Current Research in Medical Sciences
p ISSN: 3116-0298

Student Research Committee
Babol University of Medical Sciences

Original Article

Knowledge of Human Papillomavirus Infection and Vaccination among Female Healthcare Workers in Northern Iran: A Cross-Sectional Study

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Article Info.

Received: 7 May 2026
Accepted: 28 Jun 2026

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Cite this article
Babazadeh A, Amouzade Arayi M, Ramezaninejad S, Ebrahimpour S. Knowledge of Human Papillomavirus Infection and Vaccination among Female Healthcare Workers in Northern Iran: A Cross-Sectional Study. Curr Res Med Sci. 2026; 10: 28-37.
DOI: 10.22088/crms.10.1.28

[Downloaded from crms.mubabol.ac.ir on 2026-11-23]

[DOI: 10.22088/crms.10.1.28]

Abstract

Background: **:** Human papillomavirus (HPV) is the leading cause of cervical cancer, and vaccination is an effective preventive strategy. Given the limited evidence on healthcare workers' knowledge of HPV vaccination in Iran, this study aimed to assess their knowledge of HPV infection and HPV vaccination.

Methods: This descriptive-analytical study was conducted with the participation of 250 female healthcare workers from teaching hospitals in Babol, Iran. The questionnaire was developed based on previous studies and validated by expert review. SPSS version 21 was used for data analysis, with a significance level set at $p < 0.05$ and data were analyzed using chi-square and independent t-tests.

Results: The study included 220 nurses and 30 midwives with a mean age of 35.71 ± 7.67 years. Overall, 54.8% of participants had a history of undergoing a Pap smear test. The majority of participants (62%) had a high level of knowledge. knowledge levels showed significant relationships with occupation, age, work experience, and marital status. Specifically, midwives had significantly higher knowledge than nurses (17.36 ± 1.79 vs. 15.48 ± 2.73, $p < 0.001$). Additionally, employees with less work experience had significantly higher knowledge ($p = 0.011$). The lowest proportion of correct responses was for the question about the greater effectiveness of the vaccine if administered before sexual contact.

Conclusion: Targeted continuing education programs for healthcare workers may improve HPV vaccine advocacy and increase public acceptance of vaccination programs in Iran.

Keywords: Health Knowledge, Attitudes, Practice, Papillomavirus Vaccines, Health Personnel

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Introduction

Human papillomavirus (HPV) is recognized as the most prevalent sexually transmitted infection (STI) worldwide. Most sexually active males and females have experienced HPV infection at least once in their lifetime, with or without symptoms [1, 2] and some may even be infected more than once. Most of these infections are asymptomatic and transient. Most HPV infections clear spontaneously within a few months, and nearly 90% are cleared within two years [3, 4]. Several types of HPV have been recognized, and most of these are harmless [4].

Based on the type, clinical manifestations caused by HPV range from benign skin lesions to cancers of the anogenital region and head and neck region [5]. HPV is responsible for genital warts in both genders and has the strongest connection with cervical cancer. Cervical cancer is by far the most common HPV-related disease. Almost 99.7% of cases of cervical cancer are caused by persistent infection with high-risk types of HPV [2, 4, 6, 7]. Types 16 and 18 are responsible for 70-80% of cervical cancer [1, 8].

Cervical cancer is the fourth most common cancer among women [9, 10]. Developed countries have reduced the incidence and mortality of cervical cancer due to extensive screening and vaccination programs [11]. There are two main medical interventions for preventing HPV attributable diseases; HPV vaccination, which aims to prevent the spread of HPV, and cervical screening, which aims to identify and treat precancerous cell changes in the cervix and thus reduce the risk of cervical cancer developing [12]. The Cervical Pap smear is the most widely used screening method today for early detection [9].

The Pap smear test has been performed in the Iranian healthcare system from 1990. Screening for cervical cancer using the Pap test starts at age 18 years and over for married women [13]. By using the routine Pap smear screening test, invasive cervical cancer rates have decreased in developed countries over the last 50 years [14]. The indisputable finding of a causal link between HPV and cervical cancer has led the scientific community to the decision to create HPV vaccines [15] and the first safe and efficacious HPV vaccine was developed in 2006 [16]. HPV vaccines represent the first prophylactic vaccines developed against cancer [17] .

Three HPV vaccines have been licensed for use in the United States, though only the nonavalent human papillomavirus vaccine (9vHPV, Gardasil 9—Merck) remains available. The bivalent human papillomavirus vaccine and the quadrivalent human papillomavirus vaccine were discontinued in the United States in 2016 and 2017, respectively [18]. HPV vaccines are directed against high-risk HPV types .

The bivalent vaccine (Cervarix) is composed of HPV genotypes 16 and 18, which are responsible for approximately 70% of cervical cancers. The quadrivalent vaccine (Gardasil/Sylgard), in addition to HPV 16 and 18, contains types 6 and 11, which are responsible for approximately 90% of genital warts. The nine-valent vaccine (Gardasil 9) is composed of HPV types 6, 11, 16, 18, 31, 33, 45, 52, and 58, expanding coverage of high-risk HPV genotypes] [20 , 19]

The age range of 9-26 years is considered as the optimal age of HPV vaccination, and it is recommended that routine HPV vaccination be done at the age of 11-12 years [21-23]. The effectiveness of HPV vaccine is better when administered before the onset of sexual activity [23-25]. However in case of vaccination, screening is recommended later in life because there is still a possibility of infection with other virus genotypes [21]. Children ages 11–12 years should get two doses of HPV vaccine, given 6 to 12 months apart. Only two doses are needed if the first dose was given before 15th birthday. People 15–26 years old who start the series later need triple-doses of HPV vaccine (schedule is 0, 1–2, 6 months apart) [26]. Studies have shown that single or triple-dose vaccination can protects against HPV infection for at least 10 years [28, 27].

Iran has a female population of 30.13 million aged 15 and older who are at risk of developing cervical cancer. In the recent years, the prevalence of high-risk HPV infection among Iranian women has been increased. Currently the HPV vaccine has not been included in the national immunization program in Iran, and only 48% of Iranian women have participated in cervical cancer screening [8, 29].

Even though more than 10 years have passed since its introduction, the global acceptance of the HPV vaccine remains low [30]. Healthcare workers are often the first point of contact with patients and play a critical role in promoting and delivering immunization programs globally. They play pivotal roles in educating patients and their families, mobilizing communities, and administering vaccines [31]. Therefore, the

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[DOI: 10.22088/crms.10.1.28]

awareness and knowledge of HPV infection and the attitude toward HPV vaccines among healthcare workers will greatly influence the success of an immunization program against cervical cancer [32]. Although several Iranian studies have assessed HPV-related knowledge in different populations, limited evidence is available for practicing female nurses and midwives in northern Iran. Moreover, previous findings regarding factors associated with HPV knowledge have been inconsistent. Therefore, this study aimed to assess HPV infection and vaccination knowledge among nurses and midwives working in teaching hospitals affiliated with Babol University of Medical Sciences.

Methods

Study Design and Population

This cross-sectional descriptive–analytical study was conducted in 2020 among female nurses and midwives working in teaching hospitals affiliated with Babol University of Medical Sciences (Shahid Yahyanejad, Ayatolah Rouhani and Shahid Beheshti hospitals). Sampling was conducted by census. During this study period, approximately 950 eligible nurses and midwives were invited across the three teaching hospitals, and 250 healthcare workers completed the questionnaire, yielding a response rate of 26.3 %.

Inclusion Criteria

1.Nurses and midwives of the selected teaching hospitals with at least 6 months of work experience.
2.Willingness to participate in the study.

Exclusion Criteria

1.Refusal to participate in the study.
2.Incomplete questionnaires with more than 20% missing responses.

Data Collection

Data were collected anonymously using an investigator-developed questionnaire, without direct interviews. The questionnaire was distributed to participants, who completed it; the completed forms were then collected and analyzed. The questionnaire consisted of two parts. The first part included demographic questions on age, marital status, education level, length of employment, hospital of employment, department of employment, profession, and history of undergoing screening tests (Pap smear). The second part contained 20 true/false questions assessing knowledge of human papillomavirus (HPV) and its vaccine.

In the questionnaire, one point was assigned for each correct answer and zero for each incorrect answer, resulting in a total score ranging from 0 to 20. The knowledge categories were based on the score distribution (quartiles) and were performed with classification approaches used in previous studies [33]. The participants' level of knowledge was categorized into four groups:

1.No or very low knowledge (score 0–5)
2.Low knowledge (score 6–10)
3.Moderate knowledge (score 11–15)
4.High knowledge (score 16–20)

Validity and Reliability of the Questionnaire

The investigator-developed questionnaire was designed based on previously published studies on HPV infection and vaccination. [12, 33]. Face and content validity were assessed qualitatively through expert review by infectious disease specialists, gynecologists, epidemiologists, and nursing faculty members. The questionnaire was evaluated for clarity, relevance, comprehensiveness, and simplicity, and necessary modifications were made based on the experts' comments.

A pilot study was conducted on 20 healthcare workers with characteristics similar to the target population to assess comprehensibility and feasibility of the questionnaire. Internal consistency was assessed using Cronbach's alpha coefficient ($\alpha = 0.81$).

Statistical Analysis

Data were analyzed using Statistical Package for the Social Sciences (SPSS) software version 21 (IBM Corp., Armonk, NY, USA).

Descriptive statistics were presented as mean ± standard deviation (SD) for continuous variables and frequency (percentage) for categorical variables. The independent t-test and one-way analysis of variance (ANOVA) were used to compare mean knowledge scores between groups. The chi-square test was used to assess associations between categorical variables. A p-value < 0.05 was considered statistically significant.

Ethical Considerations

The study protocol was approved by the Ethics Committee of Babol University of Medical Sciences (Ethics Code: IR.MUBABOL.REC.1400.227). Participation in the

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[DOI: 10.22088/crms.10.1.28]

study was voluntary, and informed consent was obtained from all participants prior to enrollment. Participants' anonymity and confidentiality were strictly maintained throughout the study.

Results

Demographic characteristics

A total of 250 female healthcare workers participated in the study, including 220 nurses (88%) and 30 midwives (12%) from three hospitals. The participants were between 23 and 55 years old, with an average age of 35.71±7.67 years. Most participants (n=202, 80.8%) were married.

The majority (n = 229, 91.6%) held a bachelor's degree, while the remaining participants (n = 21, 8.4%) had higher education (Master's or Ph.D). Length of employment ranged from 1 to 29 years, with an average of 10.58 ± 6.56 years. More than half (n = 137, 54.8%) had a history of undergoing a screening test at least once. The screening rate among married individuals was 66.8%, with the highest screening rate observed in the age group over 40 years, at 71% (Table 1).

Knowledge of HPV and Vaccination

The average knowledge score among participants was 15.70 ± 2.71 out of 20. The minimum knowledge score was 0, and the maximum was 20. Eight participants (3.2%) answered all questions correctly, while one participant (0.4%) answered none of the questions correctly. Based on the classification, 2 participants (0.8%) had very low knowledge, 8 (3.2%) had low knowledge, 85 (34%) had moderate knowledge, and 155 (62%) had high knowledge (Table 2). The questionnaire and the distribution of correct answers to the 20 knowledge questions are shown in Table 3. The first 5 questions concerned general knowledge of HPV infection. The average score for these questions was 4.48±0.74 out of 5 points. More than half of the participants (n = 151, 60.4%) answered all 5 questions correctly.

The next 15 questions addressed knowledge of the HPV vaccine. The average score for these questions was 11.22 ± 2.40 out of 15 points, and only 4% of participants (n = 10) answered all 15 questions correctly.

Table 1: Demographic characteristics of the participants

Variable		Frequency n(%)
Marital status	Married	202(80.8%)
	Single	48(19.2%)
Age groups	≤ 30 years	73(29.2%)
	> 30 years	177(70.8%)
Level of education	Bachelor's degree	229(91.6%)
	Master's and Ph.D.	21(8.4%)
Hospital	Yahainejad	50(20%)
	Beheshti	54(21.6%)
	Rouhani Hospital	146(58.4%)
Department	ICU,CCU	48(19.2%)
	Infectious	14(5.6%)
	Internal medicine	35(14%)
	Surgery	15(6%)
	Obstetrics and Gynecology	45(18%)
	Cardiology	19(7.6%)
	Neonatal	17(6.8%)
	Emergency	33(13.2%)
	Others	24(9.6%)
Profession	Nurse	220(88%)
	Midwife	30(12%)
History of performing screening tests (Pap smear)	Yes	137(54.8%)
	No	113(45.2%)
Work years	0–5 years	70(28%)
	6–10 years	42(16.8%)
	11–20 years	119(47.6%)
	>20 years	19(7.6%)

Ph.D: Doctor of Philosophy- ICU: Intensive Care Unit – CCU: Coronary Care Unit

Table 2: Level of knowledge of HPV infection and its vaccine

Level of knowledge	n (%)
Very low	2 (0.8%)
Low	8(3.2%)
Moderate	85 (34%)
High	155 (62%)

The highest number of correct answers was for the question about the relationship between HPV infection and cervical cancer (94.8%).The lowest rate of correct answers was for the question about the greater

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[DOI: 10.22088/crms.10.1.28]

effectiveness of the vaccine if administered before sexual contact (46%).

Factors associated with knowledge

We conducted an analysis to determine the relationship between knowledge scores and demographic characteristics (Table 4). In this analysis, knowledge scores were significantly associated with profession, marital status, age group, and years of work experience (Table 4).

Table 3: HPV and vaccine knowledge questions

Questions	Correct answer (%)	Incorrect answer (%)
1. HPV can cause cervical cancer. (Correct)	94.8	5.2
2. HPV can be transmitted through sexual contact. (Correct)	94.4	5.6
3. A person could have HPV for many years without having any symptoms. (Correct)	87.6	12.4
4. HPV can cause genital warts. (Correct)	92.8	7.2
5. A person with no symptoms cannot transmit the HPV infection. (Incorrect)	78.4	21.6
6. HPV vaccines protect against all sexually transmitted infections. (Incorrect)	76.8	23.2
7. Girls who have had the HPV vaccine do not need to have smear tests when they are older. (Incorrect)	92.8	7.2
8. Someone who has had HPV vaccine cannot develop cervical cancer. (Incorrect)	93.6	6.4
9. The HPV vaccines are most effective if given to people who have never had sexual contact. (Correct)	46	54
10. The HPV vaccines offer protection against most cervical cancers. (Correct)	68.8	31.2
11. The HPV vaccine offers protection against genital warts. (Correct)	72.8	27.2
12. The HPV vaccine provides lifelong protection.(Incorrect)	76.8	23.2
13. The appropriate age group to receive the vaccine is under 30 years old. (Correct)	62.4	37.6
14. Common side effects of the HPV vaccine include pain, redness, and swelling at the injection site, fever, nausea, headache, fatigue, muscle and joint pain. (Correct)	84	16
15. The FDA has not approved the HPV vaccine. (Incorrect)	81.6	18.4
16. Anaphylaxis (severe hypersensitivity reaction) and syncope are rare side effects of the HPV vaccine. (Correct)	70.4	29.6
17. There is no reliable evidence of long-term side effects of the HPV vaccine. (Correct)	66.4	33.6
18. A person with a history of a severe allergic reaction (anaphylaxis) to a previous dose of the vaccine or its contents, such as yeast, should not receive the HPV vaccine. (Correct)	75.2	24.8
19. Common side effects of the HPV vaccine are mild and resolve on their own. (Correct)	83.6	16.4
20. According to studies, immunity from the HPV vaccine lasts for at least 10 years, but it can persist for several decades. (Correct)	71.6	28.4

HPV: Human Papillomavirus – FDA: Food and Drug Administration

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[DOI: 10.22088/crms.10.1.28]

Table 4: Participant's knowledge scores in relation to demographic characteristics

Variable		Knowledge score (mean ± standard deviation)	Frequency (%)	p-value
Marital status	Married	15.50 ± 2.80	80.8	0.017
	Single	16.54±2.09	19.2	
Age groups	30 years ≤	16.24 ± 2.14	29.2	0.023
	>30 years	15.48±2.88	70.8	
Level of education	Bachelor's degree	15.69±2.73	91.6	0.729
	Master's and Ph.D.	15.90±2.52	8.4	
Hospital	Yahainejad	15.88±2.16	20	0.810
	Beheshti	15.79±3.36	21.6	
	Rouhani Hospital.	15.61 ± 2.62	58.4	
Department	ICU,CCU	15.35±3.07	19.2	0.333
	Infectious	16.21 ± 2.11	5.6	
	Internal medicine	15.28 ± 2.20	14	
	Surgery	16.26±2.71	6	
	Obstetrics and Gynecology	16.57±2.24	18	
	Cardiology	15.42±2.45	7.6	
	Neonatal	15.58±2.52	6.8	
	Emergency	15.72±3.36	13.2	
	Others	15.04±2.92	9.6	
Profession	Nurse	15.48±2.73	88	<0.001
	Midwife	17.36±1.79	12	
History of undergoing a Pap smear test	Yes	15.48±2.90	54.8	0.160
	No	15.97±2.44	45.2	
Work years	0–10 years	16.18 ± 2.27	44.8	0.011
	>10 years	15.31 ± 2.97	55.2	

Discussion

Cervical cancer is largely preventable through HPV vaccination, cervical screening, and treatment of precancerous lesions [34]. According to the 2019 WHO report, Iran had the lowest reported cervical cancer incidence rate in Asia. HPV remains an important public health concern because of its association with cervical cancer and other HPV-related diseases [35]. Previous evidence from Iran has demonstrated insufficient knowledge regarding HPV infection and vaccination among various population groups, including healthcare workers [19]. Given the pivotal role of healthcare professionals in health education, disease prevention, and vaccine advocacy, their level of knowledge may substantially influence both personal preventive behaviors and public acceptance of HPV vaccination [36]. In the present study, the overall level of knowledge regarding HPV infection and vaccination among nurses and midwives was relatively satisfactory. More than half of the participants (62%) demonstrated a high level of knowledge, whereas only a small proportion had low or very low knowledge. These findings are consistent with studies by Sherman et al. [12] and Zargar et al. [33], which reported moderate to high levels of HPV-related knowledge among healthcare personnel. However, lower levels of knowledge have been reported in other Iranian studies, including those conducted by Lotfi et al. and Hashemipour et al. [37, 38]. In Engindeniz's study, there was low knowledge of vaccine-related questions [34]. The observed differences between studies may be attributable to variations in study populations, educational backgrounds, and access to updated educational resources.

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[DOI: 10.22088/crms.10.1.28]

More than half of the participants had undergone Pap smear screening at least once, suggesting a relatively positive attitude toward cervical cancer prevention. This finding is comparable to the results reported by Ebu et al. [39] but substantially higher than the rate observed in Karasu's study [40]. Nevertheless, no statistically significant association was found between knowledge level and Pap smear screening history. This finding does not establish the absence of an association or clarify how knowledge relates to screening behavior.

Comparison between occupational groups showed that midwives had significantly higher levels of knowledge than nurses ($p < 0.001$). This finding highlights the influence of educational and professional background on HPV-related knowledge and is consistent with previous studies reporting higher knowledge among healthcare providers working in gynecology-related settings or among midwifery students [12, 37]. In the study by Zargar et al., there was a significant difference in knowledge about HPV vaccination among different educational groups [33]. In Hashemipour's study, there was a significant relationship between students' field of study and their average knowledge score [38].

Participants aged 30 years or younger had significantly higher knowledge of HPV infection and vaccination than those older than 30 years ($p = 0.023$). Participants in the longer work-experience group had lower knowledge than those in the shorter work-experience group ($p = 0.011$). In contrast, in Zargar et al.'s study, knowledge about HPV infection and vaccination increased with age [33]. In Ebu's study, younger individuals had greater knowledge and acceptance of the HPV vaccine [39].

The knowledge level of single people was statistically significantly higher ($p = 0.017$), which may be due to the age difference between the two groups. The average age of single people was significantly lower ($p<0.001$). In Lotfi et al.'s study, married students had more knowledge than unmarried students [37]. In Hashemipour's study, the average knowledge of unmarried students was significantly higher [38].

Knowledge was higher among participants with greater educational attainment, but the difference was not statistically significant. In Daniel et al.'s study of college students, knowledge was significantly higher among senior students and was directly related to the number of years of university education [41]. In the study by Ghojazadeh et al., the level of education affected the level of knowledge, and the average knowledge score of midwifery and nursing assistants and graduate students was higher than that of other groups [42]. In the study by Ebu et al., the level of education was strongly related to knowledge and acceptance of HPV vaccination, and this relationship was statistically significant [39].

Knowledge was also higher among participants working in gynecology and obstetrics, surgery, and infectious disease wards, but the association between ward assignment and knowledge was not statistically significant. Greater exposure to HPV-related clinical conditions in these departments may partly explain the higher observed awareness, as previously suggested by Sherman et al. and Güven et al [12, 43].

In the present study, 94.8% of participants correctly identified the relationship between cervical cancer and HPV infection. This finding is comparable to Sherman and Wamai's study [12, 31] but lower rates were observed in other studies [37, 38, 40, 42, 44].

In the present study, 94.4% of participants correctly identified sexual contact as a route of HPV transmission. Comparable rates have been reported in previous studies, including 97.8% in Sherman et al. [12], 86% in Karasu et al. [40], 68.4% in Wamai et al. [31], 49.5% in Lotfi et al. [37], 88.6% in Ghojazadeh et al.[42],and 62.8% in Hashemipour et al.[38].

Regarding the necessity of undergoing Pap smear screening after HPV vaccination, 92.8% of participants in the current study responded correctly. Similar findings were reported by Sherman et al. with a correct response rate of 95.3% [12] and Engindeniz et al. with 94% [34]. In contrast, lower rates were observed in Karasu et al. (67%) [40]; Hashemipour et al. (35.5%) [38]; and Mojahed et al. (35.3%) [44].

In the present study, 62.4% of participants correctly identified the appropriate age for HPV vaccination. This rate was lower than those reported by Daniel et al. (94%) [41], and Cheung et al. (73.8%) [45], but higher than the findings of Mojahed et al. (19.6%) [44]. The result of the current study was relatively comparable to that reported by Engindeniz et al. (59.2%) [34].

Regarding the greater effect of the vaccine if administered before sexual contact, the correct response rate in this study was 46%, while in

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[DOI: 10.22088/crms.10.1.28]

Sherman's study it was 83.4%. Regarding the effect of the vaccine in preventing most cases of cervical cancer, the correct answer rate in this study was 68.8%, in Sherman's study 71.5% [12], and in Mojahed's study 4.5% [44].

This study has some limitations. First, the cross-sectional design precludes causal inference between demographic variables and knowledge levels. Second, data were collected using a self-administered questionnaire, which may be subject to response and social desirability bias. Third, the relatively low response rate may have introduced selection bias. Fourth, the study included only female healthcare workers, limiting the generalizability of the findings to male healthcare workers. Finally, potential confounding variables were not controlled for using multivariable regression analysis.

Knowledge was lower among older healthcare workers, those with longer work experience, and nurses compared with midwives, possibly reflecting differences in exposure to updated HPV-related education. These findings highlight the need for continuous professional education and regular refresher training. Consistent with our findings, previous studies have shown that educational interventions significantly improve healthcare workers' knowledge, attitudes, and willingness to recommend HPV vaccination [36, 46].

Conclusion

Although 62% of participants were classified as having high knowledge of HPV infection and vaccination, fewer than half correctly recognized that vaccination is most effective before sexual exposure. Lower knowledge was observed among nurses, participants older than 30 years, and those with longer work experience; however, these associations were not adjusted for potential confounding. These findings support continuing professional education focused on specific gaps in HPV vaccination knowledge. Whether such education improves vaccine recommendation practices or vaccination uptake requires further evaluation.

Acknowledgment

This study was conducted as part of an approved research project at Babol University of Medical Sciences. The authors are grateful for the support of the Vice Chancellor for Research and Technology of Babol University of Medical Sciences. We also thank the nursing managers and all nurses and midwives who generously participated in this research.

Conflict of Interests

The authors declare that they have no conflicts of interest.

Author's contribution

All authors contributed to the study design. AB and SE were responsible for the study design, data analysis and the definition of the intellectual content. MAA contributed to the study design, literature search and data acquisition. SR contributed to manuscript preparation. All authors reviewed and edited the manuscript and approved the final manuscript.

Additional information:

No additional information is available for this paper.

Source(s) of Support: This study was conducted at Babol University of Medical Sciences, supported by funding from the Deputy of health. This research project approved by the Deputy Research of Babol University of Medical Sciences in 2021

Financial support and sponsorship

This study was supported by the Deputy of Health, Babol University of Medical Sciences, Year 2021. The funder had no role in study design, data collection, analysis, interpretation, or manuscript preparation.

Ethics statement

The study was approved by the Ethics Committee of Babol University of Medical Sciences (Ethics Code: IR.MUBABOL.REC.1400.227). All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and the 1964 Declaration of Helsinki and its subsequent amendments or comparable ethical standards.

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