

Factors Influencing the COVID-19 Infection Control Practice of Physical Therapists

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Purpose: The purpose of this study was to investigate the knowledge, awareness and performance of COVID-19 infection control among physical therapists and to identify the impact factors on performance

Methods: Data were collected from March 16th to March 24th in 2022 from the physical therapist's in Busan. Data analysis was conducted on 170 surveys, after excluding 27 surveys that were found to be unsuitable for data analysis.

Results: When correlating the study variables, knowledge and awareness were found to have a positive, meaningful correlation with performance. Performance of COVID-19 personal infection control regression analysis showed that the working department (clinic and long-term care hospital), clinical experience, the more knowledgeable, the awareness (personal), and the more clinical experience had significant positive impacts on the performance of COVID-19 infection control. Performance of COVID-19 treatment room infection control regression analysis showed that the working department (long-term care hospital), educational experience, the awareness (treatment room) had significant positive impacts on the performance of COVID-19 infection control

Conclusion: The results of this study may be used as basic data for educating physical therapist's working at the COVID-19 response department. This study suggests that physical therapist's need educational programs to improve their knowledge and awareness and performance of infection control against infectious diseases such as COVID-19. Differentiated physical therapists practice education curricula must be developed and provided after understanding the varying characteristic of physical therapist's with different levels of work experience.

Keywords: COVID-19, Infectious disease knowledge, Infectious disease awareness, Infection control practice, Physical therapist

INTRODUCTION

In January 2020, the first case of infection with the novel coronavirus, COVID-19 (hereafter, COVID-19) occurred in Korea, and respiratory infections emerged as a social health issue. During the COVID-19 outbreak, the practice rate of preventing COVID-19 infection by medical workers who face a large number of patients was not high,¹ and medical workers who were infected with COVID-19 rather played a role in spreading the virus to inpatients.^{2,3} As previous studies have already known that health care workers are a risk group for 'hospital-acquired Infections', protecting health care workers from viruses is important not only for the health of individual health care workers but also for protecting the health of patients.⁴ In particular, in the case of physical therapists, because they direct-

ly contact patients through manual therapy, they are more vulnerable to COVID-19 infection.⁵ In addition, Recently, as the importance of cardio-respiratory physical therapy for critically ill patients with respiratory diseases has increased,⁶ the risk of infection has increased by giving exercise and rehabilitation treatment to highly contagious patients such as COVID-19.⁶ In addition, when modalities using medical devices are implemented, contamination cases such as detection of microorganisms and pathogens are often reported as many patients use them together.⁷⁻¹⁰ Despite the risk of infection by physical therapists, the level of practice and awareness of infection control among medical workers is not very high,^{11,12} and the level of practice is not high compared to the level of awareness.⁵ According to previous studies, infection control practices and awareness levels differed depending on the infection control department and infec-

Received Nov 15, 2022 Revised Dec 10, 2022

Accepted Dec 16, 2022

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tion control training program.¹³⁻¹⁵ In particular, low infection control practice rates were pointed out due to indifference to infection control and lack of knowledge and awareness of infection control.¹⁶⁻¹⁹

In the early stages of the COVID-19 pandemic, healthcare workers were infected relatively more with COVID-19, and this was mainly due to incorrect preventive actions due to lack of knowledge about COVID-19.^{20,21} As the pandemic continued, prevention's response guidelines from the Korea Disease Control and Prevention Agency were frequently updated,²² and it was difficult to acquire such knowledge.²³ A low level of knowledge about COVID-19 is known as one of the causes of increased risk of infection for healthcare workers as it results in confusion and reduced efficiency in work.²⁴ Accordingly, if healthcare workers identify the level of infection control knowledge and provide services, it is possible to not only protect healthcare workers' safety, but also contribute to suppressing community transmission by blocking infection to patients or their families. Despite the fact that health workers' knowledge and awareness of infection control have an impact on infection control practices, during the pandemic, studies related to COVID-19 infection prevention activities were mainly aimed at nurses, so there was relatively little interest in physical therapists.

Therefore, this study aimed to analyze the correlation between knowledge of COVID-19, awareness and practice of COVID-19 infection control, and factors affecting infection control practice for physical therapists who provide direct services to patients in hospitals.

METHODS

1. Subjects

The subjects of this study were physical therapists working at medical institutions located in B city, and the selection criteria are as follows. First, it was defined as a person who understood the purpose of this study and agreed to cooperate with the questionnaire, and second, a person who could read and understand the contents of the questionnaire and be able to communicate. The sample number of subjects was calculated using the G*Power 3.1.9.7 program. Assuming that the effect size for multiple regression analysis (effect size = .15), the significance level (α) is .05, the power (1- β) is .95, and there are 5 independent variables affecting the practice, the optimal number of samples is 138 was a person. In consideration of the dropout rate of 20%, a total of 170 questionnaires were distributed, of which 143 were used for the final analysis, excluding 27 insincere responses.

2. Experimental methods

1) Measurement

(1) COVID-19 knowledge

COVID-19 knowledge was measured using a tool that was modified and supplemented for physical therapists referring to the Guidelines for Response to COVID-19 (12th Edition) based on the knowledge measurement tool for COVID-19 proposed by Yuk.¹ We first developed it using a total of 22 preliminary questions and conducted content validity verification for 6 infection control experts. The final tool consists of four sub-areas: disease characteristics (6 items), infectious disease patient criteria (5 items), personal protective equipment (5 items), and environmental management (5 items). Questions with a value of 1.0 or higher were selected, and the questionnaire was finally composed of a total of 21 questions. This tool responds with 'yes', 'no', and 'don't know', measuring 1 point for correct answers and 0 points for incorrect or 'don't know'. The higher the score, the higher the awareness of knowledge. The reliability of the Kuder-Richardson 20 (KR-20) was 0.64 in this study.

(2) Awareness of COVID-19 infection control

The awareness level of COVID-19 infection control was used by modifying and supplementing the awareness and practice measurement tool for hospital infection developed by Kim,⁵ referring to the Guidelines for Response to Coronavirus Infectious Disease-19 (12th edition). First, we developed a total of 26 preliminary questions and conducted content validity verification for 6 infection control experts. The infection control awareness questionnaire consisted of final 25 items by selecting items with a content validity index of 1.0 or higher for each item. The sub-domain of the final item consisted of a total of 25 items, including 11 items on 'personal hygiene awareness' and 14 items on 'awareness of treatment room hygiene'. Each item was measured on a 5 Point Likert scale. The higher the score, the higher the awareness of COVID-19 infection control. As for the reliability of the items, 'personal hygiene awareness' was 0.89 and 'treatment room hygiene awareness' was 0.94 based on Cronbach's Alpha coefficient.

(3) Practice COVID-19 infection control

The COVID-19 infection control practice was modified and supplemented with reference to the Corona Virus Infectious Disease-19 Response Guidelines (12th Edition) based on the awareness and practice measurement tool developed by Kim.⁵ We first developed a total of 26 preliminary questions, and after receiving advice from 6 infection control experts, content validity was verified. Items with a content validity index of 1.0 or

higher were selected.

The sub-area of the questionnaire consisted of a total of 25 items, with 11 items on 'Personal Hygiene Practice Level' and 14 items on 'Treatment Room Hygiene Practice Level'. Each item was measured on a 5 Point Likert scale. The higher the score, the better the COVID-19 infection control is being practiced. The reliability confirmed through Cronbach's Alpha was 0.88 for 'personal hygiene practice' and 0.91 for 'treatment room hygiene practice'.

3. Experimental Procedure

The data collection period for this study was from March 16 to March 24, 2022. For this purpose, a questionnaire was distributed to 50 physical therapists who participated in online manual therapy education in metropolitan city B and 231 people in the community of physical therapists in B city. Of the total 281 patients, 170 physical therapists (60.5%) responded, and these were confirmed as the final study subjects. The survey was conducted through an internet-based survey due to the threat of infection with COVID-19. A summary statement summarizing the purpose and contents of the study and a consent form for participation in the study were included so that the participants could understand the purpose of the study and participate in the survey by voluntary participation.

4. Data analysis

SPSS 25.0 statistical program was used for data analysis in this study, and frequency analysis and descriptive statistical analysis were performed to derive general characteristics of subjects. Independent sample t-test and one-way ANOVA were performed for differences in knowledge, practice, and awareness of COVID-19 according. If there was a significant difference in the results, post-hoc analysis was performed with the Scheffe test. In addition, correlation between the subject's knowledge, awareness and practice of COVID-19 was analyzed by Pearson's correlation analysis. Finally, multiple regression analysis was performed to examine the impact on the practice of COVID-19 infection control.

RESULTS

1. General characteristics

The general characteristics of the subjects are as follows. By gender, 89 (62.2%) were female, and out of 143 subjects, 60 (42.5%) were in their 20s. In terms of education status, 98 (68.5%) were from university, and 42 (29.4%) worked in hospitals in terms of work places. In addition, 90 (62.9%)

worked in a hospital with an infection control department, and 5-10 years of experience was the most at 56 (39.2%). There were 90 (62.9%) patients who had treatment experience with confirmed or suspected COVID-19 patients, and 80 (55.9%) were classified as contacts of confirmed patients while on duty. Lastly, there were 92 subjects (64.3%) who had received education on infection control (Table 1).

Table 1. General characteristics of participants

Characteristics	N	(%)
Sex		
Men	54	37.7
Women	89	62.2
Age groups		
20-29	60	42.5
30-39	59	31.3
40 and over	14	16.8
Marital status		
Partnered	84	58.7
Single	59	41.3
Family type		
Single-person household	40	28.0
Family or friends living together	103	72.0
Education		
College	10	7.0
bachelor's degree	98	68.5
Master degree and over	35	24.5
Types of medical institute		
Clinic	13	9.1
Hospital	42	29.4
Long-term care hospitals	21	14.7
General hospitals	31	21.7
Tertiary medical institutions	21	14.7
Etc. (public health center, etc.)	15	10.5
Infectious disease control department		
Yes	90	62.9
No	53	37.1
Clinical experience		
Under 5 years	10	7.0
5 years to 10 years	86	60.1
Over 10 years	47	32.9
Job status		
General physical therapist	97	67.8
Deputy general physical therapist	46	32.2
Treatment experience with confirmed or suspected COVID-19 patients		
Yes	90	62.9
No	53	37.1
Experience of contact person triage		
Yes	80	55.9
No	63	44.1
Receiving education on infection control		
Yes	92	64.3
No	51	35.7

Table 2. Correlation between knowledge, practice and awareness of COVID-19

	Knowledge of COVID-19	Awareness of COVID-19 infection control			Practice of COVID-19 infection control		
		Total	Personal hygiene	Treatment room hygiene	Total	Personal hygiene	Treatment room hygiene
	r (p)	r (p)	r (p)	r (p)	r (p)	r (p)	r (p)
Knowledge of COVID-19	1						
Awareness of COVID-19 infection control							
Total	0.143 (0.088)	1					
Personal hygiene	0.033 (0.694)	0.664** (<0.001)	1				
Treatment room hygiene	0.163 (0.051)	0.924** (<0.001)	0.329** (<0.001)	1			
Practice of COVID-19 infection control							
Total	0.317** (<0.001)	0.360** (<0.001)	0.197* (0.018)	0.353** (<0.001)	1		
Personal hygiene	0.314** (<0.001)	0.322** (<0.001)	0.356** (<0.001)	0.223* (0.007)	0.736** (<0.001)	1	
Treatment room hygiene	0.230** (0.006)	0.284** (0.001)	0.037 (0.663)	0.339** (<0.001)	0.895** (<0.001)	0.356** (<0.001)	1

*p < 0.01, **p < 0.001.

2. Correlation between knowledge of COVID-19, awareness and practice of COVID-19 infection control

The correlation coefficient between practice and awareness was $r = 0.360$ ($p < 0.001$), which showed a positive correlation. The correlation between COVID-19 knowledge and practice was positive (+) with $r = 0.317$ ($p < 0.001$). As a result of analyzing the correlation for each sub-item of COVID-19 infection control practice and awareness, the correlation coefficient between personal hygiene awareness and personal hygiene practice for COVID-19 infection control was $r = 0.356$ ($p < 0.001$), which showed a positive correlation. Also, the relationship between treatment room hygiene awareness and treatment room hygiene practice ($r = 0.339$), personal hygiene practice and knowledge ($r = 0.317$), personal hygiene practice and treatment room hygiene awareness ($r = 0.223$), and the relationship between treatment room hygiene practice and knowledge relationships ($r = 0.230$) were all statistically moderated positive correlations (Table 2).²⁵

3. Factors affecting the practice of COVID-19 infection control

1) Factors influencing personal hygiene control practices

Age of physical therapist, whether there is an infectious disease control department at a hospital, experience in infection control education, type of medical institution, experience of treating COVID-19 confirmed and suspected patients, as well as knowledge of COVID-19, awareness of infection control for COVID-19 (individual hygiene awareness, treatment room hygiene awareness), were included as independent variables for analysis. Since the Dubin-Watson statistic was 2.34, there was no autocor-

relation between the error terms, the tolerance limit was 0.1 or more, and the Variance Inflation Factor (VIF) was less than 10, so there was no problem of multicollinearity between independent variables. As a result of the analysis, the variables affecting the practice of personal hygiene infection control were working at a clinic, working at a long-term care hospital treatment experience for confirmed and suspected COVID-19 patients, personal hygiene awareness related to COVID-19 infection control, and knowledge of COVID-19, and the explanatory power of the model was 25.4% (Table 3).

$$Y (\text{Practice of COVID-19 infection control}) = 17.724 + 3.444 \times \text{Clinic} + 2.994 \times \text{Long-term care hospital} + 1.685 \times \text{Treatment experience for confirmed and suspected COVID-19 patients} + 0.500 \times \text{Personal hygiene awareness} + 0.384 \times \text{Knowledge of COVID-19}$$

2) Factors influencing treatment room hygiene practices

Independent variables and models for deriving influencing factors on hygiene practice in treatment rooms were applied in the same way as the Factors influencing personal hygiene management practices model described above. Since the Dubin-Watson statistic was 1.89, there was no autocorrelation between the error terms, the tolerance limit was 0.1 or more, and the Variance Inflation Factor (VIF) was less than 10, so there was no problem of multicollinearity between independent variables. As a result of the analysis, the variables affecting the practice of treatment room hygiene practices were working at a long-term care hospital, experience in infection control education and treatment room hygiene awareness, and the

Table 3. Factors influencing personal hygiene control practices

Variables	B	SE	β	t	p
Constant	17.724	5.776		3.069	0.106
Age group (ref = over 40s)					
20s	-0.132	1.041	-0.015	-0.127	0.899
30s	-0.256	0.963	-0.030	-0.266	0.791
Type of hospitals (ref = etc)					
Clinic	3.444	1.512	0.235	2.278	0.024
Long-term care hospital	2.994	1.288	0.251	2.324	0.022
Hospital	1.623	1.205	0.175	1.347	0.180
General hospital	1.595	1.358	0.156	1.175	0.242
Tertiary medical institutions	2.748	1.419	0.231	1.937	0.055
Existence of infection control department (ref = No)					
Yes	0.611	0.864	0.070	0.707	0.481
Experience of infection control training program (ref = No)					
Yes	0.090	0.754	0.010	0.119	0.905
Treatment experience with confirmed or suspected COVID-19 patients (ref = No)					
Yes	1.685	0.682	0.193	2.472	0.015
Awareness of COVID-19 infection control					
Personal hygiene	0.500	0.119	0.337	4.190	<0.001
Treatment room hygiene	0.070	0.061	0.093	1.143	0.255
Knowledge of COVID-19	0.384	0.127	0.268	3.016	0.003
F (p)			4.722 (<0.001)		
adj.R ²			0.254		
Durbin-Watson			2.340		

Table 4. Factors influencing treatment room hygiene practices

Variables	B	SE	β	t	p
Constant	40.546	10.242		3.959	<0.001
Age group (ref = over 40s)					
20s	0.017	1.598	0.001	0.011	0.992
30s	2.255	1.478	0.174	1.526	0.130
Type of hospitals (ref = etc)					
Clinic	-0.302	2.322	-0.014	-0.13	0.897
Long-term care hospital	3.933	1.978	0.218	1.989	0.049
Hospital	0.390	1.850	0.028	0.211	0.834
General hospital	0.465	2.085	0.030	0.223	0.824
Tertiary medical institutions	3.582	2.179	0.198	1.644	0.103
Existence of infection control department (ref = No)					
Yes	0.872	1.326	0.066	0.657	0.512
Experience of infection control training program (ref = No)					
Yes	2.575	1.158	0.193	2.224	0.028
Treatment experience with confirmed or suspected COVID-19 patients (ref = No)					
Yes	-0.349	1.047	-0.026	-0.334	0.739
Awareness of COVID-19 infection control					
Personal hygiene	-0.226	0.183	-0.101	-1.235	0.219
Treatment room hygiene	0.348	0.094	0.305	3.687	<0.001
Knowledge of COVID-19	0.079	0.196	0.036	0.401	0.689
F (p)			4.370 (<0.001)		
adj.R ²			0.236		
Durbin-Watson			1.981		

explanatory power of the model was 23.6% (Table 4).

Y (Treatment room hygiene practices) = $17.724 + 3.444 \times$ Long-term care hospital + $2.994 \times$ Experience in infection control education + $1.685 \times$ Treatment room hygiene awareness

DISCUSSION

This study was conducted to investigate the knowledge, infection control practice, and awareness level of physical therapists about COVID-19 in the context of the COVID-19 pandemic, and to analyze the factors affecting the practice of COVID-19 infection control. The knowledge of COVID-19 of the physical therapists participating in this study averaged 12.7 points out of 21, indicating a correct answer rate of 60.6%. Compared with the 71% correct rate of the COVID-19 knowledge tool for dental hygienists in Choi's research²⁶ and the 64% of correct answer rate of the COVID-19 knowledge tool for nurses in Yuk's study,¹ the physical therapist's knowledge level of COVID-19 was relatively low.

Awareness and practice of COVID-19 infection control were confirmed to be at an average of 3 or higher in both areas of the individual and treatment room, which was judged to be at a relatively good level. After converting to a 100-point scale, when checking the awareness and practice level of COVID-19 infection control by sub-items, the treatment room hygiene awareness was 93.2 points and the treatment room hygiene practice was 80.9 points, which was lower than the personal hygiene awareness 95.2 points and the practice 90.5 points. The results were consistent with the previous research study.⁵

In the case of treatment room hygiene practices, this may be a result of reflecting the low level of awareness of physical therapists. In addition, there was a marked difference between the awareness and practice of hygiene in the treatment room compared to the difference between the awareness and practice of personal hygiene. It may have been difficult to implement infection prevention guidelines based on standard precautions due to environmental factors.²⁷ In other words, in order to improve infection control awareness and practice, the physical environment and institutional support of medical institutions are needed.

As a result of examining the correlation between the main variables of this study, knowledge of COVID-19, infection control awareness of COVID-19, and COVID-19 infection control practice, COVID-19 infection control practice was correlated with knowledge and awareness of COVID-19. However, we could not confirm the correlation between knowledge of COVID-19 and awareness of COVID-19 infection control.

As a result of analyzing the correlation for each sub-item of COVID-19 infection control practice, personal hygiene practice was correlated with knowledge of COVID-19, personal hygiene awareness, and treatment room hygiene awareness. In addition, it was found that treatment room hygiene practice was correlated with knowledge of COVID-19 and awareness of treatment room hygiene. According to Yoon's study²² with nurses, there was a correlation between knowledge of COVID-19 and infection control practice, and according to Seol's study with physical therapists, there was a correlation between infection control awareness and infection control practice. These results were consistent with our findings. However, there was no relationship between COVID-19 knowledge and infection control practice in the LEE study²⁸ conducted on nurses, so further research on physical therapists is needed in the future.

Meanwhile, multiple regression analysis was conducted to identify the factors affecting the practice of infection control by physical therapists. As a result, personal hygiene practices were influenced by the hospital types, the experience of treating patients with confirmed and suspected COVID-19, awareness of COVID-19 infection control, and knowledge of COVID-19. In addition, it was found that the hospital types, infection control education, and awareness of COVID-19 infection control were the factors affecting the practice of treatment room hygiene. The explanatory power of the model affecting the personal hygiene practice and treatment room hygiene practice was 25% and 23%, respectively, which is similar to previous studies and this was decided to have significant explanatory power according to Ozili's study.^{1,29}

In the case of personal hygiene practices, the more experience they had in treating confirmed and suspected COVID-19 patients, and the higher their knowledge of COVID-19, the higher the likelihood. Through this, it can be inferred that physical therapists may have accumulated relevant knowledge through experiences with confirmed and suspected COVID-19 patients. Acquiring correct knowledge about infectious diseases is the key to preventing the spread of infectious diseases, and in our study, knowledge was derived as an important factor affecting personal hygiene practices, and the results were consistent with existing studies.¹

In addition, physical therapists working in clinics performed better in preventing infection than physical therapists working in public health centers and physical therapy centers. This may have affected personal hygiene practices as the Rapid Antigen Test became possible after March 14, 2022. Both personal hygiene practices and treatment room hygiene practices were confirmed to be at a higher level than physical therapists working in public health centers and physical therapy centers, compared to

physical therapists working in nursing homes. It was judged that this may have affected the practice as government-level measures such as restrictions on outside access, training of workers, cohort isolation, and preemp-tive testing were implemented after the COVID-19 outbreak.

As a result, it was confirmed that the subject who received infection control training was a significant factor influencing treatment room hygiene practices. In many studies, the question with the lowest percentage of correct answers among infection control knowledge was found to be 'environmental management'. In this study, considering that the question with the lowest correct rate among the knowledge of COVID-19 was 'environmental management',^{1,22,30} it is possible that learning about environmental management through education may have an impact on the practice of sanitation in the treatment room.

In a previous study focusing on physical therapists, the level of infection control practice was lower than the awareness level of infection control, and the higher the awareness of infection control, the more tended to practice infection control.^{5,31,32} It is known that infection control awareness is greatly influenced by education.³³⁻³⁵ However, there was no statistically significant difference between the awareness of infection control and the experience of infection control education in this study. It may have been difficult to acquire knowledge compared to non-face-to-face education in a situation where group education became difficult due to COVID-19. As a result, infection control training is absolutely necessary for physical therapists to practice infection control,⁵ and the development of an infection control training system for physical therapists is important.³¹ In other words, in order to raise the level of infection control practice of physical therapists, it is important to consider the environment and situation of the physical therapy room, and to raise awareness of infection control in order to increase the knowledge and awareness level of physical therapists.

This study identified factors influencing the practice of COVID-19 infection control from the personal and environmental aspects of physical therapists, identified various influencing factors, and emphasized education for physical therapists' practice of COVID-19 infection control. Despite the significance, this study has limitations in that it is difficult to generalize the results of all physical therapists in that the study was conducted only for physical therapists working in metropolitan city B. However, the significance of the study is still great in that it is the first attempt in Korea to study the relationship between knowledge of COVID-19, awareness of infection control, and practice for physical therapists, one of the health care workers who have the most direct contact with patients.

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