.70 (0.09–4.80)	2	1.34 (0.33–5.21)
Prefer not to answer	1	0.14 (0.01–0.98)	0	0.00	0	0.00	0	0.00
Receipt of the Influenza vaccine in the last 12 months								
Yes	349	68.70 (64.52–72.59)	266	77.33 (72.58–81.45)	19	33.93 (22.77–47.20)	61	58.10 (48.45–67.15)
No	158	31.10 (27.21–35.27)	77	22.38 (18.27–27.10)	37	66.07 (52.79–77.22)	44	41.90 (32.84–51.54)
I don't know	1	0.20 (0.02–1.38)	1	0.29 (0.04–2.04)	0	0.00	0	0.00
Prefer not to answer	0	0.0 (N/A)	0	0.00 (N/A)	0	0.00 (N/A)	0	0.00 (N/A)

Table 1 (continued)

Characteristics	Overall (*N* = 720)		Willing (*N* = 423)		Not willing (*N* = 143)		Don't know (*N* = 149)	
	n	% (95% CI)	*n*	% (95% CI)	*n*	% (95% CI)	*n*	% (95% CI)
Self-reported prior receipt of other vaccines in the last ten years, except the influenza vaccine								
COVID-19	600	83.33 (80.40-85.98)	373	88.18 (84.73–90.93)	88	61.54 (53.30-69.15)	135	90.60 (84.74–94.36)
Pertussis (whooping cough vaccines)	42	5.83 (4.23–7.80)	35	8.27 (5.99–11.31)	6	4.20 (1.89–9.03)	1	0.67 (0.09–4.62)
Shingles	190	26.39 (23.20-29.77)	144	34.04 (29.67–38.69)	19	13.29 (8.63–19.90)	26	17.45 (12.15–24.41)
Tetanus	185	25.69 (22.53–29.05)	123	29.08 (24.94–33.59)	25	17.48 (12.08–24.60)	37	24.83 (18.54–32.40)
Other vaccine(s)	66	9.17 (7.16–11.51)	46	10.87 (8.23–14.22)	10	6.99 (3.79–12.52)	10	6.71 (3.64–12.03)
Prefer not to answer	32	4.44 (3.05–6.21)	6	1.42 (0.63–3.12)	20	13.99 (0.91–20.70)	5	3.36 (1.40–7.81)
Missing	12	1.67 (0.86–2.89)	0	0.00	11	7.69 (3.24–12.14)	1	0.67 (0.11–21.2)

Table presents the participant characteristics overall (N=720) and stratified by willingness to receive the vaccine (Yes/No/Don't know). Five participants selected "prefer not to answer" for the willingness question and were excluded from the stratified analysis (N=715). The "Other" category under gender includes participants who identified as gender-fluid, nonbinary, trans man, trans woman, or two-spirit woman. Invalid responses for frequency of provider visits include those who selected both more than one annual and less than one annual visit frequency

than once a year (52.2% vs. 33.5%), having heard of the pneumococcal vaccine (81.0% vs. 67.8%), receiving the influenza vaccine annually (60.0% vs. 11.1%), receiving the influenza vaccine in the past 12 months (77.3% vs. 33.9%), and having received the COVID-19 (88.1% vs. 61.5%), shingles (34.0% vs. 13.2%), and/or tetanus (29.0% vs. 17.4%) vaccines in the past 10 years.

Regarding factors that could influence pneumococcal vaccination willingness, 36% of participants disagreed or strongly disagreed with the statement "My healthcare provider recommended the pneumococcal vaccine". Furthermore, only 28.3% agreed that they were not at risk and therefore did not need the vaccine (Table 4). Participants with underlying health conditions were more likely to perceive themselves at risk, with 18.2% strongly disagreeing with the statement, compared to just 5.9% of those without an underlying health condition. For questions related to access and understandability of vaccine information, 63.7% of participants found it easy or very easy to access general vaccine information, yet only 22.0% reported accessing information specifically about the pneumococcal vaccine (Fig. 1). When asked about trusted sources of information about pneumococcal vaccines, 83.7% cited their family physician, followed by pharmacies (54.3%), health departments (53.4%), and hospitals (50.9%). Social influence also played a role, with 40.4% of participants reporting that their family or friends would want them to get vaccinated.

In terms of barriers related to vaccination, affordability and lack of knowledge about vaccination sites were the most frequently cited. Specifically, 31.9% agreed or strongly agreed that they could not afford the vaccine, and 24.8% agreed or strongly agreed that they did not know where to go to receive the vaccine. Stratified analysis showed that participants who disagreed with the affordability as a barrier were more likely to be willing to receive the vaccine compared to those not willing (21.5% vs. 11.1%). Other barriers showed similar distribution between participants willing and unwilling to receive the vaccine, with overlapping CIs (Table 5).

Factors associated with willingness to receive a pneumococcal vaccine

Adjusted ordinal logistic regression identified several significant predictors of willingness to receive a pneumococcal vaccine (Table 6). After adjusting for sociodemographic and health-related factors, participants with good knowledge (aOR: 2.68, 95% CI: 1.44-5.00) and a neutral (aOR: 2.61, 95% CI: 1.65–4.17) or positive attitude (aOR: 14.83, 95% CI: 9.20-23.92) had significantly higher odds of vaccination willingness compared to those with poor knowledge and a negative attitude. Compared to receipt of pertussis, receipt of other vaccines, such as tetanus (aOR: 5.01, 95% CI: 1.08–23.21) and vaccines in the "other" category (aOR: 5.11, 95% CI: 1.02–25.66), was positively associated with willingness to receive the pneumococcal vaccine, while receipt of COVID-19 and shingles were not significant associated. Compared to participants who reported receiving the influenza vaccine every year, those who received it occasionally (aOR: 0.33, 95% CI: 0.20–0.56), only once (aOR: 0.38, 95% CI: 0.21–0.71), or never (aOR: 0.14, 95% CI: 0.08–0.23) were significantly less likely to be willing to receive the pneumococcal vaccine Respondents from the Prairie Provinces had higher odds of willingness to receive the vaccine (aOR: 1.63, 95% CI: 1.01–2.65) compared to those from other provinces. Wide confidence intervals were observed for some subgroups, indicating wide variability and/or limited sample sizes (Table 6).

The results of the generalized ordinal logistic regression were similar to the results of the ordinal logistic regression (Appendix 2, Table 1), that is, good knowledge and a neutral or positive attitude were associated with more willingness to receive the pneumococcal vaccine. Correlation analysis supported these findings (data not shown). Willingness to receive the vaccine was strongly correlated

Table 2 Participants' knowledge of Pneumococcal vaccines and Pneumococcal disease based on response to individual questions and composite score (*N* = 720)

Knowledge statements	*n* (%)
Know the diseases the pneumococcal vaccine protects against	
Yes	432 (60.00)
No	283 (39.31)
Prefer not to answer	5 (0.69)
Pneumococcal bacteria can lead to serious and potentially fatal infections	
True	625 (86.81)
False	71 (9.86)
Prefer not to answer	24 (3.33)
Groups that are most at risk of developing pneumococcal infections	
Children	278 (38.61)
Anyone who has a chronic condition (examples: diabetes, chronic respiratory disease)	518 (71.94)
People aged 65 years or older	642 (89.17)
People living in long-term care facilities	403 (55.97)
Other	8 (1.11)
Prefer not to answer	13 (1.81)
Chronic diseases of the heart, lung, kidney, and/or liver, alcoholism, diabetes, and smoking increase the risk of developing pneumococcal disease.	
True	641 (89.03)
False	50 (6.94)
Prefer not to answer	29 (4.03)
Aware that the pneumococcal vaccine is recommended to adults aged ≥ 65	
Yes	506 (70.28)
No	140 (19.44)
I don't know	72 (10.00)
Prefer not to answer	2 (0.28)
Familiar with the potential benefits of the pneumococcal vaccine for adults aged ≥ 65	
Yes	382 (53.06)
No	222 (30.83)
I don't know	107 (14.86)
Prefer not to answer	9 (1.25)
Knowledge of pneumococcal vaccine and disease (composite score categories)	
Poor (0%49%)	73 (10.14)
Moderate (50%-79%)	244 (33.89)
Good (80%-100%)	403 (55.97)

Correct responses were scored as 1, and the rest of the responses were 0. Individual responses were summed across all knowledge items to create a total knowledge score percentage for each participant. Scores were categorized into three categories: "Poor" for participants who scored between 0–49%, "Moderate: for participants who scored between 50–79%, and "Good" for participants who scored between 80–100%

with attitudes toward vaccines (ρ = 0.62), indicating that more positive attitudes were associated with greater willingness. In contrast, knowledge of the vaccine showed a weaker correlation with willingness (ρ = 0.29), suggesting that while knowledge plays a role, attitudes may have a stronger influence in vaccine decision-making.

Subgroup analysis by participant sex

Subgroup analyses revealed some sex-specific patterns (Appendix 3, Table 1). Knowledge was not a significant predictor in either sex group, whereas a positive attitude towards vaccination remained significantly associated with willingness for both males and females. Among males, prior receipt of COVID-19, shingles, tetanus, or other vaccines compared to pertussis was significantly associated with willingness. Among females, frequent healthcare provider visits (more than once per year) were most strongly associated with willingness.

Discussion

Our study offers important insights into the complex interplay between knowledge, attitudes, and vaccination behavior among older adults regarding pneumococcal vaccination. While over half of participants demonstrated good knowledge about pneumococcal disease and vaccines, and nearly half showed positive attitudes toward the vaccine, a substantial proportion remained unwilling or unsure about their willingness to receive the vaccine. These findings underscore the critical need for targeted interventions that address both knowledge dissemination and trust-building, as knowledge alone appears insufficient to drive attitudinal change.

The observed gap between knowledge and attitude highlights a fundamental challenge in vaccine promotion: information alone may be insufficient to drive willingness. Emotional, cultural, and trust-based factors as well as practical barriers often outweigh knowledge in vaccine decision-making processes [17]. This disconnect was evident in our findings, where participants with moderate knowledge did not always exhibit willingness to be vaccinated – supporting previous research showing that attitudinal and trust-related factors play a more decisive role in vaccine hesitancy [18].

Table 3 Participants' attitudes towards the Pneumococcal vaccine based on response to individual questions and composite score (*N* = 720)

Attitude statements	*n* (%)
The pneumococcal vaccine is important for my health	
Strongly disagree	25 (3.47)
Disagree	25 (3.47)
Neutral	230 (31.94)
Agree	265 (36.81)
Strongly agree	169 (23.47)
Prefer not to answer	6 (0.83)
The pneumococcal vaccine is safe	
Strongly disagree	19 (2.64)
Disagree	28 (3.89)
Neutral	205 (28.47)
Agree	279 (38.75)
Strongly agree	182 (25.28)
Prefer not to answer	7 (0.97)
The pneumococcal vaccine is effective.	
Strongly disagree	21 (2.92)
Disagree	18 (2.50)
Neutral	228 (31.67)
Agree	282 (39.17)
Strongly agree	164 (22.78)
Prefer not to answer	7 (0.97)
Attitude towards pneumococcal vaccine (composite score categories)	
Negative (0%-49%)	257 (35.69)
Neutral (50%-79%)	124 (17.22)
Positive (80%-100%)	339 (47.08)

Responses of "Agree and "Strongly Agree" were coded as 1 (correct response), while all other responses were coded as 0. Scores were summed across all items, and participants were categorized into three categories based on the percentage of total score

Among all predictors examined, positive attitudes emerged as the strongest driver of pneumococcal vaccination willingness – notably more influential than knowledge. This pattern aligns with established behavioral science theories emphasizing the centrality of beliefs, values, and emotional responses in shaping health behaviours [19]. Consequently, interventions aimed solely at improving knowledge may yield modest gains in uptake unless they also address attitudes and trust. Studies examining behavioral change interventions have found that addressing cognitive biases and employing social facilitation techniques can effectively reduce vaccine hesitancy [20]. Notably, over one-third of participants said their healthcare provider had not recommended the vaccine – a missed opportunity given the influential role providers play in vaccine decision-making [21–23].

A particularly concerning finding was misconception around vaccine cost and access. Despite universal public funding of pneumococcal vaccination for adults aged 65 years and older in Canada [24], nearly one-third of participants believed they could not afford it. Additionally, a substantial number reported not knowing where to receive the vaccine. These gaps point to shortcomings in health communication strategies. While general vaccine information was reportedly accessible, pneumococcal vaccine-specific information was less frequently accessed, and practical details about where and how to get vaccinated were lacking. These barriers align with previous Canadian research identifying lack of vaccine information as a key challenge [25].

Participants with a history of receiving tetanus vaccine and adult vaccines other than influenza/pertussis/COVID-19/singles/tetanus, and who received a yearly influenza vaccine were significantly more likely to express willingness to receive the pneumococcal vaccine. This finding supports the concept of "vaccine readiness" as a cumulative process, shaped by positive prior healthcare experiences and recommendations from trusted providers [23, 26]. Each positive vaccination experience may build confidence and openness toward subsequent vaccines, creating opportunities for healthcare providers to discuss and recommend additional age-appropriate vaccines. The finding also highlights the importance of addressing barriers to initial vaccine uptake, as early positive experiences may facilitate acceptance of subsequent vaccinations throughout the lifespan. The policy and program implications emerging from this research are substantial. Our finding suggests that embedding vaccine promotion in primary care and pharmacy settings, where trust and continuity of care are established, may enhance both reach and effectiveness of vaccination programs. Research has shown that interventions targeting healthcare provider-patient communication are among the most effective approaches for improving pneumococcal vaccine uptake in older adults in high-income countries [27]. Furthermore, introducing a clear and simple, age-based adult vaccination schedule, similar to the childhood model, and integrating it into electronic medical records with automated, jurisdiction-specific reminders could further support uptake. This may also reduce confusion for both patients and providers.

Community-informed messaging represents another crucial component of effective vaccine promotion strategies. Rather than employing one-size-fits-all approaches, public health programs should develop culturally safe, community-specific messaging that addresses local concerns and leverages trusted community voices. This approach recognizes that vaccine acceptance is influenced by social, cultural, and community factors that vary across different populations and geographic regions. Research has shown that vaccine-hesitant attitudes are significantly higher among certain demographic groups, including rural and politically conservative older adults in some contexts [28], necessitating tailored intervention strategies.

Table 4 Factors that could influence willingness to receive the Pneumococcal vaccine stratified by willingness to get Pneumococcal vaccine (*N* = 715)

Characteristic	Overall *n* (%)	Willing *n* (%)	Not willing *n* (%)	Don't know *n* (%)
My healthcare provider recommended the pneumococcal vaccine				
Strongly disagree	80 (11.11)	29 (6.86)	26 (18.18)	24 (16.11)
Disagree	180 (25.00)	74 (17.49)	47 (32.87)	59 (39.60)
Neutral	220 (30.56)	137 (32.39)	33 (23.08)	48 (32.21)
Agree	126 (17.50)	88 (20.80)	26(18.18)	12 (8.05)
Strongly agree	106 (14.72)	92 (21.75)	11 (7.69)	3 (2.01)
Prefer not to answer	8 (1.11)	3 (0.71)	0 (0.00)	3 (2.01)
I want to protect my health.				
Strongly disagree	3 (0.42)	2 (0.47)	0 (0.00)	0 (0.00)
Disagree	8 (1.11)	5 (1.18)	2 (1.40)	1 (0.67)
Neutral	50 (6.94)	18 (4.26)	20 (13.99)	11 (7.38)
Agree	300 (41.67)	162 (38.30)	64 (44.76)	72 (48.32)
Strongly agree	358 (49.72)	236 (55.79)	57 (39.86)	64 (42.95)
Prefer not to answer	1 (0.14)	0 (0.00)	0 (0.00)	1 (0.67)
I think I am not at risk, so I do not need the vaccine.				
Strongly disagree	90 (12.5)	84 (19.86)	3 (2.10)	1 (0.67)
Disagree	195 (27.08)	164 (38.77)	12 (8.39)	19 (12.75)
Neutral	224 (31.11)	96 (22.70)	41 (28.67)	86 (57.72)
Agree	121 (16.81)	46 (10.87)	44 (30.77)	30 (20.13)
Strongly agree	83 (11.53)	32 (7.57)	42 (29.37)	9 (6.04)
Prefer not to answer	7 (0.97)	1 (0.24)	1 (0.70)	4 (2.68)
I do not know where to get good and reliable information about the vaccine.				
Strongly disagree	97 (13.47)	64 (15.13)	23 (16.08)	9 (6.04)
Disagree	202 (28.06)	117 (27.66)	46 (32.17)	39 (26.17)
Neutral	189 (26.25)	107 (25.30)	37 (25.87)	44 (29.53)
Agree	148 (20.56)	84 (19.86)	19 (13.29)	44 (29.53)
Strongly agree	77 (10.69)	47 (11.11)	17 (11.89)	12 (8.05)
Prefer not to answer	7 (0.97)	4 (0.95)	1 (0.70)	1 (0.67)
I had a bad experience with a previous vaccination.				
Strongly disagree	218 (30.28)	154 (36.41)	30 (20.98)	33 (22.15)
Disagree	256 (35.56)	163 (38.53)	36 (25.17)	56 (37.58)
Neutral	94 (13.06)	41 (9.69)	24 (16.78)	27 (18.12)
Agree	79 (10.97)	34 (8.04)	30 (20.98)	15 (10.07)
Strongly agree	68 (9.44)	29 (6.86)	22 (15.38)	16 (10.74)
Prefer not to answer	5 (0.69)	2 (0.47)	1 (0.70)	2 (1.34)
I fear needles.				
Strongly disagree	254 (35.28)	154 (36.41)	49 (34.27)	49 (32.89)
Disagree	212 (29.44)	137 (32.39)	25 (17.48)	50 (33.56)
Neutral	110 (15.28)	53 (12.53)	30 (20.98)	27 (18.12)
Agree	90 (12.50)	57 (13.48)	19 (13.29)	14 (9.40)
Strongly agree	51 (7.08)	21 (4.96)	20 (13.99)	8 (5.37)
Prefer not to answer	3 (0.42)	1 (0.24)	0 (0.00)	1 (0.67)
I am concerned about the number of injections.				
Strongly disagree	152 (21.11)	112 (26.48)	18 (12.59)	20 (13.42)
Disagree	170 (23.61)	122 (28.84)	16 (11.19)	32 (21.48)
Neutral	190 (26.39)	102 (24.11)	45 (31.47)	43 (28.86)
Agree	131 (18.19)	56 (13.24)	38 (26.57)	36 (24.16)
Strongly agree	73 (10.14)	29 (6.86)	26 (18.18)	17 (11.41)
Prefer not to answer	4 (0.56)	2 (0.47)	0 (0.00)	1 (0.67)

Presents the overall participant responses to factors that may influence willingness (*N* = 720) and stratified by willingness to receive the vaccine (Yes/No/Don't know). Five participants selected "prefer not to answer" for the willingness question and were excluded from the stratified analysis (*N* = 715)

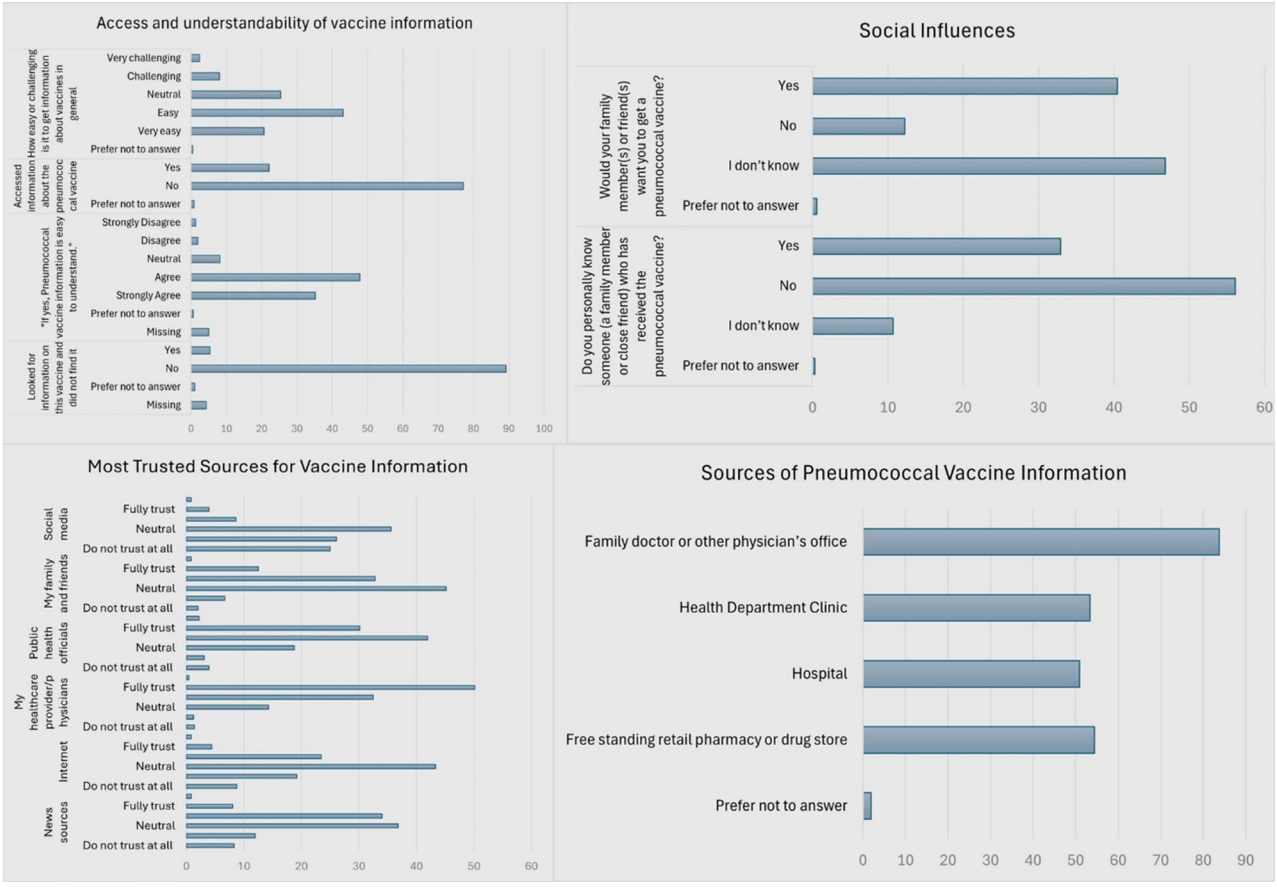

Fig. 1 Access to and understandability of vaccine information

A multifaceted approach is needed – one that tackles both cognitive and structural barriers, including misconceptions about vaccine cost and availability. Programs that focus exclusively on knowledge transfer are likely to achieve limited success, while those that address the full spectrum of factors influencing vaccine decision-making may prove more effective in increasing coverage rates. Recent literature supports the use of behavior change frameworks to design more comprehensive and effective interventions [29]. The lack of information regarding cost and access barriers necessitates communication efforts that specifically address these misconceptions. Healthcare providers and public health programs should consider prioritizing clear communication about vaccine availability and eligibility criteria, coverage policies, and vaccination sites. In light of the 2024 NACI recommendation to preferentially use conjugate vaccines, such communication efforts are particularly timely, offering an opportunity to reinforce messaging on cost and access.

This study offers several important strengths. It provides timely, Canada-wide insights into the knowledge, attitudes, and willingness to receive pneumococcal vaccination among older adults who have not yet been vaccinated – a population at high risk and insufficiently explored. The use of a carefully crafted survey instrument grounded in the WHO's BeSD framework [10] enhances the robustness of the data collected, while pilot testing with older adults helped confirm the accessibility of the online platform and the completeness and retrievability of response data. However, some limitations should be noted. The study relied on self-reported data, which may introduce recall and social desirability biases, potentially leading participants to overstate their knowledge or attitudes; nonetheless, this issue is likely mitigated by the recruitment and data collection strategies adopted, as the survey was self-administered and participants' identity was not linked to survey responses at any stage of the process, although such biases cannot be fully eliminated. Additionally, the sample underrepresents certain subpopulations, limiting our ability to draw conclusions about the experiences and perspectives of marginalized groups such as immigrants and Indigenous communities. The online recruitment method may also have introduced selection bias, favoring individuals with internet access and digital literacy. These factors may limit the generalizability of the findings, but they do not diminish the importance of the insights generated for understanding barriers and opportunities in pneumococcal vaccination

Table 5 Systemic barriers to vaccination stratified by willingness to receive the Pneumococcal vaccine

Systemic barriers	Overall (*N* = 720)		Willingness to get vaccinated with pneumococcal vaccine (*N* = 715)					
			Willing		Not willing		Don't Know	
	n	% (95% CI)	*n*	% (95% CI)	*n*	% (95% CI)	*n*	% (95% CI)
Ease of getting the pneumococcal vaccine for self								
Very hard	13	1.81 (1.05–3.08)	8	1.89 (0.94–3.73)	0	0.00 (N/A)	4	2.68 (1.00-6.94)
Hard	21	2.92 (1.90–4.43)	13	3.07 (1.79–5.22)	4	2.80 (1.05–7.22)	4	2.68 (1.00-6.94)
Neutral	153	21.25 (18.41–24.39)	77	18.20 (14.80-22.17)	24	16.78 (11.50-23.83)	51	34.23 (27.04–42.21)
Easy	306	42.5 (38.92–46.15)	188	44.44 (39.76–49.22)	58	40.56 (32.81–48.80)	59	39.60 932.05–47.66)
Very easy	222	30.83 (27.56–34.31)	136	32.15 (27.86–36.76)	57	39.86 (32.15–48.10)	29	19.46 (13.86–26.62)
Prefer not to answer	5	0.69 (0.28–1.65)	1	0.24 (0.03–1.66)	0	0.00 (N/A)	2	1.34 (0.03–5.21)
Physical limitation hinders access to vaccination								
Strongly Disagree	315	43.75 (40.15–47.40)	182	43.03 (38.37–47.80)	71	49.65 (41.52–57.79)	62	41.61 (33.95–49.68)
Disagree	200	27.78 (24.62–31.17)	107	25.30 (21.37–29.66)	33	23.08 (16.88–30.69)	58	38.93 (31.42–46.98)
Neutral	81	11.25 (9.13–13.77)	50	11.82 (9.06–15.26)	19	13.29 (8.63–19.90)	12	8.05 (4.62–13.65)
Agree	84	11.67 (9.51–14.22)	59	13.95 (10.95–17.59)	14	9.79 (5.87–15.86)	11	7.38 (4.13–12.85)
Strongly Agree	34	4.72 (3.39–6.54)	24	5.67 (3.82–8.33)	5	3.50 (1.46–8.13)	5	3.36 (1.40–7.81)
Prefer not to answer	6	0.83 (0.37–1.84)	1	0.24 (0.03–1.66)	1	0.70 (0.09–4.80)	1	0.24 (0.09–4.62)
Need someone to accompany to get the vaccine								
Strongly Disagree	226	31.39 (28.09–34.87)	119	28.13 (24.04–32.61)	61	42.66 (34.80–50.90)	46	30.87 (23.97–38.74)
Disagree	193	26.81 (23.69–30.16)	105	24.82 (20.93–29.17)	34	23.78 (17.49–31.44)	52	34.90 (27.66–42.89)
Neutral	117	16.25 (13.72–19.13)	62	14.66 (11.59–18.36)	29	20.28 (14.46–27.67)	26	17.45 (12.15–24.41)
Agree	120	16.67 (14.11–19.57)	95	22.46 (18.72–26.69)	9	6.29 (3.30-11.66)	16	10.74 (6.67–16.82)
Strongly Agree	60	8.33 (6.52–10.59)	42	9.93 (7.41–13.47)	10	6.99 (3.79–12.52)	8	5.37 (2.70-10.37)
Prefer not to answer	4	0.56 (0.20–1.47)	0	0.00 (N/A)	0	0.00 (N/A)	1	0.67 (0.09–0.46)
Lack of information regarding vaccination sites								
Strongly Disagree	189	26.25 (23.15–29.59)	101	23.88 (20.04–28.18)	57	39.86 (32.15–48.10)	31	20.81 (15.02–28.08)
Disagree	197	27.36 (24.22–30.74)	115	27.19 (23.15–31.63)	37	25.87 (19.35–33.67)	44	29.53 (22.75–37.35)
Neutral	150	20.83 (18.01–23.96)	96	22.70 (18.94–26.93)	25	17.48 (12.08–24.60)	29	19.46 (13.86–26.62)
Agree	126	17.50 (14.89–20.45)	76	17.97 (14.58–21.92)	18	12.59 (8.06–19.10)	31	20.81 (15.02–28.08)
Strongly Agree	53	7.36 (5.66–9.51)	34	8.04 (5.79–11.04)	6	4.20 (1.89–9.03)	13	8.72 (5.12–14.45)
Prefer not to answer	5	0.69 (0.28–1.65)	1	0.24 (0.03–1.66)	0	0.00 (N/A)	1	0.67 (0.09–4.62)
Geographic accessibility-vaccination clinics are too far								
Strongly Disagree	215	29.86 (26.62–33.31)	125	29.55 (25.38–34.08)	53	37.06 (29.53–45.27)	37	24.83 (18.54–32.40)
Disagree	210	29.17 (25.95–32.60)	115	27.19 (23.15–31.63)	39	27.27 (20.59–35.15)	55	36.91 (29.54–44.95)
Neutral	187	25.97 (22.89–29.30)	108	25.53 (21.59–29.91)	30	20.98 (15.06–28.43)	48	32.21 (25.19–40.13)
Agree	64	8.89 (7.01–11.20)	41	9.69 (7.21–12.90)	17	11.89 (7.51–18.30)	6	4.03 (1.81–8.68)
Strongly Agree	37	5.14 (3.74–7.01)	31	7.33 (5.19–10.23)	4	2.80 (0.33–5.21)	2	1.34 (0.33–5.21)
Prefer not to answer	7	0.97 (0.46–2.02)	3	0.71 (0.22–2.17)	0	0.00 (N/A)	1	0.67 (0.09–4.62)
Transportation barriers								
Strongly Disagree	317	44.03 (40.43–47.68)	190	44.92 (40.22–49.69)	65	45.45 (37.47–53.67)	61	40.94 (33.32–49.01)
Disagree	225	31.25 (27.96–34.73)	125	29.55 (25.38–34.08)	40	27.97 (21.22–35.89)	59	39.60 (32.05–47.66)
Neutral	50	6.94 (5.29–9.05)	28	6.62 (4.60–9.42)	9	6.29 (3.30-11.66)	12	8.05 (4.62–13.65)
Agree	73	10.14 (8.13–12.57)	49	11.58 (8.86-15.00)	19	13.29 (8.63–19.90)	5	3.36 (1.40–7.81)
Strongly Agree	52	7.22 (5.54 – 0.36)	31	7.33 (5.19–10.23)	10	6.99 (3.79–12.52)	11	7.38 (4.13–12.85)
Prefer not to answer	3	0.42 (0.13–1.28)	0	0.00 (N/A)	0	0.00 (N/A)	1	0.67 (0.09–4.62)
Scheduling barriers- clinic hours not suitable								
Strongly Disagree	227	31.53 (28.23–35.02)	132	31.21 (26.96–35.78)	53	37.06 (29.53–45.27)	42	28.19 (21.54–35.94)
Disagree	233	32.36 (29.03–35.87)	136	32.15 (27.86–36.76)	38	26.57 (19.97–34.41)	57	38.26 (30.79–46.31)
Neutral	156	21.76 (18.80-24.83)	82	19.39 (15.88–23.43)	35	24.48 (18.11–32.19)	38	25.50 (19.13–33.11)
Agree	72	10.0 (8.00-12.41)	50	11.82 (9.06–15.26)	15	10.49 (6.41–16.68)	7	4.70 (2.24–9.53)
Strongly Agree	24	3.33 (2.24–4.92)	20	4.73 (3.06–7.21)	2	1.40 (0.34–5.42)	2	1.34 (0.33–5.21)
Prefer not to answer	8	1.11 (0.55–2.20)	3	0.71 (0.22–2.17)	0	0.00 (N/A)	3	2.01 (0.64–6.06)
Concerns regarding wait times								
Strongly Disagree	182	25.28 (22.23–28.58)	107	25.30 (21.37–29.66)	49	34.27 (26.94–42.42)	26	17.45 (12.15–24.41)

Table 5 (continued)

Systemic barriers	Overall (*N* = 720)		Willingness to get vaccinated with pneumococcal vaccine (*N* = 715)					
			Willing		Not willing		Don't Know	
	n	% (95% CI)	*n*	% (95% CI)	*n*	% (95% CI)	*n*	% (95% CI)
Disagree	210	29.17 (25.95–32.60)	122	28.84 (24.71–33.35)	30	20.98 (15.06–28.43)	57	38.26 (30.79–46.31)
Neutral	198	27.5 (24.35–30.88)	96	22.70 (18.94–26.93)	46	32.17 (25.02–40.26)	55	36.91 (29.54–44.95)
Agree	83	11.53 (9.38–14.07)	65	15.37 (12.22–19.13)	13	9.09 (5.34–15.03)	5	3.36 (1.40–7.81)
Strongly Agree	38	5.28 (3.86–7.17)	30	7.09 (4.99–9.96)	5	3.50 (1.46–8.13)	3	2.01 (0.64–6.06)
Prefer not to answer	9	1.25 (0.65–2.38)	3	0.71 (0.22–2.17)	0	0.00 (N/A)	3	2.01 (0.64–6.06)
Time constraints to get the vaccine								
Strongly Disagree	272	37.78 (34.30-41.38)	160	37.83 (33.31–42.55)	60	41.96 (34.13–50.20)	52	34.90 (27.66–42.89)
Disagree	240	33.33 (29.97–36.86)	134	31.68 (27.41–36.27)	42	29.37 (22.47–37.35)	63	42.28 (34.59–50.35)
Neutral	110	15.28 (12.82–18.09)	69	16.31 (13.08–20.15)	20	13.99 (9.19–20.70)	20	13.42 (8.81–19.90)
Agree	57	7.92 (6.15–10.13)	38	8.98 (6.60-12.11)	12	8.39 (4.82–14.20)	7	4.70 (2.23–9.53)
Strongly Agree	34	4.72 (3.39–6.54)	21	4.96 (3.25–7.49)	8	5.59 (2.81–10.79)	5	3.36 (1.40–7.49)
Prefer not to answer	7	0.97 (0.46–2.02)	1	0.24 (0.03–1.66)	1	0.70 (00.9–4.80)	2	1.34 (0.03–5.21)
Financial barriers-vaccine affordability								
Strongly Disagree	168	23.33 (20.38–26.56)	105	24.28 (20.93–29.17)	42	29.37 (22.47–37.35)	21	14.09 (9.36–20.66)
Disagree	139	19.31 (16.58–22.35)	91	21.51 (17.84–25.69)	16	11.19 (6.96–17.49)	31	20.81 (15.02–28.08)
Neutral	175	24.31 (21.30-27.57)	89	21.04 (17.41–25.19)	34	23.78 (17.49–31.44)	52	34.90 (27.66–42.89)
Agree	134	18.61 (15.92–21.62)	83	19.62 (16.10-23.69)	24	16.78 (11.50-23.83)	27	18.12 (12.72–25.15)
Strongly Agree	96	13.33 (11.03–16.02)	52	12.29 (9.48–15.78)	26	18.18 (12.67–25.38)	17	11.41 (7.20–17.6)
Prefer not to answer	8	1.11 (0.55–2.20)	3	0.71 (0.22–2.17)	1	0.70 (0.09–4.80)	1	0.67 (0.09–4.62)

Presents the participants' overall response to systemic barriers to vaccination (*N* = 720) and stratified by willingness to receive the vaccine (Yes/No/Don't know). Five participants selected "prefer not to answer" for the willingness question and were excluded from the stratified analysis (*N* = 715)

among older adults. Approximately 10% of survey participants completed the survey through a proxy respondent; although proxies were instructed to answer based on the participant's situation, differences in perspectives may have introduced some bias. The large odds ratios for positive attitude may partly reflect overlap with general vaccine confidence. To address this, we examined correlations among predictors, which did not indicate problematic multicollinearity; however, residual confounding cannot be fully excluded.

Future research should explore the roots of both positive and negative attitudes toward pneumococcal vaccination, such as misinformation, misperceptions, and lack of trust to inform targeted interventions. Additionally, exploring healthcare providers' perspectives could help identify factors contributing to communication gaps around vaccination. Studies should use frameworks that help determine which vaccination promotion strategies are effective, for whom, and in what contexts, such as the COM-B model (Capability, Opportunity, Motivation – Behaviour) [30] and the Consolidated Framework for Implementation Research (CFIR) [31]. Recognizing that interventions are not universally effective, research must identify the characteristics of individuals and communities that predict responsiveness to various approaches. There is a pressing need to rigorously evaluate behavior-change interventions and assess their real-world impact on vaccine uptake, using robust study designs like randomized controlled trials. These evaluations should measure not only shifts in attitudes and intentions but also short-term and long-term vaccination behavior. Studies must also dedicate efforts to including diverse and historically underrepresented populations, accounting for differences in attitudes, access to care, and cultural contexts. Additionally, research should investigate the distinct roles of institutional and interpersonal trust in vaccination decisions to inform more tailored and effective strategies. Future research could also explore how variations in health system structures and provincial vaccination strategies influence uptake and outcomes, thereby complementing individual-level perspectives with system-level insights.

Conclusion

Pneumococcal disease poses a significant public health challenge in Canada, especially among adults aged 65 and older who face the highest risk of severe complications and death. Despite existing pneumococcal vaccine recommendations, vaccination rates remain suboptimal. This study found that over half of the participants – all of whom were not vaccinated against pneumococcal disease – had good knowledge about the pneumococcal vaccine, and nearly half held positive attitudes towards it, yet many still felt unsure or hesitant about the pneumococcal vaccine. Importantly, having a positive attitude towards the vaccine was a stronger predictor of willingness to get vaccinated than simply having knowledge about it. This suggests that providing information alone

Table 6 Results of ordinal logistic regression analysis to explore participants' knowledge of and attitudes towards vaccination and their willingness to receive a Pneumococcal vaccine, adjusting for sociodemographic characteristics and health-related factors. (*N* = 715)

Willingness to receive vaccine	Odds Ratio	95% CI	
		Upper	Lower
Knowledge of Pneumococcal vaccine and pneumococcal disease			
Poor (reference)	1.0		
Moderate	1.84	0.99	3.41
Good	2.68	1.44	5.00
Attitude towards pneumococcal vaccine			
Negative (reference)	1.0		
Neutral	2.61	1.65	4.15
Positive	14.83	9.20	23.92
Sex			
Female (reference)	1.0		
Male	1.15	0.79	1.68
Frequency of visit to Provider			
No provider (reference)	1.0		
More than 1 visit a year	1.71	0.864	3.39
1 visit a year	1.20	0.59	2.45
Less than 1 visit a year	1.57	0.73	3.34
Province of residence			
Ontario (reference)	1.0		
British Columbia	1.31	0.77	2.23
Quebec	1.44	0.72	2.91
Newfoundland and Labrador	2.63	0.65	10.56
Maritime Province	1.38	0.66	2.89
Prairie Province	1.63	1.01	2.65
Underlying Health Condition			
Yes (reference)	1.0		
No	0.95	0.64	1.40
I Don't Know	1.11	0.40	3.09
Prefer not to answer	4.50	0.63	31.73
Self-reported prior receipt of other vaccines, except the influenza vaccine			
Pertussis (reference)	1.0		
COVID-19	3.73	0.81	17.04
Shingles	4.22	0.88	20.19
Tetanus	5.01	1.08	23.21
Other	5.11	1.02	25.66
Prefer not to answer	0.77	0.13	4.57
Ever received Influenza Vaccine			
Yes, every year (reference)	1.0		
Yes occasionally	0.33	0.20	0.56
Yes, once	0.38	0.21	0.71
Never	0.14	0.08	0.23
I don't know	9.01	2.06	39.39

Results presented in this table are based on the categories of composite scores of knowledge of and attitude towards the pneumococcal vaccine. Five participants selected "prefer not to answer" for the willingness question and were excluded from the analysis

may not be enough to boost vaccination rates sufficiently. Participants who had received other vaccines were more likely to be willing to receive the pneumococcal vaccine, indicating a potential association between prior vaccination behavior and pneumococcal vaccine acceptance. To improve vaccination rates among adults aged 65 and older, it is important to explore strategies that go beyond simply providing information. Future initiatives should aim to understand what strategies are most effective for different populations and develop programs to increase vaccination coverage.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12889-025-26170-x.

Supplementary Material 1.

Supplementary Material 2.

Supplementary Material 3.

Supplementary Material 4.

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Authors' contributions

NM led project coordination, performed data management and statistical analysis, and drafted the manuscript. **CL** contributed to developing the data collection tools and analysis plan, and participated in manuscript review and editing. **TR** supported study design, provided statistical expertise, and participated in manuscript review and editing. **SM, JM, NEB, SF, MA, KW, SC, SE, KB, ** and **JB** contributed to study design and participated in manuscript review and editing. **GS** conceptualized the study, was responsible for funding acquisition, oversaw the study design and implementation, and provided critical input during manuscript review and editing. All authors read and approved the final manuscript.

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Data availability

The data that support the findings of this study are publicly available through the University of Ottawa's Borealis data repository at: https://doi.org/10.5683/SP3/AXHKHN.

Declarations

Ethics approval and consent to participate

This study received ethical approval from the University of Ottawa Health Sciences and Science Research Ethics Board (Approval #H-09-23-9475) and was conducted in accordance with the Declaration of Helsinki and Tri-Council Policy Statement (2022). Potential participants were provided with detailed

information about the study, including procedures, risks, confidentiality, and privacy, via an electronic consent form accessible on the study website. Informed consent was obtained from all participants before enrollment. Each participant was assigned a unique identifier to ensure confidentiality.

Consent for publication
Not applicable.

Competing interests
GS serves as Editorial Board Member for BMC Public Health. KW is a co-founder of CANImmunize Inc. and has served as a member of the safety committees for Medicago and Moderna. MKA reports research grant funding from Icosavax, unrelated to the present manuscript. All other authors have declared that no competing interests exist.

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