http://www.pjbs.org

PJBS

ISSN 1028-8880

Pakistan Journal of Biological Sciences

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

OPEN ACCESS Pakistan Journal of Biological Sciences

ISSN 1028-8880
DOI: 10.3923/pjbs.2021.920.927

Research Article
Some Immunological Impacts of Face Mask Usage During the COVID-19 Pandemic

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Abstract
Background and Objective: COVID-19 is a fast-spreading worldwide pandemic caused by SARS-CoV-2. The World Health Organization recommended wearing face masks. Masks have become an urgent necessity throughout the pandemic, the study's goal was to track the impact of wearing masks on immunological responses. **Materials and Methods:** This study was conducted on 40 healthy people who were working in health care at Nineveh Governorate Hospitals from September-December, 2020. They wore face masks at work for more than 8 months for an average of 6 hrs a day. The control sample included 40 healthy individuals, who wore masks for very short periods. All samples underwent immunological and physiological tests to research the effects of wearing masks for extended periods within these parameters. **Results:** The results showed a significant decrease in total White Blood Count and the absolute number of neutrophils, lymphocytes, monocytes and phagocytic activity. However, there was a significant increase in the absolute number of eosinophils in participants compared with the control. The results also suggested there were no significant differences in IgE, haemoglobin concentration and blood O_2 saturation in participants who wore masks for more than 6 hrs compared to the control group. The results showed a significant increase in pulse rate in participants who wore masks for more than 6 hrs compared to the control group. The results also showed a strong correlation coefficient between the time of wearing masks and some immunological, haematological parameters. **Conclusion:** Wearing masks for long periods alters immunological parameters that initiate the immune response, making the body weaker in its resistance to infectious agents.

Key words: COVID-19, facemask, immunological parameters, phagocytic activity, correlation coefficient

Citation: Al-Allaff, R.G.M., S.M.Y. Al-Taee and S.T.D. Baker, 2021. Some immunological impacts of face mask usage during the COVID-19 pandemic. Pak. J. Biol. Sci., 24: 920-927.

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

The city of Mosul in Iraq saw its first official case of COVID-19 in March, 2020. In December, 2019, a novel coronavirus known as SARS-Cov-2 was discovered in Wuhan, China. Hundreds of thousands of cases were discovered in a short amount of time throughout the world, causing the WHO to declare it a pandemic on January 30, 2020. During an increase in cases of transmissible diseases such as tuberculosis, SARS and COVID-19, the Centers for Disease Control and Prevention(CDC) and WHO suggest wearing masks[1]. Surgical masks are effective against large respiratory particles but they are ineffective against smaller particles. Face masks do not prevent leakage around the mask when the patient inhales. As a result, surgical masks are inefficient and do not offer enough protection against COVID-19[2].

Long-term use of masks causes several physiologic and immunologic issues as well as a reduction in work efficiency. When masks are worn, activity cannot be effectively sustained for as long as when they are not worn. Wearing masks often reduces the amount of time that a physician can perform an operation[3]. Long-term use of masks can cause harmful physical effects, such as headaches, difficulty breathing, skin problems, rashes and a loss of cognition. They also interfere with vision, communication and thermal equilibrium. Mechanical conditions, hypercapnia and hypoxemia may also cause headaches due to extended periods of mask-wearing. The mechanical causes of headaches include tight straps and pressure on the superficial facial and cervical nerves[1]. Hypercapnia is caused by tight-fitting masks that prevent sufficient ventilation and result in elevated levels of Carbon Dioxide (CO_2). Healthcare professionals report symptoms of hypoxemia, such as chest pain and tachypnea, when wearing a mask for a prolonged period. A hot and humid environment in the facial area can form as a result of mask-wearing, which causes discomfort and hyperthermia[3]. Sensitivity to mask components can cause urticaria and contact dermatitis. An allergic reaction to thiuram, which is found in medical mask ear loops, can also develop[4].

Although the number of cases of COVID-19 continues to climb, policymakers around the world are gradually easing their national lockdown policies. Despite the fear of infection, this is a relief to health professionals and the general public. They can now resume some typical daily activities while wearing face masks when out in public. However, given the minimal data regarding this matter, wearing face masks to prevent the spread of Covid-19 is arguable[5].

The WHO only advises mask use for COVID-19 patients but mask use has also become a subject of ethical discussion in today's society[6]. This immunological and physiological paper strives to answer the following questions: Does the use of a face mask change immunological and physiological responses? Does wearing a face mask increase the risk of contracting COVID-19? How does a typical person manage immune and physiological changes while wearing a face mask? Therefore, this study aimed to examine the effects of mask-wearing on health care staff within immunological and haematological parameters and will assess the relationship between the immune and blood variables and the number of hours spent wearing a mask.

MATERIALS AND METHODS

Subject group: This study was conducted on 40 healthy people (20 males and 20 females) between the ages of 25 and 45 who worked in health care at Nineveh Governorate Hospitals from January-March, 2021. They wore face masks for an average of 6 hrs daily for more than eight months. The control sample included 40 healthy individuals, 20 males and 20 females, who did not wear masks except for very short, intermittent periods not exceeding one hour and who did not work in the health field. The data obtained from the participants being monitored included age, gender, time spent wearing a mask, infection with COVID-19, a pulse oximeter reading and heart rate. People who had previously contracted COVID-19 were excluded from this study.

Blood and serum collection: The 5 µL of venous blood was collected from every participant. For the complete blood count procedure, 1 µL of blood was placed in an EDTA tube. The residual blood samples were left to clot in a gel tube for five 5 min at 37°C and a centrifugation process was performed at 3000 rpm/5 min. The separated serum was obtained and collected in Eppendorf tubes, which were then preserved at 20°C for further research.

Measure oxygen levels in the blood and pulse rate: The pulse oxygen saturation is the percentage of HbO_2 in the overall Hb in the blood, also known as the O_2 concentration in the blood. A fingertip pulse oximeter from Shenzhen Jumper Medical Equipment Company was used to keep a record of arterial haemoglobin oxygen saturation (SpO_2) and pulse rate[7].

Complete blood count (CBC): This was carried out using an automated Mythic™ 18 (Switzerland) which read 18 haematological parameters[8].

Differential white blood cell count: Slides were used to make thin blood films. After 1-2 min, the slides were stained with Leishman Stain. After 5-6 min, the stain was diluted with an equal volume of buffer water and then flooded off with a buffer. After applying the oil droplets, the film was examined and the white blood cell count was estimated by noting the number of white cells per high power field (100X). The total number per 100 in a differential count is the proportion of each cell type[9].

Phagocytic activity: The 50 µL of Nitro Blue Tetrazolium (NBT) stain was transferred to a sterile vial and carefully mixed with 50 µL of heparinized blood. After incubating at 37°C for half an hour, 5 µL of the mixture was placed on a clean glass slide. To avoid mechanical damage to formazan-containing cells, which become more fragile, a relatively thick smear was formed and then dyed with Leishman stain[10].

Microscopic examination and counting: A stained smear was scanned using an oil immersion objective and counting a total of 100 or more neutrophils. Neutrophils showing formazan deposits were recorded as positive[10]:

$$\text{Phagocytic cells (\%)} = \frac{\text{Number of neutrophils with formazan}}{\text{Total number of neutrophils}} \times 100$$

Determination of IgE concentration in serum: Anichroma TM kit supplied by the company Korea Boditech Med Inc. was used. The test is a fluorescence immunoassay (FIA), which determines total IgE levels quantitatively and uses a sandwich immune detection method. The detection antibody in the buffer binds to the sample's total IgE, which forms IgE-anti-IgE complexes and migrates to the nitrocellulose matrix, where it is trapped by the immobilized anti-IgE on the test strip. The more IgE in a sample, the more IgE-anti IgE complexes produced, which results in a brighter fluorescence signal. The reader then interprets this signal to indicate the sample's total IgE concentration[11].

Procedure: In a closed tube, 50 µL of serum sample was added to the detection buffer tube and shaken at least five times until it was well mixed. After that, 75 µL of the mixture was transferred into the sample well of the cartridge. The sample-loaded cartridge was read immediately by the ichroma TM II device after being incubated for 12 min at room temperature[11].

Statistical analysis: An Analysis of Variance (ANOVA) with probability $p \leq 0.05$ was used to compare means statistically. A correlation coefficient between hours of mask-wearing and heartbeat, WBC count, neutrophils, lymphocytes, monocytes, eosinophils, Hb, phagocytic activity and IgE was found. Statistical analyses were conducted using the SPSS 22 statistical analysis program and SPSS 22.0 software.

RESULTS AND DISCUSSION

The current study involved tracking the most essential immunological indicators, which play a significant role in resisting infection agents, In Table 1 the results showed a significant decrease in the total WBC count (5940±1469.12 compared to the control 8185±1709.19 cell mm^{-3}), a significant decrease in the absolute number of neutrophils (3381±970.35 compared to the control 5371±1203.26 cell mm^{-3}), a significant decrease in the absolute number of lymphocytes (1714±484.78 compared to the control 2290±711.879 cell mm^{-3}) a significant decrease in the absolute number of monocytes (328±135.67 compared to the control 450±207.13 cell mm^{-3}). However, the study noted a significant increase in the absolute number of eosinophils in participants who wore masks for more than 6 hrs (515±363 compared to the control 72±50.55 cell mm^{-3}).

The immunological measures chosen for the current study are important because they are the most widely used internationally for assessing immunity at the individual level, a decrease in the number of white cells reflected the presence of a defect in the number of immune army cells in general in 1 µL. The reduction in the absolute number of neutrophils, on the other hand, indicates a decrease in the number of cells responsible for the activity of the cellular process of phagocytosis in one microliter of blood. The reduction in lymphocyte count explains the presence of a deficiency in the specific immune response to the infection agents. The decrease in absolute numbers of monocytes indicates the existence of tissue inflammation, which resulted in the withdrawal of cells from the circulation into the tissues since this type is in charge of the phagocytosis process throughout the body of the tissue. On the contrary, the study found that an increase in the absolute number of eosinophils that are responsible for allergic responses (type I). The excess moisture,

Table 1: A comparison between the total WBC count and the absolute numbers of neutrophils, lymphocytes, monocytes and eosinophils in participants who wore masks and the control group

Cell mm^{-3}	Sample	Sample N	Mean±SD cell mm^{-3}	Extreme value cell mm^{-3}	p-value
WBC count	Samples	40	5940.0±1469.12	3500-8800	0.000*
	Control	40	8185.0±1709.19	6100-10000	
Neutrophils	Samples	40	3381.0±970.35	1855-5236	0.000*
	Control	40	5371.0±1203.26	2808-7200	
Lymphocytes	Samples	40	1714.0±484.78	1005-3740	0.005*
	Control	40	2290.0±711.879	1152-3740	
Monocytes	Samples	40	328.0±135.67	115-607	0.003*
	Control	40	450.0±207.13	208-1080	
Eosinophils	Samples	40	515.0±363	240-1320	0.000*
	Control	40	72.0±50.55	0-120	

$^*p\leq 0.05$

Table 2: A comparison of phagocytic activity between participants who wore masks and the control group

	Samples	Sample N	Mean±SD cell mm^{-3}	Extreme value cell mm^{-3}	p-value
Phagocytic cell	Samples	40	2281.0±739.20	1094-2769	0.000*
	Control	40	4072.0±1059.26	2100-6291	

$^*p\leq 0.05$

Table 3: A comparison of IgE concentration between participants who wore masks and the control group

	Samples	Sample N	Mean±SD IU mL^{-1}	Extreme value IU mL^{-1}	p-value
IgE	Samples	40	47.301±74.866	2.58-268.45	0.984
	Control	40	46.940±28.928	4.45-87.12	

$^*p\leq 0.05$

Table 4: A comparison of haematological parameters between participants who wore masks and the control group

	Samples	Sample N	Mean±SD	Extreme value	p-value
Hb (g dL^{-1})	Samples	40	13.7400±1.880	9.7-16.1	0.627
	Control	40	14.0000±1.45095	12.0-16	
Blood O_2 saturation	Samples	40	97.1000±1.16	95.0-98	0.583
	Control	40	96.9000±1.11	96.0-98	
Pulse rate BPM	Samples	40	77.7500±2.403	72.0-80	0.003*
	Control	40	75.1500±2.758	70.0-80	

$^*p\leq 0.05$

water vapour and mask raw materials may have a clear effect on the occurrence of a specific type of allergy to one of these elements.

The results also recorded a significant decrease in phagocytic activity in participants who wore masks for more than 6 hrs (2281±739.20 cell mm^{-3} compared to the control 4072±1059.26 cell mm^{-3}) as shown in Table 2. The decrease in the number of phagocytic cells suggests a deficiency in phagocytic activity, which requires a steady supply of free oxygen in the circulation so that these cells can reduce foreign body particles after ingestion and destruction.

The results showed no significant differences in IgE concentration in participants who wore masks for more than 6 hrs (47.301±74.866 IU mL^{-1} compared to the control group 46.940±28.928 IU mL^{-1}) as shown in Table 3. Although no significant difference in the proportions of IgE antibodies was observed, indicating the absence of indications for type 1 allergic reactions against masks, the estimation of the level of IgE antibodies was chosen for its direct association with the increase in the number of eosinophils responsible for allergic reactions.

Some haematological measures were chosen for their direct relationship with immune functions. However, the results suggest no significant differences in haemoglobin concentration and blood O_2 saturation in participants who wore masks for more than 6 hrs (13.7400±1.880 g dL^{-1} compared to the control 14.000±1.45095 g dL^{-1}), Blood O_2 (97.10±1.16 compared to the control 96.9±1.11). But the results showed a significant increase in pulse rate in people who wore masks for more than six hours (77.75±2.403 compared to the control 75.15±2.758) as shown in Table 4. The lack of significant differences in haemoglobin and free oxygen concentrations indicates that all cells in the body, including white blood cells, obtain normal levels of oxygen transported by red cell haemoglobin to carry out their functions (cell phagocytosis) but there may be indirect reasons for the decrease in phagocytic activity in the bloodstream. The significant rise in heart rate is directly connected to an increase in blood flow in the blood vessels, which has an immediate impact on immunological responses.

The results of the correlation coefficient test showed a strong positive relationship between WBC count and neutrophils, lymphocytes, eosinophils and phagocytic cells (0.854**, 0.760**, 0.577**, 0.779**, respectively) in Table 5. A strong positive correlation coefficient was also noted between the number of neutrophils and phagocytic cells (0.940**) and the number of lymphocytes and monocytes (0.754**). A positive correlation was also observed between heartbeat and hours spent wearing a mask, WBC count, lymphocytes and eosinophils (0.453*0.492*, 0.470*, 0.502*, respectively). A positive correlation coefficient was also observed between hours of mask-wearing and eosinophils (0.483*). A positive correlation was also observed between the numbers of monocytes and haemoglobin and WBC count (0.509* and 0.462*, respectively). Finally, a positive correlation coefficient was shown between eosinophils and IgE and the number of lymphocytes (0.457* and 0.507, respectively)as shown in Table 5.

There has been a decline in work and physical performance as a result of preventative measures taken during the COVID-19 pandemic, which include the use of face masks during work hours. Health care personnel can try to combat this but extended working hours often leads to increased fatigue, which can lead to burnout and frustration over time.

Surgical masks impose some measurable airway resistance, according to a study by Beder *et al.*[12] but it is unclear whether this increases respiration significantly. Although it appears that hypoxaemia can be caused by an increase in carbon dioxide content in inspired air as a result of carbon dioxide exhalation trapped under a surgical face mask. The level of oxygen saturation in the blood of a physician after completing an operation was statistically significant and was shown to be unrelated to prolonged standing or stress, according to the study done by Beder *et al.*[12].

Roberge *et al.*[13] found that quick movements and exercises combined with the usage of customized thin face masks resulted in an atmosphere with severe hypoxia (low oxygen O_2 and increased carbon dioxide CO_2). When wearing face masks, the acidic environment at the level of the alveoli and blood vessels causes a variety of physiological changes, such as a change in metabolism, stress on the heart and lungs, changes in the immune system mechanism and changes to the nervous system and the brain. The body's metabolism is heavily reliant on a constant supply of oxygen and carbon dioxide exchange with the environment. Nasopharyngeal patency, autonomic stability and heartbeat all affect metabolic efficiency[14]. However, anaerobic metabolism predominates during quick to moderate movement and a considerable amount of O_2 is required when the activity ends to convert lactic acid. Although not fully airtight, the face mask creates a closed circuit of inhaled and exhaled air. Carbon dioxide concentrations over the limit are re-inhaled, increasing the severity of acidity in an acidic environment[15]. People who wear a face mask while working or participating in the light athletic activity will experience physiological symptoms similar to those associated with Chronic Obstructive Pulmonary Disease (COPD), which include restlessness, fatigue, dizziness, headache and shortness of breath[16]. Furthermore, light activity can enhance carbon dioxide inhalation while decreasing O_2 through the mask. As a result, it can predict that this effect will be enhanced while performing any quick and continuous movement during extended working hours.

The results of this study show that the number of white blood cells decreased significantly as well as a decrease in all types of white cells except for eosinophils. Hypoxic white cells may withdraw to the site of pneumonia caused by prolonged mask-wearing, increasing the risk of infection during the pandemic. Immobile cilia syndrome is caused by a shift in humidity and temperature in the upper airway, which predisposes people to lower respiratory infection by deep seeding of the oropharyngeal pharynx[17]. The current data also revealed a considerable rise in the number of eosinophils. It is worth noting that most participants increased their vitamin intake during the COVID-19 pandemic since vitamins and nutritional supplements boost immune responses. An increase in the absolute number of eosinophils occurs when the number of vitamins and nutritional supplements consumed exceeds the body's requirements[18]. In this study, it was hypothesized that the increase in eosinophils was due to the presence of an allergy to the mask's components, particularly when humid conditions from beneath the mask.

The WBC count has a strong positive correlation coefficient with neutrophils, lymphocytes, monocytes, eosinophils and phagocytic cells. The value of each type of white cell is a part of the total number of white blood cells, therefore any changes in the overall number of white cells are immediately reflected in the number of each of these cell types.

The results showed a significant decrease in the phagocytic activity of subjects who wear masks for an extended time compared to the control group. The decrease in phagocytic activity may be related to the decrease in the number of neutrophils because they are responsible for this process in the bloodstream. This conclusion was confirmed after a strong correlation coefficient was shown between the numbers of neutrophils and phagocytic activity (0.940**). As previously noted, high temperature and humidity under the mask may cause abnormalities in the airways and lungs,

Table 5: Correlation coefficient test between the number of hours of wearing masks and select immunological and haematological parameters

		Hour	Heartbeat	Oximeter	Haemoglobin	WBC	Neutrophil	Lymphocyte	Monocyte	Eosinophil	Phagocytosis	IgE
Hours	Pearson C	1	0.453*	0.310	-0.289	0.137	-0.076	0.241	-0.130	0.483*	-0.178	0.260
	Sig.	0.045	0.184	0.216	0.565	0.750	0.307	0.586	0.031	0.453	0.269	
	N	40	40	40	40	40	40	40	40	40	40	40
Heartbeat	Pearson C	0.453*	1	0.438	-0.073	0.492*	0.303	0.476*	0.120	0.502*	0.213	0.369
	Sig.	0.045	0.053	0.760	0.027	0.194	0.034	0.615	0.024	0.368	0.109	
	N	40	40	40	40	40	40	40	40	40	40	40
Oximeter	Pearson C	0.310	0.438	1	-0.002	0.139	0.209	-0.009	-0.006	0.017	0.171	0.002
	Sig.	0.184	0.053		0.994	0.559	0.375	0.969	0.979	0.942	0.470	0.993
	N	40	40	40	40	40	40	40	40	20	40	40
Haemoglobin	Pearson C	-0.289	-0.073	-0.002	1	0.006	-0.196	0.308	0.509*	-0.054	-0.224	0.146
	Sig.	0.216	0.760	0.994		0.980	0.408	0.186	0.022	0.820	0.342	0.540
	N	40	40	40	40	40	40	40	40	40	40	40
WBCc	Pearson C	0.137	0.492*	0.139	0.006	1	0.854**	0.760**	0.462*	0.577**	0.779**	0.047
	Sig	0.565	0.027	0.559	0.980		0.000	0.000	0.040	0.008	0.000	0.843
	N	40	40	40	40	40	40	40	40	40	40	40
Neutrophils	Pearson C	-0.076	0.303	0.209	-0.196	0.854**	1	0.356	0.171	0.243	0.940**	-0.321
	Sig.	0.750	0.194	0.375	0.408	0.000	0.123	0.472	0.303	0.000	0.167	
	N	40	40	40	40	40	40	40	40	40	40	40
Lymphocytes	Pearson C	0.241	0.476*	-0.009	0.308	0.760**	0.356	1	0.754**	0.507*	0.279	0.429
	Sig.	0.307	0.034	0.969	0.186	0.000	0.123	0.000	0.023	0.233	0.059	
	N	40	40	40	40	40	40	40	40	40	40	40
Monocytes	Pearson C	-0.130	0.120	-0.006	0.509*	0.462*	0.171	0.754**	1	0.033	0.126	0.052
	Sig.	0.586	0.615	0.979	0.022	0.040	0.472	0.000		0.889	0.596	0.826
	N	40	40	40	40	40	40	40	40	40	40	40
Eosinophil	Pearson C	0.483*	0.502*	0.017	-0.054	0.577**	0.243	0.507*	0.033	1	0.219	0.457*
	Sig.	0.031	0.024	0.942	0.820	0.008	0.303	0.023	0.889		0.354	0.043
	N	40	40	40	40	40	40	40	40	40	40	40
Phagocytosis	Pearson C	-0.178	0.213	0.171	-0.224	0.779**	0.940**	0.279	0.126	0.219	1	-0.340
	Sig.	0.453	0.368	0.470	0.342	0.000	0.000	0.233	0.596	0.354		0.142
	N	40	40	40	40	40	40	40	40	40	40	40

*Correlation is significant at the 00.05 level (2-tailed). **Correlation is significant at the 00.01 level (2-tailed) promoting the growth of pathogenic bacteria and symptoms of the beginning of pneumonia. The change in white blood cells and the activity of phagocytes is one of the primary symptoms of pneumonia[19].

Pulse oximetry is a non-invasive method for measuring arterial oxygen saturation with clinically acceptable precision. It is currently considered a standard of clinical care. This study Conflicts with a study done by Romney *et al.*[20] that found that physicians who used medical masks for more than three hours had an increase in blood oxygen saturation of more than 1% following surgery. However, the results of this study showed no significant difference in haemoglobin concentration and oxygen saturation rate, which indicates that the oxygen level in the blood and Hb remained within normal levels in participants who wore masks for an extended time.

The increased availability of CO_2 will significantly increase heart rate and blood pressure even at low workloads. This physiological alteration may lead to increased aortic pressure and left ventricular pressure, resulting in increased cardiac overload and coronary demand[21]. The results of the correlation coefficient as shown in Table 4, showed a positive direct relationship between the number of heartbeats and the number of hours wearing a mask as the number of heartbeats increased with the increase in the length of time spent wearing the mask. Additionally, heart rate affects the flow rate of white blood cells and lymphocytes and eosinophilia in the bloodstream. This was confirmed by the results of the correlation coefficient test between the total number of heartbeats and the total numbers of white blood cells, lymphocytes and eosinophils.

The increased respiratory load against the valve breathing causes respiratory muscle strain and pulmonary artery pressure to rise, increasing the cardiac strain. In healthy people, these changes may be minor. These alterations may aggravate the underlying pathophysiology in those with established chronic illness, leading to hospitalization or increased medication use.

Since it is acknowledged that heat and moisture can get trapped under masks, it seems plausible that some of the carbon dioxides emitted from exhalation can also be trapped underneath it, leading to an abnormal environment. With a stable and balanced ratio of oxygen, in addition to a withdrawal of the accumulated CO_2 gas inside the cells, the disturbance in the pulse and the stability of the gaseous exchange under the mask, a suitable environment for the occurrence of infections develops within the deep respiratory tracts and increases vulnerability to bacterial infections that affect the lower areas of the lung. This causes them to be less resistant to COVID-19. Although respirator masks are intended to be barriers for preventing aerosol depositions in the respiratory tract, this study finds that they increase the risk of more serious respiratory infections. Vainshelboim[22] asserts that atypical healthy individuals shouldn't be wearing masks since it generates a false feeling of security and individuals tend to touch their face more often as compared to not wearing masks[23].

CONCLUSION

It was concluded that wearing face masks for an extended amount of time has clear physiological effects on breathing and heart rate, which are directly reflected by the flow of immune cells to the sites of inflammation and the response of phagocytes to foreign antigens. However, wearing masks during the COVID-19 pandemic has become necessary during working hours, especially when working with the general public. Thus, maintain the use of masks, especially in crowded places. However, removing them after 2 hrs of wear and leaving them off for no less than a quarter of 1 hr to restore the balance of breathing, heart rate and vital activities.

SIGNIFICANCE STATEMENTS

This study discovered the Wearing masks for lengthy periods during working hours with constant movement increases the risk of secondary infections due to weakened immune responses. This study will help the researchers to uncover the critical areas of Follow-up of the variables affecting the development of secondary bacterial infections in individuals who wear masks for long periods as well as the role of immune factors in the management of many infections during the Corona pandemic.

REFERENCES

1. Lim, E.C.H., R.C.S. Seet, K.H. Lee, E.P.V. Wilder-Smith, B.Y.S. Chuah and B.K.C. Ong, 2006. Headaches and the N95 face-mask amongst healthcare providers. Acta Neurol. Scand., 113: 199-202.
2. Chughtai, A.A., H. Seale and C.R. Macintyre, 2020. Effectiveness of cloth masks for protection against severe acute respiratory syndrome coronavirus 2. Emerging Infect. Dis., Vol. 26. 10.3201/eid2610.200948.
3. Johnson, A.T., 2016. Respirator masks protect health but impact performance: A review. J. Biol. Eng., Vol. 10. 10.1186/s13036-016-0025-4.
4. Al Badri, F.M., 2017. Surgical mask contact dermatitis and epidemiology of contact dermatitis in healthcare workers. Curr. Allergy Clin. Immunol., 30: 183-188.

5. Cheng, V.C.C., S.C. Wong, V.W.M. Chuang, S.Y.C. So and J.H.K. Chen *et al*., 2020. The role of community-wide wearing of face mask for control of coronavirus disease 2019 (COVID-19) epidemic due to SARS-CoV-2. J. Infec., 81: 107-114.
6. Greenhalgh, T., M.B. Schmid, T. Czypionka, D. Bassler and L. Gruer, 2020. Face masks for the public during the COVID-19 crisis. BMJ, Vol. 369. 10.1136/bmj.m1435.
7. Pu, L.J., Y. Shen, L. Lu, R.Y. Zhang, Q. Zhang and W.F. Shen, 2012. Increased blood glycohemoglobin A1C levels lead to overestimation of arterial oxygen saturation by pulse oximetry in patients with type 2 diabetes. Cardiovasc. Diabetology, Vol. 11. 10.1186/1475-2840-11-110.
8. Wassmuth, A.K., B. Riond, R. Hofmann-Lehmann and H. Lutz, 2011. Evaluation of the mythic 18 hematology analyzer for use with canine, feline and equine samples. J. Vet. Diagn. Invest., 23: 436-453.
9. Bain, B.J., S.M. Lewis and J.V. Dacie, 2012. Dacie and Lewis practical haematology. Edinburgh: 12th Edn., Elsevier, Amsterdam, Netherlands, ISBN-13: 9780702066962, Pages: 600.
10. Kasper, D.L., E. Braunwald, A.S. Fauci, S.L. Hauser, D.L. Longo and J.L. Jameson, 2005. Harrison`s Principles of Internal Medicine. 16th Edn., McGraw-Hill Professional, United States, ISBN-13: 978-0071402354, Pages: 2607.
11. Carosso, A., M. Bugiani, E. Migliore, J.M. Antò and R. DeMarco, 2007. Reference values of total serum IgE and their significance in the diagnosis of allergy in young European adults. Int. Arch. Allergy Immunol., 142: 230-238.
12. Beder, A., Ü. Büyükkoçak, H. Sabuncuoğlu, Z.A. Keskil and S. Keskil, 2008. Preliminary report on surgical mask induced deoxygenation during major surgery. Neurocirugía, 19: 121-126.
13. Roberge, R.J., A. Coca, W.J. Williams, J.B. Powell and A.J. Palmiero, 2010. Physiological impact of the N95 filtering facepiece respirator on healthcare workers. Respir. Care, 55: 569-577.
14. Joyner, M.J. and D.P. Casey, 2015. Regulation of increased blood flow (hyperemia) to muscles during exercise: A hierarchy of competing physiological needs. Physiol. Rev., 95: 549-601.
15. Jacobson, T.A., J.S. Kler, M.T. Hernke, R.K. Braun, K.C. Meyer and W.E. Funk, 2019. Direct human health risks of increased atmospheric carbon dioxide. Nat. Sustainability, 2: 691-701.
16. Smith, C.L., J.L. Whitelaw and B. Davies, 2013. Carbon dioxide rebreathing in respiratory protective devices: Influence of speech and work rate in full-face masks. Ergonomics, 56: 781-790.
17. Kempeneers, C., C. Seaton, B.G. Espinosa and M.A. Chilvers, 2019. Ciliary functional analysis: Beating a path towards standardization. Pediatr. Pulmonol., 54: 1627-1638.
18. Mejia, R. and T.B. Nutman, 2012. Evaluation and differential diagnosis of marked, persistent eosinophilia. Seminars Hematol., 49: 149-159.
19. Chen, Y., Z. Zhou and W. Min, 2018. Mitochondria, oxidative stress and innate immunity. Front. Physiol., Vol. 9. 10.3389/fphys.2018.01487.
20. Romney, M.G., 2001. Surgical face masks in the operating theatre: Re-examining the evidence. J. Hosp. Infec., 47: 251-256.
21. Melnikov, V.N., V.E. Divert, T.G. Komlyagina, N.S. Consedine and S.G. Krivoschekov, 2017. Baseline values of cardiovascular and respiratory parameters predict response to acute hypoxia in young healthy men. Physiol. Res., 66: 467-479.
22. Vainshelboim, B., 2021. Retracted: Facemasks in the COVID-19 era: A health hypothesis. Med. Hypotheses, Vol. 146. 10.1016/j.mehy.2020.110411.
23. de la Cámara, M.Á., A. Jiménez Fuente and A.I. Pardos- Sevilla, 2020. Confinement time due to the COVID-19 disease: An opportunity to promote and engage people in regular physical exercise? Transl. Sports Med., Vol. 4. 10.1002/tsm2.170.