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Level of Awareness on Cervical Cancer and Parental Willingness Towards its Vaccination Among Mothers in Lahore, Pakistan

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Abstract

In Pakistan, the uptake of human papillomavirus (HPV) vaccines is low due to a lack of information, social barriers, and misperceptions. This study seeks to investigate the mothers' knowledge, attitudes, and parental willingness to accept HPV-based cervical cancer vaccinations in Lahore, Pakistan. A cross-sectional survey was conducted, and the data were collected from 300 mothers who have at least one daughter between the ages of 9 and 14 years. A closed-ended questionnaire was used to collect the information about socio-demographics, knowledge, attitude, and parental willingness to receive HPV vaccinations. The study highlights that there is a need to increase mother awareness and wipe out social stigma about HPV vaccination in Pakistan. The policymakers ought to focus on the inclusion of the HPV vaccine in the national immunization programs, ensuring equal access and inviting the community to engage. The benefits of reinforcing these measures can significantly minimize the burden of cervical cancer and achieve global health goals of its elimination.

Keywords: Cervical Cancer, Awareness, Mothers, Survey Research, Pakistan.

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1. Introduction

Cervical cancer is a severe international community health issue, and it is one of the most avoidable but deadly cancers that affect women across the world. It has become the fourth most common cancer among women with regard to both incidence and mortality, with the estimates of 600,000-670,000 new cases and 340,000-350,000 annual deaths (World Health Organization, 2024). Cervical cancer has a disproportionately high disease burden in the low- and middle-income countries (LMICs), which contribute over 85 percent of the global mortality rate; this disparity is because of limited access to screening, early detection, and treatment (Arbyn et al., 2020; WHO, 2024). This geographical and socioeconomic difference not only helps us to understand cervical cancer as a medical condition but also as an indicator of more healthcare inequalities. Continuous infection by oncogenic variants of human papillomavirus (HPV) has now been known to be the main cause of virtually all incidences of cervical cancer. HPV DNA is found in over 95 percent of tumors of the cervix, making it an important etiologic factor supported by molecular and epidemiological studies (Walboomers et al., 1999; Bosch et al., 2002). Among the established 200 HPV genotypes, approximately 14 fall into the high-risk or oncogenic category, with HPV-16 and HPV-18 causing almost 70-90% of invasive cervical cancer worldwide. These cancerous HPVs produce viral oncoproteins (E6 and E7) that suppress important tumor suppressor proteins (p53 and retinoblastoma protein), leading to unregulated proliferation, genetic instability, and malignant transformation of cells (Doorbar, 2006; Schiffman et al., 2016).

New scientific findings have also changed the world's perception of the best HPV vaccination schedules. Traditionally, HPV vaccines were used in two or three doses, but recent randomized trials and large observational cohort studies indicate that a single dose of the HPV vaccine can elicit long-term immunity and offer strong protection against persistent HPV infection and high-grade precancerous lesions (Barnabas et al., 2022; Whitworth et al., 2024). Such results are particularly significant to the low- and middle-income countries, where logistical, budgetary, and healthcare system constraints often reduce the feasibility of the multi-dose immunization programs. Single dosage techniques reduce programmatic expenditures, cut the challenge of the supply chain, and enhance the likelihood of accessing the inaccessible individuals, improving the likelihood of fair vaccination coverage at the population segment (WHO, 2022). Due to the growing body of scientific evidence, the WHO has already given explicit and evolving policy guidance to inform the vaccination programs in the countries. It is currently the recommendation of the WHO that regular HPV vaccination be administered to girls between the ages of 9 and 14 as the primary target population, as vaccination before exposure to the HPV virus will provide the most protective benefit (World Health Organization, 2023). WHO now suggests either one dose or two doses of the vaccine to girls between the ages of 9 and 14 based on the national situation and the capability of the program to administer immunizations, but two doses are suggested in girls older than 15 and in those who are immunocompromised (World Health Organization, 2024). A major policy change was foreseen by the 2022 position paper of the WHO, informed by the Strategic Advisory Group of Experts (SAGE) on Immunization, in publicly adopting simplified schedules to scale up the world and ensure greater equality in vaccination, especially in resource-constrained environments.

Cervical cancer is a crucial community health problem in Pakistan, and it is also one of the leading causes of cancer morbidity and mortality in women. Cervical cancer is one of the top three most prevalent malignancies among Pakistani women, with one out of every five thousand women between the ages of 18 and 50 years reporting 5,000-6,000 new cases and 3,000-3,500 deaths annually, according to national statistics in Pakistan (Brui et al., 2023; Arbyn et al., 2020). The

number is particularly threatening considering that Pakistan has one of the largest populations, socioeconomic inequalities, and poor accessibility to preventive healthcare interventions (ICO/IARC HPV Information Center, 2023). Although there are more opportunities to receive tertiary healthcare facilities, urban areas such as Lahore have a considerable number of cases because of the high population density and internal migration, as well as the absence of systemic preventative measures (Khan et al., 2023; Arbyn et al., 2020). In general, although Pakistan has made recent governmental commitments to the war on cervical cancer vaccination, there are still great gaps in screening infrastructure, health education, and community involvement (Ahmed et al., 2024). Lahore is a significant urban center with the potential and issues of cervical cancer prevention in Pakistan and hence a perfect place to conduct research regarding cervical cancer prevention among mothers in terms of their knowledge, attitudes, and parental willingness related to HPV vaccination (Setia, 2016).

2. Literature Review

The World Health Organization (WHO) established the Global Strategy to Accelerate the Elimination of Cervical Cancer as a Public Health Issue because of recognizing cervical cancer as a disease of inequality and an indicator of failure of the health care system (WHO, 2020; Canfell et al., 2020). The required reduction to fewer than 4 cases per 100,000 woman-years is termed "elimination," which has been previously achieved by certain countries with high income. It is premised on the evidence-based targets of 2030 of 90% of girls aged 15 fully vaccinated against HPV; 70% of women aged 45 and above screened (with a test of high performance, such as an HPV DNA test) at least twice; and 90% of women with cervical disease receiving treatment and care (WHO, 2020). These global goals would mean millions of diseases and fatalities that may be avoided by the century due to mathematical modeling (Canfell et al., 2020; Simms et al., 2019). The South Asian region, characterized by the Association of Regional Cooperation (SAARC) has a unique and complicated cervical cancer environment (GLOBOCAN, 2022). A number of the South Asian nations have lower reported cases of crude incidence as compared with many high-income regions, although mortality rates are skewed (Bray et al., 2018; Sung et al., 2024). To a considerable extent, such apparent paradox is explained by the lack of diagnostic work, suboptimal systems of cancer monitoring, and population-based screening coverage (Sankaranarayanan et al., 2015). There are high incidences of women in the region reporting disease at advanced stages, which, due to long durations of symptoms, significantly reduce the possibility of effective treatment and eventual survival (WHO, 2020).

The ultimate cause of the high mortality rate associated with cervical cancer in Pakistan is the late treatment regime presentation and access to timely, high-quality treatment (Qadri & Faruqui, 2023; WHO, 2020). Clearly, there are no organized population-based screening programs, and opportunistic screening is at the back end, which can be found only in cities (Ali et al., 2021). The population lacks awareness of cervical cancer, its precipitating factors and prevention treatments, including misconceptions on gynecological screening, further discouraging women from consulting health facilities (Hirani et al., 2019; Khan et al., 2021). Because of this, several of the cases can hardly be diagnosed before the symptoms develop out of the ordinary and the disease advances. Another factor that leaves an impression is age which influences attitudes and acceptability. There is a tendency to encourage HPV vaccination among younger individuals aged 18-35, unlike among older individuals (Khan et al., 2023; Mehboob et al., 2023). It might have to do with an increased desire to engage in preventative health campaigns, more educational achievements, and more exposure to digital media (WHO, 2020). The older generations, however, often report the rise of skepticism, lack of perceived relevance, and strongly rooted

misunderstandings (Hussain et al., 2020). All these features form the basis of the necessity to implement interventions based on age and context with specific reference to community-based education in rural areas, the involvement of elder caregivers, and providing healthcare professionals with the opportunity to actively promote HPV vaccination and cervical cancer prevention (WHO, 2023; UNICEF, 2023). In Pakistan, sexual and reproductive health remains a very sensitive and taboo issue that presents a significant challenge to the free discussion of prevention of cervical cancer and HPV vaccination (Hussain et al., 2020; Qadri & Faruqui, 2023). Since sexual contact is the main infection of HPV, it is often violently misinterpreted that the vaccine encourages sexual activity and not cancer (WHO, 2020). Most parents, especially of young females, consider HPV to give them license to promiscuity by fearing that immunization against sexually transmitted disease may be an invitation to premarital sex (Ali et al., 2021; Mehboob et al., 2023). These are beliefs that are deeply entrenched into cultural values that groom chastity and modesty such that any talk about teenage sexual health is not a socially comfortable issue in the family and society (Hirani et al., 2019; Hussain et al., 2020).

There are also religious and ethical considerations that affect the opinion about vaccinations (Qadri & Faruqui, 2023). Other caretakers would be worried about the allowable content of vaccines, namely the use of reports of the presence of haram substances like porcine-derived proteins (WHO, 2020; UNICEF, 2023). Without definitive, official directives, such concerns may incubate and increase indecisiveness (Hussain et al., 2020). The stigma of sexual health, commonly held ignorance, past distrust and religious uncertainty are all actors in a tangled web of barriers to HPV vaccination acceptance and uptake in Pakistan (WHO, 2023). Receptivity has been proven to be increased by educational campaigns that position the HPV vaccine strategically as an empowerment and cancer prevention tool and not by emphasizing sexual transmission (Khan et al., 2023; Mehboob et al., 2023). When messaging is done in a manner that overrides the importance of preserving the future health and fertility and well-being of daughters, parents and caregivers will positively react (Ali et al., 2021). With community talks, school-based programs, and involvement of local leaders that people trust, these methods have the potential of transforming suspicion into acceptance (WHO, 2020; UNICEF, 2023). The agreement among such facilitators holds that culturally based, faith-based, and community-based strategies play a crucial role in eliminating barriers and enhancing rates of HPV vaccination in Pakistan (WHO, 2023).

In 2025, the government of Pakistan made an important step of becoming the first country to establish a countrywide initiative on HPV suppliers and vaccination programs in September for preventing cervical cancer (UNICEF, 2025; WHO, 2025). This initiative was the pioneer venture in the country that involved the largest-scale movement to implement the preventive arm of the WHO cervical cancer strategy through the use of a preventive pill (WHO, 2020). The program was aimed at 13 million girls between the ages of 9 and 14, which is the age range recommended to have optimal immunization coverage before sexual debut (WHO, 2022; Gavi, 2024). The earliest implementation focused on Punjab, Sindh, the Islamabad Capital Territory (ICT), and Azad Jammu and Kashmir—areas that were selected according to populace, preparedness of health systems, and logistical feasibility (Government of Pakistan, 2025; UNICEF, 2025). In facilitating this integration, Pakistan agreed with Gavi to a new co-financing plan down to a 33 percent government contribution to the costs of vaccines instead of 45 percent (Gavi, 2024). This change was meant to ease budgetary constraints and enhance affordability at the initial stages of scale-up as well as amidst the wider economic restrictions (Gavi, 2024; WHO, 2023). This financial restructuring is essential in the continuity of the programs and the prevention of disruptions that can decrease the trust of the people (WHO, 2020). The geographic expansion of the program will

be done at separate stages to ensure the preparedness of the healthcare system and logistical sustainability (Government of Pakistan, 2025). Khyber Pakhtunkhwa will become a member in the year 2026, with Balochistan and Gilgit-Baltistan becoming members in 2027 (UNICEF, 2025). These subsequent steps will require the use of specific implementation strategies to manage challenges such as security, geography, a shortage of health workforce, and low levels of knowledge (WHO, 2023; UNICEF, 2025). Enhancing surveillance mechanisms, ensuring uninterrupted vaccination supplies, and developing community confidence are essential for a country's coverage and for transferring the benefits of vaccination to a decrease in long-term incidences and mortality rates due to cervical cancer (WHO, 2020; Canfell et al., 2020).

The Health Belief Model (HBM) is possibly one of the most popular and oldest theoretical models of the study of preventive health behaviors, including the one of vaccination uptake (Rosenstock, 1947; Becker, 1974). The method is premised on the hypothesis that people make health-related choices by their subjective views of risk, usefulness, and possibility instead of the objective medical information itself (Glanz et al., 2015). The HBM is particularly applicable in the context of HPV vaccination, where personal beliefs about cervical cancer and HPV infection affect an individual and a caregiver in making accounts on the topic (Brewer & Fazekas, 2007; Bish et al., 2011). The Theory of Planned Behavior (TPB) offers an in-depth and behavior-based explanation of vaccine uptake with a further focus on behavior intention as the most proximate and active predictor of behavior (Ajzen, 1991). The TPB postulates that intention is determined by three main constructs, which include attitudes toward conduct, subjective norms, and perceived behavioral control (Ajzen, 1991; Fishbein & Ajzen, 2010). The concept in particular is significant to the decision of vaccination that is often purposeful, socially driven, and situational (Bish et al., 2011).

3. Research Methodology

The research design for this study focuses on the knowledge, attitudes and parental willingness towards the human papillomavirus (HPV) infection and cervical cancer vaccination having one daughter under the age of 9-14 years. A quantitative approach was employed for this research to gather the data. Those mothers were selected who were living in Lahore and had one daughter aged 9-14 years. A random sampling technique was used to ensure representation of mothers from diverse educational backgrounds, economic statuses, marital statuses, occupational statuses, and numbers of children they have. The sample size for this study was 300 mothers. A structured closed-ended questionnaire was used to collect data. Mothers were surveyed in an offline manner. The research survey contained five sections, having eight demographic questions, four questions about the knowledge of cervical cancer and HPV vaccination, nine questions on the knowledge of cervical cancer vaccination and HPV infection, four questions about the attitude towards HPV vaccination, and eight questions on the parental willingness towards the cervical cancer vaccination and HPV infection.

To ensure the reliability of this self-developed questionnaire used in this study, statistical analysis was conducted. The reliability assessment focuses on the internal consistency. This helps gauge how closely the same idea applies to all the objects. It also guarantees that the data gathered is reputable, correct and precise. To test internal consistency, Cronbach's alpha (α) was applied to each section of the questionnaire. Alpha 0.70 was believed to be a strong relationship between variables. The Cronbach's alpha values of different variables are: Knowledge of cervical cancer and HPV infection: 0.703. Attitudes towards the HPV vaccination: 0.664. Willingness towards the HPV vaccination: 0.888. The results show that the surveyed questionnaire is acceptable and highly reliable to measure all these factors.

Ethical considerations were ensured by taking the respondent's voluntary participation in the study, which was based on his or her own choice and ability to join or quit at any time. Informed consent means that by accepting participation in the study or refusing to participate, the participants ought to be informed about the purpose of the study. T. Researchers ensured that they kept respondents' information confidential.

4. Data Analysis

4.1 Data Analysis Procedure:

This study has three methods in the data analysis. The current data analysis was done with the help of the IBM SPSS software. The analysis firstly checks the reliability of the research tool. Secondly, the frequency and percentage of the participants' background information should be analyzed. Thirdly, one-way ANOVA was executed to check the relationship between the age group and monthly income group and the willingness of the mothers towards vaccination. Fourthly, to summarize the data and inference statistics like Pearson correlation and regression analysis to investigate relationships among important variables.

4.3 Descriptive Statistical

Socio-Demographic Characteristics of Respondents (N=300)

Table 1: *Socio-Demographic Characteristics of Respondents*

Variable	Category	n	Percentage
Age	25–34 years	95	31.7
	35–44 years	101	33.7
	45–54 years	64	21.3
	55 years and above	40	13.3
Marital Status	Married	189	63.0
	Widowed	31	10.3
	Divorced	40	13.3
	Separated	40	13.3
Education	No Formal Education	11	3.7
	Primary	24	8.0
	Secondary	40	13.3
	Intermediate	111	37.0
	Graduate	84	28.0
	Postgraduate	30	10.0
Occupation	Housewife	143	47.7
	Private Employee	81	27.0
	Government Employee	40	13.3
	Self-Employed	31	10.3

	Other	5	1.7
Monthly Income	< 30,000 PKR	64	21.3
	30,000–50,000 PKR	148	49.3
	50,000–100,000 PKR	78	26.0
	> 100,000 PKR	10	3.3

Table 1 illustrates the socio-demographic characteristics of 300 mothers who were sampled for the study. The majority of respondents were between 35 and 44 years of age (33.7%), while the people aged between 25 and 34 were in the next position (31.7%). The majority of the participants were married (63.0), having intermediate-level education (37.0), and housewives (47.7). Almost (49.3%) half of the respondents indicated that the monthly income of their family ranges from 30,000 to 50,000 PKR.

Reliability Analysis of the Tool

Table 2: *Reliability Analysis of the Variables*

Variable	Number of Items	Cronbach's α	Mean	SD
Knowledge	9	.703	4.61	2.30
Attitude	4	.664	11.56	3.03
Willingness	8	.888	17.31	5.84

Table 2 explains that Cronbach's alpha was used in the investigation to determine the internal consistency of the scales used in the study. The instrument was used for further analysis as the knowledge scale, attitude scale and willingness scale showed good, acceptable and excellent reliability, respectively, as the α values were .703, .664, and .888, respectively.

Knowledge of Cervical Cancer and HPV Infection and Vaccination

Table 3: *Knowledge of Cervical Cancer and HPV Vaccination*

Item	Correct Response (%)
Heard about cervical cancer and HPV vaccination	80.7
Cervical cancer affects only women	51.0
Cervical cancer is curable in early stages	63.3
Abnormal vaginal bleeding is a symptom	63.0
HPV vaccine can be given to sexually active individuals	67.0
Regular Pap smear needed after vaccination	80.3
HPV is sexually transmitted	47.7
HPV can affect individuals without multiple sexual partners	66.0

Knowledge of Cervical Cancer and HPV Vaccination

Table 3 explains the knowledge of cervical cancer and HPV infection and vaccination. The majority (80.7%) of the respondents said that they heard about cervical cancer and HPV

vaccination. Regarding disease-related knowledge, 63.3% responded that cervical cancer could be cured if an individual got the treatment early on, and 80.3% knew it was important to have regular pap tests after the HPV vaccine. Notwithstanding, misconceptions were present, with only 47.7% identifying HPV as a sexually transmitted disease.

Attitude Towards HPV Vaccination

Table 4: *Attitude Towards HPV Vaccination*

Statement	Agree/Strongly Agree (%)
Concerned about HPV vaccine side effects	41.6
Need more information before deciding	43.6
HPV vaccination and screening are expensive	35.7
HPV vaccination encourages early sexual activity	18.3

Table 4 demonstrates the attitude towards HPV vaccination; around one-half of the respondents talked about concerns about the potential side effects of HPV vaccines, including 41.6% who stated they were concerned with the potential side effects associated with HPV vaccination. Additionally, 43.6% expressed a need for more information prior to deciding on a vaccination. There was also a high proportion (35.7%) of those saying that HPV vaccination and cervical screening were costly.

Parental Willingness Towards HPV Vaccination

Table 5: *Parental Willingness Towards HPV Vaccination*

Variable	Response	n	%
Healthcare professional recommended HPV vaccine	Yes	71	23.7
Daughter received HPV vaccine	Yes	143	47.7
Will vaccinate if government provides vaccine free of cost	Yes	141	47.0
Recommend HPV vaccine to other mothers	Yes	116	38.7
Participate in awareness programs	Yes	73	24.3
Accept vaccine if strongly recommended by doctor	Yes	100	33.3

Table 5 explains the parental willingness towards HPV vaccination, in which 23.7% of the respondents had been recommended by a health care provider to receive HPV vaccination. Almost half (47.7%) said that their daughters had already been vaccinated with the HPV vaccine. 47.0% reported that they would vaccinate their daughters if they could be given the vaccine for free.

One- Way ANOVA Results for Willingness Across Age Groups.

Table 6 illustrates the One-Way ANOVA results for willingness across age groups. To test the difference in willingness scores between age groups, a one-way ANOVA was performed. Statistically, there were no differences in willingness between different age categories, $F(3, 296) = 1.08$, $p = .357$. Thus, mothers' age was not a significant factor when it came to their daughter getting the HPV vaccine.

Table 6: One-Way ANOVA Results for Willingness Across Age Groups

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	110.440	3	36.813	1.081	.357
Within Groups	10080.107	296	34.054		
Total	10190.547	299			

One-Way ANOVA Results for Willingness Based on Monthly Income

Table 7 explains the one-way ANOVA results for willingness based on monthly income. One-way ANOVA was also conducted to determine the differences in willingness among the monthly income groups. The results showed that the difference between the means was significant, $F(3, 296) = 16.296, p < .001$. The respondents with the lowest monthly income (PKR 30,000 and below) presented significantly higher mean scores for willingness than the other categories of income.

Table 7: One-Way ANOVA Results for Willingness Based on Monthly Income

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1444.529	3	481.510	16.296	.000
Within Groups	8746.018	296	29.547		
Total	10190.547	299			

Pearson Correlation Matrix Among Knowledge, Attitude, and Willingness

Table 8 illustrates the Pearson correlation matrix among knowledge, attitude and willingness. A significant positive Pearson correlation was found between knowledge and willingness ($r = .523, p < .001$). Moreover, there was a strong relationship between knowledge and attitude, $r = .603, p < .001$. The results indicate that knowledge is correlated with positive attitudes and willingness to get HPV vaccination.

Table 8: Pearson Correlation Matrix Among Knowledge, Attitude, and Willingness

Variable	1	2	3
Knowledge	—		
Attitude	.603***	—	
Willingness	.523***	—	—

Multiple Regression Analysis Predicting Willingness Toward HPV Vaccination

Table 9 demonstrates a multiple regression analysis predicting willingness to vaccinate. Multiple linear regression analysis was performed to assess the predictive models of knowledge and attitude on willingness towards HPV vaccination. The overall regression model was statistically significant, $F(2, 297) = 67.60, p < .001$, explaining 31.3% of the variance in willingness ($R^2 = .313$). Knowledge emerged as the strongest predictor of willingness ($\beta = .372, p < .001$), followed by attitude ($\beta = .250, p < .001$). These findings suggest that a mother's knowledge and positive attitudes towards HPV vaccination were significant and strongly linked to increased willingness to vaccinate daughters.

Table 9: Multiple Regression Analysis Predicting Willingness Towards Vaccination

Predictor	B	SE	β	t	P
Constant	7.392	1.112	—	6.648	< .001
Knowledge	0.946	0.153	.372	6.173	< .001
Attitude	0.481	0.116	.250	4.139	< .001

5. Discussion and Conclusion

5.1 Discussion

This study shows a persistent knowledge-attitude-willingness "gap," which is a rather significant issue in the interventions of the public health of the HPV vaccination. While the findings show a relatively high level of general awareness about cervical cancer and HPV, such awareness appears to be rather surface and fragmented, not the depth of awareness that will enable good health decision-making. A significant percentage of the respondents did not identify HPV as the leading cause of cervical cancer or completely comprehend the mechanisms of transmission and prevention of HPV. This lack of awareness towards knowledge indicates that exposure to information is not an adequate element in the creation of behavior change. Rather, knowledge should be accurate, complete and relevant, and humans should be able to internalize the health risks and benefits in a way that influences behavior. This is consistent with the literature that points out that health education interventions need not only raise the awareness but must focus on increasing the level of health literacy, critical thinking and consideration of culturally relevant knowledge to close the knowledge-willingness gap.

The study also finds that the advent of social media as a mainstream mode of communication is an opportunity and a threat to the field of communication in swaying the target audience on the issue of health with the rising dominance of the field. On the one hand, Internet tools could present fast, global and low-cost methods of delivering health information, especially with urban dwellers increasingly having access to the Internet. Conversely, the controlled and decentralized forms within social media make it easy to propagate disinformation, misconceptions and unsubstantiated claims, especially on sensitive issues such as HPV that is closely scrutinized against the background of sexual transmission. This two-level type of social media makes knowledge more complex since it presents individuals with conflicting messages, causing confusion, anxiety, and, eventually, reluctance to get vaccinated. This point is further worsened by the systematically relatively low role of the healthcare professionals as the source of information, indicating a lack of trust or lacking accessibility or effectiveness of communication within the formal healthcare system. Furthermore, vaccine refusals and doubts' persistence despite the removal of financial obstacles suggests that financial affordability is not sufficient to promote vaccine acceptance. On the contrary, culturally ingrained beliefs, perceptions of sexually transmitted diseases, and worries about safety and side effects of the vaccination are vital in attitude and behavioral formation. The results of these studies demonstrate the need to employ multi-dimensional methods of communication that should not only deliver correct information but also combat false information and respond to sociocultural issues.

Statistically significant correlations between knowledge, attitudes, and willingness to vaccinate provide essential theoretical and practical insights into the dynamics of health behavior. Not only the positive correlation between knowledge and willingness but also the strong connection between information and attitudes justifies assumptions that are designed in the behavioral

frameworks of established models of health behavior like the Health Belief Model (HBM) and the Theory of Planned Behavior (TPB). The assumption made by these models is that the perceptions of risk, perceived benefits and barriers, and social norms can shape the health-related behavior of individuals. In this respect, the results imply that better knowledge will result in the formation of more positive attitudes towards HPV vaccination, which will raise the chances of acceptance of vaccines. The explanatory strength of knowledge and attitudes, however, is not universal, meaning that there are other factors, like subjective norms, perceived behavioral control, trust in healthcare institutions, and experience with misinformation, that contribute to behavioral intentions. Accordingly, population health education, to build trust and reduce anxiety and engagement of the community in productive discussion, should be part of the total intervention program on HPV vaccination uptake.

Socioeconomic disparities in willingness indicated that low-income respondents exhibited a greater propensity to receive the vaccination compared to their high-income counterparts. This trend might be considered paradoxical, yet it can be attributed to unequal attitudes to risk, access to information, and belief in the availability of health care services by the government. Populations who are less advantaged might feel more susceptible to health risks since they cannot have access to healthcare services and thus are more open to preventative health care strategies like vaccination. By contrast, wealthier respondents might be able to access greater numbers of sources of information, some of which provoke doubt or consideration of the risks, hence leading to warier or critical responses to vaccination. Moreover, the fact that there was no significant difference in age and willingness ideally means that vaccination hesitation is a universal phenomenon that cannot be divided by any demographic. It suggests that the needs of various individuals should be addressed by various population-wide strategies that are inclusive and require the attention of multiple groups to carry out public health intervention in a universal manner and not restrictively in terms of age. Such interventions can be made more effective by formulating the message in the way that it can be presented to various socioeconomic groups.

The study provides a reference to the value of multifaceted public health interventions, which have the potential to improve the knowledge gaps, change attitudes, counter disinformation, and establish favorable social environments over health promotion activity. Moreover, the results imply the necessity of the context-specific interventions based on the cultural and socioeconomic aspects of the target audience, instead of the generic awareness-raising activities. Such an all-inclusive approach may be more useful in encouraging the use of the HPV vaccine and helping achieve the long-term goal of reducing the burden of cervical cancer in Pakistan, with the help of policymakers and healthcare practitioners.

5.2 Recommendations

5.2.1 Utilization of Trusted Information Channels on Social Media

Since the use of social media as a notable source of information in general is important, then government bodies and health authorities should strategically use digital media to provide credible and evidence-based information. This involves establishing a proactive and credible presence on popular websites where precise content can be provided in the form of an infographic, a little movie, a testament or interactive features. In the meantime, similar actions need to be executed to counter misinformation and disinformation, which might become viral with time and contribute greatly toward the reluctance to become vaccinated. Digital influence makers, healthcare specialists, and boosters of the community will also be potential partners to expand the scope of the correct message. It should be noted that such digital methods should be highlighted with

improved or extended traditional modes of communication like television, radio and print media so that those with limited or no internet access may be included. By applying current and traditional approaches, the public health message could negatively affect people and gain trust.

5.2.2 Enhancing the Role of Healthcare Professionals

Some of the major players who offer quality health information and help are the Lady Health Workers, nurses, physicians, etc. The results of the study indicate that they are supposed to be more engaged in HPV-related education and promulgation of vaccination. This could be achieved through the deployment of customized training programs that would help provide the healthcare staff with the latest HPV information, communications skills, and how they would respond to patient concerns and misconceptions. The patient-centered model will guide health care professionals and ensure they engage in deliberate discussions with mothers and provide individualized advice that will restore their trust and confidence in accepting the immunization. Also, introducing HPV education and instruction in routine health care provider interactions (as a part of visits to mothers and children) would provide the opportunity to create awareness and support constantly. Such a patient's empowerment method will not only enhance the quality of information given but will also result in the overall boost in the credibility of the public health programs.

5.2.3 Promoting Community and Religious Engagement

Since health behaviors in Pakistan are affected by sociocultural and religious determinants, it is important to include community leaders and religious experts in the activities of promoting the HPV vaccination in Pakistan. The moral or cultural issues that may underline a misperception relating to HPV vaccination can lead to antagonism and stigma, especially in more conservative situations. By bringing in more recognized authority within communities, the rewriting of myth to be centered on vaccination as a preventative measure of health instead of sexual behavior would be reinstated. In such a case, religious leaders, in particular, may become precisely the key to the successful illustration of the idea that vaccination does not contradict the overall objectives of health maintenance and illness prevention. The community-based forums, awareness, and collaborative activities could all be utilized to foster open communication, stigma reduction, and trust development. Interventions that concentrate on what cultures believe are significant are essential in breaking down massive hurdles as well as building a holistic approach to convince the entire community to volunteer to take the HPV vaccination.

5.2.4 Implementation of School-Based Vaccination Programs

Vaccination in schools is a classic and effective approach that can be implemented and expanded to bring an increase in HPV vaccination rates of the target age group. The intended audience (large groups of teenagers) at schools can be easily accessed in a professional and relaxed environment. Inclusion of HPV vaccination into the existing school health interventions may help to mainstream the process, overcome logistical challenges, and assure timely immunization. More so, parent and school educational activities could be used in encouraging school-based interventions, which would promote the presence of knowledge and a suitable environment for the vaccination process. By incorporating vaccination into the learning cycle, the politicians will be able to make the processes of access and uptake of vaccination considerably easier.

5.2.5 Policy Integration and Long-Term Sustainability

To make sure that HPV vaccination programs are effective in the long term, the national immunization program implemented in Pakistan ought to think about using the HPV vaccine as a

form of preventative health care. It ought to be stated as a policy commitment towards financial stability, fair distribution of finances, and implementation within all sectors of the economy, with special reference being given to underprivileged and rural groups. The inclusion of HPV immunization in current immunization initiatives can be effective in boosting efficiency, reduce redundancy, and bring about long-term change. Moreover, transparency during the development of national guidelines, monitoring, and evaluation will aid policymakers to analyze progress, address barriers and make revisions based on the existing data.

5.3 Conclusion

The current research highlighted the importance of awareness of HPV and the willingness of mothers towards cervical cancer vaccination for their daughters. Although a high percentage of the interviewed mothers claimed that they had heard about cervical cancer and the availability of vaccines, they had shallow and insufficient knowledge about the disease, how HPV is passed, and the effectiveness of the vaccine in prevention measures against this disease. This gap shows that merely being exposed to information is insufficient to obtain functional health literacy; otherwise, it cannot be put to use to make educated judgments. Moreover, the results show that mothers' knowledge, as well as attitudes, are one of the most significant predictors of the willingness to vaccinate, although they do not occur in isolation. Instead, there is a complex mechanism of being uninformed and having to deal with the consequences of that ignorance, such as cultural values and norms in the society, fear of sexually transmitted diseases, and distrust of healthcare facilities and professionals. Consequently, this hinders and delays the process of translating information into preventive health practices because more people are becoming aware. It is necessary to reassess public health campaigns to guarantee that they facilitate not only the dissemination of information but also the provision of high-quality, credible, and culturally relevant information. Therefore, a contextual approach is essential to surpass the conventional methods of enhancing awareness of the HPV vaccine.

Conflict of Interest

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