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COMPARISON OF COMFORT LEVELS BETWEEN LEVEL III PPE USED IN COVID-19 ISOLATION ROOMS WITH SUNS (SURGEONS OF UNS)

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ABSTRACT

Introduction. *In 2020, WHO declared COVID-19 a pandemic, impacting global health systems, including Indonesia. COVID-19 patient care required Level 3 PPE. UNS developed a PPE equivalent to Level 3, named Surgeon of UNS (SUNS). This article aims to compare the comfort level between SUNS and Level 3 PPE.*

Method. *This cross-sectional analytical observational study compares the comfort of Level 3 PPE and SUNS PPE. Conducted from August to September 2020, the study involved healthcare workers treating COVID-19 patients. There were two groups: the intervention group with 15 participants using SUNS PPE, and the control group with 15 participants using Level 3 PPE. The measured parameters included comfort level and vital signs such as heart rate, respiratory rate, oxygen saturation, and body temperature.*

Results. *The study included 15 males and 15 females, with an average age of 37.83 ± 5.18 years. There was no significant difference in gender and age between the groups. Heart rate, respiratory rate, and body temperature were significantly lower with SUNS PPE ($p<0.001$, $p=0.01$, $p<0.001$ respectively) and oxygen saturation was significantly higher ($p=0.008$). Thirteen out of 15 subjects felt comfortable using SUNS PPE, while only 3 out of 15 felt comfortable using Level 3 PPE. Using SUNS PPE was significantly more comfortable, being 26 times more likely to be preferred ($p<0.001$, OR 26.00).*

Conclusion. *There is a noticeable difference in comfort between Level 3 PPE and SUNS PPE used in COVID-19 isolation rooms. SUNS PPE is significantly more comfortable, being 26 times more preferred than Level 3 PPE in these settings.*

Keywords: *Personal Protective Equipment, COVID-19, Isolation, Comfort, Healthworker*

INTRODUCTION

In December 2019, mysterious pneumonia cases were first reported in Wuhan, Hubei Province. Linked initially to a seafood market, these cases soon led to five patients being treated for Acute Respiratory Distress Syndrome (ARDS). COVID-19, the virus responsible, spread rapidly, affecting over 190 countries. On March 12, 2020, WHO declared it a pandemic. By the end of March 2020, there were 634,835 cases globally with 33,106 deaths. Preventive measures include handwashing, mask-wearing, and maintaining distance.[1,2]

Level 3 PPE is required for healthcare workers treating confirmed COVID-19 patients. This protective gear prevents direct contact with the virus.[3] Since no single material can shield against all contaminants, layered clothing is used. Most protective gear is moisture-resistant, limiting heat transfer from the body, crucial in hot environments. To address this, cooling vests are sometimes employed.[4] The pandemic highlighted the need for effective PPE, leading Sebelas Maret University to develop the Surgeon of UNS (SUNS) PPE. This study compares the comfort level of SUNS with standard Level 3 PPE among healthcare workers at RSUD Dr. Moewardi Surakarta.

METHOD

Figure 1. The SUNS PPE

This cross-sectional analytical observational study compares the comfort of Level 3 PPE and SUNS PPE. Conducted at Dr. Moewardi General Hospital from August to September 2020, the study involved healthcare workers treating COVID-19 patients. There were two groups: the intervention group with 15 participants using SUNS PPE, and the control group with 15 participants using Level 3 PPE. The measured parameters included comfort level and vital signs such as heart rate, respiratory rate, oxygen saturation, and body temperature.

SUNS (Surgeons of UNS) is a personal protective equipment (PPE) developed by Sebelas Maret University in Indonesia (Fig 1). The SUNS covers the upper body and entire front of the head, making it airtight. This design prevents droplets from sticking to the skin, face, hair, and mucous membranes and eliminates the risk of inhaling infectious particles from the work area. It features an "air filtrator" with a mini fan to assist breathing and reduce humidity and heat, similar to fish gills. A multi-purpose hole allows for safe access to the face for tasks like drinking or adjusting the mask. SUNS offers comfort, durability, and environmental friendliness, making it a suitable long-term PPE solution.

The comfort of PPE was assessed through 5 questions with pre-provided answers. The evaluation aimed to determine factors influencing PPE usage, dividing comfort levels into two categories: comfortable if respondents correctly answered >50% of questions or scored >2, and less comfortable if respondents correctly answered ≤50% of questions or scored ≤2. The Shapiro-Wilk test was used to assess data distribution. Parametric data are presented as Mean ± SD, while non-parametric data are presented as median (IQR). Statistical analysis was conducted using SPSS. Differences were tested using independent T-test for parametric data and Mann-Whitney test for non-parametric data. Categorical data were analyzed using the Chi-Square test. Results were considered significant if $p<0.05$.

RESULTS

Table 1. Subject Characteristics

Characteristics	Mean±SD/ Median (IQR)/ N (%)			p-value
	Overall	Level 3 PPE	SUNS PPE	
Age	37.83 ± 5.18	37.80 ± 5.28	37.87 ± 5.27	0.973[a]
Gender				
Male	15 (50%)	7 (46.7%)	8 (53.3%)	0.715[b]
Female	15 (50%)	8 (53.3%)	7 (46.7%)	
Heart Rate	93.33 (11.11)	101.87 (9.59)	84.80 (2.78)	**<0.001[c]**
Respiratory Rate	18.73 (2.15)	19.80 (2.37)	17.67 (1.23)	**0.010[c]**
O2 Saturation	96.17 ± 1.64	95.40 ± 1.64	96.93 ± 1.28	**0.008[a]**
Temperature	37.33 (0.44)	37.67 (0.34)	36.99 (0.15)	**<0.001[c]**

[a]Independent T-Test, [b]Chi-Square Test, [c]Mann-whitney Test

There were no significant differences in age and gender between the groups, making the sample in this study comparable. Heart rate, respiratory rate, and body temperature were significantly lower with SUNS PPE ($p<0.001$, $p=0.01$, $p<0.001$, respectively), while oxygen saturation was significantly higher ($p=0.008$).

Table 2. Bivariate Analysis of Comfort Level

Characteristics	Level 3 PPE	SUNS PPE	Odds Ratio	p-value
Comfort				
Comfortable	3 (20.0%)	13 (86.7%)	**26.00**	**<0.001**
Uncomfortable	12 (80.0%)	2 (13.3%)		

Table 2 shows that for Level 3 PPE, only 3 subjects (20.0%) found it comfortable, while 12 (80.0%) found it uncomfortable. In contrast, SUNS PPE was comfortable for 13 subjects (86.7%) and uncomfortable for only 2 (13.3%). The odds ratio indicates that SUNS PPE is 26 times more likely to be comfortable compared to Level 3 PPE, with a p-value of <0.001, indicating statistical significance.

DISCUSSION

The comfort assessment in this study used both objective and subjective data. Objective data included heart rate, respiratory rate, oxygen saturation, and temperature. Subjective data were obtained through a comfort questionnaire based on Loibner et al.[5], where a score >2 indicates comfort.[5] Previous studies by Jiang et al.[6] and Mao et al.[7] reported that high temperatures while wearing PPE lead to discomfort. Judd et al.[8] also found that PPE usage negatively impacts work ability, communication, and user comfort. This study compares modified PPE designed for comfort and safety, SUNS, with standard Level 3 PPE used in COVID-19 isolation rooms.

In this study, objective data such as heart rate, respiratory rate, oxygen saturation, and temperature were significantly lower with SUNS PPE compared to standard Level 3 PPE. The median temperature in the SUNS PPE group was 36.99 (0.15) °C, compared to 37.67 (0.34) °C in the Level 3 PPE group, showing a significant difference ($p<0.001$). Similar results were reported by Karahan et al.[9] where most healthcare workers reported increased temperature and poor ventilation while using PPE. Studies by Hunt et al.[10] and Messeri et al.[11] also found high temperatures causing discomfort. Fang et al.[12] observed an average temperature increase to 37.2 ± 0.3 °C while using PPE, indicating that standard PPE increases the user's temperature.

The heart rate in the SUNS PPE group was significantly lower compared to the Level 3 PPE group. The median heart rate for SUNS PPE was 84.80 (2.78) bpm, while for Level 3 PPE, it was 101.87 (9.59) bpm. Normal adult heart rates range from 60 to 100 bpm.[13] Jiang et al.[6] found heart rates could reach 133 bpm with an average of 100-120 bpm due to increased temperatures while using PPE. Similarly, Fang et al.[12] reported an increase from 73 ± 7 bpm to 85 ± 9 bpm, potentially reaching 121 bpm.

This study also showed a significant difference in comfort between the SUNS PPE and Level 3 PPE groups. SUNS PPE was 26 times more comfortable than Level 3 PPE. This is due to additional features in SUNS PPE, like improved air circulation and a multi-purpose hole for accessing cold drinks, adjusting masks, and providing oxygenation. Gabr et al.[14] noted that discomfort mainly stemmed from breathing difficulties and heat. Lee et al.[15] found that ice slurry consumption during PPE use effectively reduced temperature-related discomfort. These modifications in SUNS PPE aim to enhance user comfort.

Improved air circulation in SUNS PPE was evidenced by lower respiratory rates and higher oxygen saturation compared to Level 3 PPE, indicating better breathing comfort. The median respiratory rate for SUNS PPE was 17.67 (1.23) breaths per minute, compared to 19.80 (2.37) breaths per minute for Level 3 PPE. This aligns with Fang et al.[12], where PPE use

resulted in an average respiratory rate of 18 ± 5 breaths per minute, compared to 16 ± 4 breaths per minute after removal. The average oxygen saturation in the SUNS PPE group was 96.93 ± 1.28%, compared to 95.40 ± 1.64% in the Level 3 PPE group, contrary to Fang et al.[12] who found no significant difference. The data suggest that SUNS PPE provides better breathing comfort than standard Level 3 PPE.

This study has the advantage of assessing a novel innovation in the healthcare sector, particularly in personal protective equipment (PPE). The results provide insight into the protective effects of SUNS PPE, a new innovation from Indonesia, especially UNS. Being the first of its kind, the study sets a benchmark for further innovation and research in PPE. However, a limitation is that it was conducted at only one center, so further studies at multiple centers are needed for more homogeneous data.

CONCLUSION

This study concluded that there is a significant difference in comfort levels between Level 3 PPE and SUNS PPE used in COVID-19 isolation rooms, with SUNS PPE being 26 times more comfortable. For future research, it is recommended to standardize psychological stress levels before the study, increase the sample size, and include varied germ translocation parameters. Further studies should also evaluate the safety, cost-effectiveness, and sustainability of SUNS PPE compared to Level 3 PPE. Health researchers are encouraged to innovate in medical technology to improve service, comfort, and cost-effective healthcare.

DISCLOSURE

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