

Parental gender influences their intention to HPV vaccinate their children, and the association between HPV and COVID-19 vaccination intentions

Emiko Oka^{a,b}, Yutaka Ueda^{a,*}, Asami Yagi^a, Yuri Ito^b, Yoshihiko Hosokawa^c, Takahiro Tabuchi^d, Tadashi Kimura^a

^a Department of Obstetrics and Gynecology, Osaka University Graduate School of Medicine, 2-2, Yamadaoka, Suita, Osaka 565-0871, Japan

^b Department of Medical Statistics, Research & Development Center, Osaka Medical and Pharmaceutical University, 2-7, Daigakumachi, Takatsuki, Osaka 569-0801, Japan

^c Department of Obstetrics and Gynecology, Institute of Medicine, University of Tsukuba, 1-1-1, Tennodai, Tsukuba, Ibaraki 305-8575, Japan

^d Department of Cncer Epidemiology, Cancer Control Center, Osaka International Cancer Institute, 3-1-69, Otemae, Chuo-ku, Osaka 541-8567, Japan

ARTICLE INFO

Keywords:

HPV vaccine
COVID-19 vaccine
Parental intention
Gender
Fear
Vaccine hesitancy

ABSTRACT

Purpose: The coronavirus disease of 2019 (COVID-19) pandemic has increased public awareness of infectious diseases and interest in vaccines, including the human papilloma virus (HPV) vaccine. We investigated differences between parental gender and intentions to vaccinate their child for HPV and COVID-19.

Methods: We analyzed data from Japan's COVID-19 and Society Internet Survey (JACSIS), a web-based cross-sectional survey of 2,444 respondents in 2021.

Results: Females were more knowledgeable and more afraid of HPV and COVID-19 than males. The proportions of females in favor of, or against, HPV vaccination was higher than among males. The fathers' intention for HPV vaccination was significantly associated with the child's gender, knowledge regarding HPV, and intention to inoculate with the COVID-19 vaccine. The mothers' intention was also associated with her knowledge of HPV and her intention to seek the COVID-19 vaccine, but it included a greater fear of HPV infection. Both male and female parents favored the COVID-19 vaccine over the HPV vaccine. Parents approving of COVID-19 vaccination believed in the overall efficacy of vaccines and were more receptive to opinions from the administration and physicians, even if the parent was currently against HPV vaccination.

Conclusions: Mothers were more knowledgeable about HPV and more favorable to vaccinate their child for HPV than fathers. The intention to have children COVID-19 vaccinated was also higher than for HPV vaccination. During this period of heightened public interest in vaccines due to the COVID-19 pandemic, this is a good time to educate and inform the public about HPV.

Introduction

The human papillomavirus (HPV) vaccine is effective in the prevention of HPV infection, the leading cause of cervical cancer [1,2]. The World Health Organization (WHO) has listed the following three goals which must be achieved by 2030 for the elimination of cervical cancer; 90 % of girls fully vaccinated with HPV vaccine by age 15 years, 70 % of women are screened with a high-performance test by 35 years of age and again by 45 years of age, 90 % of women identified with cervical disease receive treatment [3]. In line with this highly ambitious WHO policy,

among the 194 WHO member countries, 107 now have routine HPV vaccination programs for girls, and 33 have started programs for boys [4]. The average one-dose HPV vaccination rate within these countries is estimated to be 67 %, and the average three-dose fully-vaccinated rate is 53 %. Unfortunately, hesitancy against the HPV vaccine is currently very high in Japan due to the suspension of the governmental recommendation for HPV vaccination and the resultant HPV vaccination rate is currently extremely low; only 1.8 % of age-eligible Japanese girls are reported to be fully vaccinated [5].

The Coronavirus disease of 2019 (COVID-19) pandemic that began in

Abbreviations: COVID-19, Coronavirus disease of 2019; HPV, Human papillomavirus; JACSIS, Japan COVID-19 and Society Internet Survey; WHO, World Health Organization; SES, Socio-Economic Status.

* Corresponding author.

E-mail address: ZVF03563@nifty.ne.jp (Y. Ueda).

<https://doi.org/10.1016/j.jvacx.2024.100441>

Received 25 September 2023; Received in revised form 15 January 2024; Accepted 18 January 2024

Available online 20 January 2024

2590-1362/© 2024 The Author(s). Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Table 1
Sociodemographic characteristics of respondents by parental gender and sex of child.

	Have a daughter aged 12 to 19			Have a son aged 12 to 19		
	Male (N = 917)	Female (N = 775)	p-value	Male (N = 828)	Female (N = 751)	p-value
<i>Age group</i>						
–39	77 (8.4)	77 (8.4)	<0.001	72 (8.1)	114 (13.7)	<0.001
40–49	535 (58.3)	535 (58.3)		521 (58.4)	550 (66.1)	
50+	305 (33.3)	305 (33.3)		298 (33.5)	169 (20.2)	
<i>Employment</i>						
Employer	61 (6.6)	61 (6.6)	<0.001	57 (6.4)	8 (0.9)	<0.001
Self-employed	64 (6.9)	64 (6.9)		84 (9.4)	23 (2.8)	
Employee	772 (84.2)	772 (84.2)		744 (83.5)	571 (68.5)	
Unemployed	21 (2.2)	21 (2.2)		7 (0.7)	232 (27.8)	
<i>Academic attainment</i>						
Junior or high school	431 (47.1)	431 (47.1)	<0.001	407 (45.6)	389 (46.7)	<0.001
Junior college	142 (15.5)	142 (15.5)		143 (16.1)	298 (35.8)	
University	341 (37.2)	341 (37.2)		341 (38.3)	138 (16.6)	
Others	2 (0.3)	2 (0.3)		0 (0)	8 (1)	
<i>Income level</i>						
Lower	29 (3.2)	29 (3.2)	0.002	42 (4.7)	79 (9.5)	<0.001
Intermediate	257 (28.1)	212 (27.4)		255 (28.6)	244 (29.2)	
Higher	496 (54.1)	335 (43.3)		484 (54.3)	319 (38.3)	
Not answered	134 (14.7)	169 (21.9)		111 (12.4)	191 (22.9)	
<i>Marital status</i>						
Married	895 (97.6)	676 (87.2)	<0.001	870 (97.6)	727 (87.3)	<0.001
Not married	22 (2.4)	99 (12.8)		22 (2.4)	105 (12.7)	
<i>Vaccinated against COVID-19</i>						
Yes	810 (88.4)	625 (80.7)	0.004	774 (86.8)	689 (82.8)	0.15
<i>Knowledge about HPV</i>						
Knowledgeable	345 (37.65)	610 (78.8)	<0.001	341 (38.2)	636 (76.4)	<0.001
Less knowledgeable	572 (62.4)	165 (21.3)		551 (61.8)	196 (23.6)	
<i>Fear against HPV infection</i>						
Afraid	169 (18.4)	239 (30.8)	<0.001	157 (17.7)	222 (26.7)	0.005
Not afraid or neutral	748 (81.6)	536 (69.2)		734 (82.3)	611 (73.4)	
<i>Fear against COVID-19 infection</i>						
Afraid	436 (47.6)	503 (64.9)	<0.001	440 (49.4)	530 (63.6)	<0.001
Not afraid or neutral	481 (52.5)	272 (35.1)		451 (50.6)	303 (36.4)	

2020 has detrimentally impacted HPV vaccination, as the rates are lower now than in the same period just before the pandemic [6]. To this point, a study of parents of adolescents aged 9–17 years found that the parents preferred the COVID-19 vaccine over the HPV vaccine [7].

Numerous studies have shown that mothers have a significant influence on their daughters' HPV vaccination [8–10]. On the other hand, few studies have focused on the fathers or on parental gender. The importance of surveying not only mothers but also fathers regarding their intentions to vaccinate their children against HPV has been advocated [11].

In this context, we investigated differences by parental gender in HPV vaccination intention, and its association with COVID-19 vaccination intention, using data from a nationwide internet survey, the Japan COVID-19 and Society Internet Survey (JACSIS).

Methods

Study design and participants

The JACSIS survey was a web-based, cross-sectional, self-reported

questionnaire survey conducted by a major internet research agency (Rakuten Insight, Inc.). The questionnaire was distributed to 33,081 individuals selected in a simple random sampling by gender and age for all 47 prefectures (the primary administrative districts in Japan). This survey was conducted between 27 September and 29 October 2021. Panel members aged 18–79 years were surveyed in an overlapping period, between 23 October and 28 October 2021, using the same questionnaire. This survey was closed when the number of respondents reached the target number of 31,000. To validate data quality, we excluded 2,825 respondents who had unnatural or inconsistent responses using a previously developed algorithm [12]. We were interested in parental attitudes toward HPV versus COVID-19 vaccination for their children, so the target population of respondents was limited to those with a daughter or son who was age-eligible at the time of the survey for HPV vaccination as routine vaccination or as a catch-up vaccination, i.e., aged 12 to 19 years. The overall flowchart is shown in [Supplementary Fig. 1](#). The Japanese government had not yet resumed its recommendation for HPV vaccination at the time we conducted this survey.

This study was approved by the by Ethical Review Board Osaka

Table 2
Intention to get a daughter aged 12 to 19 vaccinated against HPV or COVID-19.

HPV vaccine	Male N (%) (N = 917)	Female N (%) (N = 775)	p-value	COVID-19 vaccine	Male N (%) (N = 917)	Female N (%) (N = 775)	p-value
<i>Inoculate as soon as possible</i>							
Agree	159 (17.4)	169 (21.8)	<0.001	Agree	321 (35.0)	382 (49.3)	<0.001
Neutral	650 (70.9)	371 (47.9)		Neutral	522 (56.9)	262 (33.8)	
Disagree	107 (11.7)	235 (30.3)		Disagree	74 (8.1)	132 (17.0)	
<i>Inoculate if doctors recommend the vaccination</i>							
Agree	239 (26.1)	246 (31.7)	<0.001	Agree	332 (36.2)	400 (51.6)	<0.001
Neutral	564 (61.5)	333 (43.0)		Neutral	511 (55.8)	263 (34.0)	
Disagree	113 (12.4)	196 (25.3)		Disagree	74 (8.0)	111 (14.4)	
<i>Inoculate after I received the routine vaccination invitation from the government or municipality</i>							
Agree	219 (24.0)	207 (26.7)	<0.001	Agree	308 (33.6)	359 (46.4)	<0.001
Neutral	581 (63.4)	364 (47.0)		Neutral	546 (59.6)	308 (39.8)	
Disagree	116 (12.6)	204 (26.3)		Disagree	63 (6.9)	107 (13.8)	
<i>Inoculate after some friends inoculate their daughters with the vaccine</i>							
Agree	176 (19.2)	198 (25.6)	<0.001	Agree	267 (29.2)	331 (42.7)	<0.001
Neutral	640 (69.8)	416 (53.6)		Neutral	574 (62.7)	347 (44.8)	
Disagree	100 (11.0)	161 (20.8)		Disagree	75 (8.2)	96.8 (12.5)	
<i>Inoculate if media reports that many of my daughter's peers have been vaccinated</i>							
Agree	181 (19.7)	233 (30.1)	<0.001	Agree	265 (29.0)	355 (45.9)	<0.001
Neutral	628 (68.5)	386 (49.9)		Neutral	578 (63.0)	332 (42.8)	
Disagree	108 (11.8)	155 (20.0)		Disagree	73.4 (8.0)	88 (11.4)	

Table 3
Intention to get a son aged 12 to 19 vaccinated against HPV or COVID-19.

HPV vaccine	Male N (%) (N = 891)	Female N (%) (N = 833)	p-value	COVID-19 vaccine	Male N (%) (N = 891)	Female N (%) (N = 833)	p-value
<i>Inoculate as soon as possible</i>							
Agree	103 (11.6)	81 (9.7)	<0.001	Agree	333 (37.3)	387 (46.5)	0.039
Neutral	671 (75.2)	531 (63.7)		Neutral	462 (51.9)	328 (39.4)	
Disagree	118 (13.2)	221 (26.6)		Disagree	96 (10.8)	118 (14.2)	
<i>Inoculate if doctors recommend the vaccination</i>							
Agree	172 (19.3)	213 (25.6)	<0.001	Agree	343 (38.5)	419 (50.4)	<0.001
Neutral	620 (69.6)	465 (55.9)		Neutral	477 (53.5)	325 (39.1)	
Disagree	100 (11.2)	154 (18.5)		Disagree	72 (8.1)	88 (10.6)	
<i>Inoculate after I received the routine vaccination invitation from the government or municipality</i>							
Agree	155 (17.4)	192 (23)	<0.001	Agree	324 (36.3)	398 (47.8)	<0.001
Neutral	641 (71.9)	478 (57.5)		Neutral	491 (55.0)	335 (40.2)	
Disagree	95 (10.6)	163 (19.5)		Disagree	77 (8.6)	100 (12.0)	
<i>Inoculate after some friends inoculate their daughters with the vaccine</i>							
Agree	148 (16.6)	189 (22.7)	0.005	Agree	275 (30.9)	326 (39.1)	0.012
Neutral	640 (71.8)	503 (60.4)		Neutral	531 (59.6)	404 (48.5)	
Disagree	103 (11.6)	141 (16.9)		Disagree	85 (9.5)	103 (12.4)	
<i>Inoculate if media reports that many of my daughter's peers have been vaccinated</i>							
Agree	159 (17.8)	221 (26.5)	<0.001	Agree	296 (33.2)	360 (43.2)	0.003
Neutral	644 (72.3)	473 (56.8)		Neutral	513 (57.5)	368 (44.2)	
Disagree	88 (9.9)	139 (16.7)		Disagree	83 (9.3)	104 (12.5)	

University Hospital (14361–14). All participants gave their informed consent on the web before responding to the questionnaire. They were also free to abstain from participation in the study at any time. They were not involved in the design, implementation, or analysis of the study.

Covariates and outcomes

The covariates were selected based on previous studies regarding the intention of mothers to vaccinate their daughter against HPV [13], or against COVID-19 infection [14]. The demographics included age (categorized as ≤ 39 , 40–49, 50–59, ≥ 60) and gender. The Socio-Economic Status (SES) parameters the survey garnered included employment status (employer, self-employed, employee, or unemployed

Table 4
Analysis of factors influencing acceptance of HPV vaccination of a child (Male respondents).

	n	%	Univariate analysis		Multivariate analysis	
			Odds ratio (95 %CI)	p-value	Odds ratio (95 %CI)	p-value
<i>Age group</i>						
–39	42	31.7	1.0 (0.5–2.2)	0.98	1.3 (0.5–3.3)	0.55
40–49	272	31.5	1		1	
50–59	178	33.1	1.1 (0.8–1.5)	0.67	1.0 (0.7–1.5)	0.84
<i>Income level</i>						
Lower	16	25.9	1.0 (0.4–2.8)	0.95	0.8 (0.3–2.1)	0.62
Intermediate	108	25.3	1		1	
Higher	323	38.8	1.9 (1.3–2.8)	0.002	1.3 (0.8–2.2)	0.25
Not answered	44	21	0.8 (0.4–1.4)	0.42	0.6 (0.3–1.2)	0.17
<i>Child sex</i>						
Male	176	28.7	1		1	
Female	202	31.6	1.2 (0.8–1.6)	0.45	1.6 (1.0–2.5)	0.032
Male and female	113	40.7	1.7 (1.1–2.7)	0.026	2.2 (1.3–3.9)	0.005
<i>Knowledge about HPV</i>						
Less knowledgeable	252	26.7	1		1	
Knowledgeable	239	40.7	1.9 (1.4–2.6)	<0.001	1.7 (1.1–2.6)	0.011
<i>Fear against HPV infection</i>						
Not afraid or neutral	379	30	1		1	
Afraid	112	41.8	1.7 (1.1–2.6)	0.018	1.3 (0.8–2.2)	0.311
<i>Fear against COVID-19 infection</i>						
Not afraid or neutral	230	29.6	1		1	
Afraid	261	34.7	1.3 (0.9–1.8)	0.16	0.9 (0.6–1.3)	0.51
<i>Vaccinated against COVID-19</i>						
Unvaccinated	34	18	1		1	
Vaccinated	457	34.1	2.4 (1.3–4.2)	0.003	1.0 (0.5–2.1)	0.95
<i>Intention to inoculate a child with COVID-19</i>						
Disagree or neutral	39	4.9	1		1	
agree	452	61.2	30.4 (19.1–48.6)	<0.001	31.6 (18.8–53.2)	<0.001

(including homemaker), academic attainment (graduated from a junior or high school, junior college (including vocational school), college/university (including graduate schools), or ‘other’), income level (categorized using approximate tertiles of the distribution of household income calculated from the results of a comprehensive survey of living conditions in 2019 [15]). COVID-19 vaccination status was categorized as “Vaccinated” for those who had received at least one dose of the COVID-19 vaccine, and “Unvaccinated” for those who had never received the vaccine. Respondents were asked to select “Known” or “Unknown” for six questions regarding their knowledge of HPV infection and HPV vaccination (Supplementary Table 1). Respondents who answered “Known” to one or more of the questions were defined as “Knowledgeable”. Respondents were asked to rate their fear towards HPV or COVID-19 infections on a 5 scale (Very afraid, Afraid, Neutral, Not very afraid, Not afraid at all). Respondents who answered “Very afraid” or “Afraid” to one or more of the questions were combined and defined simply as having “Afraid”. Respondents were asked to rate on a 5 scale (Strongly agree, Relatively agree, Neutral, Relatively disagree, or Strongly disagree) their intention to inoculate their children with the HPV or COVID-19 vaccines.

The primary outcome was the proportion of those who agreed that had an intention to seek HPV vaccination for their children. Respondents who answered “Strongly agree” or “Relatively agree” to one or more of the questions regarding their attitudes toward HPV or COVID-19 vaccination were combined and defined simply as having “Agreed”.

Statistical analysis

Using the chi-square test, we first compared males against females for all SES characteristics, knowledge of HPV, fear of HPV or COVID-19 infection, and intention to inoculate their children with HPV or COVID-19 vaccine. We used inverse probability weighting to account for the potential disadvantage that Internet surveys may not be representative of the target population of interest because of limited population access to the Internet. Using data from the 2016 National Consumer Survey and the current Internet survey combined, we estimated each individual’s probability of participating in the survey by a multivariate logistic regression model, and used the inverse of this probability as a weight in the analysis [12].

Next, we used binomial logistic regression analysis to evaluate the association between the parental intention to inoculate their children with the HPV vaccine and each of the variables among those with daughters or sons aged 12 to 19, stratified by the gender of the respondents.

We summarized the responses based on the intention to inoculate children with HPV or COVID-19 vaccine in four pairs of combinations. In addition, among those who responded ‘neutral’ or ‘disagree with the intention to inoculate children with HPV vaccine’, we summarized their attitudes toward the general vaccine, recommended routine immunizations for children, by each attitude toward the COVID-19 vaccine.

All analyses were conducted using Stata (ver. 17.0 MP) Parallel Edition (StataCorp, LLC, Texas, USA). We considered an adjusted p-value of <0.05 to be statistically significant.

Table 5
Analysis of factors influencing acceptance of HPV vaccination of a child (Female respondents).

	N (%)	Univariate analysis		Multivariate analysis	
		Odds ratio	p-value	Odds ratio	p-value
Age group					
–39	64 (34.5)	0.7 (0.3–1.3)	0.21	0.7 (0.3–1.4)	0.3
40–49	402 (44.4)	1		1	
50–59	110 (39.7)	0.8 (0.6–1.2)	0.31	0.7 (0.5–1.1)	0.15
Income level					
Lower	45 (35.8)	0.6 (0.3–1.3)	0.16	0.8 (0.3–2.1)	0.62
Intermediate	185 (49.9)	1		1	
Higher	251 (46)	0.9 (0.6–1.3)	0.45	1.3 (0.8–2.2)	0.25
Not answered	95 (29.3)	0.4 (0.3–0.7)	<0.001	0.6 (0.3–1.2)	0.17
Child sex					
Male	236 (39.7)	1		1	
Female	232 (43.2)	1.2 (0.8–1.7)	0.44	1.1 (0.7–1.7)	0.66
Male and female	109 (45.7)	1.3 (0.8–2.1)	0.35	1.0 (0.6–1.8)	0.88
Knowledge about HPV					
Less knowledgeable	91 (28.6)	1		1	
Knowledgeable	485 (46.2)	2.1 (1.4–3.3)	0.001	1.9 (1.1–3.1)	0.015
Fear against HPV infection					
Not afraid or neutral	368 (36.9)	1		1	
Afraid	209 (56)	2.2 (1.5–3.2)	<0.001	2.0 (1.3–2.9)	0.001
Fear against COVID-19 infection					
Not afraid or neutral	182 (36.4)	1		1	
Afraid	394 (45.4)	1.5 (1.0–2.1)	0.048	0.9 (0.6–1.4)	0.66
Vaccinated against COVID-19					
Unvaccinated	55 (21.4)	1		1	
Vaccinated	521 (46.9)	3.2 (2.0–5.4)	<0.001	1.7 (0.9–3.3)	0.12
Intention to inoculate a child with COVID-19					
Disagree or neutral	103 (18.9)	1		1	
agree	474 (57.5)	5.8 (3.7–9.2)	<0.001	4.9 (3.0–8.2)	<0.001

Results

Respondent characteristics

The characteristics of the respondents are summarized in Table 1. Mothers were more likely than fathers to be unemployed, and less likely to have a university education, higher income, or be currently married ($p < 0.001$). More than 80 % of both fathers and mothers had received the COVID-19 vaccine. Regardless of the gender of the child, mothers tended to be younger than fathers ($p < 0.001$). Mothers more often

responded as being knowledgeable than fathers on HPV ($p < 0.001$). More mothers than fathers were afraid of HPV or COVID-19 infection ($p < 0.001, 0.005$). Both fathers and mothers were more fearful of COVID-19 infection than of HPV infection.

Intention to inoculate children with the HPV vaccine or the COVID-19 vaccine

The respondents' intentions to vaccinate their children against HPV or COVID-19 is summarized in Table 2 and Table 3. Regarding the HPV and COVID-19 vaccines, the percentage of mothers in favor of, or opposed to, vaccination of their children was significantly higher than that of fathers ($p < 0.001$). With regard to the inoculation of their children, both fathers and mothers accepted the COVID-19 vaccine more than the HPV vaccine.

Factors in play for intention to vaccinate children with the HPV vaccine

Child gender, parent's knowledge of HPV, and parent's intention to inoculate the children with the COVID-19 vaccine were significantly associated with the fathers' intention to HPV vaccinate the child, whereas knowledge of HPV, fear to HPV infection, and intention to inoculate children with COVID-19 vaccine were significantly associated with the mothers' intention to inoculate their children with the HPV vaccine (Table 4 and Table 5). Fathers with at least one daughter were more likely to approve of HPV vaccination than fathers without daughters [OR; daughter only: 1.60(1.04–2.46), son + daughter: 2.24 (1.28–3.92)] (Supplementary Fig. 2). There was no significant association between child gender and mothers' intention to inoculate children with the HPV vaccine [OR; daughter only: 1.10(0.72–1.66), son + daughter: 1.04(0.62–1.75)].

Opinion on general vaccines by pairs of intention to inoculate children with HPV and COVID-19 vaccines

Among four pairs of intention-to-vaccinate children with HPV and COVID-19 vaccines (Table 6), the least number of pairs supported the HPV vaccine only (4.9 % [142/2,898]). Respondents who were against or neutral on both HPV and COVID-19 vaccines tended to be less knowledgeable about HPV ($p < 0.001$).

Opinions on general vaccines among respondents who were against or neutral on inoculation with the HPV vaccine for their children are summarized in Fig. 1. More respondents in favor of COVID-19 vaccination believed in the efficacy of general vaccines and accepted the opinions of the government and healthcare providers. However, 63.5 % of them were concerned about the potential for adverse effects from vaccines.

Discussion

We found that a parent's gender significantly influenced their intention to inoculate their children with the HPV vaccine. As found in previous reports [16], more mothers than fathers in this survey were positive and supportive toward HPV or COVID-19 vaccination with their children. Unexpectedly, we also found that more mothers than fathers were somewhat or strongly against HPV or COVID-19 vaccination of their children – as opposed to being neutral. Fathers were more likely to be neutral or undecided towards HPV or COVID-19 vaccination with their children. This indicates that mothers, who are more in charge of day-to-day family health matters have formed strong pro or con opinions about their children's vaccinations more often than fathers, who are generally less involved. In Japan, the idea of gender of labor, men working and women doing the housework and childcare, still exists, and even working women spend more time on housework and childcare than do men [17]. This concept of gender roles is likely to have influenced the differences we observed between fathers and mothers in their interests

Table 6
Characteristics by intention to inoculate a child with COVID-19 or HPV.

	HPV: Agree COVID-19: Agree N = 925 (%)	HPV: Agree COVID-19: Disagree or neutral N = 142 (%)	HPV: Disagree or neutral COVID-19: Agree N = 636 (%)	HPV: Disagree or neutral COVID-19: Disagree or neutral N = 1195 (%)	p-value
Sex					
Male	452 (48.8)	39 (27.5)	286 (45.0)	753 (63.0)	<0.001
Female	474 (51.2)	103 (72.5)	350 (55.0)	442 (37.0)	
Vaccinated against COVID-19					
Unvaccinated	63 (6.8)	27 (18.7)	42 (6.5)	316 (26.4)	<0.001
Vaccinated	863 (93.2)	115 (81.3)	595 (93.5)	879 (73.6)	
Child sex					
Male	340 (36.7)	72 (50.7)	316 (49.6)	480 (40.2)	0.008
Female	379 (40.9)	54 (38.4)	236 (37.1)	505 (42.2)	
Male and female	207 (22.4)	15 (10.9)	84 (13.3)	210 (17.6)	
Knowledge about HPV					
Less knowledgeable	311 (33.6)	32 (22.6)	264 (41.5)	654 (54.8)	<0.001
Knowledgeable	614 (66.4)	110 (77.4)	372 (58.5)	541 (45.3)	
Fear against HPV infection					
Not afraid or neutral	632 (68.3)	115 (81.2)	519 (81.6)	992 (83.0)	<0.001
Afraid	294 (31.7)	27 (18.8)	117 (18.4)	203 (17.0)	
Fear against COVID-19 infection					
Not afraid or neutral	340 (36.8)	72 (51.0)	251 (39.5)	616 (51.5)	<0.001
Afraid	585 (63.2)	70 (49.0)	385 (60.5)	579 (48.5)	

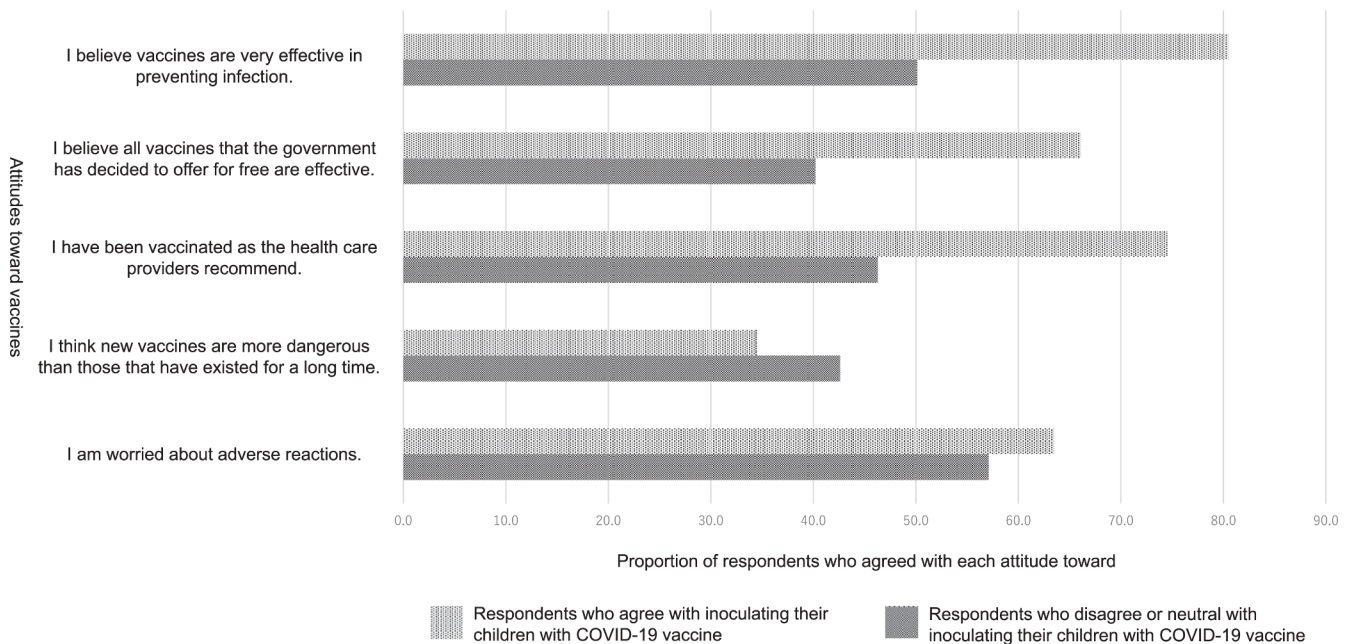


Fig. 1. Proportion of respondents who agreed with each attitude toward vaccines among respondents who disagree or are neutral with regards to inoculating their children with the HPV vaccine.

toward vaccinating their children.

There is a considerable gap between the very real risks and the public’s perceptions concerning the severe morbidity and mortality from HPV or COVID-19 infections and the efficacy of vaccines for these infections. The lifetime risk of an HPV infection reaches about 80 % in women who have sexual intercourse [18]. The case-fatality ratio of HPV-caused cervical cancer in Japan is estimated to be 26.5 % [19]. On the other hand, the estimated case-fatality ratio of COVID-19 infection ranges from 0.001 % (5–9 years old) to 8.29 % (>80 years old) [20]. The

efficacy of HPV and COVID-19 vaccines is as high as 95 % or more, and their relative safety is also high [21–23]. Nevertheless, our survey found that people were more afraid of a COVID-19 infection than an HPV infection and more willing to inoculate their children with the COVID-19 vaccine than with the HPV vaccine.

There are several possible reasons for the vaccine acceptance gap. First, parents face almost daily media reports about the dangers of COVID-19, forcing them to limit their behavior. Death from cervical cancer due to HPV infection will occur years to decades in the future,

whereas deaths from COVID-19 infection seem to have immediacy [24]. In addition, people have tended to hesitate to access routine vaccinations of every kind due to their fear of contracting COVID-19 virus during a clinic visit [25].

People can sometimes act with “herd behavior”, making decisions based on the actions of others, but mainly their family, friends, peers and acquaintances [26]. Whether or not her child’s best friend has been HPV vaccinated is significantly associated with a mother’s intention to vaccinate her own child [27]. The huge difference in current HPV and COVID-19 vaccination rates implies that there are many acquaintances who have received the COVID19 vaccine but few acquaintances who have received the HPV vaccine.

Interestingly, the fear of COVID-19 infection may have influenced HPV vaccination hesitancy in both good and bad ways. The increased awareness of the use of powerful and innovative vaccines to battle the infectious COVID-19 pandemic may have promoted better acceptance of HPV vaccination. Those who are in favor of COVID-19 vaccination are more likely to be in favor of HPV vaccination as well [28]. Our survey agrees, indicating that those approving of inoculation to children with the COVID-19 vaccine were more likely to approve of inoculation their children with the HPV vaccine, although this tendency was more apparent among male respondents (OR: male 31.6(18.8–53.2), female 4.9(3.0–8.2)). In addition, respondents who agreed with child COVID-19 vaccination were more likely to believe in the efficacy of vaccines in general and they were more accepting to the opinions of government and healthcare providers, although they were against or neutral toward HPV vaccination for their children. The finding that many of them were concerned about potential adverse effects of the vaccines suggests that dissemination of better targeted information about the safety of the HPV vaccine could lead to a positive shift in vaccination intentions.

Unfortunately, many (29.6 % [353/1,194]) of the respondents who were against or neutral regarding inoculation for their children with either or both the HPV or COVID-19 vaccines did not consider the information provided by their government to be reliable. However, they had a better relative acceptance of the opinions of healthcare providers (46.3 % [553/1,194]). The importance of promoting the effectiveness of vaccines by trusted healthcare providers was strongly reinforced.

This survey has several limitations. First, the study is a point-in-time cross-sectional study and cannot reveal changes over time in individuals’ intentions. Although associations between some variables can be evaluated, it is also difficult to infer causal dependence between those variables and the parental intention to inoculate children with the HPV vaccine. Second, this is a web-based questionnaire survey, and the respondents could possibly differ from the general population. We attempted to minimize this bias by inverse probability weighting. Third, the opinions on the general vaccine may not be completely compatible with the opinions on the HPV vaccine. However, the percentage approval of vaccinating daughters if a doctor recommends the HPV vaccine as investigated in a previous report is similar to the results in this study (27). It can be assumed that there is not a significant difference between the opinions on the general vaccine and the opinions on the HPV vaccine.

Conclusion

We revealed that, between parental genders, there is currently a significant difference regarding their intention to inoculate their children with the HPV vaccine. The intention to have children COVID-19 vaccinated is higher than for HPV vaccination. Those in favor of COVID-19 vaccination also better understood vaccine efficacy and were more likely to HPV vaccinate their children by following the recommendations of the government and healthcare providers. The COVID-19 pandemic has heightened awareness of infectious diseases and the usefulness of vaccines. The government resumed its recommendation for HPV vaccination in April of 2022. During this period of enhanced favorable public interest in vaccines, our government and healthcare

providers need to make renewed concerted and urgent efforts to inform the public about the purpose, the efficacy and the safety of the HPV vaccine, and that HPV vaccination for males should now be an added priority.

CRedit authorship contribution statement

Emiko Oka: Conceptualization, Data curation, Formal analysis, Methodology, Writing – original draft. **Yutaka Ueda:** Conceptualization, Funding acquisition, Investigation, Methodology, Project administration, Supervision, Validation, Visualization, Writing – review & editing. **Asami Yagi:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Methodology, Supervision, Writing – review & editing. **Yuri Ito:** Methodology, Supervision, Writing – review & editing. **Yoshihiko Hosokawa:** Conceptualization, Supervision, Writing – review & editing. **Takahiro Tabuchi:** Conceptualization, Funding acquisition, Investigation, Methodology, Project administration, Resources, Supervision, Writing – review & editing. **Tadashi Kimura:** Supervision, Writing – review & editing.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Yutaka Ueda reports financial support was provided by Merck Sharp and Dohme. Tadashi Kimura reports financial support was provided by Merck Sharp and Dohme.

Data availability

Data will be made available on request.

Acknowledgements

We would like to thank Dr. GS Buzard for his constructive critique and editing of our manuscript. This result was presented by AY as a poster at the 81st Annual Meeting of the Japanese Cancer Association in 2022.

Funding

This work was funded by the Japan Society for the Promotion of Science (JSPS) KAKENHI grants (21H04856, 22H03229).

Contributions

Conceptualization – E.O., Y.U., and A.Y.; Formal analysis – E.O. and Y.I. Investigation – Y.U., A.Y., Y.H. and T.T.; writing-original draft preparation – E.O.; writing-review and editing – Y.U., A.Y., Y.I., Y.H. and T.T.; Supervision - TK. All authors have read and agreed to this submitted version.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jvacx.2024.100441>.

References

- [1] Suzanne M, Garland MD, Mauricio Hernandez-Avila MD, Cosette M, Wheeler PD, et al. Quadrivalent vaccine against human papillomavirus to prevent high-grade cervical lesions. *N Engl J Med* 2007;356:1915–27.
- [2] Huh WK, Joura EA, Giuliano AR, et al. Final efficacy, immunogenicity, and safety analyses of a nine-valent human papillomavirus vaccine in women aged 16–26 years: a randomised, double-blind trial. *Lancet* 2017;390:2143–59.
- [3] Global strategy to accelerate the elimination of cervical cancer as a public health problem. World Health Organization 2020.

- [4] Bruni L, Saura-Lazaro A, Montoliu A, et al. HPV vaccination introduction worldwide and WHO and UNICEF estimates of national HPV immunization coverage 2010–2019. *Prev Med* 2021;144:106399.
- [5] Human Papillomavirus (HPV) vaccination coverage. Available at: <https://immunizationdata.who.int/pages/coverage/hpv.html?CODE=JPN&YEAR=> Accessed March 2023.
- [6] Bhavini Patel Murthy M, Elizabeth Zell M, Karen Kirtland P, et al. Impact of the COVID-19 Pandemic on Administration of Selected Routine Childhood and Adolescent Vaccinations — 10 U.S. Jurisdictions, March–September 2020. *Morbidity and Mortality Weekly Report* 2021;70.
- [7] Footman A, Kanney N, Niccolai LM, et al. Parents' acceptance of COVID-19 compared to human papillomavirus vaccines. *J Adolesc Health* 2022;71:673–8.
- [8] Egawa-Takata T, Ueda Y, Morimoto A, et al. Survey of Japanese mothers of daughters eligible for human papillomavirus vaccination on attitudes about media reports of adverse events and the suspension of governmental recommendation for vaccination. *J Obstet Gynaecol Res* 2015;41:1965–71.
- [9] Feiring B, Laake I, Molden T, et al. Do parental education and income matter? A nationwide register-based study on HPV vaccine uptake in the school-based immunisation programme in Norway. *BMJ Open* 2015;5:e006422.
- [10] Azh N, Hosseinzadeh K, Javadi A, et al. Factors predicting mothers' intention toward human papilloma virus vaccination of adolescents: A cross-sectional study among Iranian Families. *Iran J Nurs Midwifery Res* 2021;26:495–9.
- [11] Walhart T. Parents, adolescents, children and the human papillomavirus vaccine: a review. *Int Nurs Rev* 2012;59:305–11.
- [12] Tabuchi T, Kiyohara K, Hoshino T, et al. Awareness and use of electronic cigarettes and heat-not-burn tobacco products in Japan. *Addiction* 2016;111:706–13.
- [13] Yagi A, Ueda Y, Masuda T, et al. Japanese Mothers' Intention to HPV Vaccinate Their Daughters: How Has It Changed over Time Because of the Prolonged Suspension of the Governmental Recommendation? *Vaccines (Basel)* 2020;8.
- [14] Miyawaki A, Tabuchi T, Tomata Y, et al. Association between participation in the government subsidy programme for domestic travel and symptoms indicative of COVID-19 infection in Japan: cross-sectional study. *BMJ Open* 2021;11:e049069.
- [15] The overview of a comprehensive survey of living conditions in 2019. Available at: <https://www.mhlw.go.jp/toukei/saikin/hw/k-tyosa/k-tyosa19/index.html> Accessed March 2023.
- [16] Larebo YM, Eililo LT, Abame DE, et al. Awareness, Acceptance, and Associated Factors of Human Papillomavirus Vaccine among Parents of Daughters in Hadiya Zone, Southern Ethiopia: A Cross-Sectional Study. *Vaccines (Basel)* 2022;10.
- [17] Ikeda S. Women's Employment Status and Family Responsibility in Japan: Focusing on the Breadwinner Role. *Japan Labor Issues* 2019;3.
- [18] Steben M, Duarte-Franco E. Human papillomavirus infection: epidemiology and pathophysiology. *Gynecol Oncol* 2007;107:S2–5.
- [19] Statistics on cervical cancer. Available at: https://ganjoho.jp/reg_stat/statistics/stat/cancer/17_cervix_uteri.html Accessed March 2023.
- [20] O'Driscoll M, Ribeiro Dos Santos G, Wang L, et al. Age-specific mortality and immunity patterns of SARS-CoV-2. *Nature* 2021;590:140–5.
- [21] Joura EA, Giuliano AR, Iversen OE, et al. A 9-valent HPV vaccine against infection and intraepithelial neoplasia in women. *N Engl J Med* 2015;372:711–23.
- [22] Polack FP, Thomas SJ, Kitchin N, et al. Safety and efficacy of the BNT162b2 mRNA covid-19 vaccine. *N Engl J Med* 2020;383:2603–15.
- [23] Fukushima W, Hara M, Kitamura Y, et al. A nationwide epidemiological survey of adolescent patients with diverse symptoms similar to those following human papillomavirus vaccination: background prevalence and incidence for considering vaccine safety in Japan. *J Epidemiol* 2022;32:34–43.
- [24] Miyoshi A, Ueda Y, Kimura T. Contemplating HPV vaccination in Japan during the time of COVID-19. *Hum Vaccin Immunother* 2021;17:836–7.
- [25] Chido-Amajuoyi OG, Pande M, Agbajogu C, et al. HPV Vaccination Uptake, Hesitancy, and Refusal: Observations of Health-Care Professionals During the COVID-19 Pandemic. *JNCI Cancer Spectr* 2022;6.
- [26] Kahneman D. *Thinking, Fast and Slow*. Penguin, 2012.
- [27] Yagi A, Ueda Y, Tomine Y, et al. The 'best friend effect': a promising tool to encourage HPV vaccination in Japan. *Int J Clin Oncol* 2022;27:1750–7.
- [28] Shimizu Y, Hirai K, Ueda Y, et al. Impact of the threat of COVID-19 infections on the perceived risk to HPV vaccination. *Vaccines (Basel)* 2022;10.