



Exploring the Relationship between Health Literacy and the Effectiveness of Educational Intervention on Pap Smear Testing in Muchesh City in 2023

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Abstract

Introduction: Health literacy is a crucial determinant of preventive health behaviors; however, its role in enhancing the effectiveness of educational interventions for cervical cancer screening, particularly in underserved populations, remains underexplored. This study investigated the interaction between health literacy and a Protection Motivation Theory (PMT)-based educational intervention on Pap smear testing among women in Muchesh City.

Methods: In 2023, a randomized controlled trial was conducted in Muchesh City, Iran, involving 216 eligible women (aged 18–54, married for at least three years, with no history of cancer or hysterectomy) recruited from local health centers. Participants were stratified by health literacy level (high or insufficient), as measured by the validated Health Literacy Assessment Tool for Iran (Cronbach's alpha: 0.72–0.89), and randomly assigned to intervention or control subgroups using block randomization. The intervention group attended four 45-minute educational sessions based on Protection Motivation Theory (PMT), while the control group received standard information after the study concluded. Data were collected using a Sociodemographic Information Questionnaire, the Health Literacy Assessment Tool, and a PMT Constructs Questionnaire. Pap smear uptake was assessed three months post-intervention. Logistic regression and the Sobel test were employed to examine the relationships among health literacy, the intervention, and Pap smear uptake ($p < 0.05$), using SPSS version 26.

Results: Participants had a mean age of 31.69 ± 7.64 years. Regarding education, 34.2% had completed high school and 29.1% had completed middle school, while 92.2% were homemakers. The intervention group was significantly more likely to undergo Pap smear testing compared to the control group (odds ratio = 2.503, 95% CI: 2.848–9.505, $p < 0.001$). Additionally, each one-unit increase in health literacy score was associated with a 2% increase in the likelihood of undergoing screening (odds ratio = 1.020, 95% CI: 1.008–1.033, $p = 0.002$). Health literacy significantly mediated the effect of the educational intervention on Pap smear uptake ($Z = 2.5$, $p < 0.001$).

Conclusions: The PMT-based educational intervention significantly increased Pap smear uptake, with health literacy serving as a key mediating factor. These findings underscore the importance of incorporating health literacy-oriented strategies into cervical cancer screening programs, particularly in low-resource settings.

INTRODUCTION

Cervical cancer is the second most common cancer in women, following breast cancer, and it accounts for 10%

of cancer-related deaths. It is the most prevalent cancer among women aged 20 to 39 in developing countries [1,

2]. According to the World Health Organization's report, malignant tumors are responsible for 25% of women's deaths, with 18% of these cases attributed to cervical cancer [3]. In Iran, cervical cancer ranks as the fourth most prevalent cancer with a prevalence of 3-6% [4, 5]. Pap smear testing, or cervical cytology, has been proven to be the most effective and cost-efficient method for cervical cancer screening. It helps reduce incidence and mortality rates by detecting the disease in its pre-invasive and early invasive stages [6]. A single negative Pap smear can decrease cancer risk by 45%, and annual testing can reduce the incidence of invasive cervical cancer by around 90%. Having nine negative Pap smears over a lifetime can lower this risk to 99% [7]. Various studies have identified low health literacy, insufficient education, lack of knowledge about cervical cancer and Pap smear testing, negative attitudes toward examination, cultural barriers, misconceptions about the disease, and other psychosocial or demographic factors as the main reasons for non-screening [5].

One of the key strategies for enhancing adult public health is the provision of healthcare services such as cancer screening and timely medical interventions. The lack of awareness and knowledge regarding the importance of cancer screening behaviors is often attributed to inadequate health literacy [8]. Health literacy is a skill that enhances individuals' capacity to prevent diseases and improve the quality of self-care [9]. It influences the decisions and behaviors people make regarding their lifestyle [10]. Low health literacy can act as a barrier to accessing health information, healthcare services, medication utilization, and disease prevention [11]. It is associated with limited knowledge of cancer screening, reluctance to undergo screening, reduced access to treatment, inappropriate medication use, non-compliance with medical instructions, increased hospitalizations, and additional financial burdens on individuals, families, and communities [12].

A study by Ghannbari and colleagues in 2016 demonstrated that individuals with adequate health literacy were more proactive in undergoing Pap smear screening than others [13]. The rate of Pap smear testing is low among many Iranian women [14, 15]. Evidence suggests that educational and promotional intervention programs aimed at enhancing developmental factors and motivation can contribute to increased participation and awareness. The impact of educational interventions largely depends on the use of appropriate models in selecting educational programs and addressing health issues [16, 17].

In this research, the protective motivation theory was used to implement educational intervention in women and improve their health literacy level. This theory, proposed by Rogers in 1975, explains the effects of health-related threat perception and the adoption of protective health behaviors. It comprises two stages: Threat appraisal and Coping appraisal, along with the

fear structure. The outcome of these two stages is protection motivation, which includes behavioral intention and actual behavior. For protection motivation to occur, it requires perceived vulnerability and perceived intensity to be more influential than the rewards of an incompatible response, and perceived self-efficacy and perceived response efficiency should be more significant than the costs of an adaptive response [18].

While numerous studies have explored the relationship between education and health literacy and their respective effects on health outcomes, this study seeks to specifically investigate the potential mediating role of health literacy in this relationship. It is among the first to rigorously examine how health literacy may help explain the link between educational attainment and health behaviors. The innovation of this study lies in examining the mediating role of health literacy in the effect of a Protection Motivation Theory-based educational intervention on Pap smear uptake in an area that has been rarely explored empirically in underserved populations. By focusing on a Middle Eastern community, the study also addresses a gap in the global literature. The primary objective of this study was to examine the relationship between health literacy and the effectiveness of educational interventions on Pap smear testing among eligible women.

METHODS

This experimental study was conducted in 2023 in Muchesh City, Iran, targeting all eligible women attending local health centers. Inclusion criteria were: willingness to participate, age between 18 and 54 years, being married for at least three years, and no history of cancer or hysterectomy. Exclusion criteria included non-participation in educational sessions, irregular attendance, excessive absenteeism, or becoming pregnant during the study period (Figure 1). The sample size was determined using power analysis via the *shiny* package in R software, based on a 95% confidence level and 80% statistical power. A total of 108 participants per group was calculated, guided by correlations between independent, mediating, and dependent variables reported in prior studies [19-21]. Sampling was conducted in multiple stages. Initially, the names of eligible women were randomly selected from the SIB system—the national electronic health record platform, known in Persian as the 'Samaneye Behdasht' (Integrated Health System). They completed the Health Literacy Questionnaire. Participants were then divided into high and low health literacy groups based on their scores. Within each group, individuals were randomly assigned to intervention and control groups using block randomization with blocks of four.

Three questionnaires were administered: the Sociodemographic Information Questionnaire, the

Health Literacy Assessment Tool for the urban population of Iran (ages 18 to 65), and the Motivation Protection Theory Constructs Questionnaire. The Sociodemographic Information Questionnaire collected data on age, education, occupation, etc. The Health Literacy Questionnaire had 33 questions covering five dimensions: reading, access, comprehension, evaluation, and decision-making, scored on a 5-point Likert scale. Four additional dimensions were scored on a 4-point Likert scale. Total health literacy scores were calculated and categorized as insufficient (0 to 50), moderately sufficient (50.1 to 66), sufficient (66.1 to 84), or high (84.1 to 100). Montazeri et al.'s research confirmed the questionnaire's structural validity and reliability (Cronbach's alpha coefficients ranging from 0.72 to 0.89) [22, 23].

The Protective Motivation Theory constructs questionnaire, developed by MorowatiSharifAbad et al. [18], used a 5-point Likert scale to assess responses. Constructs like perceived vulnerability, severity, fear, cost, response efficacy, self-efficacy, protective motivation, and reward were measured with specific

items and scoring ranges. Internal stability of the constructs was also acceptable [18].

After obtaining written informed consent and assuring participants of confidentiality, demographic data and health literacy levels were recorded. Individuals with moderately sufficient health literacy were excluded from the study. Participants were then categorized into four subgroups: intervention with high health literacy, control with high health literacy, intervention with insufficient health literacy, and control with insufficient health literacy. The Protection Motivation Theory (PMT) Constructs Questionnaire was administered to the intervention subgroups. A training program based on PMT constructs was delivered across four 45-minute sessions, utilizing various teaching methods, including lectures, group discussions, and educational media. Three months after the intervention, a post-test was conducted, and data on Pap smear uptake were collected. Following the intervention period, general information about Pap smear testing was provided to the control subgroups.

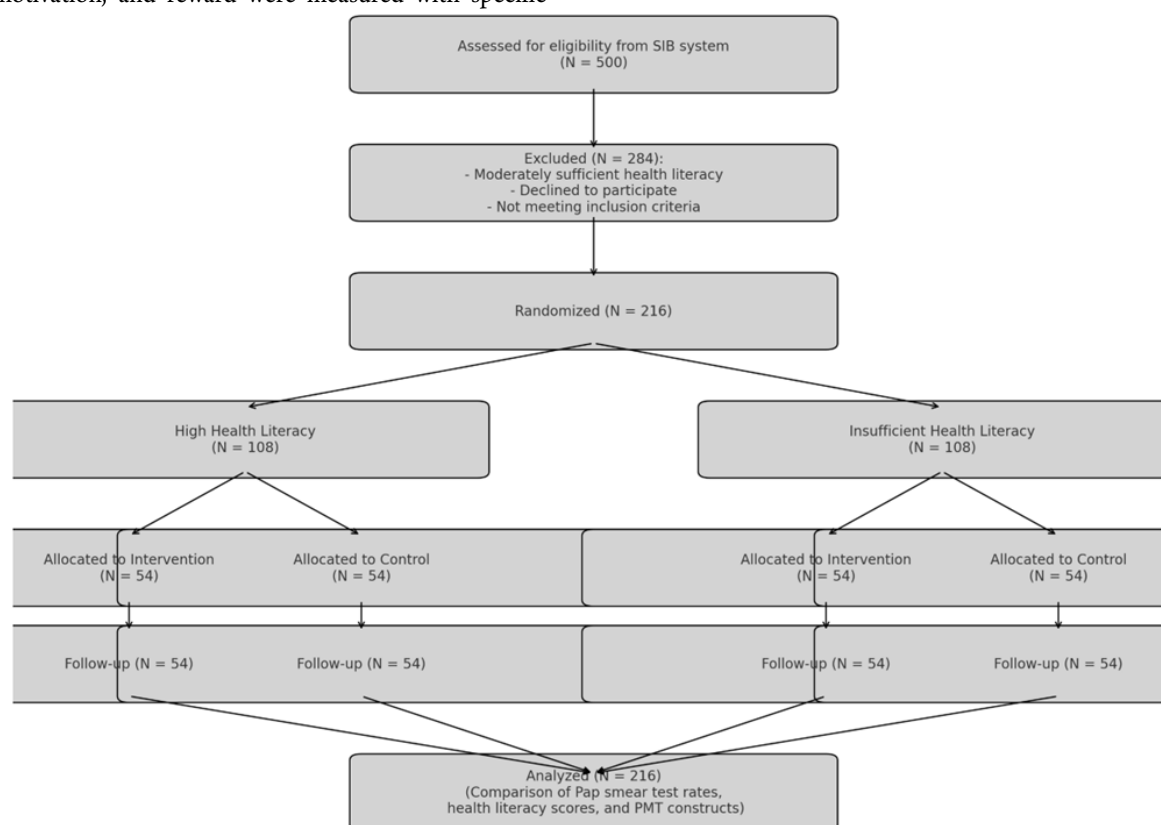


Figure 1. Consort diagram

Data analysis was done using SPSS version 26, with a significance level of 0.05. Mediation analysis and logistic regression were used to examine the relationship between Pap smear testing and educational interventions, considering the influence of health literacy, tested with the Sobel test.

RESULTS

The results indicated that the average age of the individuals in this study was approximately 31.69 ± 7.64 years, and the average duration of marriage was approximately 14.13 ± 7.96 years. Most women had a high school education (34.2%) and middle school

education (29.1%), while the majority of husbands had middle school and high school education, with 33.2% and 27.8%, respectively. The majority of individuals were homemakers (92.2%), and a smaller percentage worked as employees (7.8%). The results showed that most people (31.4%) had undergone a Pap smear test in the last 3 years. Descriptive information for the components of the health literacy questionnaire indicated that the average and standard deviation of

individuals' scores in the areas of reading were 9.8 ± 4.3 , in access 14.9 ± 6.73 , in comprehension 17.7 ± 7.3 , in evaluation 10.2 ± 4.00 , and in decision-making 29.9 ± 11.7 . The average and standard deviation of the total health literacy score were 37.7 ± 23.05 . Descriptive information for the components of the health literacy questionnaire, separated by control and test groups, is presented in Table 1.

Table 1. Descriptive Information for the Components of the Health Literacy Questionnaire, Differentiated by Control and intervention Groups (N = 108)

Components	Minimum score	Maximum score	Mean	±SD	crookedness
Control					
Reading	4.00	20.00	8.99 ± 4.20		1.45
Access	6.00	30.00	13.13 ± 7.18		1.40
Comprehension	7.00	35.00	15.76 ± 7.59		1.40
Evaluation	4.00	20.00	9.04 ± 3.87		1.39
Decision-Making	15.00	59.00	26.16 ± 11.04		1.53
Standardized Reading	00	100.00	31.19 ± 26.27		1.45
Standardized Access	00	100.00	29.74 ± 29.95		1.40
Standardized Comprehension	00	100.00	31.31 ± 27.13		1.40
Standardized Evaluation	00	100.00	31.53 ± 24.23		1.39
Standardized Decision-Making	6.25	97.92	29.50 ± 23.01		1.53
Total Health Literacy Score	8.93	94.11	30.66 ± 24.01		1.61
Intervention					
Reading	4.00	20.00	8.82 ± 4.13		1.21
Access	6.00	30.00	13.45 ± 7.13		1.22
Comprehension	7.00	35.00	15.87 ± 7.91		1.24
Evaluation	4.00	20.00	9.09 ± 3.88		1.25
Decision-Making	12.00	60.00	27.34 ± 13.17		1.37
Standardized Reading	00	100.00	30.15 ± 30.08		1.21
Standardized Access	00	100.00	31.05 ± 29.73		1.22
Standardized Comprehension	00	100.00	31.68 ± 28.28		1.24
Standardized Evaluation	00	100.00	31.82 ± 24.31		1.25
Standardized Decision-Making	00	100.00	31.96 ± 27.44		1.37
Total Health Literacy Score	8.93	94.11	31.33 ± 25.76		1.44

Table 2. Comparison of Pap smear test between intervention and control groups and also between high and insufficient health literacy

	Pap smear test		P-value
	No (N= 118)	Yes (N= 98)	
Health literacy			0.021
insufficient	68(57.6%)	41(41.8%)	
high	50(42.4%)	57(58.3%)	
Text			< 0.001
control	79(66.9%)	29(29.6%)	
intervention	39(33.1%)	69(70.4%)	

The descriptive data of the items in the Protection Motivation Questionnaire showed that the average perceived vulnerability score was 50.55 ± 16.98 , the perceived severity score was 63.23 ± 27.14 , the fear score was 62.42 ± 20.91 , the response cost score was 51.71 ± 20.57 , the perceived response efficacy score was 67.34 ± 35.37 , self-efficacy score was 59.19 ± 20.18 , protection motivation score was 61.69 ± 15.37 , and the reward score was 52.16 ± 29.88 . Additionally, the total protection motivation score had an average of 58.56 ± 6.80 . After the educational intervention, there was no statistically significant difference in the average perceived vulnerability score between the control and intervention groups ($p = 0.416$). However, based on the estimated values from the model, the average perceived severity score, standardized response cost score,

standardized perceived response efficacy score, standardized self-efficacy score, standardized protection motivation score, standardized perceived reward score, and total protection motivation score were statistically significant between the control and intervention groups ($p < 0.001$). The results of the chi-square test demonstrated that the relationship between health literacy and the educational intervention in undergoing Pap smear tests was statistically significant ($p < 0.001$) (Table 2).

The results indicated that the statistical relationship between health literacy and undergoing Pap smear tests was significant ($p < 0.001$). Specifically, a one-unit increase in health literacy score increased the likelihood of undergoing a Pap smear test by approximately 2% (Table 3).

Simultaneously, the statistical significance of the relationship between the educational intervention and health literacy with undergoing Pap smear tests was observed ($p < 0.001$). Specifically, the likelihood of undergoing Pap smear tests in the intervention group was approximately 2.5 times higher than the control group. Additionally, a one-unit increase in health literacy score increased the likelihood of undergoing Pap smear tests by around 2% (odds ratio 1.02) (Table 4).

Table 3. Relationship between health literacy and Pap smear using logistic regression model

Independent variable	odds ratio	95% confidence interval		P-value
		lower limit	upper limit	
health literacy	1.018	1.006	1.029	0.003

Table 4. The Relationship between Educational Intervention and Health Literacy in Relation to Pap Smear Utilizing a Logistic Regression Model

Independent variable	odds ratio	95% confidence interval		P-value
		lower limit	upper limit	
Intervention	2.503	2.848	9.505	<0.001
Health Literacy	1.020	1.008	1.033	0.002

The results demonstrated that the role of health literacy as a mediating variable in the relationship between the educational intervention and undergoing Pap smear tests was statistically significant ($Z = 2.5$ and $p < 0.001$).

DISCUSSION

This study investigated the interplay between health literacy and the effectiveness of a Protection Motivation Theory (PMT)-based educational intervention in promoting Pap smear testing among women in Muchesh city in 2023. The results demonstrated that the intervention significantly increased Pap smear uptake, with the intervention group being 2.5 times more likely to undergo testing compared to the control group ($p < 0.001$). Furthermore, a one-unit increase in health literacy score was associated with a 2% increase in the likelihood of undergoing a Pap smear test ($p = 0.002$). Health literacy also played a significant mediating role in the relationship between the educational intervention and Pap smear uptake ($p < 0.001$). These findings highlight the critical role of health literacy as a mediator in enhancing the effectiveness of theory-driven interventions to promote cervical cancer screening in underserved populations. The significant increase in Pap smear uptake following the PMT-based intervention aligns with existing literature on the efficacy of educational programs in promoting preventive health behaviors. For instance, Eghbal et al. (2020) demonstrated that a tailored educational intervention significantly increased cervical

cancer screening rates among rural Iranian women, with post-intervention screening rates rising by 45% in the intervention group compared to controls [5]. Similarly, Malmir et al. (2018) reported that 58% of women in an intervention group underwent Pap smear testing post-education, compared to only 3% in the control group—underscoring the potential of targeted education to overcome barriers such as lack of awareness or access [24]. However, contrasting findings from Rosser et al. (2015) in rural Kenya showed no significant increase in screening uptake post-intervention, possibly due to cultural barriers, limited healthcare infrastructure, or differences in intervention design [25]. These inconsistencies suggest that the success of educational interventions may be context-dependent, necessitating tailored approaches that account for local socio-cultural and structural factors.

The mediating role of health literacy in this study is a key contribution to the literature, as it elucidates how health literacy amplifies the impact of PMT-based interventions. Women with higher health literacy scores were more likely to undergo Pap smear testing, consistent with Rakhshani et al. (2023), who found that higher health literacy was associated with a 1.8-fold increase in regular Pap smear testing [26]. Similarly, Kim et al. (2016) reported that women with higher health literacy exhibited more positive attitudes and behaviors toward cervical cancer screening, with a higher likelihood of screening adherence [27]. The current study extends these findings by demonstrating that health literacy not only directly influences screening behavior but also enhances the effectiveness of educational interventions by facilitating better comprehension, evaluation, and decision-making. This is further supported by Chaleshgar-Kordasiabi et al. (2021), who showed that health literacy strengthens cognitive appraisals and coping strategies for disease prevention, thereby increasing the efficacy of health interventions [28].

The significant improvements in PMT constructs post-intervention ($p < 0.001$)—including perceived severity, response efficacy, self-efficacy, and protection motivation—underscore the value of theory-driven interventions. These findings align with Lee et al. (2000), who identified low knowledge and self-efficacy as key barriers to Pap smear testing among Korean women, with educational interventions increasing screening uptake by addressing these constructs [29]. Similarly, Karimi et al. (2019) highlighted that negative attitudes and lack of knowledge were significant obstacles to screening, which can be mitigated through targeted education that enhances perceived severity and self-efficacy [30]. The current study's use of PMT constructs to design the intervention likely contributed to its success, as these constructs address both motivational and cognitive barriers to behavior change.

Despite the growing body of literature on health literacy and cervical cancer screening, a critical research gap exists regarding the mediating role of health literacy in the context of theory-driven educational interventions, particularly in low-resource settings like Muchesh city. While previous studies have explored the direct effects of health literacy or educational interventions on Pap smear uptake, few have examined their synergistic interaction using a robust theoretical framework such as PMT. This study addresses this gap by demonstrating that health literacy significantly mediates the relationship between PMT-based interventions and Pap smear testing, with a 2% increase in screening likelihood per unit increase in health literacy score. This finding is particularly relevant in underserved communities, where low health literacy and limited access to healthcare services pose significant barriers to preventive care. The study's focus on a Middle Eastern population further addresses a geographical gap, as much of the existing literature focuses on Western or East Asian contexts.

The findings have important implications for public health practice. Health policymakers should prioritize interventions that enhance health literacy alongside educational programs to maximize screening uptake. For instance, integrating health literacy assessments into routine healthcare visits could identify women who would benefit most from targeted education. Additionally, the use of PMT constructs in intervention design offers a replicable model for other preventive health behaviors, such as breast cancer screening or vaccination uptake. The study's results also highlight the need for community-based interventions that address structural barriers, such as the lack of local laboratory facilities in Muchesh city, which was identified as a limitation.

The study has several limitations. First, reliance on self-reported data may introduce response bias, potentially inflating reported screening behaviors. Second, the lack of local laboratory facilities in Muchesh city may have limited access to Pap smear testing, affecting participation rates. Third, the study's focus on a single city may limit generalizability to other populations with different socio-cultural or economic contexts. Future research should incorporate objective measures of screening uptake, such as medical records, and explore the long-term sustainability of PMT-based interventions. Additionally, comparative studies across diverse geographical settings could elucidate contextual factors influencing intervention effectiveness. Finally, investigating the cost-effectiveness of health literacy-focused interventions could inform their scalability in resource-constrained settings.

CONCLUSION

The results demonstrated that interventions aimed at enhancing health literacy can positively influence Pap smear test uptake, highlighting the crucial role of knowledge and awareness in advancing public health and preventing cervical cancer. This study confirms that employing a health education model—particularly the Protection Motivation Theory (PMT)—can effectively increase health literacy, thereby promoting preventive behaviors and contributing to overall community health. Given that health literacy levels in Iran and globally are generally suboptimal, and despite extensive evidence supporting its significance and positive outcomes, it is strongly recommended that targeted training programs be implemented using evidence-based health education models. Such efforts are essential for improving and sustaining preventive behaviors, especially in the context of cancer prevention.

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CONFLICT OF INTEREST

There is no conflict of interests.

ETHICAL CONSIDERATIONS

This study received ethical approval from the Ethics Committee of Kurdistan University of Medical Sciences with the ethics code IR.MUK.REC.1402.046.

AUTHOR CONTRIBUTIONS

All authors have their own responsibilities in this review manuscript. All authors read the final draft of the manuscript and confirmed it.

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