



Jordan Journal of Nursing Research

Journal homepage: <https://jjnr.just.edu.jo/jjnr/>



Nurses' Knowledge, Perceptions and Practices Regarding the Use of Respiratory Protective Equipment during the Coronavirus Pandemic

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ARTICLE INFO

Article History:

Received: February 11, 2023

Accepted: May 23, 2023

ABSTRACT

Background: Nurses are at high risk of several respiratory hazards comprising respiratory pathogens. So, respiratory protective equipment (RPE) are vital to protect nurses from novel coronavirus (2019-nCoV) outbreak. **Purpose:** The current study aimed to examine the knowledge level, practice and perceptions among nurses in a specialized cancer center using RPE. **Methods:** A descriptive study design was used. The Occupational Safety and Health Administration Questionnaire was utilized to collect data. The data was collected from 387 nurses working at a specialized cancer center as a convenience sampling technique. **Results:** An overall number of 387 staff nurses participated in the study. The majority of nurses had moderate knowledge levels, where the mean total score of nurses' knowledge was 12.98, with a range between 4 and 20. Also, the majority of nurses had good perceptions regarding the use of RPE (Total mean= 30.44, SD= 3.62). Regarding practice, most of the nurses wash their hands after contact with the outer surface of the respirator (F= 357, 92.2%). **Conclusion:** The good nurses' knowledge and perceptions regarding RPE's use were sufficient to provide an adequate practice level. However, implementing the RPE policy in hospitals could be useful to enhance the nurses' and other healthcare workers' knowledge, perceptions and practice regarding RPE. **Implications for Nursing:** Good practices are a crucial element in respiratory safety and nurses' protection against their place of work respiratory hazards.

Keywords: 2019-nCoV, Nurses, Knowledge, Perceptions, Practice, Respiratory protective equipment.

What does this paper add?

1. Nurses had a good level of practice in using RPE during the 2019-nCoV pandemic.
2. Policies regarding RPE's use and availability are necessary to avoid wrong practices that might cause the spread of infection.
3. Good practices are a crucial element in respiratory safety and nurses' protection against their place of work respiratory hazards.

Introduction

Novel coronavirus (2019-nCoV) disease is a very

infectious disease that appeared intensely as one of the most challenging conditions in 2019. The virus has spread worldwide and more rapidly than earlier coronaviruses' family, such as Middle East Respiratory Syndrome (MERS) and Severe Acute Respiratory Syndrome (SARS) (Peeri et al., 2020). On January 30, 2020, World Health Organization (WHO) stated that the 2019-nCoV pandemic was an international public-health crisis (World Health Organization, 2020b). In different countries, the explosive rise of 2019-nCoV renders the virus a global problem that overwhelms health services worldwide (Huang et al., 2020).

Nurses are at high risk of several respiratory hazards comprising respiratory pathogens, such as seasonal influenza, 2019-nCoV, chickenpox tuberculosis and chemical factors, such as disinfectant and cleaning materials, anesthetics, chemotherapy and biological agents (European Agency for Safety and Health at Work, 2015; Stein et al., 2003). The effective use of RPE is to protect nurses from respiratory risks in healthcare settings (Jensen et al., 2005).

In cancer care, nurses are at a higher risk of exposure to airborne hazards, such as cytotoxic treatments and immunosuppressed patients susceptible to resistance (Pirschel, 2016). It is common knowledge that oncology nurses know how to don and doff (remove) their personal protective equipment (PPE) for administering hazardous drugs, but not how to prevent or control infection. It is also possible that colleagues in other specialties do not wear personal protective equipment daily. In light of the novel coronavirus pandemic COVID-19, oncology nurses should understand how to use PPE for infection control to protect themselves and those around them (LeFebvre & Ginex, 2020).

Both surgical masks and N95 respirators are the most common respiratory protection equipment (RPE) utilized in healthcare settings (Coia et al., 2013; College of Respiratory Therapists of Ontario, 2016). N95 respirators protect nurses against airborne pollutants, whereas surgical masks protect nurses from inhaling infected microorganisms and droplets spread into the nose and mouth (College of Respiratory Therapists of Ontario, 2016). However, N95 respirators afford greater protection than surgical masks (MacIntyre et al., 2013; World Health Organization, 2016), but both can cause breathing opposition, warmth, wetness and annoyance for workers (Li et al., 2005).

Regardless of illnesses or disabilities, nurses are on the front line working with patients. Since there are no clear protocols for patients with 2019-nCoV, nurses are practiced the standard infection management methods for patients with 2019-nCoV (Millar, 2020). Several studies explained that nurses usually poorly adhere to RPE guidelines and procedures (Honarbakhsh et al., 2018; Madan et al., 2011; Nickell et al., 2004). There are many causes for why nurses aren't regularly utilizing RPE, such as they don't have immediate access to RPE or don't recognize that a patient has a transmittable disease (De Perio et al., 2012; Honarbakhsh et al., 2018; Wise et al., 2011). Additional influences seem to affect

PRE performance, such as knowledge and perceptions (Khalilzadeh et al., 2013b).

When nurses contact an infected person during an infectious-disease outbreak, they experience much of the burden of infection control implementation and operations (Barrera-Cancedda et al., 2019; Huang et al., 2020). So, the sufficient supply of RPE acts as a factor that increases voluntary willingness to use RPE during the pandemic (Martin, 2011). While medical workers often repeat the process of putting on, taking off and removing RPE, nurses do not have a choice, so they wear the RPE all day long to remain close to the patients (Verbeek et al., 2020). Proper wearing of RPE is essential to prevent the spread of infectious diseases and ensure medical workers' safety. However, the level of implementation of RPE wearing (donning) and removal (doffing) by healthcare workers (HCWs) is low (June & Choi, 2016; Picard et al., 2020).

Many agencies and other nursing representatives issued a report considering 2019-nCoV as the first of its kind across 191 countries and expressed concern regarding the threat confronting the profession and stressed the need for protective measures (UN News, 2020). Besides, there are multiple sources of information on how nurses and other healthcare providers can protect themselves from catching the disease (Nemati et al., 2020). These sources may have an advantage in increasing the awareness of people and healthcare providers; however, they could include confusing messages about the 2019-nCoV mode of transmission, vulnerability, pathogenicity and other relevant issues.

In light of the current outbreak of the 2019-nCoV pandemic, for which there is no particular treatment (World Health Organization, 2020a), nurses' knowledge is key to dealing with it. The knowledge transfer about RPE in pandemic diseases must be time-effective and efficient. Earlier studies on pandemic infections, such as SARS, MERS and 2019-nCoV showed that the two crucial indicators of efficient transfer of knowledge among nurses are optimum theoretical knowledge and practical competence (Gupta et al., 2020; Khan et al., 2014; Zhong et al., 2020).

Several studies recommended that nurses should expand their knowledge of RPE to respond to 2019-nCoV and be updated through continuous education and training. Moreover, replicated studies pursuing HCWs and nurses in different hospitals are needed. Dated

knowledge might expose nurses' compliance with infection control and protective measures and might raise harmful practices, attitudes and risk perceptions. However, a higher knowledge level about 2019-nCoV was found to be significantly associated with a lower level of negative attitudes and possibly unsafe practices regarding the 2019-nCoV pandemic. Good knowledge about the 2019-nCoV pandemic was connected with positive attitudes and correct practices towards 2019-nCoV (Gupta et al., 2020; Zhong et al., 2020).

Nurses who worked with patients with 2019-nCoV or alike novel infectious diseases experienced distress and fear of contracting and spreading infection, dealing with new protocols that change regularly and fatigue due to overwhelming workload and usage of personal protection equipment (PPE) (Dubey et al., 2020; Huang et al., 2020; Kackin et al., 2020; Kang et al., 2018; Liu et al., 2020; Roth et al., 2017). Furthermore, they faced a shortage of PPE, lengthy separation from their families, social stigmatization, isolation, extensive media coverage, ambiguity, absence of efficient vaccines and treatment, observing patients' deaths and lack of being satisfactorily supported.

Fronting such serious circumstances has major psychological harms, such as stress, fear, depression, anxiety and insomnia symptoms (Brooks et al., 2018; Dubey et al., 2020; Huang et al., 2020; Kang et al., 2018; Liu et al., 2020; Xiong & Peng, 2020). In this respect, such challenging situations and effects could not only reduce the ability of nurses to concentrate, learn and make decisions to care for patients with 2019-nCoV, but could also impact the physical and psychological well-being of nurses following the epidemic (Preti et al., 2020; Xiong & Peng, 2020).

Aim

The current study aimed to examine the levels of knowledge, practice and perceptions among nurses using RPE in a specialized cancer center.

Methods

Design

A descriptive study design was used to recognize the knowledge, practice and perceptions of RPE in nurses working during the 2019-nCoV pandemic. A correlational study is an effective design for gathering large quantities of data about particular phenomena (Polit & Beck, 2016).

Setting

Data was collected from 387 nurses working at a specialized cancer center in Jordan. This hospital receives cancer cases from all over the Hashemite Kingdom of Jordan, almost covering all population groups in Jordan. It's also accredited with highly technological and well-equipped facilities with a bed capacity of 352 beds.

Instruments

A demographic information sheet was utilized to collect data concerning gender, age, marital status, living status, education level, experience and working units. The Occupational Safety and Health Administration (OSHA) questionnaire based on the Respiratory Protection Program standard requirements (Occupational Safety and Health Administration (OSHA), 2017) was employed to gather data about nurses' knowledge, perceptions and practice of RPE. The questionnaire consisted of three parts, knowledge (22 items) is categorized as correct (score 1); incorrect and I don't know (score 0). Perceptions (eight items) applied a five-point Likert scale which ranged from 1 (completely disagree) to 5 (completely agree). Practice (seven items) also was classified as a yes response (score 1) and no response (score 0). All negative items' responses were scored reversely.

The participants' responses were calculated in each part and obtained scores from each item were added and divided to the maximum obtainable scores (7, 22 and 40) for practice, knowledge and perception, respectively. Each section's final score was categorized into four classes (excellent from 76 to 100%, good from 51 to 75%, poor from 26 to 50% and very poor from 0 to 25%).

Five Healthcare workers and five experts in the occupational health and safety fields assessed the questionnaire's validity and reliability (Occupational Safety and Health Administration (OSHA), 2017). The reliability was examined by Cronbach's alpha ($\alpha = 0.870, 0.860$ and 0.899 for practice, knowledge and perceptions, respectively).

Inclusion and Exclusion Criteria

The sample was selected using a convenience sampling technique. This technique is used to capture the highest number of participants in a short time. Nurses' had to be employed at King Hussein Cancer

Center (KHCC) for more than six months as registered nurses and express their willingness to participate in the study. All participants who did not meet the inclusion criteria mentioned were excluded.

Sample Size Estimation and Sampling Strategy

Cochran formula was used to calculate the sample size ($n = Z^2 * p(q) / \delta^2$).

$Z = 1.96$ and represents a 95% confidence level as the standard choice, P and $q = 0.5$ and error tolerance around the estimation (δ) = 0.05 (Cochran, 1977). However, we are dealing with a finite population, where the number is estimated to be around 1,200. So, the above formula becomes as follows:

$$\text{New Sample size} = \frac{\text{Sample size}}{1 + \frac{\text{Sample size} - 1}{\text{Population}}} = \frac{384}{1 + \frac{383}{1200}} = 291$$

The calculated minimum required sample size is 291 participants, but oversampling was intended to overcome any incomplete data. A total of 387 participants responded to the questionnaire.

Data-collection Methods

A convenience sampling technique was used to select the sample. Demographic data was obtained in addition to the primary questionnaire. Survey data was collected in electronic form using Google Forms. The primary investigator sent a questionnaire link to those who met the inclusion criteria. The data was collected between May and August 2020. All responses *via* the online Google Forms were completely anonymous; no identifying information was collected. Data was averaged and reported in aggregates. Since the data was collected electronically through Google Forms, the participants did not sign a consent and a waiver of documentation was requested. To ensure the anonymity of the participants, the data from the completed questionnaires was coded and accessed by only the investigators. Finally, all data was stored on a computer protected by a password.

Statistical Analysis

Statistical Package for Social Sciences (SPSS), version 21 was used to analyze the data. Descriptive statistics, such as percentage, frequency, mean and standard deviation were used. The Shapiro-Wilk test of normality suggested that the distribution of the sample was normal. The p-value obtained from the test was greater than 0.05, suggesting that there was no significant departure from normality in the data. The t-test and one-way ANOVA were used to examine the difference between demographic variables with the level of knowledge, perceptions and practice. An analysis of the relationship between knowledge, perceptions and practice was conducted using the Pearson correlation coefficient.

Protection of Human Rights

We obtained ethical approval from KHCC's Institutional Review Board (IRB) for this study. All participants in this study are voluntarily participating. It was explained to participants that participation in the study would not provide any direct benefits to them. However, the responses can help us identify areas for improvement regarding the nurses' knowledge, perceptions and practice regarding RPE's use during the 2019-nCoV pandemic. Moreover, there are no foreseeable risks involved in participating in this study.

Results

Participants' Demographic Characteristics

Table 1 shows the participants' demographic and work-related characteristics. The questionnaire was sent to 1000 nurses and the response rate was 38.7%. An overall number of 387 staff nurses participated in the study. The participants' mean age was 28.06 years ($SD=5.61$); the years of experience mean was 5.36 ($SD=5.35$). Most of the participants were females ($n= 238$, 61.5%), most of them were single ($n= 221$, 57.1 %) and the majority have bachelor degrees in nursing ($n= 239$, 90.2%). In addition, the majority were living with their parents ($n= 225$, 58.1 %); most of them also worked in the inpatient units ($n= 250$, 64.6%).

Table 1. Demographic characteristics of participants

Variables		Frequency	Percentage
Gender	Female	238	61.5%
	Male	149	38.5%
Marital Status	Single	221	57.1%
	Married	159	41.1%
	Divorced	5	1.3%
	Widowed	2	0.5%
Living Status	Living alone	19	4.9%
	Living with parents	225	58.1%
	Living with spouse	33	8.5%
	Living with children	110	28.4%
Educational Level	BSc	349	90.2%
	MSc	28	7.2%
	MSN	10	2.6%
Working Units	Inpatient	250	64.6%
	Outpatient	137	35.4%
Variables		Mean	S.D.
Age		28.06	5.61
Experience		5.36	5.35

Nurses' Knowledge about RPE during 2019-nCoV

Most of the nurses reported that each person should wear a respirator that fits his/her face dimensions (F= 355, 91.7%). In the event that hands contact the outer surface of the respirator, the hands should be immediately washed to prevent infection transmission (F= 357, 92.2%). Most of the participants agreed that

N95 respirator or Powered Air-Purifying (PAPR) respirator must be used to deal with patients with seasonal flu and tuberculosis (F= 306, 79.1%). Detailed information is available in Table 2. The majority of nurses had moderate knowledge levels, where the mean total score of nurses' knowledge was 12.98, with a range between 4 and 20.

Table 2. Nurses' knowledge items related to RPE

Statements	True T (%)	False F (%)	Don't know
Having facial hair (beard) or acne has a negative influence on the protective performance of the respirator.	184 (47.5%)	138 (35.7%)	65 (16.8%)
Surgical and N95 respirators should be discarded after usage.	208 (53.7%)	167 (43.2%)	12 (3.1%)
Each person should wear a respirator that fits his/her face dimensions.	355 (91.7%)	22 (5.7%)	10 (2.6%)
N95 respirators are suitable for protection against gases and vapors from chemicals.	241 (62.3%)	110 (28.4%)	36 (9.3%)
Surgical masks are as effective as N95 respirators against biological agents.	89 (23%)	279 (72.1%)	19 (4.9%)
Surgical masks or N95 respirators cannot be stored to be reused.	166 (42.9%)	203 (52.5%)	18 (4.7%)
I know how to correctly don and doff the respirators (adjust respirators on the face, grab the bands in doffing).	287 (74.2%)	34 (8.8%)	66 (17.1%)
Before using respirators for the first time, it is necessary to be medically evaluated.	273 (70.5%)	74 (19.1%)	40 (10.3%)
A seal check shall be performed before each time wearing N95 respirators.	268 (69.3%)	71 (18.3%)	48 (12.4%)
After each contact with infectious patients, the N95 respirator should be replaced.	197 (50.9%)	162 (41.9%)	28 (7.2%)
In case that hands contact the outer surface of the respirator, hands should be washed immediately to prevent the transmission of the infection.	357 (92.2%)	18 (4.7%)	18 (4.7%)
For people with chronic respiratory diseases, heart diseases or medical	224	82	81

conditions, an N95 respirator equipped with an expiratory valve is recommended.	(57.9%)	(21.2%)	(20.9%)
Surgical masks must be replaced after visiting each patient.	265 (68.5%)	113 (29.2%)	9 (2.3%)
For first exposure to unknown diseases, the Powered Air-Purifying Respirator (PAPR) must be used.	205 (53%)	52 (13.4%)	130 (33.6%)
N95 respirators with expiratory valves should not be used in operating and sterile rooms.	169 (43.7%)	134 (34.6%)	84 (21.7%)
In operating rooms, surgical N95 respirators should be used.	187 (48.3%)	144 (37.2%)	56 (14.5%)
PAPR is a suitable respirator for people with facial hair (beard).	151 (39%)	72 (18.6%)	164 (42.4%)
For decontamination and maintenance, PAPR is recommended to be worn.	186 (48.1%)	49 (12.7%)	152 (39.3%)
To deal with patients with seasonal flu and tuberculosis, N95 or PAPR respirators must be used.	306 (79.1%)	51 (13.2%)	30 (7.8%)
N95 respirators are not an effective protection against hazardous drugs (chemotherapy, hormone).	166 (42.9%)	140 (36.2%)	81 (20.9%)
To deal with the Severe Acute Respiratory Syndrome (SARS) patients, N95 or PAPR respirators are efficient.	324 (83.7%)	37 (9.6%)	26 (6.7%)
For protection against infectious aerosols produced during intubation or bronchoscopy, N95 or PAPR respirators should be used.	282 (72.9%)	47 (12.1%)	58 (15%)

Nurses' Practice toward RPE during 2019-nCoV

Around 96 male nurses usually have facial hair (beard) when using a respirator (64.4%). The majority of the nurses wash their hands after contact with the respirator's outer surface (F= 357, 92.2%). Also, more

than a half (F= 197, 50.9%) reported that they had received medical evaluation before using the respirator for the first time. Detailed information about nurses' practice is available in Table 3.

Table 3. Nurses' practice toward RPE

Variables	Yes	No
Do you usually have facial hair (beard) when using a respirator? This variable is for males only.	96 (64.4%)	53 (35.6%)
Do you use the bands when doffing the respirator?	274 (70.8%)	113 (29.2%)
Do you adjust the nose clip when donning the respirator?	340 (87.9%)	47 (12.1%)
Do you perform the seal check (test to ensure the completely fit of the respirator on the face) when wearing the N95 respirator?	316 (81.7%)	71 (18.3%)
Do you wash your hands after contact with the outer surface of the respirator?	357 (92.2%)	30 (7.8%)
Have you received a medical evaluation before using the respirator for the first time?	197 (50.9%)	190 (49.1%)
Do you discard the N95 and surgical mask after each use?	104 (26.9%)	283 (73.1%)

Nurses' Perceptions toward RPE during 2019-nCoV

The majority of nurses had good perceptions regarding the use of RPE (total mean= 30.44, SD= 3.62).

Most nurses agreed that hospital staff should be trained on how to use RPE (mean= 4.48, SD= 0.65). Most of them also think that a completely fit respirator on the

user's face is very important in its performance (mean= 4.23, SD= 0.73). Detailed information about nurses'

perceptions is available in Table 4.

Table 4. Nurses' perceptions toward RPE

Variables	Mean	S.D
I think that HCWs are aware of the respiratory contaminations of their jobs.	3.96	0.73
I think that the hospital staff should be examined for their respiratory system at least once a year.	4.29	0.75
Hospital staff should be trained on how to use RPE.	4.48	0.65
I think that the staff should not have contact with suspected patients and respiratory pollutants, without using a respirator.	4.16	1.05
I think that using a respirator alone (without ventilation and biological hoods) is not enough to protect against respiratory pollutants in hospitals.	3.73	0.92
I think that a completely fit respirator on the user's face is very important for its performance.	4.23	0.73
I think that respiratory pollutants in hospitals are not so dangerous to wear respirators.	2.81	1.26
I think that short contact with suspected infectious patients using the surgical mask is not dangerous.	2.74	1.24
Total perception score.	30.44	3.62

Demographic Variables Associated with Knowledge, Practice and Perceptions

Table 5 displays socio-demographic variables associated with perceptions, practice and knowledge in the study population. According to the analysis of variance (ANOVA) and t-test, there was an insignificant difference among gender based on perceptions

t (364.8) = -1.32, p= 0.18, practice t (282.4)= -1.09, p= 0.27 and knowledge t (297.3)= 0.04, p= 0.96. However, there was a significant difference in working units based on perceptions t (150.9) = -2.11, p= 0.035 and living status based also on perceptions F (383, 386) = 2.96, p= 0.032. Detailed information is available in Table 5.

Table 5. ANOVA and t-test analysis of the demographic variables associated with perceptions, practice and knowledge

		N	Mean	S.D.	t or F	df	P	95% Confidence Interval	
								Lower	Upper
Gender									
Perceptions	Female	238	30.21	3.98	-1.32	364.8	0.18	-1.19	0.23
	Male	149	30.69	3.14					
Practice	Female	238	4.15	1.028	1.09	282.4	0.27	-0.09	0.34
	Male	149	4.02	1.17					
Knowledge	Female	238	12.99	2.695	0.04	297.3	0.96	-0.55	0.58
	Male	149	12.97	2.897					
Working Unit									
Perceptions	Inpatient	291	30.17	3.584	-2.11	150.9	0.035	-1.764	-0.066
	Outpatient	96	31.08	3.917					
Practice	Inpatient	291	4.1168	1.10801	0.423	172.4	0.672	-0.19797	0.30664
	Outpatient	96	4.0625	1.03428					
Knowledge	Inpatient	291	12.93	2.736	-0.626	155.3	0.532	-0.846	0.437
	Outpatient	96	13.14	2.882					

Marital Status									
Perceptions	Single	221	30.40	3.747	0.045	385	0.964	-0.728	0.762
	Married	166	30.39	3.613					
Practice	Single	221	4.1131	1.07062	0.203	385	0.839	-0.19745	0.24297
	Married	166	4.0904	1.11639					
Knowledge	Single	221	12.88	2.781	-0.852	385	0.394	-0.802	0.317
	Married	166	13.12	2.759					
Education Level									
Perceptions	BSc	349	30.45	3.69	0.39	(2), (384)	0.67	30.03	30.76
	MSc	28	30.04	3.64					
	MSN	10	29.60	3.77					
Practice	BSc	349	4.09	1.07	0.19	(2), (384)	0.82	3.99	4.21
	MSc	28	4.21	1.16					
	MSN	10	4.00	1.49					
Knowledge	BSc	349	13.04	2.72	0.77	(2), (384)	0.46	12.71	13.26
	MSc	28	12.57	3.03					
	MSN	10	12.20	3.70					
Living Status									
Perceptions	Living alone	19	28.26	3.57	2.96	(383), (386)	0.032	30.03	30.76
	Living with parents	225	30.63	3.68					
	Living with spouse	33	29.64	3.15					
	Living with children	110	30.52	3.75					
Practice	Living alone	19	3.8947	0.87526	0.88	(383), (386)	0.449	3.9945	4.2122
	Living with parents	225	4.1511	1.10773					
	Living with spouse	33	4.2424	1.11888					
	Living with children	110	4.0000	1.07516					
Knowledge	Living alone	19	12.05	3.171	0.85	(383), (386)	0.467	12.71	13.26
	Living with parents	225	12.97	2.710					
	Living with spouse	33	13.06	2.221					
	Living with children	110	13.15	2.967					

Relationship between Age and Experience with Knowledge and Perceptions

This part affords a summary of the relationship between age and experience with nurses' knowledge and experience about using RPE. Table 6 shows the correlation matrix between these variables using a Pearson product-moment correlation. A significant

positive association was observed between the overall score of perceptions and knowledge ($r = 0.234^{**}$, $p \leq 0.001$). However, there was an insignificant relationship between age and experience with other variables (perceptions, practice and knowledge) $p \geq 0.05$. Detailed information about correlations is available in Table 6.

Table 6. Relationship between age and experience with knowledge, practice and perceptions

		Age	Experience	Knowledge	Perceptions	Practice
Age	<i>r</i>	1	0.937**	-0.002	0.085	-0.051
	<i>P</i>		0.000	0.973	0.094	0.319
Experience	<i>r</i>	0.937**	1	-0.002	0.094	-0.055
	<i>P</i>	0.000		0.969	0.066	0.281
Knowledge	<i>r</i>	-0.002	-0.002	1	0.234**	0.202**
	<i>P</i>	0.973	0.969		<0.001	<0.001
Perceptions	<i>r</i>	0.085	0.094	0.234**	1	0.117*
	<i>P</i>	0.094	0.066	<0.001		0.021
Practice	<i>r</i>	-0.051	-0.055	0.202**	0.117*	1
	<i>P</i>	0.319	0.281	<0.001	0.021	
** Correlation is significant at the 0.01 level (2-tailed).						
* Correlation is significant at the 0.05 level (2-tailed).						

Discussion and Implications for Nursing

The current study aimed to assess levels of knowledge, practice and perceptions among nurses using RPE in a specialized cancer center. The findings revealed that most of the nurses had a moderate level of knowledge and a good level of practice and perceptions concerning the use of RPE. However, knowledge can be enhanced through several interventions, such as education and training, whereas attitude can impact practice and perceptions (Hughes & Ferrett, 2012; Khalilzadeh et al., 2013a) Eventually, good knowledge and the right attitude can contribute to promoting practice and good perceptions (Achal, 2001; Honarbakhsh et al., 2018).

In the current study, nurses had moderate knowledge regarding the N95 respirator limitations and how to choose and use suitable RPE to guard themselves against hazardous drugs and chemical vapors. Likewise, the nurses' knowledge of PAPR was at a moderate level. These findings are consistent with a study on using RPE at Iran hospitals (Honarbakhsh et al., 2018). In contrast, the nurses' knowledge about the effectiveness of N95 respirators against biological agents in comparison to surgical masks was excellent. However, this finding is inconsistent with a study about using RPE at Iran hospitals (Honarbakhsh et al., 2018). However, some possible reasons are infection control and prevention as a primary responsibility of nurses, along with the use of personal protective equipment (PPE), such as respirators and masks. Their education may have included specific information on the differences between surgical masks and N95 respirators and their efficacy against biological

agents. It is likely that nurses who work in high-risk environments, such as emergency rooms or intensive care units, have been exposed to infectious diseases in the past. As a result of this experience, they might now understand the importance of wearing proper PPE and the effectiveness of N95 respirators.

These respirators are commonly used for personnel with facial hair or who cannot accommodate the respirator effectively on their faces, as well as for staff employed in the decontamination procedure or primary care of chemical and biological emergencies (California Department of Public Health, Occupational Health Branch, 2012). So, it is essential to promote studies about nurses' knowledge regarding these RPE usages and restrictions.

Nurses had a good level of practice in using RPE during the 2019-nCoV pandemic. The primary deficiency in this respect was that more than a half of the nurses didn't receive medical evaluation before using RPE for the first time. There was an insignificant weak correlation between knowledge and perceptions about using RPE. This result is in contrast to Truong's research, which found that the knowledge level and attitude towards the use of RPE were weak, whereas all participants had a moderate-to-high level of practice (Truong et al., 2009). It seems that there are possible other causes that are more important than knowledge, which can contribute to practice improvement if targeted in a respiratory protection program (RPP).

There was no significant relationship between participants' age and experience with knowledge and perceptions in the current study. Regardless of the

nurses' age and work experience, the participants have the same knowledge and perceptions of using RPE. These results are inconsistent with other studies (Honarbakhsh et al., 2018; Jahangiri et al., 2013; Mohamed et al., 2015; Monazzam & Soltanzadeh, 2009; Mortazavi et al., 2011; Nasab et al., 2009). This may be because these younger nurses with lower work experience had received comprehensive training regarding occupational safety and health problems during the general nursing orientation program when they joined the hospital; so they had a comparable knowledge to older nurses about workplace risks.

Interestingly, in the current study, nurses who have a bachelor degree had the same level of knowledge, perceptions and practice compared with nurses with MSc or MSN degrees. This could be due to the nurses with lower education having the same responsibilities and job obligations during the 2019-nCoV pandemic compared to nurses with higher education degrees. Moreover, all nurses are vulnerable to high-risk respiratory threats and they have to comply with safety, health and quality regulations. The nurses are also receiving the same education plan when they join the hospital, such as general nursing orientation for one month and preceptorship for three months, including in-service education sessions and competency checkoff. Moreover, the latest guidelines and research on personal protective equipment, infection control and PPE are often shared with nurses during pandemics. It is possible that they have read articles or attended seminars related to the 2019-nCoV pandemic.

Limitations

There are some limitations to this study. This study was conducted in a specialized cancer center only; so, the results might not be generalized to other hospitals.

Furthermore, the study was conducted based on a self-report survey, which could be vulnerable to self-bias responses. Moreover, nonprobability sampling was used. However, the current findings may provide vital evidence for promoting teaching and training on nurses' respiratory protection. Additional studies with more representative samples are required.

Conclusion

Good practices represent a crucial element in respiratory safety and nurses' protections against their place of work respiratory hazards. The good nurses' knowledge and perceptions regarding RPE's use were sufficient to provide an adequate practice level. However, implementing the RPE policy in hospitals could be useful to enhance the nurses' and other healthcare workers' knowledge, perceptions and practice regarding RPE. Policies regarding RPE's use and availability are necessary to avoid wrong practices that might cause the spread of infection. Interventional studies are suggested about RPE use to improve practice and update countrywide infection control strategies and guidelines.

Funding or Sources of Financial Support

This research received no specific grant from any funding agency in the public, commercial or non-for-profit sectors or support in the form of equipment or other assistance.

Conflict of Interest

We hereby certify that this material, which we now submit for Jordan Journal of Nursing Research is entirely our own work and there is "no conflict of interest to be declared".

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