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Electronic Health Literacy of Nurses: Analysis of Demographic and Occupational Determinants

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Abstract

Background: Electronic health literacy, the ability to seek, evaluate, and apply digital health information has become essential for improving care quality. Nurses, as frontline providers, must possess strong eHealth literacy skills. Previous research suggests nurses' literacy levels are influenced by access to educational resources, experience, and demographic characteristics.

Aim: This study aimed to evaluate eHealth literacy and its demographic and occupational determinants among nurse.

Method: This descriptive cross-sectional study was conducted from November 2024 to February 2025. Using stratified random sampling, 334 nurses were selected from public hospitals affiliated with medical universities in Tehran, Iran. Data were collected via a demographic and occupational form and Norman and Skinner's validated eHealth Literacy Scale (eHEALS). Statistical analyses included descriptive statistics, Spearman's correlation, Kruskal–Wallis, Mann–Whitney tests, and multiple linear regression using SPSS version 24, with significance set at $p<0.05$.

Results: The mean eHealth literacy score was 26.08 ± 6.1 (out of 40), indicating a moderate level. Only 10.5% of nurses showed high literacy. eHealth literacy was significantly associated with age, education, work experience, marital status, and work shift ($p<0.05$). Higher literacy was found among younger nurses, those with higher education, and morning-shift workers, while lower scores were seen among older, married, and rotating-shift nurses.

Implications for Practice: The moderate eHealth literacy level was significantly associated with younger age, higher education, morning shifts, and single status, emphasizing the importance of demographic and occupational determinants. Given the cross-sectional nature of the study, these associations do not imply causation. Targeted training for older and rotating-shift nurses, combined with strategies to bolster digital infrastructure, is recommended.

Keywords: Cross-Sectional Study, Digital Health, Determinants, eHealth Literacy, Nurses

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Introduction

The rapid evolution of digital technologies has transformed healthcare delivery systems across the globe. Over the past decade, the integration of digital tools and platforms into clinical practice has introduced new competencies required by healthcare providers (1). Within this context, electronic health literacy (eHealth literacy)—defined as the ability to seek, evaluate, and apply electronic health information—has become an essential professional competency for healthcare providers (2-5). Beyond its effects on patient outcomes, this competency directly influences nurses' clinical decision-making, professional performance, and quality of care delivery (6, 7).

Nurses, as the largest group of healthcare professionals and primary users of hospital information systems, require adequate eHealth literacy to effectively integrate digital resources into clinical practice (8). Insufficient eHealth literacy may compromise evidence-based practice, reduce efficiency in using electronic systems, and limit nurses' ability to guide patients in digital health environments (9-11).

eHealth literacy, as operationalized through the lily model, includes six domains: traditional literacy, media literacy, scientific literacy, computer literacy, information literacy, and health literacy (12). This multidimensional construct highlights that effective use of digital health resources requires both technical and critical appraisal skills. Therefore, identifying factors associated with nurses' eHealth literacy is essential for workforce development and healthcare quality improvement (2, 13, 14).

Nurses, who constitute the largest proportion of healthcare professionals, play a dual role in this digital landscape. They are both users of digital health tools for continuous learning and improvement and facilitators who support patients in navigating health information safely and effectively (15, 16).

Empirical studies indicate that higher levels of eHealth literacy among nurses are linked to increased job satisfaction (17), improved psychosocial functioning (18), better clinical decision-making (17-19), and higher quality of care (18, 20).

Despite the recognized importance of this competency, "evidence on the current status of nurses' eHealth literacy remains mixed". While studies in Denmark (11), South Korea (18), and Jordan (8) report moderate literacy levels among nurses, others from Canada (21) and Ethiopia (22) suggest high proficiency. These discrepancies may be attributed to contextual differences in infrastructure, digital training opportunities, and institutional support mechanisms.

In Iran, empirical data on eHealth literacy among nurses are limited. The few available studies mostly conducted in Tehran and Isfahan (23, 24) have often used small samples and have not comprehensively examined its determinants .Moreover, the Iranian healthcare system has undergone rapid digital transformation in recent years, and contextual factors such as workplace conditions, training opportunities, and cultural–organizational characteristics may influence nurses' eHealth literacy. Therefore, updated and context-specific evidence is needed.

Recent studies have emphasized that demographic and occupational variables can significantly influence nurses' eHealth literacy. Age is a commonly reported factor, with younger nurses typically demonstrating higher levels of digital competency due to their greater familiarity with technology from earlier life stages (25-28). Similarly, higher educational attainment has been associated with better navigation of digital resources and a more critical appraisal of online health information (26, 29). Work experience may contribute positively by enhancing exposure to electronic health systems (30, 31), whereas shift patterns—especially rotating shifts—can limit access to digital training or reduce consistency in information-seeking behavior (18, 32). While demographic variables such as age, educational level, and work experience cannot be directly modified by management, investigating their relationship with eHealth literacy provides important practical insights. For instance, knowing that nurses with higher education levels demonstrate greater eHealth literacy does not imply a mandatory requirement for postgraduate education, but it can guide targeted training programs for nurses with lower formal education. Similarly, understanding the effects of age and work experience helps managers identify subgroups that may benefit most from digital literacy interventions, enabling strategic allocation of educational resources. Despite these associations, research on how these factors interact to influence eHealth literacy, particularly in non-Western contexts such as Iran, remains scarce and underexplored However, the combined effects of these factors have not been adequately investigated in the Iranian nursing workforce.

This study was therefore designed to assess the level of eHealth literacy and its demographic and occupational determinants among nurses working in public hospitals in Tehran, Iran, in 2024.

Methods

This descriptive-analytical study was conducted between November 2024 and February 2025 in Tehran, Iran. The statistical population and research setting included all 10,971 nurses (33) employed in governmental and public educational hospitals affiliated with the Ministry of Health, Treatment, and Medical Education in Tehran (Tehran University of Medical Sciences, Iran University of Medical Sciences, Shahid Beheshti University of Medical Sciences, and the University of Social Welfare and Rehabilitation Sciences).

The sample size was calculated on the basis of parameters derived from the study by Cho et al. (2018) (18), which investigated associations between eHealth literacy and health-promoting behaviors among hospital nurses in South Korea. A correlation coefficient of 0.2 was used as the estimated effect size, corresponding to a small-to-moderate association based on Cohen's criteria (Cohen, 1988) (34). This value was selected because Cho et al. reported a standardized regression coefficient ($\beta \approx 0.20$) for the association between eHealth literacy and overall health-promoting behavior, which aligns with our target analysis. Assuming a power of 80%, an alpha of 0.05, and a design effect of 1.2 to account for cluster sampling, the minimum required sample size was calculated to be 334 via STATA software.

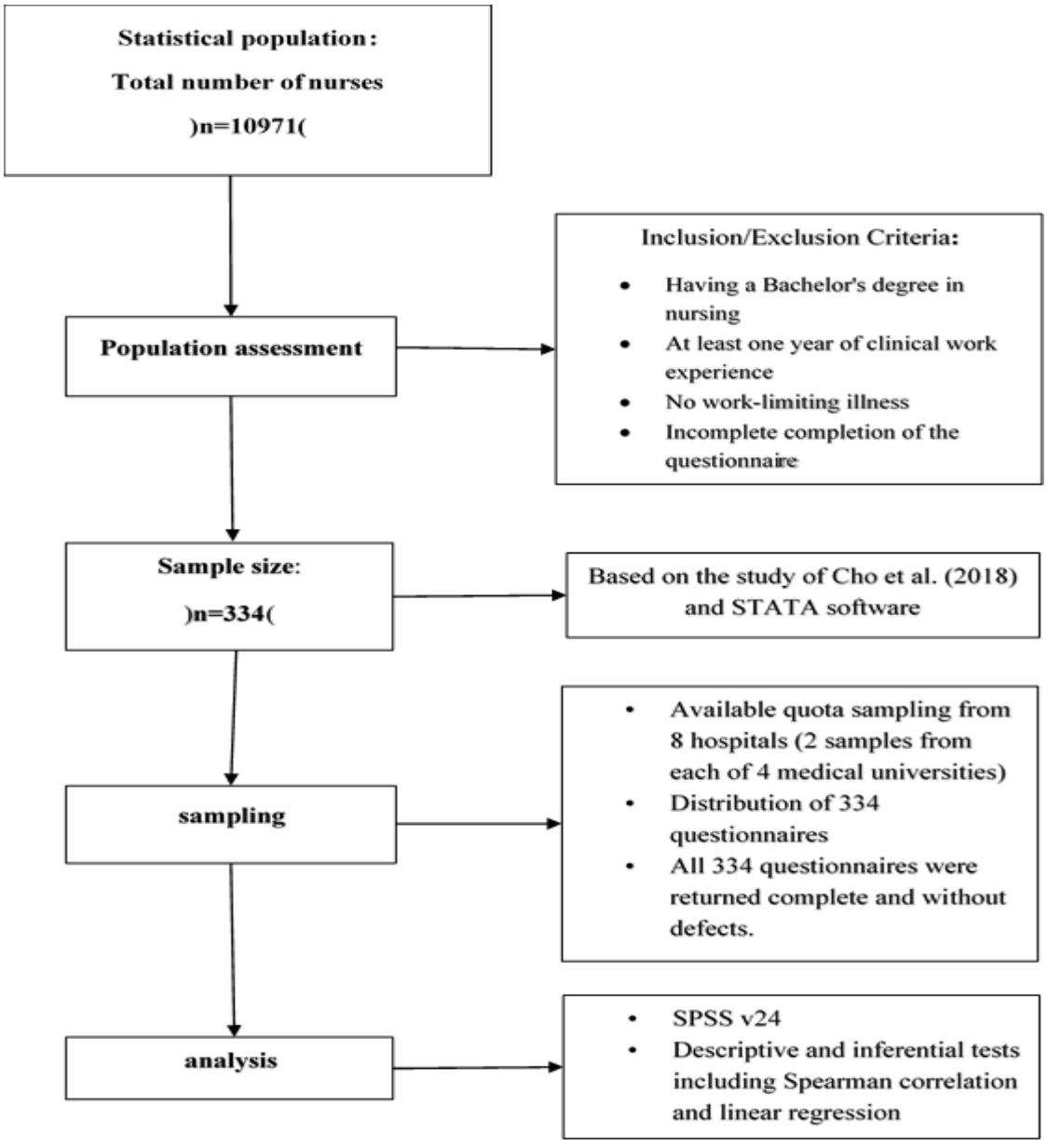

Figure 1: The flowchart of the study process

A flowchart illustrating the participant selection process is presented in Figure 1. In accordance with the instructions of the Iranian Ministry of Health, each of the aforementioned universities covers specific areas of Tehran: Shahid Beheshti University of Medical Sciences (North, Northeast, and East), Tehran University of Medical Sciences (Center and South), Iran University of Medical Sciences (Northwest and West), and the University of Social Welfare and Rehabilitation Sciences (Southeast). Accordingly, sampling was conducted from general hospitals in these regions. Ultimately, two hospitals from each university were selected and included in the study.

Cluster random sampling was used to select eligible hospitals; only general teaching hospitals affiliated with the four major universities in Tehran city were included, and single-specialty hospitals were excluded. From each university, two hospitals were selected: the largest general teaching hospital and one additional hospital randomly chosen from the remaining eligible hospitals (Figure 2).

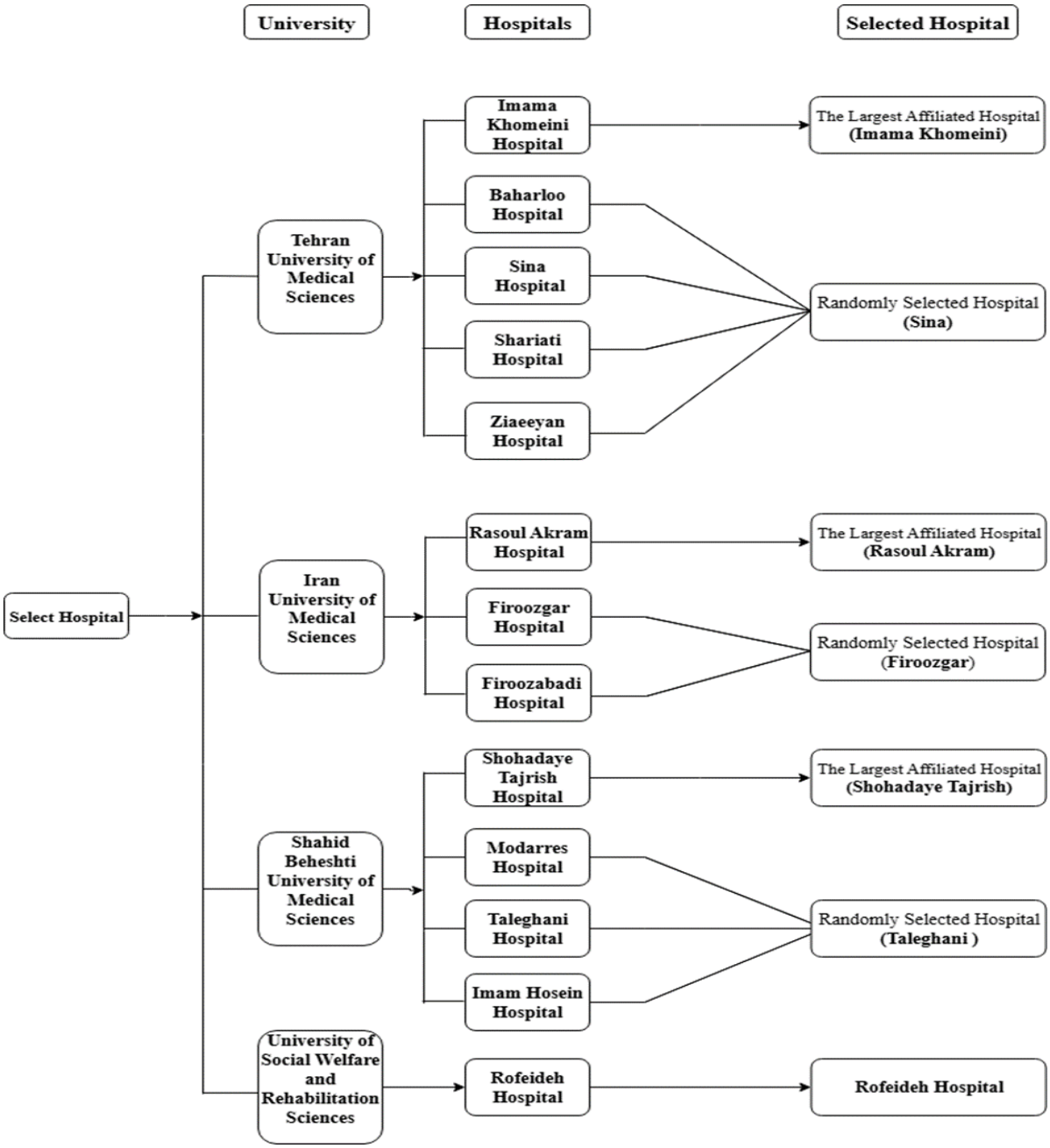

Figure 2: Flowchart of the hospital selection

On the basis of the estimated sample size (n = 334), at least 100 nurses were planned to be recruited from each of the three major universities (Tehran University of Medical Sciences, Iran University of Medical Sciences, and Shahid Beheshti University of Medical Sciences), with the remaining participants selected from a single eligible hospital affiliated with the University of Social Welfare and Rehabilitation Sciences. Within each hospital, nurse selection was carried out through convenience sampling, taking into account shift schedules and staff availability. Although the overall target sample size was achieved, the number of nurses recruited from each hospital slightly varied due to practical limitations such as shift patterns and partial non-cooperation of eligible staff.

Data were collected using two instruments:

Demographic and occupational characteristics registration form: This questionnaire included items on age, gender, marital status, educational level, work experience, shift type, and affiliated university.

Norman and Skinner's eHealth Literacy Scale (eHEALS): A standardized 8-item questionnaire assessing perceived skills in locating, evaluating, and applying electronic health information. Each item is scored on a 5-point Likert scale (1 = very low to 5 = very high), with total scores ranging from 8 to 40 (3). Bazm et al. (35), in a cross-sectional study, assessed the validity and reliability of the Persian version of the eHEALS among 525 youths in Yazd, Iran, reporting a Cronbach's alpha of 0.933. Scoring for this tool is categorized into three levels: low (8–22), moderate (23–32), and high (33–40) (36, 37).

It should be noted that some potentially influential factors such as access to Internet or digital resources, prior digital health training, and general computer skills were not measured in this study and are acknowledged as limitations in the analysis and discussion.

Paper-based questionnaires were administered to participants after informed consent was obtained and sufficient explanations were provided. Immediately after completion, all questionnaires were reviewed for completeness, and no missing data were observed.

The data obtained from the questionnaires were statistically analyzed via SPSS software (version 24) in two sections: descriptive and inferential statistics. In the descriptive statistics section, measures such as frequency percentages, means, and standard deviations were calculated, and statistical tests, including Mann–Whitney U tests and Kruskal–Wallis tests, were employed. In the inferential statistics section, the Kolmogorov–Smirnov test was used to assess data normality, and Spearman's correlation coefficient was applied to determine correlations between variables. Additionally, multiple linear regression using the backward elimination method was performed to identify independent predictors of eHealth literacy scores. The probability for entry was set at $p<0.05$, and removal at $p>0.10$ (standard criteria in SPSS for backward selection). Multicollinearity was assessed using variance inflation factors (VIF); all values were below 5 (maximum VIF = 2.668 in the initial model), indicating no serious multicollinearity. Assumptions of linearity, independence of residuals, and homoscedasticity were evaluated through diagnostic plots. $p<0.05$ was considered to indicate statistical significance.

Ethical Consideration

In this study, the STROBE checklist (38) was utilized to ensure compliance with reporting standards. This checklist includes essential elements such as the study design, data collection methods, and analysis, which are discussed in detail in the corresponding sections of the article. This study was conducted in accordance with the Declaration of Helsinki (39) and extracted from a master's thesis conducted at the University of Social Welfare and Rehabilitation Sciences, Tehran, Iran, and supported by the Vice-Chancellor for Research of the same university (Ethics Code: IR.USWR.REC.1403.174). All participants provided written informed consent after receiving detailed information about the study's purpose, confidentiality, and right to withdraw at any time without consequences. Additionally, this study poses no significant risks to participants, and its benefits are related to improvements in nursing services and patient satisfaction.

Results

Overall, the largest age group was 20-29 years (58.4%). The gender distribution was nearly equal, with a majority being single (65.9%). Most participants held a bachelor's degree (85.6%), while the highest proportion of work experience was in the 5 to 10year range (37.1%). With respect to work shifts, 56% of the individuals, equating to 187 people, were on rotating shifts (Table 1).

Table 1: Frequency distributions and percentages of demographic variables among nurse participants (N=334)

Demographic variables	N (%)
Age (years)	
20-29	195 (58.4)
30-39	100 (29.9)
40-49	39 (11.7)
50 ≥	0 (0)
Gender	
Male	148 (44.3)
Female	186 (55.7)
Marital status	
Married	114 (34.1)
Unmarried	220 (65.9)
Work shift	
Morning	47 (14.1)
Evening	16 (4.8)
Night	84 (25.1)
Rotating shift	187 (56)
Education level	
Bachelor	286 (85.6)
Master	45 (13.5)
PhD	3 (0.9)
Work experience (years)	
1-5	95 (28.4)
5-10	124 (37.1)
10-15	92 (27.5)
15-20	23 (6.9)
20 ≥	0 (0)
Affiliated university	
Iranian Medical Sciences	120 (35.9)
Tehran Medical Sciences	91 (27.2)
Shahid Beheshti Medical Sciences	96 (28.7)
Social Welfare and Rehabilitation Sciences	27 (8.1)

The mean eHealth literacy score was 26.08 ± 4.76 (range: 12–40). eHealth literacy levels were classified as weak in 65 participants (19.4%), moderate in 234 (70.1%), and strong in 35 (10.5%). Differences in eHealth literacy across demographic and occupational variables were examined using non-parametric tests due to non-normal distribution (Kolmogorov-Smirnov $p<0.001$). The Kruskal-Wallis test revealed significant differences by age group (H (df) = 36.083, $p<0.001$), education level (H = 7.596, $p=0.022$), work experience (H = 22.488, $p<0.001$), and work shift (H = 14.614, $p=0.002$). The Mann-Whitney U test showed significantly lower scores in married compared to single participants (Z = -3.060, p=0.002). No significant differences were found by gender or university affiliation ($p>0.05$). Specifically, higher mean scores were observed in 30–39 years (27.14 ± 3.36), those with doctoral degrees (33 ± 0), participants with 1–5 years of work experience (26.77 ± 6.58), and morning-shift workers (26.98 ± 4.84) (Table 2 and 3).

Table 2: Levels of eHealth literacy categorized among nurse participants (N=334)

Variable	Score Range	N (%)
Electronic Health Literacy	weak level (8-22)	65 (19.4)
	moderate level (23-32)	234 (70.1)
	strong level (33-40)	35 (10.5)

Table 3: Relationships between demographic data and health literacy among nurse participants (N=334)

Demographic variable	Test	DF	Statistic Value	*p*-value
Gender	Mann–Whitney U	-	Z = -1.543	**0.123**
Marital Status	Mann–Whitney U	-	Z = -3.060	**0.002**
Age	Kruskal–Wallis	2	H = 36.083	**<0.001**
Education	Kruskal–Wallis	2	H = 7.596	**0.022**
Work Experience	Kruskal–Wallis	3	H = 22.488	**<0.001**
Work Shift	Kruskal–Wallis	3	H = 14.614	**0.002**
Affiliated University	Kruskal–Wallis	3	H = 1.159	**0.763**

To assess the assumption of univariate normality, the Kolmogorov–Smirnov test was used, and the skewness (1.487) and kurtosis (-0.051) of the research variables were examined. The test results (p<0.001) revealed that the scores for eHealth literacy were not normally distributed. The normal distribution of eHealth literacy is illustrated in Figure 2.

To examine the relationships between demographic data and eHealth literacy, the Mann–Whitney U test was used for two-group data, and the Kruskal–Wallis test was used for data from more than two groups; the results are presented in Table 3.

The results of the present study indicated that eHealth literacy is significantly influenced by demographic and occupational variables, including age, education level, work experience, work shift, and marital status (Table 3). Data analysis via the Kruskal–Wallis test (p<0.001, H = 36.083) revealed that the mean eHealth literacy significantly differed across various age groups. Additionally, the Kruskal–Wallis test (p=0.022, H = 7.596) revealed a significant difference in the mean eHealth literacy among individuals with different education levels. Similarly, the mean eHealth literacy significantly differed among groups with varying degrees of work experience (p<0.001, H=22.488). Furthermore, the mean eHealth literacy significantly varied among groups with different numbers of work shifts (p=0.002, H=14.614). Finally, according to the Mann–Whitney U test (p=0.002, Z= -3.060), eHealth literacy significantly differed between married and single individuals.

These results suggest that gender and university affiliation are not significant factors affecting nurses' eHealth literacy, as nurses across different genders and university groups generally perform similarly in eHealth literacy.

In this study, all questionnaires were immediately checked for completeness after completion, and no cases of missing data were reported.

To determine the factors influencing eHealth literacy among nurses, multivariate linear regression analysis was employed. To check for multicollinearity, variance inflation factors (VIF) were calculated for all independent variables in the initial regression model. All VIF values were less than 5 (maximum VIF = 2.668 for age in Model 1; maximum VIF = 1.168 in the final Model 5), confirming the absence of substantial multicollinearity. In the initial model, variables including age, gender, education level, work shift, and work experience were included. With the backward elimination method, nonsignificant variables were sequentially removed from the model. The final model for eHealth literacy retained age group, work experience, and work shift as the most influential factors. Multiple linear regression with backward elimination revealed that older age groups (40-49 years: B = -7.55, 95% CI [-10.06, -5.04], p<0.001), evening shift (B = -8.19, 95% CI [-11.23, -5.15], p < 0.001), night shift (B = -3.39, 95% CI [-5.25, -1.53], p<0.001), and rotating shift (B = -3.02, 95% CI [-4.71, -1.33], p=0.001) were significantly associated with lower eHealth literacy scores compared to their reference categories. Additionally, work experience of 10-15 years showed a positive association (B = 2.46, 95% CI [0.34, 4.58], p=0.024). Detailed results, including standardized coefficients (as effect sizes) and 95% confidence intervals, are presented in Table 4.

Table 4: Multiple linear regressions between the main and dependent variables among nurse participants (N=334)

Variables		Coefficient	Std-err	Sig.	95% CL Lower	95% CL Upper
	Age (years)					
	20-29	1	-	-	-	-
	30-39	-0.41	0.84	0.631	-2.06	1.24
	40-49	-7.55	1.28	0.000	-10.06	-5.04
eHealth	**Work experience (years)**					
Literacy	1-5	1	-	-	-	-
	5-10	-0.34	0.66	0.610	-1.64	0.96
	10-15	2.46	1.08	0.024	0.34	4.58
	15-20	1.66	1.56	0.289	-1.40	4.72
	Work shift					
	Morning	1	-	-	-	-
	Evening	-8.19	1.55	0.000	-11.23	-5.15
	Night	-3.39	0.95	0.000	-5.25	-1.53
	Rotating shift	-3.02	0.86	0.001	-4.71	-1.33

Discussion

This study assessed the level of eHealth literacy and its associated factors among nurses working in public hospitals in Tehran. The results revealed a moderate average eHealth literacy score, which is consistent with findings from Palshof et al. (2023) (11), Isazadeh et al. (2020) (40), Shudayfat et al. (2023) (8), Cho et al. (2018) (18), and Kritsotakis et al. (2021) (41). However, other studies, such as those by Shiferaw et al. (2019) (21), Alipour and Payandeh (2022) (42), and Chereka et al. (2022) (22), have reported higher literacy levels. These discrepancies may reflect contextual differences in healthcare systems, training structures, and digital infrastructure across countries. Interestingly, Alipour and Payandeh (2022) (42) reported higher eHealth literacy among nurses in northeast Iran compared to the moderate level found in the present study conducted in Tehran. This unexpected finding may be attributed to differences in sampling methods, hospital types (teaching vs. non-teaching), or specific digital health initiatives implemented in the northeastern region during the study period. Additionally, the timing of data collection may have influenced results, as rapid technological changes and training programs can significantly alter eHealth literacy levels within short periods.

The gap in nurses' digital competencies appears to be most pronounced in skills related to information retrieval, critical evaluation, and patient education using digital resources (43, 44). Despite widespread access to digital information infrastructures, many nurses face operational challenges in the effective transfer of these data to patients. This finding highlights the importance of not only increasing access to technology but also providing structured training and opportunities to develop confidence and fluency in the application of digital tools. Similar conclusions were drawn in studies by Comparcini et al. (2024) (29) and Ghazi-Mirsaeed et al. (2018) (45).

The findings of this study regarding the relationship between nurses' eHealth literacy and demographic data indicate that average eHealth literacy differs significantly across age groups. Additionally, the average eHealth literacy among groups with varying levels of work experience was significantly different. Although the majority of participants were aged 20–29 years, the highest mean eHealth literacy score was observed among nurses aged 30–35 years. This finding suggests that optimal eHealth literacy may reflect a combination of digital familiarity and professional experience. While younger nurses may possess greater exposure to digital technologies due to generational factors, individuals in the 30–35 age group may benefit from both technological competence and accumulated clinical experience, enabling more effective application of digital health information in practice. Therefore, eHealth literacy appears to be influenced not solely by age, but by the interaction between technological exposure and professional maturity. This result aligns with the studies by Isazadeh et al. (2020) (46) and Yang et al. (2020) (47). Moreover, the average eHealth literacy among individuals with different educational levels was significantly different. This difference appears to be due primarily to more specialized training at higher educational levels, greater research and managerial experience in utilizing digital resources, and broader access to advanced databases. This

finding is consistent with the studies by Isazadeh et al. (2020) (46), Comparcini et al. (2024) (32), and Ghazi-Mirsaeed et al. (2018) (45). Notably, our review of the available literature did not reveal substantially contradictory evidence regarding this association, although differences in study settings and methodological approaches may influence reported outcomes.

A particularly notable finding was the lower eHealth literacy scores among nurses working night and rotating shifts. This group likely faces limitations in attending training sessions, reduced support during off-hours, and greater physical and mental fatigue, all of which may hinder their ability to engage with digital learning tools. These observations are supported by Cho et al. (2018) (18) and Comparcini et al. (2024) (29), who emphasize the importance of adapting digital training delivery to shift schedules.

Interestingly, no significant difference in eHealth literacy was found based on gender or university affiliation. This result suggests that uniform access to digital tools and national nursing education policies may have helped bridge previous gender-based disparities, in line with the findings of Isazadeh et al. (2020) (46) but in contrast with those of Kayser et al. (2022) (48).

Although the findings of this study provide valuable insights into the eHealth literacy of nurses in Tehran, several limitations should be considered. The data were collected through self-report questionnaires, which may have been influenced by mood fluctuations or cognitive biases, potentially affecting the accuracy of responses. Additionally, the use of convenience sampling limits the ability to generalize the findings to broader nursing populations with different demographic characteristics or work environments. Furthermore, the cross-sectional nature of the study design restricts the ability to infer causal relationships between the examined variables, suggesting that future research with longitudinal designs is necessary to better understand the directionality of these associations.

Implications for practice

This study revealed a moderate level of eHealth literacy among nurses in public hospitals in Tehran, with significant disparities associated with age, education, work experience, and shift schedule. Improving eHealth literacy is critical for enhancing healthcare quality and patient safety. Nursing managers and policymakers should prioritize targeted educational interventions particularly for older and rotating-shift nurses and integrate eHealth literacy modules into undergraduate and continuing education programs. Structured training in digital information search, critical appraisal, and clinical application, supported by institutional investment in digital infrastructure, can strengthen nurses' professional competencies and improve patient outcomes in an increasingly digital healthcare environment. Future studies should employ longitudinal designs to examine causal relationships between demographic factors and eHealth literacy development over time. Interventional research is also recommended to evaluate the effectiveness of targeted educational programs, particularly for older and rotating-shift nurses. Additionally, qualitative studies may provide deeper insight into the contextual and organizational barriers affecting nurses' engagement with digital health technologies. Comparative studies across different regions of Iran could further clarify the role of infrastructural and institutional variations in shaping eHealth literacy levels. Finally, incorporating objective performance-based assessments alongside self-report instruments would strengthen the validity of future findings.

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Conflicts of interest
The authors declare that there are no competing interests.

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Authors' Contributions
All the authors contributed to the concept and design of the study. B.M contributed to conceptualization, data management, formal analysis, investigation, methodology, and drafting of the original manuscript. M.H.F supervised the study and was responsible for validation, project management, resources, and reviewing/editing the manuscript. M.D assisted with methodology, visualization, and manuscript revisions. M.S conducted the statistical analysis, data validation, and formal analysis. All the authors reviewed and approved the final version.

AI Statement
We have not used any AI tools or technologies to prepare this manuscript.

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