Socio-economic variations in anticipated adverse reactions to testing HPV positive: implications for the introduction of primary HPV-based cervical screening

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Abstract

Some cervical cancer screening programmes are replacing cytology with human papillomavirus (HPV) DNA testing as the primary screening test. Concerns have been previously raised around the potential psychosocial impact of testing positive for HPV. We analysed socio-economic variations in anticipated adverse reactions to testing positive for HPV in women of screening age in the general population. A questionnaire was mailed to a random sample of 5,553 women aged 20-64 in 2010, selected through primary care in Ireland. This included questions on: socio-economics; HPV knowledge; and women's anticipated adverse psychosocial responses to testing HPV positive (shame, anxiety, stigma and worry). Multivariable linear regression was used to identify socio-economic factors significantly associated with each anticipated adverse reaction. The response rate was 62% (n = 3,470). In multivariate analyses, having only attained primary level education was significantly associated with higher mean scores for all four adverse outcomes. Religion was significantly associated with all four adverse outcomes. Age was associated with anxiety and worry; younger women (<30 yrs) had the highest mean scores. Being married/cohabiting was significantly associated with significantly lower shame and worry scores. Not working was significantly associated with higher mean anxiety and worry scores. Our large population-based survey found significant socio-economic variations in anticipated adverse reactions to testing HPV positive. In order to minimise possible negative impacts on screening uptake and alleviate potential adverse psychological effects of HPV-based screening on women, screening programmes may need to develop specific messages around HPV infection and HPV screening that target certain subgroups of women.

1. Introduction

It is a time of rapid change in cervical cancer prevention. Certain "high-risk" sexually transmitted strains of human papillomavirus (HPV), particularlyHPV16 and HPV18, are established as the necessary cause for cervical cancer (Bosch and Munoz, 2002). Vaccines against HPV16 and 18 have been available for the last 11 years and many countries have HPV vaccination programmes in place (Drolet et al., 2015). Many cervical screening programmes have already implemented HPV testing in the context of triage of women who have abnormal cervical cytology and/or follow-up of women treated for cervical intra-epithelial neoplasia (CIN). In addition, screening based on primary HPV testing is more effective and cost-saving than conventional cytology-based screening (Kitchener et al., 2011; Lew et al., 2017), and several programmes have begun using primary HPV screening (e.g. the Netherlands, Sweden), recommended a switch to primary HPV screening in the near future (e.g. England, Ireland, Italy, New Zealand, Norway) or are in the process of implementing this (e.g. Australia).

HPV testing is a sensitive and multifaceted issue for women. Testing positive for HPV has been associated with a range of negative emotional consequences - including distress, anxiety, fear, anger, and feelings of self-blame (Maissi et al., 2004; Maissi et al., 2005; McCaffery et al., 2003; Daly et al., 2010) – and can impact adversely on a woman's sexual relationships (Maissi et al., 2004; Kitchener et al., 2008). A review on the possible impact of the introduction of primary HPV screening protocols in organized screening programmes highlighted that communication of HPV positivity may increase anxiety and suggested that this effect may vary socio-economically (Rossi et al., 2014). There is, therefore, a need for further empirical research investigating adverse emotional responses to HPV testing and how these responses vary between women with different socio-economic backgrounds. To date, although there has been extensive qualitative work exploring the experiences of women who test positive for HPV (McCaffery et al., 2006; Waller et al., 2007a; O'Connor et al. 2014a; Patel et al., 2018), most quantitative studies on adverse psychological reactions to HPV testing have related to the triage or post-treatment setting, or been undertaken within trials (Maissi et al., 2004; 2005; Kitchener et al., 2008; O'Connor et al., 2014a). Afew studies have investigated the wider potential impact of primary HPV testing on screening (Ogilvie et al., 2013; Burger et al., 2014; Ogilvie et al., 2016). More recently, studies have begun to look at the psychological impact of testing positive for HPV in the context of primary HPV screening (McBride et al., 2016).. However, limited quantitative research has been carried out on potential adverse psychological reactions to testing positive for HPV among women of screening age in the general population (Waller et al., 2007b; 2009). In one such previous study, young female students

comprised the sample so the findings are unlikely to be generalisable to the wider screening-eligible population (Waller et al., 2007b).

In Ireland, a recent health technology assessment (HTA) has recommended the introduction of primary HPV screening at 3 yearly intervals in women <30 years and 5 yearly intervals in women >30 years to improve the clinical and cost-effectiveness of the national cervical screening programme (HIQA, 2017).In a large national survey in Ireland, we investigated socio-economic variations in women's (anticipated) adverse emotional impact to testing positive for HPV among women of screening age in the general population.

2. Methods

2.1. Study population & recruitment

Data collection took place in August-September 2010. The overall aim of the study was to assess women's views on cervical screening, HPV testing and HPV vaccination. At the time the study was conducted, a national cervical screening programme had been in place for two years and a school-based HPV vaccination programme for girls aged 12-13 years was being implemented. An age- and area-stratified random sample of 6,500 women aged 20-64 years was identified via patient databases in 20 general practices across Ireland and three Dublin-based Well Women Centres (WWC); WWCs provide a range of primary health care services including screening. GPs at each practice and senior staff in the WWCs reviewed the list of selected women and removed any whom they considered it would be inappropriate to contact about the study (e.g. women with a serious illness or intellectual difficulties, women who recently had a family bereavement or other family issues).

Women who remained in the study population (n = 5,553) were sent a pre-contact letter informing them that they had been selected to participate in the study. For women selected from GP practices, two weeks later all were sent a questionnaire. Women selected from WWCs were invited to return a reply slip enclosed with the pre-contact letter indicating whether they would be willing to receive the questionnaire; the survey was dispatched to those who responded positively.

2.2. Survey design and measures

A postal questionnaire was developed from the existing literature and focus group discussions (McRae et al., 2014; O'Connor et al., 2014b). A range of questions gathered information on women's socio-economic characteristics and cervical cytology test status; Table 1 lists these variables. HPV knowledge has been previously associated with anticipated adverse emotional responses to testing positive for HPV (Waller et al., 2009). There were no validated HPV knowledge scales available at the time the survey was conducted (although such measures have become available since e.g. Perez et al., 2016). Therefore knowledge levels were assessed by a set of 10 factual questions about HPV (with "yes","no" or "not sure" response options), which were constructed after careful review of the relevant literature (see Appendix A). Prior to the questions assessing HPV knowledge levels, women were asked whether they had ever heard of HPV. Women who had never heard of HPV were directed to the next section of the questionnaire. Responses to the 10 questions were coded as correct or incorrect; if women answered a question as "unsure" or did not provide an answer, her response was coded as incorrect (Appendix B displays the numbers and percentages of women who answered each question correctly)HPV knowledge scores were grouped into three categories (approximate tertiles based on number of respondents) for analysis - 'high' (8-10 questions answered correctly), 'medium' (6-7 questions answered correctly), 'low' (<=5 questions answered correctly) (Table 1). These 10 HPV knowledge items had high internal consistency (Cronbach's α = 0.86). Following the questions on HPV knowledge, women were given some information on HPV infection in a text box. This indicated that it is a very common infection and most sexually active adults will get it at some stage in their lives (Appendix C).

In terms of outcome variables, based on questions developed by Cunningham et al. (2002 & 2005) and adapted by Waller et al. (2007b), women were asked to imagine that they had been tested for HPV and the result had been positive (after reading the text box information on HPV infection). They then responded to statements relating to how they would expect to feel: five statements related to shame, three related to anxiety, and eight related to stigma (see Appendix D). Nine worry statements were also developed based on a review of the literature (McCaffery et al., 2003 & 2006; Kahn et al., 2005) (Appendix D). Response options to all statements were 'strongly disagree', 'disagree', 'agree' or 'strongly agree'. All four scales had high internal consistency (Cronbach's α = 0.91 for shame; α = 0.85 for anxiety; α = 0.93 for stigma; and α = 0.91 for worry).

2.3. Statistical analysis

Stata (version 15) was used for analysis. For each outcome, the item scores were summed to produce a total score for the scale; this was then divided by the number of items in the scale to produce a score

between 1 and 4. Throughout, a higher score indicates a greater adverse response. Where a participant had answered at least 50% of items (but not all items) within a scale, pro-rating s was applied; the missing responses were replaced by the means for questions answered.

Multivariate linear regression was used to determine which variables were associated with anticipated shame, anxiety, stigma and worry, with a separate model built for each outcome. In addition to the socio-economic variables of interest, HPV knowledge score and cervical cytology status were also considered as potential covariates. Women were dropped from multivariable models if they had missing values for the covariates in the models. Univariate linear regression was used initially to determine which variables were considered in the multivariate models. Variables that were significant at the 5% level in univariate testing were put forward as candidate variables for multivariate models. The intention was to build parsimonious models, therefore only variables that were significant at the 5% level in the multivariate setting were retained in the final model. Likelihood ratio tests were used to test the significance of variables in the final model. Tests of the assumptions underlying the models were performed including tests of: model specification; multicollinearity; and heteroscedasticity. In models where heteroscedasticity was found (only for stigma) robust variances were calculated. Finally, Pearson correlations between the levels of shame, anxiety, stigma and worry experienced were also calculated.

3.   Results

3.1. Characteristics of participants
5,553 women were sent questionnaires. Table 1 shows the socio-economic characteristics of the 3,470 (response rate=62%) who returned these.

3.2. Mean anticipated shame, anxiety, and stigma and worry scores
The mean anticipated shame score (based on 3372 women) was 2.57 out of a maximum 4 (sd 0.64); the mean anxiety score (n=3377) was 2.93 (sd 0.59); mean stigma score (n= 3385) was 2.30 (sd 0.55); and mean worry score (n = 3365) was 2.97 (sd 0.55). The correlations between the outcomes ranged from 0.4 and 0.6 and were all statistically significant (p-value <0.001) (see Appendix E).

3.3. Univariate results
The results of univariate analyses for associations between socio-economic characteristics and each of the four outcomes are shown in Appendix F.

3.4. Multivariate results

3.4.1 .Socio-economic variations in shame

In multivariate analyses, adjusted for HPV knowledge score and cytology test status, the following socio-economic variables were significantly associated with shame score: age, educational attainment, marital status, religion, and medical card status (Table 2). The mean shame score decreased with increasing age; 0.04 points (95% CI -0.11, 0.04) lower in women aged 30-39 years and 0.15 points (-0.23, -0.08) lower in women aged 40+ compared to women aged <30. It also decreased with increasing educational level attained; on average 0.13 (-0.19, -0.07) points lower in women who had completed secondary education, and 0.21 (-0.28, -0.14) points lower in women who had completed third level education compared with those who had completed primary education only. Being unmarried/not cohabiting was associated with a higher mean shame score than being married/cohabiting (0.10 points higher, 95% CI 0.06, 0.15). Compared to women with no religion, those who were Catholic had a higher mean shame score. Women who did not have a medical card had a 0.08 (-0.13, -0.02) points lower mean shame score than women with a medical card.

3.4.2. Socio-economic variations in anxiety

In multivariate analyses, adjusted for HPV knowledge score, the following socio-economic variables were significantly associated with anxiety score: age, educational attainment, employment status, religion, and medical card status (Table 3). Compared to the youngest women, women aged 30-39 had on average 0.09 (95% CI -0.15, -0.02) points lower mean anxiety score; women aged 40-49 years had a 0.10 (-0.16, 0.04) points lower score; and women aged ≥50 years had a 0.09 (0.16, 0.03) points lower score. The mean anxiety score decreased with increasing level of education attained. Not working was associated with a 0.07 (0.02, 0.11) points higher mean anxiety score than working. Compared to women with no religion, those who were Catholic had a significantly higher mean anxiety score. Not having a medical card was associated with a lower mean anxiety score (on average 0.06 (-0.11, -0.01 points lower).

3.4.3. Socio-economic variations in stigma

The following variables remained significantly associated with a higher mean stigma score in multivariate analysis after adjusting for HPV knowledge score and cytology test status: place of residence, educational attainment, religion, medical card status, and private health insurance status (Table 4). Women who lived in a rural location had a 0.05 (95% CI 0.01, 0.1) points higher mean stigma score than women who lived in a city/town. The mean stigma score decreased with increasing educational level attained. The mean stigma score was significantly higher in women who were Catholic compared to those with no religion. Women without a medical card had on average a 0.11(-0.16, -0.06) points lower mean stigma score.

Women with no private health insurance had, on average, a 0.05 (0.00, 0.10) points higher mean stigma score.

3.4.4. Socio-economic variations in worry

In multivariate analyses, the following were significantly associated with a higher mean worry score: age, educational attainment, employment status, marital status and religion (Table 5). On average, women aged <30 years had the highest mean worry score. The mean worry score decreased with increasing level of education attained. Women who were not working had on average a 0.05 (0.00, 0.09) points higher mean worry score than those who were working. Women who were unmarried (or non-cohabiting) had on average a 0.08 (0.04, 0.12) points higher mean worry score than women who were married/cohabiting. Compared to women with no religion, those who were Catholic had a significantly higher mean worry score.

4. Discussion

Previous studies have shown that, among women, concerns and worries about the outcome of screening tests are associated with non-participation in (cytology-based) cervical cancer screening (Marlow et al., 2015; Waller et al., 2012 Oscarsson et al., 2008). It seems likely that these concerns will persist if new screening protocols (i.e. primary HPV-based screening) are implemented. If HPV testing raises concerns among women eligible for screening, or has serious negative emotional effects among those actually screened, this could have implications for the routine use of HPV-based primary screening. Potential implications include negative impacts on screening uptake (which is the most important concern) as well as on the effectiveness, and cost-benefit ratio, of screening (which are dependent on uptake). Examining women's anticipated emotional reactions to testing HPV positive - and identifying subgroups who anticipate worse responses - is, therefore, important and timely.

The findings of the current study indicate that certain sub-groups of women of screening age in the general population are potentially at risk of worse adverse emotional responses to testing HPV positive: in particular, those with lower attained education, and those who are not working, younger, or not married or cohabiting. In light of the imminent replacement of conventional cytology with primary HPV screening in many settings, screening programmes may need to consider including tailored messages within HPV-related information materials that are targeted at certain subgroups of women, to minimise any potential adverse impact on screening uptake and adverse psychological effects among women.

In our study, women with only school-level education scored higher for all anticipated negative emotional responses than women who had attained further education. Similarly, in previous work among Chinese women, participants who were primary school educated had higher stigma scores (Kwan et al. 2010). Lower educational level is a marker of lower socio-economic status in Ireland (as elsewhere) (Barry et al., 2007), and is associated with lower health literacy, which is a limited ability to understand and appraise information on health-related matters (Doyle et al., 2012). It seems plausible that lower educational level may be a proxy for limited ability to process information about HPV specifically (particularly due to the multifaceted issues surrounding HPV infection/virus), and that this is what leads to a greater anticipated psychological burden.

Religion (overall) was significantly associated with all four adverse outcomes in our study. Compared to women with no religion, those who were Catholic had a significantly higher mean shame, anxiety, stigma and worry scores Previous qualitative research has suggested that HPV testing and the prospect of a HPV

positive result heightens pre-existing stigma surrounding sexual activity and promiscuity among Catholic women (McCaffery et al., 2006).   While the overwhelming majority of our respondents were Catholic, other Christian, non-Christian religions and those with no religion were represented. Negative psychosocial consequences of HPV testing have been shown to be related to ethnic and religious background –for example, among Muslim women – it has been suggested that attending for HPV testing and testing positive for HPV could potentially communicate unwanted messages to one's partner, family and community (about sexual activity). (McCaffery et al., 2003). Religious and cultural beliefs can be a barrier for ethnic minority women to attending cervical screening (Ekechi et al., 2014). Our results indicate therefore that screening programmes which are implementing primary HPV screening, need to be aware of, and sensitive to, the varying religious beliefs of women and how these might affect women's screening-related decisions.

Women under 30 years old had, on average, worse anticipated adverse emotional responses to testing HPV positive; this was seen for anxiety and worry. This suggests that the potential adverse emotional consequences of HPV positivity could discourage some younger women from attending for cervical screening. For the past few years there have been concerns that uptake of cytology-based cervical screening has declined, and in some settings this decrease is particularly worrying among younger women (aged 25-29 years) (Health and Social Care Information Centre, 2017; Lancucki et al., 2010). Although the reasons for younger women not attending for cervical screening are likely complex, it is important that any switch to primary HPV-screening not exacerbate this further. Research shows that younger women typically have much higher HPV prevalence than older women (Sargent et al., 2008). In the context of primary HPV screening, there are likely to be more positive test results in this age-group. If the anticipated adverse reactions to HPV positivity observed in our study translate into "real-world" reactions this has implications for the (psychological) costs of screening from the perspective of women. Screening programmes should consider how best to pre-empt the possibility of adverse emotional reactions to HPV screening among younger women. For example, the inclusion of information in test result letters and screening pamphlets about the high prevalence of HPV infection in this age group may help to normalise a positive result and reassure women.

4.1 Implications for screening programmes

It is important for screening programme providers to understand the impact (if any) of changing screening protocols on women and the wider programme. Understanding the potential impact of HPV testing on women can inform the development of appropriate educational initiatives and other strategies. If this is not done, there is a risk that participation in screening will be reduced and the psychological harms of

screening participation will increase (Waller et al., 2005). When primary HPV screening is implemented, it will also be important to monitor uptake and psychological wellbeing, with a particular focus on the subgroups who may be at increased risk of negative psychological reactions (e.g. younger women). This has begun to happen in the specific sites in England where HPV primary screening is being piloted (McBride et al., 2016). As more countries adopt HPV testing for primary screening , further research is needed to evaluate relationships between negative psychological reactions and screening intentions and ultimately uptake. The way in which HPV infection and HPV test results are communicated to women can impact on their emotional responses to hearing about the infection (O'Connor et al. 2014a). Therefore, careful development of HPV information materials (including how to communicate HPV infection to women) for smeartakers and health professionals involved in the care of women is required.

4.2 Strengths and limitations

A major strength of this study is the large sample size. We cannot entirely be sure of the reasons why GPs and senior staff at WWCs removed women from the lists selected to complete the survey and this may have introduced bias into the source population. Of women who responded, 61% had private health insurance (somewhat higher than the population) and 66% were working (somewhat higher than the population; CSO Census Reports, 2016), suggesting, as is typical in surveys, that respondents are likely to be somewhat biased towards higher socio-economic groups. This means we may have underestimated the true mean scores for the four outcomes of interest. Another limitation is that non-validated scales were used to measure the outcomes in the survey. Recent media coverage on the HPV vaccine in Ireland and elsewhere may have increased awareness and knowledge levels around HPV since the survey was carried out. Therefore, current emotional reactions to HPV infection may differ from those reported in 2010. For example, greater awareness of how common HPV infection is among the population may reduce adverse reactions. As with other studies, we asked women to hypothetically consider how they may feel if they tested positive for HPV so we cannot be certain our findings would apply in an actual primary HPV screening setting. However, there is no reason to think that the demographic patterns of responses would not hold true in a 'real life' context. In addition, as far as we are aware, our study is the first of its kind to investigate socio-economic variations in possible negative emotional responses to HPV screening. A further possible limitation is that women were not specifically asked about their anticipated emotional responses to testing HPV positive specifically in the context of primary HPV screening. However, prior to responding to the statements about HPV, women read some text on HPV infection/testing. Within this text, women were told that HPV testing is like having a smear test and that in the future HPV testing may be used for cervical screening instead of smear tests. Therefore, it seems quite likely that the women would interpret the statements in the primary screening context.

5. Conclusion

Our findings suggest that there are socio-economic variations in anticipated adverse emotional responses to testing HPV positive among women in the general population. Women with particular socio-economic characteristics – including those with lower attained education, those who are not working, younger women and those not married or cohabiting - may be at risk of having more psychologically adverse responses to testing HPV positive. Tailoring messages within HPV-related information materials that take into account women from various backgrounds may help minimise negative feelings women have to receipt of a HPV positive result in the context of primary HPV screening.

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Conflict of interest

The authors declare that there are no conflicts of interest.

Appendices A, B, C, D, E & F. Supplementary data

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Table 1. Socio-economic characteristics, cytology test status and HPV knowledge scores of participants (n=3,470)

	Total	
	n	*%*
Age		
<30	559	16.1
30-39	810	23.4
40-49	1028	29.7
50+	1069	30.8
Not stated	4	
Place of residence		
City/Town	2484	72.2
Rural area[a]	958	27.8
Not stated	28	
Education (highest level attained)		
Primary	706	20.5
Secondary	1553	45.1
Third level	1181	34.3
Not stated	30	
Employment status		
Working[b]	2203	65.8
Not working[c]	1147	34.2
Not stated	120	
Marital status		
Married/cohabiting	2265	65.6
Other[d]	1190	34.4
Not stated	15	
Ethnicity		
White/Irish traveller	3415	99.0
Other	29	1.0
Not stated	26	
Nationality		
Irish	3246	94.2
Other	201	5.8
Not stated	23	
Religion		
Catholic	2984	87.4
Other Christian[e]	120	3.5
Other[f]	52	1.5
None	260	7.6
Not stated	54	
Has children		

Yes	2253	65.6
No	1183	34.4
Not stated	34	
Currently pregnant		
Yes	106	3.3
No	3065	96.7
Not stated	299	
Medical card		
Yes	915	26.6
No	2522	73.4
Not stated	33	
Private health insurance		
Yes	2091	60.9
No	1343	39.1
Not stated	36	
Current smoker		
Yes	828	24.0
No	2622	76.0
Not stated	20	
Ever had a cytology test		
Yes	3182	93.1
No	237	6.9
Not stated	51	
HPV knowledge score		
High (8-10 out of 10)	747	21.5
Medium (6-7 out of 10)	889	25.6
Low (≤5 out of 10)	917	26.4
Not answered[g]	917	26.4
Not stated	0	

[a]Rural areas =Village/Country. [b]Working includes self-employed. [c]Not working includes unemployed, looking after family/home, retired, student. [d]includes 'single', 'separated', 'divorced' and 'widowed'. [e]Other Christian (e.g. Protestant). [f]Other (e.g. Islam). [g]Women who had never heard of HPV were directed to the next section of the questionnaire. Ethnicity not considered in the modelling as the 'other' group was too small. Currently pregnant was not considered in the modelling as the 'yes' group was too small. Survey conducted in 2010 in Ireland.

Table 2. Multivariate analysis results showing significant associations between socio-demographic variables, HPV knowledge score, previous cytology test status and shame: β, 95% confidence intervals (CI), p values and LRT p values

	n	β	95% CI	p-value	LRT p-value
Age					
<30	529	-	-	-	
30-39	770	-0.04	-0.11, 0.04	0.350	
40-49	968	-0.15	-0.23, -0.08	0.000	
50+	958	-0.15	-0.23, -0.08	0.000	<0.001
Education (highest level attained)					
Primary	642	-	-	-	
Secondary	1472	-0.13	-0.19, -0.07	0.000	
Third Level	1111	-0.21	-0.28, -0.14	0.000	<0.001
Marital Status					
Married/Co-habiting	2113	-	-	-	
Other	1112	0.10	0.06, 0.15	0.000	<0.001
Religion					
Catholic	2815	-	-	-	
Other Christian[a]	116	-0.08	-0.20, 0.03	0.159	
Other[b]	47	-0.01	-0.19, 0.17	0.910	
No Religion	247	-0.22	-0.30, -0.14	0.000	<0.001
Medical Card[c]					
Yes	847	-	-	-	
No	2378	-0.08	-0.13, -0.02	0.006	0.006
Ever had a cytology test					
Yes	3001	-	-	-	
No	224	0.11	0.02, 0.21	0.016	0.016
HPV Knowledge Score					
High	712	-	-	-	
Medium	845	-0.02	-0.08, 0.04	0.535	
Low	845	-0.03	-0.09, 0.04	0.380	
Not Answered	823	-0.09	-0.15, -0.03	0.006	0.032

Note. Estimates are unstandardized regression coefficients. [a]Other Christian (e.g. Church of Ireland). [b]Other (e.g. Islam). [c]provides access to medical services free at the point of delivery; entitlement based on limited means. Survey conducted in 2010 in Ireland. The number of observations included in the final model was 3225.

Table 3. Multivariate analysis results showing associations between socio-demographic variables, HPV knowledge score, previous cytology test status and anxiety: β, 95% confidence intervals (CI), p values and LRT p values

	n	β	95% CI	p-value	LRT p-value
Age					
<30	528	-	-	-	
30-39	766	-0.09	-0.15, -0.02	0.009	
40-49	938	-0.10	-0.16, -0.04	0.002	
50+	942	-0.09	-0.16, -0.03	0.004	0.010
Education (highest level attained)					
Primary	618	-	-	-	
Secondary	1445	-0.09	-0.15, -0.03	0.003	
Third Level	1111	-0.15	-0.22, -0.08	0.000	<0.001
Employment Status					
Working	2104	-	-	-	
Not working	1070	0.07	0.02, 0.11	0.006	0.006
Religion					
Catholic	2771	-	-	-	
Other Christian	118	-0.11	-0.21, 0.00	0.052	
Other	44	-0.12	-0.29, 0.05	0.177	
No Religion	241	-0.15	-0.23, -0.07	0.000	<0.001
Medical Card					
Yes	807	-	-	-	
No	2367	-0.06	-0.11, -0.01	0.018	0.018
HPV Knowledge Score					
High	715	-	-	-	
Medium	830	0.05	-0.01, 0.11	0.077	
Low	822	0.09	0.03, 0.15	0.002	
Not Answered	807	0.06	0.01, 0.12	0.033	0.023

Survey conducted in 2010 in Ireland. The number of observations included in the final model was 3174.

Table 4. Multivariate analysis showing associations between socio-demographic variables, HPV knowledge score, previous cytology test status and stigma: β, 95% confidence intervals (CI), p values and LRT p values

	n	β	95% CI	p-value	LRT p-value
Place of residence					
City/Town	2324	-	-	-	
Rural area	890	0.05	0.01, 0.10	0.014	0.014
Education (highest level attained)					
Primary	638	-	-	-	
Secondary	1465	-0.04	-0.10, 0.01	0.135	
Third Level	1111	-0.09	-0.16, -0.03	0.003	0.007
Religion					
Catholic	2803	-	-	-	
Other Christian	115	-0.08	-0.18, 0.02	0.123	
Other	48	0.00	-0.17, 0.18	0.958	
No Religion	248	-0.10	-0.16, -0.04	0.001	0.008
Medical Card					
Yes	839	-	-	-	
No	2375	-0.11	-0.17, -0.06	0.000	<0.001
Private health insurance					
Yes	1967	-	-	-	
No	1247	0.05	0.00, 0.10	0.033	0.033
Ever had a cytology test					
Yes	2994	-	-	-	
No	220	0.12	0.04, 0.19	0.003	0.003
HPV Knowledge Score					
High	711	-	-	-	
Medium	838	0.05	0.00, 0.10	0.048	
Low	823	0.08	0.03, 0.14	0.003	
Not Answered	842	0.08	0.03, 0.13	0.004	0.008

Note. Robust variance used as there was significant heteroscedasticity in the original model. The number of observations included in the final model was 3214.

Table 5. Multivariate analysis results showing associations between socio-demographic variables, HPV knowledge score, previous cytology test status and worry: β, 95% confidence intervals (CI), p values and LRT p values

	n	β	95% CI	p-value	LRT p-value
Age					
<30	539	-	-	-	
30-39	767	-0.10	-0.16, -0.04	0.002	
40-49	940	-0.15	-0.21, -0.09	0.000	
50+	928	-0.11	-0.17, -0.05	0.000	<0.001
Education (highest level attained)					
Primary	622	-	-	-	
Secondary	1436	-0.14	-0.20, -0.09	0.000	
Third Level	1116	-0.26	-0.32, -0.20	0.000	<0.001
Employment Status					
Working	2109	-	-	-	
Not working	1065	0.05	0.00, 0.09	0.033	0.033
Marital Status					
Married/Co-habiting	2079	-	-	-	
Other	1095	0.08	0.04, 0.12	0.000	<0.001
Religion					
Catholic	2766	-	-	-	
Other Christian	118	-0.03	-0.13, 0.07	0.525	
Other	46	-0.07	-0.23, 0.09	0.371	
No Religion	244	-0.12	-0.19, -0.05	0.001	0.008

Survey conducted in 2010 in Ireland. The number of observations included in the final model was 3174.

Appendix A. Items on HPV used in the questionnaire to assess HPV knowledge levels

Please read the following statements and for each one indicate whether you think it is false or true.

		False	True	Not sure
a.	A person may be infected with HPV and not know it	1	2	3
b.	HPV is the virus that causes AIDS	1	2	3
c.	There is a cure for HPV	1	2	3
d.	Condoms help protect you from getting HPV	1	2	3
e.	HPV is spread from person to person by sexual contact	1	2	3
f.	Having had several sexual partners increases the chance of getting a HPV infection	1	2	3
g.	Using oral contraceptives (e.g. the pill) increases the chance of getting a HPV infection	1	2	3
h.	Smoking increases the chance of getting a HPV infection	1	2	3
i.	HPV is a virus that can cause cancer	1	2	3
j.	Poor personal hygiene can cause HPV	1	2	3

Appendix B. Number and % of women who answered each item on HPV knowledge correctly[a]

Item	n	%
A person may be infected with HPV and not know it	2183	85.52
HPV is the virus that causes AIDS	1853	72.58
There is a cure for HPV	711	27.85
Condoms help protect you from getting HPV	1492	58.44
HPV is spread from person to person by sexual contact	1702	66.67
Having had several sexual partners increases the chance of getting a HPV infection	1865	73.05
Using oral contraceptives (e.g. the pill) increases the chance of getting a HPV infection	143	5.60
Smoking increases the chance of getting a HPV infection	305	11.95
HPV is a virus that can cause cancer	2008	78.65
Poor personal hygiene can cause HPV	1479	57.93

[a]Women who did not answer any of the items (n=917) were excluded from these calculations.

Appendix C. Text box information on HPV infection and testing included in the questionnaire

Please read this information carefully and then answer the questions that follow.

Infection with particular types of human papillomavirus (HPV) causes cervical cancer. (Some other types of HPV cause genital warts).

The HPV types that cause cervical cancer are transmitted through genital skin-to-skin contact (not necessarily sexual intercourse).

HPV is a very common infection and most sexually active people (both men and women) will get it at some point in their lives. It does not cause any symptoms, and usually clears up on its own.

In some women the HPV infection does not clear up and can lead to changes in the cells of the cervix, which can eventually (after 10-20 years) turn into cancer. There is no direct treatment for HPV, but the abnormal cells that the virus causes may be able to be removed to prevent cancer occurring.

A woman can have a test to find out whether she has a HPV infection. This test is very like a smear test. In some countries HPV testing is used for cervical screening, either instead of, or as well as, smear tests.

Appendix D. Items and corresponding outcomes (Shame, anxiety, stigma and worry)

Imagine you were HPV positive (you had a HPV infection). Please rate how much you agree with each of the following statements:

Items (Strongly disagree/Strongly agree)	Outcome
I would feel responsible	
I would feel ashamed	
I would feel embarrassed	Shame
I would feel guilty	
I would be disappointed in myself	
I would feel anxious	
I would feel scared	Anxiety
I would feel angry	
People would avoid me	
People would be angry with me	
People would think badly of me	
People would blame me	Stigma
People would think I was unclean	
People would not want to be my friend	
People would be uncomfortable around me	
People would not want to have a sexual relationship with me	
I would be worried that having sex with someone may infect them with HPV	
I would worry that my partner would think I was unfaithful to them	
I would be worried about spreading HPV because it causes cancer	
I would feel worried about telling my partner that I was infected with HPV	
I would worry about my ability to get pregnant	Worry
I would be worried that having sex might make my HPV infection worse	
I would worry that if I told my partner that I had a HPV infection they might not want to have sex with me	
I would be worried that my partner had been unfaithful to me	
I would be worried about getting cervical cancer	

Note. Items for shame, anxiety, stigma based on questions developed Cunningham et al., 2002 &2005] and adapted by Waller et al., 2007; items for worry developed based on a review of the literature. Survey conducted in 2010 in Ireland.

Appendix E. Correlation matrix for the four outcomes of interest

Pearson rho	worry	stigma	anxiety	shame
worry	1			
stigma	0.530	1		
anxiety	0.466	0.419	1	
shame	0.489	0.528	0.559	1

Note. All significant at p <0.001. Survey conducted in 2010 in Ireland.

Appendix F. Results of univariate analysis of associations between socio-demographic variables and anticipated shame, anxiety, stigma and worry: number of women, mean outcome scores, β, 95% confidence intervals (CI)

	Shame				Anxiety				Stigma				Worry			
	n	mean score	β	95% CI	*n*	mean score	β	95% CI	*n*	mean score	β	95% CI	*n*	mean score	β	95% CI
Age																
< 30 yrs	549	2.69	-	-	548	3.00	-	-	555	2.36	-	-	557	3.06	-	-
30 – 39 yrs	798	2.60	-0.09	-0.16, -0.02*	796	2.91	-0.09	-0.16, -0.03*	800	2.24	-0.12	-0.18, -0.06*	796	2.95	-0.11	-0.17, -0.05*
40 – 49 yrs	1006	2.51	-0.19	-0.25, -0.12*	1006	2.91	-0.09	-0.15, -0.03*	1010	2.28	-0.08	-0.14, -0.02*	1008	2.93	-0.13	-0.19, -0.07*
50+ yrs	1015	2.54	-0.15	-0.22, -0.08*	1023	2.94	-0.05	-0.11, 0.01	1016	2.32	-0.04	-0.09, 0.02	1000	2.99	-0.06	-0.12, -0.01*
Place of residence																
City/Town	2430	2.57	-	-	2434	2.93	-	-	2437	2.27	-	-	2424	2.97	-	-
Rural areas[a]	919	2.58	0.02	-0.03, 0.07	920	2.94	0.01	-0.03, 0.06	925	2.36	0.09	0.05, 0.13*	918	2.98	0.01	-0.03, 0.05
Education (highest level attained)																
Primary	666	2.71	-	-	671	3.08	-	-	678	2.41	-	-	671	3.13	-	-
Secondary	1520	2.57	-0.14	-0.20, -0.08*	1522	2.94	-0.14	-0.20, -0.09*	1520	2.31	-0.10	-0.15, -0.05*	1508	2.98	-0.15	-0.20, -0.10*
Third level	1162	2.49	-0.21	-0.28, -0.15*	1160	2.84	-0.24	-0.29, -0.18*	1164	2.21	-0.20	-0.25, -0.14*	1163	2.87	-0.26	-0.31, -0.21*
Employment status																
Working[b]	2159	2.53	-	-	2160	2.88	-	-	2171	2.25	-	-	2157	2.94	-	-
Not working[c]	1101	2.64	0.11	0.06, 0.15*	1104	3.02	0.13	0.09, 0.18*	1102	2.38	0.13	0.09, 0.17*	1097	3.04	0.10	0.06, 0.14*
Marital status																
Married/co-habiting[d]	2202	2.52	-	-	2205	2.92	-	-	2209	2.28	-	-	2198	2.95	-	-
Other	1158	2.66	0.14	0.09, 0.18*	1160	2.96	0.04	0.00, 0.08	1164	2.33	0.05	0.01, 0.09*	1155	3.03	0.08	0.04, 0.12*
Nationality																
Irish	3157	2.57	-	-	3161	2.94	-	-	3168	2.29	-	-	3149	2.98	-	-
Other	194	2.53	-0.04	-0.14, 0.05	195	2.89	-0.04	-0.13, 0.04	197	2.32	0.02	-0.06, 0.10	196	2.89	-0.09	-0.17, -0.01*
Religion																
Catholic	2897	2.60	-	-	2903	2.96	-	-	2909	2.31	-	-	2889	2.99	-	-
Other Christian[e]	120	2.44	-0.16	-0.27, -0.04*	119	2.79	-0.17	-0.28, -0.06*	118	2.19	-0.13	-0.23, -0.02*	119	2.89	-0.10	-0.20, 0.00
Other[f]	49	2.57	-0.03	-0.21, 0.15	49	2.83	-0.13	-0.30, 0.03	50	2.31	-0.01	-0.16, 0.15	50	2.89	-0.10	-0.25, 0.06
No religion	254	2.33	-0.27	-0.35, -0.18*	254	2.76	-0.20	-0.27, -0.12*	256	2.17	-0.14	-0.21, -0.07*	256	2.83	-0.16	-0.23, -0.09*
Has children																
Yes	2178	2.56	-	-	2184	2.94	-	-	2189	2.32	-	-	2170	2.98	-	-
No	1164	2.59	0.03	-0.01, 0.08	1163	2.91	-0.03	-0.07, 0.01	1166	2.25	-0.06	-0.10, -0.02*	1166	2.96	-0.02	-0.06, 0.02
Medical card																

	N	Mean	Diff	95% CI	N	Mean	Diff	95% CI	N	Mean	Diff	95% CI	N	Mean	Diff	95% CI
Yes	877	2.69	-	-	881	3.05	-	-	889	2.43	-	-	885	3.06	-	-
No	2468	2.53	-0.17	-0.22, -0.12*	2469	2.89	-0.16	-0.20, -0.11*	2469	2.25	-0.19	-0.23, -0.15*	2456	2.94	-0.11	-0.16, -0.07*
Private health insurance																
Yes	2046	2.51	-	-	2051	2.89	-	-	2049	2.24	-	-	2035	2.94	-	-
No	1294	2.66	0.15	0.11, 0.20*	1294	3.01	0.13	0.08, 0.17*	1304	2.38	0.14	0.11, 0.18*	1301	3.03	0.10	0.06, 0.13*
Current smoker																
Yes	803	2.64	-	-	808	2.97	-	-	807	2.34	-	-	806	3.04	-	-
No	2550	2.55	-0.10	-0.15, -0.05*	2550	2.92	-0.05	-0.09, 0.00*	2559	2.28	-0.06	-0.10, -0.02*	2541	2.95	-0.08	-0.13, -0.04*
Ever had a cytology test																
Yes	3095	2.56	-	-	3098	2.92	-	-	3110	2.29	-	-	3088	2.97	-	-
No	231	2.77	0.21	0.12, 0.30*	232	3.05	0.13	0.05, 0.20*	229	2.44	0.15	0.08, 0.23*	230	3.09	0.12	0.05, 0.19*
HPV knowledge score																
High	743	2.55	-	-	743	2.84	-	-	742	2.20	-	-	742	2.89	-	-
Medium	885	2.57	0.02	-0.05, 0.08	886	2.92	0.08	0.02, 0.14*	883	2.28	0.08	0.03, 0.14*	877	2.97	0.08	0.02, 0.13*
Low	892	2.62	0.07	0.00, 0.13*	893	3.00	0.16	0.10, 0.21*	883	2.35	0.15	0.10, 0.20*	876	3.03	0.14	0.08, 0.19*
Not answered[g]	852	2.54	-0.02	-0.08, 0.05	855	2.96	0.11	0.05, 0.17*	877	2.33	0.13	0.08, 0.19*	870	3.01	0.12	0.06, 0.17*

*p ≤ 0.05. [a]Rural areas =Village/Country. [b]Working includes self-employed. [c]Not working includes unemployed, looking after family/home, retired, student. [d]includes 'single', 'separated', 'divorced' and 'widowed'. [e]Other Christian (e.g. Protestant). [f]Other (e.g. Islam). [g]Women who had never heard of HPV were directed to the next section of the questionnaire. Survey conducted in 2010 in Ireland.