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## Easy access to vaccination was important for adherence during the 2016–2019 HPV catch-up vaccination in Norway

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### ABSTRACT

Between September and October 2019, the Norwegian Institute for Public Health (NIPH) surveyed women born between 1991 and 1996 who were offered catch-up vaccination for human papilloma virus (HPV). The aim was to identify determinants of vaccine schedule adherence. A random sample of 10,000 women who were offered catch-up vaccination were invited to participate in the survey. We defined adherence as receiving all three doses. Determinants of HPV vaccination adherence were investigated using descriptive, univariable and multivariable logistic regression analyses providing adjusted odds ratios (aOR). Data from 3,762 respondents who received at least one dose were included. Overall, 92.1% (95% CI = 89.3–91.9) of those initiating vaccination adhered to the complete schedule. The following factors were significantly associated with HPV vaccination adherence compared to non-adherence: country of origin (aOR = 0.43; 95% CI = 0.47–0.97), having children (aOR = 0.51; 95% CI = 0.35–0.73), ease of finding out where to get vaccinated (aOR = 1.94; 95% CI = 1.69–2.23), preference for receiving information from health authorities (aOR = 1.37; 95% CI = 1.04–1.81) and vaccination being readily available (aOR = 2.28; 95% CI = 1.50–3.37). Information from NIPH via SMS and social media were negatively associated for Norwegians (aOR = 0.68, 95% CI = 0.46–1.01) and positively associated for those whose country of origin was not Norway (aOR = 1.48, 95% CI = 0.69–3.14; not significant). Those who did not adhere to the full vaccination schedule reported that they had forgotten (40.4%; 95% CI = 33.5–47.8) or had no time (32.9%; 95% CI = 26.2–40.4). Despite NIPH's targeted communication campaign, the main barriers for HPV vaccination adherence were difficulty to find out where to get the vaccine, forgetting to take the vaccine or not having time to complete the schedule.

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### Introduction

Human papillomavirus (HPV) vaccination and screening reduce cervical cancer incidence and mortality.<sup>1</sup> While HPV vaccine efficacy has been clearly demonstrated in clinical trials,<sup>2</sup> an effective vaccination program depends on vaccination acceptance, initiation and adherence.<sup>3</sup> Vaccination acceptance is not directly linked to actual vaccination. Rather, it reflects positive attitudes toward vaccination. Vaccination initiation is defined as receiving at least one dose of the vaccine, but not completing the schedule. Vaccination adherence is defined as the completion of the recommended vaccination schedule.<sup>4,5</sup> Even if vaccination acceptance and initiation are high, vaccination adherence can be challenging to achieve,<sup>3,6</sup> particularly amongst adolescents and adults.<sup>7,8</sup> Vaccination adherence for multi-dose vaccines against varicella, hepatitis A and hepatitis B have been reported to be 40–50% in Europe and the USA.<sup>9,10</sup> Failure to complete the full schedule of a vaccine leads to suboptimal protection against the disease. Potential barriers to vaccination adherence among adolescents may include lack of routine medical visits, lack of prioritization of vaccination, population mobility, lack of familiarity by adolescents and medical providers with the recommended schedules.<sup>9</sup> A crucial step to optimize effective HPV vaccination is to understand and address the drivers behind HPV vaccination adherence.

In 2009, Norway included HPV vaccination in the national childhood immunization program. HPV vaccination has been routinely offered only to girls in the seventh grade (12–13 years of age). To date, all women born after 1997 have been offered vaccination in the routine program. In the period 2016–2019, the Norwegian authorities organized catch-up vaccination for women who were born between 1991 and 1996 and for those who missed the opportunity to access HPV vaccination through the childhood immunization program. Municipalities were responsible for the actual implementation of the vaccination, including selecting vaccination locations. In most municipalities, the vaccination was available at multiple locations, including GP practices, schools and at community health centers. The bivalent HPV vaccine (Cervarix<sup>®</sup>) was used, which protects against HPV types 16 and 18 and has shown cross-protection against additional carcinogenic HPV types.<sup>11</sup> The vaccination schedule consists of three doses given over a period of 6–12 months.

The Norwegian Institute for Public Health (NIPH) created a targeted communication strategy to raise awareness of HPV vaccination in women born in 1991. The communication strategy was developed based on a series of surveys, focus group discussions and interviews with women from the target group. The communication strategy consisted of different integrated communication measures, including social media campaigns (Facebook,

Instagram and Snapchat), text messages, brochures and posters. In addition, a webpage was established for health professionals and women in the target group on the NIPH website.

After the end of the HPV catch-up vaccination program, those who had missed the opportunity to participate could no longer access free HPV vaccination. Following the catch-up HPV vaccination campaign, NIPH, in collaboration with Statistics Norway (SSB), conducted a cross-sectional survey among women who had been offered catch-up HPV vaccination. In this study, we aimed to assess self-reported barriers and facilitators for HPV vaccination adherence. Our results will inform future HPV routine vaccination and catch-up programs.

## Materials and methods

### Study design

Between 23 September and 6 October 2019, NIPH and SSB conducted a nationwide cross-sectional population-based survey. Respondents provided informed consent before participation and the study followed requirements of the Personal Data Act. We did not have access to personal identifiable information. A more detailed description of the study methodology can be found elsewhere.<sup>12</sup>

### Measurements and outcomes

The outcome was self-reported adherence to the three-dose HPV vaccination schedule offered through the catch-up program. The variable was divided into two levels: (i) non-adhering defined as a person who received one or two doses of the HPV vaccine and (ii) adhering defined as a person who received all three doses of the HPV vaccine. Study participants who did not receive any dose were excluded from the analyses.

The explanatory variables were grouped into:

- Socio-demographic characteristics, including age, region of residence in Norway, educational level, country of origin, duration of residence in Norway, marital status, children and household income, the caregivers' country of origin and duration of residence in Norway.
- Self-reported reasons to complete all doses of the HPV vaccination schedule, including the role of (social) media and availability of HPV vaccination and information, caregivers, friends and health-care providers.
- Preferences of vaccination administration and communication, including location(s) where HPV vaccination was received and preferred vaccination location, preferred means and frequency of communication from NIPH regarding the HPV vaccination and preferred information sources.

Study participants who did not adhere to the full HPV vaccination schedule were asked to identify the reasons why they did not complete the initiated HPV vaccination. Because these questions were not asked to those adhering to the full schedule, we only described these results in terms of frequency distributions.

Two questions were combined to assess whether study participants were able to receive HPV vaccination at their preferred locations. Several questions, especially those related to opinions and preferences, were asked using a 5-point Likert scale.

The questionnaire was provided in Norwegian; the English translation can be found elsewhere.<sup>12</sup>

### Analysis

We weighted the descriptive analysis on education level, country of origin and age of the study participants using the Survey command in Stata. We compared those adhering and those not adhering to the full vaccination schedule using frequencies and chi-square tests.

We assessed the association between demographic and organizational determinants that may have affected HPV vaccination adherence using univariable and multivariable logistic regression. For the analysis, we recorded the Likert scales to binary variables: 'disagreed' if 1–3, and 'agreed' if 4–5. Those not adhering to the full HPV vaccination schedule were used as the reference group. All determinants with a *p*-value lower or equal to 0.25 in the univariable analyses were used in the multivariable analysis. We calculated odds ratios (OR) and 95% confidence intervals (95%CI) as measures of associations in the univariable analyses. For the multivariable analyses, we calculated adjusted ORs (aOR) and 95% CI. We identified 'country of origin' as an effect modifier for 'information via SMS and social media being a reason for completing the vaccination schedule' and we therefore added its interaction term to the multivariable analysis. All data were analyzed using STATA version 16 (StataCorp. 2019. *Stata Statistical Software: Release 16*. College Station, TX: StataCorp LLC).

## Results

### Response proportion

Of all the invited women (*n* = 10,000), 5,033 women (50.3%) completed the questionnaire, of which 3,762 met inclusion criteria for this analysis (received at least one dose of the HPV vaccine). One thousand two hundred and five women were excluded from this analysis as they did not receive any HPV vaccination. The selection process and socio-demographic characteristics of the survey respondents are presented elsewhere.<sup>12</sup>

### Characteristics of study participants

Of the 3,762 respondents, 3,464 adhered and 298 did not adhere to the full vaccination schedule (220 respondents received two doses and 78 respondents received only one dose). This resulted in 92.1% (95% CI = 89.3–91.9) adherence to the complete schedule among those initiating vaccination. Compared to those not born in Norway, those born in Norway were more frequently adhering to the full vaccination schedule (Table 1).

### Determinants of self-reported HPV vaccination adherence

The prevalence of the different opinions and preferences regarding the catch-up campaign and the proportion adhering within those groups are presented in Table 2. Overall, almost all women thought that receiving SMS was good (98.6%; 95% CI = 97.8–99.1), that the prevention of cervical cancer was important for them (99.8%; 95% CI = 99.6–99.9) and that health-care professionals' recommendation played an important role for their vaccination initiation (97.0%; 95% CI = 96.2–97.7).

Those adhering more often agreed that it was very easy to find out where one could get vaccinated (adhering: 94.6%; 95% CI = 93.2–95.7), or easy to find out (adhering: 88.4%; 95% CI = 85.5–90.8;  $p < .001$ ). Those adhering more often reported that the readily availability of the HPV vaccine was a reason for vaccination (adhering: 92.0%; 95% CI = 90.7–93.2;  $p < .001$ ). Those adhering more often agreed that information in the media was one of the reasons to complete the HPV vaccination schedule (adhering: 91.4%; 95% CI = 89.9–92.7;  $p = .180$ ).

Overall, most women received the HPV vaccination at community health services (69.0%; 95% CI = 67.1–70.8), followed by the GP (15.0%; 95% CI = 13.7–16.4) and the infection control offices (12.1%; 95% CI = 11.0–13.4). Although no statistical comparison was possible because multiple locations could be used by the women, adherence seemed highest for those receiving vaccination at an infection control office (93.9%; 95% CI = 90.9–95.9, Table 2). The adherence was also different between those who received the HPV vaccination at their preferred location (91.6%; 95% CI = 90.2–92.9) and those who did not (87.5%; 95% CI = 83.9–90.3). Overall, 77.3% (95% CI = 75.5–78.9) received the vaccine at their preferred location (Table 2).

The following factors were significantly negatively associated with HPV vaccination adherence compared to non-adherence (Table 3): country of origin (aOR for non-Norwegians = 0.43; 95% CI = 0.47–0.97) and having children (aOR = 0.51; 95% CI = 0.35–0.73), while the following showed a positive association: ease of finding out where to get vaccinated (aOR = 1.94; 95% CI = 1.69–2.23), preference for receiving information from health authorities (aOR = 1.37; 95% CI = 1.04–1.81) and vaccination being readily available (aOR = 2.28; 95% CI = 1.50–3.37). SMS and social media were negatively associated for Norwegians (aOR = 0.68; 95% CI = 0.46–1.01) and positively associated for those whose country of origin was not Norway (aOR = 1.48; 95% CI = 0.69–3.14; not significant).

Those who did not adhere to vaccinations often reported that they had forgotten (40.4%; 95% CI = 33.5–47.8) or had no time (32.9%; 95% CI = 26.2–40.4) to finish the three doses (Table 4, full table in Appendix 1). Only a small percentage of women indicated that vaccine skepticism (2.2%; 95% CI = 0.7–6.7) or fear of side effects of HPV vaccination (3.1%; 95% CI = 1.5–6.3) were drivers for not adhering to the HPV vaccination schedule.

### Discussion

Our study identified barriers to HPV vaccination adherence, similar to those related to other vaccines offered to adolescents.<sup>13</sup> Easy access to the vaccination location site was

the strongest facilitator of HPV vaccination adherence. During the catch-up campaign in Norway, study participants who adhered to HPV vaccination most often received vaccination at a community health services or GP practice. These locations were also the ones that were most preferred. Shorter distance between home and the vaccination location was previously found to be associated with higher vaccine uptake.<sup>13–15</sup> In the USA, pharmacies are increasingly used as an alternative vaccination location as they provide easy access to vaccination, especially for adults.<sup>8</sup> Ease of finding out where to get vaccinated and the HPV vaccine being readily available were strong predictors of HPV vaccination adherence. Considering the life phase of study participants, it is possible that they were moving for studies or work and therefore may not have known where to get vaccinated in their new place of residence.

Among reasons for non-adherence to HPV vaccination, study participants frequently indicated that they forgot or did not have time to get the vaccination. These reasons have also been identified in another qualitative study among adolescents.<sup>16</sup> This highlights the need to continue using different communication channels to frequently remind the target group during vaccination programs. Unfortunately, due to data protection considerations, NIPH was unable to remove those who had already been vaccinated from the recipient list for the SMS reminders. NIPH was also unable to identify those who had only received one or two doses and send them targeted reminder text messages to encourage vaccination adherence. It is crucial to find a balance between the frequency of communication to inform and remind about the vaccine shots and sending too many reminders, which may create frustration. Only a small percentage of young women who did not complete their HPV vaccination reported being skeptical of the HPV vaccine or were uncertain about its side effects and decided not to complete the multi-step HPV vaccination schedule. As these women did initiate HPV vaccination, a more in-depth understanding of why they changed their minds would be interesting. The fact that more than 95% of the women reported that awareness of the role of HPV vaccination in the prevention of cervical cancer was a reason to initiate and adhere to the HPV vaccination shows that these young women made an informed choice. Studies that were conducted in the early years after the introduction of the HPV vaccine showed that HPV vaccine initiation and adherence were negatively correlated with skepticism regarding the effectiveness and safety of the HPV vaccine or vaccines in general and fear about side effects.<sup>17,18</sup> Therefore, study participants' perceived utility of the HPV vaccine, their decision to initiate HPV vaccination, and the fact that HPV vaccination has been implemented in Norway for over a decade, presumably minimized study participants' skepticism or fear of vaccination. After the catch-up campaign ended in 2019, women who were born before 1996 could no longer access free HPV vaccination. In other countries, catch-up vaccinations are often organized in a more flexible manner. For example, by allowing those who have missed the vaccination opportunity due to pregnancy or concerns about the side effects of the vaccination while breastfeeding, to be vaccinated at

**Table 1.** Demographic characteristics of study participants: women born between 1991 and 1996 who adhered and did not adhere to the free catch-up HPV vaccination between 1 November 2016 and 30 June 2019 in Norway (N = 3,762).

	Non-adhering			Adhering		
	Sample			Sample		
	n	%	Weighted % (95% CI) <sup>a</sup>	n	%	Weighted % (95% CI) <sup>a</sup>
Overall	298	7.9	9.3 (8.1–10.6)	3,464	92.1	90.7 (89.3–91.9)
Country of origin (study participant) (n = 3,760)						
<i>Norway</i>	255	7.4	7.6 (6.7–8.6)	3,193	92.6	92.4 (91.4–93.3)
<i>EU, USA, Canada, Australia, New Zealand</i>	17	13.2	13.3 (8.4–20.3)	112	86.8	86.7 (79.7–91.6)
<i>Asia, Africa, Latin America, Oceania, Europe (outside EU)</i>	26	14.2	14.4 (10.0–20.4)	157	85.8	85.6 (79.6–90.0)
Duration of residence in Norway for non-Norwegians (study participant) (n = 314)						
<i>0–4 years</i>	16	17.0	16.5 (10.3–25.4)	78	83.0	83.5 (74.6–89.7)
<i>5–9 years</i>	4	10.3	20.3 (3.9–24.7)	35	89.7	89.7 (75.4–96.2)
<i>10 years or more</i>	23	12.7	13.3 (9.0–19.3)	158	87.3	86.7 (80.7–91.0)
Country of origin (caregivers) (n = 3,395)						
<i>Both caregivers from Norway</i>	207	7.11	7.1 (6.2–8.1)	2,703	92.89	92.9 (91.9–93.8)
<i>At least one caregiver from EU, USA, Canada, Australia, New Zealand</i>	20	10.0	13.5 (8.1–21.9)	181	90.0	86.5 (78.2–91.9)
<i>At least one caregiver from Asia, Africa, Latin America Oceania, Europe (outside EU)</i>	27	9.5	12.2 (8.0–18.2)	257	90.5	87.8 (81.8–92.0)
Region of residence (n = 3,762)						
<i>Akershus og Oslo</i>	114	10.0	11.0 (8.8–13.7)	1,030	90.0	89.0 (86.3–91.2)
<i>Hedmark og Oppland</i>	11	5.3	8.9 (4.5–17.0)	196	94.7	91.1 (83.0–95.6)
<i>Østlandet ellers</i>	34	6.6	8.3 (5.4–12.5)	482	93.4	91.7 (87.5–94.6)
<i>Agder og Rogaland</i>	43	8.5	9.3 (6.5–13.1)	465	91.5	90.8 (86.9–93.5)
<i>Vestlandet</i>	45	6.9	9.8 (6.9–13.6)	604	93.1	90.3 (86.5–93.1)
<i>Trøndelag</i>	26	6.1	5.7 (3.9–8.3)	399	93.9	94.3 (91.7–96.2)
<i>Nord-Norge</i>	25	8.0	8.5 (5.3–13.5)	288	92.0	91.5 (86.6–94.7)
Marital status (n = 3,762)						
<i>Single</i>	76	6.0	7.6 (5.8–9.9)	1,187	94.0	92.4 (90.1–94.2)
<i>In a relationship</i>	62	8.0	9.3 (6.8–12.5)	717	92.0	90.8 (87.6–93.2)
<i>Cohabiting</i>	126	8.8	9.5 (7.8–11.6)	1,305	91.2	90.5 (88.4–92.2)
<i>Married</i>	33	11.7	14.4 (9.6–21.0)	249	88.3	85.6 (79.0–90.4)
<i>Separated</i>	1	14.3	20.4 (2.8–69.2)	6	85.7	79.6 (30.8–97.2)
Children (n = 3,762)						
<i>Yes</i>	73	12.4	13.6 (10.4–17.6)	518	87.6	86.4 (82.4–89.6)
<i>No</i>	225	7.1	8.5 (7.2–9.9)	2,946	92.9	91.5 (90.1–92.8)
Highest completed education (n = 3,762)						
<i>Primary</i>	41	12.1	14.6 (10.5–19.9)	298	87.9	85.4 (80.1–89.5)
<i>Secondary</i>	83	9.0	10.1 (7.9–12.8)	841	91.0	89.9 (87.2–92.1)
<i>University or college</i>	174	7.0	7.8 (6.4–9.3)	2,325	93.0	92.3 (90.7–93.6)
Household income after tax (in NOK) (n = 3,711)						
<i>P10 214000</i>	100	7.8	9.2 (7.3–11.6)	1,191	92.3	90.8 (88.4–92.7)
<i>P20 266000</i>	30	8.4	10.7 (6.9–16.2)	327	91.6	89.3 (83.8–93.1)
<i>P30 305000</i>	23	8.4	8.9 (5.5–14.0)	251	91.6	91.1 (86.1–94.5)
<i>P40 339000</i>	21	8.0	10.2 (6.1–16.5)	240	92.0	89.8 (83.5–93.9)
<i>P50 372000</i>	18	7.0	8.8 (5.0–15.0)	241	93.0	91.2 (85.0–95.0)
<i>P60 408000</i>	18	6.6	8.6 (5.0–14.5)	256	93.4	91.4 (85.5–95.0)
<i>P70 450000</i>	17	6.0	6.2 (3.6–10.4)	266	94.0	93.8 (89.6–96.4)
<i>P80 507000</i>	24	8.9	9.9 (6.1–15.7)	247	91.1	90.1 (84.4–93.9)
<i>P90 606000</i>	22	8.1	8.1 (5.0–13.0)	250	91.9	91.9 (87.0–95.0)
<i>P100 &gt; 606001</i>	20	11.8	12.3 (7/4–20.0)	149	88.2	87.7 (90.0–92.7)
		Median			Median	
		(range)			(range)	
Age (n = 3,762)		26 (23–28)			26 (23–28)	

<sup>a</sup>Weighted on education level, country of origin and age of the study participants.

a later stage. In Norway, the option of delayed vaccination was not offered, and pregnancy was indicated by 16% of those not adhering as a reason for not completing the full HPV vaccination schedule.

As has been shown in a parallel analysis of the same survey, country of origin and having children were also important determinants of HPV vaccination completion.<sup>12</sup>

Our study design has several limitations that are described elsewhere.<sup>12</sup> A specific limitation of the adherence analysis is the relatively small sample size of the reference (non-adhering) group, which affected the standard errors for the measured associations. In addition, this survey particularly asked young women about the organization and communication strategies for the HPV catch-up vaccination. As the preferences may be dependent on the context, the age group of the study

participants and that the preferences may have been for a catch-up vaccination (as opposed to routine immunization programs), we cannot extrapolate the findings beyond the HPV catch-up vaccination.

Our study found that the main facilitators for HPV vaccination adherence were that HPV was readily available and the ease of finding the HPV vaccination site, while barriers included forgetting to take the vaccine or making time for vaccination completion, and not vaccine skepticism or opposing vaccination in general. Making sure that HPV vaccination remains easily available, by offering HPV vaccination at primary health care providers everywhere (community health services and GP practices), might improve HPV vaccination adherence. Finally, we recommend facilitating adherence to the full vaccination schedule by offering more flexibility around the end date of catch-up

**Table 2.** Opinions and preferences regarding the organization of HPV vaccination and communication strategies of women born between 1991 and 1996 who were invited for free catch-up HPV vaccination between 1 November 2016 and 30 June 2019 in Norway.

	All women		Non-adhering (N = 298; 7.9%)		Adhering (N = 3,464; 92.1%)		$\chi^2$ (d <sup>b</sup> , p <sup>c</sup> )
	Sample %	Weighted % (95% CI) <sup>a</sup>	Sample n	Weighted % (95% CI) <sup>a</sup>	Sample n	Weighted % (95% CI) <sup>a</sup>	
What do you think about receiving information from NIPH via SMS? (n = 2,866)							1.44 (1, .230)
<i>Good</i>	98.9	98.6 (97.8–99.1)	199	7.9 (6.7–9.3)	2,635	92.1 (90.7–93.3)	
<i>Not good</i>	1.1	1.4 (0.9–2.2)	4	15.6 (4.9–40.1)	28	84.4 (59.9–95.1)	
Over a 2-year period, NIPH sent 5 SMSs to remind people of the free HPV vaccination, what do you think about it? (n = 2,834)							1.35 (1, .510)
<i>Good to be reminded</i>	93.0	93.2 (92.0–94.2)	187	7.9 (6.7–9.4)	2,450	92.1 (90.6–93.3)	
<i>Good to be reminded, but 5 SMS is too many</i>	5.5	5.2 (4.4–6.3)	8	4.7 (2.3–9.4)	148	95.3 (90.6–97.7)	
<i>Do not think SMS should be sent</i>	1.4	1.6 (1.1–2.3)	4	18.2 (6.4–4.2)	37	81.9 (58.1–93.6)	
Where did you get the HPV vaccine? (multiple locations possible)							
Community health service (n = 2,616)**							
Yes	69.6	69.0 (67.1–70.8)	224	10.0 (8.5–11.7)	2,392	90.0 (88.4–91.5)	4.72 (1, .030)*
Student health service (n = 339)**							
Yes	9.0	8.7 (7.7–9.9)	20	7.4 (4.3–12.6)	319	92.6 (87.4–95.7)	2.10 (1, .147)
Military (n = 15)**							
Yes	0.4	0.4 (0.2–0.7)	2	12.6 (3.0–39.9)	13	87.4 (60.1–97.0)	0.60 (1, .438)
General practitioner (n = 584)**							
Yes	15.5	15.0 (13.7–16.4)	33	7.2 (4.8–10.6)	551	92.8 (89.4–95.2)	4.92 (1, .027)*
Infection control office (n = 498)**							
Yes	13.3	12.1 (11.0–13.4)	33	6.1 (4.1–9.1)	465	93.9 (90.9–95.9)	1.34 (1, .248)
Other (n = 328)**							
Yes	8.7	9.7 (8.5–11.0)	19	7.5 (4.3–12.8)	309	92.5 (87.2–95.7)	2.23 (1, .134)
Did you receive the vaccine at your preferred location? (n = 3,762)							9.87 (1, .002)*
Yes	78.3	77.3 (75.5–78.9)	212	8.4 (7.1–9.8)	2,735	91.6 (90.2–92.9)	
No	21.7	22.7 (21.1–24.5)	86	12.6 (9.7–16.1)	729	87.5 (83.9–90.3)	
How easy or difficult was it for you to find out where you could get the free HPV vaccine? (n = 3,762)							175.15 (5, <.001)*
Very easy	62.0	60.4 (58.5–62.4)	107	5.4 (4.3–6.8)	2,226	94.6 (93.2–95.7)	
Easy	26.9	27.6 (25.8–29.4)	101	11.6 (9.2–14.6)	911	88.4 (85.5–90.8)	
Neither easy nor difficult	7.8	8.5 (7.4–9.8)	52	18.2 (13.3–24.5)	241	81.8 (75.5–86.7)	
Difficult	2.7	3.0 (2.3–3.8)	34	38.4 (27.0–51.1)	69	61.7 (48.9–73.0)	
Very difficult	0.5	0.5 (0.3–0.9)	4	32.7 (11.3–65.1)	13	67.3 (34.9–88.8)	
If you wanted to get more information, where would you get it? (multiple locations possible)							
Internet (n = 3,762)							0.87 (1, .352)
Yes	83.5	81.3 (79.7–82.9)	243	9.3 (8.0–10.8)	2,897	90.7 (89.2–92.0)	
No	16.5	18.7 (17.1–20.4)	55	9.4 (6.9–12.8)	567	90.6 (87.2–93.1)	
Friends or colleagues (n = 3,762)							0.09 (1, .760)
Yes	24.2	23.9 (22.3–25.6)	70	9.9 (7.5–13.1)	841	90.1 (86.9–92.5)	
No	75.8	76.1 (74.4–77.7)	228	9.1 (7.8–10.6)	2,623	90.9 (89.4–92.2)	
Family (n = 3,762)							1.71 (1, .192)
Yes	19.0	19.0 (17.5–20.6)	48	8.7 (6.2–12.1)	665	91.3 (87.9–93.8)	
No	81.0	81.0 (79.4–82.5)	250	9.5 (8.2–11.0)	2,799	90.5 (89.1–91.9)	
Community health service (n = 3,762)							0.19 (1, .663)
Yes	40.1	41.1 (39.2–43.1)	116	9.4 (7.5–11.6)	1,393	90.6 (88.4–92.5)	

(Continued)

Table 2. (Continued).

	All women		Non-adhering (N = 298; 7.9%)		Adhering (N = 3,464; 92.1%)		$\chi^2$ (df, p <sup>c</sup> )
	Sample %	Weighted % (95% CI) <sup>a</sup>	Sample n	Weighted % (95% CI) <sup>a</sup>	Sample n	Weighted % (95% CI) <sup>a</sup>	
No	59.9	58.9 (56.9–60.8)	182	9.3 (7.8–11.0)	2,071	90.7 (89.0–92.2)	
GP (n = 3,762)							0.15 (1, .694)
Yes	55.4	57.1 (55.1–59.0)	162	9.8 (9.1–11.7)	1,924	90.2 (88.3–91.9)	
No	44.6	42.9 (41.0–44.9)	136	8.7 (7.1–10.6)	1,540	91.3 (89.5–92.9)	
Health authorities (n = 3,762)							11.23 (1, .001)*
Yes	43.8	42.9 (41.0–44.9)	103	6.9 (5.5–8.7)	1,545	93.1 (91.3–94.5)	
No	56.2	58.6 (56.7–60.5)	195	11.0 (9.3–13.0)	1,919	89.0 (97.0–90.7)	
What were the reasons why you completed the HPV vaccination? ... information from the media (n = 3,001)							4.17 (1, .041)*
Agree	88.5	87.4 (85.8–88.8)	201	8.6 (7.3–10.2)	2,455	91.4 (89.9–92.7)	
Disagree	11.5	12.6 (11.2–14.3)	37	13.7 (9.3–19.6)	308	86.3 (80.4–90.7)	
... information from NIPH via SMS and social media (n = 3,151)							1.801 (1, .180)
Agree	89.9	88.7 (87.1–90.1)	215	8.5 (7.2–9.9)	2,617	91.5 (90.1–92.8)	
Disagree	10.1	11.3 (9.9–12.9)	31	14.9 (10.0–21.8)	288	85.1 (78.2–90.1)	
... HPV vaccination was free of charge (n = 3,614)							0.414 (1, .520)
Agree	95.9	96.0 (95.2–96.7)	275	9.1 (7.9–10.5)	3,190	90.9 (89.5–92.1)	
Disagree	4.1	4.0 (3.3–4.8)	14	13.7 (7.2–24.3)	135	8.6 (75.8–92.8)	
... HPV vaccination was readily available (n = 3,580)							98.33 (1, <.001)*
Agree	96.4	96.1 (95.2–96.9)	234	8.0 (6.8–9.3)	3,218	92.0 (90.7–93.2)	
Disagree	3.6	3.9 (3.1–4.8)	39	34.0 (24.2–45.5)	89	66.0 (54.5–75.8)	
... my parents and/or friends thought I should take the vaccination (n = 3,037)							0.32 (1, .570)
Agree	91.6	90.5 (89.0–91.8)	203	8.3 (7.0–9.8)	2,580	91.7 (90.2–93.0)	
Disagree	8.4	9.5 (8.2–11.0)	21	10.4 (6.2–17.0)	233	89.6 (83.0–93.8)	
... healthcare professionals and central health authorities recommended vaccination (n = 3,355)							1.94 (1, .164)
Agree	97.1	97.0 (96.2–97.7)	248	8.7 (7.6–10.2)	3,011	91.3 (89.9–92.5)	
Disagree	2.9	3.0 (2.3–3.8)	11	13.6 (6.7–25.6)	85	86.4 (74.5–93.3)	
... the vaccine can prevent cervical cancer (n = 3,644)							0.67 (1, .415)
Agree	99.8	99.8 (99.6–99.9)	279	8.9 (7.7–10.2)	3,357	91.1 (89.8–92.3)	
Disagree	0.2	0.2 (0.0–0.4)	0	0	8	1	
... I, or someone I know, has had cell changes/cervical cancer (n = 3,174)							0.369 (1, .544)
Agree	66.3	64.6 (62.5–66.7)	168	9.4 (7.8–11.2)	1,937	90.6 (89.0–91.8)	
Disagree	33.7	35.4 (33.3–37.5)	92	9.9 (7.7–12.5)	977	90.1 (87.5–92.3)	

<sup>a</sup>Weighted on education level, country of origin and age of the study participants.<sup>b</sup>d = degrees of freedom.<sup>c</sup>p = p value.

\* = p value significant at p &lt; .05.

\*\*The reference used for these categories is those not vaccinated at the indicated location.

**Table 3.** Univariable and multivariable analyses of determinants of full HPV vaccination adherence with those non-adhering to the full vaccination regime as reference group.

	Univariable analysis			Multivariable analysis (n = 3,458)		
	OR	95% CI	p	aOR	95% CI	p
Age (n = 3,762)	0.96	0.89–1.02	.193	0.99	0.91–1.08	.850
Country of origin (study participant) (n = 3,760)			.001*			.031*
Norway	1			1		
Not Norway	0.39	0.21–0.65		0.43	0.47–0.97	
Country of origin (caregivers) (n = 3,475)			.001*			.468
Both caregivers from Norway	1			1		
At least one caregiver from outside of Norway	0.72	0.44–1.16		0.75	0.45–1.25	
Both caregivers from outside of Norway	0.53	0.38–0.75		0.81	0.45–1.45	
Region of residence (n = 3,762)			.051			.153
Akershus og Oslo	1			1		
Hedmark og Oppland	1.97	1.04–3.72		1.87	0.93–3.77	
Østlandet ellers	1.57	1.05–2.34		1.69	1.08–2.64	
Agder og Rogaland	1.20	0.83–1.73		1.22	0.80–1.84	
Vestlandet	1.49	1.04–2.13		1.39	0.93–2.07	
Trøndelag	1.70	1.09–2.64		1.66	1.02–2.70	
Nord-Norge	1.28	0.81–2.00		1.21	0.73–2.00	
Marital status (n = 3,762)			.009*			.417
Single	1			1		
In a relationship	0.74	0.31–0.74		0.80	0.54–1.17	
Cohabiting	0.66	0.05–3.23		0.71	0.51–1.01	
Married	0.48	0.52–1.05		0.76	0.46–1.28	
Separated	0.38	0.49–0.89		1.31	0.12–13.99	
Children (n = 3,762)			<.001*			<.001*
Yes	0.54	0.41–0.72		0.51	0.35–0.73	
Highest completed education (n = 3,762)			.002*			.094
Primary or none	1			1		
Secondary	1.39	0.94–2.07		1.11	0.70–1.77	
University or college	1.84	1.28–2.64		1.46	0.94–2.27	
Household income after tax (in NOK) (n = 3,711)			.689			
P10 214000	1					
P20 266000	0.92	0.60–1.40				
P30 305000	0.92	0.57–1.47				
P40 339000	0.96	0.59–1.57				
P50 372000	1.12	0.67–1.89				
P60 408000	1.19	0.71–2.01				
P70 450000	1.31	0.77–2.23				
P80 507000	0.86	0.54–1.38				
P90 606000	0.95	0.59–1.54				
P100 > 606001	0.63	0.38–1.04				
Ease to find out where you could get the free HPV vaccine (n = 3,762)	2.05	1.82–2.30	<.001*	1.94	1.69–2.23	<.001*
Receipt of vaccination at your preferred location (n = 3,762)			.002*			.664
Yes	1.52	1.17–1.98		1.07	0.79–1.45	
If you wanted to get more information about the vaccines, where would you get this? (multiple locations possible) (n = 3,762)						
Internet	1.16	0.85–1.57	.352			
Friends or colleagues	1.04	0.79–1.38	.761			
Family	1.24	0.90–1.71	.192	1.08	0.76–1.54	.667
Community health service	1.06	0.83–1.35	.664			
GP	1.05	0.83–1.33	.694			
Health authorities	1.52	1.19–1.95	.001*	1.37	1.04–1.81	.025*
What were the reasons why you completed the HPV vaccination? (multiple answers possible)						
... information from the media (n = 3,754)	1.18	0.92–1.52	.192	1.03	0.76–1.41	.842
... information from NIPH via SMS and social media (n = 3,755)						
Country of origin: Norway	1.09	0.81–1.46	.584	0.68	0.46–1.01	.034*
Country of origin: Not Norway	1.76	0.91–3.41	.092	1.48	0.69–3.14	.312
... HPV vaccination was free of charge (n = 3,758)	0.99	0.63–1.54	.958			
... HPV vaccination was readily available (n = 3,760)	3.61	2.65–4.90	<.001*	2.28	1.50–3.37	<.001*
... my parents and/or friends thought I should take the vaccination (n = 3,762)	1.37	1.06–1.76	.017*	1.20	0.89–1.62	.226
... healthcare professionals and central health authorities recommended vaccination (n = 3,761)	1.34	0.98–1.85	.070	0.68	0.46–1.01	.057
... the vaccine can prevent cervical cancer (n = 3,761)	2.16	1.30–3.57	.003*	1.31	0.70–2.43	.395
... I, or someone I know, has had cell changes/cervical cancer (n = 3,756)	0.99	0.78–1.25	.904			

•The estimate of OR of receiving information from FHI via SMS and social media for study participants whose country of origin is not Norway is based on the multiplication of the estimate of the OR of study participants whose country of origin was Norway (presented in the Table 3) \* the interaction term (1.62 (95%CI: 0.79–3.35), p-value: 0.19).

••The estimate of aOR of receiving information from FHI via SMS and social media for study participants whose country of origin is not Norway is based on the multiplication of the estimate of the aOR of study participants whose country of origin was Norway (presented in the Table 3) \* the interaction term (2.18 (95%CI: 0.98–4.88), p-value: 0.06).

\* = p value significant at  $p < .05$ .

(a)OR = (adjusted)odds ratio.

**Table 4.** Self-reported reasons for incomplete HPV vaccination according to women who did not adhere to the free HPV vaccination (n = 298) between 1 November 2016 and 30 June 2019 in Norway (weighted percentage and 95% confidence interval).

	Totally agree % (95% CI)	Fairly agree % (95% CI)	Neither agree/ disagree % (95% CI)	Fairly disagree % (95% CI)	Completely disagree % (95% CI)
I forgot to finish the 3 doses	40.4 (33.5–47.8)	15.8 (11.7–21.1)	13.9 (9.5–19.9)	7.9 (4.9–12.5)	21.9 (16.7–28.3)
I did not have time to finish the 3 doses	32.9 (26.2–40.4)	16.0 (11.7–21.5)	18.6 (13.9–24.6)	8.4 (5.0–13.6)	24.1 (18.6–30.6)
It took too long between doses and I did not want to start again	18.1 (12.9–24.8)	18.6 (13.5–25.0)	21.8 (16.4–28.3)	5.9 (3.7–9.3)	35.7 (29.2–42.8)
I became pregnant and could not complete the vaccination	16.2 (11.9–21.8)	0.9 (0.3–2.5)	2.3 (0.7–7.3)	0.5 (0.1–2.1)	80.0 (73.9–85.0)
I moved and did not know where to get the vaccination	9.3 (5.8–14.4)	11.6 (7.5–17.6)	6.8 (3.9–11.8)	3.8 (1.9–7.4)	67.6 (60.4–74.1)
I moved abroad	5.8 (3.2–10.4)	5.3 (2.6–10.6)	3.4 (1.3–8.3)	3.1 (1.1–8.4)	82.5 (75.4–87.8)
I read that someone was skeptical of the vaccination, and became skeptical myself	2.2 (0.7–6.7)	8.0 (4.5–13.8)	5.3 (2.7–9.9)	2.3 (0.9–5.5)	82.3 (75.5–87.5)
I became uncertain of the side effects of the vaccination and did not want to take more doses	3.1 (1.5–6.3)	5.4 (2.6–11.2)	7.5 (4.0–13.6)	4.7 (2.3–9.4)	79.3 (72.0–85.1)

HPV vaccination programs, so that those who missed the opportunity to participate can still access free HPV vaccination.

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