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Young Adults' Awareness and Knowledge of Human Papillomavirus, Oropharyngeal Cancer, and the HPV Vaccine

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A thesis submitted in partial fulfillment of the requirements for the Master of Science degree in Health and Rehabilitation Sciences

YOUNG ADULTS' AWARENESS AND KNOWLEDGE OF HUMAN PAPILLOMAVIRUS, OROPHARYNGEAL CANCER, AND THE HPV VACCINE

By

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ABSTRACT

The Human Papillomavirus (HPV) is an extremely prevalent and sexually transmitted infection that is a known cause of morbidities such as genital warts and cancers of the cervix, anus, and oropharynx. Non-cervical HPV-related cancers have been a developing problem in North America, increasing in incidence by up to 225% in some instances over a span of two decades.

This study investigated levels of *awareness* and *knowledge* of HPV, Oropharyngeal Cancer (OPC), and the HPV vaccine using a self-administered web-based survey designed specifically for this research. University students (n=1,005) aged 18-30 completed a 42-item questionnaire that included demographic information, awareness questions, and a series of "true/false/I don't know" knowledge questions. Results revealed that participants had relatively high levels of awareness. However, many respondents had significant gaps in their knowledge of HPV, OPC, and the HPV vaccine. These data suggest that further efforts to educate young adults on these topics are warranted.

Keywords: Human Papillomavirus, cancer, awareness, knowledge

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CHAPTER 1

Introduction and Review of Literature

Overview. The Human Papillomavirus (HPV) has been described as an 'equal opportunity' pathogen as much a part of the human condition as sexuality itself (Bosch et al., 2013). Up to 80% of sexually active people will acquire an HPV infection of some type at one time in their life (Bosch et al., 2013), making HPV the most common sexually transmitted infection in the world. At present, there are more than 120 identified strains of HPV, over 40 of which infect the anogenital tract (Munoz, Castellsagué, & de Gonzalez, 2006).

The role of HPV as a human carcinogen was solidified in the late 1970's, when Dr. Harold zur Hausen discovered the causal link between HPV infections and cervical cancer (Nour, 2009). To this day, cervical cancer remains a significant global health burden, affecting over 500,000 women each year worldwide (Torre et al., 2015). HPV infection remains essentially the sole cause of this cancer (Walboomers et al., 1999). As such, most fields of HPV research (epidemiology, prevention, interventions, etc.) have traditionally been studied from the perspective of cervical cancer in females. While this work has been vital to understanding the virus, HPV research has expanded in recent decades, as the causative role of HPV in other non-cervical cancers and morbidities has been uncovered.

The vast majority of HPV infections occur without perceptible symptoms and approximately 91% of infections clear spontaneously within two years, with the mean duration of infection being 8 months (Ho, Bierman, Beardsley, Change, & Burk, 1998). When symptoms do arise, they may manifest as anogenital warts (most commonly due to

infection with either HPV strain 6 or 11) or as precancerous lesions of the anogenital tract (most commonly due to infection with "high risk" strains 16 or 18) (Bosch et al., 2013). Although unpleasant, anogenital warts are typically benign and pose no serious health risks. Therefore, infection with HPV strains 6 or 11 is considered "low risk". On the contrary, HPV strains 16, 18 (and to a lesser extent HPV strains 31, 33, 45, 52, 58 and others) are considered "high risk" because they are found in the majority of HPV-related cancers (Bosch et al., 2013). These HPV-related cancers typically begin as precancerous lesions that may remain dormant or grow undetected for decades. In economically and socially developed countries, cervical screening programs for women have been effective in detecting and treating these precancerous lesions before they transform into cancer. However, very few screening programs exist for women in developing areas of the world. Furthermore, HPV screening interventions are limited to the cervix only; therefore, such programs do not include the screening of men or for other anatomical areas of potential infection in either gender.

HPV is transmitted through skin-to-skin contact with the anogenital region. This may include any form of intimate sexual contact such as oral, vaginal, or anal sex. Evidence also suggests that HPV can be transmitted orally through open mouth kissing (Gillison et al., 2012; Pickard, Xiao, Broutian, He, & Gillison, 2012). However, the typical lack of symptoms associated with HPV infection, and the ease of transmission (i.e., skin-to-skin contact) are thought to be contributing factors to the high worldwide prevalence of HPV infection. In the sections to follow, several issues related to HPV will be addressed. This includes the global burden of HPV infection, HPV-related morbidities and mortality, HPV vaccination efforts, and public awareness and knowledge of HPV.

Global Burden of HPV Infection

As mentioned previously, HPV is the most common sexually transmitted infection in the world. In a meta-analysis of 194 studies assessing HPV prevalence in over 1 million females, the global prevalence of cervical HPV infection was found to be 11.7% (Bruni et al., 2010). Prevalence rates have been shown to range from up to 35% in developing regions such as eastern Africa and central America to below 10% in more developed regions of North America and Europe (Bruni et al., 2010). Across all geographic regions, both developed and non-developed, prevalence of cervical HPV infection was highest among females under the age of 25. In this age group, prevalence was 24% globally (Bruni et al., 2010). Many North American studies also have noted that the peak prevalence of cervical HPV infection occurs in university/college aged females (age 20-24) and steadily declines after age 25 (Ho et al., 1998; Sellors et al., 2000; Steinau et al., 2014; Trottier & Franco, 2006).

Although the majority of HPV strains are benign, meaning that they are rarely associated with any substantial symptoms or morbidity, infection with certain "high risk" strains of HPV is a known cause of certain morbidities including genital warts and cancers of the cervix, oropharynx (including base of tongue, tonsils, soft palate, and pharynx), anus, vulva, and penis. Approximately 96% of all cervical cancers (Muñoz et al., 2004), 35-72% of oropharyngeal cancers (Chaturvedi et al., 2011; Kreimer, Clifford, Boyle, & Franceschi, 2005), 78% of vaginal cancers (Daling et al., 2002), 40% of vulvar cancers (De Vuyst, Clifford, Nascimento, Madeleine, & Franceschi, 2009), 84% of anal cancers (De Vuyst et al., 2009), and 48% of penile cancers have been reported to contain

HPV DNA (Backes, Kurman, Pimenta, & Smith, 2009). Thus, HPV infection represents a significant causal factor in the development of anogenital and oropharyngeal cancers.

In particular, HPV strains 16 and 18 are responsible for the vast majority of HPV-positive tumors. More specifically, it has been reported that 70% of cervical cancers, 90% of HPV-positive oropharyngeal cancers (Kreimer et al., 2005), and 80% of HPV-positive anal cancers (De Vuyst et al., 2009) can be attributed to one of these two strains of the virus. Unfortunately, these high-risk strains of HPV are also the most prevalent strains. HPV 16 alone accounts for 22.5% of all HPV infections worldwide (Bruni et al., 2010). Furthermore, HPV-6 and HPV-11 are known to cause over 85% of genital warts (Garland et al., 2009).

More recently, epidemiological studies on HPV have expanded to include consideration of men, this being a result of the rising incidence of non-cervical HPV-associated cancers (Giuliano, Lee, Fulp, Villa, Lazcano, et al., 2011; Kreimer et al., 2011; Pickard et al., 2012). In a large multinational study of men aged 18-70, the prevalence of genital HPV infection was found to be 50% (Giuliano, Lee, Fulp, Villa, Lazcano, et al., 2011). Furthermore, in a large cross-sectional study of both men and women aged 14-19 in the United States, the prevalence of oral HPV infection was found to be 6.9% (Gillison et al., 2012). Oral HPV prevalence was much higher in men compared to women (10.1% vs. 3.6%) and, in contrast with cervical HPV infection, was more common in older individuals (Gillison et al., 2012). Oral HPV infection was found to be eight times higher in individuals who have had sex versus those who have not. Likewise, oral HPV infection is also strongly associated with lifetime and recent numbers of vaginal or oral sex partners, confirming the sexually transmitted nature of oral HPV infection (Gillison et al.,

2012). The commonplace nature of these sexual practices in many countries, combined with the lack of symptoms associated with HPV infection, along with other factors, likely explains the high prevalence of infection across many geographic regions.

HPV Prevalence

Despite being a highly developed continent, North America still represents a relatively high prevalence of HPV infections. In the United States, it has been estimated that approximately 79 million people are currently infected with HPV (Centers for Disease Control and Prevention, 2014). Furthermore, roughly 14 million Americans become newly infected each year (Centers for Disease Control and Prevention, 2014). A proportionally similar number of infections has been estimated to occur each year in Canada; the Society of Obstetricians and Gynaecologists of Canada (2007) estimate that between 13-26% of the adult population currently has an active HPV infection. Fortunately, a large proportion of these infections occur from "low risk" strains of the virus and the vast majority of all infections are transient, meaning they are self-limiting and clear on their own. However, among the most common strains of HPV is HPV 6, which is known to cause genital warts in some individuals. Furthermore, HPV 16, a "high risk" strain found in the majority of HPV-related malignancies, is the second most prevalent strain of HPV, accounting for approximately 7% of all infections (Ho et al., 1998).

Although the majority of HPV infections are transient, persistent infection – especially with high-risk HPV strains (i.e., HPV 16 and 18) can lead to a variety of health conditions. While cervical cancer still represents a significant public health burden both at home and abroad, other HPV-related cancers appear to be growing in both incidence

and prevalence (Chaturvedi et al., 2011; Jemal et al., 2013). This trend is especially apparent in men, who have traditionally not been thought of as being vulnerable to HPV-related cancers. Although more attention has been paid to non-cervical HPV-related cancers in both the scientific literature as well as the popular press in recent years, cervical cancer in women still dominates the public's relational understanding of HPV and cancer. This more focused attention and understanding exists despite a relatively equal burden of HPV-related cancer between both genders when other anatomical sites (such as the oropharynx and anus) are considered. Increasing public awareness of these non-cervical cancers, especially in men, may pose a valuable opportunity for prevention. However, increasing attention on non-cervical HPV cancers should not come at the expense of cervical cancer awareness.

HPV-Related Morbidities and Mortalities

As mentioned previously, HPV represents a major source of morbidity and mortality worldwide. Although great strides have been made in understanding this virus, infection rates remain high, especially in those under the age of 25 (Bruni et al., 2010; Steinau et al., 2014). Unfortunately, HPV strains that are known causes of morbidity are also the most prevalent. Most notably, HPV 16 and 18, which are found in the overwhelming majority of HPV-related cancers, are the two most prevalent strains, respectively (Bruni et al., 2010). Furthermore, HPV 6, which causes genital warts in some individuals, is the fourth most prevalent strain in North America (Bruni et al., 2010). These morbidities will be discussed further in the following paragraphs.

Genital Warts. Anogenital warts are by far the most common consequence of HPV infection. As mentioned previously, HPV strains 6 and 11 account for over 85% of

all cases of genital warts (Garland et al., 2009). Genital warts manifest as benign, but visible lesions around one or more areas of the anogenital tract. Although benign, genital warts may have significant psychological and social consequences for the infected individual (Woodhall et al., 2008). They also represent a significant burden on the health care system, as they typically recur and require ongoing management (Hoy, Singhal, Willey, & Insinga, 2009; Lacey, Lowndes, & Shah, 2006).

Between the years 1999-2004, 5.6% of adults aged 18-59 in the United States reported that they had been diagnosed with genital warts at one time (Dinh, Sternberg, Dunne, & Markowitz, 2008). In both the United States and Europe, the incidence of genital warts is highest among people aged 20-24 (Koutsky, Galloway, & Holmes, 1998). Since the introduction of the HPV vaccine in 2007 (Mariani, Vici, Suligoi, Checcucci-Lisi, & Drury, 2015), studies have shown that the incidence of genital warts has decreased substantially in countries and populations with high vaccination rates. Australia, for example, has seen a 92.6% reduction in the incidence of genital warts in females under 21 since the introduction of the HPV vaccination program (Mariani et al., 2015).

HPV-Related Cancers. Of the 12.7 million new cancer diagnoses worldwide in 2008, approximately 5% can be attributed to HPV infection (De Martel et al., 2012). Contracting HPV clearly represents a very significant burden to both the individual who has the infection, as well as that of the health systems where one's care may be provided. One possible benefit to the high number of HPV-related cancers is that HPV-positive tumors are associated with better three and/or five-year survival outcomes compared to HPV-negative tumors of the same anatomical site; this tendency remains true for all of

the previously discussed anatomical sites including the penis (Djajadiningrat et al., 2015), oropharynx (Ang et al., 2010), anus (Ravenda et al., 2015), vulva and vagina (Rodrigues et al., 2013; Sinno et al., 2014). The vastly different survival outcomes between individuals with HPV-positive and HPV-negative tumors have led many experts to suggest that these may be two distinctly different types of cancer. HPV-positive oropharyngeal cancer, for example, is vastly different from HPV-negative oropharyngeal cancer in terms of risk factors, etiology, treatment considerations, and survival outcomes (Benson, Li, Eisele, & Fakhry, 2013; Gillison, D'Souza, et al., 2008). Similar distinctions between HPV-positive and HPV-negative cancers have been observed at other anatomical sites.

For example, a study by Gillison et. al (2008) found that individuals with HPV-positive head and neck cancers were more likely to be younger, college educated, have an income greater than $50,000 per year, and be more sexually active compared to individuals with HPV-negative head and neck cancers. Furthermore, several measures of sexual behaviour were strongly associated with HPV-positive tumors including a higher number of lifetime sexual partners and infrequent condom use (Gillison, D'Souza, et al., 2008). Equally important was the fact that traditional risk factors for head and neck cancer, that is, tobacco and heavy alcohol use, had no association with HPV-positive tumors; however, these factors were strongly associated with HPV-negative tumors. Analogous differences relating to associations with sexual behaviour and age of tumor detection have also been observed between HPV-positive and HPV-negative tumours of the penis, anus, vulva and vagina (Gillison, Chaturvedi, & Lowy, 2008).

Cervical Cancer. Between 90-100% of cervical cancers contain HPV DNA (Bosch, Lorincz, Muñoz, Meijer, & Shah, 2002), making the association between HPV and cervical cancer stronger than the association between smoking and lung cancer. Worldwide, cervical cancer is the second most common cancer diagnosed in women. There were an estimated 527,600 new cases of cervical cancer reported in 2012 worldwide, resulting in 265,700 deaths (Torre et al., 2015). About 90% of these mortalities occurred in developing parts of the world, where the incidence of cervical cancer is much higher. Age-standardized incidence rates can range from as high as 42.7 per 100,000 people in Eastern Africa to 6.6 per 100,000 in developed regions such as North America (Torre et al., 2015). The likely cause of this large geographic variation in the rate of cervical cancer is related to the concomitant variation in genital HPV infection rates. As with cervical cancer, genital HPV infection rates are much higher in developing regions compared to economically and socially developed regions (Bruni et al., 2010).

In the United States, cervical cancer rates have been declining in recent decades due to improved screening measures and the development of an HPV vaccine. HPV screening (commonly referred to as a "Pap test") detects infection with "high risk" strains of HPV as well as precancerous lesions of the cervix. When test abnormalities occur, women can be monitored or treated in an effort to prevent or reduce the likelihood of cervical cancer developing. However, cervical cancer still affects over 12,000 women per year, 4000 of whom succumb to the disease (Siegel, Ma, Zou, & Jemal, 2014). A proportionately similar number of women are affected each year in Canada, with an expected 1,450 new cases expected in 2014 (Canadian Cancer Society's Advisory Committee on Cancer Statistics, 2014).

Anal Cancer. In 2002, there were 30,400 reported cases of anal cancer worldwide (Parkin & Bray, 2006). Although a relatively uncommon cancer, the incidence of anal cancer seems to be rising in the United States (Jemal et al., 2013). Between the years 2000 and 2009, the incidence of anal cancer increased at an average rate of 2.8% per year in the United States (Jemal et al., 2013). Furthermore, between 84-90% of anal cancers can be attributed to HPV (De Vuyst et al., 2009; Parkin & Bray, 2006). Due to the sexually transmitted nature of HPV, risk of anal cancer risk is elevated for females who engage in anal sex and homosexual males (Parkin & Bray, 2006).

Penile Cancer. There were 26,300 cases of penile cancer recorded in 2002 worldwide (Parkin & Bray, 2006). Approximately 48% of penile cancers are attributable to HPV (Backes et al., 2009). Similar to cervical cancer, prevalence of penile cancer is much higher in developing countries compared to parts of North America and Europe (Backes et al., 2009). This is likely due to the higher prevalence of genital HPV infection in these regions.

Vaginal and Vulvar Cancer. Together, these two anatomical sites accounted for 40,000 new cases of cancer worldwide in 2002 (Parkin & Bray, 2006). Approximately 70% of vaginal cancers and 40% of vulvar cancers can be attributed to HPV (De Vuyst et al., 2009). Similar to other HPV-related cancers, the incidence of vulvar cancer also has increased drastically in recent decades. Between the years 1973 and 2000, the incidence of invasive vulvar cancer increased by 20% and the incidence of in situ vulvar carcinoma increased by an astounding 411% (Judson, Habermann, Baxter, Durham, & Virnig, 2006). The discrepancy in incidence increase between these two types of vulvar cancer has been attributed to HPV. In situ vulvar carcinoma is strongly related to HPV, whereas

the association between invasive vulvar carcinoma is less well documented (Madeleine et al., 1997).

Oropharyngeal Cancers. The oropharynx is complex anatomical region that is comprised of the soft palate, posterior one third of the tongue, the tonsils, and the circumferential structures of the throat. Over the last three decades, the incidence of HPV-positive oropharyngeal cancer has increased by 225% in the United States (Chaturvedi et al., 2011). Furthermore, the proportion of OPCs that were identified as HPV-positive rose from 16.3% in 1984 to 72.7% between 2000-2004 (Chaturvedi et al., 2011). Similar trends have been observed in Canada (Auluck et al., 2010; Nichols et al., 2013) and other developed countries. This alarming trend has prompted organizations such as the Center for Disease Control and Prevention (CDC), World Health Organization, and the Canadian Cancer Society to label the rising incidence of oropharyngeal cancer as an epidemic.

Meanwhile, the incidence of HPV-negative OPC decreased by 50% between 1988 and 2004 in the United States (Chaturvedi et al., 2011). Furthermore, oral cavity cancers and lung cancer, which have traditionally shared the same risk factors as OPC (i.e., heavy smoking and alcohol use), significantly decreased during the same time period in developed countries such as Canada, the United States, and Australia in concordance with declining rates of tobacco use (Chaturvedi et al., 2013). However, although the incidence HPV-negative OPC has decreased by 50% over the last two and a half decades, the overall incidence of oropharyngeal cancer has increased by 28% (Chaturvedi et al., 2011). This increase has been attributed to HPV, although it is still unclear why the virus seems to affect the oropharynx more than other anatomical sites of the upper airway. One

theory is that the oropharynx is more directly exposed to HPV during oral sex when compared to other parts of the upper airway (e.g., the nasopharynx). Another theory is that the convoluted structure of the tonsils and base of tongue provide the perfect environment for HPV DNA to become trapped and incubate. However, more research is clearly needed to determine why HPV-related tumours disproportionately affect the oropharynx compared to other areas of the upper airway.

Oropharyngeal cancer also seems to disproportionately affect men. In 2009, there were approximately 13,000 new cases of OPC in the United States, 10,500 (81%) of which occurred in men (Jemal et al., 2013). Furthermore, it is estimated that by 2020 the annual number of new HPV-positive OPCs will surpass the number of new cervical cancers in the United States, roughly 85% of which will occur in men (Chaturvedi et al., 2011). Head and neck cancer has traditionally been more common in men, and this trend seems to be continuing as the proportion of head and neck cancers that are HPV-positive continues to rise. However, it is still unknown why this discrepancy exists for HPV-positive head and neck cancers, considering relatively equal rates between genders for participation in oral sex acts. In fact, within the United States, while differences by age group do exist, it has been reported that approximately 85.4% of men and 83.2% of women have performed oral sex (D'Souza, Cullen, Bowie, Thorpe, & Fakhry, 2014).

Introduction of the HPV Vaccine

In 2006, Health Canada, along with the Food and Drug Administration (FDA) in the United States, approved the use of a quadrivalent HPV vaccine (Gardasil™) to protect against HPV strains 6, 11, 16 and 18. A subsequent bivalent vaccine (Cervarix™) was approved in 2009, this vaccine protecting against HPV strains 16 and 18 only. Since

the HPV vaccine protects against a sexually transmitted virus, it would be most effective if administered prior to the onset of sexual activity. In 2003, a national survey indicated that the mean age of first sexual intercourse was 15.7 years for both males and females (Statistics Canada, 2003). Furthermore, only 3.5% of the population had engaged in intercourse by 13 years old (Statistics Canada, 2003). Therefore, Gardasil™ was initially recommended for use in females between 9 and 13 years old to prevent cervical lesions. Health Canada also recommended that females up to the age of 26 receive the vaccine as well, even if they had already been sexually active. The efficacy of the vaccine for preventing cervical lesions had previously been found to be greater than 95% effective (Garland et al., 2007).

Between the years 2007 and 2009, many developed countries including Canada, the United States, the UK, Sweden, Japan, and others introduced a publically-funded HPV vaccination program for adolescent girls as a means to prevent HPV infection. While the original purpose of the vaccine was to prevent the development of anogenital cancer and genital warts in women (Garland et al., 2007), the recommended use of the vaccine has recently expanded to include use in males (Centers for Disease Control and Prevention, 2011). In 2009, Gardasil™ was approved for use in males as a means to prevent genital warts (United States Food and Drug Administration, 2011). In 2010, the United States Food and Drug Administration (FDA) added prevention of anal cancer as another reason to vaccinate both males and females (United States Food and Drug Administration, 2011). Finally, in 2011 the Advisory Committee on Immunization Practices of the FDA recommended that Gardasil™ be routinely used in males aged 11-12 (Centers for Disease Control and Prevention, 2011). In summary, there is strong and

consistent support across many developed countries for the use of the HPV vaccine in both males and females as a means to prevent anogenital cancers and genital warts.

Both of the current vaccines (i.e., Cervarix™ and Gardasil™) provide a very high prevention rate for cervical and anal HPV 16 or 18 infections (Garland et al., 2007; Harper et al., 2004). Although there is no high-level evidence to suggest the two vaccines are equally effective at other anatomical sites such as the oropharynx and penis, preliminary data supports the efficacy of the vaccine to protect against HPV infection at other anatomical sites; blood samples of vaccinated individuals show that the immune response is similar in males and females (Garland et al., 2007; Giuliano, Palefsky, et al., 2011). Since the majority of HPV-related cancers are caused by strains 16 and 18, both of the HPV vaccines may hold significant potential to prevent a large proportion of the cancers discussed previously. As the incidence of HPV-related cancers continues to rise, especially in men, the prevention of these cancers is becoming increasingly important.

A recent systematic review by Mariani et al. (2015) suggests that the HPV vaccine has been extremely effective at preventing genital warts associated with HPV 6 and 11. Genital wart incidence has declined up to 92% in some populations since the introduction of school-based HPV vaccination programs (Mariani et al., 2015). Reductions in incidence were highest in countries with the highest vaccination rates and in females under the age of 25 (Mariani et al., 2015). Even in the United States, where vaccination rates are relatively low compared to other countries such as Australia, the incidence of genital warts decreased 37.9% between 2006 and 2010 in females aged 20-25 (Flagg, Schwartz, & Weinstock, 2013). The impact that the HPV vaccine is having on HPV-related cancers caused by HPV 16 and 18 has yet to be determine due to the lag

time between HPV infection and cancer development. The full effect of the HPV vaccine is not anticipated to be observed at the population level until 30-50 years after the introduction of the vaccine because of the long lag time between infection and detection of cancer (Dasbach, Insinga, & Elbasha, 2008). However, some studies have shown that the prevalence of HPV 16 and 18 infections has decreased since the introduction of the vaccine (Markowitz et al., 2013; Mesher et al., 2013).

Vaccination Rates. Unfortunately, HPV vaccination rates in Canada have remained well below the idealized target of 90% coverage for elementary school-aged girls (Canadian Immunization Committee, 2007). In Ontario, HPV vaccine uptake was initially below 50% when it was first introduced in 2007; however, uptake has gradually increased to 70.2% in 2012 (Lim, McIntyre, & Wilson, 2013). Nationwide, the HPV uptake rate for school-aged females ranges from 50% in Alberta and Manitoba to 85% in Newfoundland, Nova Scotia and Quebec (Shearer, 2011).

While the national HPV vaccination program allows adolescent girls to receive the vaccine free-of-charge, no such funding exists for males. Only two provinces (Alberta and PEI) provide the vaccine to males for free. Health Canada has claimed it is more cost-effective to vaccinate females only, citing the phenomenon of "herd immunity" as a way to prevent HPV infections in the entire population (Canadian Immunization Committee, 2014). However, this strategy has limitations for several reasons. First, it does not protect men who have sex with men (MSM), even though the prevalence of high-risk HPV is higher in this population compared to the general population at large (National Advisory Committee on Immunization, 2012). Second, herd immunity is ineffective at protecting males in areas where female vaccination rates are low because

there are still sufficient numbers of unprotected females who can transmit the infection. Lastly, when a broader range of health outcomes are considered (i.e., HPV-related cancers in males), or when female vaccination rates are low, it may actually be more cost-effective to provide the HPV vaccine to males (Graham et al., 2015).

Reasons for Non-Vaccination. A variety of reasons to explain the low rates of HPV vaccination have been cited in the literature. Since the vaccine is administered at such a young age (grades 4-8, depending on province), it is unlikely that the recipients fully understand the reasoning behind the vaccine. Therefore, the role of the parent(s) becomes paramount in deciding whether or not to vaccinate children. Many parents simply do not want to talk to their adolescent children about sexually transmitted infections; similarly, other parents feel that by vaccinating their children they are somehow acknowledging that it is okay to act promiscuously in the future (Zimet, Rosberger, Fisher, Perez, & Stupiansky, 2013). Follow-up studies have proven this fear to be groundless, as there are no differences in sexual behaviour (Forster, Marlow, Stephenson, Wardle, & Waller, 2012; Hansen et al., 2014) or attitudes towards cervical cancer screening (Mather, McCaffery, & Juraskova, 2012) between vaccinated and non-vaccinated females.

Safety concerns are frequently cited as another reason for non-vaccination (Reiter et al., 2013). Although many high-level scientific studies have proven the HPV vaccine is safe, fear-inducing stories on the Internet and in the popular media have much more influence over the general population than scientific journals. The so-called “anti-vaccination” movement, which has become increasingly prevalent in recent years, has provided strong opposition to the HPV vaccine. This anti-vaccination movement has

prospered by spreading misinformation, and in some cases, outright falsehoods over the Internet. Ongoing efforts to educate the general population must move beyond scientific publications and into the mainstream if they are to be effective as educational resources. Educational efforts must also provide accurate information that is easy to understand, as well as serving to highlight the risks of non-vaccination.

Finally, one of the biggest reasons for non-vaccination is the lack of knowledge people have regarding HPV, HPV risk factors and its potential morbidities, and the HPV vaccine itself. Not knowing enough about the vaccine and not knowing boys could get the HPV vaccine are frequently cited reasons for non-vaccination (Donahue, Stupiansky, Alexander, & Zimet, 2014; Zimet, Weiss, Rosenthal, Good, & Vichnin, 2010). Therefore, having an accurate understanding of the risks associated with contracting an HPV infection, in addition to having accurate knowledge of the HPV vaccine, are key factors in one's decision to become vaccinated. Therefore, issues related to awareness and knowledge of HPV will be explored further in the sections to follow.

HPV Awareness and Knowledge as an Important Factor in Prevention

Despite the extremely high prevalence of HPV infection, according to existing data, opportunities for infection prevention and subsequent prevention of the many associated morbidities still exist. The HPV vaccine will certainly play a large role in the prevention strategies of many countries; however, broad-focused sexual education and information on behavioural factors are equally important factors in combatting the high prevalence of HPV infection. The decision to engage in health-protective behaviours is also borne of having an accurate understanding of the potential consequences involved with engaging in high-risk sexual behaviour. In the context of HPV infection, behavioural

factors such as the decision to initiate new sexual relationships, use of protection during sex, and the type of sexual activities in which one participates almost certainly is moderated by one's awareness, knowledge, and perceived risk of the virus. Many health behaviour theories confirm the importance of awareness and knowledge (sometimes referred to as information) as a necessary precursor to health-protective behaviour (Bandura, 2004; Fisher, 2012). These same principles apply in the decision making process of those considering HPV vaccination for themselves or their children, as previous studies have shown a relationship between HPV knowledge levels and vaccine uptake (Chan, Chan, Ng, & Wong, 2012).

From a population standpoint, it is known that the prevalence of HPV infection is highest among people under the age of 25. It is also known that 85% of males and 82% of females will have engaged in sexual activity by the time they are 25 years of age (Chandra, Mosher, Copen, & Sionean, 2011), making this life stage an extremely important time period for the development of sexual activity behaviours. Therefore, having an accurate sense of what this general young adult population (age 18-24) knows about HPV, HPV-related cancers, and the HPV vaccine has important implications for educators, policy makers, and health care providers tasked with preventing HPV-related morbidity and mortality. As such, a summary of current awareness and knowledge levels will be discussed in the following section.

Awareness and Knowledge of HPV, HPV-Related Cancers, and the HPV Vaccine

For the purposes of the study to be described in following sections, the term "awareness" refers to one's yes/no acknowledgment of ever having heard of something. The term "knowledge" refers to one's understanding of specific facts relating to the person, place, or thing in question. Therefore, awareness is a necessary precursor for knowledge. That is to say, one cannot have knowledge of HPV without first having heard of HPV. However, one *can* be aware of HPV without having any knowledge of it, as knowledge exists on a continuum ranging from no knowledge to an expert level of understanding.

Many studies have evaluated the awareness and knowledge levels of HPV in various populations. HPV awareness levels can range from as low as 10% in a large sample of over 10,000 Danish men of all ages (Nielsen, Munk, Liaw, & Kjaer, 2009) to over 95% of the population in samples of female university students (Dillard & Spear, 2011). Similar variability has been reported for HPV vaccine awareness, ranging from 63% awareness in a sample of American males (Reiter, Brewer, & Smith, 2010) to 87% awareness in the general population (Ragin et al., 2009) to over 95% in populations of female university students (Bendik, Mayo, & Parker, 2011).

Knowledge. Knowledge of HPV and the HPV vaccine is also highly variable depending on the population studied. In a systematic review that assessed HPV knowledge in over 20,000 individuals across many countries, correct responses to questions regarding common facts about HPV varied widely. For example, between 8-68% of respondents knew HPV was a risk factor for cervical cancer, between 10-73% of respondents knew that HPV can be asymptomatic, and between 47-87% of respondents

knew HPV is sexually transmitted (Klug, Hukelmann, & Blettner, 2008). In general, it appears that women tend to know more about HPV than do men (Klug et al., 2008), however, the fact remains that many women also have a very limited understanding of HPV and how it relates to cancer (Chan et al., 2012). Since the introduction of the HPV vaccine in 2007, it appears that knowledge and awareness of the virus is increasing, however, knowledge gaps still remain (Gerend & Magloire, 2008).

Influence of Demographic Variables

Many studies have also shown significant racial and ethnic differences in HPV awareness and knowledge. In a study by Joseph et al. (2014), only 42% of African-American individuals identified HPV as a risk factor for cervical cancer, compared to 90% of Caucasian individuals. Racial disparities in awareness and knowledge of HPV and the HPV vaccine also have been reported in samples of women only (Gelman, Nikolajski, Schwarz, & Borrero, 2011). Differences in knowledge between publicly and privately insured women have also been reported, with significantly higher knowledge levels observed in privately insured women, suggesting a potential link between socio-economic status (SES) and HPV knowledge (Kennedy, Osgood, Rosenbloom, Feinglass, & Simon, 2011). Socio-economic status may be confounded by other factors such as cultural background, level of education, and ethnicity, as each of these variables has been associated with differences in HPV knowledge levels (Joseph et al., 2014; Klug et al., 2008; Marlow, Zimet, McCaffery, Ostini, & Waller, 2013; Waller, McCaffery, & Wardle, 2004).

Furthermore, people who are younger, female, and who have more education are significantly more likely to have heard of the HPV vaccine (Gollust, Attanasio, Dempsey,

Benson, & Fowler, 2013). Increases in awareness and knowledge are also strongly correlated with the intention to receive the HPV vaccine (Kang & Kim, 2011; Krawczyk, Stephenson, Perez, Lau, & Rosberger, 2013), engage in health-protective behaviours (Pask & Rawlins, 2015), and vaccine uptake (Donadiki et al., 2013; Laz, Rahman, & Berenson, 2013).

Summary

HPV infection is extremely prevalent in sexually active 18-25 year olds. As noted previously, many HPV infections are benign and clear spontaneously. However, infection with HPV strains 6 or 11 may lead to anogenital warts and infection with certain "high risk" strains, namely HPV 16 or 18, may lead to the development of cancers in the upper airway (most commonly the oropharynx) or anogenital tract. The incidence of HPV-positive cancer is increasing, especially in men. The introduction of the HPV vaccine in 2007 was an important step forward in preventing these cancers, however, vaccination uptake remains low in certain populations. This low uptake is true even for advanced countries whose populace is generally well educated and economically prosperous. Awareness and knowledge of HPV, HPV risk factors and associated morbidities, and the HPV vaccine is strongly associated with both vaccine uptake and engaging health protective behaviours. Therefore, it is essential that an accurate measure is taken of awareness and knowledge of HPV in the population at highest risk for HPV infection; that is, those who are under the age of 25, those who may have an increased likelihood of engaging in sexual activity, and those who are eligible for HPV vaccination. This will allow identification of knowledge gaps related to HPV and the HPV vaccine in order to inform current and future prevention and education interventions.

Statement of Problem

Based on existing data, HPV infection is an extremely prevalent health issue. Further, HPV-related morbidities have become increasingly prevalent in recent decades (Auluck et al., 2010; Bosch et al., 2013; Chaturvedi et al., 2011; Jemal et al., 2013; Judson et al., 2006). This observation led to the introduction of the HPV vaccine in 2007. Research has shown that young adults in Canada and other developed countries with established HPV vaccination programs generally have high awareness levels of HPV and the HPV vaccine. However, there is wide variation in HPV knowledge levels (i.e., what people actually know about it) depending on the population studied. Furthermore, few studies have assessed knowledge of HPV or the HPV vaccine as it relates to non-cervical cancers, particularly in respect to head and neck cancer in general and oropharyngeal cancer in specifics. Due to the importance of knowledge as a precursor for the prevention of HPV infection through health-protective behaviours (including vaccination), understanding the awareness and knowledge levels of young adults most at risk for HPV infection becomes paramount.

Objectives of the Current Study

Thus, the objectives of the current study are to:

1) Assess awareness and knowledge of HPV, HPV-related cancer, and the HPV vaccine in a population of young adult university students;
2) Identify knowledge gaps in young adults' understanding of HPV, OPC and the HPV vaccine through a series of "true/false/I don't know" questions; and
3) Identify demographic variables that may lead to greater or lesser levels of awareness and knowledge specific to the HPV-related topics identified above.

CHAPTER 2

Method

Participants

In total, 1005 individuals participated in this study. Participants ranged in age from 18 years, 0 months to 30 years, 11 months (mean = 20.92 years). 711 participants were female, 292 were male, and 2 participants self-identified as being of non-binary gender. Female participants were slightly younger, with a mean age of 20.84 years (range = 18-30) when compared to their male counterparts who had a mean age of 21.12 years (range = 18-30). All participants were current students at the University of Western Ontario (UWO) main campus. Although variability in representation existed, the sample population included students from every faculty at the University of Western Ontario including Arts & Humanities, Business, Education, Engineering, Health Sciences, Information and Media Studies, Law, Medicine & Dentistry, Music, Science, and Social Science. A complete breakdown of the number of participants from each faculty can be found in Table 1.

All participants were initially recruited in one of three ways:

1) A member of the research team approached a potential participant in a common area of the university campus (University Community Centre, Recreation Centre, building lobbies, etc.) and provided a brief verbal description of the study. If interested, the potential participant provided their email address. Within 24 hours, the letter of information for the study, which contained a link to the online survey, was emailed to them. A reminder email was sent to all participants who had not responded after 7 days since their original recruitment. Interested participants

could also choose to complete the survey at the time of contact with the researcher using a Blackberry Playbook™ tablet connected to Wi-Fi internet.

2) After obtaining permission from class instructors, verbal announcements were made in various university courses at the end of lectures. These announcements consisted of a short description of the study objectives and protocol lasting approximately two minutes. In some instances, a visual slide containing similar information about the study in text format was projected simultaneously. Potential participants were instructed to email the researcher directly if interested. Upon receiving emails from these potential participants, the letter of information for the study along with a direct link to the online survey were sent back to them within 24 hours.
3) In conjunction with recruitment Method 2, and with the course instructor's permission, an announcement was posted to the OWL course website of the classes in which a verbal announcement was made. This announcement contained a reminder about the verbal announcement made in class and an attached letter of information with a link to the survey.

Prior to the initiation of this research study, the Ethics Review Board at The University of Western Ontario approved this protocol; ERB Approval #105733 (see Appendix A).

Inclusion Criteria. In order to be included in this study, participants had to be currently registered as students at the University of Western Ontario. Both undergraduate and graduate students were included in the study. All participants were required to be between the ages of 18 and 30 and English speakers. This population was chosen because

they represent the age cohort with the highest prevalence of both cervical and oral cavity HPV infection (D'Souza, Agrawal, Halpern, Bodison, & Gillison, 2009; Sellors et al., 2000; Steinau et al., 2014).

Exclusion Criteria. Individuals who were younger than 18 years of age or greater than 30 years of age were excluded from the study. These exclusion criteria were based on the judgement that individuals over the age of 30 represent a different cohort than that of traditional "university aged" young adults. Both males and females over age 30 also fall outside of the age group that is at the highest risk of acquiring an HPV infection (Giuliano, Lee, Fulp, Villa, Lazano, et al., 2011; Sellors et al., 2000). Additionally, individuals over the age of 30 were either above or near the upper limit of the recommended age of vaccination when the HPV vaccine was first introduced in 2007 (Shefer et al., 2008) and, therefore, may have less knowledge of HPV compared to those who were exposed to the national HPV vaccination program and its' related advertising campaign (Donders et al., 2009).

Due to the method in which participants were recruited and data were collected (i.e., posted on OWL for all members of a class), some survey respondents were over the age of 30 (n=19). Some respondents also failed to answer one or more sections of the survey (n=26); for this reason, these respondents were removed from the data set prior to data analysis and are not included in the final number of participants for whom data were analyzed.

Procedure

The study consisted of a cross-sectional, self-administered, web-based survey design. For this investigation, a questionnaire was designed and utilized for data collection purposes with the intent of assessing awareness and knowledge of the Human Papillomavirus (HPV), Oropharyngeal Cancer (OPC), and the HPV vaccine in a sample of university students. The researcher-designed questionnaire was designed and administered through the website Surveymonkey.com.

All individuals who were recruited for the study were provided with a letter of information (see Appendix B) either via email or through OWL announcements. A link to the online survey was provided at the end of the letter of information. In compliance with ethical requirements, informed consent was indicated by the participant's voluntary completion of the questionnaire. This procedure of obtaining informed consent was explicitly stated in the letter of information. The letter of information also informed potential participants of the purpose of the study, the voluntary nature of one's participation, the benefits and risks of participating in the study, and the compensation they may be eligible for by participating in the study. The entire survey typically took between three and six minutes to complete.

Compensation. At the conclusion of the online survey, participants had the option to navigate to a separate web page where they could enter their email address into a draw for a $50 gift card. A separate web page was used for this draw in order to ensure that participant responses were not linked to their email addresses, thus, maintaining anonymity. Participants were also informed in the letter of information that enrollment into the gift card draw was not dependent on completing the survey. Therefore,

participants who did not answer one or more questions were still eligible for compensation.

Measurement Instrument/Questionnaire

The questionnaire utilized for this study was a 42-item, self-designed survey consisting of four sections: Demographic Information, HPV Awareness and Knowledge, OPC Awareness and Knowledge, and HPV Vaccine Awareness and Knowledge. Individual survey items were adapted and modified from a total of seven previous studies. The questionnaire was designed specifically for this project. Five of these studies focused on knowledge and awareness of HPV and the HPV vaccine (Bowyer, Marlow, Hibbitts, Pollock, & Waller, 2013; Gerend & Magloire, 2008; Pelullo, Di Giuseppe, & Angelillo, 2012; Ragin et al., 2009; Ramirez, Ramos, Clayton, Kanowitz, & Moscicki, 1997), while the other two identified risk factors for oropharyngeal cancer (Gillison, D'Souza, et al., 2008; Nichols et al., 2013). Data from the two OPC risk factor studies were transformed into a series of true/false/I don't know questions in order to test participants' knowledge of OPC.

Individual items included in the questionnaire were adopted from the aforementioned literature and selected for inclusion in the present study based on their relevance to the objectives of the study. While some of the questionnaire items were adapted from previous studies that used a validated survey tool for assessing HPV knowledge, the questionnaire used for this study had not been previously validated. However, prior to the initiation of data collection, 10 individuals (5 graduate students and 5 undergraduate students) examined the questionnaire for face validity. The complete

questionnaire and the published studies from which they were sourced can be found in Appendix C.

Demographic Information. The demographic section consisted of seven items: participant's age, gender, ethnicity, current level of education, faculty in which they were enrolled, HPV vaccination status, and primary source of HPV information. Age was measured in years plus the closest number of additional months since birthday (e.g., 20 years, 7 months). Ethnicity categories were sourced from the 2006 Canadian census and participants were able to specify 'other' if they did not identify with any of the ethnic categories listed (Statistics Canada, 2006). Current level of education was assessed based on year of study (e.g., first, second, third, fourth, fifth year undergraduate or graduate student) and all graduate students were considered to be in the same category of education level, regardless of what year of study they were in. HPV vaccination status was assessed by number of doses of the vaccine received; participants could also select "not vaccinated" or "I don't know" in reference to vaccination status.

HPV Awareness. HPV awareness was assessed with the single yes/no question, "Prior to this survey, have you ever heard of the Human Papillomavirus (HPV)?". If the participant answered 'yes' to this question, they would proceed to the HPV knowledge questions. If the participant answered 'no' they would go directly to the next section which addressed OPC awareness and knowledge. This method of question administration assumed that if the participant had never previously heard of HPV, they would also know nothing about it. Therefore, to prevent these participants from guessing and potentially skewing the data, those participants who had not heard of HPV before never had access to the HPV knowledge questions.

Perceived Concern of HPV Infection. All participants were asked to rate their personal level of concern about potentially becoming infected with HPV. This rating was made using an equal-appearing interval (EAI) scale that ranged from 1 to 5. A response of 1 meant that the participant was "not concerned at all", while a response of 5 indicated that the participant was "extremely concerned" about becoming infected with HPV.

Self-Perceived HPV Knowledge. All participants also were asked to rate their self-perceived level of HPV knowledge on a second EAI scale that again ranged from 1 to 5. A response of 1 meant the participant believed that they knew "nothing" about HPV, with a response of 5 representing "very much/expert", thus, indicating that the participant thought their knowledge levels were considerable.

HPV Knowledge. The HPV knowledge section consisted of 17 statements regarding established facts about HPV and HPV risk factors. After reading each statement, participants could choose the responses 'true', 'false', or 'I don't know'. The 'I don't know' option was once again included in an effort to reduce or prevent participants from guessing; participants were explicitly instructed to choose this option if they would consider their answer to be a guess.

Oropharyngeal Cancer Awareness. OPC awareness was assessed with a single "yes/no" question: "Prior to this survey, have you ever heard of oropharyngeal cancers (cancer of the throat, base of tongue, soft palate, and/or the tonsils?)". Similar to the previous section, if the participant answered 'yes' to this question, they would proceed to the OPC knowledge questions. Again, if they answered 'no', they would go directly to the next section (HPV vaccine awareness and knowledge).

Self-Perceived Concern of Developing Oropharyngeal Cancer. All participants were asked to rate their level of concern about developing oropharyngeal cancer using a 5-point EAI scale. A response of 1 meant that the participant was "not concerned at all", while a response of 5 meant that the participant was "extremely concerned" about developing OPC.

Self-Perceived Oropharyngeal Cancer Knowledge. Similarly, all participants were asked to rate their self-perceived level of oropharyngeal cancer knowledge on an EAI scale that again ranged from 1 to 5. A response of 1 meant that the participant thought they knew "nothing" about oropharyngeal cancer, while a response of 5 ("very much/expert") indicated that the participant thought they had considerable knowledge.

Oropharyngeal Cancer Knowledge. The OPC knowledge section consisted of six questions for which either a True/False or "I don't know" response was required. Questions in this section addressed OPC risk factors (e.g., "Smoking tobacco increases the risk of developing oropharyngeal cancer"), incidence trends (e.g., "The number of new oropharyngeal cancer cases per year in Canada is increasing"), and general OPC-related facts (e.g., "Both men and women can get oropharyngeal cancer").

HPV Vaccine Awareness. This section followed the same format as the previous two sections. HPV vaccine awareness was assessed with the yes/no question: "Prior to this survey, have you ever heard of the HPV vaccine (brand names Gardasil™ or Cervarix™)?". An answer of 'no' to this question would take the participant to the end of the survey. If the participant answered 'yes', they would proceed to the HPV vaccine knowledge questions before finishing the survey.

HPV Vaccine Knowledge. The HPV vaccine knowledge section consisted of five statements to which participants could once again respond with one of three options: 'true', 'false', or 'I don't know'. Items in this section included statements regarding the vaccine's function (e.g., "The HPV vaccine protects against cervical cancer") and who can receive the vaccine (e.g. "Men cannot obtain the HPV vaccine").

Data Analysis

Raw data in the form of individual survey responses were exported from Surveymonkey.com into a Microsoft® Excel (2011) spreadsheet. Descriptive statistics (i.e., means, medians, standard deviations, and ranges) were calculated for the demographic data. Descriptive statistics were also used to summarize the responses to the three awareness questions (e.g., total number of people who had heard of HPV, OPC, and the HPV vaccine).

A knowledge score for each of the three knowledge sections was generated using the number of correct responses within each section. Therefore, a participant's knowledge score could range from 0-17 in the HPV knowledge section, 0-6 in the OPC knowledge section, and 0-5 in the HPV vaccine knowledge section. All responses of 'I don't know' were counted as an incorrect response. Participants who skipped a knowledge section due to an answer of 'no' on the preceding awareness question were given a knowledge score of zero for that section. This followed the logic that if, for example, participants had no awareness of HPV, then they also would not have knowledge related to it. Upon completion, the number of correct responses to all 28 knowledge questions was summed to create a total knowledge score for each participant. Hence, total knowledge scores could range from 0-28.

Descriptive statistics were also used to report the percentage of participants who answered each individual question correctly, allowing for the identification of specific knowledge gaps in this sample.

Overall levels of knowledge were determined using the cumulated mean scores of each participant for each of the three knowledge categories. A mean total knowledge score was calculated by determining the average number of correct responses to all 28 knowledge questions from all participants. Comparisons were made between different demographic groups using these mean knowledge scores.

Comparison of Knowledge Scores Between Genders.

Four independent t-tests were performed using SPSS 16.0 for Windows (SPSS Inc., 2008) in order to compare the HPV, OPC, HPV Vaccine, and Total mean knowledge scores between men and women. An a priori alpha level of $p \leq 0.05$ was used in order to determine significance. However, because four t-tests were performed, the alpha level of 0.05 was divided by four in order to further decrease the probability of a type 1 error (i.e., finding a significant difference when, in fact, there is not one). Therefore, an a priori significance level of 0.0125 was used to test for significance. Results of these comparisons will be presented in Chapter 3.

Correlation Analyses of Knowledge Scores

A Pearson's product-moment correlation coefficient was performed using SPSS 16.0 for Windows (SPSS Inc., 2008) in order to determine potential relationships between the four knowledge scores (HPV, OPC, HPV vaccine and Total). Male and female knowledge scores were correlated separately. Demographic variables such as age

and year of study were also included in the correlational assessment relative to the scores obtained.

CHAPTER 3

Results

Response Rates

In total, 454 individuals were approached directly in common areas of the university using Recruitment Method 1. Of these 454 people, 198 completed the survey at the time of contact using a tablet provided by the researcher. The remaining 236 individuals provided their email address and asked to have the survey sent to them, of which 119 (50.4%) eventually completed it. Twenty people refused participation altogether. Overall, 317 (69.8%) of the 454 people approached using this method of recruitment completed the survey.

In addition to the recruitment method outlined above, 45 class announcements were made in various courses across campus using Recruitment Method 2. Based on the number of students enrolled in each class, and assuming all students were present, it was estimated that 4,985 students were exposed to this method of recruitment. In total, 733 responses were collected using this method of recruitment, equating to a response rate of 14.7%.

Therefore, based on both methods of recruitment, 5439 students were exposed to at least one method of recruitment and 1050 responses were gathered, bringing the overall response rate to 19.3%.

Participant Response Exclusions

Forty-five of the 1,050 responses were excluded from final data analysis. Of these, 19 were excluded due to being 30 years of age or older, 3 were excluded for missing responses on one section of the survey, and 23 were excluded due to missing

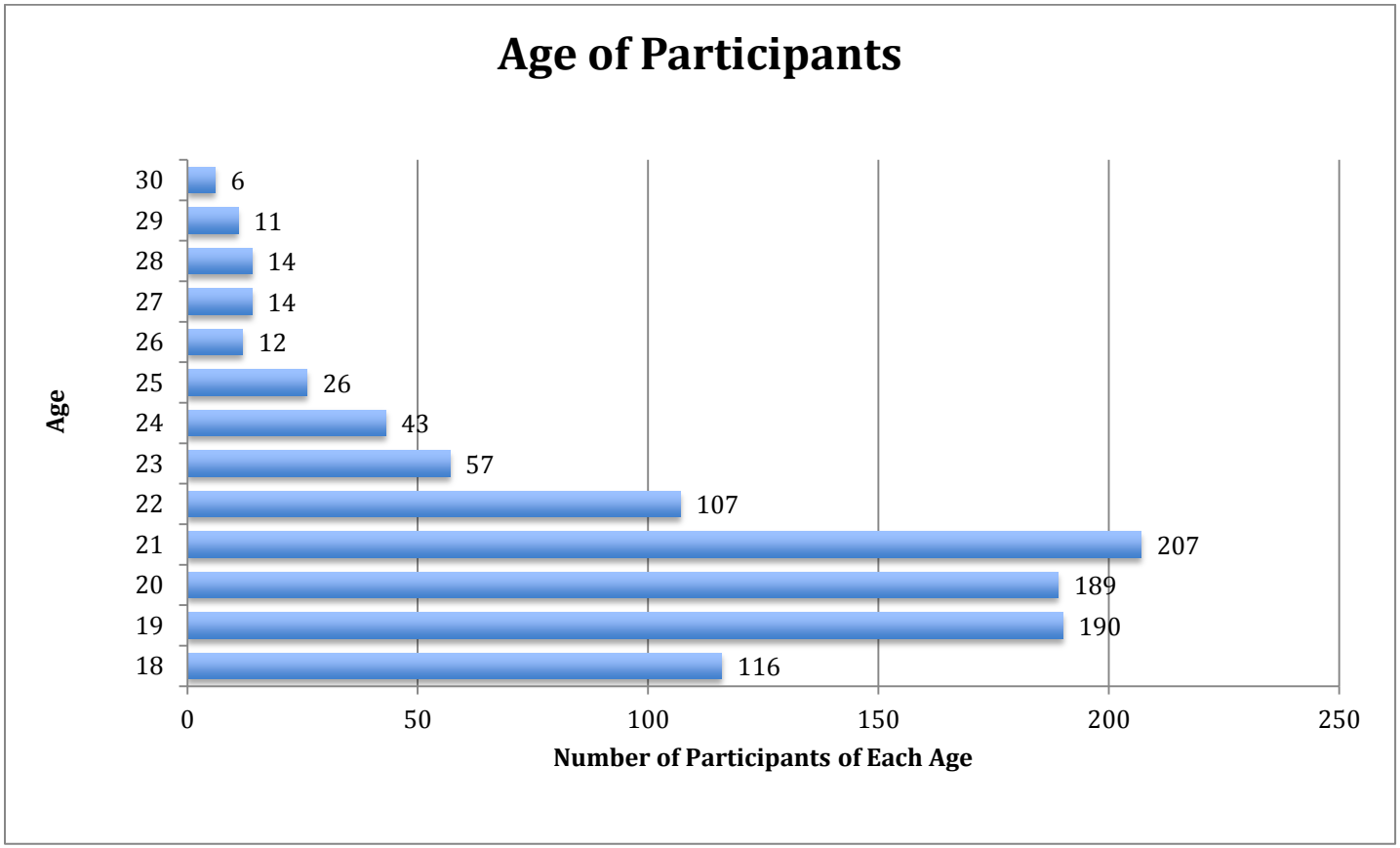
responses on multiple sections of the survey. Therefore, a total of 1,005 responses were included in final data analysis. Thus, the following results are based on the responses of 1,005 participants.

Demographic Information

Gender: In total, 711 females (mean age = 20.84 years, range = 18 years, 0 months – 30 years, 0 months), 292 males (mean age = 21.12 years, range = 18 years, 0 months – 30 years, 10 months), and 2 non-binary (mean age 20.5 years) individuals were included in final data analysis. "Non-binary" is a term for individuals with any gender identity that does not conform to the mutually exclusive categories of male and female, including transgender, agender, bigender, genderfluid, and others. The proportion of males (29%) to females (71%) in this study differed slightly from the overall full-time undergraduate and graduate student body at Western, which is reported to be comprised of 45% males and 55% females. See Appendix D for a complete breakdown of Western's student body by gender and program of study. Non-binary individuals were not included in gender comparisons; however, they were included in other demographic comparisons (year of study, program of study, etc.).

Age. The mean age of all 1,005 participants was 20.92 years (range = 18 years, 0 months – 30 years, 10 months). 13 participants did not specify their age. The age distribution of participants is displayed in Figure 1.

Figure 1. Age of Participants



*13 participants did not specify their age.

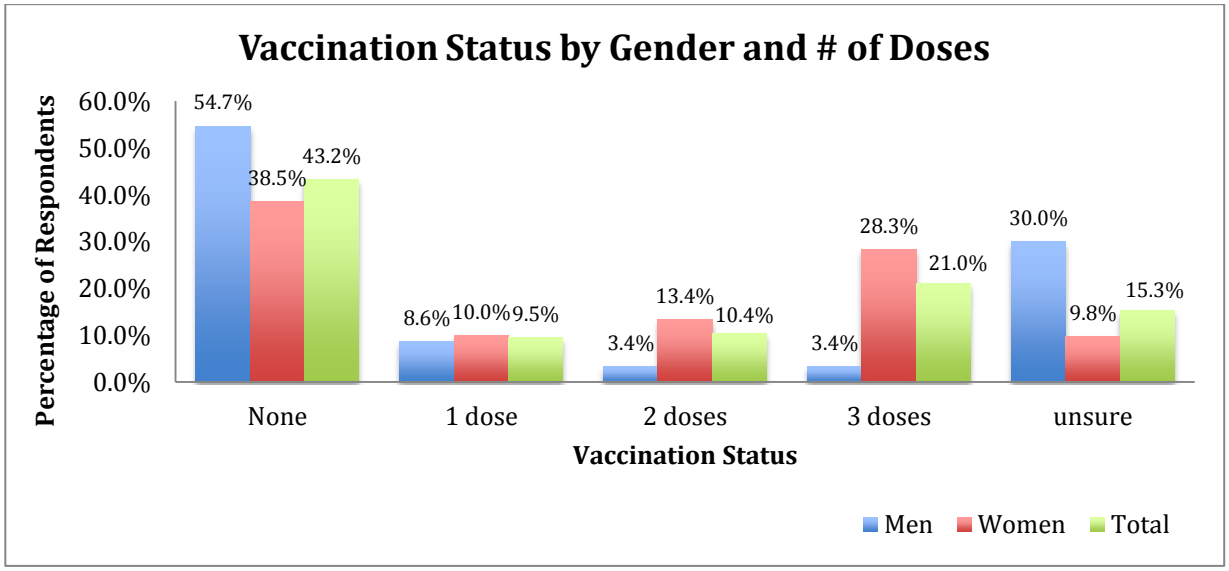
Table 1. ***Demographic Data of Participants***

Variable	Women n (%)	Men n (%)	Total
Number of Participants	711 (71)	292 (29)	1005*
Age (years)	Mean 20.84	Mean 21.12	Mean 20.92
Ethnicity	n (% of total)	n (%)	n (%)
Caucasian	522 (71)	218 (29)	740 (74)
Chinese	55 (70)	23 (30)	79 (8)
South Asian	44 (73)	15 (27)	60 (6)
Black	17 (74)	6 (26)	23 (2)
Filipino	6 (100)	0 (0)	6 (.6)
Aboriginal	1 (100)	0 (0)	1 (.01)
Latin American	10 (77)	3 (23)	13 (1)
Southeast Asian	10 (83)	2 (17)	12 (1)
Arab	8 (44)	10 (56)	18 (2)
West Asian	1 (100)	0 (0)	1 (.01)
Korean	8 (80)	2 (20)	10 (1)
Japanese	2 (100)	0 (0)	2 (.02)
Other	27 (66)	12 (34)	40 (4)
Year of Study[a]	n(%)	n(%)	n(%)
1st year undergrad	94 (69)	43 (31)	137 (14)
2nd year undergrad	173 (75)	58 (25)	232 (23)
3rd year undergrad	134 (71)	56 (29)	190 (19)
4th year undergrad	152 (68)	72 (32)	224 (22)
5th year undergrad	25 (52)	23 (48)	48 (5)
Graduate student	129 (77)	38 (23)	167 (17)
Faculty of Participant's Enrollment[b]	n(%)	n(%)	n(%)
Arts & Humanities	35 (78)	9 (22)	45 (4.5)
Business	39 (48)	43 (52)	82 (8)
Education	0 (0)	1 (100)	1 (.001)
Engineering	25 (30)	59 (70)	84 (8)
Health Sciences	307 (84)	57 (16)	364 (36.5)
Information and Media Studies	54 (90)	6 (10)	60 (6)
Law	27 (73)	10 (27)	37 (4)
Music	39 (71)	16 (29)	55 (5)
Schulich Medicine and Dentistry	6 (33)	11 (66)	18 (2)
Science	81 (660)	42 (33)	123 (12)
Social Science	98 (73)	37 (27)	135 (13.5)

*2 participants self-identified as non-binary gender.
[a] 7 participants did not indicate their year of study.
[b] 1 participant did not indicate their faculty of enrolment.

HPV Vaccination Status. Based on data gathered, 412 (40.9%) respondents had received at least one dose of the HPV vaccine. Vaccination rates were much higher in females, with 51.6% of females (n=367) and 15.4% (n=45) of males having received at least 1 dose of the vaccine. Thirty percent of males (n=85) and 9.8% of females (n=67) were unsure of their vaccination status; only participants who explicitly indicated they had received at least one dose of the vaccine were counted as having been vaccinated.

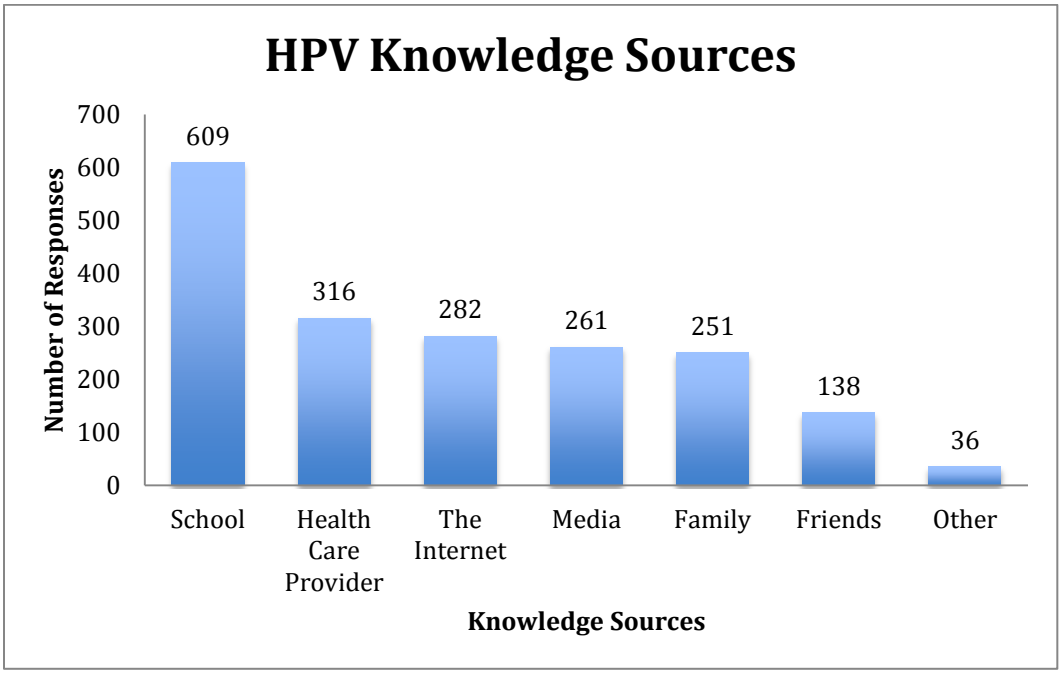
Figure 2. Participant Vaccination Status



HPV knowledge Sources

As part of this survey study, participants were asked to indicate where in the past they had obtained information regarding HPV. Participants were permitted to select more than 1 option, if applicable. Results from this question are presented in Figure 3.

Figure 3. HPV Knowledge Sources



HPV Awareness

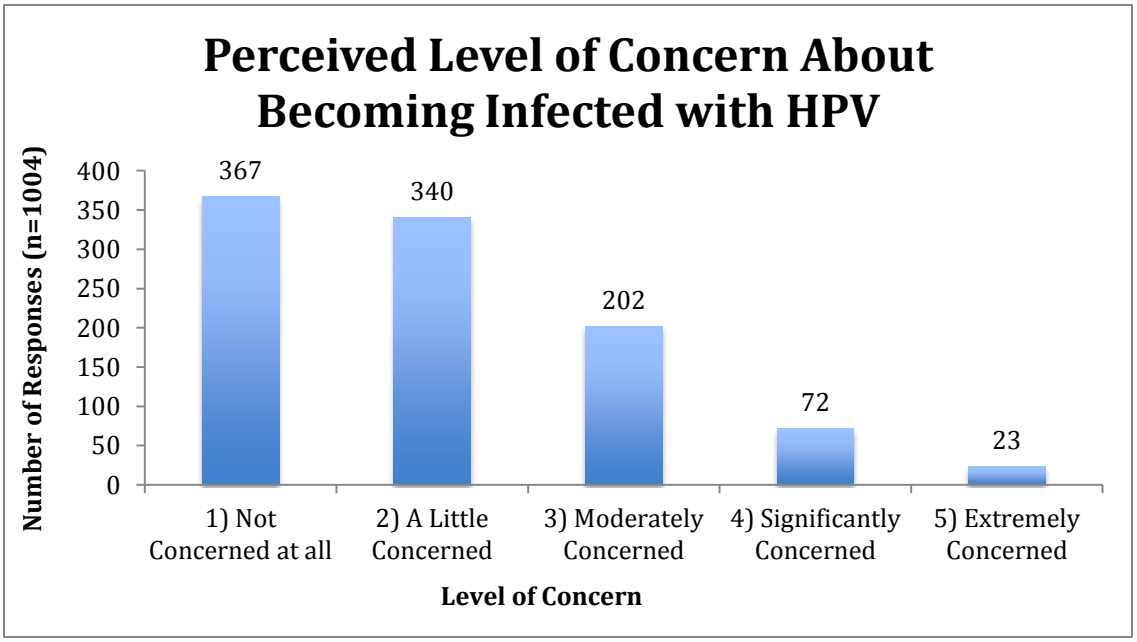
Data revealed that 92.94% (n=933) of participants had heard of HPV prior to their completion of this survey. 5.07% (n=51) of participants had not heard of HPV prior to this survey. HPV awareness was slightly higher in females (95.07%) than in males (87.33%). Twenty-one (2.09%) additional participants did not respond to this question. However, those who left the awareness question blank were still able to answer the HPV knowledge questions.

Perceived Concern of HPV Infection

All participants were asked to rate their perceived level of concern specific to becoming infected with HPV using a 5-point Likert style scale with 1 indicating the participant was "not concerned at all" and 5 indicating that they were "extremely concerned". Data revealed that the majority of participants (90.4%) rated their level of

concern as a 3, or "moderately concerned" or lower. 72 (7.1%) participants rated their level of concern as a 4, or "significantly concerned" and 23 (2.2%) participants rated their level of concern as a 5, or "extremely concerned". One participant did not respond to this question. A complete breakdown of responses is shown in Figure 4.

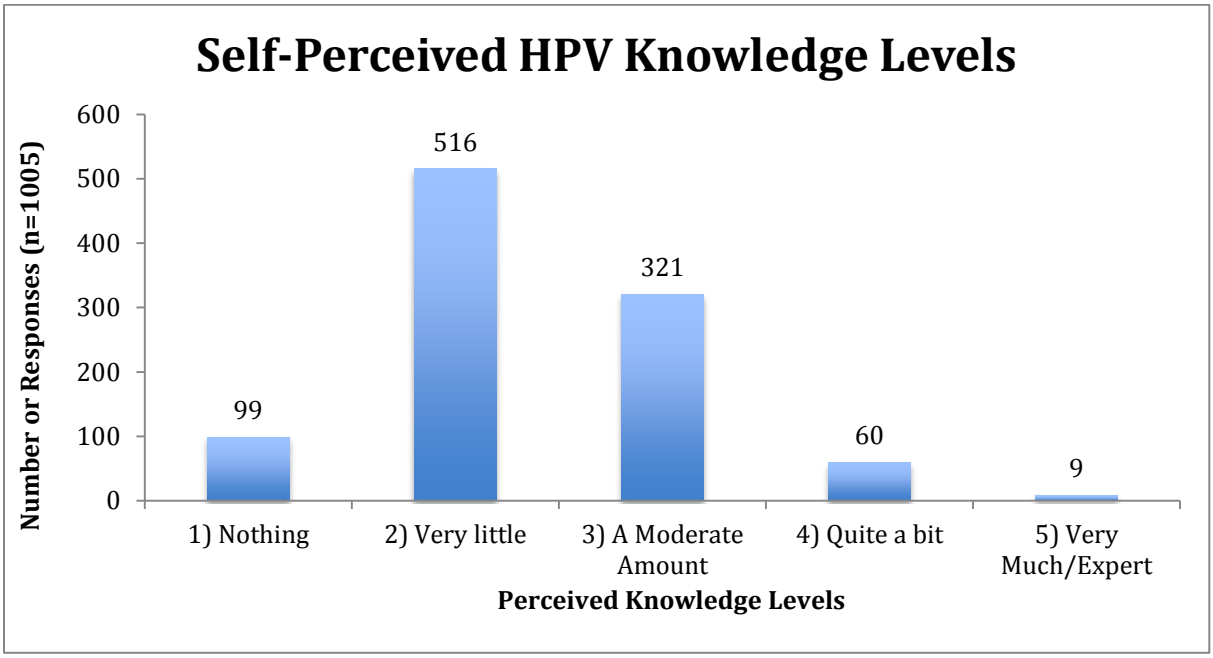
Figure 4. Perceived Level of Concern about HPV Infection



Self-Perceived HPV Knowledge

All participants also were asked to rate their self-perceived level of HPV knowledge using a similar 5-point scale with 1 representing no knowledge and 5 representing an expert level knowledge. Data indicated that the majority of respondents (51.3%) perceived themselves as having "very little" knowledge of HPV, that is, a scaled response of 2. A complete breakdown of participant responses to this question is shown in Figure 5.

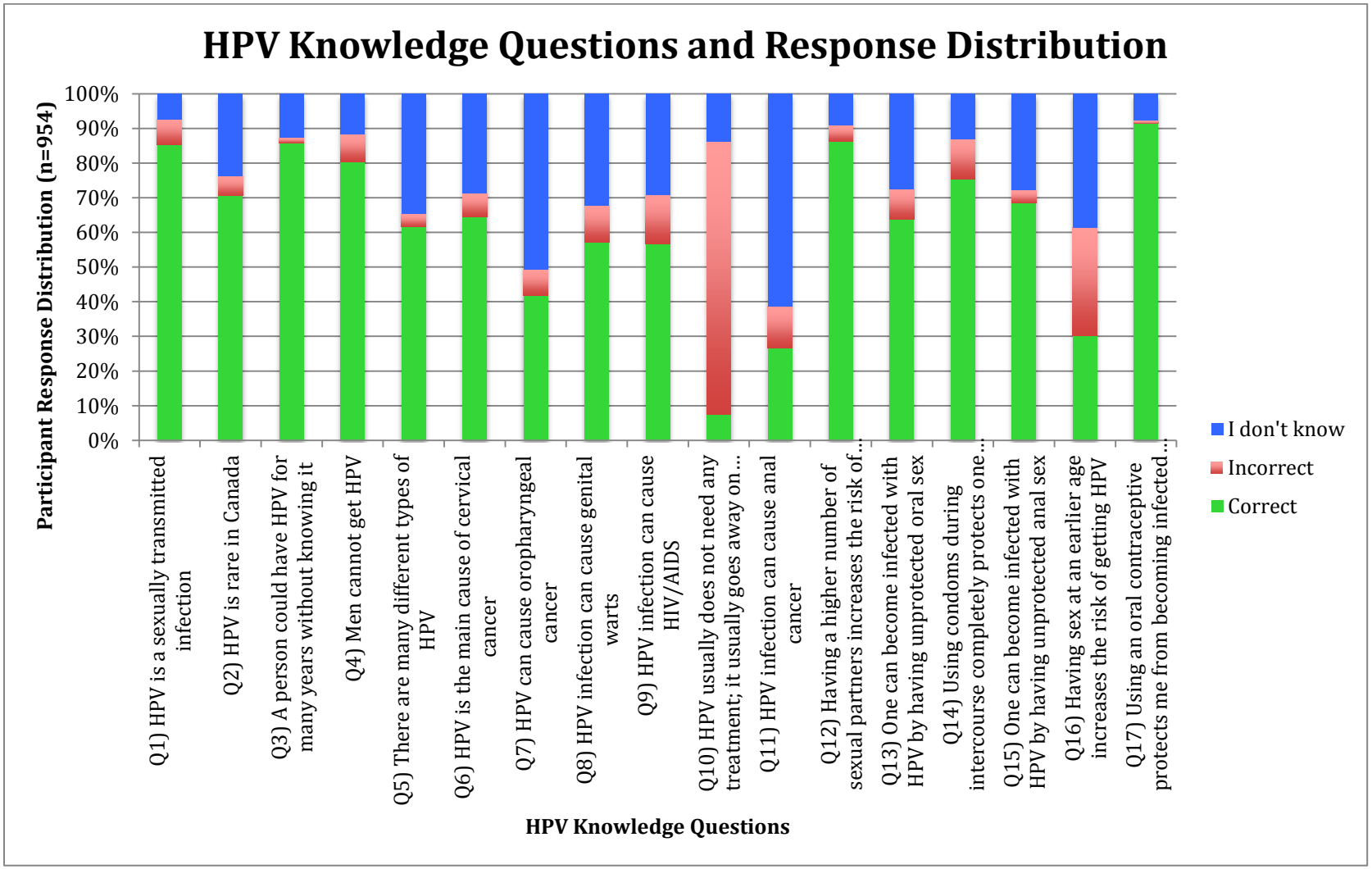
Figure 5. Self-Perceived HPV Knowledge Levels



HPV Knowledge

In total, 954 participants (259 males, 693 females, 2 non-binary) fully completed the HPV knowledge section of the survey. Fifty-one participants were excluded from this section because they had never heard of HPV before. Responses to each knowledge question provided in the survey are summarized in Figure 6.

Figure 6. HPV Knowledge Questions



HPV Knowledge Scores. As part of data analysis, HPV "knowledge scores" were generated. HPV knowledge scores were calculated by summing the number of questions answered correctly in this section for each participant. Therefore, HPV knowledge scores could range from 0-17. Of the 954 participants who completed the knowledge section, the mean HPV knowledge score was 10.54 out of 17 (SD = 3.44, Range = 0-17, Median = 11). Knowledge scores were slightly higher for females (10.62, SD = 3.33, Range = 0-17, Median = 11) compared to males (10.39, SD = 3.68, Range = 0-17, Median = 11).

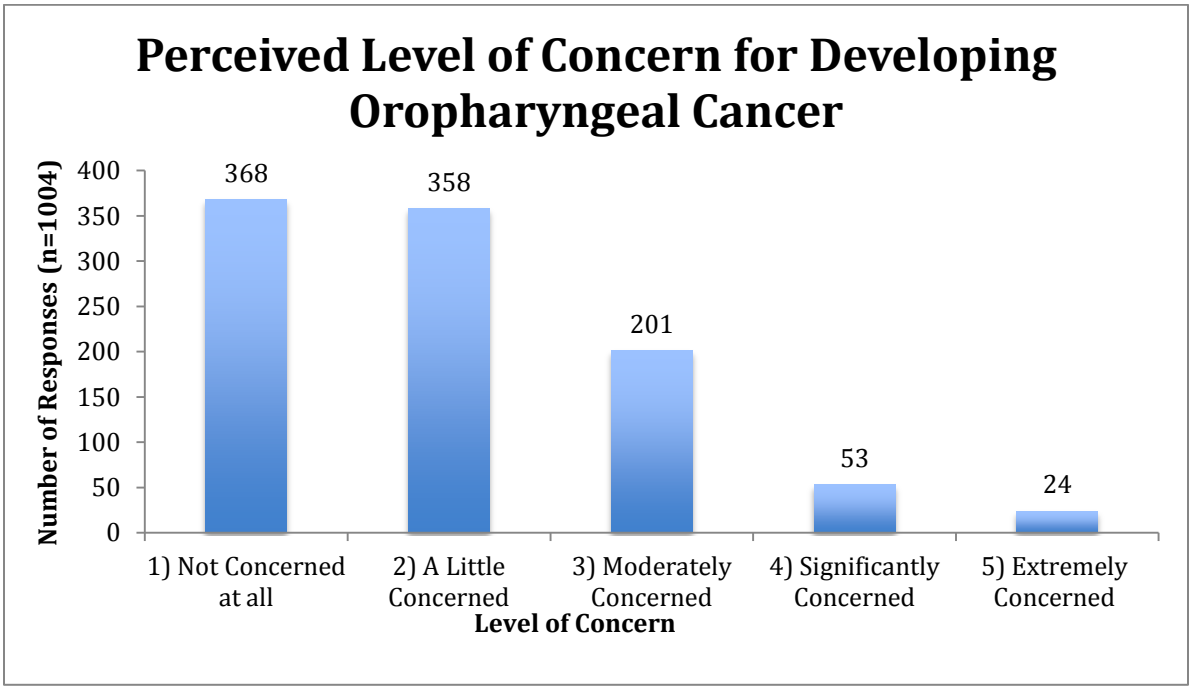
Oropharyngeal Cancer (OPC) Awareness

Specific to cancer awareness, 77.51% (n=779) of participants reported having heard of OPC prior to their completion of this survey; 21.29% (n=214) of participants had never heard of oropharyngeal cancer previously. Further, 1.19% (n=12) of participants did not respond to this question. OPC awareness was approximately 7% higher for females than males, with 78.89% of females and 71.92% of males indicating they were aware of OPC prior to the survey.

Self-Perceived Concern of Developing Oropharyngeal Cancer

All participants were asked to rate their perceived level of concern about becoming infected with HPV, again, using a 5-point scale. Most participants indicated they were 1) "not concerned at all" (n=368) or 2) "a little concerned" (n=358). One participant did not respond to this question. A complete breakdown of responses is shown in Figure 7.

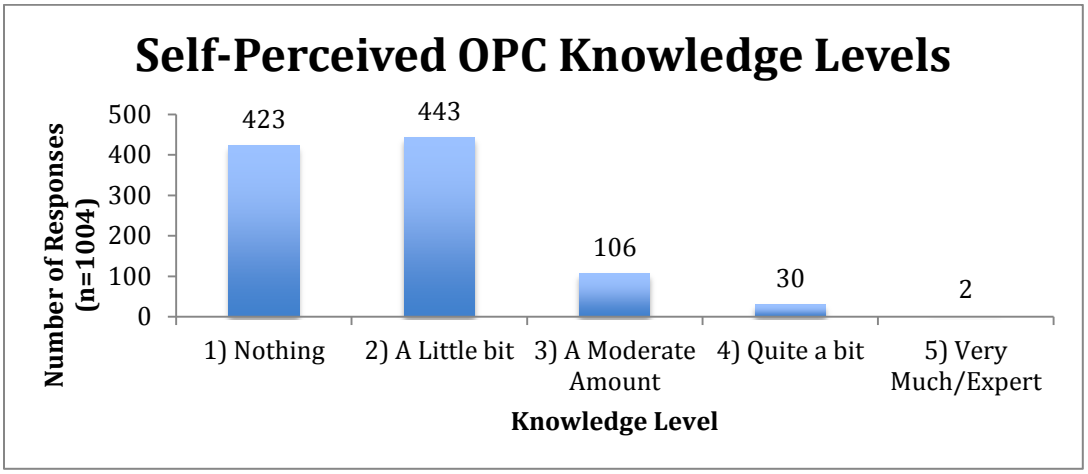
Figure 7. Level of Concern About Developing OPC



Self-Perceived OPC Knowledge

All participants were asked to rate their self-perceived level of OPC knowledge with a 5-point scale. Data revealed that the vast majority of participants either knew "nothing" (n=423) or only "a little bit" (n=443); 138 (13.7%) participants indicated they had a moderate amount of knowledge or above. One participant did not respond to this question. A complete breakdown of responses is shown in Figure 8.

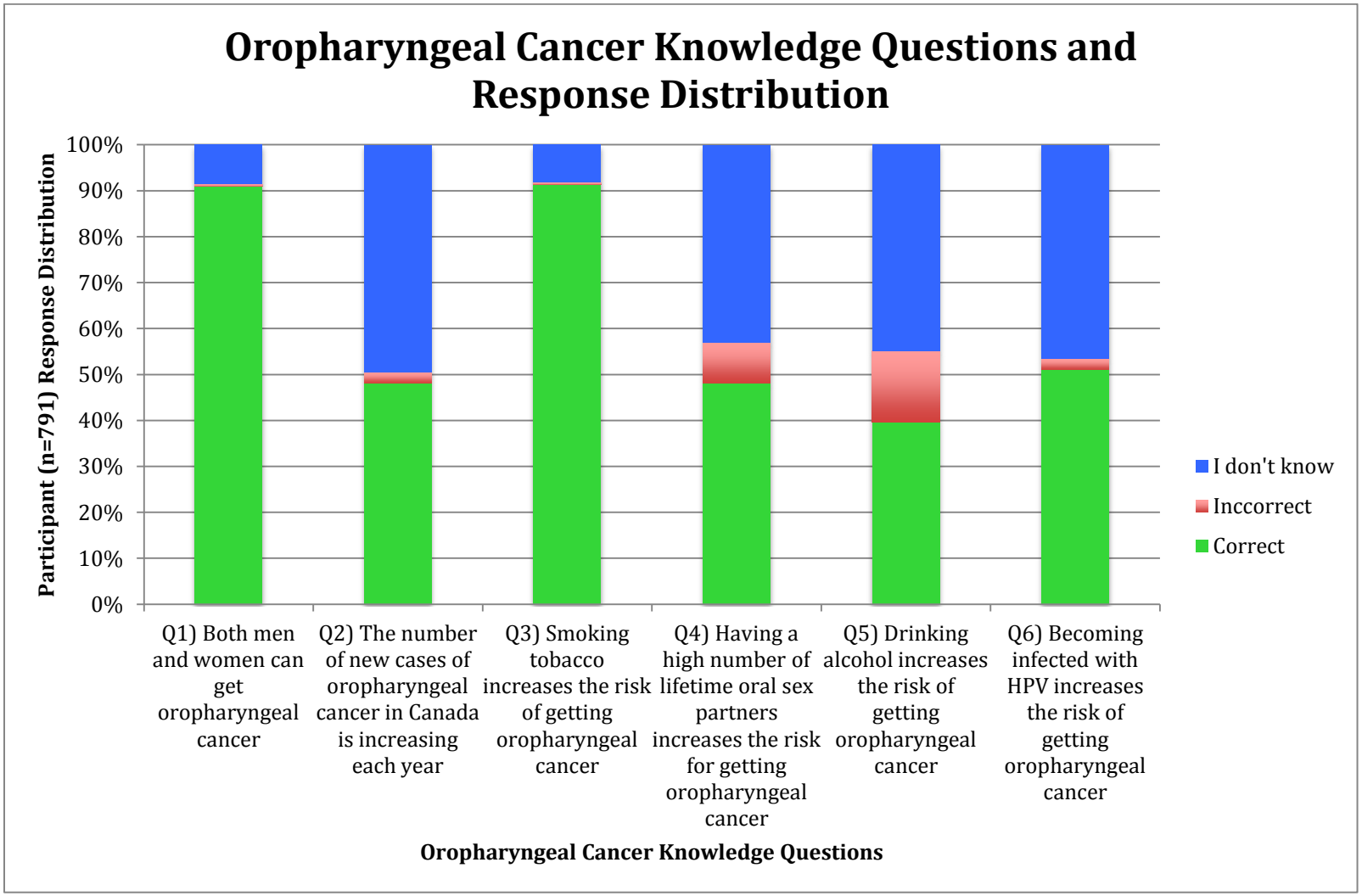
Figure 8. Self-Perceived OPC Knowledge Levels



OPC Knowledge

In total, 791 participants (576 females, 214 males, 1 non-binary) completed this section of the survey. Scores could range from 0-6. Interestingly, 214 participants (21.29%) were excluded from this section because they had never heard of OPC before. A summary of the response distribution for each OPC knowledge question is presented in Figure 9.

Figure 9. OPC Knowledge Questions and Responses



OPC Knowledge Scores. Similar to data analyses for the HPV knowledge section of the survey, OPC knowledge scores also were generated by summing the number of correct responses for each participant in this section. OPC knowledge scores could range from 0-6. Of the 791 participants who completed this section, the mean OPC knowledge score was 3.69 out of 6 (SD = 1.49, Range = 0-6, Median = 4). Once again, knowledge scores were slightly higher for females (3.70, SD = 1.45, Range = 0-6, Median = 4) when compared to males (3.67, SD = 1.57, Range = 0-6 Median = 4).

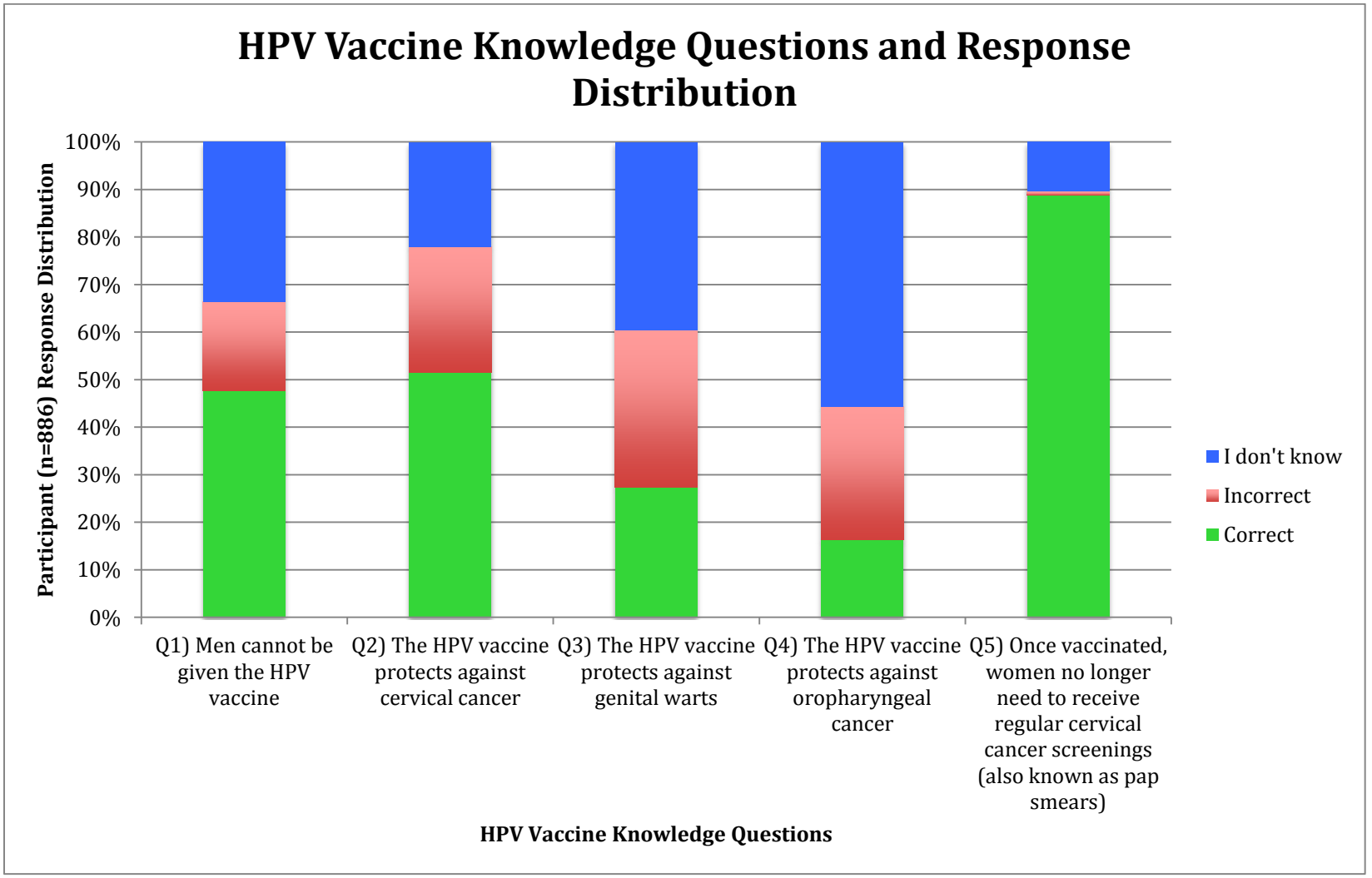
HPV Vaccine Awareness

Fully 87.86% (n= 883) of participants indicated that they had heard of the HPV vaccine prior to this survey. Vaccine awareness was 17.28% higher for females (92.97%) than for males (75.69%). However, 119 (11.84%) participants (49 females, 69 males, 1 non-binary) had never heard of the HPV vaccine prior to their participation in this study and three participants did not respond to this question.

HPV Vaccine Knowledge

In total, 886 participants completed the HPV vaccine knowledge section (662 female, 223 male, 1 non-binary). 119 participants were excluded from this section because they had never heard of the HPV vaccine before. A summary of the response distribution for each HPV vaccine knowledge question is presented in Figure 10.

Figure 10. HPV Vaccine Knowledge Questions and Responses



HPV Vaccine Knowledge Scores. Once again, HPV vaccine knowledge scores were generated by summing the number of questions answered correctly in this section for each participant. Vaccine knowledge scores could range from 0-5. Of the 886 participants who completed this section, the mean vaccine knowledge score was 2.32 out of 5 (SD = 1.23, Range = 0-5, Median = 2). The mean HPV vaccine knowledge scores were slightly higher for females (2.33, SD = 1.18, Range = 0-5, Median = 2) compared to males (2.29, SD = 1.38, Range = 0-5, Median = 2).

Total Knowledge Scores

Total knowledge scores for participants were calculated by summing each individual's number of correct responses from all three knowledge sections. Therefore, total knowledge scores could range from 0-28. The mean total knowledge score for all participants was 14.95 out of 28 (SD = 6.12, Range = 0-28, Median = 15). Data revealed that females had higher total knowledge scores (15.51, SD = 5.59, Range = 0-28, Median = 16) compared to males (13.66, SD = 7.04, Median = 14). Given that participants could access each section's knowledge questions only if they answered "yes" to the preceding awareness question, not all participants had access to all 28 knowledge questions. Therefore, participants who answered 'no' to one or more awareness questions could not achieve a perfect total knowledge score (i.e., a score of 28). However, this is consistent with the logic used throughout the survey that awareness is a necessary precursor for the assessment of one's knowledge.

Demographic Factors, Awareness, and Knowledge

Year of Academic Study. Participants were separated into their respective year of university education, as determined by the demographic section of the questionnaire.

Seven participants did not specify their year of education and were, therefore, not included in this summary. Awareness levels and mean knowledge scores were calculated for each cohort and for each section of the questionnaire (HPV, OPC, and HPV vaccine). Awareness levels were calculated by determining the percentage of participants in each cohort who had previously heard of HPV, OPC, and the HPV vaccine, respectively. Mean knowledge scores for each section were generated using only the responses of participants whom had either answered 'yes' to the corresponding awareness question or left the awareness question blank, thereby granting them access to the knowledge questions. That is, participants who answered 'no' to the question "have you ever heard of HPV prior to this survey?" were not included in the calculation of mean HPV knowledge scores. This rule applied for the OPC and HPV vaccine sections as well. Results are shown in Table 2.

Table 2. Awareness Levels and Mean Knowledge Scores by Year of Education

Year of Study	HPV Awareness	HPV Knowledge (Possible Range = 0-17)	OPC Awareness	OPC Knowledge (Possible Range = 0-6)	HPV Vaccine Awareness	Vaccine Knowledge (Possible Range = 0-5)
1st Year N = 137	**87.6%**	**Mean = 9.91** SD= 3.66 N=127	**67.9%**	**Mean = 3.60** SD = 1.705 N= 97	**80.3%**	**Mean = 2.20** SD = 1.232 N=110
2nd N = 232	**93.97%**	**Mean = 10.04** SD = 3.10 N = 221	**70.26%**	**Mean = 3.47** SD = 1.467 N = 167	**88.36%**	**Mean = 2.092** SD = 1.127 N = 205
3rd N = 190	**92.93%**	**Mean = 10.46** SD = 3.514 N = 181	**75.79%**	**Mean = 3.77** SD = 1.503 N = 145	**90.00%**	**Mean = 2.5058** SD = 1.313 N = 172
4th N = 224	**93.75%**	**Mean = 10.77** SD = 3.558 N = 214	**83.48%**	**Mean = 3.86** SD = 1.3882 N = 190	**87.50%**	**Mean = 2.4141** SD = 1.144 N = 198
5th N = 48	**97.92%**	**Mean = 11.32** SD = 3.349 N = 47	**89.58%**	**Mean = 3.98** SD = 1.4704 N = 44	**95.83%**	**Mean = 2.543** SD = 1.5449 N = 46
Grad Student N = 167	**92.81%**	**Mean = 11.28** SD = 3.29 N = 157	**85.63%**	**Mean = 3.61** SD = 1.46 N=144	**88.62%**	**Mean = 2.30** SD = 1.24 N = 148

Program of Study. Participants also were separated into their respective programs of study, as determined by the demographic section of the questionnaire. One participant did not specify their program of study and, therefore, this participant was not included in this summary. Awareness levels and mean knowledge scores were calculated for each cohort and for each section of the questionnaire (HPV, OPC, and HPV vaccine). Awareness levels were calculated by determining the percentage of participants in each

cohort who had previously heard of HPV, OPC, and the HPV Vaccine, respectively. Mean knowledge scores for each section were generated using only the responses of participants whom had either answered 'yes' to the corresponding awareness question or left the awareness question blank, thereby granting them access to the knowledge questions. Results are shown in Table 3 below.

Table 3. Awareness Levels and Mean Knowledge Scores by Program of Study

Program of Study	**HPV Awareness**	**HPV Knowledge (Possible Range = 0-17)**	**OPC Awareness**	**OPC Knowledge (Possible Range = 0-6)**	**Vaccine Awareness**	**Vaccine Knowledge (Possible Range = 0-5)**
Arts & Humanities N = 45	**100%**	**Mean = 10.13** SD = 3.51 N = 45	**68.89%**	**Mean = 3.69** SD = 1.71 N = 32	**86.67%**	**Mean = 2.56** SD = 1.43 N = 39
Business N = 82	**85.37%**	**Mean = 9.86** SD = 3.45 N = 71	**65.85%**	**Mean = 3.35** SD = 1.58 N = 54	**73.17%**	**Mean = 2.20** SD = 1.25 N = 60
Education N = 1	**100%**	12 correct	**100%**	3 correct	**100%**	5 correct
Engineering N = 84	**88.10%**	**Mean = 9.80** SD = 3.66 N = 74	**67.85%**	**Mean = 3.39** SD = 1.41 N = 59	**87.80%**	**Mean = 2.28** SD = 1.36 N = 72
Health Science N = 364	**96.15%**	**Mean = 11.29** SD = 3.20 N = 356	**89.84%**	**Mean = 4.04** SD = 1.39 N = 328	**94.23%**	**Mean = 2.43** SD = 1.18 N = 345
IMS N= 60	**90.00%**	**Mean =**	**66.67%**	**Mean =**	**93.33%**	**Mean =**

		10.17 SD = 3.23 N = 59		**8.57** SD = 1.53 N = 42		**2.13** SD = 1.19 N = 56
Law **N = 37**	**97.30%**	**Mean =** **10.72** SD = 3.49 N = 36	**67.57%**	**Mean =** **3.44** SD = 1.39 N = 25	**86.11%**	**Mean =** **2.32** SD = 1.35 N = 31
Music = 55	**90.90%**	**Mean =** **8.13** SD = 3.54 N = 54	**70.90%**	**Mean =** **2.95** SD = 1.50 N = 42	**85.45%**	**Mean =** **1.85** SD = 0.97 N = 48
Schulich = 18	**100%**	**Mean =** **12.00** SD = 3.29 N = 18	**77.79%**	**Mean =** **4.43** SD = 1.34 N = 14	**88.89%**	**Mean =** **3.13** SD = 1.44 N = 16
Science **N = 123**	**90.24%**	**Mean =** **9.72** SD = 3.20 N = 114	**72.36%**	**Mean =** **3.65** SD = 1.54 N = 90	**81.30%**	**Mean =** **2.23** SD = 1.28 N = 100
Social Science **N = 135**	**91.85%**	**Mean =** **10.30** SD = 3.46 N = 126	**75.56%**	**Mean =** **3.53** SD = 1.48 N = 104	**87.41%**	**Mean =** **2.203** SD = 1.14 N = 118

*1 participant did not indicate their program of study and was therefore excluded from this summary.

Ethnicity. Due to the high number of Caucasian participants (73.6%), and the relatively small number of participants in each of the other self-identified ethnicity

cohorts, participants were grouped into one of two categories for this comparison: Caucasian or Other. Awareness levels and mean knowledge scores were generated in the same manner as the previous demographic variables and the results are presented below in Table 4.

Table 4. Awareness Levels and Mean Knowledge Scores By Ethnicity

Ethnicity	**HPV Awareness**	**HPV Knowledge (Possible Range = 0-17)**	**OPC Awareness**	**OPC Knowledge (Possible Range = 0-6)**	**Vaccine Awareness**	**Vaccine Knowledge (Possible Range = 0-5)**
Caucasian N = 740	**94.73%**	**Mean = 10.79** SD = 3.44 N = 716	**81.08%**	**Mean = 3.75** SD = 1.46 N = 608	**91.76%**	**Mean = 2.35** SD = 1.22 N = 682
All Other Ethnicities N = 265	**87.55%**	**Mean = 9.79** SD = 3.36 N = 238	**67.55%**	**Mean= 3.50** SD = 1.58 N = 183	**76.98%**	**Mean = 2.20** SD = 1.26 N = 204

Vaccination Status, Awareness and Knowledge. Participants were categorized into three categories based on their HPV vaccination status: (1) not vaccinated, (2) vaccinated, or (3) unsure. Participants were deemed vaccinated if they had received at least one dose of the HPV vaccine (either Gardasil™ or Cervarix™). Five participants did not indicate their vaccination status and were therefore excluded from this summary. Awareness levels and mean knowledge scores were generated for each cohort and for each section of the questionnaire and the collective results are shown in Table 5.

Table 5. Awareness Levels and Mean Knowledge Scores by Vaccination Status

Vaccine Status	**HPV Awareness**	**HPC Knowledge (Possible Range = 0-17)**	**OPC Awareness**	**OPC Knowledge (Possible Range = 0-6)**	**Vaccine Awareness**	**Vaccine Knowledge (Possible Range = 0-5)**
No Vaccine N = 434	**92.17%**	**Mean = 10.81** SD = 3.42 N = 406	**77.42%**	**Mean = 3.69** SD = 1.46 N = 343	**85.71%**	**Mean = 2.3431** SD = 1.25 N = 373
Vaccine N = 412	**97.33%**	**Mean = 10.832** SD = 3.17 N = 411	**82.77%**	**Mean = 3.909** SD = 1.43 N = 343	**97.09%**	**Mean = 2.440** SD = 1.18 N = 402
Unsure N = 154	**83.12%**	**Mean = 8.789** SD = 3.81 N = 133	**62.99%**	**Mean = 2.89** SD = 1.55 N = 100	**69.48%**	**Mean = 1.747** SD = 1.25 N = 107

*5 participants did not indicate their vaccine status and were therefore excluded.

Comparison of Mean Knowledge Scores Between Genders

As noted previously, an independent t-test was performed to test for potential differences between males and females relative to mean knowledge scores of each of the three knowledge sections and total knowledge scores. A Bonferroni correction was made to the alpha level of p = .05 due to the fact four t-tests were performed. Therefore, an a priori significance level of 0.0125 was used to test for significance.

HPV Knowledge. The effect of gender was not found to be statistically significant in relation to HPV knowledge (t = 0.856, p = .393).

OPC Knowledge. The effect of gender was not found to be statistically significant in relation to OPC knowledge (t = 0.214, p = .830).

HPV Vaccine Knowledge. The effect of gender was not significantly different in relation to HPV vaccine knowledge (t = 0.352, p = .725).

Total Knowledge Score. The difference between males' and females' total knowledge scores was found to be statistically significant using a p value of 0.0125 (t = 4.009, p = .000).

Correlational Analyses of Knowledge Scores

Pearson product-moment correlation coefficients were generated to assess potential relationships between HPV, OPV, HPV vaccine and total knowledge scores. Male and females scores were correlated separately. Results for both males and females indicated very strong correlations between HPV knowledge scores and total knowledge scores. Strong correlations were also noted between OPC knowledge and total knowledge and HPV vaccine knowledge and total knowledge. Weak-to-moderate correlations were found between the three knowledge section scores (HPV to OPC, OPC to HPV vaccine, and HPV to HPV vaccine). However, for males, a moderate correlation was noted between HPV knowledge and HPV vaccine knowledge. Therefore, males who had higher HPV knowledge scores also had higher HPV vaccine knowledge scores.

No correlation was found between age or year of academic study and knowledge scores.

Table 6 Correlational Analyses of Female Knowledge Scores

	Age	Year of Study	HPV Knowledge	OPC Knowledge	Vaccine Knowledge	Total Knowledge
Age	1	.836**	.156**	.169**	.070	.179**
Year of Study		1	.158**	.219**	.090*	.201**
HPV Knowledge			1	.424**	.466**	.914**
OPC Knowledge				1	.339**	.707**
Vaccine Knowledge					1	.655**
Total Knowledge						1

**p<0.01 level (2-tailed)

Table 7 Correlational Analyses of Male Knowledge Scores

	Age	Year of Study	HPV Knowledge	OPC Knowledge	Vaccine Knowledge	Total Knowledge
Age	1	.818**	.043	-.045	.037	.024
Year of Study		1	.071	-.057	.059	.044
HPV Knowledge			1	.444**	.556**	.937**
OPC Knowledge				1	.372**	.685**
Vaccine Knowledge					1	.710**
Total Knowledge						1

**p<0.01 level (2-tailed)

CHAPTER 4

Discussion

The present study was designed to address three specific research objectives. Those objectives were to:

1) Assess awareness and knowledge of HPV, HPV-related cancer, and the HPV vaccine in a population of young adult university students;
2) Identify knowledge gaps in young adults' understanding of HPV, OPC, and the HPV vaccine through a series of "true/false/I don't know" questions; and
3) Identify demographic variables that may lead to greater or lesser levels of awareness and knowledge specific to the HPV-related topics identified above.

The discussion to follow will address the findings from the present study in relation to the above stated objectives. In doing so, the discussion will first address relevant issues specific to survey response rates and participant demographics (e.g., age, gender, program of study, ethnicity). Next, the data gathered and its representation to each of the three research objectives will be interpreted and discussed in relation to the current state of literature. This will include an exploration of demographic variables that may lead to greater or lesser awareness and knowledge of HPV, OPC, and the HPV vaccine. Finally, limitations of the current research will be addressed, followed by the implications of the present findings, directions for future research, and the overall conclusions that emerged from this investigation.

Response Rates

The overall response rate for this study was 19.3% (n = 1,005). Recruitment Method 1 (approaching individuals directly) yielded a much higher response rate, as 69.8% (n=317) of the 454 people recruited using this method completed the survey. Recruitment Method 2 (class announcements) yielded more responses overall (n=733), despite a lower response rate of 14.7%. Overall, however, the present investigation yielded a response rate that is consistent with previous research reported by Ratanasiripong, Cheng, & Enriquez (2013) who utilized a web-based survey tool to asses HPV knowledge levels of female college students in California.

Participant Demographics

Participants in this study included young adults between the ages of 18 and 30 who were currently registered students at The University of Western Ontario. This population was chosen for the study because they represent the age cohort with the highest prevalence of both cervical and oral cavity HPV infection (D'Souza et al., 2009; Sellors et al., 2000; Steinau et al., 2014). Given the two methods of participant recruitment, this sample can be considered one of fixed location convenience. However, given the relatively large sample size of this study, this sample is believed to be representative of the greater student population at Western University (see Appendix D for Western University student demographics).

Gender. With respect to gender, 71% (n = 711) of the respondents to the present survey were female and 29% (n = 292) were male. This proportion differed slightly from the overall population of Western University, which is currently reported to be 55% female and 45% male (see Appendix D). The high proportion of female participants in

this study may be partially explained by the fact that a high proportion of respondents (36.5%) were from the Faculty of Health Sciences and the Faculty of Social Sciences (13.5%), which have higher proportions of females than males (71.5% and 55%, respectively).

Given the significant difference that was identified for the total knowledge scores between males and females in the present research, it is plausible that overall knowledge levels may have decreased slightly had there been a higher proportion of male participants in this study. This assumption is based on the fact that males had a significantly lower total knowledge score than did females who participated in this study. Had the number of male participants been equal to the number of female participants in this study, the overall knowledge level of the present population also may have been lowered. However, although this anticipated trend has been extrapolated from the present sample, this assumption requires additional validation in future work.

Ethnicity. The self-identified ethnicity categories for which participants could choose from were sourced from the 2006 Canadian Census (Statistics Canada, 2006). While the researcher recognizes that no method of categorizing ethnicity is perfect, especially in an ethnically diverse setting such as a university, the census categories were chosen for this study because they represent the best means of categorizing one's ethnic identity, and consequently may provide the existing "gold standard" for this demographic descriptor.

The majority of participants in this research (74%) self-identified as Caucasian. "Caucasian" is a collective term used for people with lighter/"white" skin, but who may not necessarily share similar ethnic backgrounds. The other ethnicity categories (e.g.,

Chinese, Filipino, Korean, etc.) were much more specific, which may have led to fewer respondents per category. No current data exist for the ethnic composition of Western University; therefore, the sample obtained for this study cannot be compared to the overall university population. However, given the large sample size obtained in this study, it is reasonable to assume that the sample is representative of the greater Western University population.

Faculty of Participant's Enrollment. All of the 11 major faculties at Western University were represented in this study's participant sample. The Faculty of Health Sciences accounted for the largest proportion of respondents, comprising 36.5% of the total sample. Next, Social Science (13.5%) and Science (12%) faculties accounted for the second and third highest proportion of respondents, respectively. Although each faculty was not evenly represented in this sample, there is no reason to assume that members of one faculty would have inherently better or worse HPV, OPC, HPV vaccine knowledge or awareness than members of another faculty. This assumption is supported by the data, which show only minor differences in awareness and knowledge levels between respondents who came from different faculties.

HPV Vaccination Status. 40.9% of survey respondents indicated that they had received at least one dose of the HPV vaccine. This overall vaccination rate comprised 51.6% of female respondents and 15.4% of male respondents. The 51.6% vaccination rate for females in this sample is significantly lower when compared to the reported vaccination rate of 70.2% for females in Ontario (Lim et al., 2013). However, Ontario's vaccination rates are based on statistics gathered from females in Grade 8, the age at which the vaccine is initially available and/or provided in Ontario's school-based

vaccination program (Lim et al., 2013). The females who participated in the present research would have been exposed to the HPV vaccination program at a time when the vaccine was much newer and when coverage rates were much lower (e.g., 50% coverage in 2007) (Lim et al., 2013). This finding suggests that as vaccination rates continue to rise in elementary aged females, and these females subsequently become older, vaccination coverage rates will naturally increase in university-aged individuals in the coming years. The likely effect of this trend would then manifest as a decreased HPV infection prevalence in this population. Obviously, efforts that seek to monitor such trends in the years to come would be extremely valuable relative to understanding associated increases in awareness and knowledge of HPV.

In contrast to females, data on male vaccination rates in Ontario are inconsistent due to the fact there is no publically-funded HPV vaccination program for males in Ontario. However, data from a national sample of males aged 13-17 in the United States estimates an HPV vaccination rate of 34.6% (Center for Disease Control and Prevention, 2014), a rate that is more than doubled from the 15.4% vaccination rate of males who participated in the current sample.

Interestingly, fully 30% of male respondents in this study were unsure of their vaccination status. This surprising finding is likely tied to the fact that close to 24% of male respondents in this study had never heard of the HPV vaccine prior to this study. One possible explanation for this finding may be that vaccination efforts have primarily been targeted at females in Ontario. As such, health promotion and health education materials (advertising, public service announcements, etc.) and health care provider recommendations have mostly excluded males. This finding also may speak to a certain

level of unawareness in males relative to HPV, a topic that will be discussed further in the sections to follow.

Year of University Study. The distribution of participants based on their year of university study was relatively even compared to the University population as a whole. The one exception to this finding is the relatively smaller proportion of students in their first year of study compared to students in other, later years of study. This discrepancy in part may have resulted from a sampling bias or a simple non-response bias. As some students in their first year of study are potentially under the age of 18, some may have been prevented from participating in this study due to age being one of the exclusion criteria. However, it is unclear how many potential participants this may have affected. It also is possible that younger students may have been less interested in participation in academic research or deemed the study unimportant. In the latter case, if a determination that the study was unimportant drove the decision not to participate for those in their first year, substantial concerns clearly arise. More specifically, sexual activity by university students is not uncommon (Chandra et al., 2011), therefore, not realizing the potential risks associated with such activity (e.g., HPV infection) poses a considerable challenge for this population. This would certainly raise questions about the ideal time for education concerning HPV and the associated risks. It also suggests that increasing age that corresponds to year of university study also carries with it some relative advantage.

In general, knowledge and awareness seemed to improve with increasing year of study. When participants were separated by their year of study, the lowest awareness levels and lowest mean knowledge scores were found for those participants who were in either their first or second year of study. This was true across all three knowledge

categories (HPV, OPC, and HPV vaccine). This finding suggests that level of education may play some role in one's increasing knowledge and awareness of HPV, OPC, and HPV vaccine. Previous research in a sample of the general population has confirmed that education level is significantly associated with awareness of HPV (Marlow et al., 2013).

Findings Specific to Research Objectives

HPV Awareness. A very high rate (92.94%) of participants had heard of HPV prior to their participation in this study. The high level of HPV awareness in this sample is in line with previous research that has assessed awareness of HPV in a sample of university students. These previous studies have reported awareness rates of between 94% and 96%, although they have primarily focused only on females (Dillard & Spear, 2011; Krawczyk et al., 2012). The higher awareness levels in females (95.07%) versus males (87.33%) found in the present study is also consistent with the results of previous research which compared awareness levels of males and females (Dahlström et al., 2012; Marlow et al., 2013; Reimer, Schommer, Houlihan, & Gerrard, 2014). Again, exposure to information on HPV and its vaccine, as well as associated advertising and educational materials for females is likely an influencing factor for this finding. Perhaps if males had more exposure to information or greater opportunities to receive the vaccine, males' HPV awareness would begin to approximate the awareness levels observed in our female participants.

Caucasian participants had higher levels of HPV awareness (94.73%) than did non-Caucasian participants (87.55%). This finding is consistent with previous research, as Reimer et al. (2014) have previously linked Caucasian ethnicity as a significant predictor of higher HPV Awareness levels. While more aware of HPV, a national sample

of adults in the United States revealed that Caucasian individuals also engage in oral sex practices more often than people of other races (Chandra et al., 2011). Interestingly, having a higher level of education also was related to having two or more vaginal sexual partners within the last year for males and more frequent oral sex for both men and women (Chandra et al., 2011).

HPV Knowledge. Although a relatively high level of general awareness was present in the present participant sample, HPV knowledge varied greatly by individual knowledge item. As outlined in the methods, HPV knowledge was assessed through a series of 17 "true/false/I don't know" questions. In total, 954 participants completed the HPV knowledge section of the survey. The mean summed knowledge score of these 954 participants was 10.54 out of a potential high score of 17 (range = 0-17), reflecting a moderate level of HPV knowledge.

Certain general facts about HPV were fairly well known, suggesting that young adults in the current sample have been exposed to a least some form of HPV education, whether or not that exposure has been provided in a formal manner. This theory is further supported by the fact that 60.5% of respondents to this survey reported that they had received some information or knowledge of HPV from school. This previous exposure may explain the fact of why respondents were able to correctly answer certain HPV knowledge questions. For example, 85.2% of respondents to the HPV knowledge section correctly identified HPV as a sexually transmitted infection, while 91.4% of respondents knew that using an oral contraceptive does not protect against HPV infection, and finally, 85.8% of respondents knew that HPV infections could be asymptomatic for many years. Furthermore, 80.4% of all respondents to this section knew that men could become

infected with HPV. Similar findings have been observed by Krawczyk et al. (2012) relative to university students' knowledge that HPV is a sexually transmitted infection. The present findings, in addition to those of Krawczyk et al. (2012), represent examples of positive results of past sexual education programs. As mentioned previously, knowledge is an important first step in the prevention of HPV, as well as other types of sexually transmitted infections. It is, therefore, encouraging to find that a high proportion of the university students who participated herein are at least able to identify the sexually transmitted nature of HPV. Given that sexual experimentation is a common endeavor for many university students, building on this rudimentary knowledge of HPV will be an important goal for future educators.

Certain risk factors for HPV were also fairly well known by respondents of the present study. For example, 86.2% of respondents correctly identified that having a high number of lifetime sexual partners is an important risk factor for HPV and 75.4% correctly noted that condoms do not completely protect against HPV infection during intercourse of any kind. Less well known was the fact that HPV can be spread through oral and anal sex, with 63.8% and 68.4% of respondents, respectively, correctly identifying these behaviours as substantial risk factors. The fact that roughly one-third of respondents to this survey *did not* know that oral or anal sex may lead HPV infection should be of concern and may be leading to unsafe sexual practices. This conclusion is based on a national sample from the Unites States which found that approximately 89% of women and 90% of men aged 15-44 have performed oral sex. Furthermore, 36% of women and 44% of men have reported engaging in anal sex with an opposite-sex partner (Chandra et al., 2011).

The collective results outlined above indicate that the young adults in this sample may posses at least a basic understanding of HPV and the associated risk factors for acquiring an HPV infection. However, in contrast, the potential consequences of HPV infection were not as well known. Only 57.1% of respondents in the present study knew that HPV can cause genital warts. Compared to a similar survey by Ratanasiripong et al. (2013) which assessed HPV knowledge in a sample of female college students in California, these results are quite similar. In that study, 43.5%-46.9% of their participants knew HPV could cause genital warts. These data suggest that knowledge levels of the present sample are slightly higher relative to these two knowledge items, but overall, young adults continue to require more education relative to the potential consequences of HPV infection.

Perhaps the biggest knowledge gaps that were identified from the HPV knowledge portion of the current study were those related to HPV's association with certain cancers. For example, 64.6% of respondents who completed the knowledge section of the present survey correctly identified HPV infection as the main cause of cervical cancer. This finding was surprising due to the fact that HPV is essentially the sole cause of this type cancer. Since the release of the HPV vaccine and subsequent public health vaccination programs in 2007, opportunities for HPV education have undoubtedly increased. This is in addition to regular cervical cancer screening programs that are common in most economically and socially developed countries. Despite this increased attention and energy that is directed toward preventing cervical cancer in women, fewer than 65% of the respondents to this survey correctly identified the link between HPV and cervical cancer.

Comparatively, 41.8% of respondents identified HPV infection as a risk factor for oropharyngeal cancer and only 26.7% of participants identified HPV infection as a risk factor for anal cancer. One possible explanation for these findings may be the relatively low incidence of these two types of cancer in North America when compared to other forms of malignancy. Anecdotally, it is true that more prevalent cancers, such as breast, lung, colon, and prostate, dominate North American popular culture and public interest. Interestingly, however, is the fact that many of the respondents to the present survey indicated that they first learned of the link between HPV and OPC from actor Michael Douglas, who was diagnosed with HPV-positive OPC in 2010.

Based on the data obtained in the current investigation, participants were largely unaware of the association between HPV and cancer, especially its relationship to oropharyngeal and anal cancer. Knowledge of HPV's relation to cervical cancer was again similar to findings from previous samples of Canadian university students in which 61% of respondents were aware of the association (Krawczyk et al., 2012). However, other studies have shown much higher levels of knowledge in relation to the link between HPV and cervical cancer. For example, a study by Ratanasiripong et al. (2013) found that 86.3% of female Californian college students respondents were aware of the link between HPV and cervical cancer. The present research did find that a higher proportion of females (69.4%) than males (52.1%) knew about the relation of HPV to cervical cancer. However, the female participants in the study by Ratanasiripong et al. (2013) still demonstrated higher knowledge levels relative to this fact than did the females who participated in the present research.

In contrast to the above noted comparisons, fewer studies have addressed whether people understand the association between HPV and oral/oropharyngeal cancer. This observation exists despite a 225% increase in incidence of HPV-positive OPC between 1988 to 2004 in the United States (Chaturvedi et al., 2011). A national sample of men in the United States revealed that only approximately one-in-five (21%) men were aware of the association between HPV and OPC (Reiter et al., 2010). The present sample revealed nearly double the level of knowledge relative to this fact which is comparable to the findings of a study from Italy (Pelullo et al., 2012) in which 31%-47% of participants, who were identified as either lesbian, gay, or bisexual, were aware of the association.

Similar to the above findings, fewer than 27% of respondents of the present study knew that HPV was a risk factor for anal cancer. This was by far the least understood association between HPV and cancer. This poor knowledge of HPV as a risk factor for anal cancer also was found in the study by Reiter et al. (2010); only 14% of men were aware of this association. Although homosexual men are at an increased risk for anal cancer (Machalek et al., 2012), this should be a concern for heterosexual men and their female partners as well. As mentioned previously, approximately 44% of men in the United States report having had anal sex with a female partner (Chandra et al., 2011).

Together, these findings confirm that while most people have heard of HPV, significant gaps in HPV-related knowledge still exist. Thus, while awareness is a necessary and crucial component of one's understanding of HPV, it does not offer the whole picture. In other words, having a complete understanding of the virus relative to risks and potential consequences is much more likely to influence behaviour than simply knowing that the virus exists. Ongoing educational efforts must address the knowledge

gaps identified in this population - most notably, knowledge of the associations between HPV and cancers of the cervix, oropharynx, and anus. Efforts to educate the population about these HPV-related cancers will be imperative as the incidence of both oropharyngeal and anal cancers continue to rise (Chaturvedi et al., 2011; Jemal et al., 2013)

Oropharyngeal Cancer Awareness. HPV-positive OPC incidence has been rising drastically in developed countries such as Canada and the United States in recent decades (Chaturvedi et al., 2011; Nichols et al., 2013). This trend has prompted organizations such as the United States Centers for Disease Control and Prevention and The World Health Organization to label this trend as an epidemic. Relative to other cancers, HPV-related OPC was a relatively unknown disease up until quite recently. Previous studies have not explicitly investigated public awareness or knowledge of this cancer. However, as incidence rates of HPV-related OPC continue to increase, gaining an understanding of awareness levels and knowledge gaps may be highly valuable for future educational development. Therefore, in an effort to further investigate what young adults know about this particular type of HPV-related cancer, this study explored awareness and knowledge relative to oropharyngeal cancer and its risk factors.

The results of this study found that 77.5% of participants (n=779) had heard of OPC prior to this survey. As a single independent measure, a 77.5% awareness rate in this population could be considered good. Unfortunately, no similar studies or data could be found to compare this finding. As with HPV awareness and knowledge, relatively high awareness levels may not directly translate to high levels of knowledge. Therefore, OPC

knowledge was assessed further in this population in an effort to identify its potential link(s) to awareness.

Oropharyngeal Cancer Knowledge. OPC knowledge was assessed through a series of six "true/false/I don't know" questions. Overall, 791 of the 1005 participants completed the OPC knowledge section of the survey. Of these 791 respondents, over 90% correctly identified smoking tobacco as a risk factor for OPC and additionally that both men and women are susceptible to OPC. However, the remaining four questions of the OPC knowledge section were answered much less accurately. For example, less than half (48.2%) of the present respondents on this section knew that the incidence of OPC is currently rising in Canada. Furthermore, only 39.7% of respondents correctly identified consuming alcohol as a risk factor for OPC.

With respect to OPC and its relation to HPV, 51% of respondents to this section knew that HPV infection was a risk factor for OPC. Similarly, only 48% knew that having a higher number of lifetime oral sexual partners increased the chances of acquiring OPC. There were no differences between male and females with respect to these two questions. Previous studies that have assessed knowledge of oral/oropharyngeal cancer have typically focused on populations of dental or other health professionals and, therefore, no appropriate data are available for comparison to this study's sample (Applebaum, 2009; Cannick, Horowitz, Drury, Reed, & Day, 2005). However, the relatively low level of knowledge relative to OPC and HPV may speak to a general lack of understanding about this type of cancer in the population studied. This conclusion is further supported by the fact that the overwhelming majority (i.e., 86.3%) of participants in this study rated their self-perceived level of knowledge regarding OPC as either

"nothing" or "a little bit". This finding suggests that young adults may be engaging in clearly risky sexual behaviours without the understanding that their behaviour is in fact risky. Further efforts to educate individuals about the simple risk factors related to OPC may be warranted, and should be encouraged, as the incidence of this cancer continues to increase in the coming decades.

HPV Vaccine Awareness. 833 (87.86%) of the 1,005 participants in this study had previously heard of the HPV vaccine (either Gardasil™ or Cervarix™). HPV vaccine awareness was much higher in females (93%) compared to males (75.7%) and this result was expected due to the fact the vaccine has been primarily marketed towards - and provided free of cost - to females only in Ontario since its introduction in 2007. Female HPV vaccine awareness levels were consistent with findings from similar samples of female university students in both Canada and the United States, who had a 91% and 95% vaccine awareness rate, respectively (Krawczyk et al., 2012; Ratanasiripong et al., 2013). Male vaccine awareness in this study was slightly higher than the vaccine awareness level of 63% found by Reiter et al. (2010) in a national sample of American men. The difference in awareness levels between these two studies may be explained by the fact that the HPV vaccine had not yet been approved for use in males at the time when Reiter et al. (2010) collected their data.

Now that the HPV vaccine has been approved for use in males (Centers for Disease Control and Prevention, 2011), and is being routinely administered to males in provinces such as Alberta and Prince Edward Island, further education efforts should focus on increasing awareness and knowledge of the HPV vaccine in males. The possibility of increasing vaccination rates in males presents a significant opportunity to

increase vaccination coverage among the entire population and subsequently, may drastically reduce the prevalence of HPV infection and its resulting morbidities. This may be especially important for men who have sex with men, as these individuals are at an even higher risk for HPV infection and are not protected under female-only vaccination programs. Therefore, increasing both awareness and knowledge levels specific to HPV and the HPV vaccine should be a high priority for educators and health care providers moving forward. This conclusion is supported by a systematic review by Nadarzynski, Smith, Richardson, Jones, & Llewellyn, (2014) which found that MSM who were aware of HPV expressed greater willingness to receive the vaccine.

HPV Vaccine Knowledge. HPV vaccine knowledge was assessed through a series of five "true/false/I don't know" questions. 886 of the 1,005 participants in this study completed the HPV vaccine knowledge section. The relatively high levels of vaccine awareness did not translate to high levels of vaccine knowledge. In fact, vaccine knowledge was quite poor relative to the other knowledge sections of this survey. For example, less than half of respondents (47.7%) knew that men could receive the HPV vaccine. Previous studies have found much greater knowledge relative to this fact. A study of Canadian adult females in Ontario found that 71% of respondents knew that men could receive the HPV vaccine (Sadry, Souza, & Yudin, 2013). Again, increasing the knowledge of this fact and the access to vaccination, especially in males, may provide an opportunity for increased vaccine uptake.

Perhaps the most surprising finding from this research was the observation that only just more than half of respondents (51.5%) to the vaccine knowledge section knew that the vaccine protects against cervical cancer. Furthermore, only 27.3% of the

respondents to this section knew that the vaccine protects against genital warts. These findings were surprising for two reasons: First, both of the HPV vaccines currently in use (Gardasil™ and Cervarix™) were explicitly developed in order to prevent cervical cancer in females. Gardasil™, the more popular of the two vaccines in Ontario, also protects against genital warts. Second, 40.9% of the participants in this study reported having received at least one dose of the HPV vaccine, meaning that at least some participants received the vaccine without knowing why it was administered. These findings suggest a clear distinction between awareness and knowledge about the HPV vaccine. While 87.7% of respondents had previously heard of the vaccine, only 51.5% of these individuals knew the vaccine's main purpose. This lack of knowledge regarding the HPV vaccine may be related to the generally poor knowledge of the consequences of HPV infection. In other words, there may be confusion about the purpose of the HPV vaccine for individuals who do not know the association between HPV and cervical cancer/genital warts. Yet, it is also conceivable that the consequences are known, but that they are disregarded in the context of the commonality of sexual practices in this age group.

One question in this section was, however, answered correctly by a large proportion of respondents; 88.8% of participants correctly noted that once vaccinated, women must still receive regular cervical cancer screening. A similarly high proportion of respondents answered this question correctly in a study by Ragin et al. (2009).

Influence of Demographic Variables

Age. Based on the correlations generated, no relationships between age and awareness or knowledge were identified in the present study.

Year of University Study. Overall, a clear pattern was noted between year of university study and both awareness and knowledge levels or HPV, OPC, and the HPV vaccine. However, correlational analyses revealed weak correlations between year of University Study and knowledge scores.

Program of Study. Comparisons of awareness and knowledge levels between respondents in different programs of study were somewhat difficult to perform given the unequal representation of each faculty in the sample. However, no noteworthy differences were noted in awareness or knowledge of HPV between the programs of study. With respect to HPV vaccine awareness, respondents from the Faculty of Health Sciences and the Faculty of Information & Media Studies had the highest levels (94% and 93%, respectively. This may be due to the fact that the majority of respondents from these faculties were female (84% and 90%, respectively). Participants enrolled in Schulich School of Medicine and Dentistry demonstrated noticeably higher levels of HPV vaccine knowledge, suggesting individuals in this faculty have had a greater exposure to this information within their prior or current education given their potential future plans to work within a medically related area.

Ethnicity. Compared to non-Caucasian respondents, Caucasian individuals demonstrated much higher levels of both awareness and knowledge for all categories. This finding is consistent with previous research by both Sadry et al. (2013) and Joseph et al. (2014) which found significantly higher HPV awareness and knowledge in Caucasian compared to non-Caucasian adult females.

Vaccination Status. Somewhat surprisingly, there were very minimal differences between awareness and knowledge of HPV and the HPV vaccine between people who

have been vaccinated and those who have not. However, individuals who were unsure of their vaccination status had much lower levels of awareness and knowledge.

Gender. As mentioned previously, females had higher levels of both awareness and knowledge for all three categories. Statistical analyses of the data revealed no statistically significant differences in any of the knowledge sub-scores, however, a statistically significant difference between male and female total knowledge scores was identified. These findings were expected given results of previous studies which have shown major differences in knowledge levels of HPV between males and females (Dahlström et al., 2012; Gerend & Magloire, 2008; Gollust et al., 2013).

Implications of the Present Findings

As discussed previously, HPV infection is extremely prevalent in young adults aged 18-30. While the majority of these infections are believed to clear spontaneously with no residual effects, a number of HPV-related infections and subsequent consequences have become increasingly prevalent in recent decades. Furthermore, other HPV-related morbidities such as genital warts also are most prevalent in this age group (Koutsky et al., 1998). Therefore, having an accurate estimate of what this young adult population (age 18-30) knows about HPV, HPV-related cancers, and the HPV vaccine has important implications for educators, policy makers, and health care providers tasked with preventing HPV-related morbidity and mortality.

The findings of the present study have clearly identified both strengths and weaknesses in young adults' understanding of HPV, HPV-related cancers, and the HPV vaccine. More directly, clear knowledge gaps exist in both general awareness related to HPV, as well as more comprehensive knowledge related to its potential health

consequences. Based on the present data, efforts that enable future education programs to build on existing knowledge, while simultaneously seeking to address common misconceptions or unknowns may be enhanced.

Since knowledge is a necessary precursor for health-protective behaviours, including the decision to become vaccinated, addressing these knowledge gaps may enable young adults to make better choices. For example, increasing knowledge of HPV-related morbidities may lead to safer sexual practices among university students. Similarly, increasing vaccine knowledge, especially in males, could lead to higher vaccine coverage rates and decreased HPV prevalence. Furthermore, doing so may provide direct and observable health benefits.

Over 60% of the participants in the current study identified "school" as a source of their HPV information. This finding suggests that the best place to address some of the knowledge gaps identified herein is within the educational "school" setting. The province of Ontario has recently reformed their sexual education curriculum, including discussions of sexually transmitted infections and safe sex practices. Because of this reform, it will be interesting to see how knowledge may be influenced by this change in the years to come. Health care providers also will have an important role to play in further education regarding HPV and the HPV vaccine. In this regard, 31.4% of participants in this study reported a "health care provider" as a personal source of HPV information. Furthermore, previous studies have shown that a health care provider's recommendation is an extremely important factor in many people's decision to receive the HPV vaccine (McRee, Katz, Paskett, & Reiter, 2014; Perkins et al., 2013).

Limitations of the Present Study

As with any research project, limitations of the present study must be acknowledged and considered. First, the sample obtained in this study contained a disproportionately high proportion of females compared to the general population of Western University. This was likely a result of a sampling bias or response bias that favoured students enrolled in the Faculty of Health Sciences where a greater number of females are enrolled. However, given the minimal differences in awareness and knowledge levels observed between individuals from different faculties, the over-representation of Health Sciences students in this sample likely did not change the findings in any meaningful way. Furthermore, while Health Sciences students may be considered more "health-conscious" in general, there is no reason to assume they have better or poorer understanding of HPV, OPC, or the HPV vaccine – or that their experiences with these subjects are any different when compared to other students.

Given that a significant difference in total knowledge scores was found in this study between males and females, the high proportion of female students in this sample relative to the population as a whole may have contributed to some sampling bias, and thus, some skewing of the data. If this did, in fact, effect the data in any way, it would likely result in an overestimation of actual awareness and knowledge levels in this population given that females were found to have higher levels of both compared to males. Two factors are relevant to this limitation; first, the findings of this study were generally in line with previous studies that have assessed knowledge and awareness in samples of university students; and second, the large sample size of 1,005 acquired in this

study may increase confidence that that data obtained are representative of a larger population sample.

An additional limitation of this study is the survey tool utilized for data collection. This measurement tool was designed specifically for this study and the items of the survey were adapted from tools used in previous studies, some of which were validated. While the tool that was developed did undergo a face validity assessment by 10 current university students, the measure itself was not validated. Therefore, issues of reliability and validity need to be considered when interpreting the results of this study.

Finally, the population studied in this research is not representative of the entire population at large. The population of 18-30 year old university students was chosen for this research due to the very high prevalence of HPV infection and potentially risky sexual behaviour in this population. While the sample obtained is believed to be representative of the population in question, the findings of this research cannot be generalized to the population at large (i.e., individuals younger than 18 or over 30 years old).

Thus, despite the considerably large sample obtained herein, the external validity of these data must be considered carefully. Given the increased levels of awareness and knowledge found with increased education level in this study, in addition to previous studies that have reported much lower levels of awareness and knowledge in the population at large (Donahue et al., 2014; Nielsen et al., 2009), awareness and knowledge levels found at present are likely higher than those of the general population.

Nevertheless, despite the limitations noted above, this study does provide valuable insights into the current levels of awareness and knowledge relative to HPV, OPC, and

the HPV vaccine in a large sample of university students. The students in this sample demonstrated good awareness of the topics in question; further, some basic knowledge of HPV, OPC and the HPV vaccine was revealed. However, this study has clearly identified specific knowledge gaps and opportunities for future education. Based on these insights, some directions for future research will be discussed in the subsequent section.

Directions for Future Research

While awareness and knowledge are important considerations when determining what factors lead people to adopt health-protective behaviours, they only comprise two pieces of a larger puzzle. For example, further research might address how demographic factors such as ethnicity or gender may influence behaviour, including the decision to receive the HPV vaccine. Further research is also needed to determine the psychosocial and contextual factors that influence awareness and knowledge of HPV, OPC, and the HPV vaccine. This work should include an attempt to identify barriers and facilitators (both real and perceived) of safe sexual behaviours and vaccination decisions. This may be of particular importance to those who are sexually active, including university aged young adults. Future work also may benefit from building on work by Fisher (2012), Ratanasiripong et al. (2013), and others who have utilized health behaviour theories to understand HPV vaccination uptake, or the lack thereof, in young adults.

Finally, strategies to address expanded educational programs and knowledge gaps identified by this research will need to be developed. Questions such as when to provide education, to whom, and in what setting will need to be addressed. Most importantly, opportunities to translate this education into behavioural action will need to be

implemented. Nevertheless, this issue of "*how"* educational opportunities can be translated into behavioural actions will also need to be determined.

Summary and Conclusions

This research investigated young adults' awareness and knowledge of HPV, OPC, and the HPV vaccine. Based on the data gathered from this research study, several conclusions may be made. First, clear and significant gaps in knowledge of HPV, OPC and the HPV vaccine exist in this population. More explicitly, this research showed poor understanding of the potential consequences of HPV infection. Most notably, the young adults in this sample were largely unaware of the association between HPV and cancers of the anus and oropharynx. This knowledge gap will need to be addressed, especially if the incidence of these two types of cancers continues to increase steadily, as has been observed and documented in recent decades.

Second, males in particular seem to have less awareness and knowledge relative to the topics addressed in this study. This may be a result of previous HPV and HPV vaccine information that has been primarily directed towards females. Ongoing efforts to increase awareness and knowledge in the entire population should pay particular attention to males, given that HPV-related cancers are increasingly prevalent in males.

Finally, this study did find that most individuals had awareness and at least a basic understanding of HPV. The knowledge strengths identified by this study may provide a starting point for future educational efforts. Educational efforts that increase awareness and knowledge of HPV, HPV-related morbidities, and the HPV vaccine may ultimately lead to direct health benefits in the population at large.

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APPENDIX A

Western Research

Research Ethics

Western University Health Science Research Ethics Board
HSREB Delegated Initial Approval Notice

Principal Investigator: Dr. Philip Doyle
Department & Institution: Health Sciences\Communication Sciences & Disorders,Western University

HSREB File Number: 105733
Study Title: Awareness and Knowledge of Human Papillomavirus-Related Cancer In Young Adults
Sponsor:

HSREB Initial Approval Date: October 06, 2014
HSREB Expiry Date: September 30, 2015

Documents Approved and/or Received for Information:

Document Name	Comments	Version Date
Western University Protocol		2014/09/19
Recruitment Items	OWL announcement	2014/09/19
Instruments	Survey	2014/09/19
Recruitment Items	In-class announcement	2014/09/19
Recruitment Items	Information letter and accompanying verbal description	2014/09/19
Letter of Information & Consent		2014/09/19

The Western University Health Science Research Ethics Board (HSREB) has reviewed and approved the above named study, as of the HSREB Initial Approval Datenoted above.

HSREB approval for this study remains valid until the HSREB Expiry Date noted above, conditional to timely submission and acceptance of HSREB ContinuingEthics Review. If an Updated Approval Notice is required prior to the HSREB Expiry Date, the Principal Investigator is responsible for completing andsubmitting an HSREB Updated Approval Form in a timely fashion.

The Western University HSREB operates in compliance with the Tri-Council Policy Statement Ethical Conduct for Research Involving Humans (TCPS2), theInternational Conference on Harmonization of Technical Requirements for Registration of Pharmaceuticals for Human Use Guideline for Good Clinical PracticePractices (ICH E6 R1), the Ontario Personal Health Information Protection Act (PHIPA, 2004), Part 4 of the Natural Health Product Regulations, Health CanadaMedical Device Regulations and Part C, Division 5, of the Food and Drug Regulations of Health Canada.

Members of the HSREB who are named as Investigators in research studies do not participate in discussions related to, nor vote on such studies when theyare presented to the REB.

The HSREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000940.

Ethics Officer (on behalf of Dr. Marcelo Kremenchutzky, HSREB Vice Chair

Ethics Officer to Contact for Further Information

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APPENDIX B

Laboratory for Well-Being and Quality of Life in Oncology
School of Communication Sciences and Disorders
Western University

Letter of Information

Project Title: "Awareness and Knowledge of Human Papillomavirus-Related Oropharyngeal Cancer In Young Adults"

Investigators:
Philip C. Doyle, Ph.D., Principle investigator – Laboratory for Well-Being and Quality of Life in Oncology, Rehabilitation Sciences, Western University
Eric Davis, BHSc., Co-investigator – Laboratory for Well-Being and Quality of Life in Oncology, Rehabilitation Sciences, Western University

Purpose of the Study
The purpose of this study is to assess the current level of knowledge and awareness of the Human Papillomavirus (HPV) in university-aged young adults.

Activities You Will Participate In
If you agree to participate, you will be asked to complete a short online survey. This survey takes approximately 10 minutes to complete. The survey will ask you to provide demographic information such as your age, gender, race, program of study, year of study, and HPV vaccination status. You will then be asked to answer 30 true/false/I don't know questions that will explore your knowledge of HPV, the HPV vaccine, and cancers commonly caused by HPV. If you do not know the correct answer to a question, please select the "I don't know" option. You will also be asked 3 "yes or no" questions relating to your experience with HPV. No personal identifiers will be collected in this survey and your responses will be kept completely anonymous.

Voluntary Participation
Participation in this study is entirely voluntary. You may refuse to participate, refuse to answer any question, or exit the survey at any time. There are no known risks associated with participation in this study. Furthermore, refusal to participate or withdrawal from the study at any time will in no way influence your status as a student at UWO.

Compensation
On the final page of this survey there is a link to a separate website where you may enter your name into a draw for a $50 gift card to the UWO bookstore. Entry into this draw is not dependent on the completion of the survey. You may choose to not answer 1 or more questions of the survey and still be eligible for the draw. Simply navigate to the last page of the survey by clicking "next page" until you arrive to find the link to the draw website.

Confidentiality

All data obtained will remain confidential. Furthermore, your survey responses will contain no personally identifiable information. Therefore, your identity will remain completely anonymous.

Please note that the surveymonkey.com servers are located in the United States and are therefore subject to the laws of the United States of America Patriot Act. For more information about the USA Patriot Act, please follow this link: http://www.justice.gov/archive/ll/highlights.html

Should you have any questions about the study, you can contact Dr. Philip Doyle at 519-661-2111, ext. 88942. Or via email at pdoyle@uwo.ca.

Consent

By clicking on the web link below, you are acknowledging that you have read and agreed to the conditions of this study. By completing the survey, you are consenting to participation in this study; and as such, your survey responses will be entered into a database and used as data for this study.

Please click here to begin the survey:

https://www.surveymonkey.com/s/HPVawareness

APPENDIX C

Study Questionnaire

Demographics

1) What is your age in years and the closest number of additional months (e.g., 20 years, 7 months)? _____ Yrs, _____Mths

2) What gender do you identify with? Male Female Other

3) What race/ethnicity do you identify with?

- Caucasian (white)
- Chinese
- South Asian (East Indian, Pakistani, Sri Lankan, etc.)
- Black
- Filipino
- Aboriginal
- Latin American
- Southeast Asian (Vietnamese, Cambodian, Malaysian, Laotian, etc.)
- Arab
- West Asian
- Korean
- Japanese
- Other (please specify) _____

4) Please identify your current level of education

- 1st year undergrad student
- 2nd year undergrad student
- 3rd year undergrad student
- 4th year undergrad student
- 5th year undergrad student
- Graduate Student
- Other (please specify) _____

5) In which faculty are you enrolled?

- Arts and Humanities
- Business
- Dentistry
- Education
- Engineering
- Health Sciences

- Information and Media Studies
- Law
- Schulich School of Medicine and Dentistry
- Music
- Science
- Social Science

6) Have you received one or more doses of the Human Papillomavirus (HPV) vaccination?

- Yes, one dose
- Yes, two doses
- Yes, three doses
- No

7) Where did you obtain your knowledge of HPV?

- Family members
- School
- Friends
- A doctor or nurse
- The internet
- The media (television, radio, movies, etc.)
- Other (please specify) _____

HPV Awareness

8) Prior to this survey, have you ever heard of the Human Papillomavirus (HPV)?[2]
Yes No

General Question on HPV

9) On a scale of 1-5 (with 1 being 'not concerned at all' and 5 being 'extremely concerned', how concerned are you about becoming infected with HPV?[4]

Not concerned at all				Extremely concerned
1	2	3	4	5

10) On a scale of 1-5 (with 1 being 'nothing' and 5 being 'very much/expert'), how much would you say you know about HPV?

Nothing		A moderate amount		Very much/Expert
1	2	3	4	5

HPV Knowledge

11) HPV is a sexually transmitted infection[1,3] (T) True False I don't know

12) HPV infection is rare in Canada[3] (F) True False I don't know

13) A person could have HPV for many years without knowing it[3] (T)
True False I don't know

14) Men cannot get HPV[1,3] (F) True False I don't know

15) There are many different types of HPV[3] (T) True False I don't know

16) HPV is the main cause of cervical cancer[1,2,3] (T) True False I don't know

17) HPV infection can cause oropharyngeal (mouth and throat) cancer[2] (T)
True False I don't know

18) HPV infection can cause genital warts[1,3] (T) True False I don't know

19) HPV infection can cause HIV/AIDS[3] (F) True False I don't know

20) HPV usually does not need any treatment[3] (T) True False I don't know

21) HPV infection can cause anal cancer[2] (T) True False I don't know

HPV Risk Factors

22) Having a higher number of sexual partners increases the risk of contracting HPV[2.3] (T)
True False I don't know

23) One can become infected with HPV by having unprotected oral sex[1,2] (T)
True False I don't know

24) Using condoms during intercourse completely protects one from becoming infected with HPV[1,2,3] (F)
True False I don't know

25) One can become infected with HPV by having unprotected anal sex[1,2] (T)
True False I don't know

26) Having sex at an earlier age increases the risk get getting HPV[3] (T)

True False I don't know

27) Using an oral contraceptive (the birth control pill) protects me from becoming infected with HPV[2] (F)

True False I don't know

Oropharyngeal Cancer Awareness

28) Prior to this survey, have you ever heard of oropharyngeal cancers (cancer of the throat, base of tongue, soft palate, and/or the tonsils)?[2]

YES NO

General oropharyngeal cancer questions

29) On a scale of 1-5 (with 1 being 'not concerned at all' and 5 being 'extremely concerned'), how concerned are you about getting oropharyngeal cancer?[4]

Not concerned at all				Extremely concerned
1	2	3	4	5

30) On a scale of 1-5 (with 1 being 'nothing' and 5 being 'very much/expert'), how much would you say you know about oropharyngeal cancer?

Nothing		A moderate amount		Very much/Expert
1	2	3	4	5

Oropharyngeal Cancer Knowledge

31) Both men and women can get oropharyngeal cancer[5] (T)

True False I don't know

32) The number of new cases of oropharyngeal cancer in Canada is increasing[6] (T)

True False I don't know

33)Smoking tobacco increases the risk for getting oropharyngeal cancer[5] (T)

True False I don't know

34) Having a high number of lifetime oral sex partners increases the risk for getting oropharyngeal cancer[5] (T) True False I don't know

35) Drinking alcohol increases the risk of getting oropharyngeal cancer[5] (T)

True False I don't know

36) Having an HPV infection increases the risk of getting oropharyngeal cancer[2,5] (T)

True False I don't know

HPV Vaccine Awareness

37) Prior to this survey, have you ever heard of the HPV vaccine (brand names Gardasil© or Cervarix©)[2]

YES NO

HPV Vaccine Knowledge

38) Men cannot obtain the HPV vaccine[7] (F)

True False I don't know

39) The HPV vaccine protects against cervical cancer[2,7] (T)

True False I don't know

40) The HPV vaccine protects against genital warts[7] (T)

True False I don't know

41) The HPV vaccine protects against oropharyngeal cancer[2] (T)

True False I don't know

42) Once vaccinated, women no longer have to receive regular cervical cancer screening (pap smears)[7] (F)

True False I don't know

The items of this questionnaire were based on information from, or adopted directly from, the following publications:

[1] Questions from Ramirez, J. E., Ramos, D. M., Clayton, L., Kanowitz, S., Moscicki, a B. (1997). Genital human papillomavirus infections: knowledge, perception of risk, and actual risk in a nonclinic population of young women. Journal of Women's Health, 6(1), 113–21.

[2] Questions adapted from Pelullo, C. P., Di Giuseppe, G., & Angelillo, I. F. (2012). Human papillomavirus infection: knowledge, attitudes, and behaviors among lesbian, gay men, and bisexual in Italy. PloS One, 7(8), e42856.

[3] Questions adapted from Bowyer, H. L., Marlow, L. a V, Hibbitts, S., Pollock, K. G., & Waller, J. (2013). Knowledge and awareness of HPV and the HPV vaccine among young women in the first routinely vaccinated cohort in England. Vaccine, 31(7), 1051–6. doi:10.1016/j.vaccine.2012.12.038

[4] Question adapted from Gerend, M. a, & Magloire, Z. F. (2008). Awareness, knowledge, and beliefs about human papillomavirus in a racially diverse sample of young adults. The Journal of Adolescent Health, 42(3), 237–42.

[5] Questions were developed based on OPC risk factors identified by Gillison, M. L., D'Souza, G., Westra, W., Sugar, E., Xiao, W., Begum, S., & Viscidi, R. (2008). Distinct risk factor profiles for human papillomavirus type 16-positive and human papillomavirus type 16-negative head and neck cancers. Journal of the National Cancer Institute, 100(6), 407–20.

[6] Question was developed based on data from Nichols, A. C., Palma, D. A., Dhaliwal, S. S., Tan, S., Theuer, J., Chow, W., … Barrett, J. W. (2013). The epidemic of human papillomavirus and oropharyngeal cancer in a Canadian population. Current Oncology (Toronto, Ont.), 20(4), 212–9.

[7] Questions adapted from Ragin, C. C., Edwards, R. P., Jones, J., Thurman, N. E., Hagan, K. L., Jones, E. a, … Taioli, E. (2009). Knowledge about human papillomavirus and the HPV vaccine--a survey of the general population. Infectious Agents and Cancer, 4 (1), S10.

APPENDIX D

FULL-TIME CONSTITUENT ENROLMENT 2014-15
by Faculty and Gender

UNDERGRADUATES

	1st Year			All Years		
	Male	**Female**	**Total**	**Male**	**Female**	**Total**
Arts & Humanities	61	206	267	282	839	1,121
Business				669	431	1,100
Dentistry				143	119	262
Education				201	456	657
Engineering	422	89	511	1,239	307	1,546
Health Sciences	278	586	864	920	2,318	3,238
Information & Media Studies	59	277	336	186	738	924
Law				252	234	486
Medicine				873	702	1,575
Music	40	59	99	184	273	457
Science	645	829	1,474	2,250	2,356	4,606
Social Science	790	870	1,660	2,978	3,623	6,601
TOTAL	**2,295**	**2,916**	**5,211**	**10,177**	**12,396**	**22,573**

GRADUATE STUDENTS

	Masters			PhD		
	Male	**Female**	**Total**	**Male**	**Female**	**Total**
Arts & Humanities	38	77	115	125	131	256
Business	254	111	365	30	23	53
Dentistry	5	4	9	0	0	0
Education	71	309	380	37	119	156
Engineering	256	112	368	240	65	305
Health Sciences	165	396	561	54	152	206
Information & Media Studies	40	135	175	34	27	61
Interdisciplinary Studies	63	85	148	60	29	89
Law	4	5	9	1	3	4
Medicine	151	180	331	111	94	205
Music	30	66	96	14	23	37
Science	182	149	331	235	159	394
Social Science	106	152	258	149	160	309
TOTAL	**1,365**	**1,781**	**3,146**	**1,090**	**985**	**2,075**

CONCURRENT PROGRAM STUDENTS

	Undergraduate			Graduate		
	Male	**Female**	**Total**	**Male**	**Female**	**Total**
Business/BA	3	4	7	0	0	0
Business/BHSc	4	7	11	0	0	0
Business/BMedSci	11	12	23	0	0	0
Business/BSc	14	11	25	0	0	0
Business/Engineering	48	15	63	0	0	0
Business/Law	15	17	32	2	1	3
Business/MIT	2	2	4	0	0	0
Business/SocSci	18	9	27	0	0	0
Law/MIT	0	2	2	0	0	0
Law/Sci	0	0	0	2	0	2
Law/SocSci	1	0	1	1	0	1
TOTAL	**116**	**79**	**195**	**5**	**1**	**6**

Eric N. Davis

Education

2013-2015	Masters of Science, Rehabilitation Sciences
2009-2013	Bachelor of Health Science, Honours Specialization in Rehabilitation Sciences

Employment

2015	**Teaching Assistant** CSD 4439B – Language Acquisition Western University
2014	**Teaching Assistant** HS 3300A, KIN 3222A – Anatomy of the Human Body Western University
2014	**Teaching Assistant** HS 2300B, KIN 2222B – Systemic Approach to Functional Anatomy Western University
2013	**Teaching Assistant** HS 3300A, KIN 3222A – Anatomy of the Human Body Western University
2013	**Research Assistant** Lawson Health Research Institute, Spinal Cord Research Department, Parkwood Institute London, Ontario, Canada
2012-2015	**Research Associate** The Laboratory for Well-Being and Quality of Life in Oncology & The Voice Production and Perception Laboratory, Rehabilitation Sciences Western University

Awards and Achievements

2015	Meritorious Poster Submission Award, American Speech-Language-Hearing Convention
2015	Best Oral Presentation, Health and Rehabilitation Sciences Graduate Research Conference
2014	Western Graduate Research Scholarship
2014	Health and Rehabilitation Sciences Graduate Student Travel Award (x2)
2014	Faculty of Health Sciences Graduate Student Travel Award (x2)
2013	Western Graduate Research Scholarship
2013	Faculty of Health Sciences Dean's Honour List
2012	Faculty of Health Sciences Dean's Honor List

Scholarly and Professional Activities

2015	Attendee, The International Association of Laryngectomees Annual Meeting
2014	Executive Member, Health & Rehabilitation Sciences Research Forum Committee
2014	Attendee, The International Association of Laryngectomees Annual Meeting
2013-2015	Rehabilitation Sciences Journal Club, Student Member
2013-2015	Member, Society of Graduate Students, Western University
2012	Student Transitional Executive Program, Western University
2012	Leadership Education Program Tier I and II, Western University

Publications and Presentations

Publications (Peer-Reviewed) (1)

Yeung, J. C., Fung, K., **Davis, E.,** Rai, S. K., Day, A. M. B., Dzioba, A., … Doyle, P. C. (2015). Longitudinal variations of laryngeal overpressure and voice-related quality of life in spasmodic dysphonia. *The Laryngoscope*, *125*(3), 661–666. doi:10.1002/lary.24953

Poster Presentations (6)

Doyle, P.C., **Davis, E.** Self-Assessment of Airway & Breathing Issues Following Total Laryngectomy. American Speech-Language-Hearing Association Annual Convention, Denver, CO, November 12-14, 2015. **Presenting author**

Doyle, P.C., **Davis, E.,** Cox, S., Tsui, T., Day, A.M.B., Bornbaum, C., Dzioba, A. Using The Voice-Related Quality of Life Questionnaire to Examine Voice Disability Following Total Laryngectomy. American Speech-Language-Hearing Association Annual Convention, Denver, CO, November 12-14, 2015. **Presenting author**

Davis, E., Yeung, J., Fung, K., Doyle, P.C. Longitudinal Auditory-Perceptual Evaluation of Laryngeal Overpressure & Voice-Related Quality of Life in Adductor Spasmodic Dysphonia. American Speech-Language-Hearing Association Annual Convention, Orlando, FL, November 20-22, 2014. **Presenting author**

Doyle, P.C., **Davis, E.,** Fung, K. Evaluating the Psychophysical Properties of Laryngeal Overpressure in Adductor Spasmodic Dysphonia. American Speech-Language-Hearing Association Annual Convention, Orlando, FL, November 20-22, 2014. **Presenting author**

Doyle, P.C., Nash, M. M., Scott, G. M., Cox, S. R., **Davis, E.,** Izaryk, K., Bornbaum, C. C., Day, A. M. B., Dzioba, A., Skarakis-Doyle, E. Aligning the Voice-Related Quality of Life Measure with the ICF: An Examination of Voice Disability Secondary to Laryngeal

Cancer, Pacific Rim International Conference on Disability and Diversity, Honolulu, HI, May 19-20, 2014. **Presenting author**

Doyle, P.C., Dzioba, A., Cox, S., Brandt, M.G., Caty, ME., Nash, M., Scott, G.M., **Davis, E.**, Jackman, K., Wilkinson, J., Theurer,. Two labs, one shared passion: Partners in cancer-related health, well-being, and quality of life. Faculty of Health Sciences Research Day, Western University, London, On, March 25, 2014. **Presenting author**

Oral Presentations (2)

Davis, E., Doyle, P.C. Awareness and Knowledge of Human Papillomavirus-Related Cancer in Young Adults. Health and Rehabilitation Sciences Research Forum, Western University, London, On, February 4, 2015. **Presenting author**

Davis, E., Fung, K., Doyle, P.C. Voice Severity and Vocal Over-Pressure in Adductor Spasmodic Dysphonia (ADSD): Psychophysical Scaling Considerations. Health and Rehabilitation Sciences Research Forum, Western University, London, On, February 5, 2014. **Presenting author**

Publications Under Review (1)

Lee, J.Y., Ready, E.A., **Davis, E.**, Doyle, P.C. Purposefulness as a Critical Factor in Functioning, Disability and Health.

Other Professional Contributions

Bartlett D, Skarakis-Doyle E and members of the Rehabilitation Sciences Journal Club, Health and Rehabilitation Sciences Program at Western (Cox S.R., **Davis E,** Gregory M, Hope A, Izaryk K, Jeevanantham D, Kogutek D, Lee J, Lutz S, Ready E, and Doyle P). (2014). Response to the World Health Organization's request for comments on the document: How to Use the ICF: A Practical Manual for using the International Classification of Functioning, Disability and Health, October 2013. **Co-author**