Pressure injuries related to N95 respirator masks among healthcare workers during the COVID-19 pandemic

Dear Editor,

The coronavirus disease 2019 (COVID-19) pandemic outbreak, which started in 2019, has affected millions of patients globally.¹ Singapore is not spared, being one of the first countries to import COVID-19 cases from China.² Nosocomial transmission of SARS-CoV-2 had been reported in various cohort studies of healthcare workers (HCWs), highlighting the importance of effective hospital infection control policies to mitigate risk.³ In the process of protecting oneself from the SARS-CoV-2 infection, many of our HCWs suffered from skin issues ranging from pressure injuries to other skin-related lesions. While most existing literature surrounding pressure injuries is centred around patients, literature on pressure injuries in HCWs from personal protective equipment (PPE), though scarce, is rapidly emerging as the pandemic continues. A study conducted during the 2013 severe acute respiratory syndrome (SARS) outbreak in Singapore reported more than 50% adverse skin reactions resulting from PPE.⁴

The aim of our study is to examine the cross-sectional prevalence of pressure-related injuries among HCWs as a result of N95 masks in a tertiary healthcare institution during the COVID-19 pandemic.

An online questionnaire was designed to include all HCWs (doctors, nurses, allied health workers and ancillary staff) who were actively involved in patient care since the start of the COVID-19 pandemic in Singapore. Participation in this survey was optional and voluntary (see Supplementary Materials Appendix 1 in the online version of this article). The questionnaire was disseminated via Survey Monkey, an online survey platform (Momentive Inc, San Mateo, US) and was available for a duration of 3 weeks between July and August 2020. At the time of survey, N95 masks used at our institution were the 3M 8210, 3M 1860, 3M 1860S, 3M 8110S and 3M 1870+. The definition of pressure injury was defined using the standard guidelines from the National Pressure Injury Advisory Panel.⁴

Relevant data were collected and analysed using SPSS Statistics software version 24 (IBM Corp, Armonk, US). Univariate analysis was done using t-test for normally distributed continuous variables and chi-square test for categorical variables. Spearman's rank-order correlation (ρ) was used for ordinal variables. Multivariate analysis was performed using binary logistic regression. P value of ≤ 0.05 was considered to be statistically significant. Ethics review and approval were obtained from the National Healthcare Group Domain Specific Review Board.

Of approximately 2,500 HCWs within our institution, 851 replied to our survey, giving a response rate of 34%. The demographics of our survey population is described in Appendix 2 (see Supplementary Materials Appendix 2 Table S1 in the online version of this article). Of the 621 respondents who wore N95 masks daily at work during the pandemic, 394 (63.4%) answered "yes" to having had any pressure-related injuries as a result of their N95 masks (46.3% of the total surveyed population) (Appendix 2 Table S2).

A higher total average time of wearing the N95 mask correlates with a significantly higher risk of pressure injury ($p=0.229$, $P<0.001$, Appendix 2 Table S3). Also, the corresponding trend of a higher average time of wearing the N95 mask before "taking a break" also resulted in a significantly higher risk of pressure-related injury ($p=0.140$, $P=0.001$) (Appendix 2 Table S3).

Multivariate analyses showed that with the exception of 3M 1870+, there was a higher odds ratio of pressure injury when using the rest of the surveyed mask models (Appendix 2 Table S4).

Many of our respondents attempted self-management strategies including the use of emollients and prophylactic dressings (i.e. foam dressing, hydrocolloid and gauze) as a layer of cushioning over areas of high pressure such as bony prominences. A smaller number of respondents (29/208, 13.9%) shared that a change in N95 mask model to 3M 1870+ had helped to reduce or eliminate their pressure injury. Thankfully, most of our respondents (162/208, 77.9%) reported resolution with self-treatment.

Prior to the COVID-19 pandemic, the issue of pressure injury among HCWs was hardly mentioned in the literature. The prevalence of pressure injury from N95 respirator masks in our surveyed population was considerably high at 63.4%. Other similar studies have reported prevalence of skin-related problems from PPE ranging from over 50% up to 97%.^{4,6,7} In addition, our results showed that increased total time of having worn the N95 masks per day and increased duration of N95 mask usage between break times do significantly increase the risk of developing pressure injury; these findings are similar to other studies reported in literature.⁸

Current treatment strategies include regular moisturisers and/or barrier film wipes prior to N95 mask usage; and the use of prophylactic dressings between the N95 mask and the skin including thin hydrocolloid, silicone-based or foam dressings.^{5,8-11} Some of these recommended management strategies are summarised in Table 1.

Table 1. Management strategies for N95 respirator mask-induced pressure injuries

Before use of N95 mask	During the use of N95 mask	After the use of N95 mask
Adequate skin care, hygiene and use of moisturisers	Take safe, frequent breaks during active N95 mask use	Adequate skin care, hygiene and use of moisturisers
Perform regular mask refitting, particularly after significant weight change ^a	In cases of active pressure injury, use of dressing material as an interface between N95 mask and skin ^b	Seek professional consultation for Stage 3 or worse pressure injury, and/or pressure injuries that are persistent or progressing

^a Healthcare workers should be fitted for more than 1 mask model type.

^b Thin hydrocolloid, silicone-based or foam dressing. Healthcare workers are recommended to perform N95 mask refitting together with the dressing to ensure a good mask fit.

During the ongoing COVID-19 pandemic, the preventive strategies would be to focus on modifiable factors including care for the individual HCW and changes to the environment and working schedule. By sharing this information, we seek to create awareness and education on prevention of pressure injuries as part of mask-fitting exercises; adjust work environment and scheduling for HCWs who require prolonged N95 mask usage; and influence procurement of N95 masks models by taking staff comfort into key consideration.

The effect of increased awareness and education of pressure injury prevention from N95 respirator masks goes beyond the physical injury of the skin. While a mask-fit test is important to ensure a good mask seal, the act of over-tightening one's PPE will result in additional discomfort and eventual skin damage from pressure, besides not conferring any additional protective benefit.⁷ Providing our HCWs with the knowledge surrounding prevention of pressure injuries would empower our staff and thus increase their resilience during a pandemic.¹⁰

To conclude, our survey showed a prevalence of pressure injury due to N95 masks usage at 63.4%. Risk factors for N95 mask-related pressure injury include high total average time of N95 respiratory mask use and longer durations of N95 mask use before "taking a break". Follow-up studies are needed to determine the effectiveness of preventive strategies and prophylactic dressings in reducing the prevalence of N95 mask-related pressure injuries in HCWs.

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