



Effects of Medical Face- Mask on Oxygen Saturation and Respiratory Rate among Male University Students

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Background: The COVID-19 pandemic and air pollution have increased the usage of medical masks, raising questions about their potential health effects. This study investigates the effects of medical masks on blood oxygen saturation and respiratory rates among students at Kabul University of Medical Sciences.

Method: A pre-post study was conducted during the period from March to December 2024, with 243 male students, whose mean age was 21.6 years. Oxygen saturation and respiratory rate were first measured without masks, and then after wearing masks for ten minutes. Statistical analysis was conducted using the Wilcoxon paired signed-rank test, which indicated significant differences.

Results: The mean oxygen saturation decreased from 97.02% to 96.4% ($p < 0.05$), and the mean respiratory rate increased from 19.6 to 21.3 breaths per minute ($p < 0.05$). Despite these changes, all measurements remained within the normal range of 95-100%, indicating no health risks associated with mask usage.

Conclusions: According to the study results, masks do not lower oxygen saturation levels in healthy people, despite the possibility that they may cause slight physiological changes. The study highlights the importance of continued mask use in promoting public health safety without significant adverse effects.

Keywords: Male Students, Medical Mask, Oxygen Saturation, Respiratory Rate

1. Introduction

Masks are a non-pharmacological tools of protection against various diseases and air pollution [1]. In recent years, air pollution and the COVID-19 pandemic have led to an increased use of masks [2]. The World Health Organization recommended the use of masks during the outbreak of the coronavirus, [2] while the Afghan Ministry of Public Health also announced a policy making mask usage mandatory [3]. The Afghan National Environmental Protection Agency has recommended masks to combat severe air pollution, which are linked to thousands of annual deaths [4]. There are different types of masks, including N95 respirators, surgical masks, and fabric masks. The most practical and widely used masks by both medical professionals and the general population are surgical masks [5].

Numerous studies have been conducted on the effect of facial mask on blood oxygen level and respiratory rate. A study conducted by Izabela et al. indicates that prolonged use of facial masks may reduce blood oxygen



levels [2]. Another study by Shaikha et al. demonstrates that while facial masks can decrease oxygen levels in the blood, they do not impact respiratory rates [6]. Additionally, another study found the wearing surgical masks can significantly decrease blood oxygen levels while increasing respiratory rates [7]. However, Sanjay Kumar et al. found that wearing a mask does not interfere with oxygen levels [8]. They emphasize that individuals who use the excuse of reduced blood oxygen levels to justify their refusal to wear masks are perpetuating a myth rather than acknowledging reality [8]. Pedro Alvariz et al indicate that oxygen saturation level increased after mask removal [9]. An Indonesian research revealed a significant difference in the oxygen saturation and respiratory rate before and after mask [10].

Normal percentages for hemoglobin saturation with oxygen is 95-100% [6]. Prolonged use of face mask affects oxygen uptake and increases work of breathing [11]. Though various studies in healthy individuals refuted the fears of face masks decreasing oxygen saturation [11, 12]. Recently, rumors regarding the adverse effects of masks on blood oxygen levels and respiratory rates have shared in social media, causing public anxiety about mask use. The aim of this study was to investigate the effects of medical face-masks on blood oxygen levels and respiratory rate among medical students.

2. Materials and Methods

2.1. Study design

A pre-post observational study was conducted among 243 students at Kabul University of Medical Sciences from March to December 2024, following approval from the Kabul University of Medical Sciences Research Committee (#29-57-26-1402324). All participants were instructed to sit comfortably and relax for five minutes prior to measuring oxygen saturation and respiratory rate. A pulse oximeter (Model: YK-81C YONKER, Xuzhou Yonkang Technology Co. Ltd., China) was placed on the right hand's index finger, ensuring that the sensor was firmly positioned. After five seconds, the oxygen saturation level was recorded. The respiratory rate was measured by counting the number of times the students' chests and abdomens rose in one minute, without the participants being aware of the observation. In the second phase, all participants were required to wear a face mask (Alokozai Co. Ltd., UAE) and were advised not to remove their masks for a duration of ten minutes. (The respiratory system may take time to adjust to the presence of a mask. By measuring after 10 minutes, we can capture a more accurate representation of how the body responds to the mask during sustained use) [15]. Following this interval, respiratory rate and oxygen saturation were measured once again.

2.2. Sample size and Sampling Technique

An online sample size calculator (Raosoft) was used for the determination of the sample size. The total number of students was 566, and with a 95% confidence level and an alpha of 0.05, the calculated sample size was 230. Considering missing data and margin of error, 6% more students were added to the sample size (230), the final sample size adjusted 243. Stratified random sampling was used to assign participants from each classes according to the total number of each classis. Sample random number generator app (stat-tract) was used to find participants from each classes.

2.3. Statistical Analysis

Statistical tool (IBM SPSS 26) was employed for analysis. Calculating Mean $\pm$ SD for distribution, Kolmogorov Smirnov test was sued for normality testing. Because the data was not normally distributed, Wilcoxon paired signed rank test was used to compare means. Statistical significant was determined by a p-value of < 0.05 .

Statistics	Oxygen saturation Without mask (%)	Oxygen saturation With mask (%)	Respiratory rate Without mask /min	Respiratory rate With mask /min
Mean	97.02	96.4	19.6	21.3
Median	97	96	20	21
Stan. Deviation	0.79	0.7	1.5	1.5
Minimum	95	94	18	18
Maximum	98	98	25	25
P- value	P<0.001		P<0.001	

Tab (1) shows the statistics of data before and after mask usage.

3. Results

The total number of participants in this study was 243, mean age was 21.6 (± 2.06) all of whom were male. Due to the non-normally distribution of the data, the Wilcoxon paired signed rank test was used for analysis. The mean respiratory rate before mask usage was 19.6 (± 1.5) and the mean respiratory rate after mask usage was 21.3 (± 1.5), with a *p-value* of <0.05 indicating a significant difference. Additionally, the mean oxygen saturation before mask application was 97.02 (± 0.7) and the mean oxygen saturation after mask usage was 96.4 (± 0.7), also demonstrating a significant difference with a *p-value* of <0.05 .

4. Discussion

The aim of this study was to investigate the effects of medical face-masks on blood oxygen levels and respiratory rate among medical students. Due to air pollution and the COVID-19 pandemic, the use of masks has significantly increased, raising important questions regarding their physiological impacts on blood oxygen saturation and respiratory rate. This research demonstrated that while oxygen saturation levels decreased and respiratory rates increased with facial mask use, these changes were not indicative of a decline below the normal range of oxygen saturation 95-100%.

This aligns with previous research indicating that some individuals may experience changes in oxygen saturation while wearing masks, these changes do not typically result in clinically significant hypoxemia [1, 6]. A study by Yang et al. (2022) confirmed that surgical masks do not have adverse effect on oxygen saturation, suggesting that mask-related physiological impacts can vary based on the context and population studied [7]. Conversely, some literature has suggested that prolonged mask-wearing could lead to a decline in oxygen levels under certain conditions [2]. However, this study results indicate that any changes in oxygen saturation are likely compensatory responses rather than indicators of compromised respiratory function. The statistically significant increase in respiratory rate observed in our study may reflect the body's adaptive mechanisms to maintain adequate oxygen delivery, consistent with findings by Dabhi (2021), who noted similar in his observational study [8]. Some studies have employed N95 masks, which are less common and more expensive; however, this study utilized medical masks, which are more prevalent and cost-effective [10]. Hoffmann C indicates that while face-masks have not significantly impact respiratory rates, but can cause notable changes in blood oxygen saturation levels [13]. A study conducted on elderly individuals demonstrated that the use of non-medical masks did not result in any changes in blood oxygen levels [12]. Another investigation demonstrated that wearing medical face masks at rest does not affect blood oxygen saturation [14]. Most studies have been conducted on patients or older participants; however, in our study, data were obtained from healthy, young-aged students to assess the effects of medical face mask usage in



individuals with a normal physiological state. While some studies have examined the impact of mask usage over extended durations, we selected a 10-minute period to collect our data [15]. This duration was deemed sufficient for participants to adjust to the presence of the mask. The data for this study were obtained from 243 students at Kabul University of Medical Sciences, which enhances the reliability of the findings. The use of a consistent method for measuring oxygen saturation and respiratory rate minimize bias in the study design. However, a limitation is the homogeneity of the participant population, as all data were collected from male students, which restricts the generalizability of the results. Future research should involve a more diverse population to further validate these findings

5. Conclusion

This research demonstrated that although male university students experienced a slight decrease in oxygen saturation levels and a corresponding increase in respiratory rates while wearing medical face masks, these physiological changes remained well within the normal, healthy range of 95–100%. These results indicate that the body effectively adapts to mask use without compromising respiratory function. Consequently, the findings strongly suggest that wearing medical masks does not pose any meaningful health risks to healthy individuals during routine daily activities. The study's data were collected from a relatively large sample of 243 male students at Kabul University of Medical Sciences, which strengthens the internal reliability of the results. However, the demographic homogeneity of the sample primarily young, healthy males limits the extent to which the findings can be generalized to broader populations. Important factors such as age, gender, underlying health conditions, and varying levels of physical activity were not represented, leaving room for further investigation. To build on these findings, future research should incorporate more diverse groups, including females, older adults, individuals with respiratory or cardiovascular conditions, and participants from different environments and occupations. By expanding the scope of study populations, researchers can better determine whether mask-wearing remains equally safe across various demographic and clinical contexts.

Overall, this study contributes valuable evidence supporting the safety of medical face masks for healthy individuals. It reinforces the understanding that masks, when used properly, are a reliable public health measure that does not compromise basic physiological functions.

6. Recommendations

- ✓ To enhance the validity of these findings, future research should aim to include a more diverse population, encompassing various age groups, genders, and health conditions. This broader approach would help confirm the safety of mask-wearing across different demographics and further inform public health guidelines. Overall, the study reinforces the notion that mask-wearing is a safe practice for healthy individuals, particularly in contexts where respiratory protection is essential.

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