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Parents’ decision-making about the human papillomavirus vaccine for their daughters: I. Quantitative results

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Abbreviations: HPV, Human Papillomavirus; STI, Sexually Transmitted Infection; CAIQ, Commission d’Accès à l’Information du Québec; HBM, Health Belief Model; OR, Odds Ratio; GW, Genital Warts; RAMQ, Régie de l’Assurance Maladie du Québec; HL, Hosmer-Lemeshow; CI, Confidence Interval; US, United States.

Vaccination against the human papillomavirus (HPV) is an effective primary prevention measure for HPV-related diseases. For children and young adolescents, the uptake of the vaccine is contingent on parental consent. This study sought to identify key differences between parents who obtain (acceptors) and parents who refuse (non-acceptors) the HPV vaccine for their daughters. In the context of a free, universal, school-based HPV vaccination program in Québec, 774 parents of 9–10 year-old girls completed and returned a questionnaire by mail. The questionnaire was based on the theoretical constructs of the Health Belief Model (HBM), along with constructs from other theoretical frameworks. Of the 774 parents, 88.2% reported their daughter having received the HPV vaccine. Perceived susceptibility of daughters to HPV infection, perceived benefits of the vaccine, perceived barriers (including safety of the vaccine), and cues to action significantly distinguished between parents whose daughters had received the HPV vaccine and those whose daughters had not. Other significant factors associated with daughter vaccine uptake were parents’ general vaccination attitudes, anticipated regret, adherence to other routinely recommended vaccines, social norms, and positive media influence. The results of this study identify a number of important correlates related to parents’ decisions to accept or refuse the HPV vaccine uptake for their daughters. Future work may benefit from targeting such factors and incorporating other health behavior theories in the design of effective HPV vaccine uptake interventions.

Introduction

Cervical cancer is the third most common cancer among woman worldwide, with an estimated prevalence of 530,000 cases and 275,000 disease-related deaths in 2008.1 Currently available HPV vaccines protect against high-risk types of HPV, which account for approximately 70% of cervical cancers,2 as well as a proportion of vaginal, oral and anal cancers.3,4

A quadrivalent vaccine also protects against 2 low-risk types of the virus, which are responsible for 90% of genital warts (GW).5,6 Although GW are not a life-threatening condition, they can have a significant negative impact on quality of life.7 Furthermore, with the development and subsequent delivery of new vaccines, HPV-related cancers and infections can be greatly reduced in the future.

Given that HPV is sexually transmitted, the vaccine is more effective if administered before the inception of sexual activity (i.e. before possible infection). Since 2006, most guidelines recommend vaccinating girls aged 9 to 14 years,8,9 and more recently, the HPV vaccine has also been approved and recommended for boys (e.g., 2012, in Canada).10 Because such early vaccination requires parental consent, effectively promoting the HPV vaccine is highly dependent on understanding the factors that influence whether parents accept or refuse the HPV vaccine for their daughters.

HPV vaccine research has been rapidly growing in the last few years. Factors previously identified as being associated with parental vaccine acceptance include: household characteristics (income, location); access to medical care (having a general practitioner, routine medical visits); social-environmental factors

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health-related behaviors,37 including cancer prevention behavior.33 Furthermore, since early vaccination is vaccinate, which may not actually correlate highly with vaccinating.28-31

understood that parents’ decisions to vaccinate against HPV is a complex and multifactorial process.28-31

Despite this seemingly rich literature on the topic, the degree to which each of these factors as well as variations in public policy contexts contribute to parental decisions remains largely unclear. One major limitation of the literature is that few studies, with some exceptions,11,22,32 use a theoretical framework to inform their hypotheses.33 Consequently, there exists little consistency between studies, making it very difficult to compare their results and subsequently inform the focus of interventions. This consideration is especially important since previous literature suggests that theory based interventions are more effective at influencing health behavior and that, at present, the success of interventions aimed at increasing HPV remains mixed.34,35

In addition, most studies focus on intentions, and willingness to vaccinate, which may not actually correlate highly with vaccination uptake behavior.33 Furthermore, since early vaccination is critical to maximizing protection against HPV, from a public health perspective it is especially important to understand which factors underlie whether parents choose to accept or reject HPV vaccination for their daughters. To address these limitations, we examined HPV vaccine uptake among parents of daughters aged 9–10 years in a population-based design. We focused on vaccine uptake behavior, rather than intentions, and specified a clear theoretical framework to guide the development of our study.

Of the theoretical frameworks chosen, the most commonly employed framework is the Health Belief Model (HBM).36 Indeed, the HBM has been employed to study a range of health-related behaviors,37 including cancer prevention behaviors38,39 and vaccination.40,41 According to this model, HPV vaccination is determined by the following factors: perceived susceptibility to HPV, perceived severity of HPV, perceived benefits of the HPV vaccine, beliefs concerning barriers and costs of HPV vaccination and external influences prompting HPV vaccine uptake (i.e., cues to action). Furthermore, other individual factors (e.g., vaccine knowledge) are also thought to influence decisions. The utility of the HBM is that it allows researchers to identify factors that can be targeted in interventions. For example, if a significant proportion of parents who refuse to vaccinate their daughters fail to see HPV as a severe threat, then communication about the risks associated with HPV infection to parents is warranted for increasing acceptance.

Utilizing this framework, this study sought to identify key differences between parents who obtain (acceptors) and parents who refuse (non-acceptors) the HPV vaccine for their daughters. The present study was conducted in the province of Quebec, Canada, where HPV vaccination is delivered in a free, universal, school based, opt-in program delivered to girls in grade 4. Standardized written information, which has previously been reviewed by experts, is provided to parents concerning the vaccine. This information is delivered through information pamphlets which are brought home along with the consent form. In addition, parents also have the option to contact their school’s nurse if they wish to have any additional information.

Based on the HBM, we hypothesized that uptake of the HPV vaccine would be related to greater perceived susceptibility of daughters to HPV infection, greater perceived severity of the infection, greater perceived benefits of the vaccine, fewer perceived barriers, and more cues to action. Second, as found in previous HPV vaccination acceptability literature, we hypothesized that individual factors (such as positive general vaccination attitudes and anticipated inaction regret - e.g., worry about regretting not obtaining the vaccine), behavioral factors (including adherence to routinely recommended vaccination), and social factors (including positive media exposure and social norms), would also be associated with vaccine uptake.

Results

A total of 834 parents returned the questionnaire and the overall response rate was 33%. Of those, 774 (92.8%) questionnaires had complete data for all relevant items and were included in the present quantitative analyses.

Sample characteristic

The sample was quite homogenous consisting of 95.7% female. As shown in Table 1, parents were 88.5% white, 83.2% Christian and 83.7% French speaking (the proportion of French-speaking respondents in our sample is representative of Quebec’s population, which is 90.9%).32 Participants’ ages ranged from 26 to 58 (M = 40.2, SD = 5.97).

A total of 683 parents reported accepting the HPV vaccine for their daughters and 91 parents reported refusing vaccination. This represents an 88.2% acceptance rate, which was similar, though slightly higher, than the provincial vaccine uptake rate of 81% for girls in grades 4 and 9 that year.33 French speaking participants were more likely to obtain the vaccine than English speaking participants, χ² (1, N = 774) = 34.65, p < .001. White/European and Christian participants were more likely to obtain the vaccine than Non-White/European or Non-Christian participants, χ² (2, N = 774) = 12.26, p < .01, and χ² (2, N = 774) = 10.70, (p < .01), respectively. No significant differences were found between acceptors and non-acceptors when comparing education level (those with a university degree or higher compared to those with lower levels of

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Factors related to vaccination Uptake

**Univariate analyses**

As predicted by our first hypothesis, vaccination uptake was associated with 4 of the 5 HBM constructs: higher perceived susceptibility, higher perceive benefits, lower perceived barriers, and higher cues to actions (Table 2). The single perceived safety item was also a significant contributor, as parents who perceived higher levels of vaccine safety were more than twice as likely to obtain the vaccine compared with parents who perceived lower levels of vaccine safety. Knowledge, in our univariate analysis was not significantly related to vaccine uptake.

**Multivariate analyses**

As summarized in Table 2, the following factors were significantly related to uptake: perceived barriers ($p < .01$), perceived safety ($p < .001$), cues to action ($p < .001$), and knowledge ($p < .01$). The HBM constructs included in the multivariate...
may be an important focus in the development of interventions. Recent studies summarizing adverse events related to HPV vaccination have concluded that the vaccines are well tolerated, with no severe side effects, and highly effective. \cite{44-48} Since safety issues may often be in the forefront of parents’ concerns when deciding whether or not to consent to vaccination, more efforts should be made to help parents understand and be reassured by the results of such risk reports. This may include acknowledgment of minor risks, while clarifying the low probability of complications and more severe adverse reactions.\cite{49} This finding is in line with our qualitative results, as parents who refused vaccination often mentioned fear of side effects.\cite{50}

Our study displayed mixed findings regarding parental knowledge. Although our univariate analyses found no effects of HPV and HPV vaccine knowledge on uptake, our multivariate model found knowledge to have a negative impact on vaccine uptake. These mixed findings may be due to constricted variance as it was common for parents to have low knowledge about HPV. Indeed, even in our qualitative findings, both parents who accepted and refused the HPV vaccine expressed having little to no knowledge about HPV.\cite{50} Although conceptualized as a critical factor in enabling informed decisions, the role of HPV and HPV vaccine knowledge in parental vaccination decision making remains unclear with some studies showing a positive relationship \cite{10,11,16,23} and others showing no or negative relationships.\cite{14,24,15} Research limitations such as the inconsistent use of validated measures across studies,\cite{33} or differences in conceptualization of knowledge constructs, may contribute to these mixed results. However, regardless of the role of knowledge in vaccine decision-making, parents do express wanting more information about HPV in order to be confident in their decisions.\cite{50} As such, parents are likely to be receptive to interventions that include an educational component.

In line with our second hypothesis, the results of this study show that other factors not directly included in the HBM (such as anticipated regret) were also associated with vaccination uptake. This finding suggests that models other than the HBM – which include these additional factors – may be useful in expanding our current understanding of parental vaccination vaccine

### Discussion

The results of the present study provide further support for the relationship between individual cognitive variables proposed by the HBM and uptake of the HPV vaccine. Perceived vaccine barriers, perceived vaccine benefits and cues to action may be especially important in the decision process. Furthermore, perceived vaccine safety appears to have a distinct influence beyond other barriers to vaccination.

Among the variables included in the analyses, the magnitude of the adjusted odds ratio for perceived safety was the greatest; this suggests that increased focus on safety concerns of parents

| Table 3. Univariate Logistic Regression Analysis for Variables Related to Parental HPV Vaccine Uptake |
|-----------------------------------------------|----------|---------------|
| Non-HBM Variables                            | OR (95% CI) | p            |
| Past vaccination behavior                     |           |              |
| Compiled with all the recommended vaccines for their children in the past | 1.96 (1.24–3.10) | .001         |
| Have refused a vaccine for their child in the past | 0.14 (0.07–0.25) | .001         |
| Social norms                                  |           |              |
| "Most people that are important to me thought that I should have my daughter received the HPV vaccine" | 1.65 (1.43–1.91) | .001         |
| General vaccination attitudes                 |           |              |
| Positive attitudes                            | 1.13 (1.08–1.18) | .001         |
| Negative attitudes                            | 0.89 (0.86–0.92) | .001         |
| Fear of regret decision                       |           |              |
| Regret accepting vaccine                      | 0.61 (0.54–0.69) | .001         |
| Regret not accepting vaccine                  | 1.69 (1.50–1.91) | .001         |
| Media Influence                               |           |              |
| Positive media influence                      | 1.64 (1.43–1.90) | .001         |
| Negative media influence                      | 0.65 (0.56–0.75) | .001         |
decision-making. While the HBM explained about 50 percent of the variance in our study, due to lack of statistical power, we were unable to include these significant constructs (e.g., anticipated regret, vaccination attitudes, adherence to other vaccines, social norms and media influence) in the final statistical model.

Interestingly, we did not find any significant effect on parental education, level of income or employment status between acceptors and non-acceptors. While this may have found to be an important factor in previous studies, we believe that any effect may have been mitigated in our study given that the program is free in Quebec and that the province has a history of high vaccine uptake in public programs.52

Research implications and future directions
HPV vaccination decision-making among parents appears to be a multifactorial process, and the inclusion of theoretically based constructs, such as those posited by the HBM, adds important heuristic value to the study of decision-making. Future research should develop and test new, integrated, and expanded conceptual frameworks of parental vaccination decision making through the use of other health behavior theories. One particular avenue for future research may be to incorporate models describing components beyond individual health beliefs, such as decision-making styles (e.g., active vs. passive decision making) as well as parent - daughter communication, as these have also been used to describe parental HPV decision-making behavior.53 In addition, consistent with the results of the present study, anticipated regret following vaccination has been shown in previous research to be a critical and modifiable component of HPV vaccine decision making among parents.54

Models such as the HBM are also critical for delineating factors which are targetable in the context of interventions. For example in the univariate results, susceptibility to HPV was identified as a significant factor related to vaccine uptake. Those parents who perceived that their daughter was susceptible to HPV were more likely to have vaccinated their daughter. Parent's concerns that their daughter is at risk and that HPV is highly transmissible should be included in future vaccine uptake intervention studies.

In the present study, prototypical items were used to operationalize HBM constructs with respect to the HPV vaccine (e.g., benefits defined as the effectiveness of the HPV vaccine). Little research has been done to explore the breadth of how individuals conceptualize HBM factors. For example, our qualitative analysis found that parents often cited benefits in more general, global terms (e.g., overall health protection for their daughter), rather than give specific benefits about HPV vaccine effectiveness.50 This highlights the need to examine the operationalization of theoretical constructs, in order to ensure that measures represent the entirety of construct domains.

Strengths and limitations
The retrospective nature of the study limits the interpretation of the results such that it is difficult to determine whether the effects seen were a cause or consequence of parents' decisions. Accordingly, longitudinal studies (pre-post vaccination) should be developed in the future. However, since the goal of this study was to examine uptake (rather than intentions) there was no way to overcome the limitations which necessarily accompany a retrospective design. In addition, the second dose of the HPV vaccine was delivered in the spring (2009) and the data for the present study was collected the following winter. Nevertheless, survey completion closer to the actual vaccination period would have been desirable to minimize potential recall bias.

Although our response rate appears relatively low, it was similar to other mailed surveys of this kind.55,56 Because response rates can influence the representativeness of a sample, we suggest that future studies make use of various techniques to improve the likelihood of participation.57 Furthermore, we recognize that fathers were largely underrepresented in our sample. However, the mailed study was addressed to the household, and any available parent was eligible to answer the questionnaire. The high ratio of mothers to fathers is not surprising, and was also similar to that of other studies.58,59 This may reflect that mothers often play a larger role in vaccination decisions, as they have been found to invest more concern in their children’s health.60 With this in mind – and given our: (1) randomized, population-based sampling procedure, (2) finding of similar uptake rates compared to the overall province of Quebec, and (3) the confirmatory nature of our study – we believe that our results are generalizable within the Canadian context where vaccination is delivered through provincial governments and where uptake rates for other childhood vaccines are relatively high. Furthermore, given that free-school based vaccination programs often have high uptake rates, these results may also be informative in the international context.

As such, an important limitation of our results is that they were obtained in the context of very high percentage of vaccine uptake. It is possible that in populations where vaccination is not as commonly accepted, other factors may play a role in the decision-making process. For example, because large vaccination programs offer information to parents about the HPV vaccine (reinforcing a baseline knowledge level), parental knowledge of the vaccine may be more predictive in the absence of such programs. Importantly, our findings may be most informative in identifying those parents who are especially resistant to vaccination acceptance even in the context of an effective and efficient public vaccination program. Future efforts would benefit from an exploration of differential predictors of vaccine uptake both in the presence and the absence of such programs.

This study also has several important strengths. These include: (1) the incorporation of a theoretical model, (2) a population-based, random sample of parents, and (3) the specific examination of actual uptake behavior of the HPV vaccine, rather than attitudes and intentions toward vaccination. Indeed, participants had recently made a “real life” decision about vaccinating their daughters against HPV in the context of a free, universal program. Although we examined a finite number of factors, our results correspond largely with our qualitative findings,50 while providing more robust tests of association.

Future intervention work should build on similar research and target modifiable factors in well-controlled experimental and
longitudinal studies. So far, few HPV vaccination intervention studies have specifically focused on targeting the psychosocial factors outlined by theories such as the HBM and other health behavior theories. There is evidence that interventions are more successful in modifying health behaviors when theory-based. Therefore, future efforts should be directed toward using theoretical models in designing interventions to promote HPV vaccine uptake. Such studies may be crucial for maintaining the high uptake rates observed in the present given recent data suggesting that since the present study was conducted, vaccination rates for HPV have subsequently declined.

**Methods**

**Participants and procedures**

The present study is a cross-sectional survey of parents whose daughters were in grade 4 during the 2008–2009 school years in the province of Québec, Canada. Since 2008, grade 4 girls have been eligible for free HPV vaccination in a school-based, universal, opt-in program. Within this program, parents may consent to in-school vaccination for their daughter via a signed permission slip that is returned to school with their child.

A random sample of 2500 parents of 9–10 y old girls were identified using the Régie de l’assurance maladie du Québec (RAMQ: Québec Medical Health Insurance Board) database. Data were collected from January 25, 2010 to July 25, 2010. Parents were invited to participate in the study by mail, and were sent a consent form and the study questionnaire. A modified Dillman’s Total Design method was employed using a reminder post card at 1 week and a replacement surveys at 4 weeks to maximize the response rate. Participants who returned their completed questionnaires were compensated with a CAN$15.00 gift certificate for a local bookshop. The study protocol was approved by the Commission d’accès à l’information du Québec (CAIQ) and received ethical approval from the McGill University Institutional Review Board. In addition to the results presented in this article, parents were also asked to respond to 2 open-ended questions regarding their decision to vaccinate their daughters. A detailed interpretation of these results is presented in a separate manuscript.

**Measures**

Questionnaire development was guided by the HBM, and enriched by adding questions assessing other correlates of HPV vaccination acceptability found in the literature. Questions assessing each theoretical construct were based on previous parental HPV vaccine acceptability research and adapted for the purposes of this study with permissions from the authors. A preliminary questionnaire was administered to a pilot-sample of 10 parents in order to ensure comprehension, reading ease, and scale reliability. The outcome measure of the study, HPV vaccine uptake, was assessed with the question: “Has your daughter received the HPV vaccine?” Response to this question was dichotomous (yes, no). It is important to note that this question was in reference to the first dose of the HPV vaccine series.

HBM constructs were assessed using 7-point Likert scales ranging from 1 (strongly disagree) to 7 (strongly agree). Scales with 3 or more items were evaluated for internal consistency using Cronbach’s α (alphas reported in the following represent the values from the final dataset). HBM constructs included perceived susceptibility of daughter to HPV (3 items, α = .88; e.g., “Before I made the decision about the vaccine I believed that it was likely that my daughter would contract HPV”), perceived severity of HPV (4 items, α = .83; e.g., “Before I made the decision about the vaccine I believed that it would be serious if my daughter contracted HPV”), perceived benefits of the HPV vaccine (3 items, α = .74; e.g., “Before I made the decision about the vaccine I believed that the HPV vaccine is effective in preventing HPV”), perceived barriers to the HPV vaccine (9 items, α = .73; e.g. “Before I made the decision about the vaccine I worried that the HPV vaccine would encourage sexual activity”), cues to action (5 items, α = .69; e.g., “I was prompted to get the vaccine for my daughter by a health care provider”). Although conceptually part of the barriers construct of the HBM, we singled out one item specifically measuring perceived safety of the HPV vaccine (single item: “Before I made the decision about the vaccine I believed that the HPV vaccine is safe”) for separate analysis. Since much discussion of the HPV vaccine by the media is related to worries regarding side effects, such a distinction warranted exploration.

Additional factors related to vaccination acceptance found in the literature were also assessed. HPV and HPV vaccine objective knowledge was assessed using a 16-item knowledge scale based on information from the Society of Obstetricians and Gynecologists of Canada. Participants answered, “true,” “false,” or “don’t know” to each statement (e.g. “HPV is the most common sexually transmitted infection;”, “The HPV vaccine protects against genital warts”), and correct answers were summed to create a total knowledge score for each participant. General vaccination attitudes were measured using a 12-item scale (positive attitudes, α = .86; negative attitudes, α = .82). Fear of regret about the decision was assessed with 2 statements: “Before I made the decision about the vaccine, I worried that I would regret having my daughter vaccinated” and “Before I made the decision about the vaccine, I worried that I would regret not having my daughter vaccinated.” Positive and negative media influences were assessed with 2 statements: “Before I made the decision about the vaccine, what I had heard about the HPV vaccine in the media (TV, radio, newspapers, magazines, the internet, etc.) had been positive/negative.” Perceived social norms were evaluated with the statement: “Most people who are important to me thought I should have my daughter receive the HPV vaccine.”

Participants’ demographic information included: age, gender, ethnicity, language, marital status, educational level, household income, and religious affiliation. Finally, participants were asked questions regarding previous experiences with cancer and sexually transmitted infections.

**Statistical analyses**

We performed basic descriptive statistics, and used chi-square and independent-sample t-tests to identify socio-demographic
differences between parents who obtained the vaccine for their daughters (acceptors) and parents who did not obtain the vaccine (non-acceptors). We conducted univariate logistic regression analyses to test our hypotheses that, (1) the HBM constructs would be related to vaccination uptake and (2) additional constructs identified as relevant in the literature would also be related to vaccination uptake. Finally, a multivariate logistic regression model composed of all HBM constructs (including the perceived vaccine safety measure), along with knowledge, was used.

Discrimination and calibration of the logistic regression model were assessed with the c-index and Hosmer-Lemeshow goodness-of-fit test statistic (HL), respectively. The c-index for model were assessed with the c-index and Hosmer-Lemeshow goodness-of-fit test statistic (HL), respectively. The HL is a measure of the accuracy of the predicted values. A large value indicates a good model fit. All analyses were conducted using SPSS version 20.0 for Mac, and all statistical tests were 2-sided with a p < .05 significance level.

**Disclosure of Potential Conflicts of Interest**

Dr. Rosberger reports personal fees outside the submitted work as a consultant at a workshop on behavioral science issues for Merck in November 2012. All other authors declare no additional conflict of interest.

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