

Difficulties and Skin Damages Caused by Personal Protective Equipment among Nurses Caring for COVID-19 Patients

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Abstract

Background: The coronavirus disease 2019 pandemic has touched almost every zone. Personal protective equipment is the last line of preservation of healthcare providers. Due to the prolonged use of PPE, many adverse skin reactions may happen. **The aim of the study to:** Explore the difficulties and Skin Damages Caused by Personal Protective Equipment among Nurses Caring for COVID-19 Patients. **Design:** This study was Descriptive research design was applied in this study. **Setting:** The study was performed in heart and chest diseases hospital at Zagazig University Hospital. **Subjects:** This study implemented on (30) nurses, majority of nurses were females, their ages are ranged from (20-50) years old and participate in the study. **Tools:** In this study, questionnaire to combine the difficulties and self-reported skin damages among the nurses with questions on demographics and a questionnaire concerning personal protective equipment and mainly focused on difficulties and skin damages **Results:** The common clinical symptoms of skin damages were Scar in the large part of the nose, Pain in the back ears, Excessive sweating, 58.1% of nurses had difficulty related to prolonged time of using personal protective equipment. **Conclusion:** PPE among HCWs is imperative to avert the widespread diffusion of COVID-19 but could be detrimental due to utilization for long period. **Recommendation:** A comprehensive program should be taken for nurses about the proper PPE use to prevent these difficulties and skin damages.

Keywords: Personal Protective Equipments (PPE), Difficulties, Skin Damages Covid-19, Nurses

Introduction

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has diffuse speedily globally since the first cases of coronavirus disease 2019 (COVID-19) were detected in December 2019 in Wuhan, China (**Oran&Topol, 2020**). Currently, over 45 million cases of infected individuals have been certified in over 180 countries with in excess of 1 million deaths (**Chu, 2021**).

COVID-19 is an infectious respiratory disease reasoned by a novel coronavirus, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The SARS-CoV-2 virus repeats efficiently

in the upper respiratory tract and appears to cause less sudden onset of symptoms than the flu, which means that infected individuals carry on ordinary activities for longer, increasing asymptomatic transmission of infection (**Gordon&Thompson, 2020**).

The prevalence of COVID-19 was due to person to-person transmission, like Severe Acute Respiratory Syndrome (SARS) in 2003. It was found that close contact without preservation resulted in the infection among medical staff. Medical crew had to wear double personal protective equipment (PPE) including N95 masks, goggles, and protective suits to shun hospital-acquired infection (**Yuan, et al., 2021**).

Personal protective equipment (PPE) refers to the personal protective equipment used to avoid or diminish the accidental injuries and occupational hazards at work, and they are meant to protect against the physical, chemical, and biological factors encountered in the work environment (Jose , et al., 2021).

The new COVID-19 pandemic has represented the use by health care professionals of various personal protective equipment (PPE), resulting in the appearance of skin injuries associated with PPE. Knowing the epidemiology, characteristics and factors related to the use of different types of PPE and the prevention and treatment of PPE-SI can be very beneficial to recognize the scope of the problem and to define strategies for its prevention and treatment in possible future pandemics (Agreda, 2021).

PPE needs to be tightly attached to the skin surface, which press the skin at the fixed site for hours and may lead to device-related pressure injuries. The factors contributing to device-related pressure injuries include poor local blood circulation, tissue ischemia and hypoxia, skin evaporation, and the accumulation on the inside of the mask of a large amount of water vapor exhaled from the mouth and nose, keeping the facial skin in a moist environment for a long period; this softens and impregnates the skin, and minimize the ability of the stratum corneum to combat external pressure and shear forces. Thus, the skin is prone to indentations. In addition, the friction between the PPE and the skin enhances the development of erythema, blisters, or ulcers, along with pain and even secondary infection (Zhou, et al., 2021).

Long-term wearing of earmuffs can cause poor local circulation because of the pressure on the auricular skin, contributing to skin pain and excrescent congestion after

earmuff removal (Zhou et al., 2021). If the skin of the hands and feet is left in an air-impermeable environment for long periods, the sweat evaporation is reduced, and the skin is prone to impregnation, eczema, and sweat herpes (Arnold-Long, et al., 2017).

Industrial and medical protective clothing have demands for tightness, which keeps the skin over the whole body in a humid environment and makes it prone to impregnation. People with large amounts of sebaceous gland secretions are likely to develop acne in areas rich in sebaceous glands, such as the chest and back, due to the pores being blocked by sweat and sebum (Honda& Iwata, 2016). Coronavirus disease 2019 personal protective equipment has been reported to affect communication in healthcare settings (Hampton, et al., 2021).

All health workers and caregivers must receive sufficient training in infection prevention and control practices including risk assessment, standard and transmission based precautions, WHO 5 Moments for Hand Hygiene, donning and doffing of personal protective equipment and waste management to confirm that PPE is utilized effectively where indicated and does not become a source of contamination to the wearer (Who, 2020).

Significance of the study:

Personal protective equipment are all devices for individual use designed to protect the physical integrity of the worker; include gloves, eye or face protectors, respiratory protectors, aprons and protection for the lower limbs, hand hygiene cannot be ignored as one of the most important standard precautions to prevent contamination and spread of the virus during COVID-19 pandemic. The prolonged or incorrect use of PPE is accountable for the constant friction and pressure forces on skin

tissues, leading professionals to suffer skin lesions and dermatitis (Salomé & Dutra, 2021). So, it is important to explore skin damages and difficulties related to the use of personal protective equipment during the COVID-19 pandemic.

Aims of this study:

Aim of the study was to explore the difficulties and Skin Damages Caused by Personal Protective Equipment Use among Nurses Caring for COVID-19 Patients

Research Question

What are the difficulties and Skin Damages Caused by Personal Protective Equipment among Nurses Caring for COVID-19 Patients?

Subjects and Methods

Research Design

A descriptive, cross section study research design was used in the study.

Setting

The study was conducted in intensive care unit on second floor and in intensive care unit on third floor of heart and chest diseases hospital at Zagazig University Hospital.

Subjects

This study was carried out on (30) nurses from both sex, their ages are ranged from (20-50) years old work in the heart and chest diseases hospital at Zagazig university hospital.

Tools for Data Collection
one tool was be used for data collection to accomplish the aim of this study:

Tool I: nurse Assessment sheet:
It was developed by the researcher based on the current national and international literatures it includes three parts:

Part 1: Demographic data patient: To assess the demographic patient data and It includes (10) items are (Age, sex, marital status, Years of experience, level of education, confidence in self-protection, receiving training courses, number of training courses, benefits of training courses, had corona virus.

Part 2: Assessment of PPE:

To assess personal protective equipments includes (9) items are(wearing PPE in isolation area, wearing gloves, wearing mask, wearing gown, wearing goggles, wearing face shield, wearing head cover, wearing overshoes and average time of wearing clothes during work with covid-19 patient) .

Part 3: Assessment of difficulties and skin damages caused by PPE:

To assess the medical patient history developed by researcher and guided by (Jose et al,2021) & (Agarwal et al,2020) and it includes (18) items about difficulties and skin damages caused by Personal Protective Equipment Use among Nurses Caring for COVID-19 Patients.

Fieldwork

This study was performed in in the following manner:

Administrative and ethical considerations

An official permission to carry out the study was obtained from the in charge of hospital authorities of the heart and chest at Zagazig University Hospital and to achieve validity and reliability of tools, it was reviewed by experts nursing and medicine in the field of the study and necessary modifications were done.

Content validity and reliability

The content validity of study tool was examined by 3 expert professors in field of nursing and medicine they reviewed the instruments for clearness, pertinence, comprehensiveness, understanding, applicability and easiness for administrative minor modifications that required rectification was carried out accordingly. Chi-Square was used to conduct the reliability test, and the tools appeared to be reliable. Knowledge questionnaire($r=0.89$).

A pilot study

A pilot study applied in March (2021) to test the feasibility and practicability of the study tool and conducted on (10%) of the sample (3 nurses) of sample.

Data collection process

1. Data were collected from heart and chest hospital at Zagazig University Hospital for 6 months during the period from March 2021 to August 2021.
2. The study was carried out at morning and afternoon shifts for all available nurses
3. At initial interview the researcher introduce herself to start line of communication, demonstrate the nature and objective of the study to the nurses who are willing to participate in the study and fill out the sheet tool (1) to assess the nurses' demographic data, PPE, difficulties and skin damages caused by PPE.

Ethical considerations:

1. There is no risk for study subject during application of research.

2. The study was following common ethical principles in clinical research.
3. Study subject have the right to reject to engage and or leave from the study without any rational any time.

The statistical design

After data were collected had reviewed, prepared for computer entry, coded, analyzed and tabulated, Descriptive statistics using statistical software SPSS version 22.0 include (frequencies and percentages, mean and standard deviation) use Pearson chi- square.

Results:

Table (1): Reveals that 60% of studied clients aged from 20 to 30years old with mean age 29.1 ± 6.9 . Majority of studied sample was female (86.7%), The high percentage of the studied sample (83,3%) were married, 90% expressed confidence in self-protection against COVID-19 infection, 93.3% studied sample complete training courses on infection control precautions for corona virus, and expressed benefited from training courses.

Table (2): Illustrate that the majority of them wore a mask when dealing with patients (96, 7%), the highest percentage wore gloves when handling patients (83, 3%), and the majority of them wore gown and over head when dealing with patients (63, 3%).

Table (1): Frequency distribution of the Socio-demographic characteristics for the study sample (n=30)

	N	%
Age		
20 – 30	18	60
31 – 40	10	33.3
41 – 50	2	6.7
Mean ±SD	29.1 ±6.9	
Sex		
Male	4	13.3
Female	26	86.7
Marital Status		
Single	5	16.7
Married	25	83.3
Educational Level		
Secondary	16	53.3
Institute	10	33.3
Bachelor degree	4	13.3
Experience (Years)		
1 – 5	5	16.7
6 – 10	7	23.3
11 – 15	16	53.3
16 – 20	2	6.7
Mean ±SD	10.8 ±4.4	
Confidence in self-protection		
No	3	10
Yes	27	90
Training courses on infection control precautions for coronavirus		
No	2	6.7
Yes	28	93.3
How many training courses		
1	21	70
2	8	26.7
3	1	3.3
Benefit from the training		
No	2	6.7
Yes	28	93.3
Have you ever had coronavirus		
No	27	90
Yes	3	10

Table (2): Frequency distribution of nurses' wearing PPE regarding covid-19 protection (30)

	No		Sometimes		Yes	
	n	%	n	%	n	%
wearing gloves when handling patients	0	0	5	16.7	25	83.3
wearing a mask when dealing with patients	0	0	1	3.3	29	96.7
wearing gown when dealing with patients	0	0	11	36.7	19	63.3
wearing a face shield when dealing with patients	9	30	11	36.7	10	33.3
wearing over head when dealing with patients	3	10	8	26.7	19	63.3
wearing hospital overshoes when dealing with patients	2	6.7	11	36.7	17	56.7

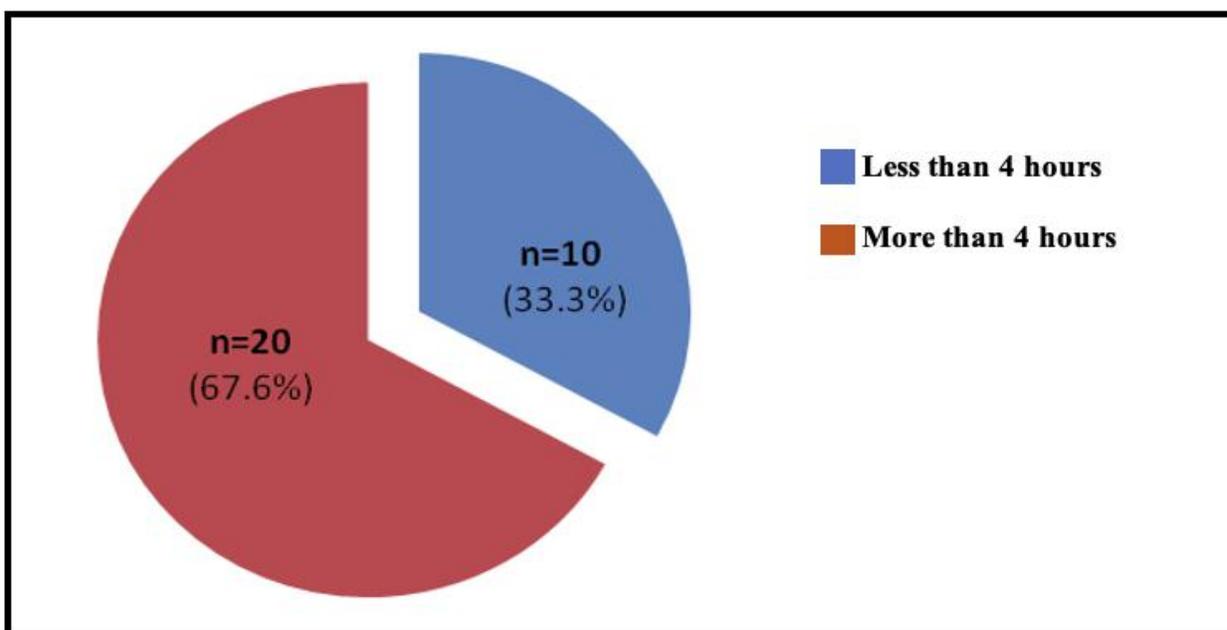


Figure (1): This figure illustrate that 67.6% of studied sample wore personal protective equipment for duration more than 4 hours.

Table (3): Number and distribution of knowledge regarding skin damages you suffer from as a result of using PPE

Skin Damages that result From	n	%	n	%
Using Mask				
Blistering in the mouth	30	100	0	0
Skin allergic dermatitis	28	93.3	2	6.7
Nasal bridge scar	12	40	18	60
Friction and inflammation of the skin	25	83.3	5	16.7
Facial itching/rashes	28	93.3	2	6.7
Indentation and pain in back of ears	14	46.7	16	53.3
Problems in breathing	18	60	12	40
None	24	80	6	20
Wearing Gloves				
Skin soaking in sweat	23	76.7	7	23.3
Skin chapping	30	100	0	0
Skin dermatosis	30	100	0	0
Skin itching/ rash	25	83.3	5	16.7
Dry skin	27	90	3	10
None	15	50	15	50
Wearing Protective Clothing				
Contact dermatitis	29	96.7	1	3.3
Itching/rash	25	83.3	5	16.7
Dry skin	30	100	0	0
Excessive sweating	17	56.7	13	43.3
None	16	53.3	14	46.7

Table (3): Reveals that nearly two-thirds of them (60%) suffer from Nasal bridge scar. Many of nurses (53.3%) had Indentation and pain in back of ears linked to wore personal protective equipment, and the high percentage of them (43.3%) had excessive sweating.

Table (5): Illustrate that there was statistical significant difference between educational level, experience years, confidence in self-protection, training courses on infection control precautions for coronavirus, benefit from the training characteristics of nurses and skin damages related to wearing PPE.

Table (4): Show that the majority of them (77.4%) said that sometimes had to repeat the treatment instructions to patients

as a result of wearing protective clothing, almost of them (71%) expressed that sometimes feel low energy or dizzy while wearing protective clothing for long periods, and 45.8 % of the studied sample felt too hot and thirsty while wearing protective clothing.

Table (6): clears that there were statistically significance difference in difficulties related to wearing PPE and educational level, experience years, confidence in self-protection, training courses on infection control precautions for coronavirus, benefit from the training characteristics of nurses and skin damages related to wearing PPE.

Table (4): Frequency distribution of difficulties related to using PPE

	No		Sometimes		Yes	
	n	%	n	%	n	%
Feeling uncomfortable while wearing protective clothing	5	16.1	12	38.7	14	45.2
Feeling too hot while wearing protective clothing	4	12.9	10	32.3	17	54.8
Feeling fatigued while wearing protective clothing	8	25.8	9	29	14	45.2
Feeling uncomfortable while wearing protective clothing for long hours of work	2	6.5	13	41.9	16	51.6
Cannot eat and drink for long hours while wearing protective clothing	3	9.7	18	58.1	10	32.3
Difficult to work quickly with the patient while wearing protective clothing	3	9.7	18	58.1	10	32.3
Difficult to go to the bathroom when needed while wearing protective clothing	11	35.5	7	22.6	13	41.9
Feeling thirsty while wearing protective clothing	0	0	14	45.2	17	54.8
Feeling hungry while wearing protective clothing	10	32.3	9	29	12	38.7
Feeling low on your energy or dizzy while wearing protective clothing for long periods	8	25.8	1	3.2	22	71
Feeling headache while wearing protective clothing	8	25.8	11	35.5	12	38.7
Feeling pain in the body while working while wearing protective clothing for long periods	7	22.6	16	51.6	8	25.8
Finding difficult to talk to patients while wearing a mask	11	35.5	10	32.3	10	32.3
Finding difficult to speak and understand speech with your colleagues while wearing a mask	11	35.5	10	32.3	10	32.3
Having to repeat the treatment instructions to patients as a result of wearing protective clothing	6	19.4	1	3.2	24	77.4

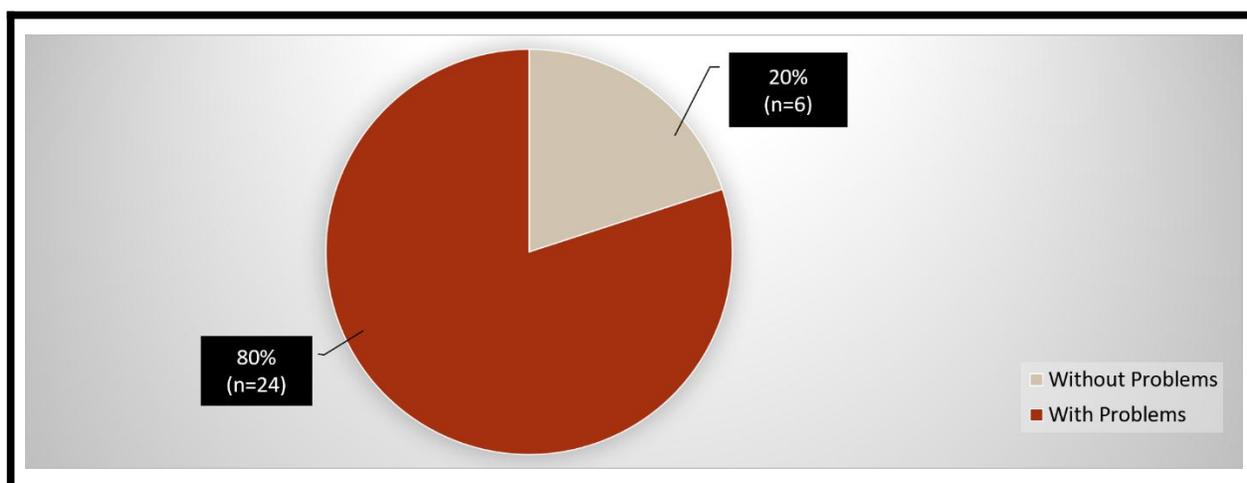


Figure (2): This figure illustrates that almost of studied nurses (80%) suffer from skin damages and difficulties related to wearing personal protective equipment during providing care for covid-19 patients.

Table (5): Association between the demographic characteristics and skin damages related to wearing PPE scores

	Encounters skin damage related to PPE infrequently (n=23)		Encounters skin damage related to PPE frequently (n=7)		Chi-Square	
	n	%	n	%	X ²	P
Age						
20 – 30	14	60.9	4	57.1		
31 – 40	7	30.4	3	42.9		
41 – 50	2	8.7	0	0	0.87	0.647
Sex						
Male	3	13	1	14.3		
Female	20	87	6	85.7	0.007	0.933
Marital Status						
Single	4	17.4	1	14.3		
Married	19	82.6	6	85.7	0.037	0.847
Educational Level						
Secondary	9	39.1	7	100		
Institute	10		0	0		
Bachelor's degree	4	17.4	0	0	7.989	0.018*
Experience (Years)						
< 5	3	13	3	42.9		
5 – 10	4	17.4	4	57.1		
> 10	16		0	0	10.435	0.005*
Confidence in self-protection						
No	1	4.3	6	85.7		
Yes	22	95.7	1	14.3	19.862	<0.001*
Training courses on infection control precautions for coronavirus						
No	1	4.3	5	71.4		
Yes	22	95.7	2	28.6	15.093	<0.001*
How many training courses						
One	14	60.9	7	100		
Two or more	9	39.1	0	0	3.913	0.048*
Benefit from the training						
No	0	0	6	85.7		
Yes	23	100	1	14.3	24.643	<0.001*
Have you ever had coronavirus						
No	18	78.3	5	71.4		
Yes	5	21.7	2	28.6	0.14	0.708

Table 6. Association between the demographic characteristics and difficulties related to wearing PPE score

	Encounter difficulties infrequently (n=17)		Encounter difficulties frequently (n=13)		Chi-Square	
	n	%	n	%	X ²	P
Age						
20 – 30	12	70.6	6	46.2	1.9	0.387
31 – 40	4	23.5	6	46.2		
41 – 50	1	5.9	1	7.7		
Sex						
Male	3	17.6	1	7.7	0.632	0.427
Female	14	82.4	12	92.3		
Marital Status						
Single	2	11.8	3	23.1	0.679	0.41
Married	15	88.2	10	76.9		
Educational Level						
Secondary	11	64.7	5	38.5	9.485	0.009*
Institute	2	11.8	8	61.5		
Bachelor's degree	4	23.5	0	0		
Experience (Years)						
< 5	3	17.6	3	23.1	8.62	0.013*
5 – 10	8	47.1	0	0		
> 10	6	35.3	10	76.9		
Confidence in self-protection						
No	0	0	7	53.8	11.94	<0.001*
Yes	17	100	6	46.2		
Training courses on infection control precautions for coronavirus						
No	0	0	6	46.2	9.808	0.002*
Yes	17	100	7	53.8		
How many training courses						
One	8	47.1	13	100	9.832	0.002*
Two or more	9	52.9	0	0		
Benefit from the training						
No	1	5.9	5	38.5	4.887	0.027*
Yes	16	94.1	8	61.5		
Have you ever had coronavirus						
No	13	76.5	10	76.9	0.001	0.977
Yes	4	23.5	3	23.1		

Discussion:

The COVID-19 pandemic has caused unprecedented global demand for personal protective equipment (PPE). Prolonged application of PPE during clinical shifts can affect skin health. Staff is required to accommodate clinical duties under this challenging condition, with a limited number of breaks to allow skin healing (**Abiakam, et al., 2021**). This study aimed to explore the difficulties and skin damages caused by personal protective equipment use among nurses caring for COVID-19 Patients.

According to demographic characteristics of the studied sample, the ongoing study results displayed that, the mean age of studied sample was 29.1 ± 6.9 and majority of them were married. This finding was in accordance with (**Jose et al, 2021**) who mentioned that mean age was 30.36 ± 3.3 . Also, according to gender of the nurses in the current study, it was showed that majority of them were females. This in the same line with (**Abiakam, et al., 2021**) who stated that 88% of studied sample were female.

The current study represents the highest percent of nurses wore PPE during providing caring for covid-19 patients, this results consonant with (**Neuwirth et al, 2020**) who reported that; commonly, the COVID-19 wards showed a higher total commitment with 85% of PPE use.

Regarding Average Daily Wearing Time personal protective equipments, high percent of respondents wore PPE for over 4 hours. This result in accordance with (**Yuan et al, 2021**) who found that 78.18% of participants wore PPE for over 4 hours.

Adverse skin damages happened due to long-time wearing PPE, the prevalence of PPE-related skin reactions was high in nurse staff in our research. (80%) participants suffered different level of skin reactions, of

which 60% suffered from nasal bridge scar. In the present study more than half of nurses (53.3%) suffer from Indentation and pain in back of ears related to wearing mask for long period. Many of study nurses (43.3%) suffered from excessive sweating related to wearing protective clothing for long period. This results consonant with (**Jose et al, 2021**) who reported that; the study exhibited that most common adverse skin reactions among frontline nurses using PPE included nasal bridge scar, facial itching, sweating profusely, skin damage, dry skin rash, chapped skin, and wheals.

The current study showed that majority of study sample suffered from difficulties including Feeling hotness, discomfort, feeling thirsty, headache, having to repeat the treatment instructions to patients as a result of wearing protective clothing during providing care for covid-19 patients. This is correspondent with (**Roekel et al, 2021**) who found that healthcare workers who treat covid-19 patients experience more sleep difficulty and physical exhaustion including threats of infection, insecurity, work pressure, emotional demands, and work-family struggle.

Conclusion

Based on the result of the present study, it can concluded that there was majority of studied nurses suffering from many difficulties and skin damages related to wearing personal protective equipments during covid-19 epidemic.

Recommendations

In the light of the main findings of current study the next recommendations are suggested:-

- Nursing guidelines include updated WHO guidelines should be developed for nurses about how to Decreasing problems and skin damages in clinical setting.

- Replicate of the study in different areas to generate the study result

References:

Abiakam N., Worsley P., Jayabal H., Mitchell K., Jones M., Fletcher J., Spratt F., & Bader D., (2021): Personal protective equipment related skin reactions in healthcare professionals during COVID-19, *International Wound Journal* ;18(3) : 312-322.

Agarwal A., Agarwal S., & Motiani P., (2020): Difficulties Encountered While Using PPE Kits and How to Overcome Them: An Indian Perspective, *Cureus*; 12(11): e11652.

Agreda JS., (2021): MAYORES EN PANDEMIA: RESISTENCIA NUMANTINA. *Gerokomos*, 32(1):1

Arnold-Long M., Ayer M., & Borchert K., (2017): Medical device-related pressure injuries in long-term acute care hospital setting. *J Wound Ostomy Continence Nurs* 2017;44 (4):325–330.

Chu J., (2021): A statistical analysis of the novel coronavirus (COVID-19) in Italy and Spain. *PLoS One*. 25;16(3):e0249037.

Hampton T., Crunkhorn R., Lowe N., Bhat J., Hogg E., Afifi W., De S., Street I., Sharma R., Krishnan M., Clarke R., Dasgupta S., Ratnayake S. & Sharma S.,(2020): The negative impact of wearing personal protective equipment on communication during coronavirus disease ,1–5.

Gordon C., &Thompson A., (2020): Use of personal protective equipment during the COVID-19 pandemic. *British Journal of Nursing*, Vol (29), No (13).

Health workforce policy and management in the context of the COVID-19 pandemic response. Geneva: World Health Organization; 3 December 2020 (<https://apps.who.int/iris/handle/10665/337333>, accessed 20August 2021.

Honda H., &Iwata K.,(2016): Personal protective equipment and improving compliance among healthcare workers in high-risk settings. *Curr Opin Infect Dis* ,29 (4):400–406.

Jose S., Cyriac MC., & Dhandapani M.,(2021): Health Problems and Skin Damages Caused by Personal Protective Equipment: Experience of Frontline Nurses Caring for Critical COVID-19 Patients in Intensive Care Units. *Indian J Crit Care Med*, 25(2), 134–139.

Roekel H V., Fels I M., Bakker A B., and Tummers L G., (2021):Healthcare Workers Who Work With COVID-19 Patients Are More Physically Exhausted and Have More Sleep Problems,;11:625-626.

Salomé GM., & Dutra AA., (2021): Prevention of facial injuries caused by personal protective equipment during the COVID-19 pandemic. *Rev Bras Enferm*, 74(Suppl 1): 1.

Neuwirth MM., Mattner F., Otchwemah R., (2020): Adherence to personal protective equipment use among healthcare workers caring for confirmed COVID-19 and alleged non-COVID-19 patients, *Antimicrobial Resistance Infection Control*; 9:199.

Oran DP., &Topol EJ.,(2020): Prevalence of Asymptomatic SARS-CoV-2 Infection. *Annual of internal medicine journal*, 173, (5), 362-367.

Zhou Q., Xue J., Wang L N., N X Ma , Tong C F ., Wang Q ., Shi X

Q., Lu Y., Jiao X C., & Hu D H.,(2020): Nursing strategies for skin injuries caused by facial medical grade protective gear. *Chin J Burns.* 36(8):686-690.

Yuan Y., Xi2H., Le3 Y., Xu H., Wang J., Meng X., & Yang Y., (2021): Online survey on healthcare skin reactions for wearing medical-grade protective equipment against COVID-19 in Hubei Province, China. 16(4):e0250869.

Zhou N., Yang L., Dong L, Li Y., An X., Yang J., Yang L., Huang C., & Tao J.,(2020): Prevention and Treatment of Skin Damage Caused by Personal Protective Equipment: Experience of the First-Line Clinicians Treating 2019-nCoV Infection. *International Journal of Dermatology and Venereology*, 10.1097/JD9.