

## RESEARCH ARTICLE

# Human Papillomavirus Vaccination Acceptability among Female University Students in South Africa

Muhammad Ehsanul Hoque<sup>1\*</sup>, Shanaz Ghuman<sup>2</sup>, Guido Van Hal<sup>3</sup>

### Abstract

**Background:** The objectives of this present study were to assess the awareness of cervical cancer and its risk factors among female undergraduates in South Africa, and to determine the their level of acceptability of Human Papillomavirus (HPV) vaccination. **Materials and Methods:** This cross-sectional study was conducted in March 2013 among 440 full time undergraduate female students. **Results:** Of those students who never had sex (n=163), 96 (58.9%) had ever heard of cervical cancer and only 12 students (12.5%) knew that HPV causes cervical cancer. More than a third (35.4%) of the students correctly said that sexual intercourse before age of 18 years is a risk factor for cervical cancer and 55.2% of the students knew about the Pap smear test which is used for screening cervical cancer. The majority (77.3%) were willing to accept HPV vaccination. Results revealed that students who knew about the Pap smear test, and were aware that having multiple sex partners, sexual intercourse before the age of 18 years, smoking and having contracted any STDs are risk factors for cervical cancer were more likely to accept HPV vaccination compared to other groups. **Conclusions:** The general knowledge of South African female university students about cervical cancer is not sufficient but they have positive attitudes toward getting vaccinated with the HPV vaccine.

**Keywords:** Cervical cancer - HPV vaccination - acceptability - university student - South Africa

*Asian Pac J Cancer Prev*, 14 (8), 4865-4869

### Introduction

Human papillomavirus (HPV) infection is the most prevalent sexually transmitted disease (STD) in the world (Denny et al., 2012). It affects 80-90% of the sexually active young women but only 3-4% of them will develop cervical cancer (Nobbenhuis et al., 2001; Schiffman et al., 2007). Nevertheless, HPV infection is the main cause of cervical cancer. The high risk HPV types 16 and 18, contribute to about 70% of cervical cancer cases (Smith et al., 2008; Seoud, 2011). Clinical trial studies have demonstrated that two vaccines (Gardasil<sup>®</sup> and Cervarix<sup>®</sup>) have almost 100% efficacy in preventing persistent infection and the development of precancerous lesions caused by HPV16 and HPV18 (Kohli et al., 2007; Paavonen et al., 2009; Lehtinen et al., 2012; Schiffman and Wacholder, 2012).

Primary prevention through HPV vaccination seems to be a promising tool to prevent cervical cancer (Schiffman and Castle, 2007; Muñoz and Jacquard, 2008; Hershey and Velez, 2009). Many studies indicate that HPV vaccines are safe and that it reduces nearly 70% the probability to develop cervical cancer (Goldie et al., 2008; Hopkins and Wood, 2013). Other studies reported that comprehensive vaccination programmes could result in up to a 76% reduction in cervical cancer-related deaths (Kohli et al.,

2007). If vaccine coverage falls to 80%, only 60% of cancer deaths would be prevented. It is estimated that 70% coverage would be sufficient to achieve reductions in lifetime risk of cervical cancer of between 31.1-60.1% in the poorest countries (Goldie et al., 2008). Many countries have already introduced HPV vaccination into their health-care systems (Mortensen, 2010).

Cervical cancer is the second common cancer after breast cancer in South Africa (SA). Every year, over 3,000 women die from cervical cancer. This figure will increase to almost 4,200 in the year 2025. The age-standardised incidence rate of cervical cancer in SA is 22.8 per 100,000 population (HPV Information Centre, 2010). There is a significant disparity in reported rates. For example, among black women it is 42.1 per 100,000 whereas among white women it is 14.5 per 100,000 population. This disparity may be partly related to unequal access to healthcare, differences in socio-economic status and exposure to HPV and HIV infection (Mqoqi et al., 2004). It is reported that 21.0% of women in the general population are estimated to harbor cervical HPV infection at any given time in SA and 62.8% of invasive cervical cancers are attributed to HPVs 16 or 18 (HPV Information Centre, 2010). The incidence of cervical cancer is unacceptably high and most cases of invasive carcinoma present late with a high case-fatality (Bothaa and Dochez, 2012).

<sup>1</sup>Graduate School of Business and Leadership, University of KwaZulu-Natal, <sup>2</sup>Department of Community Health Studies, Durban University of Technology, South Africa, <sup>3</sup>Medical Sociology and Health Policy, University of Antwerp, Belgium \*For correspondence: hoque@ukzn.ac.za, muhammad.ehsanul@gmail.com

In South Africa, the two vaccines (Gardasil® and Cervarix®) are registered but are not freely available. These vaccines are given as intramuscular injection in a three dose schedule: 0, 1 and 6 months for the Cervarix vaccine and 0, 2 and 6 months for the Gardasil vaccine (WHO, 2009). The effectiveness of vaccination programs against HPV will largely depend on how different population groups have been oriented. To our knowledge, no study has reported on the attitude towards HPV vaccines in SA. Although the current target population for HPV vaccination in developing countries is 10-14 year-old girls, female university students constitute an interesting significant group of women. They are better educated than the general population. Being an easily accessible group, their attitude towards the vaccine could provide insight into the acceptability of the vaccine among the most educated women in SA. Therefore the objectives of this study are: *i*) to assess the awareness of cervical cancer and its risk factors among female undergraduates in SA, and *ii*) to determine the level of acceptability of HPV vaccination among these students.

## Materials and Methods

### Study design, sampling, and data collection

This was a descriptive cross-sectional study carried out in March 2013 among full time undergraduate female students. The sample size was calculated using a formula for a finite population. We assumed that university students' acceptability of HPV vaccination be 50%, since we do not have foreknowledge and therefore take the worst case scenario, a sample of 440 students was selected by stratified random sampling techniques with 95% confidence and 5% reliability. Multi-stage sampling technique was employed to select the samples. Firstly, faculties of the university were considered as strata. Secondly, from each faculty, numbers of students were selected using probability proportional to sampling method. The study was conducted by means of a questionnaire survey. The questionnaire included questions on behavioural profile, knowledge on cervical cancer and its prevention method, awareness of HPV vaccination and acceptability to be vaccinated themselves. The questionnaires were translated into isiZulu by an isiZulu expert from the university's language center. Questions were simple and concise.

The research assistant explained the aims and proposed method of research to the female students before being asked for consent and to fill in the questionnaire. The questionnaires were self-administered and anonymous. Only those who voluntarily consented to complete the form were part of the study.

Ethical permission for the study was obtained from the Ethics Committee of the Faculty of Natural Sciences Research and Publications Committee of Mangosuthu University of Technology.

### Data analysis

Data were entered into a Microsoft Excel 2003 spreadsheet and imported to SPSS 21.0. for window version for analysis. The analysis results of participants' demographics outcome variables were summarised using descriptive summary measures: expressed as mean (standard deviation) for continuous variables and percent for categorical variables. The chi-square test was used to find an association between categorical variables. Binary logistical regression was carried out to find the significant predictors for acceptability of HPV vaccination. All statistical tests were performed using two-sided tests at the 0.05 level of significance. For all regression models, the results were expressed as effect (or odds ratios for binary outcomes), corresponding two-sided 95% confidence intervals and associated p values. The p values were reported to three decimal places with values lower than 0.001 reported as <0.001.

## Results

A total of 440 students completed the questionnaire in full, resulting in a response rate of 97.78%. Average age of the students was 20.39 years (SD=1.71 years). Only three students were married and the rest were single. At the time of the study, 63% (n=277) of the students were sexually experienced. Of these, 214 (77.3%) were sexually active in the preceding 12 months. The average age of sexual debut was 18.20±1.78 years. The majority of the sexually experienced students (79.4%) had only one partner. The remaining students (n=44) had between two and five sex partners. Regarding condom use, ten students (4.7%) never used condoms whereas 42.5% always used condoms and the rest (52.8%) used condom inconsistently.

Regarding awareness of HPV and cervical cancer,

**Table 1. Awareness of HPV and Cervical Cancer among Female University Students**

	Year of Study		Total	X <sup>2</sup>	p value
	1	2-3			
Ever heard of Cervical Cancer	50 (57.5)	46 (60.65)	96 (58.9)	0.156	0.693
Cervical cancer is transmitted by Sexual intercourse	28 (56.0)	19 (41.3)	47 (49.0)	2.071	0.15
Cervical Cancer and pre-cancer are associated with HPV	6 (12.0)	6 (13.0)	12 (12.5)	0.024	0.877
Cervical cancer can be screened by Pap test	27 (54.0)	26 (56.5)	53 (55.2)	0.062	0.804
Multiple sex partners are a risk factor for cervical cancer	42 (84.0)	18 (39.1)	60 (62.5)	20.58	<0.001
Having genital warts are a risk factor for cervical cancer	21 (42.0)	15 (32.6)	36 (37.5)	0.902	0.342
Sexual intercourse before age 18 is a risk factor for cervical cancer	18 (36.0)	16 (34.8)	34 (35.4)	0.016	0.901
Having contracted any STDs is a risk factor for cervical cancer	29 (58.0)	15 (32.6)	44 (45.8)	6.222	0.013
Smoking cigarettes is a risk factor for cervical cancer	11 (22.0)	18 (39.1)	29 (30.2)	3.335	0.068
Use of oral contraceptives is a risk factor for cervical cancer	6 (12.0)	9 (19.6)	15 (15.6)	1.04	0.304
Family history of cervical cancer is a risk factor for cervical cancer	19 (38.0)	16 (34.8)	35 (36.5)	0.107	0.744
Multi parity is a risk factor for cervical cancer	12 (24.0)	5 (10.9)	17 (17.7)	2.835	0.092

**Table 2. Acceptance of HPV Vaccination among Female University Students in South Africa Who never had Sex**

Variables		Will accept HPV vaccination		Total	X <sup>2</sup>	p value
		No	Yes			
Age Group (years)	≤ 20	14 (11.7%)	106 (88.3%)	120 (100.0%)	28.697	<0.001
	≥ 21	22 (51.2%)	21 (48.8%)	43 (100.0%)		
Ever heard of Cervical Cancer	No	13 (19.4%)	54 (80.6%)	67 (100.0%)	0.476	0.49
	Yes	23 (24.0%)	73 (76.0%)	96 (100.0%)		
Family members ever diagnosed with HPV or CC	No	21 (22.3%)	73 (77.7%)	94 (100.0%)	6.483	<0.001*
	Yes	2 (100.0%)	0 (0.0%)	2 (100.0%)		
Cervical Cancer and pre-cancer are associated with HPV	No	21 (25.0%)	63 (75.0%)	84 (100.0%)	0.4	0.527
	Yes	2 (16.7%)	10 (83.3%)	12 (100.0%)		
Cervical cancer can be screened by Pap Test	False	14 (32.6%)	29 (67.4%)	43 (100.0%)	3.162	0.075
	True	9 (17.0%)	44 (83.0%)	53 (100.0%)		
Cervical cancer is transmitted by sexual intercourse	False	12 (24.5%)	37 (75.5%)	49 (100.0%)	0.016	0.901
	True	11 (23.4%)	36 (76.6%)	47 (100.0%)		
Multiple sex partners is a risk factor for cervical cancer	False	13 (36.1%)	23 (63.9%)	36 (100.0%)	4.669	0.031
	True	10 (16.7%)	50 (83.3%)	60 (100.0%)		
Having genital warts is a risk factor for cervical cancer	False	14 (23.3%)	46 (76.7%)	60 (100.0%)	0.034	0.853
	True	9 (25.0%)	27 (75.0%)	36 (100.0%)		
Sexual intercourse before age 18 years is a risk factor	False	18 (29.0%)	44 (71.0%)	62 (100.0%)	2.474	0.116
	True	5 (14.7%)	29 (85.3%)	34 (100.0%)		
Having contracted any STDs is a risk factor for cervical cancer	False	9 (17.3%)	43 (82.7%)	52 (100.0%)	2.754	0.097
	Correct	14 (31.8%)	30 (68.2%)	44 (100.0%)		
Smoking cigarettes is a risk factor for cervical cancer	No	19 (28.4%)	48 (71.6%)	67 (100.0%)	2.357	0.125
	Yes	4 (13.8%)	25 (86.2%)	29 (100.0%)		
Family history is a risk factor for cervical cancer	No	13 (21.3%)	48 (78.7%)	61 (100.0%)	0.643	0.422
	Yes	10 (28.6%)	25 (71.4%)	35 (100.0%)		
Multi parity is a risk factor for cervical cancer	No	17 (21.5%)	62 (78.5%)	79 (100.0%)	1.457	0.227
	Yes	6 (35.3%)	11 (64.7%)	17 (100.0%)		

\*McNemar Test

**Table 3. Predictors for Willingness to be Vaccinated Against HPV Vaccination**

Independent Variables		Odds Ratio (OR)	95% C.I. for OR		p value
			Lower	Upper	
Age group	≤20*	1			
	≥21	0.024	0.004	0.162	<0.001
Cervical cancer can be screened by Pap test	No*	1			
	Yes	5.097	1.136	22.864	0.033
Knowledge on risk factors for cervical cancer: Multiple sexual partners	No*	1			
	Yes	18.818	2.358	150.152	0.006
Sexual intercourse before the age of 18 years	No*	1			
	Yes	8.794	1.39	55.652	0.021
Having contracted any STD	No*	1			
	Yes	0.022	0.002	0.237	0.002
Smoking is a risk factor for cervical cancer	No*	1			
	Yes	4.801	0.757	30.446	0.096
	Constant	3.796			0.043

\*Reference group. Model Summary: -2 Log likelihood=58.95; Nagelkerke R Square=0.578. \*Variable(s) entered on step 1: age group, cervical cancer can be screened by Pap test, multiple sexual partners as a risk factor for cervical cancer, sexual intercourse before the age of 18 is a risk factor for cervical cancer, having contracted any STD is a risk factor for cervical cancer, smoking is a risk factor for cervical cancer

students who never had sexual intercourse before were first asked if they had ever heard of cervical cancer. Those students, who heard of cervical cancer, were then asked about transmission, risk factors and acceptability of HPV vaccination. Results indicated that of those students who never had sex (n=163), 96 (58.9%) ever heard of cervical cancer. Amongst them 47 (49.0%) knew that cervical cancer is transmitted through sexual intercourse. Only 12 students (12.5%) knew that HPV causes cervical cancer. Significantly more first year students (84.0%) knew about multiple sexual partners and having contracted any STDs are cervical cancer risk factors than second or third year students (39.1%). More than a third (35.4%) of the students said that sexual intercourse before age of 18 years is a risk factor for cervical cancer. Also, 36.5% of the respondents considered cervical cancer to be an

inherited disease. More than half (55.2%) of the students knew about Pap smear test which is used for screening cervical cancer.

#### HPV vaccination acceptance

Of the 163 students who never had sex, 127 (77.3%) were willing to accept HPV vaccination. Reasons for not willing to accept vaccination, included: afraid of injection (78.9%), the vaccine will cause undesirable side effects (15.8%), and afraid of pain (5.3%). Bivariate analysis showed that acceptance was significantly associated with age, any family members being diagnosed with HPV or cervical cancer, and knowing multiple sex partners as a risk factor for cervical cancer (Table 2).

To find the significant predictors for HPV vaccination acceptance, a binary logistic regression model was used.

During model building, we initially included all the variables that were significantly associated as well as those variables that were closely associated ( $p < 0.25$ ) with vaccination acceptance. Table 3 shows that older students were significantly less likely to be vaccinated compared to their younger counterparts. Results also revealed that students who knew about the Pap smear test, knew that having multiple sex partners, sexual intercourse before the age of 18 years, smoking and having contracted any STDs are risk factors for cervical cancer were more likely to accept HPV vaccination compared to other groups (Table 3).

## Discussion

This study is the first investigation regarding acceptability of HPV vaccination among university female students in SA. So, it is an initial step towards more widespread introduction of this vaccine in this population. Currently the HPV vaccine is only available in the private sector. The government's plans for a nationwide vaccination program are still unclear. The present study reported that awareness of cervical cancer and HPV was low. But HPV vaccination acceptability was high.

The awareness of cervical cancer varies among university students from different countries. For example, among Nigerian students, 35.5% were aware of cervical cancer. A high awareness level was reported amongst Polish students who were between 17 and 26 years (98.5%) (Iiyasu et al., 2010; Kamzol et al., 2013). A Dutch study conducted among students between 18 and 25 years old from two university and one non-university technical college found that 94% had heard of cervical carcinoma (Lenselink et al., 2008). The present study found that 58.9% of the students were aware of cervical cancer. This rate is higher than the previous study conducted at the same institution in the year 2008 (42.9%) (Hoque and Hoque, 2009). The increase in awareness could be the result of increased interest in publicity on cervical cancer. It is also important to include this common public health problem into courses undertaken by undergraduates (Aniebue and Aniebue, 2010).

The present study reported that knowledge regarding risk factors for cervical cancer was low among the university students. Very few students knew about HPV that causes cervical cancer. Students considered having multiple sexual partners to be the most important risk factor, followed by having contracted any STDs and family history. An Indian study reported that 15% of the college students were familiar with HPV and 41% knew that sexual activity was associated with cervical cancer (Saha et al., 2011). A Malaysian study conducted among university female students reported that knowledge regarding HPV, HPV vaccination, cervical screening and cervical cancer risk factors was remarkably poor (Wong and Sam, 2010). An Italian study found low awareness of HPV (23%) among university students (Di Giuseppe et al., 2008). Another study conducted among primary or high school students in Hungary found that 35% of the pupils were aware of HPV (Marek et al., 2011). A recent review study concluded that knowledge of both cervical cancer

and HPV vaccination seems to be low among women in low- and middle-income countries (Hopkins and Wood, 2013).

Generally, HPV vaccination acceptability is high among all the population groups in all the countries. Even though knowledge of HPV was very low in our study participants, the majority (77.3%) reported that they would be willing to be vaccinated against HPV. This finding is similar to an Indian study which reported that 75% of the participants were willing to get vaccinated (Saha et al., 2010). Malaysian university students showed relatively low (48%) acceptability of receiving HPV vaccination (Wong and Sam, 2010). Other studies conducted among university students reported between 61% and 84% acceptability of HPV vaccination (Di Giuseppe et al., 2008; Gerend and Magloire, 2008; Lenselink et al., 2008; Iiyasu et al., 2010).

In comparison with other studies, this study found that younger women were more willing to be vaccinated than their older counterparts. An American study reported that women who were younger and smoker were more likely to receive the HPV vaccine (Hopenhayn et al., 2007). In this study, knowledge about Pap smear test, having knowledge of risk factors for cervical cancer such as having multiple sex partners, sexual intercourse before the age of 18 years, smoking, and having contracted any STDs significantly predicted willingness to accept HPV vaccination. This finding is in contrast with other studies where vaccination acceptance was significantly associated with higher number of sexual partners, (Hoover et al., 2000). Other studies concluded that partner's approval, history of gynaecological disease, and one's mother having experienced cancer, increased acceptance of HPV vaccination (Marlow et al., 2007; Hsu et al., 2009; Kwan et al., 2009).

This study has several limitations. Firstly, the choice of the study population. The HPV vaccine is ideally administered to adolescent girls before sexual debut. Our respondents are older, more mature and constitute an elite group. Therefore, their perception about HPV vaccines may differ from those of 10–14-year-olds. On the other hand, our main analysis involved only those students who never had sex before. These limitations necessitate the need for caution in extrapolating our findings to the general population. Nevertheless, our findings underscore the importance of advocacy to this group of people and implementation of effective public health promotion efforts in favour of vaccine introduction to prevent misperceptions from taking hold.

In conclusion, the general knowledge of South African female university students about cervical cancer is not sufficient. In particular, knowledge about the role of HPV infection in the etiology of cervical cancer is inadequate among female students. Findings from this study suggest that University women have positive attitudes toward getting vaccinated against HPV.

This study also suggests that in order to enhance HPV vaccination acceptability, provision of information about HPV infection and its link to cervical cancer is essential, with emphasis on high HPV infection rates, provision of assurance on safety and efficacy of the HPV vaccine, and eliminating stigma associated with STD prevention.

## Acknowledgements

The author wishes to acknowledge the academic board of Mangosuthu University of Technology for supporting to conduct the study. Authors also thank those students who voluntarily participated in this study.

## References

- Aniebue PN, Aniebue UU (2010). Awareness and Practice of Cervical Cancer Screening Among Female Undergraduate Students in a Nigerian University. *J Canc Educ*, **25**, 106-8.
- Bothaa MH, Dochez C (2012). Introducing human papillomavirus vaccines into the health system in South Africa. *Vaccine*, **30**, 28-34.
- Denny LA, Franceschi S, de Sanjosé S, et al (2012). Human Papillomavirus, Human Immunodeficiency Virus and Immunosuppression. *Vaccine*, **30**, 168-74.
- Di Giuseppe G, Abbate R, Liguori G, et al (2008). Human papillomavirus and vaccination: knowledge, attitudes, and behavioural intention in adolescents and young women in Italy. *Br J Cancer*, **99**, 225-9.
- Gerend MA, Magloire ZF (2008). Awareness, knowledge, and beliefs about human papillomavirus in a racially diverse sample of young adults. *J Adolesc Health*, **42**, 237-42.
- Goldie SJ, O'Shea M, Campos NG, et al (2008). Health and economic outcomes of HPV 16,18 vaccination in 72 GAVI-eligible countries. *Vaccine*, **26**, 4080-93.
- Hershey JH, Velez LF (2009). Public health issues related to HPV vaccination. *J Public Health Manag Pract*, **15**, 384-92.
- Hoover DR, Carfioli B, Moench EA (2000). Attitudes of adolescent/young adult women toward human papilloma virus vaccination and clinical trials. *Health Care Women Int*, **21**, 375-91.
- Hopenhayn C, Christian A, Christian WJ, et al (2007). Human papillomavirus vaccine: Knowledge and attitudes in two Appalachian Kentucky counties. *Cancer Causes and Control*, **18**, 627-34.
- Hopkins TG, Wood N (2013). Female human papillomavirus (HPV) vaccination: Global uptake and the impact of attitudes. *Vaccine*, (In Press). Available at: <http://dx.doi.org/10.1016/j.vaccine.2013.01.028>
- Hoque E, Hoque M (2009). Knowledge of and attitude towards cervical cancer among female university students in South Africa. *South Afr J Epidemiol Infect*, **24**, 21-4.
- Hsu YY, Fetzer SJ, Hsu KF, et al (2009). Intention to obtain human papillomavirus vaccination among Taiwanese undergraduate women. *Sex Trans Dis*, **36**, 686-92.
- Iliyasu Z, Abubakar IS, Aliyu MH, et al (2010). Cervical cancer risk perception and predictors of human papilloma virus vaccine acceptance among female university students in northern Nigeria. *J Obstet Gynaecol*, **30**, 857-62.
- Kamzol W, Jaglarz K, Tomaszewski KA, et al (2013). Assessment of knowledge about cervical cancer and its prevention among female students aged 17-26 years. *Eur J Obstet Gynecol Reprod Biol*, **166**, 196-203.
- Kohli M, Ferko N, Martin A, et al (2007). Estimating long-term impact of a prophylactic human papillomavirus 16/18 vaccine on the burden of cervical cancer in the UK. *Br J Cancer*, **96**, 143-50.
- Kwan TT, Chan KK, Yip AM, et al (2009). Acceptability of human papillomavirus vaccination among Chinese women: Concerns and implications. *BJOG*, **116**, 501-10.
- Lehtinen M, Paavonen J, Wheeler CM, et al (2012). Overall efficacy of HPV-16/18 AS04-adjuvanted vaccine against grade 3 or greater cervical intraepithelial neoplasia: 4-year end-of-study analysis of the randomised, double-blind PATRICIA trial. *Lancet Oncol*, **13**, 89-99.
- Lenselink CH, Schmeink CE, Melchers WJG, et al (2008). Young adults and acceptance of the human papillomavirus vaccine. *Public Health*, **122**, 1295-301.
- Marek E, Dergez T, Rebek-Nagy G, et al (2011). Adolescents' awareness of HPV infections and attitudes towards HPV vaccination 3 years following the introduction of the HPV vaccine in Hungary. *Vaccine*, **29**, 8591-8.
- Marlow LAV, Waller J, Wardle J (2007). Parental attitudes to pre-pubertal HPV vaccination. *Vaccine*, **25**, 1945-52.
- Mortensen (2010). Drivers and barriers to acceptance of human-papillomavirus vaccination among young women: a qualitative and quantitative study. *BMC Public Health*, **10**, 68.
- Mqoqi N, Kellett P, Sitas F, Jula M (2004). Incidence of histologically diagnosed cancer in South Africa, 1998-1999. Johannesburg: National Cancer Registry of South Africa, National Health Laboratory Service.
- Muñoz N, Jacquard AC (2008). What should be known for the introduction of an HPV vaccine? [Article in French]. *Presse Med*, **37**, 1377-90.
- Nobbenhuis M, Helmerhorst T, van den Brule A, et al (2001). Cytological regression and clearance of high-risk human papillomavirus in women with abnormal cervical smear. *Lancet*, **358**, 1782-3.
- Paavonen J, Naud P, Salmeron J, et al (2009). Efficacy of human papillomavirus (HPV)-16/18 AS04-adjuvanted vaccine against cervical infection and precancer caused by oncogenic HPV types (PATRICIA): final analysis of a double-blind, randomised study in young women. *Lancet*, **374**, 301-14.
- Saha A, Nag Chaudhury A, Bhowmik P, et al (2010). Awareness of cervical cancer among female students of premier colleges in Kolkata, India. *Asian Pac J Cancer Prev*, **11**, 1085-90.
- Schiffman M, Castle PE, Jeronimo J, et al (2007). Human papillomavirus and cervical cancer. *Lancet*, **370**, 890-907.
- Schiffman M, Wacholder S (2012). Success of HPV vaccination is now a matter of coverage. *Lancet Oncol*, **13**, 10-2.
- Seoud M, Tjalma WA, Ronsse V (2011). Cervical adenocarcinoma: moving towards better prevention. *Vaccine*, **29**, 9148-58.
- Smith JS, Lindsay L, Hoots B, et al (2007). Human papillomavirus type distribution in invasive cervical cancer and high-grade cervical lesions: a meta-analysis update. *Int J Cancer*, **121**, 621-32.
- WHO/ICO Information Centre on HPV and Cervical Cancer (HPV Information Centre). Human Papillomavirus and Related Cancers in South Africa. Summary Report 2010. Available at: [www.who.int/hpvcentre](http://www.who.int/hpvcentre) [Date accessed: 15 January 2013].
- Wong LP, Sam IC (2010). Ethnically diverse female university students' knowledge and attitudes toward human papillomavirus (HPV), HPV vaccination and cervical cancer. *Eur J Obstet Gynecol Reprod Biol*, **148**, 90-5.
- World Health Organization (2009). Human papillomavirus vaccines. WHO position paper. *Weekly Epidemiological Record*, **84**, 118-31.