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The Effect of Healthcare Professionals' Digital Literacy Status and Knowledge of Telemedicine on Perception of Telemedicine

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Abstract

Aim: The objective is to determine levels of digital literacy, knowledge and perception of telemedicine, becoming important with innovations in communication and information technologies, and to reveal correlations between them.

Methods: In the study, data was collected cross-sectionally, via on-line and face-to-face surveys. 334 healthcare workers from one tertiary and two second-line hospitals were included in the study. Correlations between variables were tested with structural equation model. To determine differences between groups, two sample t-tests were used.

Results: Knowledge of telemedicine was found to mediate the relationship between digital literacy and perception of telemedicine. In this study, perception of telemedicine ($\bar{x}$= 3.392) and digital literacy level ($\bar{x}$= 3.527) were found to be above average, while knowledge of telemedicine was

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found to be below average ($\bar{x}$= 2.090). Perception of telemedicine was found to increase positively in participants with telemedicine experience (t(332) = 4.979, p<0.05).

Conclusion: The importance of digital literacy and knowledge of telemedicine is revealed in creating positive perception in healthcare professionals about the use of telemedicine. For the success of telemedicine applications, it may be recommended to include these topics in training programs for healthcare professionals.

Keywords: Digital Literacy, Perception of Telemedicine, Knowledge of Telemedicine, Healthcare Professionals

INTRODUCTION

In the provision of health services, problems related to accessibility, deficiencies in human resources, unequal distribution of resources, increasing costs and the inability to provide similar quality health services to all those who demand all together emerge as a problem (Lovett & Bashshur, 1979). Especially in rural populations, it is not possible to provide services that require expertise in health services due to costs and lack of sufficient healthcare workers. Another problem is that this population group has financial difficulties to make progress in accessing health services (Cilliers & Flowerday, 2014). The disability of individuals requesting services also dramatically increases the difficulty of access due to geographical conditions. On the other hand, it is also difficult to maintain the quality of service in the provision of health services according to the determined standards and to improve the quality of service. To achieve this, there is a need for a more qualified medical education, continuous measurement of employee performance and rapid dissemination and measurement of medical knowledge, which is increasing day by day today. But the distance between healthcare workers reduces the reach, communication and control of healthcare workers to each other. Telemedicine has been proposed as a technological response to many of the challenges to healthcare delivery described above (Kılıç & Tosun, 2021; Lovett & Bashshur, 1979).

From past to present, quite different techniques have been developed in both applications and content related to telemedicine. Telemedicine has been defined in different ways by different researchers. One of the most comprehensive definitions has been put forward by the World Health Organization (WHO). According to the WHO, telemedicine defines telemedicine as "the provision of health services by all health professionals at times when distance is a critical factor, using

information and communication technologies in diagnosis, treatment, prevention of diseases and accidents, research, assessment, health education and other areas for health promotion" (Özyürek Ucael et al., 2021). By the American Telemedicine Association, telemedicine is defined as the use of medical information exchanged from one place to another through electronic communication to improve a patient's health status (Voran, 2015). The basis of telemedicine is the use of telecommunication technologies and computer applications for the provision of medical care or services (Albarrak et al., 2021; Dilbaz et al., 2020).

In studies, it was concluded that there are positive perceptions of employees about telemedicine applications. In a study on the practice of telemedicine in South Africa, healthcare workers in rural areas perceived the telemedicine system as beneficial to improve the quality of the health services they provided (Cilliers & Flowerday, 2014). In various studies, the opinions of the employees on the effects of telemedicine application were examined. In a recent study by Piau et al. (2020), it was found that telemedicine offers positive results in diseases requiring long-term care in the management of neuropsychiatric symptoms and even increases the quality of care and that staff perceive telemedicine applications positively (Piau et al., 2020). Other similar studies on the subject point out that telemedicine in health care increases the quality and sustainability of health and healthcare (Brown et al., 2020; Kuek & Hakkennes, 2020; Muslu et al., 2019).

Telemedicine practices may differ at the hospital or national level. It is seen that telemedicine application contents are developing day by day in Turkey, and the number of applications is increasing. In Turkey, the Ministry of Health uses the Teleradiology System, which allows images to be reported, teleconsultation between radiologists and shared with patients via e-Nabız application (T.C. Sağlık Bakanlığı, 2022). During the pandemic, the Ministry of Health has ensured that people who are positive or in contact due to illness can access on-line health services and follow up with the "Dr.e-Nabız System" and "Hayat Eve Sığar" (HES) mobile applications (Özyürek Ucael et al., 2021). To establish the legal infrastructure, "Regulation on the Provision of Remote Health Services" was published to regulate the procedures and principles regarding the authorization of health facilities to provide telehealth services, the development and registration of the telehealth information system, and the supervision of health facilities within this scope (*Uzaktan Sağlık Hizmetlerinin Sunumu Hakkında Yönetmelik*, 2022).

Despite the great advances and advantages in the fields of information technology, telemedicine, telehealth and e-health in recent years, structural problems, existing infrastructure

inadequacies, the type of health need and the ease of use of technology adversely affect success. People also want to make sure their data is safe (Albarrak et al., 2021; WHO, 2019). The success of any new technology depends on the knowledge, skills and attitudes of experts. Therefore, it is important to ensure that professionals understand the concept of telemedicine and to assess how ready they are to accept and offer telemedicine services professionally (Albarrak et al., 2021). However, there are still many obstacles and challenges to the adoption of telemedicine by healthcare professionals. The most important of these is the competence of the employees. According to the WHO, in order for healthcare professionals to move to this new way of working, they need to have sufficient training to increase their motivation and the skills to use technology easily (WHO, 2019). These skills include a high level of digital literacy, which enables the effective use of new technologies in a clinical setting (Brown et al., 2020; MacLure & Stewart, 2018).

Digital literacy, defined as the ability to survive in the digital age (Üstündağ & Güneş, 2017), ability to adapt to new or emerging technologies (Ng, 2012). In other words, digital literacy is closely related to the ability of an employee to search for information using digital devices, to organize the information he/she has reached and to draw an inference from it (Brown et al., 2020). With increasing digitalization in the delivery of health services, it is seen that digital literacy levels are important (Kuek & Hakkennes, 2020).

The availability of technology in healthcare is closely related to its acceptability (MacLure & Stewart, 2018). Studies have determined that employees' information and digital literacy levels affect their attitudes towards health information and communication technology, and even low levels of digital literacy have been identified as one of the obstacles to the adoption of electronic recording systems (Ajami & BagheriTadi, 2013).

In this study, it is aimed to determine the levels of digital literacy, knowledge of telemedicine and perception of telemedicine, which have been increasing in importance in the recent period, and to reveal the relationships between them. In addition, the determination of whether the telemedicine experience creates a difference in the perception of telemedicine was determined as another research topic. The hypotheses of the study are as follows:

H1: There is a positive correlation between digital literacy and knowledge of telemedicine.

H2: There is a positive correlation between knowledge of telemedicine and perception of telemedicine.

H3: Knowledge of telemedicine mediates the relationship between digital literacy and the perception of telemedicine.

H4: There is a difference in the perception of telemedicine between those with and without telemedicine experience.

Theoretical model of the study is given in Figure 1.
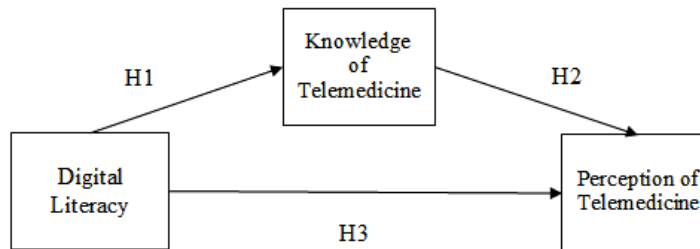
Figure 1. Theoretical Model

1. RESEARCH METHODOLOGY

Research Method: This study was maintained according to the relational screening model. These types of studies is suitable for determining the relationship between variables in a topic and for revealing the possible effects of independent variables on dependent variables (Büyüköztürk et al., 2016).

Sampling and Data Collection: The research data was collected on a voluntary basis on-line and face to face between 01.06.2022-01.10.2022. Before collecting the data, an explanation was made with the participants about the purpose of the research and how they would answer the questions. While collecting the data, the sample was not selected, the research was participated on a voluntary basis.

The research was carried out in three hospitals, one in tertiary care and two in secondary care. Within the scope of the study, the total number of health workers in the three hospitals is 710. A total of 334 health professionals participated in the study. Answer ratio is 53%. 204 of the participants were male (%61.1); 130 of the participants were female (%38.9). The mean age is 27.37 ($\bar{x}$ = 36.65±.57; 7,218, Minimum=18, Maximum=65). 33 (9.9%) of the healthcare workers are doctors; 192 (57.5%) of them are nurses; 109 (32.6%) of them are other healthcare workers. Of the participants, 68 (20.4%) work in the emergency department; 16 (4.8%) work in the operating room; 35 (10.5%) work in the internal units; 66 (19.8%) work in the surgical unit; 91

(27.2%) work in the intensive care unit; 58 (17.4%) work in other health units (sterilization, laboratory, radiology, physical therapy). While 76 (22.8%) of healthcare professionals have previous experience in telemedicine, 258 (77.2%) have no experience in telemedicine.

Data Collection Tools: The research data was collected through survey. While the first part of the survey contains questions about demographic and professional status, the second part includes items related to perception of telemedicine, knowledge of telemedicine and digital literacy. Items for measuring knowledge of telemedicine and perception were created by benefiting from research questions Albarrak vd. (2021). To measure digital literacy, the scale developed by Ng (2012) and translated into Turkish by Üstündağ & Güneş (2017) was used. All items in the measurement tools were asked in accordance with the 5-item Likert type with telemedicine information items ranging from "none" to "many", while perception of telemedicine and digital literacy items ranged from "I strongly disagree" to "I strongly agree". As scores from scales increase, digital literacy, positive perception of telemedicine and knowledge of telemedicine increase.

Data analysis: The structural validity of the substances used in the study was evaluated by confirmatory factor analysis, and then, the reliability was evaluated by calculating the Cronbach's alpha internal consistency coefficient. The relationships between the variables were also tested with the structural equation model. To determine the differences between the groups, two sample t-tests were used. Statistical procedures and research hypotheses were tested using Amos 23.0 and SPSS 23.0. In the research data, since the values of Kurtosis and Skewness were in the range of -1.5 to +1.5, it was interpreted that the distribution met the normality conditions (Tabachnick & Fidell, 2013).

Ethical Issues: The ethics committee approval required for the research was obtained on 20.05.2022 with the decision number 2022/55 of the Scientific Research and Publication Ethics Committee of the Rectorate of Hakkari University.

2. FINDINGS

2.1. Estimation of Measurement Model

In the first stage, the validity and reliability of the structures used in the research were evaluated. For this, all standardized loads in Standardized Regression Weights are determined first.

Accordingly, those with factor loads lower than 0.60 were removed (Chin et al., 1997). In this context, DL9 and DL10 items in the digital literacy scale were removed from the scale, and the analyzes were repeated. The calculated values for the measurement model are shown in Table 1 below.

Table 1 Validity and Reliability Analysis Results

Scale	Item	Unstd.	S.E.	C.R.	P	Std.	CR	AVE	Cronbach's Alpha
Digital Literacy	DL1	1.000				0.659	0.88	0.47	0.87
	DL2	1.031	0.089	11.519	***	0.740			
	DL3	1.025	0.089	11.569	***	0.744			
	DL4	1.030	0.091	11.297	***	0.722			
	DL5	1.029	0.096	10.678	***	0.675			
	DL6	0.882	0.087	10.138	***	0.635			
	DL7	0.939	0.087	10.800	***	0.684			
	DL8	0.947	0.097	9.779	***	0.609			
Knowledge of Telemedicine	KT1	1.000				0.797	0.92	0.75	0.91
	KT2	1.204	0.060	20.081	***	0.920			
	KT3	1.205	0.058	20.759	***	0.947			
	KT4	0.925	0.058	15.915	***	0.778			
Perception of Telemedicine	PT1	1.000				0.778	0.91	0.67	0.90
	PT2	0.897	0.070	12.847	***	0.675			
	PT3	1.083	0.059	18.379	***	0.906			
	PT4	1.055	0.060	17.728	***	0.879			
	PT5	1.052	0.063	16.790	***	0.842			

Cronbach's alpha, Composite Reliability (CR) and Average variance extracted (AVE) values were calculated to evaluate the reliability of the structures. The Cronbach's alpha coefficient scale was calculated as 0.87 for total digital literacy, as 0.90 for perception of telemedicine, and as 0.91 for knowledge of telemedicine. CR value was determined as 0.88 for digital literacy, as 0.91 for perception of telemedicine, and as 0.92 for knowledge of telemedicine. AVE values was calculated as 0.47 for digital literacy, as 0.67 for perception of telemedicine, and as 0.75 for knowledge of telemedicine. The calculated values were interpreted as reliable since Cronbach's alpha value is 0.70 (Hair et al., 2010) and the value of CR is 0.60 (Fornell & Larcker, 1981). On the other hand, it is recommended that the AVE value be 0.50 and above. Digital literacy is calculated below this value. However, although it is 0.50 and below, this value is considered acceptable if the CR value ≥ 0.70 (Fornell & Larcker, 1981). According to these results, all measurement items were accepted at an acceptable level.

2.2. Estimation of Structural Model

The relationships between the scales were examined to test the structural model put forward in the research. Before estimating the structural model, the results of Pearson Correlation analysis, the mean and standard deviation values of the measurements were calculated. The values in question are presented in Table 2.

Table 2. Results of Correlation Analysis

	Mean	St. Dev.	TA	TP	DO
Perception of Telemedicine (PT)	3.392	0.817	1		
Knowledge of Telemedicine (KT)	2.090	0.869	0.282[*]	1	
Digital Literacy (DL)	3.527	0.713	0.340[*]	0.237[*]	1

*$p<.0.01$.

When the correlation between the scales was examined, it was found that there were moderate and significant correlations between perception of telemedicine and digital literacy (r=0.340, p>0.01), between knowledge of telemedicine and perception of telemedicine (r=0.282, p>0.01) and between knowledge of telemedicine and digital literacy (r=0>0.01). Within the scope of the research, it was found that perception of telemedicine ($\bar{x}$= 3.392±0.817) and digital literacy level ($\bar{x}$= 3.527±0.713) were above average, while knowledge of telemedicine was below average ($\bar{x}$= 2.090±0.869). The significance of correlations between these variables has been interpreted in a way that the evaluation of structural analysis can also give appropriate results. As a result of the Structural Equation Model (SEM), the model fit indices were found to be $\chi2/df$=2.618, GFI=0.903, AGFI=0.871, CFI=0.945 and RMSEA=0.070. All of the values conform to an acceptable model (Browne & Cudeck, 1992; Hu & Bentler, 1999; Schermelleh-Engel et al., 2003) and suggests that this model can be used to explain hypotheses.

Table 3. Results of Structural Equation Analysis of the Research Model

Structural Relationships			Unstd.	S.E.	C.R.	P	Std.	R^2
KT	<---	DL	0.262	0.070	3.747	***	0.230	0.053
PT	<---	KT	0.233	0.056	4.145	***	0.235	0.205
PT	<---	DL	0.380	0.071	5.371	***	0.337	

*$p<.0.01$.

Results belonging to the Structural model are given in Table 3. All pathways in the model were found to be statistically significant. According to these results, H1 and H2 hypotheses were accepted. Digital literacy was able to account for 0.053 of the variance of knowledge of

telemedicine, digital literacy and knowledge of telemedicine were able to account for 0.205 of the variance of perception of telemedicine.

The potential intermediary effect in this research model is examined for better explanation of the model and hypotheses. In this study, bootstrapping procedure was used to test the mediation effects. A total of 5000 boot samples were used to investigate statistical significance and estimates were obtained at 95% confidence interval.

Table 4. Mediation Impact Results

Bootstrapping (Bias-corrected 95% CI)					
Affects the vehicle	**Stand. End. Effect**	**Lower Limits**	**Upper Limits**	**P**	**SE**
PT <---KT<--- DL	0.054	0.200	0.456	0.006	0.019

*$p<.0.05$.

Table 4 shows the results of the intermediary effect. It was found to be statistically significant that perception of telemedicine affects digital literacy through knowledge of telemedicine ($p>0.05$), and the H3 hypothesis was accepted. Another hypothesis in the research was examined: "There is a difference between those with and without telemedicine experience in terms of perception and knowledge of telemedicine". Associated Two Sample t Tests were applied to examine this hypothesis. The analytical results are presented below.

Table 5. Two Sample T Test Results

	Telemedicine Experience	**N**	**Mean**	**St. Dev.**	**t**	**df**	**p**
PT	Available	76	3.789	0.591	4.979	332	0.00
	None	258	3.276	0.839			

*$p<.0.05$.

According to the results of the analysis in Table 5, the perception of telemedicine varies significantly according to whether the participant has telemedicine experience or not ($t_{(332)} = 4.979$, $p<0.05$). The significant difference is in favor of those who have experienced telemedicine. In other words, the perception of telemedicine of those with telemedicine experience increases positively.

3. DISCUSSION AND CONCLUSION

This research was conducted to determine the levels of perception of telemedicine and knowledge and digital literacy, and to reveal the correlations between them. It was also investigated whether the telemedicine experience caused a difference in the perception and

knowledge of telemedicine. In the first stage, the descriptive statistics reached in the study were discussed without examining the results of the analysis of the research hypotheses. Accordingly, the perceptions of health workers in the telemedicine committee were found to be relatively higher than the average ($\bar{x}$=3.392). This descriptive statistical value indicates that the participants have a more positive view of telemedicine applications. Previous research has also identified a high perception for telemedicine (Albarrak et al., 2021). It can be interpreted that the value calculated in this research is partially parallel to the previous research findings. On the other hand, it was also found that the average level of knowledge of the participants in telemedicine was relatively low in this study ($\bar{x}$=2.090). If this situation is interpreted by blending it with the previous finding, it can be interpreted that although the level of knowledge of health professionals about telemedicine is relatively low, they have a positive perception of the subject. This situation reveals the importance of providing appropriate training to healthcare workers before telemedicine applications are used. The digital literacy status of healthcare workers was also calculated to be relatively above the average ($\bar{x}$=3.527). In a study conducted on nursing students, it was similarly determined that they had a high level of digital literacy competence in daily environments. However, it was found that their ability to translate this skill into their professional practice was limited and their access to and use digital tools in the workplace was limited (Brown et al., 2020). In some studies, it was found that digital literacy was low and that these skills needed to be developed (De la Hoz et al., 2021; MacLure & Stewart, 2018).

Within the scope of the research, it was determined that there is a positive correlation between digital literacy and knowledge of telemedicine. The correlation in question is theoretically an expected result. According to Brown et al. (2020), the competence to use digital technology makes important contributions to accessing and acquiring information in the present digital age (Brown et al., 2020).

According to the results of SEM, hypotheses were accepted, and a positive relationship was found between knowledge of telemedicine and perception of telemedicine. Previous studies have also revealed that education affects the perceived ease of use of the telemedicine system (Cilliers & Flowerday, 2014). Another result of the research is that knowledge of telemedicine has a mediating effect on the relationship between digital literacy and perception of telemedicine. This finding indicates that the high level of digital literacy provides an important readiness for the use

of telemedicine, which leads to a positive perception of the use of telemedicine. This finding is in line with the research results in the field literature (Ajami & BagheriTadi, 2013).

Another result obtained in the research is that having telemedicine experience causes a difference in the perception of telemedicine. Positive perception increases with experience. Considering that telemedicine applications are used more and more every day, this finding can be interpreted as accelerating the positive change of perceptions about telemedicine applications by health professionals.

There are a number of limitations in this research. One of the most important limitations of the study is that the perception of telemedicine and the level of knowledge of telemedicine of the participants were measured at a general level. The data collected is not specifically intended for a telemedicine application. In practice, the level of knowledge about the telemedicine practices used in different services and the level of perception of telemedicine may differ. To prevent this limitation, research hypotheses and measurement tools were prepared to measure general perception of telemedicine and knowledge of telemedicine. The difference in the level of knowledge and perception of health workers, especially towards a telemedicine application, can be examined in depth in another study. Another limitation of the study is that the study was conducted cross-sectionally and that non-probability sampling was used in the selection of participants. In other words, further research in an experimental design is needed for researchers interested in the subject to make an examination in the context of cause and effect between variables.

In this study, data was collected from three different institutions providing services at the second and third levels. This is an obstacle to the generalizability of research results for primary health care workers. Telemedicine applications used in first, secondary and tertiary health care institutions and the information and perceptions related to them may differ slightly. This is another limitation of the research. In another future study, the results can be compared by collecting data from health professionals in primary health care institutions.

Consequently, the high level of digital literacy has a positive effect on the level of telemedicine information acquisition and the perception of telemedicine. At the same time, knowledge of telemedicine also provides a positive effect on the perception of telemedicine. Accordingly, it is considered to be useful to include practical trainings in in-house training programs in order to increase the level of knowledge of telemedicine and digital literacy of

healthcare workers. At the same time, it may be recommended that these trainings be included in the training curricula of healthcare workers during their education periods.

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