- **Basic Research**

Physiological Burdens of Prolonged Use of Surgical Face Masks among Healthcare Workers During the COVID-19 Pandemic Era

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Abstract:

Context: All healthcare attendees, including staff, patients, and visitors, were to wear universal masks when the World Health Organization (WHO) declared the COVID-19 as a global pandemic in March 2020. **Objective:** Assess physiological burdens of prolonged use of surgical face masks among healthcare workers during the COVID-19 pandemic era. **Settings:** The study was conducted at Alexandria University Hospitals and El-Hadra University Hospital. **Subjects:** A convenience sample of 160 healthcare workers from the above-mentioned settings. **Method:** A descriptive, research design was used to achieve this study. **Tool of this study:** Physiological burdens of the prolonged use of surgical face masks for healthcare workers interview questionnaire. It was used to assess the physiological burdens of the prolonged use of face masks for healthcare workers. **Results:** 70% of the studied healthcare workers were experienced blurred vision, two-thirds of them (66.7%) had a burning nose, more than two-thirds (70%) experienced dry mouth ,and two-thirds (66.7%) of them had a strong sensation of thirst, Also, nearly two third of them (60%) experienced pain behind the ears. nearly two-thirds (60%) noticed skin rashes/redness on the bridge of the nose. More than half (53.3%) experienced dizziness. The majority of the studied healthcare workers (86.7%) experienced headaches following prolonged use of face masks, and 76.7% experienced shortness of breath on exertion. Additionally; it was found that the prolonged use of face masks slightly interfered with food intake during work hours in more than half of them (53.3%). In addition, the need for drinking adequate fluids slightly interfered among nearly two-thirds of them (63%). There was a statistically significant relation between oxygen saturation after four hours of wearing surgical masks and health care workers' occupation with favor to physicians than nurses and paramedical over physicians. Furthermore; there was a statistically significant relation between oxygen saturation after eight hours of wearing surgical masks and health care workers' occupations with favor for physicians over nurses. Moreover; there was statistically significant relation between oxygen saturation after eight hours of wearing surgical masks and health care workers' area of practice in favor of the emergency room over than the operating room .**Conclusion:** The use of a facemask plays a crucial role in causing significant discomfort in all the participants during its prolonged usage including blurred vision, burning nose, hot nose, dry nose and mouth, pain behind the ears, rashes/redness on the bridge of the nose, dizziness, headaches, shortness of breath on exertion and decrease on oxygen saturation.

Keywords: Physiological Burdens, Surgical Face Mask, Healthcare Workers, COVID-19 Pandemic Era.

1. Introduction

All healthcare attendees, including staff, patients, and visitors, were to wear universal masks when the World Health Organization (WHO) declared the COVID-19 as a global pandemic in March 2020. Since then, daily healthcare workers (HCWs) began to wear surgical masks during their working hours. Consequently, these long hours can result in less appropriate breaks for personal care, nutrition, and hydration. **(WHO, 2020; Badri, 2017; Center for Disease Control and Prevention, 2020; and Darlenski and Tsankov, 2020).**

Additionally; prolonged use of the surgical masks can impose a physiological stress on the HCW, for example, the extended period may cause dizziness, which could endanger the worker, workplace, and patient safety. Dizziness is an important warning indicator, that can be caused by dehydration, hyperventilation, low blood sugar, and elevated carbon dioxide (CO_2) levels in the blood . Other known physiological effects of elevated CO2 levels include headache, elevated intracranial pressure, nervous system changes involving increased pain threshold, reduction in cognition-altered judgement, decreased situational awareness, difficulty coordinating sensory or cognitive abilities with motor activity, decreased visual acuity, and widespread sympathetic nervous system activation that can counteract the direct effects of CO2 on the heart and blood vessels. In addition, increased breathing frequency; increased "work of breathing", which is the result of breathing through a filter medium and cardiovascular effects including debilitated cardiac contractility, vasodilatation of peripheral blood vessels. As well as the tolerance for lighter workloads reduced. **(Disease Control and Prevention, 2019& Foo et al., 2019)**

Masks user is always going to suffer some level of breathing difficulty or breathing resistance, even though these devices are made to eliminate breathing resistance as much as possible. Enough breathing resistance could result in a reduction in the frequency and depth of breathing, known as hypoventilation. Hypoventilation is a main cause of significant discomfort while wearing the masks **(Williams, 2020)**. However, studies done by (**Roberge et al., 2020)** indicated that this hypoventilation did not pose a substantial risk to healthcare workers over less than one hour of continuous mask use.

A hot and humid environment found in the facial region covered by masks causes discomfort and hyperthermia. This may create a situation where the healthcare professional is unable to recognize dangers and perform manual tasks, and it also significantly affects motor skills. The moist environment and pressure from tight-fitting masks also block facial ducts, this can explain the increase of acne with prolonged mask use. Frequent PPE and mask changes may cause shearing and breakdown of the skin, and breakdown on the bridge

of the nose and cheekbones can be attributed to tight-fitting masks and goggles that put pressure on these specific areas. Urticaria and contact dermatitis can occur from sensitivity to components such as thiuram which is found in the ear loops of surgical masks **(Williams, 2020; Wu, et al., 2021).**

While workers must concentrate on their important job tasks and the appropriate use of PPE for self-protection, they must also be aware of the impact of PPE including face masks on their wellbeing. The balance between the protections afforded by PPE and the burden of that PPE must be met with a plan to lessen the burden .Moreover, find a secure location to properly remove the face masks in order to lessen CO2 buildup and the harmful physiological impacts that come along with it. Breaks during shifts are essential for health care workers' health and safety **(Yan et al., 2020& Zuo et al., 2020)**.

2.Significance of the study: Wearing masks for a prolonged amount of time causes a host of physiologic burdens and can decrease work efficiency. Activity cannot be performed as long or as efficiently while wearing masks as compared to when masks are not worn, hence this study designed to evaluate the real impact of the daily use of surgical face masks on the physiological burden including health issues and physical problems related to the prolonged use of masks on physicians, nurses, and other HCWs.

3. Aim of the study: the present study aimed to assess physiological burdens of prolonged use of surgical face masks among healthcare workers during the COVID-19 pandemic era.

4. Research Question:

What are the physiological burdens of prolonged use of surgical face masks among healthcare workers during the COVID-19 pandemic era?

5. Operational Definition:

Physiological burdens: In this study, the physiological burdens meant the physical complaints, respiratory functions affections , oxygen saturation, and effects on basic needs following prolonged use of surgical face masks.

6. Subjects and method

6.1. Research Design: A descriptive, research design was utilized to meet the aim of the present study.

6.2.Setting: The study was conducted at Alexandria University Hospitals including Alexandria Main University Hospital and El-Hadra University Hospital. These hospitals offer non-paid public services for all governorates in Egypt.

6.3.Subjects:A convenience sample of 180 healthcare workers was obtained from the above-mentioned settings who are providing care for patients were included in this study.

- ***Epi info 7 was used to estimate the sample size using the following parameters:***
    - The total population size was estimated at 450
    - Expected frequency: 50%
    - Acceptable error: 5%
    - Confidence coefficient: 95%
    - The minimum sample size of 177

Inclusion Criteria: Were included healthcare workers aged from 18 to 60 and those willing for the study. Facemask was donned by healthcare workers since the beginning of the shift duty and doffed at the end of the duty.

6.4.Tool of this Study:

6.4.1.Physiological Burdens of the Prolonged Use of Surgical Face Mask for Healthcare workers Interview Questionnaire: in the present study, there was one tool used to collect the necessary data for the study. It was used to assess the physiological burdens of the prolonged use of face masks for healthcare workers. This tool was developed by the researchers in the English language after reviewing the relevant literature then translated into Arabic **(Roberge, et al., 2019 & Zuo et al., 2020)**, it was comprised of three parts:

Part I:

Healthcare workers' socio-demographic characteristics and clinical data: This part was developed by the researchers, including the following items covering data such as age, gender, level of education, years of experience, occupation, area of practice, past health history, and smoking habits.

Part II:

Physiological burdens of prolonged use of surgical face masks: This part was developed by the researchers after reviewing the relevant literature **(Roberge., et al .2019)**. It was used to assess the physiological burdens of prolonged use of surgical face masks among health care workers. It was included:

- **Subjective data such as** the alteration in the eyes, nose, mouth, or the skin, pain behind the ears, headaches, dizziness, and fatigue. Each item was assessed for its presence or absence. One score was given for" Yes "and a zero score was given for "No".
- **Objective data such as** oxygen saturation, was measured using a pulse oximeter at the beginning of the shift, after four and eight hours.

Part III:

Effect of prolonged use of face masks on health care workers' basic needs during working hours:

This part was developed by the researchers after reviewing the relevant literature **(Zuo et al., 2020)**. It was used to assess how prolonged use of face masks affects health care workers' basic needs during working hours. This tool included data about, food intake during work hours, hydration, and self-care including washing the face. Every participant expressed his/her degree of limitation due to prolonged use of face masks on a three-point Likert scale ranging from zero to two.

- "Zero": Not interfere.
- "One": Slightly interfere
- "Two": Totally interfere

6.5. Method:

The study was accomplished as follows:

- Approval from the Ethical Research Committee, Faculty of Nursing, Alexandria University was obtained.
- An official permission from the Faculty of Nursing, Alexandria University was obtained and was directed to the responsible authorities of the study settings to take their permission to conduct the study after explaining the aim of the study.
- A study tool was tested for content validity by five experts in Medical-Surgical Nursing to assure the content validity, clarity of items, comprehensiveness, appropriateness, translation, and the necessary modifications was done.
- The reliability of the study tool was tested utilizing Cronbach's Alpha. The reliability coefficient for the tool was (0.924), which meant that the tool was reliable.
- A pilot study was initially carried out before the actual data collection phase on eighteen health care workers to check the clarity, feasibility, and applicability of tools and determine obstacles that may be encountered during the period of data collection, accordingly, needed modifications were done.
- Data collection started at the beginning of July 2021 and ended in February 2022.
- Every participant was interviewed individually once for 15-20 minutes, using the study tool to collect data related to the physiological burdens of prolonged use of surgical face masks among healthcare workers during the covid-19 pandemic era.

6.6. Ethical Considerations:

- A written informed consent from subjects to participate in the study was obtained before data collection and after an explanation of the aim of the study.
- The anonymity of the study participants was assured.
- Confidentiality of the collected data was assured.

- Participants' voluntary participation and their right to withdraw from the study at any time were emphasized.

6.7. Statistical analysis:

Data were processed and analyzed using PC with statistical package for social science (SPSS ver. 23). Cronbach's alpha reliability test was used to measure the reliability of the study tool. Its maximum value is (α=1.0) and the minimum accepted value is (α= 0.7); below this level the tool would be unreliable. Count (numbers) and percentage from total, used for describing and summarizing bio-sociodemographic data, physiological burdens of prolonged use of face masks. The relation between the subjects' oxygen saturation mean and area of practice /occupation carried out using **one-way ANOVA** test.

7. Results:

Table (1): Frequency distribution of healthcare workers according to their socio-demographic characteristics. Regarding the socio-demographic characteristics of the studied healthcare workers, the results of the study revealed that one-third of the studied healthcare workers (33.3%) were in the age group of (20-30) years old. More than two-thirds of healthcare workers (73.3%) were females, and more than half of them (56.7%) were single. Also, more than two-thirds of them (70%) were from urban. In relation to the healthcare workers' educational level, more than half of them (53.3%) had diploma degrees. According to their occupation, nearly three-quarters of them (73.3%) were nurses. Concerning the area of practice, results revealed that more than half of the studied healthcare workers (60%) work in the medical department. Whereas, the minority (3.3%) work in the dialysis unit. Concerning the healthcare workers' years of experience, it was observed that more than one-third of them (40%) had experienced from 5 to 10 years. Whereas the minority (3.3%) had experienced more than 20 years. Moreover, this table showed that more than half of the studied healthcare workers had no past health history and were non-smokers (53.4% - 60%) respectively.

Table (2): Frequency distribution of healthcare workers according to their physical complains following prolonged use of face masks. Regarding the physiological burdens of prolonged use of face masks on the eye, it was noticed that more than two-thirds of the studied healthcare workers (70%) experienced blurred vision, half of them had heavy eyes and more than one-third of them had itchy eyes, while the minority of them (3.3%) had red eyes. Concerning the physiological burdens of prolonged use of face masks on the nose, it was found that two-thirds of the studied healthcare workers (80%) had irritated itchy nose ,(66.7%)of them had burning noses, and more than half of them experienced hot nose and dry nose (56.7%, 53.3%) respectively, also, nearly half of them (46.7%) complain of nasal

congestion and painful nose. While the lowest proportion (13.3%) had crusting in the nose and alteration of the smell sense.

In relation to the physiological burdens of prolonged use of face masks on the mouth, the table shows that more than two-thirds of them (70%) experienced dry mouth, two-thirds of them had a strong sensation of thirst, more than half of them (56.7%) experienced halitosis (bad mouth odor), and half of them experienced excessive sweating around the mouth. Also, results revealed that nearly two-thirds of them (60%) experienced pain behind the ears. nearly two-thirds of them (60%) noticed skin rashes/redness on the bridge of the nose. More than half of them (53.3%) experienced dizziness. Moreover, two-thirds (66.7%) of them need to rest more often or for longer periods.

Table (3): Frequency distribution of healthcare workers according to headaches assessment following prolonged use of face masks. Results revealed that the majority of the studied healthcare workers (86.7%) experienced headaches following prolonged use of face masks. Regarding the severity of headaches, it was found that nearly half of them (46.1%) had moderate headaches, more than one-third of them (38.5%) had mild headaches, and the minority (15.4%) had severe headaches. In relation to, the start time of headaches when wearing the masks, results revealed that more than half of the studied healthcare workers (57.7%) feel headaches after more than three hours of wearing the mask. More than half of them (53.8%) had headaches in the forehead. As regards the character of headaches, more than one-third of them (41%) had tight band headaches.

Table (4): Frequency distribution of healthcare workers according to their respiratory affections following the prolonged use of face masks. Regarding the respiratory function affections following the prolonged use of face masks, study results revealed that the majority of the studied healthcare workers (76.7%) experienced shortness of breath on exertion. Also, more than half of them (53.3%) experienced increased breathing frequency. While the minority (26.7%) experienced a reduction in the frequency and the depth of breathing (hypoventilation).

Figure (1): Mean Oxygen Saturation Following the Prolonged Use of Face Masks among Healthcare Workers. It was observed that the oxygen saturation mean was decreased with prolonged use of a face mask as the oxygen saturation mean was (98.27) at the beginning of the shift (96.46) after four hours (94.83) after eight hours from the shift.

Table (5): Frequency distribution of healthcare workers according to their basic needs affection during working hours following the prolonged use of face masks. It was found that the prolonged use of face masks slightly interferes with food intake during work hours in more than half of them (53.3%). In addition, the prolonged use of face masks slightly

interfered with the need for drinking adequate fluids among nearly two-thirds of them (63%). Also, the table shows that the prolonged use of face masks slightly interferes with nearly three-quarters of them (70%) with self-care activities including face and mouth washing.

Table (6): The Relationship between the Studied Health Care Workers' Oxygen Saturation Mean Score and Their Occupation: The current study revealed that there was a statistically significant relation between oxygen saturation after four hours of wearing surgical masks and health care workers' occupation as P=(0.003*) with favor to physicians over nurses where p= (0.001*) and paramedical than physicians as p=(0.047*). Furthermore; there was a statistically significant relation between oxygen saturation after eight hours of wearing surgical masks and health care workers' occupation as P=(0.042*) with favor to physicians over nurses where p= (0.051*).

Table (7): The Relationship between the Studied Health Care Workers' Oxygen Saturation Mean Score and Their Area of Practice: The current study revealed that there was not a statistically significant relation between oxygen saturation at the beginning of the working shift and after four hours of wearing surgical masks and health care workers' area of practice as P= (0.102, 0.612) respectively. On the other hand; there was statistically significant relation between oxygen saturation after eight hours of wearing surgical masks and health care workers' area of practice as P=(0.037*) with favor to the emergency room over the operating room where p=(0.029*).

Table (1): Frequency Distribution of the Healthcare Workers according to their Socio-demographic Characteristics (n=180).

n: number of studies healthcare workers SD: standard deviation

Healthcare Workers ' Socio-demographic Characteristics	No.	%
Age in years		
▪ **20<30**	**60**	**33.3**
▪ 30<40	50	27.8
▪ 40<50	25	13.9
▪ 50≤60	45	25.0
Mean ± SD	30.20±8.719	
Gender		
▪ Male	48	26.7
▪ **Female**	**132**	**73.3**
Marital status		
▪ **Single**	**102**	**56.7**
▪ Married	78	43.3
Residence		
▪ Rural	54	30.0
▪ **Urban**	**126**	**70.0**
Educational level		
▪ **Diploma**	**96**	**53.3**
▪ Bachelor	84	46.7
Occupation		
▪ **Nurses**	**132**	**73.3**
▪ Physicians	30	16.7
▪ Paramedical	6	3.3
▪ Intern-nurse	12	6.7
Area of practice		
▪ **Medical**	**108**	**60.0**
▪ Surgical	30	20.0
▪ Operating room	18	10.0
▪ Dialysis	6	3.3
▪ Emergency room (ER)	12	6.7
Years of Experience		
▪ <5	60	33.3
▪ **5 < 10**	**72**	**40.0**
▪ 10 ≤20	42	23.4
▪ More than 20	6	3.33
Past Health History of		
▪ **No history**	**96**	**53.4**
▪ Sinusitis	42	23.3
▪ Bronchial asthma	42	23.3
Smoking		
▪ **Non-smoker**	**108**	**60.0**
▪ Current smoker	6	3.3
▪ Passive smoker	66	36.7

Table (2): Frequency distribution of healthcare workers according to their physical complains following prolonged use of face masks.

Physical Complains items	Total n=180	
	No.	**%**
***Eyes**		
▪ Burning sensation.	42	23.3
▪ Itchy eyes.	72	40.0
▪ Aching sensations.	18	10.0
▪ Heavy eyes.	90	50.0
▪ Red eyes.	6	3.3
▪ Photophobia.	24	13.3
▪ **Blurred vision**	**126**	**70.0**
***Nose**		
▪ Dry nose.	96	53.3
▪ Hot nose.	102	56.7
▪ Burning nose.	120	66.7
▪ Cracking of the skin inside the nose.	30	16.7
▪ Crusting in the nose.	24	13.3
▪ Alteration of the smell sense.	24	13.3
▪ Nasal congestion.	84	46.7
▪ **Irritated/itchy nose.**	**144**	**80.0**
▪ Painful nose.	84	46.7
***Mouth & throat**		
▪ **Experienced dry mouth**.	**126**	**70.0**
▪ Experienced halitosis (bad mouth odor).	102	56.7
▪ Experienced excessive sweating around the mouth.	90	50.0
▪ Strong sensation of thirst	120	66.7
Ears		
Pain behind the ears	108	60.0
***Skin**		
▪ Noticed any acne (pimples) on the face.	78	43.3
▪ **Noticed any skin rashes/redness on bridge of nose**.	**108**	**60.0**
▪ Noticed any skin rashes/redness on Cheeks.	74	41.1
Dizziness		
Dizziness	96	53.3
***Fatigue**		
▪ Reduced tolerance to lighter workloads.	96	53.3
▪ Pacing physical activities	96	53.3
▪ Having less motivation to do anything that requires physical effort	54	30.0
▪ Having trouble to maintaining physical effort for long periods		
▪ **Need rest more often or for longer periods.**	96	53.3
	120	**66.7**

n: number of studies healthcare workers N.B: *More than one answer was allowed

Table (3): Frequency Distribution of Healthcare Workers according to Headaches Assessment following Prolonged Use of Surgical Face Masks.

Healthcare Workers' Headaches Assessment	Total n=180	
	No.	%
Incidence of headache		
▪ No	24	13.3
▪ **Yes**	**156**	**86.7**
Severity of headache	**n=156**	
▪ Mild	60	38.5
▪ **Moderate**	**72**	**46.1**
▪ Severe	24	15.4
The start time of headache in relation to wearing the mask		
▪ Within one hour of wearing the mask	12	**7.7**
▪ After one to three hours of wearing the mask	54	34.6
▪ **More than three hours after wearing the mask**	**90**	**57.7**
***Location of headache**		
▪ **Forehead**	**84**	**53.8**
▪ Behind eye	24	15.4
▪ Left side of the head	12	7.7
▪ Right side of the head	10	6.4
▪ Both sides of the head	30	19.2
[illegible]	[illegible]	[illegible]
Character of headache		
▪ Pressure	48	30.8
▪ **Tight band**	**64**	**41.0**
▪ Dull ache	44	28.2

n: number of studies healthcare workers N.B: *More than one answer was allowed

Table (4): Frequency Distribution of Healthcare Workers according to their Respiratory Functions Affections Following the Prolonged Use of Surgical Face Mask.

*Respiratory Functions	Total n=180	
	No.	%
▪ **Experienced shortness of breath on exertion (SOBOE)".**	**138**	**76.7**
▪ Increased breathing frequency.	96	53.3
▪ Reduction in the frequency and depth of breathing (hypoventilation).	48	26.7

n: number of studies healthcare workers N.B: *More than one answer was allowed

Figure (1): Illustrates the Mean Oxygen Saturation Following the Prolonged Use of Face Masks among Healthcare Workers

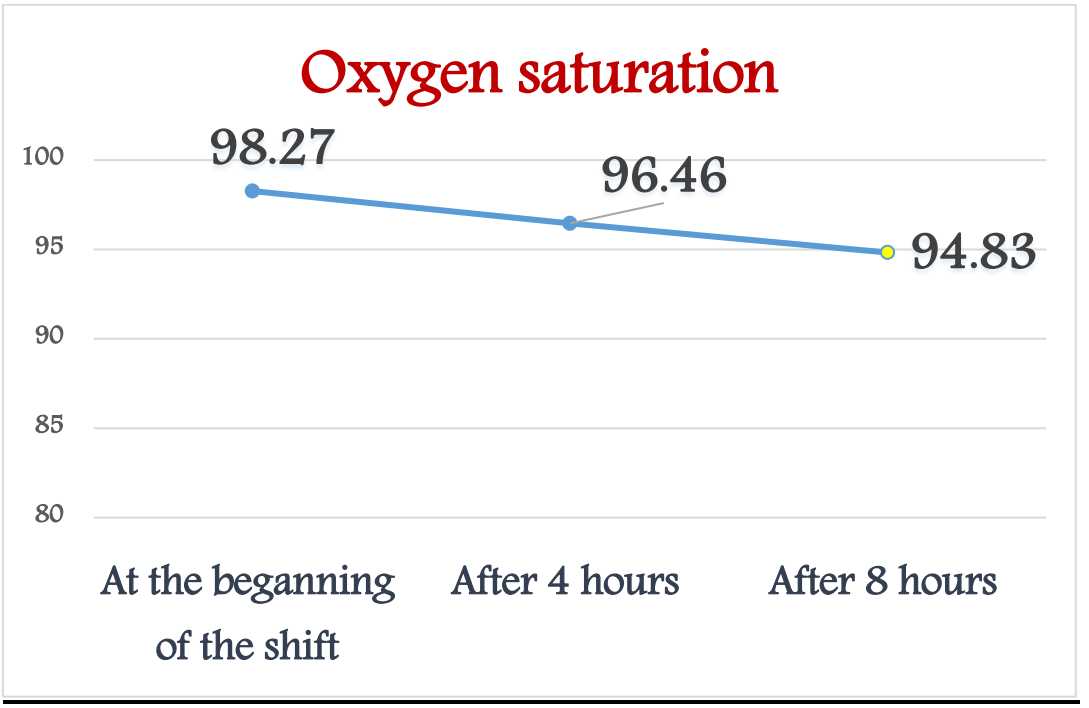

Table (5): Frequency Distribution of Healthcare Workers According to Their Basic Needs Affection During Working Hours Following The Prolonged Use Of Face Masks

Basic needs	Total n=180					
	Not interfere		Slightly interfere		Totally interfere	
	No.	%	No.	%	No.	%
▪ Food intake during work hours	30	16.7	**96**	**53.3**	54	30.0
▪ Drinking adequate fluids (hydration)	24	13.3	**114**	**63.3**	42	23.3
▪ Self-care including face and mouth washing.	18	10.0	**126**	**70.0**	36	20.0

n: number of studies healthcare workers

Table (6): The Relationship between the Studied Health Care Workers' Oxygen Saturation Mean Score and Their Occupation.

	Occupation	Oxygen saturation Mean ± S. D		Test of Significance	
At the beginning of the working shift	▪ Nurse	97.94±1.029		F= 2.550 P= 0.078	
	▪ Physician	99.00±0.000			
	▪ Paramedical	98.25±0.500			
	▪ Intern -nurse	98.75±0.500			
After four hours of wearing the working shift	▪ Nurse	95.82±1.590		F= 6.090 P= 0.003*	
	▪ Physician	98.80±0.447			
	▪ Paramedical	96.25±1.500			
	▪ Intern -nurse	96.50±0.577			
		Nurse Vs each group	**Physician Vs each group**	**Paramedical Vs each group**	**Intern - Nurse Vs each group**
	▪ **Nurse**				
	▪ **Physician**	**0.001***			
	▪ **Paramedical**	0.943	**0.047***		
	▪ **Intern -nurse**	0.812	0.084	0.994	
After eight hours of wearing the working shift	▪ Nurse	94.64±1.320		F= 3.13 P= 0.042*	
	▪ Physician	96.20±0.447			
	▪ Paramedical	94.25± 0.957			
	▪ Intern -nurse	94.50±0.577			
		Nurse Vs each group	**Physician Vs each group**	**Paramedical Vs each group**	**Intern - Nurse Vs each group**
	▪ Nurse				
	▪ Physician	**0.051***			
	▪ Paramedical	0.918	0.067		
	▪ Intern -nurse	0.995	0.132	0.989	

F: for one-way ANOVA test, pairwise bet, each 2groups was done using post Hoc test (Tukey).

***** Statistically significant at ≤ 0.05.

Table (7): The Relationship between the Studied Health Care Workers' Oxygen Saturation Mean Score and Their Area of Practice:

	Area of practice	Oxygen saturation Mean ± S. D	Test of Significance
At the beginning of the working shift	▪ Medical	98.33± 0.816	F= 2.171 P= 0.102
	▪ Surgical	98.43±0.535	
	▪ Operating room	97.00± 1.732	
	▪ Dialysis	98.33±0.577	
	▪ Emergency room (ER)	99.00±0.100	
After four hours of wearing the working shift	▪ Medical	96.800±1.820	F= 2.625 P=0.612
	▪ Surgical	96.429 ±0.975	
	▪ Operating room	94.000 ±1.732	
	▪ Dialysis	96.333± 0.577	
	▪ Emergency room (ER)	98.000 ± 0.102	
After eight hours of wearing the working shift	▪ Medical	95.06±1.099	F= 3.009 P= 0.037*
	▪ Surgical	94.42±1.272	
	▪ Operating room	93.33± 0.577	
	▪ Dialysis	95.00±1.000	
	▪ Emergency room (ER)	96.50±0.707	

	Medical Vs each group	**Surgical Vs each group**	**Operating room Vs each group**	**Dialysis Vs each group**	**Emergency room (ER)Vs each group**
▪ **Medical departments**					
▪ **Surgical departments**	0.707				
▪ **Operating room**	0.120	0.601			
▪ **Dialysis**	1.000	0.940	0.359		
▪ **Emergency room (ER)**	0.427	0.158	**0.029***	0.569	

F: for one-way ANOVA test, pairwise bet, each 2groups was done using post Hoc test (Tukey).

***** Statistically significant at ≤ 0.05.

8. DISCUSSION

Many shreds of evidence support that surgical face masks can be effective in the reduction of COVID-19 transmission. However, there are physiological side effects behind prolonged masks-wearing. **Regarding the effect of prolonged surgical face mask-wearing on eyes**; it was noticed that more than two-thirds of the studied healthcare workers experienced blurred vision, half of them had heavy eyes and more than one-third of them had itchy eyes, while the minority of them had red eyes. The present findings could be attributed to the fact that the major factor is the outflow of exhaled air, with a temperature around 36-37°C, passing over the upper border of the face mask to the ocular surface. This direct hot airflow leads to instability, increased evaporation, hyperosmolarity, and a decline in tear film turnover and clearance and resulting in ocular damage and dry eye symptoms. In this respect **Marinova et al., (2020)** found that more than two-thirds of surgical face mask users reported ocular symptoms, including burning, redness, tearing, foreign body sensation, itching, blurred vision, dry eye feeling, and undefined eye discomfort.

Concerning the effect of prolonged use of face masks on the nose, it was found that more than two thirds of the studied healthcare workers had irritated itchy nose ,two-thirds of them had burning noses, more than half of them experienced hot and dry noses, and also, nearly half of them complain of nasal congestion and painful nose. This may be explained by that prolonged usage of facemasks, might cause an increase in heat beneath the mask, which in turn decreases the water carrying capacity of air in the nose resulting in the sensation of a dry and burning nose, moreover; a mask often traps not only heat but also moisture behind it and inside the nose. Excessive moisture coating the lining of the nose can decrease the sensitivity of air passing through the nasal cavity, this can create a sensation of decreased breathing or congestion in the nose. These findings were supported by **Priya et al., (2021)** who reported that more than one-third of participants following prolonged face masks use experienced dry noses. Furthermore; this was in accordance with **(Purushothaman et al., 2021)** who found that around half of the healthcare workers, were experienced generalized nasal discomfort, more than one-quarter of them experienced dry nose, and about one-quarter of them suffered from a burning sensation in the nose, and about more than half of them developed itchy nose due to prolonged use of face masks.

In relation to the effect of prolonged use of face masks on the mouth, more than two-thirds of them experienced dry mouth, two-thirds of them had a strong sensation of thirst, more than half of them experienced halitosis (bad mouth odor), half of them experienced excessive sweating around the mouth. Wearing face masks might result in increased evaporation, this might explain why wearing time of surgical masks more strongly

impacted the change in summated dry mouth and halitosis. This finding was in the same line with **Kanzow et al., (20021),** who found that wearing face masks resulted in significantly increased self-perceived dry mouth and halitosis.

Frequent PPE and mask changes may cause shearing and breakdown of the skin, and breakdown on the bridge of the nose and cheekbones can be attributed to tight-fitting masks in addition, the elastic loops attached to the masks to keep them in place can rub the ears and skin, a phenomenon called 'ear fatigue' or ear pain, in this extent this results revealed that nearly two-thirds of health care workers experienced pain behind the ears and nearly two-thirds of them noticed skin rashes/redness on the bridge of the nose. These findings were in the same line as **Purushothaman et al., (2021)** who illustrated that more than one-third of the study subjects had pain behind the ear which is possibly due to the tight-fitting masks.

Concerning dizziness and headaches following prolonged use of face masks, more than half of healthcare workers experienced dizziness and the majority of them experienced moderate headaches on the forehead, after more than three hours of wearing the mask. This headache can be related to mechanical factors, the presence of hypoxemia and hypercapnia, or the stress associated with mask use.

Indirect factors may also contribute to headaches while wearing masks, for example, inadequate hydration and irregular eating patterns this rationale is in the same line with the current study findings as the prolonged use of face masks slightly interfere with food intake during work hours in more than half of them. In addition, the prolonged use of face masks slightly interfered with the need for drinking adequate fluids among nearly two-thirds of them. Also, prolonged use of face masks slightly interferes in nearly three-quarters of them with self-care activities including face and mouth washing.

In this context, **Scheid et al., (2020)** reported that headaches developed in people who wore both masks and protective eyewear for more than four hours. **Rosner, (2020)** found that the highest reported side effect was headaches representing more than two-thirds of respondents. More than one-fifth of the study subjects stated that their headaches occurred within one hour of wearing the mask, more than one-third of them reported that their headaches occurred after one hour of wearing the mask, and more than one-third of them after three hours or more of wearing the mask.

Regarding the respiratory function affections following the prolonged use of face masks, study results revealed that the majority of the studied healthcare workers experienced shortness of breath on exertion, also, more than half of them experienced increased breathing frequency. While the minority experienced a reduction in the frequency

and depth of breathing (hypoventilation). Oxygen saturation mean was decreased with prolonged use of face masks. These findings were consistent with **Person et al., (2018)** who stated that wearing a surgical mask modifies significantly clinical dyspnea without influencing walked distance. Additionally; **Wojtasz et al., (2022)** found that there were significant differences in participants' SpO_2 between shifts 1 and 2 in the period between 31 and 120 minutes in their study to determine the effect of face masks on blood saturation, heart rate, and well-being indicators in health care providers working in the specialized COVID-19 center.

The change in respiratory function could be interpreted in the light of the fact that; the increased rebreathing of carbon dioxide (CO_2) from the enlarged dead space volume in mask wearers can reflectively trigger increased respiratory activity with increased muscular work as well as the resulting additional oxygen demand and oxygen consumption. This is a reaction to pathological changes in the sense of an adaptation effect. Correspondingly, a mask-induced drop in blood oxygen saturation value (SpO_2) or the blood oxygen partial pressure (PaO_2) can in turn additionally intensify subjective chest complaints.

As regards the relationship between the studied health care workers' oxygen saturation mean score and their occupation; the current study revealed that there was a statistically significant relation between oxygen saturation after four hours of wearing surgical masks and health care workers' occupation with favor to physicians than nurses and paramedical than physicians. Furthermore; there was a statistically significant relation between oxygen saturation after eight hours of wearing surgical masks and health care workers' occupations with favor for physicians over nurses

This may be explained by that nurses spend more time in contact with the patients than physicians and physicians spend more time in contact with the patients than paramedical personnel which intern requires the nurses to wear the surgical mask for a prolonged time than physicians and physicians wear it more than paramedical personals so that oxygen saturation of physician better than nurses and oxygen saturation of paramedical personals better than the physician. These findings were constant with **Tabansi and Unobogu., (2020)** who found that more than half of the healthcare workers were doctors, used facemasks continuously over eight hours, and maintained normal SPO_2 levels, with the physiologic adaptation of respiratory and pulse rates.

With reference to the relationship between the studied health care workers' oxygen saturation mean score and their area of practice; the current study revealed that there was not a statistically significant relation between oxygen saturation at the beginning of the working shift and after four hours of wearing surgical masks and health care workers'

area of practice respectively. On the other hand; there was a statistically significant relation between oxygen saturation after eight hours of wearing surgical masks and health care workers' area of practice in favor of the emergency room than operating room .This may be explained that during the COVID-19 pandemic the number of the emergency rooms cases is more over than the operating rooms cases so the emergency rooms staff wear a surgical mask for prolonged time than operating rooms staff which in turn affect their oxygen saturation**.** These findings were supported by **Venesoja et al., (2021**) who study the healthcare workers' experiences and views of using surgical masks, and the majority of the study subjects were worked on the HC frontline (emergency medical services, emergency departments) and reported that using surgical facemasks for long periods caused such symptoms as tiredness, pain, dry mouth, and a sense of lack of oxygen in comparison with other health care workers.

9. Conclusions

From the findings of the present study, it can be concluded that the use of a facemask plays a pivotal role in causing significant discomfort in all the participants during its prolonged usage including blurred vision, burning nose, hot nose, dry nose and mouth, pain behind the ears, rashes/redness on the bridge of the nose, dizziness, headaches, shortness of breath on exertion and decrease on oxygen saturation. Furthermore; there was a statistically significant relation between oxygen saturation after eight hours of wearing surgical masks and health care workers' occupations with favor to physicians over nurses. Moreover; there was a statistically significant relation between oxygen saturation after eight hours of wearing surgical masks and health care workers' area of practice in favor of the emergency room over the operating room.

10. Recommendations

Frequent work breaks should be incorporated into work shifts to allow for a shorter duration

of mask use and reduction of surgical mask adverse effects.

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الملخص العربي

الأعباء الفسيولوجية للاستخدام المطول لأقنعة الوجه الجراحية بين العاملين في مجال الرعاية الصحية خلال جائحة كورونا

المقدمة: بعد أن أعلنت منظمة الصحة العالمية جائحة كورونا عالميا في مارس 2020 ، أصدرت تعليمات بضرورة الالتزام بارتداء الأقنعة (الكمامات) الجراحية لحماية جميع العاملين في مجال الرعاية الصحية ، بما في ذلك العمال والمرضى والزوار.

الهدف من الدراسة: معرفة الأعباء الفسيولوجية للاستخدام المطول لأقنعة الوجه الجراحية بين العاملين في مجال الرعاية الصحية خلال جائحة كورونا

سؤال البحث: ما هي الأعباء الفسيولوجية للإستخدام المطول لأقنعة الوجه الجراحية بين العاملين في مجال الرعاية الصحية خلال جائحة كورونا.

منهجية البحث: أجريت الدراسة في مستشفيات جامعة الإسكندرية ومستشفى الحضرة الجامعي وتم إستخدام بحث وصفي لعينة ملائمة من 160 عاملاً في مجال الرعاية الصحية .

أداة هذه الدراسة: إستبيان الأعباء الفسيولوجية الناتجة عن الاستخدام المطول لأقنعة الوجه الجراحية للعاملين في مجال الرعاية الصحية.

النتائج: لقد أسفرت نتائج البحث عن الأتي : 70٪ من العاملين في مجال الرعاية الصحية الذين خضعوا للدراسة يعانون من عدم وضوح الرؤية ، والثلث منهم(66.7٪) يعانون من حرقان في الأنف ، وأكثر من الثلثين (70٪) يعانون من جفاف الفم ، والثلث لديهم إحساس قوي بالعطش ، كما يعاني ما يقرب من الثلثين (60٪) من آلام خلف الأذنين. ما يقرب من الثلثين (60٪) لاحظوا طفح جلدي / احمرار على حاجز الأنف. أكثر من النصف (53.3٪) أصيبوا بدوخة. عانى غالبية العاملين في مجال الرعاية الصحية الخاضعين للدراسة (86.7٪) من الصداع بعد الاستخدام المطول لأقنعة الوجه ، و 76.7٪ عانوا من ضيق في التنفس عند المجهود. بالإضافة إلى ذلك؛ وجد أن الاستخدام المطول لأقنعة الوجه الجراحية يتعارض بشكل طفيف مع الاستراحة الكافية لتناول الطعام في أكثر من نصفهم (53.3٪) و يتعارض أيضا إرتداؤه مع الحاجة إلى شرب سوائل كافية بشكل طفيف فيما يقرب من الثلثين(63٪). هناك علاقة ذات دلالة إحصائية بين متوسط نسبة تشبع الأكسجين بعد أربع ساعات من ارتداء الأقنعة الجراحية وعمل العاملين في مجال الرعاية الصحية لصالح الأطباء أكثر من الممرضات والمساعدين الطبيين على الأطباء. بالإضافة إلى ذلك كانت هناك علاقة ذات دلالة إحصائية بين متوسط نسبة تشبع الأكسجين بعد ثماني ساعات من ارتداء الأقنعة الجراحية ومهن العاملين في مجال الرعاية الصحية. علاوة على ذلك؛ كانت هناك علاقة ذات دلالة إحصائية بين متوسط نسبة تشبع الأكسجين بعد ثماني ساعات من ارتداء الأقنعة الجراحية ومجال ممارسة العاملين في مجال الرعاية الصحية لصالح غرفة الطوارئ أكثر من غرفة العمليات.

التوصيات : ضرورة دمج فترات راحة متكررة في اثناء فترات العمل للسماح بمدة أقصرمن إستخدام الأقنعة الجراحية وتقليل الآثار الضارة الناتجة عن إرتدائها لفترات طويلة.