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A case study on various parameters leading to discomforts on prolonged usage of mask

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Abstract
Covid '19 has become one the threatening contagious disease world-wide and this has led to use of mask as preventive measure even by common people. This study is aimed to analyze the discomfort caused due to prolonged usage of mask among college students in TamilNadu, India. 30 volunteers were selected and a study was undertaken to analyze whether the parameters such as oxygen level, carbon dioxide level, pulse rate, facial temperature, blood lactate level, and microbial load play a vital role in causing these discomforts. From the study, it was analyzed that there was a slight reduction in oxygen level. This may be due to wearing the mask that acts as a barrier which may reduce the airflow. There was variation in the pulse rate from 85 to 97 bpm. The blood lactate level of 5 subjects was observed between 5.3 to 7.5 mg/dL. The Carbon dioxide level was also monitored qualitatively. The microbial load of the mask was also examined. Gram positive cocci were predominant as it is the normal flora of the skin.

Keywords: covid '19; carbon dioxide; oxygen; heart rate; *Staphylococcus*; mask

Introduction
The novel coronavirus disease (COVID-19) has already affected over 6.9 million people claiming more than 400000 lives in over 200 nations all over the world. The novel coronavirus disease has also infiltrated into India since 2020; hitherto over 250000 cases have been reported from the country [1]. With a population of more than 1.3 billion people, India could become the new epicenter of COVID-19 due to the remarkable population density. Many factors like poor socioeconomic conditions and personal hygienic care may also indirectly influence the current status [2]. As per the World Health Organization guidelines people are instructed to wear masks and follow social physical distancing in order to break this pandemic chain. This practice has lead to reduction in COVID cases but certain factors have to been taken into consideration especially the type of masks used and health condition of each individual. Surgical and N95 masks are used by surgeons, doctors and health care workers whereas ordinary cloth masks are used by common lay persons. The use of cloth masks of different designs and materials are available commercially in the market but effectiveness of the masks has become a question mark?. In many countries the health authorities have promoted the use of the mask as effective but we have to maintain proper hygiene while using the mask [3, 4, 5]. There are many concerns about discomfort from wearing a mask such as fatigue, difficulty in breathing, increase in pulse rate etc., One common discomfort by most persons is feeling of suffocation while wearing masks for longer period of time. The reason may be improper air circulation leading to decrease in oxygen uptake The decreased level of oxygen in the blood leads to hypoxemia [6, 7]. This can cause Hypoxia in blood tissues when your blood doesn't carry enough oxygen to your tissues to meet your body's needs. We exhale about 2.3 pounds of carbon dioxide per day. The carbon dioxide is released into the environment under normal conditions but under the condition of wearing a mask can cause hindrance in the release of the gas. This may lead to re breathing of the carbon dioxide released from the body [8]. Wearing masks prevent the spreading of microbes from the nasal and oral cavity. They act as barriers that hold back the salivary droplets while talking and sputum which has an increased amount of bacterial diversity while coughing or sneezing. Microbes grow in the presence of moisture and nutrients that is obtained saliva as most people tend to reuse the mask [9] there is a higher probability that microbes that are present in the mask can enter the respiratory tract and cause several diseases [10, 11]. It can also cause skin problems such as acne and rashes. The continuous usage of masks has become mandatory in the current pandemic situation in spite of various discomforts caused. In the present study a survey was taken among the college students within age group of 19 to 21 years to study the various discomforts caused based on parameters like oxygen, temperature, pulse rate, carbon dioxide and lactate concentration in blood.

Methods
Preliminary study
A questionnaire was prepared with 15 questions which include basic questions like if the user feel suffocated, have altered sense of smell, have itchy or dry nose, have cracking inside the nose, have crusting inside the nose, have pain in the nose, have sore throat, irritation behind the ears due to the straps, get rashes, get redness over the face, get acne, get scars on the nasal bridge, profusely sweat in the facial area, experience fogging of glasses and get dry eyes while wearing masks. It was distributed to college students of Holy Cross College, Tiruchirappalli, Tamil Nadu, India. 30 volunteers were selected from the Biochemistry department with the consent of the volunteers. The nature of study was well explained to the volunteers.

Study of oxygen level, pulse rate and facial temperature

In order to check the quality of the mask candle blow method was done. A candle was lit and the subject was made to wear one of the sample cloth masks and was instructed to blow out the candle. The Fingertip Pulse Oximeter (Model: YM201) with specificity range for SpO_2 as 0 – 100%, the accuracy for SpO2 as 70 – 100% ± 2% and the range for pulse rate as 25 –250bpm, the accuracy for pulse rate as ± 3 bpm was used to measure oxygen level and pulse rate. Reading was taken for each volunteer at 9:30 am, 12:15 pm and 3:00 pm for 30 days. The facial temperature was monitored using ZOOOK Infra Temp infrared thermometer which had high accuracy and gives fast measurement within 0.1 second. It has 32 logs of data stored for analysis and comparison.

Study of carbondioxide and lactate level

A simple set up was designed to study the carbon dioxide released during the period of wearing mask. A tube was attached to one end to mask and the other end to a latex free bag. The subjects were instructed to wear the mask for 5 hours a day and the carbon dioxide was determined qualitatively [12]. Blood samples were withdrawn from the subjects for those oxygen level dropped down for lactate estimation by using LACT2-ACN040 kit [13]. To assess the microbial load sterile swab was taken from the used mask and inoculated simultaneously in Nutrient and Mac Conkey agar. The plates were incubated at 37°C for 24 hours and the preliminary identification was performed.

Results

A questionnaire was prepared through Google forms and it was distributed among college going students. A total of 250 responses were received and the consolidated results were depicted in (Table 1).

Table 1: Analysis of various parameters that caused discomfort while wearing mask

Parameters that cause discomfort	Percentage of respondents
Feel suffocated	51.2%
Experience altered sense of smell	36%
Get dry or itchy nose	39.6%
Feel that they have cracking inside the nose	17.6%
Experience pain in the nose	32.4%
Experience sore throat	24.4%
Experience irritation behind the ears due to mask strap	53.6%
Get rashes	24%
Experience redness over the face	30.8%
Get acne	24%
Get scars on the nasal bridge	18.8%
Profusely sweat in the facial area	59.2%
Experience fogging of glasses	32.8%
Get dry eyes	22.8%

The mask was made of cotton cloth and double layered, the quality of the mask used for the present study was determined using a very simple method, the candle blow method. When the subject while wearing the cloth mask was asked to blow the candle out but was unable to do so. This proved that the mask that was distributed for the study was of good quality. The oxygen saturation level of the subjects was checked periodically for 30 days using Fingertip Pulse Oximeter (Model: YM201) and the values were recorded, the pulse rate of the subjects was checked for 30 days. Simultaneously the facial temperature was also checked for 30 days using ZOOK Infra Temp thermometer and the mean value of the recorded results is given in (Table 2).

Table 2: Data showing mean value of oxygen level, pulse rate and facial temperature

Days	Oxygen level	Pulse rate	Temperature
	***Mean* ± SD**	***Mean* ± SD**	***Mean* ± SD**
1	97.93 ± 0.85	94.07 ± 6.63	97.83 ± 0.56
2	97.84 ± 0.67	90.02 ±9.74	97.66 ± 0.60
3	98.19 ± 0.59	97.57 ±9.33	97.90 ± 0.83
4	97.98 ±0.69	97.40 ±8.77	97.90 ± 0.91
5	97.76 ± 1.59	95.85 ±6.26	97.76 ± 1.23
6	98.03 ± 0.51	97.50 ±11.00	97.72 ± 0.46
7	98.13 ± 0.68	92.98 ± 7.73	97.73 ± 0.75
8	98.13 ± 0.65	88.91 ±6.17	97.72 ± 0.65
9	97.69 ± 0.66	93.71 ± 7.32	97.68 ± 0.74
10	97.74 ± 0.50	93.37 ± 9.36	97.88 ± 0.41
11	98.23 ± 0.61	91.80 ± 7.39	97.55 ± 0.85
12	97.89 ± 0.80	91.28 ±8.13	97.79 ± 0.56
13	97.91 ± 0.68	85.33 ± 7.25	97.84 ± 0.40
14	98.00 ± 0.57	90.73 ± 6.74	97.44 ± 0.70
15	97.62 ± 1.03	93.58 ±8.25	97.72 ± 0.67
16	98.05 ± 0.71	86.07 ± 6.14	97.84 ± 0.54
17	98.10 ± 0.65	93.33 ± 7.57	97.27 ± 1.12
18	98.07 ± 0.82	88.79 ± 8.84	97.43 ± 0.73
19	97.92 ± 0.76	91.68 ±6.29	97.73 ± 0.36
20	97.86 ± 0.73	87.19 ± 7.59	97.39 ± 0.58
21	97.67 ± 0.70	96.43 ± 5.80	97.86 ± 0.66
22	98.68 ± 0.66	89.40 ±6.43	97.71 ± 0.57
23	97.74 ± 0.82	94.88 ±7.82	97.54 ± 0.51
24	98.84 ± 0.85	97.71± 7.66	97.52 ± 0.88
25	98.64 ± 0.40	95.04 ±6.88	97.59 ± 0.81
26	98.39 ± 0.65	91.34 ± 7.14	97.90 ± 0.67
27	98.31 ± 0.52	97.04 ± 7.82	97.85 ± 0.60
28	98.00 ± 0.74	90.24 ± 8.90	97.84 ± 0.76
29	98.32 ± 0.43	86.20 ± 7.66	97.78 ± 0.78
30	98.05 ± 0.71	95.94 ±9.71	97.73 ± 0.66

A simple set up was designed to capture the carbon dioxide exhaled by the subject. The carbon dioxide that was collected in the latex bag was removed using a syringe and introduced into a test tube containing Calcium hydroxide solution (Figure 1). The solution turned milky white forming calcium carbonate as precipitate indicating the presence of carbon dioxide. This proves that while wearing mask the carbon dioxide that has been exhaled can be subjected to rebreathing by the user which may lead to mild suffocation.

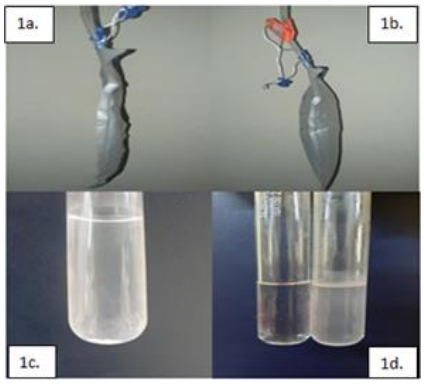

Fig 1: The figure (A, B) showing the accumulation of carbon dioxide in latex bag and (C, D) showing the presence of calcium hydroxide

Five subjects were selected based on oxygen level fluctuation and lactate levels of them were estimated in the plasma (Figure 2).

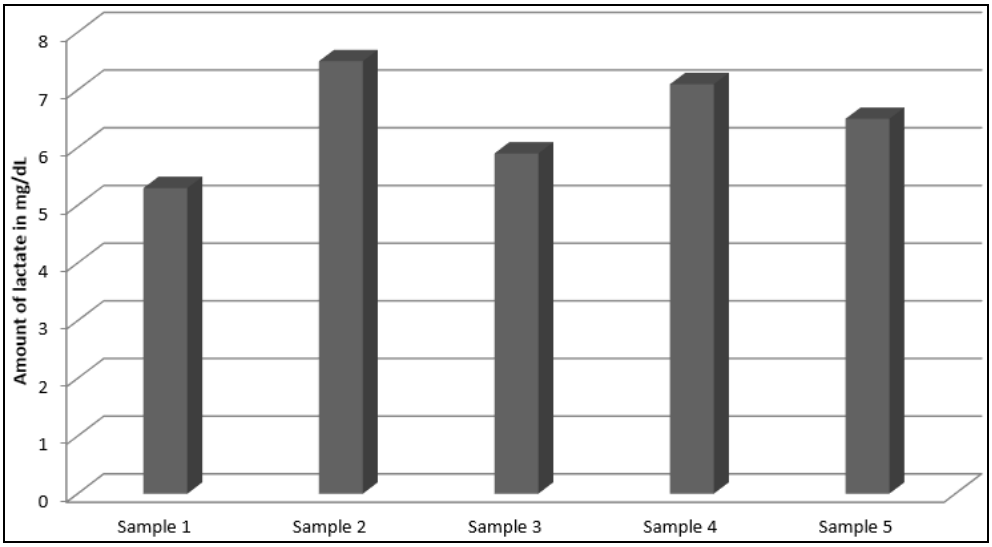

Fig 2: Estimation of lactate in plasma by UV enzymatic method

The normal range of lactate ranges from 4.5 to 19.8 mg/dL. The subject was instructed to blow onto both Nutrient agar and Macconkey medium with and without mask. It was observed that number of colonies in the plates that was blown onto without mask was higher than that blown with mask. This proves that cloth mask prevents the spread of microbes. The swabs collected from the masks worn by the subjects were streaked onto both Nutrient agar and MacConkey agar plates along with controls and incubated at 37°C for 24 hours. No growth was observed in the sample collected from 20 subjects. The samples collected from 10 subjects showed colony growth (Figure 3).

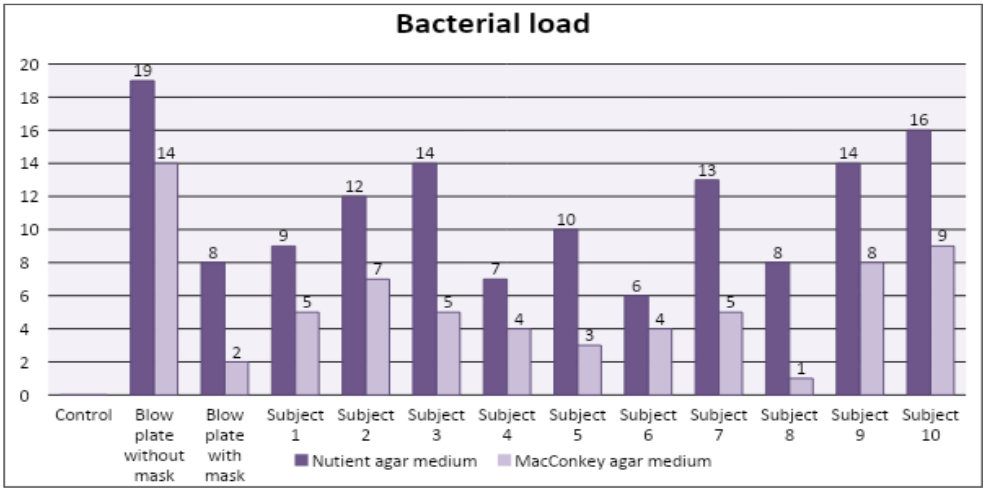

Fig 3: The graph representing the total number of bacterial colonies

Preliminary identification was done using Gram staining on selected colonies and most of them were Gram positive cocci and few were Gram negative rods.

Discussion

A questionnaire was distributed to 250 volunteers and the consolidated report showed that only half of the students wore mask for more than 5 hours. The reason may be due to lack of awareness and various discomforts caused by wearing mask for longer duration. Most of respondent felt suffocated due to wearing masks for prolonged duration which may be due to psychological reasons. Various parameters were taken into consideration and results showed that they were only meager change in altered smell, dry itchy nose, don't have cracking inside the nose or pain, do not experience redness over the face, don't get scars on the nasal bridge and dry eyes. An average percent of persons experience sore throat, rashes and acne. A higher proportion observed irritation behind the ears due to straps in the masks and profusely sweating in the facial area [14, 15]. In this context the present study was done mainly to understand the reason behind the feeling of suffocation. Henceforth three important parameters- oxygen level, carbondioxide level and pulse rate was monitored periodically for a period of one month. From the study, it was analyzed that very slight reduction in oxygen level of 97% was observed for 43% of subjects but this was seen within the normal range (95-100%). This may be due to wearing the mask that acts as a barrier which may reduce the airflow. Only when the oxygen level reduces below 90% it is considered as hypoxemia condition. There was a vast fluctuation in the pulse rate ranging from 85 to 97 bpm this may be due

various physical activities that may influence the pulse rate. The normal pulse rate of resting heart for 18-30 year's was found to be within the range of 60 -100 bpm [16, 17]. The presence of carbon dioxide proves that there is a possibility of rebreathing the carbon dioxide while wearing mask for prolonged duration which may lead to slight suffocation. When the person felt suffocated they felt better when they removed the mask this may support the hypothesis of rebreathing. It is also observed that physiologically they may feel discomfort while wearing mask. The lactate levels obtained from the subjects were also observed to be within the normal range which disproves the hypothesis that wearing mask for longer duration may result in hypoxic condition [18]. Lactate level is also influenced by shallow breathing, tiredness, and decreased appetite. The facial temperature also remained within the normal limits and use of cotton mask has to certain extent reduced the discomfort caused by sweating [19]. The study on microbial load showed that majority of isolates was Gram positive cocci in clusters which thereby belong to genera- *Staphylococcus*. *As Staphylococcus* is mainly observed as normal microbiota prolonged duration of mask usage could have led to increase in the bacterial count [20]. In certain cases this would have become an opportunistic pathogen that may lead to various skin problems such as acne and rashes.

Conclusions

The present study shows that the common people face many discomforts while wearing mask for duration of 5 hours. This discomforts mainly the fluctuation in oxygen level and pulse rate does not affect the physiological condition of the person. Wearing of mask is therefore the best preventive measure to prevent COVID.

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Conflict of Interest

The authors declare that there is no conflict of interest

References

1. Pal R, Yadav U. "COVID-19 Pandemic in India: Present Scenario and a Steep Climb Ahead", Journal of Primary Care & Community Health, 2020. 11:2150132720939402. doi: 10.1177/215013272093 9402.
2. Jose H. "The importance of wearing masks in curtailing the COVID-19 pandemic", Journal of Family Medicine and Primary Care,2020:9(6):2606-2607.
3. Tso RV, Cowling BJ. "Importance of Face Masks for COVID-19: A Call for Effective Public Education", Clinical Infectious Diseases,2020:71(16):2195-2198. doi: 10.1093/cid/ciaa593.
4. Pope CA 3rd, Burnett RT, Thun MJ, Calle EE, Krewski D, Ito K. *et al*. "Lung cancer, cardiopulmonary mortality, and long-term exposure to fine particulate air pollution", Journal of the American Medical Association,2002:287(9):1132-41. doi: 10.1001/jama. 287.9.1132.
5. Jensen LA, Onyskiw JE, Prasad NG. "Meta-analysis of arterial oxygen saturation monitoring by pulse oximetry in adults", Heart Lung,1998:27(6):387-408. doi: 10.1016/s0147-9563(98)90086-3.
6. Scarano A, Inchingolo F, Lorusso F. "Facial Skin Temperature and Discomfort When Wearing Protective Face Masks: Thermal Infrared Imaging Evaluation and Hands Moving the Mask", International Journal of Environmental Research and Public Health,2020:17:4624. 10.3390/ijerph17134624.
7. Roberge RJ, Kim JH, Coca A. "Protective facemask impact on human thermoregulation: an overview", Annuals of Occupational Hygiene,2012:56(1):102-12. Doi: 10.1093/annhyg/mer069.
8. Ou YE, Lin ZM, Hua DM, Jiang Y, Huo YT, Luo Q. *et al*. "Evaluation of carbon dioxide rebreathing during exercise assisted by noninvasive ventilation with plateau exhalation valve", International journal of chronic obstructive pulmonary disease,2017:12:291-298. https://doi.org/10.2147/COPD.S121637
9. Niemeier-Walsh C, Ryan P, Meller J, Nicholas JO, Atin A, Reponen T. *et al*. "Exposure to Traffic-Related Air Pollution is Associated with Greater Bacterial Diversity in the Lower Respiratory Tract of Children", Public Library of Science (PLOS) ONE, 2020. DOI: 10.1101/2020.12.09.417501.
10. Fisher EM, Shaffer RE. "Considerations for recommending extended use and limited reuse of filtering facepiece respirators in health care settings", Journal of Occupational and Environmental Hygiene,2014:11(8):115-28.doi:10.1080/15459624. 2014.902954.
11. Zheng Wang. "Survival of Bacteria on Respirator Filters", Aerosol Science & Technology,1999:30(3):300-308.
12. Rubio-Portillo E, Orts D, Llorca E. *et al*. "The Domestic Environment and the Lung Mycobiome", Microorganisms,2020:8(11):1717. doi:10.3390/ microorganisms8111717
13. Han SJ, Yoo M, Kim, DW, Wee JH. "Carbon Dioxide Capture Using Calcium Hydroxide Aqueous Solution as the Absorbent", Energy & Fuels,2011:25(8):3825-3834.
14. MacIntyre CR, Wang Q, Seale H, Yang P, Shi W, Gao Z. *et al*. "A randomized clinical trial of three options for N95 respirators and medical masks in health workers", American Journal of Respiratory and Critical Care Medicine,2013:187:960-966.
15. Lee VJ, Aguilera X, Heymann D, Wilder-Smith A. "Lancet Infectious Diseases Commission. Preparedness for emerging epidemic threats: a Lancet Infectious Diseases Commission", Lancet Infectious Diseases,2020:20(1):17-19.
16. Davies A, Thompson KA, Giri K, Kafatos G, Walker J, Bennett A. *et al*. "Testing the efficacy of homemade masks: would they protect in an influenza pandemic?", Disaster Medicine and Public Health Preparedness,2013:7(4):413-418. doi:10.1017/dmp. 2013.43
17. Radonovich LJ Jr, Simberkoff MS, Bessesen MT, Brown AC, Cummings DAT, Gaydos CA. *et al*. "ResPECT investigators. N95 Respirators vs Medical Masks for Preventing Influenza Among Health Care Personnel: A Randomized Clinical Trial"; Journal of the American Medical Association,2019:322(9):824-833. doi: 10.1001/jama.2019.11645.
18. Xia W, Fu L, Liao H, Yang C, Guo H, Bian Z. *et al*. "The Physical and Psychological Effects of Personal

Protective Equipment on Health Care Workers in Wuhan, China: A Cross-Sectional Survey Study", Journal of Emergency Nursing,2020:46(6):791-801.e7. doi:10.1016/j.jen.2020.08.004
19. Chen HY, Chen A, Chen C. "Investigation of the Impact of Infrared Sensors on Core Body Temperature Monitoring by Comparing Measurement Sites", Sensors (Basel),2020:20(10):2885. doi:10.3390/s20102885
20. Holmes B, Pinning CA, Dawson CA. "A probability matrix for the identification of gram-negative, aerobic, non-fermentative bacteria that grow on nutrient agar", Journal of General Microbiology,1986:132(7):1827-42. doi: 10.1099/00221287-132-7-1827.