Impact of Inhalation Resistance on Facial Surface Temperature and Stress Levels During Mask Wearing

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SUMMARY Carbon dioxide levels have been reported to affect human cognitive abilities [1]. When wearing a mask, the increased inhalation resistance places a greater burden on breathing compared to not wearing a mask, potentially leading to breathlessness and discomfort, which can act as a psychological stressor for some individuals. In addition, wearing a mask can cause physiological effects, such as increased breathing load and elevated facial surface temperature, which may activate the sympathetic nervous system and affect heart rate variability, resulting in an increase in the stress index. In this paper, we present the findings of our experiments investigating the relationship between respiratory resistance, facial surface temperature, and stress levels when wearing masks.
keywords: *RRI, Stress index, Carbon dioxide,*

1. Experiment

The experiment was conducted in a university conference room over three months, from October to December 2022. In the experiment, subjects wore masks with different inhalation resistance, and heart rate variability and facial surface temperature were measured.

2. Experimental Results and Considerations

Figure 1 shows the distribution of the surface temperature of the face (forehead area) 7 minutes after the mask was worn, for each mask's air intake resistance. The temperature distribution on the face surface without a mask (intake resistance: 0 Pa) is also shown for a comparison. The order of facial surface temperature distribution from highest to lowest was: no mask, (1) 50 Pa mask, and (2) 100 Pa mask. The correlation coefficient between inhalation resistance and facial skin surface temperature was 0.6, indicating a positive correlation. However, there were six cases in each subject where the temperature of the 100 Pa mask (2) did not increase more than that of the 50 Pa mask (1).

Figure 2 illustrates the range of variation in the stress index concerning the mask's inhalation resistance. The range of variation was calculated by subtracting the minimum value from the maximum value of the stress index while wearing the mask for 7 minutes. To account for variability, 95% of the data centered on the mean value were considered. The stress index's variation range was smaller for (1) 50 Pa masks and larger for (2) 100 Pa masks. The correlation coefficient between inhalation resistance and stress index variability was 0.3, indicating a weak positive correlation. However, in seven cases, the stress index variability for (2) 100 Pa masks was smaller than that for (1) 50 Pa masks.

Thus, the experiment on healthy adults showed that facial surface temperature tended to increase with higher inhalation resistance. Additionally, an increase in inhalation resistance appeared to elevate stress index variability. However, individual differences were observed in the effect of mask wearing on the stress index among subjects. Interviews with the subjects revealed that some participants adapted to wearing masks and did not experience stress easily, finding masks comfortable. Therefore, the impact on stress levels seems to depend on individuals' adaptation to wearing masks.

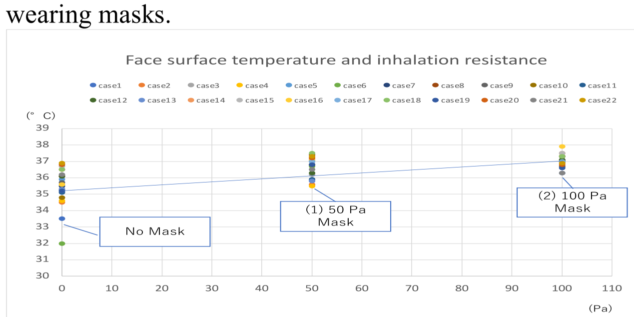

Fig. 1 Face Surface Temperature and Inhalation Resistance.

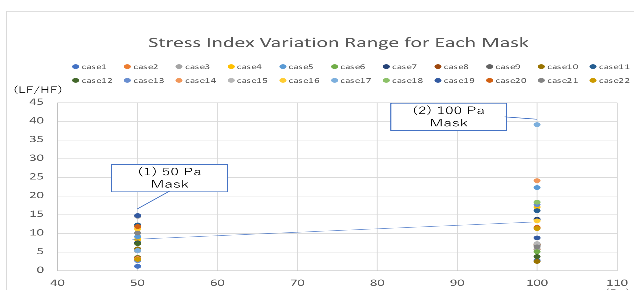

Fig. 2 Range of variation of stress index.

Acknowledgments

This study was carried out as part of a JSPS KAKENHI Grant Number JP22H04433.

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