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Impact of Interactive Digital Health Media on Student's Awareness about Human Papilloma Virus and its vaccination using ADDIE Model

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Abstract

Human papillomavirus (HPV) is a widely occurring infection contracted through sexual contact, particularly between those who are late adolescents to early adults. Therefore, it is imperative to provide education to college students regarding HPV. **Aim**: Evaluate the impact of interactive digital health media on student's awareness about human papilloma virus and its vaccination using ADDIE model (Analysis, Design, Development, Implementation, Evaluation). **Setting and Design**: Utilizing a quasi-experimental research approach at Minia University's Faculty of Nursing. **Sample:** Stratified random sample consisted of 1077 nursing students including the four grades. **Tools**: Tool I: Socio-demographic characteristics, Tool II: Knowledge about HPV and its vaccination, Tool (III): Attitude toward HPV and its vaccination. **Results**: Showed that 58.9% of students had poor knowledge about HPV and its vaccination in pretest which was lessened to 15.6 % in posttest. In addition, 82.8 % of them had a negative attitude toward HPV and its vaccinations in pretest which was minimized to 24.4% of in posttest. Also, a positive correlation was observed between studied sample's knowledge and attitude in pre and posttest with statistically significant differences. **Conclusion**: There was a positive correlation between knowledge and attitude in pretest and posttest before and after using interactive digital health media. So, the interactive digital health media application showed a good impact on student's knowledge and attitude improvement regarding HPV. **Recommendations**: Adolescents' knowledge gaps may be closed with the effective mass media use, the need to launch culturally appropriate public education initiatives, and awareness campaigns on HPV and its vaccination.

Keywords: ADDIE Model, HPV, Interactive digital health media, Student's Awareness & Vaccination.

Introduction

Human papillomaviruses constitute a set of viruses that attack epithelial tissues for infection which consider the "most common sexually transmitted infection" (STI) in the world. Although the majority of human papillomavirus (HPV) sorts are considered less-risky and typically resolve on their own or go undetected, specific high-risky ones, particularly HPV sixteen and eighteen, are oncogenic and are associated with a variety of cancers. These include vulvar, vaginal, or cervical cancers in women even, penile cancer in men; Also, oropharyngeal as well as anal cancers in both genders. Notably, these high-risk HPV types make up over 70% of all instances of cervical cancer worldwide. **(Bruni et al., 2023).**

Sexual intercourse and other forms of contact with the genital area, like putting your hand on an infected person's genitalia, are among the 100 different forms of HPV that are transferred by skin-to-skin contact. Encountering items like toilet seats cannot spread HPV, Typically, the immune system effectively eliminates the HPV infection before it manifests as warts. When warts do occur, their characteristics can vary based on the specific type of HPV involved. Furthermore, symptoms associated with an HPV infection may not present until years after having intercourse with an infected individual, complicating the identification of the initial **(Abdelaliem et al., 2023).**

99.7% of cervical cancer specimens have been confirmed to include HPV, a sexually transmitted virus. It is particularly prevalent in younger people, with the highest incidence among those in the 20–30 age range, which includes many college students. Between fifty and eighty percent of women who engage in sexual activity are thought to have the virus at least once in their lifetime. About 70% of all cases are of the most prevalent strains, HPV16 and HPV18**(Sung et al., 2021).**

For HPV infection, there are established risk factors and how it progresses to cervical cancer. These include long term oral contraceptive pills (OCP) usage, cigarette use, having several sexual partners, starting sexual intercourse at a young age, immunosuppression, and diet. Over the years, screening for cancer cervix has been made possible by the length of time that separates HPV infection from cancer cervix. As of right now, the World Health Organization (WHO) suggests cervical screening, HPV vaccination, and broad health education as a part of complete cancer prevention strategy. (**Fontham et al., 2020).**

WHO initiated in 2020, a global strategy aimed at expediting the eradication of cervical cancer as a public health concern. This strategy encompasses three primary global objectives to be achieved by the year 2030: firstly, to guarantee that 90% of girls have received all recommended HPV vaccinations by the time they are fifteen; secondly, to achieve a high-performance test to screen 70% of women by the age of 15 or 35, with a subsequent screening by the age of 45; and thirdly, to guarantee that adequate therapy is received by ninety percent of women with cervical illness. **(Ashry et al., 2024).**

The available human papillomavirus (HPV) vaccines are acknowledged as effective primary prevention measures, providing protection against approximately 92% of HPV and genital related cancers. Since 2009, the HPV vaccine has been accessible in Egypt for individuals who possess both the financial means and motivation to obtain it. However, it has not yet been incorporated into the national vaccination schedule, and its cost of approximately US$ 30 renders it unaffordable for a significant portion of the population. Currently, two vaccines; Gardasil and Cervarix are licensed in numerous countries, Egypt as well, to guard against HPV strains 16 and 18, which are high-risk (**WHO, 2022 & National Cancer Institute, 2022**).

Adolescent males and females between the ages of 11 and 12 should get periodic immunizations, although it may commence as early as age 9. HPV vaccination is siggested up to age 21 for males and up to age 26 for females and other priority populations, such as men who have sex with men and transgender individuals. Consequently, college and university health systems play a crucial role in comprehensive public health strategies aimed at mitigating the burden of HPV. Health professionals in college settings can contribute by enhancing awareness and understanding of HPV, promoting healthy sexual practices, and facilitating vaccination for interested students **(Berenson et al., 2021**).

Innovative teaching methods, such as employing PowerPoint presentations in lectures and conferences and computer-assisted instruction that incorporates supporting components such tables, videos, photos, and text, must be used in nursing education in order to prepare students for the expectations of the global community. (**Tastan et al., 2020)**.

Numerous instructional design models have been created by instructional designers with varying degrees of experience and are appropriate for a range of educational objectives. The ADDIE model, Dick and Carey's model, Kemp model, and ASSURE model are examples of instructional models. They are all predicated on the idea of the ADDIE model. The five phases of the ADDIE instructional design paradigm include analysis, design, development, implementation, and assessment **(Mahnaz et al., 2020).**

Research indicates that practice nurses serve as a vital source of information and guidance for patients regarding HPV infection, testing, and vaccination. They are also likely to provide support for women experiencing distress due to an HPV diagnosis or abnormal cervical smear results. In conclusion, HPV is an exceedingly prevalent sexually transmitted virus that can lead to malignant transformations in cases of persistent high-risk infection. There exists a notable gap in public knowledge regarding the virus, underscoring the essential role of primary care nurses in educating and supporting patients on these matters **(McSherry et al., 2023)**.

Significance of the study

It is well established that human papillomavirus (HPV) infection causes cervical cancer, and there is growing evidence that HPV contributes significantly to head and neck cancers as well as other anogenital cancers, such as those of the anus, penis, vulva, and vagina.The strains of HPV between 16 and 18 are responsible for nearly seventy percent of all cases of cervical cancer worldwide. There are currently HPV vaccines that guard against HPV 16 and 18 infections, and they may lower the risk of cervical and other anogenital malignancies **(Bruni et al., 2023).**

The prevalence of Human Papillomavirus (HPV) in Egypt is reported to be 10.4% among women aged 18 years and older, with the age group of 45 to 54 years showing the highest prevalence at 9.2%. This information serves as a critical reference for public health officials engaged in HPV prevention initiatives within the country **(Elazab et al., 2021)**. World Health Organization's International Agency for Research on Cancer (IARC) claims that, cervical cancer results in approximately 250,000 fatalities among women globally each year, with 85% of these deaths occurring in low- and middle-income nations. In Egypt, it is estimated that around 1,320 new cases of cervical cancer are diagnosed annually (data for

2020). Cervical cancer is ranked as the 13th leading cause of cancer among women in Egypt and is the 9th most prevalent cancer among women aged 15 to 44 years **(Bruni et al., 2021)**

In addition to being at high risk for contracting the human papillomavirus and its related difficulties, nursing students are also the workforce of the future. As a result, they are an important group that needs to fully comprehend HPV and its vaccine. So, the current research will help to increase student's awareness about human papilloma virus and its vaccine.

One of the most popular models for instructional design is the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) approach. It was created in the 1970s and offers a methodical approach that guarantees careful planning, creation, and evaluation of educational resources **(Ali et al., 2021).** Since ADDIE is a prescriptive paradigm, its linear form might be useful when creating structured learning environments that need precise objectives and evaluations. However, the model's rigidity has drawn criticism for its lack of adaptability, especially in dynamic learning environments where student demands and course content can change quickly. In spite of this, ADDIE is still a crucial tool for developing comprehensive, outcome-focused learning experiences in corporate training and higher education contexts **(Garrett et al., 2021).**

Aim of the study:

Evaluate the impact of interactive digital health media on students' awareness about human papilloma virus and its vaccination using ADDIE model.

Research Hypothesis

1. Nursing students who will receive interactive digital health media regarding human papilloma virus and its vaccination will have higher level of knowledge at posttest than pretest.
2. Nursing students who will receive interactive digital health media regarding human papilloma virus and its vaccination will have positive attitude at posttest than pretest
3. There will be a correlation between knowledge and attitudes toward HPV among undergraduate nursing students at Minia University.

Subjects and Method:

Research Design:

The present study employed a quasi-experimental research design, specifically a one-group pretest-posttest framework, to fulfill its objectives.

Setting:

Minia University's Faculty of Nursing served as the site of this research.

Sample:

This study employed a stratified random sample.

Sample size:

Only undergraduate nursing students were included in the sample at the Faculty of Nursing, Minia University 2023-2024, a representative sample of 30% of the total number of all four grades' pupils in of the faculty of nursing which was estimated to be (3594) students and determined according to inclusion criteria. The sample size was calculated by using the **Isaac & Micheal (1995)** formula which was computed as (N=P*30/100), N= 3594*30/100 the sample size = (1077) students.

The sample size =1077 nursing students

Grade	Population	Sample
1st	665	199
2nd	964	289
3rd	955	286
4th	1010	303
Total	3594	1077

Inclusion criteria:

Students enrolled in undergraduate nursing programs (first through fourth year) at the Faculty of Nursing - Minia University.

Exclusion criteria:

Students who were not willing to participate in the study, those enrolled in internship and postgraduates.

Data Collection Tools:

Three tools were utilized in the current study to collect data.

Tool (I): A structured self-administered questionnaire which included nursing students' socio-demographic characteristics and was used to collect data related to students such as: age, gender, academic level, marital status, area of residence, father educational level, mother educational level, additional questions like; familial history of cervical carcinoma, did you receive HPV vaccine, Have you ever heard about HPV infection and its vaccines?, and sources of HPV infection information and its vaccines?

Tool (II): Knowledge of Nursing Students toward HPV infection and its vaccination: it was included two parts(pre-posttest):

(**Part 1): Knowledge of Nursing Students toward HPV** it was developed by **(Kasymova et al., (2019), Mazian et al., (2018) and Horio et al., (2023)** and was modified by the researchers after reviewing the related literatures. It included 38 statement about HPV infection with the options of right, wrong, and I don't know, was classified into: the first (7) questions about the definition and types of HPV infection, the next (10) questions about the mode of transmission, signs and symptoms of HPV infection, after that,

question about the risk factor, diagnosis of HPV infection which include (10) questions and the last (11) questions about the prevention, complications and treatment of HPV infection.

(Part 2):Knowledge of Nursing Students regarding HPV vaccination (pre-posttest) it was developed by (Mazian & Hui, (2018) and was modified by the researchers and reviewed by Jury, it included 23 statement about HPV vaccine with the options of right, wrong, and I don't know which include (HPV vaccination can protect users from getting some forms of cancer, it is only available for girls and women, authorized for use in boys and young men aged 9 and up, and it guards against malignancies of the throat, penis, and anal region.

Scoring System: The sum of questions: about HPV and its vaccination were 61 questions. The student's answers of HPV related knowledge and its vaccination was scored and calculated. Each correct answer was given a score of two and incorrect answer or don't know a score of one respectively these scores were converted into a percentage score (poor knowledge scored <50% (<61 scores), moderate knowledge 50%75% (61 - 91 scores) and good knowledge scored >75% (>91 scores).

Tool (III): Nursing students' attitude toward HPV and vaccination (Modified Likert's scale) (pre-posttest): It developed by (**Abdelaliem et al., (2023)** to assess attitude of nursing students toward HPV and its vaccination and was modified by the researchers. The scale consisted of (16) statement from three points (Likert scale type) which include (The HPV vaccine works well to prevent cancer, HPV is safe for injection, HPV is successfully prevent cervical cancer in both them and their sexual partners, as well as in potential partners. and other and Cost would influence the decision for me to receive the HPV vaccine…. etc.)

Scoring system: Likert scale type was evaluated by using three points Likert scale (2 = agree, 1 =neutral, 0= disagree) which include 16 statements and maximum score of 32 and minimum of zero. The total score < 50% (<16 scores) were considered as a negative attitude and ≥ 50% (≥ 16 scores) were considered as a positive attitude.

Validity:

To verify its validity, the questionnaire was tested on a panel of five professors with expertise in Obstetrics and Gynecological Nursing. These professors evaluated the instruments for ease of use, comprehension, comprehensiveness, relevance, and clarity.

Reliability:

The Cronbach's alpha test was used to assess the tools' internal consistency and determine whether it was reliable. The HPV and vaccination knowledge questionnaire were highly reliable (0.918). In addition, it was also for the attitude (.956).

Pilot Study:

A pilot study was carried out involving 10% (108) of the students from the previously mentioned setting to evaluate the clarity, validity, and time efficiency of the current study tools. The findings from the pilot study indicated that no adjustments were necessary, and the students who participated in the pilot were subsequently included in the study sample.

Field work:

Between April and June 2024, the ADDIE model was implemented as a conceptual framework for the development and execution of interactive digital health media. The study was divided into five phases:

Phase I (Analysis):

After an official authorization acquired from the research ethics committee at the Faculty of Nursing, Minia University, participants who met the inclusion criteria were interviewed. Initially, the researchers welcomed the students, explained the aims, duration, and activities of the study and took oral consent, after that data collected using a questionnaire sent electronically via Google forms platform which include student's demographic characteristics (tool I) after that, assess the students' knowledge about HPV and its vaccination (tool II) and attitude (tool III) as a pretest. The researchers inform the students that follow up evaluation will be done by the same method throughout Google forms platform. This phase took about two weeks from the beginning of data collection.

Phase II (Designing):

Following the analysis phase, the researchers determined the needs of the students and created interactive digital health media to establish a baseline understanding of HPV knowledge and its vaccines as: have you ever heard about HPV, what are sources of information, mode of transmission, risk factor, types, importance of screening, signs and symptoms and prevention of HPV, importance of vaccine, protection and doses. In addition, 16 statements about attitude of students regarding HPV was designed to enhance nursing students' knowledge and attitudes about HPV, and its vaccines which took the next two weeks after data analysis.

Phase III (development):

The researchers developed the interactive digital health media in the form of digital power point presentation and utilizing a 2010 Microsoft Office PowerPoint presentation that featured animation, layout, narration, text, and graphics to the students. This phase took the first two weeks at the beginning of May 2024.

Phase IV (Implementation):
The aforementioned setting was used to implement the interactive digital health media. After providing the students with verbal instructions and a PowerPoint presentation displayed on a laptop, the researchers gave them a booklet for reeducation. This phase took approximately 45 minutes included knowledge about HPV and its vaccination which had occurred in around one month to complete this phase.

Phase V (Evaluation)
Students' knowledge about HPV and its vaccination was reassessed again at the end of the 4th weeks after implementation of the interactive digital health media (posttest) by using the same tools of pretest (tool II and III) to evaluate the impact of the interactive digital health media on students' knowledge and attitude about HPV and its vaccination. This phase took about two weeks.

Ethical consideration:
Prior to conducting both the pilot and the main study, an official permission was secured by the Faculty of Nursing Dean, as well as approval from the faculty's ethical committee. Students who were willing to participate in the study provided their consent after being informed about the study's nature and purpose. Students had the right to decline participation or withdraw from the study at any time without needing to provide a reason. Privacy was prioritized during data collection, and there was no health risks involved. Participants were guaranteed that the information they provided would be kept private, and to further protect their privacy, each participant assigned a number instead of using their names.

Results:

Table (1): Socio-demographic characteristics of studied sample (N = 1077)

Socio-demographic characteristics	Studied sample (1077)	
	No	%
Age/year		
18-<20	282	26.2
20-<22	428	39.7
22-24	367	34.1
Mean ± SD	**20.74±1.523**	
Gender		
Male	386	35.8
Female	691	64.2
Academic year		
First year	199	18.5
Second year	289	26.8
Third year	286	26.6
Fourth year	303	28.1
Marital status		
Single	1056	98.1
Married	21	1.9
Area of Residence		
Urban	283	26.3
Rural	794	73.7
Father educational level		
Illiterate	100	9.3
Primary school	122	11.3
Secondary school	356	33.1
University education	499	46.3
Mother educational level		
Illiterate	299	27.7
Primary school	117	10.9
Secondary school	353	32.8
University education	308	28.6

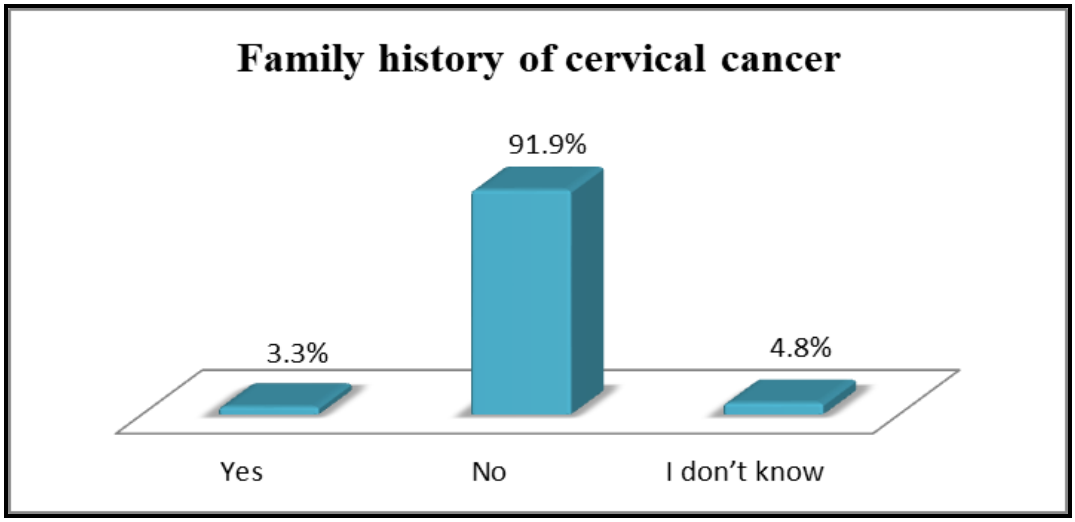

Figure (1): Family history of cervical cancer (N = 1077)

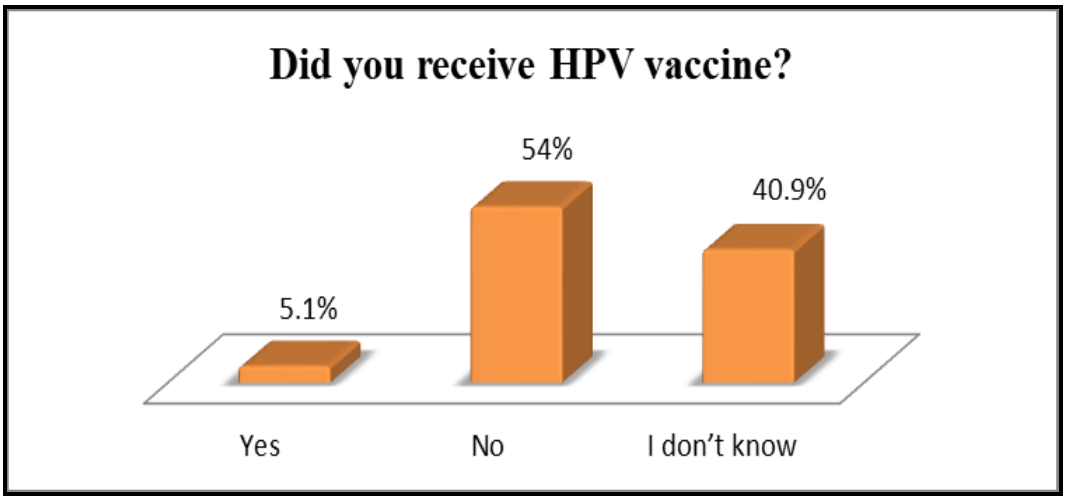

Figure (2): Did you receive HPV vaccine? (N = 1077)

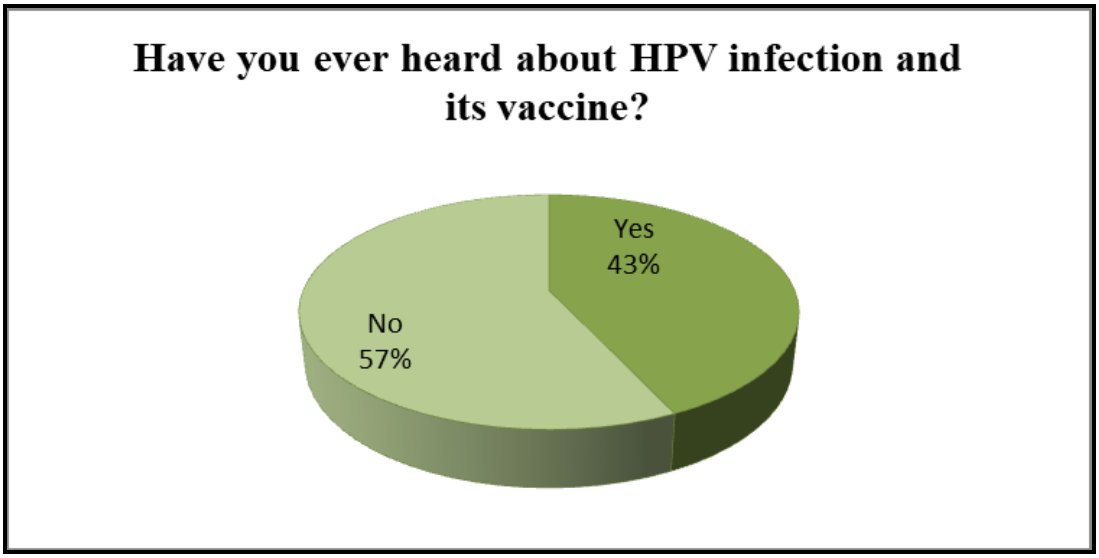

Figure (3): Have you ever heard about HPV infection and its vaccination? (N = 1077)

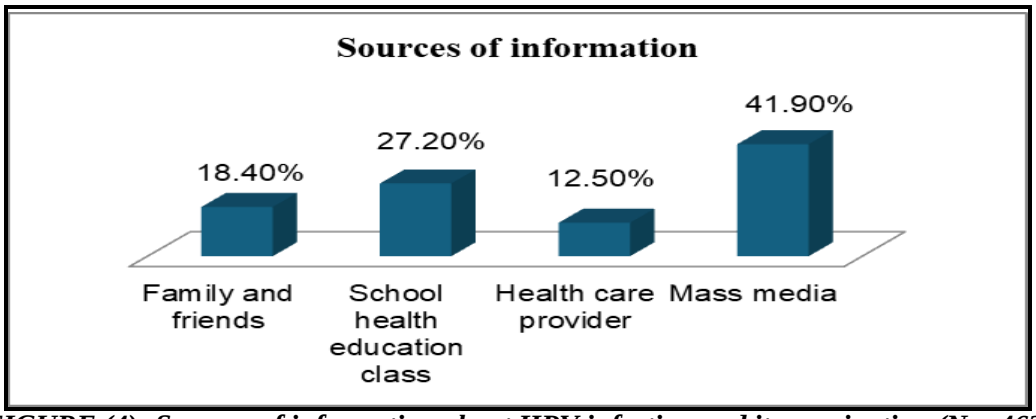

FIGURE (4): Sources of information about HPV infection and its vaccination (N = 463)

Table (2): The total knowledge means of HPV infection and its vaccination in pre and posttest using interactive digital health media among the studied sample (n=1077)

knowledge items	Pretest	Posttest	T	P- Value
	Mean ±SD	Mean ±SD		
Total knowledge about the definition and types of HPV infection	7.21 ± 5.319	11.19 ± 4.496	38.255	0.001**
Total knowledge about the mode of transmission, signs and symptoms of HPV infection	8.60 ± 8.000	14.17 ±7.758	34.794	0.001**
Total knowledge about the risk factor and diagnosis of HPV infection	10.20 ±7.79	14.99 ±7.435	33.808	0.001**
Total knowledge about the Prevention, complications and treatment of HPV infection	10.63 ± 4.243	18.61 ± 5.061	47.529	0.001**
Total Knowledge about HPV vaccination	21.08± .4.650	39.31 ± 10.405	55.034	0.001**
Total knowledge scores	**57.73 ± 21.131**	**98.27 ± 29.860**	**50.864**	**0.001****

Test used: paired sample T test. ***Highly statistically significant at P value ≤ 0.01.*

Table (3): Total knowledge regarding HPV infection and its vaccination among the studied sample pre and post using interactive digital health media (n=1077)

Total Knowledge	Pretest		Posttest		T	P- Value
	No	%	No	%		
Poor < (50%) (<61 scores)	634	58.9	168	15.6	**55.695**	**0.001****
Moderate (50- 75%) (61-91 scores)	429	39.8	76	7.1		
Good > (75%) (>91scores)	14	1.3	833	77.3		
Total knowledge scores	**57.73 ± 21.131**		**98.27 ± 29.860**			

Test used: paired sample T test. ***Highly statistically significant at P value ≤ 0.01.*

Table (4): The mean distribution of the studied sample according to their attitude towards HPV infection and its vaccinations in pre and posttest using interactive digital health media (N=1077)

Items	Pretest	Posttest	T	P
	Mean ±SD	Mean ±SD		
1. HPV vaccine is effective in cancer prevention	.68 ± .734	1.42 ±.852	16.086	.001**
2. HPV vaccine is safe for injection	.63 ± .779	1.47 ±.769	18.216	.001**
3. Receiving HPV vaccination can effectively protect themselves and their sexual partners	.69 ± .790	1.63 ±.602	23.403	.001**
4. Never considered of receiving HPV vaccine	.65 ± .768	1.52 ±.736	19.719	.001**
5. HPV vaccine would be inefficient because of previous sexual activities	.69 ± .728	1.47 ±.761	17.824	.001**
6. If females already vaccinate against HPV males aren't need.	.70 ± .730	1.67 ±.630	24.713	.001**
7. Males should be vaccinated against HPV in order to protect their future partners	.58 ± .703	1.70 ±.542	31.210	.001**

Items	Pretest Mean ±SD	Posttest Mean ±SD	T	P
8. Cost would influence the decision for me to receive the HPV vaccine.	.51 ± .612	1.39 ±.849	20.905	.001**
9. I think my parents could pay for the vaccine.	.73 ± .732	1.44 ±.855	15.560	.001**
10. I would get the vaccine if it were for free	.57 ± .724	1.63 ±.647	28.890	.001**
11. I would be embarrassed to ask my parents/guardians about vaccination.	.71 ± .679	1.45 ±.856	20.274	.001**
12. My parents would not allow me to get the vaccine.	.62 ± .728	1.51 ±.717	23.431	.001**
13. Concerned of side effects of receiving HPV vaccination	.69 ± .777	1.47 ±.856	17.376	.001**
14. Only sexually active women should receive the vaccine.	.61± .726	1.38 ±.851	19.541	.001**
15. I wish to get more information about HPV and HPV vaccination	.62 ± .761	1.45 ±.857	19.227	.001**
16. Do you think that HPV infection tests should be added to premarital tests?	.65 ± .698	1.43 ±.828	21.106	.001**
Total attitude regarding HPV and its vaccination	**10.34 ± 9.056**	**24.04 ± 11.773**	**22.280**	**.001****

Test used: paired sample T test. ***Highly statistically significant difference at P – value≤.01*

Table (5): Total attitude regarding HPV and its vaccinations among the studied sample pre and posttest using interactive digital health media (N=1077)

Total attitude	Pretest		Posttest		T	P- Value
	No	%	No	%		
Negative attitude (<50%= <16 scores)	892	82.8	263	24.4	**22.280**	**.001****
Positive attitude (≥ **50%=** (≥ 1**6 scores)**	185	17.2	814	75.6		
Mean ± SD	**10.34 ± 9.056**		**24.04 ± 11.773**			

Test used: paired sample T test. ***Highly statistically significant at P value ≤ 0.01.*

Table (6): Relation between total knowledge of the studied group in pre, and posttest with their socio-demographic characteristics (n = 1077).

Socio-demographic characteristics	Total knowledge					
	Pretest			Posttest		
	Poor (N=634)	Moderate (N=429)	Good (N=14)	Poor (N=168)	Moderate (N=76)	Good (N=833)
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Age/year						
18- <20 (N=282)	210 (33.2%)	70 (16.3%)	2 (14.3%)	51 (30.4%)	26 (34.2%)	205 (24.6%)
20< 22 (N=428)	224 (35.3%)	200 (46.6%)	4 (28.6%)	62 (36.9%)	24 (31.6%)	340 (40.8%)
22- 24 (N=367)	200 (31.5%)	159 (37.1%)	8 (57.1%)	55 (32.7%)	26 (34.2%)	288 (34.6%)
X^2 (P – value)	**41.518 (.001)** **			**5.769 (.217)** NS		
Gender						
Male (N=386)	222 (35.0%)	158 (36.8%)	6 (42.9%)	76 (45.2%)	26 (34.2%)	284 (34.1%)
Female (N=691)	412 (65.0%)	271 (63.2%	8 (57.1%)	92 (54.8%)	50 (65.8%)	549 (65.9%)
X 2 (P – value)	**.670 (.715)** NS			**7.645 (.02)***		
Academic year						
First year (N=199)	147 (23.2%)	51 (11.9%)	1 (7.1%)	43 (25.6%)	17(22.4%)	139 (16.7%)
Second year (N=289)	143 (22.6%)	145 (33.8%)	1 (7.1%)	39 (23.2%)	19(25.0)	231(27.7%)
Third year(N=286)	150 (23.7%)	131 (30.5%)	5 (35.8%)	42 (25.0%)	18 (23.7%)	226(27.1%)
Fourth year (N=303)	194 (30.6%)	102 (23.8%)	7 (50.0%)	44 (26.2%)	22 (28.9%)	237(28.5%)
X^2 (P – value)	**44.417 (.001)** **			**8.606 (197)** NS		
Marital status						
Single (N=1056)	622 (98.1%)	421 (98.1%)	13 (92.9%)	164(97.6%)	73(96.1%)	819(98.3%)
Married (N=21)	12 (1.9%)	8 (1.9%)	1 (7.1%)	4(2.4%)	3(3.9%)	14(1.7%)
X^2 (P – value)	**2.002 (.368)** NS			**2.065 (.356)** NS		
Residence						
Urban (N=283)	170 (26.8%)	106 (24.7%)	7 (50.0%)	50(29.8%)	20(26.3%)	213(25.6%)
Rural (N=794)	464 (73.2%)	323 (75.3%)	7 (50.0%)	118(70.2%)	56(73.7%)	620(74.4%)
X^2 (P – value)	**4.706 (.095)** NS			**1.268 (.530)** NS		

Test used: chi squire. *** Statistically significant at P value ≤0.01.*

NS *No statistically significant relation at P value more than 0.05*

***HighlystatisticallysignificantdifferenceatP– value≤ .01*

Table (7): Relation between total attitude of the studied group in pre, and posttest with their socio-demographic characteristics (n = 1077).

Socio-demographic characteristics	Total attitude			
	Pretest		Posttest	
	Negative (N=892)	Positive (N=185)	Negative (N=263)	Positive (N=814)
	N (%)	N (%)	N (%)	N (%)
Age/year				
18- <20 (N=282)	240 (26.9%)	42 (22.7%)	74 (28.1%)	208 (25.6%)
20< 22 (N=428)	356 (39.9%)	72 (38.9%)	97 (36.9%)	326 (40.0%)
22- 24 (N=367)	296 (33.2%)	71 (38.4%)	92 (35.0%)	280 (34.4%)
***X*² (*P* – value)**	**2.285 (.319) NS**		**1.034 (.596) NS**	
Gender				
Male (N=386)	316 (35.4%)	70 (37.8%)	105 (39.9%)	281 (34.5%)
Female (N=691)	576 (64.6%)	115 (62.2%)	158 (60.1%)	533 (65.5%)
X 2 (P – value)	**.388 (.534) NS**		**2.524 (.112) NS**	
Academic year				
First year (N=199)	171 (19.1%)	28 (15.1%)	60 (22.8%)	139 (17.1%)
Second year (N=289)	249 (27.9%)	40 (21.6%)	65 (24.7)	224 (27.5%)
Third year(N=286)	236 (26.5%)	50 (27.0%)	63 (24.0%)	223(27.4%)
Fourth year (N=303)	236 (26.5%)	67 (36.3%)	75 (28.5%)	228 (28.0%)
***X*² (*P* – value)**	**8.817 (.03)***		**5.028 (170) NS**	
Marital status				
Single (N=1056)	876 (98.2%)	180 (97.3%)	256 (97.3%)	800 (98.3%)
Married (N=21)	16 (1.8%)	5 (2.7%)	7 (2.7%)	14(1.7%)
***X*² (*P* – value)**	**.662 (.416) NS**		**.922 (.337) NS**	
Residence				
Urban (N=283)	229 (25.7%)	54 (29.2%)	74 (28.1%)	209 (25.7%)
Rural (N=794)	663 (74.3%)	131 (70.8%)	189 (71.9%)	605 (74.3%)
***X*² (*P* – value)**	**.978 (.323) NS**		**.622 (.430) NS**	

Test used: chi squire. ** Statistically significant at P value ≤0.01.*
NS No statistically significant relation at P value more than 0.05
***Highly statistically significant difference at P– value≤ .01*

Table (8): Correlation between studied sample knowledge and attitude regarding HPV infection and its vaccination in pretest and posttest

Variables	Pretest		Posttest	
	Knowledge	Attitude	Knowledge	Attitude
Knowledge				
r. value	1	.571	1	.294
P. value	-	.001**	-	.001**
Attitude				
r. value	.571	1	.294	1
P. value	.001**	-	.001**	-

*** Correlation is significant at the 0.01 level (2- tailed).*
** Correlation is significant at the 0.05 level (2- tailed).*

Table (1): Illustrates the socio-demographic characteristics among the studied sample, it showed that 39.7% of them their age was between 20- < 22 years, with Mean and SD 20.74±1.523 years, 64.2% were female, 28.1% of them were at the fourth academic year, 98.1% were single, 73.7% of the students were from the rural area. Regarding father educational level, 46.3% of them had a university education; concerning mother educational level, 32.8% of them had a secondary school.

Figure (1): Demonstrates the family history of cervical cancer. It shows that cervical cancer was not a familial history for 91.9% of the students under study.

Figure (2): Shows the history of receiving of HPV vaccine, it reveals that only (5.10%) of them received HPV vaccine and (54%) of studied sample didn't receive it.

Figure (3): Illustrates the previous hearing about HPV infection and its vaccination, it reveals that 57%

of studied sample didn't hear about HPV infection and its vaccination.

Figure (4): Demonstrates the source of HPV infection information and its vaccination. It exhibits that (41.9%) of studied sample reported that mass media was their source of information.

Table (2): Illustrates the overall knowledge mean of HPV infection and its vaccinations in pre and posttest using interactive digital health media among the studied sample. It reveals that there was a notable improvement with highly statistically significant difference in all items related to knowledge about HPV and its vaccination after using interactive digital health media (p-value = 0.001 in each one).

Table (3): Demonstrates total knowledge HPV infection and its vaccination among the studied sample pre and post using interactive digital health media, it reveals that 58.9 % of studied sample had poor knowledge about HPV infection and its vaccination in pretest which decreased to 15.6% of in posttest. Mean score of their knowledge was 57.73 ± 21.131in pretest, increased to 98.27 ± 29.860 in posttest with highly statistically significant improvements in their knowledge level.

Table (4): Illustrates the mean distribution of the studied sample according to their attitude towards HPV infection and its vaccinations in pre and posttest using interactive digital health media. It reveals that there was significant improvement in all items related to attitude about HPV and its vaccinations after using interactive digital health media with highly statistically significant (where p-value = 0.001 in each one).

Table (5): Demonstrates total attitude regarding HPV and its vaccinations among the studied sample pre and post test using interactive digital health media. It reveals that 82.8 % of studied sample had a negative attitude toward HPV and its vaccinations in pretest which decreased to 24.4% of in posttest. Mean score of their total attitude was 10.34 ± 9.056 in pretest which increased to 24.04 ± 11.773in posttest with highly statistically significant improvements in their total attitude.

Table (6): Represents the relation between total knowledge of the studied group in pre, and posttest with their socio-demographic characteristics. It shows that there was a highly statistically significant relation between the studied group total score of knowledge in pretest with age and academic year at (P value= 0.001). Also, there was a statistically significant relation between the studied group total score of knowledge in posttest and gender at (P value= 0.02). While there was no statistically significant relation between the studied group total knowledge score and the other socio-demographic characteristics in pre and posttest ($p > 0.05$) respectively.

Table (7): Illustrates the relation between the overall attitude of the studied group in pre, and posttest with their socio-demographic characteristics. There was a statistically significant relation between the studied group's total score of attitudes in pretest and academic year at (P value= 0.03). While there was no statistically significant relation between the studied group total attitude score and the other socio-demographic characteristics in pre and posttest at ($p > 0.05$) respectively.

Table (8): Shows pretest and posttest correlation of the studied sample knowledge and attitude regarding HPV infection and its vaccination. It reveals that there was a positive statistically significant correlation between studied sample's knowledge and attitude in pre and posttest as p value was .001.

Discussion

The prevalent sexually transmitted diseases that infect the reproductive system is the human papillomavirus (HPV), this can result in cancer and is present in both men and women. **(MAZLAN & HUI, 2018).** The health burden caused by HPV, WHO recommends implementing a number of comprehensive primary preventive interventions, including screening, immunizations, and community health education **(WHO, 2020).**

As regard socio-demographic characteristics, the present study showed that, Over one-third of the participants were between the ages of 20 and less than 22, with Mean and SD 20.74±1.523 years, near to two thirds were female, more than one quadrant was at the fourth academic year, the majority were single, nearly three quadrant of students were from rural area, near to half of their fathers had a university education; and nearly one third of their mothers had a secondary school educational level.

This outcome concurred with **(Aldawood et al., 2024)** who stated that vast majority of pupils were between the ages of 20 and 21. Nearly three quarters were females, and most of the research participants were unmarried. Also, the study finding agreed with **(Varer & Alanya, 2023)** who concluded that, 21.4 ± 3.4 years was the average age of the students., nearly two third were female, more than three quarter were from rural area, and more than one quarter were at the 4thacademic year. However, the findings disagreed with **(Alshammari & Khan, 2022)** who stated that, the age mean was 24 ± 7.1 years, and near to two thirds were male.

Regarding the family history of cervical cancer, most of the studied participants didn't have a family history of cervical cancer. Concerning the history of receiving of HPV vaccine, it revealed that over than

half of studied sample didn't receive it. Related to the previous hearing about HPV infection and its vaccination, over half of the participants in the study were unaware of HPV prevention and even its infection. These findings agreed with **(Varer & Alanya, 2023 & Abdelaliem et al., 2023)** who stated that, the majority of the studied participant didn't have a family history of genital cancer, more than half didn't receive HPV vaccination and over half of the participants in the study were unaware of HPV infection and its vaccination.

Regarding the information's original source of HPV infection and its vaccination. The results exhibited that over than half of studied sample didn't know HPV infection and its vaccination and the highest percentage of them their source of information about it was mass media. The finding contradicted with **(Açıkgöz & Göl 2023**) who found that approximately three quarters had already heard at their educational institution about HPV and were aware of the HPV vaccine. Also, the findings were in contrast with **(Kohler et al., 2024 & Yesaya, 2020)** who stated that most students had heard of HPV, and more than half said that they learned about it from their healthcare practitioners, the internet, or the media. This disagreement may be due to culture difference.

Regarding the total knowledge about HPV infection and its vaccination among the studied sample pre and post using interactive digital health media, the results found that over than half of studied sample had poor knowledge about HPV infection and its vaccination in pretest which declined in posttest. Their knowledge mean score was 57.73 ± 21.131in pretest, increased to 98.27 ± 29.860 in posttest with increase in their level of knowledge that are extremely statistically significant.

From researchers' point of view, students' active engagement and effective communication with the researchers who assisted them in learning may be the cause of this increase in their understanding, and due to Egyptian culture, the planned educational program services are still insufficient in Egypt, particularly when it comes to themes like STDs. Student were interested in the research topic because the planned educational program services are still insufficient in Egypt, particularly when it comes to themes like STDs.

The results agreed with **(Aldawood et al., 2024)** who stated that the overall knowledge score increased from nearly one third before the intervention to more than three quarters after the intervention, showing a significant increase in the participants' knowledge about HPV, so there were significant improvements in HPV knowledge. P-values < 0.0001 following the educational intervention, demonstrating the effectiveness of the interventions. Additionally, the results have been strengthened and enhanced by **(Somera et al., 2023)** who stated that there was a significant increase in HPV Knowledge and Awareness scores from pre- to post test in all groups. The standard errors, as well as pre-post-test means, and 95% confidence intervals (CIs) for mean differences.

Moreover, the finding in the same line with **(Açıkgöz & Göl, 2023)** who revealed that the HPV education provided increase in the HPV total knowledge score, in which the mean score of their knowledge was 15.69±4.80, 23.95±2.84, 24.60±2.70 prior to, one month following, and three months following the training, respectively.

Concerning the total attitude regarding HPV and its vaccinations among the studied sample in pre and posttest using interactive digital health media it revealed that more than three quarters of studied sample had a negative attitude toward HPV and its vaccinations in pretest which decreased in posttest. Mean score of their total attitude was 10.34 ± 9.056 in pretest which increased to 24.04 ± 11.773 in posttest with highly statistically significant improvements in their total attitude. This underlines why it is imperative to create health education materials, particularly for teenagers, about topics like HPV, which is mostly a sexually transmitted infection.

The current study come in the same line with **(Ebrahim et al., 2021**), approximately one-fifth, three-quarters, and slightly less than three-quarters of the sample under study had positive total attitude scores at the pre-intervention, immediate post-intervention, and four-week post-intervention phases, respectively, So educational interventions are crucial for college students, particularly those pursuing health-related careers.

Also, the current results came in consistent with (**Atitt-allah et al., 2019)** who found that, when comparing the post-test findings to the pre-test results, there was a very statistically significant difference in favor of the post-test for all questions pertaining to students' attitudes toward human papillomavirus infection ($p<0.001$) and vaccination ($p<0.001$). This could be because they received useful knowledge during intervention sessions that could influence their beliefs, which would then influence their attitude.

Regarding the pre, and posttest relation between the studied group total knowledge and their socio-demographic characteristics it shows that there was highly statistically significant relation between the studied group total score of knowledge in pretest with age and academic year at (P value= 0.001) and, there was statistically significant relation between the studied group total score of knowledge in posttest with gender at (P value= 0.02). While there was no

statistically significant relation between the studied group total knowledge score and the other socio-demographic characteristics in pre and posttest ($p > 0.05$) respectively.

The current finding agreed with **(Aldawood, et al., 2024)** who stated that the awareness of HPV was strongly correlated with age group and the gender was a significant predictor of HPV awareness, while other sociodemographic factors, including GPA, university level, and college of study, did not significantly correlate with HPV awareness. Additionally, the results were corroborated by (**Abdelaliem et al., 2023**), who reported that there was a highly significant association between nursing students' age and academic year with their general knowledge ($p = 0.007$ and $p = 0.019$, respectively). This outcome may have resulted from the nursing students' interest in sexual health awareness during their adolescent and adult developmental stages.

The current finding conflicted with (**Thanasas et al., 2022)** who indicated that there was no statistically significant difference was seen in the level of knowledge regarding HPV based on the sex of the participants. On the other hand, there was a statistically significant difference between the participants' various residence locations, ethnicities, and yearly family income levels.

Also, the result inconsistent with (**Atitt-Allah et al., 2019)** who found no statistically significant relationship between the study sample's personal characteristics (age, residence, marital status, and mother's educational attainment) and the total knowledge score about human papillomavirus infection and vaccination at the pre-intervention and post-intervention phases ($P>0.05$).

Exploring the relation between the total attitude of the studied group in pre, and posttest with their socio-demographic characteristics. There was a statistically significant relation between the studied group's total score of attitudes in pretest and academic year at (P value= 0.03). While there was no statistically significant relation between the studied group total attitude score and the other socio-demographic characteristics in pre and posttest at ($p > 0.05$) respectively.

This finding supported by (**Abdelaliem et al., 2023)** they discovered a highly significant correlation between overall attitude and nursing students' age and academic year ($r = 0.301$, $p < 0.001$, and $r = 0.361$, $p < 0.001$, respectively). While the study finding contradicted with (**Thanasas et al., 2022)** They demonstrated that there is a statistically significant variation in HPV vaccination willingness rates according to sex and residence. It noted that girls showed a significantly higher willingness to be vaccinated than boys and students from urban were more likely to be vaccinated, particularly when compared to those from rural areas.

About the relationship between the knowledge and attitudes of the study sample about HPV infection and the pre- and post-test vaccination. The results showed that the knowledge and attitude of the study sample were positively correlated in both the pre and posttests, with statistically significant differences ($p =.001$). This is possibly explained by the fact that better information causes the sample's attitudes and beliefs investigated to change for the better. This further bolsters the necessity for health education publications, particularly when it comes to topics like HPV.

The study results were backed by **(Abdelaliem et al., 2023)** who reported that the general attitudes and knowledge of nursing students on HPV immunization was with a positive correlation between each other in a highly significant way ($r = 0.483$, $p < 0.001$, $r = 0.557$, $p < 0.001$, and $r = 0.579$, $p < 0.001$, respectively). Also, the study finding was verified by (**Brandt et al., 2020)** who demonstrated that knowledge and attitude had a significantly significant relationship, with students reporting that the intervention altered their attitudes and views regarding HPV vaccination. Additionally, participants talked about how their confidence grew because of their enhanced knowledge and how it encouraged them to talk to friends and family about HPV vaccination. Furthermore, the study finding agreed with (**Atitt-Allah et al., 2019)** They identified a positive statistical relationship between prior to the intervention vaccination and overall knowledge and attitude about human papillomavirus infection. The significance of educational programs is highlighted by the fact that increased knowledge leads to improved attitudes and beliefs and vice versa.

Conclusions

The current study found that the total knowledge and total attitude scores before and after utilizing interactive digital health media using the ADDIE paradigm differed in a highly statistically significant way ($P<0.001$). Additionally, there were statistically significant differences in the attitudes of the examined sample in the pretest and posttest, as well as a positive link between their knowledge of HPV infection and vaccination. Therefore, utilizing the ADDIE approach to apply interactive digital health media has a positive effect on enhancing attitudes and understanding about HPV infection and vaccination.

Recommendation:

1. Launching public education initiatives and awareness projects on HPV infection and vaccination.
2. Active involvement of medical experts in awareness initiatives and the efficient use of the media could help close the current knowledge gaps among teenagers.
3. Creating and assessing community outreach initiatives run by college students to inform the public about HPV and assessing how well they raise awareness.
4. Examining the application of technological advancements, including virtual reality or smartphone apps, to improve HPV education and public participation.
5. By incorporating the HPV vaccine in Egypt's national vaccination schedule and expanding vaccine access and reach, school-based vaccination programs raise HPV vaccination rates.

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