

RESEARCH PAPER

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Estimates and determinants of HPV non-vaccination and vaccine refusal in girls 12 to 14 y of age in Canada: Results from the Childhood National Immunization Coverage Survey, 2013

Nicolas L. Gilbert^{a,b}, Heather Gilmour^c, Ève Dubé^d, Sarah E. Wilson^{e,f,g}, and Julie Laroche^a

^aCentre for Immunization and Respiratory Infectious Diseases, Public Health Agency of Canada, Ottawa, Ontario, Canada; ^bDépartement de médecine sociale et préventive, Université de Montréal, Montréal, Québec, Canada; ^cHealth Analysis Division, Statistics Canada, Ottawa, Ontario, Canada; ^dInstitut national de santé publique du Québec, Québec, Québec, Canada; ^ePublic Health Ontario, Toronto, Ontario, Canada; ^fDalla Lana School of Public Health, University of Toronto, Toronto, Ontario, Canada; ^gInstitute for Clinical Evaluative Sciences, Toronto, Ontario, Canada

ABSTRACT

Since the introduction of HPV vaccination programs in Canada in 2007, coverage has been below public health goals in many provinces and territories. This analysis investigated the determinants of HPV non-vaccination and vaccine refusal. Data from the Childhood National Immunization Coverage Survey (CNICS) 2013 were used to estimate the prevalence of HPV non-vaccination and parental vaccine refusal in girls aged 12–14 years, for Canada and the provinces and territories. Multivariate logistic regression was used to examine factors associated with non-vaccination and vaccine refusal, after adjusting for potential confounders. An estimated 27.7% of 12–14 y old girls had not been vaccinated against HPV, and 14.4% of parents reported refusing the vaccine. The magnitude of non-vaccination and vaccine refusal varied by province or territory and also by responding parent's country of birth. In addition, higher education was associated with a higher risk of refusal of the HPV vaccine. Rates of HPV non-vaccination and of refusal of the HPV vaccine differ and are influenced by different variables. These findings warrant further investigation.

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Introduction

Human papillomavirus (HPV) infections are associated with a range of health outcomes, including anogenital warts and cancers (vaginal, vulvar, penile, anal), in addition to a subset of head and neck squamous cell carcinomas.¹ HPV vaccine recommendations were first issued in Canada in 2007 by the National Advisory Committee on Immunization (NACI)² and publicly-funded programs targeting pre-adolescent females began in select Canadian provinces and territories the same year. By 2010, all jurisdictions included the HPV vaccine within their publicly-funded immunization schedules for females, with some of them offering catch-up programs.³ Following a recommendation by NACI in 2012, some jurisdictions have expanded their programs to also include boys. The Canadian Immunization Committee (CIC) recommended that 80% and 90% of eligible girls receive the required doses of HPV vaccine within 2 and 5 y of program introduction, respectively.⁴ The coverage necessary to achieve herd immunity effects for HPV remains uncertain, but a recent systematic review and meta-analysis suggest the presence of herd effects in high-income countries with female HPV vaccination coverage of at least 50%.⁵

Since HPV vaccination programs were introduced in Canada, uptake has been influenced by factors including limited knowledge or understanding of HPV and the diseases it causes, beliefs and concerns about the risk of side effects or that monogamous

individuals do not need the vaccine.⁶ In British Columbia⁷ and Quebec,⁸ concerns regarding HPV vaccine safety were cited by parents as a factor in vaccine decision-making.

In Canada, delivery of immunization programs is the responsibility of provinces and territories, and therefore programs vary by jurisdiction. HPV immunization programs are primarily school-based in all jurisdictions and the target age group ranges from grade 4 to 8 (approximately ages 8 to 13 years). Canadian coverage estimates demonstrate heterogeneity in uptake across the country. In the province of Ontario, where school-based HPV immunization of grade 8 girls began in the 2007–2008 school year, 3-dose HPV vaccine coverage has risen over time, from only 51% in the first year of the program⁹ to 80% in the 2012–2013 school year.¹⁰ In a survey of 2,025 parents of grade-6 girls in British Columbia in 2008–2009, 65% reported that their daughters had received at least their first dose of HPV vaccine.⁷ A higher uptake was reported in Québec, where in a survey of 774 parents of 9- to 10-year-old girls, 88% of respondents reported agreeing to have their daughter receive the HPV vaccine.⁸ Finally, in Prince Edward Island in 2013, 85% of grade-6 girls had received 3 doses of the HPV vaccine.¹¹ In comparison, in the United States, where the HPV vaccine is delivered primarily by healthcare providers outside the school setting, 3-dose coverage of girls aged 13–17 was 38% in 2013.¹²

Analyses of the 2013 Childhood National Immunization Coverage Survey (CNICS) data were undertaken to assess rates and determinants of HPV non-immunization and of parental refusal of the vaccine in a nationally representative sample of Canadian girls aged 12 to 14 y.

Results

The response rate (individuals agreeing to participate / individuals selected from the sampling frame) for parents or guardians of girls aged 12–14 was 60.4%, yielding an analytical sample of 5720 respondents.

An estimated 27.7% (95% CI 25.8–29.6) of 12 to 14 y old girls had not received any dose of the HPV vaccine. Provincial and territorial non-vaccination rates ranged from 10.9% in Newfoundland and Labrador to 47.6% in Northwest Territories (Table 1). Nunavut and the Northwest Territories had non-vaccination rates significantly higher than all other provinces and territories, and the rate of non-vaccination in Newfoundland was significantly lower than in most

other jurisdictions. Independent risk factors for not being vaccinated, determined by multiple logistic regression, were being aged 12 or 13 compared to 14, living in Ontario or further west or in one of the 3 territories compared to Prince Edward Island, and responding parent born in a country in the Americas other than Canada, or in Europe (compared to born in Canada). Non-vaccination decreased with age, which may be explained by catch-up programs.

Compared to non-vaccination, the proportion of parents who refused the HPV vaccine for their daughter was lower, at 14.4% (95% CI 13.0–15.9) (Table 2). Refusal ranged from 2.9% to 17.9%, with Newfoundland and Labrador (2.9%) being significantly lower than in all other provinces or territories. Among parents of girls who had received at least one dose of the HPV vaccine, 1.5% (95% CI 1.0–2.0) reported having ever refused the vaccine. Fifty percent (50.0%, 95% CI 45.9–54.1) of parents of unvaccinated girls reported having refused the vaccine for their daughter.

Socio-demographic determinants of parental refusal of the vaccine differed from those of non-vaccination. Parents living

Table 1. Association between sociodemographic variables and not being vaccinated against HPV in 12–14-year girls, Canada, 2013.

	n	Rate (95% CI)		Unadjusted OR (95% CI)	p	Adjusted OR (95% CI)	p
Overall	5720	27.7 (25.8–29.6)					
Age (years)							
12	1723	28.9 (26.0–31.8)		1.22 (0.98–1.52)	0.074	1.46 (1.16–1.83)	0.001
13	2007	29.7 (26.4–33.1)		1.27 (1.01–1.60)	0.040	1.31 (1.03–1.67)	0.026
14	1990	25.0 (21.9–28.0)		Reference			
Province or territory							
Newfoundland and Labrador	527	10.7 (8.1–13.3)		0.63 (0.43–0.93)	0.019	0.64 (0.43–0.94)	0.022
Prince Edward Island	335	15.9 (12.5–19.2)		Reference		Reference	
Nova Scotia	563	21.1 (17.7–24.5)		1.42 (1.02–1.97)	0.038	1.35 (0.97–1.89)	0.075
New Brunswick	486	18.5 (15.0–22.0)		1.20 (0.86–1.69)	0.281	1.15 (0.82–1.62)	0.429
Quebec	652	20.3 (17.2–23.4)		1.35 (0.99–1.85)	0.055	1.25 (0.91–1.71)	0.174
Ontario	405	32.4 (27.6–37.1)		2.54 (1.84–3.51)	<0.001	2.42 (1.72–3.40)	<0.001
Manitoba	500	34.8 (30.6–39.0)		2.83 (2.08–3.86)	<0.001	2.59 (1.89–3.57)	<0.001
Saskatchewan	504	23.9 (20.0–27.8)		1.66 (1.20–2.30)	0.002	1.60 (1.14–2.23)	0.006
Alberta	571	29.2 (25.5–32.9)		2.19 (1.61–2.96)	<0.001	2.03 (1.49–2.76)	<0.001
British Columbia	490	32.4 (28.2–36.7)		2.55 (1.86–3.48)	<0.001	2.20 (1.58–3.05)	<0.001
Yukon	264	35.7 (32.7–38.7)		2.94 (2.22–3.91)	<0.001	2.65 (1.98–3.54)	<0.001
Northwest Territories	257	47.6 (43.6–51.6)		4.82 (3.61–6.46)	<0.001	4.62 (3.43–6.23)	<0.001
Nunavut	166	47.4 (42.0–52.9)		4.79 (3.44–6.66)	<0.001	4.68 (3.36–6.53)	<0.001
Place of Birth							
Canada	5161	26.5 (24.5–28.5)		Reference		Reference	
Americas (outside Canada)	91	35.2 (22.8–47.6)	A	1.51 (0.86–2.64)	0.154	1.14 (0.58–2.23)	0.709
Europe	63	45.4 (28.0–62.9)	A	2.31 (1.10–4.82)	0.026	1.33 (0.55–3.22)	0.531
Africa	62	21.1 (9.6–32.6)	A	0.74 (0.36–1.54)	0.422	0.73 (0.24–2.19)	0.569
Asia	259	36.6 (27.7–45.4)		1.60 (1.07–2.39)	0.022	1.45 (0.88–2.38)	0.142
Oceania/other/not stated	84	38.4 (23.0–53.7)	A	1.73 (0.88–3.40)	0.113	1.57 (0.55–4.55)	0.402
Education of responding parent							
Secondary or less	1927	28.3 (25.1–31.5)		1.00 (0.79–1.27)	0.985		
Post-secondary	2003	26.2 (23.0–29.3)		0.90 (0.70–1.14)	0.375		
University graduate	1598	28.3 (24.7–32.0)		Reference			
Total household income							
0 - \$19,999	358	26.2 (19.2–33.2)		1.01 (0.69–1.50)	0.947		
\$20,000 - \$39,999	770	29.7 (24.7–34.8)		1.21 (0.92–1.59)	0.181		
\$40,000 - \$59,000	786	31.3 (26.1–36.5)		1.30 (0.99–1.71)	0.061		
\$60,000 - \$79,999	849	28.4 (23.6–33.1)		1.13 (0.86–1.48)	0.370		
\$80,000 or more	2957	26.0 (23.4–28.5)		Reference			
Country of birth of responding parent							
Canada	4623	24.7 (22.6–26.8)		Reference		Reference	
Americas (outside Canada)	185	37.3 (27.7–46.9)		1.81 (1.17–2.79)	0.007	1.69 (1.03–2.77)	0.037
Europe	172	50.7 (39.5–61.9)		3.13 (1.96–5.01)	<0.001	2.66 (1.58–4.49)	<0.001
Africa	107	26.0 (15.6–36.4)	A	1.07 (0.61–1.88)	0.819	1.23 (0.55–2.75)	0.620
Asia	470	32.2 (26.2–38.1)		1.45 (1.07–1.95)	0.016	1.06 (0.73–1.54)	0.754
Oceania/other/not stated/ respondent not a parent	163	34.5 (23.6–45.5)	A	1.61 (0.97–2.67)	0.067	1.34 (0.60–3.02)	0.475

Rates and odds ratios are weighted (see methods)

Adjusted OR: adjusted for all variables shown in the column

A: coefficient of variation between 16.5% and 33%; interpret with caution

Table 2. Association between sociodemographic variables and parental refusal of HPV vaccination in 12–14-year girls, Canada, 2013.

	n	Rate (95% CI)		Unadjusted OR (95% CI)	p	Adjusted OR (95% CI)	p
Overall	5595	14.4 (13.0–15.9)					
Age (years)							
12	1683	13.6 (11.3–15.9)		0.93 (0.70–1.24)			
13	1972	14.9 (12.4–17.4)		1.04 (0.78–1.37)			
14	1940	14.4 (12.0–16.9)		Reference			
Province or territory							
Newfoundland and Labrador	525	2.9 (1.5–4.3)	A	0.28 (0.16–0.51)	<0.001	0.31 (0.17–0.56)	<0.001
Prince Edward Island	331	12.3 (9.2–15.4)		1.34 (0.89–2.02)	0.163	1.37 (0.90–2.07)	0.144
Nova Scotia	558	9.5 (7.0–12.0)		Reference		Reference	
New Brunswick	484	11.8 (8.9–14.7)		1.28 (0.85–1.92)	0.235	1.32 (0.88–2.00)	0.183
Quebec	634	10.5 (8.1–12.9)		1.12 (0.76–1.65)	0.553	1.17 (0.79–1.74)	0.440
Ontario	401	16.7 (13.1–20.2)		1.91 (1.28–2.84)	0.001	2.13 (1.42–3.21)	<0.001
Manitoba	486	17.9 (14.4–21.3)		2.08 (1.41–3.06)	<0.001	2.31 (1.55–3.45)	<0.001
Saskatchewan	491	11.0 (8.2–13.8)		1.18 (0.78–1.79)	0.439	1.29 (0.84–1.96)	0.241
Alberta	556	15.9 (12.9–19.0)		1.81 (1.25–2.63)	0.002	2.01 (1.36–2.97)	<0.001
British Columbia	473	17.6 (14.1–21.0)		2.03 (1.38–2.99)	<0.001	2.33 (1.56–3.49)	<0.001
Territories	656	12.7 (11.2–14.2)		1.39 (0.99–1.94)	0.055	1.59 (1.12–2.25)	0.010
Born outside Canada							
No	5076	14.7 (13.2–16.2)		Reference			
Yes	464	12.3 (8.4–16.2)		0.93 (0.62–1.38)	0.704		
Education of responding parent		0.0 (0.0–0.0)					
Secondary or less	1878	11.9 (9.7–14.2)		0.60 (0.44–0.81)	0.001	0.61 (0.43–0.87)	0.006
Post-secondary	1970	14.4 (11.9–16.9)		0.74 (0.56–0.99)	0.041	0.69 (0.51–0.92)	0.013
University graduate	1578	18.5 (15.5–21.5)				Reference	
Total household income							
0 - \$19,999	350	9.8 (5.3–14.4)	A	0.57 (0.33–0.98)	0.043	0.73 (0.39–1.36)	0.326
\$20,000 - \$39,999	744	11.9 (8.4–15.4)		0.70 (0.48–1.04)	0.077	0.89 (0.58–1.35)	0.577
\$40,000 - \$59,000	773	13.2 (9.3–17.2)		0.79 (0.54–1.16)	0.238	0.98 (0.64–1.50)	0.920
\$60,000 - \$79,999	824	15.4 (11.5–19.3)		0.95 (0.67–1.33)	0.747	1.07 (0.74–1.53)	0.720
\$80,000 or more	2904	16.1 (13.9–18.3)		Reference		Reference	
Country of birth of responding parent							
Canada	4547	14.9 (13.1–16.6)		Reference		Reference	
Americas (outside Canada)	181	16.8 (8.6–25.0)	A	1.16 (0.62–2.17)	0.650	1.13 (0.59–2.17)	0.719
Europe	168	25.4 (15.7–35.0)	A	1.95 (1.13–3.36)	0.016	1.67 (0.94–2.95)	0.079
Africa	104	16.7 (7.6–25.8)	A	1.15 (0.56–2.36)	0.700	1.11 (0.52–2.36)	0.787
Asia	456	9.4 (5.9–12.8)	A	0.59 (0.38–0.92)	0.020	0.47 (0.29–0.77)	0.003
Oceania/other/not stated/ respondent not a parent	139	–		0.27 (0.07–0.97)	0.045	0.49 (0.12–1.93)	0.308

Rates and odds ratios are weighted (see methods)

Adjusted OR: adjusted for all variables shown in the column

A: coefficient of variation between 16.5% and 33%; interpret with caution – Unreliable estimate because coefficient of variation >33%

in Newfoundland and Labrador, Ontario, Manitoba, Alberta, British Columbia or the territories (compared to Nova Scotia) and those with higher educational attainment were more likely to have refused the vaccine, whereas responding parents born in Asia (compared to Canada) were significantly less likely to have refused it.

Among parents who refused the HPV vaccine for their daughter, the main reasons given were concerns about vaccine safety (44.2%, 95% CI 38.6–49.8), and not considering the vaccine necessary (30.4%, 95% CI 25.2–35.6).

All parents were asked general questions about their knowledge, attitudes and beliefs about vaccines. Beliefs that vaccines are safe, effective, and important for health, were associated with lower odds of HPV vaccine refusal, while concern about vaccine side-effects and the belief that alternative practices can replace vaccines were associated with higher odds of refusal (Table 3). Understanding how vaccines work, the belief that a vaccine can give the same disease it is meant to prevent, and feeling that they had enough information about immunization were not associated with HPV vaccine refusal.

Discussion

This analysis of a large, nationally representative, cross-sectional survey found significant differences across provinces and territories with respect to non-immunization and refusal of the HPV vaccine among Canadian adolescent girls. Overall 27.7% of girls aged 12–14 y in 2013 had not received any doses of the HPV vaccine despite the presence of school-based HPV vaccine delivery in all Canadian provinces and territories since 2010, and 14.4% of parents reported having refused the HPV vaccine for their daughter. The factors associated with non-vaccination and HPV vaccine refusal differed.

There was considerable variation in non-vaccination across the country. Girls residing in the Northwest Territories and Nunavut were the most likely (almost half) to be unvaccinated. The higher proportions of non-vaccination may be explained in part by the timing of HPV program introduction. The HPV program began in 2009–2010 in the territories (Yukon, Northwest Territories and Nunavut) as opposed to 2007–2008 in the provinces.³ Refusal of the HPV vaccine in the territories did not differ significantly from the provinces (with the exception of Newfoundland and Labrador), suggesting that the high pro-

Table 3. Association between knowledge, attitudes and beliefs, and parental refusal of HPV vaccination in 12–14-year girls, Canada, 2013.

	n	Rate (95% CI)	Unadjusted OR (95% CI)	p
TOTAL				
Childhood vaccines are safe				
Strongly agree	3453	11.2 (9.4–12.9)	0.26 (0.17–0.40)	<0.001
Somewhat agree	1792	17.5 (14.9–20.2)	0.44 (0.28–0.68)	<0.001
Somewhat/strongly disagree	238	32.6 (23.8–41.3)	Reference	
Childhood vaccines are effective				
Strongly agree	3798	12.6 (10.9–14.3)	0.31 (0.18–0.52)	<0.001
Somewhat agree	1512	17.7 (14.7–20.7)	0.46 (0.27–0.78)	0.005
Somewhat/strongly disagree	144	32.0 (21.3–42.7)	Reference	
Childhood vaccines are important for child's health				
Strongly agree	4201	11.4 (9.9–13.0)	0.24 (0.14–0.40)	<0.001
Somewhat agree	1144	21.7 (18.2–25.3)	0.51 (0.31–0.86)	0.011
Somewhat/strongly disagree	149	35.2 (24.5–45.8)	Reference	
In general, (I) understand how vaccines work				
Strongly agree	3599	15.0 (13.2–16.8)	1.92 (0.65–5.64)	0.237
Somewhat agree	1742	14.7 (12.0–17.4)	1.87 (0.64–5.50)	0.255
Somewhat/strongly disagree	153	–	Reference	
In general, (I am) concerned about the potential side effects of vaccines				
Strongly agree	1718	19.9 (16.8–22.9)	2.47 (1.53–3.99)	<0.001
Somewhat agree	2095	15.7 (13.3–18.2)	1.87 (1.17–2.96)	0.008
Somewhat disagree	893	6.7 (4.1–9.3)	0.72 (0.39–1.31)	0.281
Strongly disagree	765	9.1 (5.6–12.6)	Reference	
In general, a vaccine can give a serious case of the very same disease it is meant to prevent				
Strongly agree	583	16.8 (12.0–21.7)	1.34 (0.87–2.06)	0.185
Somewhat agree	1351	14.5 (11.7–17.4)	1.13 (0.80–1.58)	0.494
Somewhat disagree	1616	16.2 (13.4–19.0)	1.28 (0.93–1.75)	0.129
Strongly disagree	1528	13.1 (10.4–15.9)	Reference	
In general, the use of alternative practices, such as homeopathy or chiropractics, can eliminate the need for vaccination,				
Strongly agree	232	16.3 (9.1–23.5)	1.30 (0.74–2.29)	0.365
Somewhat agree	645	20.6 (15.6–25.5)	1.73 (1.23–2.45)	0.002
Somewhat disagree	1339	16.0 (13.0–19.0)	1.28 (0.96–1.70)	0.094
Strongly disagree	2742	13.0 (11.1–15.0)	Reference	
(I) feel (I) have enough information about immunization				
No	946	14.8 (11.3–18.3)	1.00 (0.73–1.37)	0.991
Yes	4503	14.8 (13.1–16.4)	Reference	

Rates and odds ratios are weighted

A: Coefficient of variation between 16.5 and 33.3%; interpret with caution –: Unreliable estimate because coefficient of variation equal to or greater than 33.3%

portion of unvaccinated girls in the territories was not fully explained by vaccine refusal. Although there have been a handful of Catholic school boards across Canada who have refused to allow public health delivery of the HPV vaccine within their schools over the period of time captured by the survey, these have been scattered geographically^{13,14} and are not felt to explain the provincial/territorial variability observed.

The estimated rate of non-vaccination in British Columbia (32.4%) is close to that reported from a survey conducted in this province (35%) using a similar definition for vaccination, i.e., receiving at least one dose of the vaccine.⁷ The estimated rate of parental refusal of the vaccine in Quebec (10.5%) is similar to what was reported by another study in that province (12%).⁸ Results from Ontario and Prince Edward Island cannot be compared to those previously published from these jurisdictions because of differences in data collection methods and definitions.^{10,11}

HPV vaccine refusal ranged from 2.9 to 17.9% across provinces and territories. Active refusal of HPV vaccine by parents was higher among those who had graduated from university compared to those with secondary or less education, and lower in those born in Asia compared to Canada. Not surprisingly, having positive attitudes about vaccines in general, such as believing they are safe, effective, and important for health were

associated with lower odds of HPV vaccine refusal whereas concerns about potential side effects of vaccines in general were associated with a higher risk of refusal. It has been shown previously that general attitudes toward vaccines are significant predictors of the uptake of HPV vaccine.⁸

Higher vaccine refusal rates among parents with higher educational attainment is consistent with a study of HPV vaccine acceptance from British Columbia⁷ and with results from the National Immunization Survey-Teen in the United States.¹⁵ However, this pattern has not been consistently observed, as a recent meta-analysis found no association between HPV vaccine refusal and education.¹⁶ We did not find an association between income and vaccine refusal, contrary to a recent study from Ontario using administrative data which found that living in a higher deprivation area was associated with a lower risk of having received zero doses of vaccine.¹⁷ The relationship between socioeconomic status, parental educational attainment and HPV vaccine acceptance remains unclear, with studies showing both positive and negative associations.^{18,19}

Girls whose responding parent was born in Europe or in a country within the Americas aside from Canada had significantly higher rates of non-vaccination, but not of vaccine refusal, compared to those whose responding parent was born in Canada. In contrast, parents born in Asia had a significantly

lower rate of vaccine refusal than those born in Canada, but with no difference in the rate of non-vaccination among their daughters.

The discrepancies between estimates of HPV non-vaccination and vaccine refusal is one of the most striking findings from this study. Among parents of girls who had never been vaccinated against HPV, less than half had refused the HPV vaccine for their daughter. There are several possible explanations for the discrepancy between uptake and refusal. This difference may be true or artifactual. If the difference is true, it may reflect the influence of factors other than parental acceptance of the vaccine such as access to immunization services, or vaccine refusal by the adolescent girl herself at the time of immunization, or absence from school on the day of a scheduled school-based immunization clinic. In contrast, an artifactual difference may reflect incomplete data within parent-held immunization records for vaccines delivered at school and/or parent's lack of recall of having consented to vaccination leading to responding no to the question on HPV vaccination.

The fact that some girls had been vaccinated against HPV while their responding parent or guardian had refused the vaccine may be because consent was given by the girl's other parent or by the girl herself. In all Canadian provinces and territories, with the exception of Quebec, a young person's ability to understand the nature and consequences of a proposed medical treatment form the basis for consent to treatment, rather than reaching the age of majority. In Quebec, the Civil Code establishes the age of consent to be at 14 y.²⁰ That said, a recent process evaluation of Ontario's school-based HPV program found variability in the extent to which public health nurses would accept consent from the adolescent directly (in the absence of parental consent).¹³ An alternate explanation for the discrepancy is that respondents may have changed their minds after initially refusing the vaccine, as they were asked if they had "ever" refused a vaccine for their daughter.

This study is the largest assessment of HPV vaccine uptake conducted in Canada to date. However, there are limitations to consider (in addition to the consent-related issues noted above).

1. Data were primarily collected from parents or guardians' recall and from immunization records they held, which may under-estimate vaccine coverage. However, the extent of under-estimation was mitigated using health care provider information to complement parental information for one third of participants.
2. Knowledge and attitude questions were about vaccines in general, and would not have captured attitudes related specifically to the HPV vaccine, e.g., parents believing that the HPV vaccine is less safe or less useful than vaccines in general.

In conclusion, rates of HPV non-vaccination and of refusal of the HPV vaccine are different, and are influenced by different sets of variables. The rate of HPV vaccine refusal is also higher in those who are more educated. These findings warrant further investigation in order to inform the development of targeted intervention.

Methods

The childhood national immunization coverage survey

The 2013, Childhood National Immunization Coverage Survey (CNICS) was conducted by Statistics Canada on behalf of the Public Health Agency of Canada.²¹ It was a cross-sectional survey of Canadian children aged 2, 7 or 17, plus girls 12–14 y of age (for HPV vaccine only) on March 1, 2013. Participants were randomly selected from the list of children whose parent or guardian applied for the Canadian Child Tax Benefit (CCTB), which is estimated to cover 96% of Canadian children.²² People living on First Nation reserves were excluded. Parents or guardians of total of 24,651 children agreed to participate in the survey. Data collection took place between September 16, 2013 and March 14, 2014 using computer-assisted telephone interviews.

This analysis examined data from the sample of 12- to 14-year-old females. For the province of Ontario, only girls aged 13–14 y were included in the analysis as school-based HPV immunization starts in grade 8, making some 12-year-old girls not yet eligible for the vaccine.

Parents or guardians (respondents) were asked about their child's immunization history and about their own knowledge, attitudes and beliefs relative to immunization, as well as socio-demographic information such as household income, education, and place of birth.

Respondents were asked if their child had ever received any immunization. If the answer was yes, they were asked if they had the child's immunization card or booklet. If yes (58.3% of participants), the interviewer guided them through the card or booklet and recorded all immunizations received by the child. If parents had no immunization record for the child or if HPV was not recorded in it, parents were asked if their child had ever received the HPV vaccine. If a girl did not have a dose of the HPV vaccine recorded and parents responded that she had not received one, she was considered as non-vaccinated against HPV for the purposes of these analyses.

If consent was given, Statistics Canada contacted health care provider(s) who had given immunizations to the child to collect data from their records. Health care provider information was available for approximately 31% of participants. Girls were considered to have received a dose of the HPV vaccine if it was reported by either their parent or healthcare provider.

Parents were also asked if they had ever decided not to give a vaccine to their child and if so, to specify which vaccines(s) they had refused and why they refused these specific vaccines. Those who listed HPV as one of the vaccines they decided not to give were considered as having refused HPV vaccination for their daughter. To assess knowledge, attitudes and beliefs about vaccines, parents were asked whether they strongly agree, somewhat agree, somewhat disagree or strongly disagree to a series of statements. In some cases the "somewhat" and "strongly disagree" response categories were combined due to small numbers. Parents were also asked whether they believed they had enough information about immunization.

Among variables analyzed, only household income was imputed and this was done using the nearest-neighbor imputation method.²³ Income was imputed for 30.8% of participants.

Data analysis

Data was analyzed using SAS 9.3 (Cary, NC). Survey sampling weights were applied so that the analyses would be representative of the Canadian population of children in the target age range. Frequencies and cross-tabulations were used to estimate prevalence and examine characteristics associated with HPV non-vaccination and vaccine refusal. Logistic regressions were used to calculate unadjusted and adjusted odds ratios. For most socio-demographic dependent variables, the category with the lowest rate of non-vaccination or refusal was used as reference in logistic regressions; exceptions were countries of birth of children and responding parent, for which Canada was always used as a reference, and province or territory in the analysis of non-vaccination, where Prince Edward Island was used instead of Newfoundland because the latter appeared as an outlier. Non-responses were always included in logistic regression analyses as a separate category (in some instances merged with response categories too small to be analyzed, e.g., Oceania as a birth place). For knowledge, attitudes and belief statements, those who responded “somewhat disagree” (or strongly or somewhat disagree when small numbers obliged us to combine the categories) were used as reference, regardless of the direction of association. Independent variables with $p < 0.1$ in simple regression models were included in multiple regressions. To account for the complex survey design, standard errors, coefficients of variation and confidence intervals were estimated with the bootstrap technique.²⁴ The statistical significance level was set at < 0.05 .

Ethics

CNICS was conducted by Statistics Canada as part of its mandate to “collect, compile, analyze, abstract and publish statistical information relating to the commercial, industrial, financial, social, economic and general activities and conditions of the people of Canada,” and was not therefore considered as health research. The survey was done on a voluntary basis and data were kept confidential. Authors of this study had no access to any identifiable record.

Disclosure of potential conflicts of interest

No potential conflicts of interest were disclosed.

Disclaimer

The views expressed in this articles are those of the authors and do not represent the positions or policies of the Public Health Agency of Canada or Statistics Canada.

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Contributors

NG and HG designed the study and conducted the analysis. All authors contributed to the interpretation of results. NG and HG drafted the manuscript, to which all authors provided input. All authors approved the final manuscript.

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