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### Reduction of allergic rhinitis symptoms with face mask usage during the COVID-19 pandemic



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#### Clinical Implications

- Multicenter questionnaire data characterized the impact of face masks on allergic rhinitis symptoms reported by nurses with chronic allergic rhinitis. A decrease in symptom severity with mask usage highlights the potential benefit of face masks for patients with allergic rhinitis.

The coronavirus disease 2019 (COVID-19) pandemic demanded widespread adoption of personal protective equipment for viral transmission prevention. The prevalence of allergic rhinitis, ranging from 10% to 20% of the general population,<sup>1</sup> together with extensive use of face masks during the pandemic provided an opportunity to study the effects of face masks on rhinitis symptoms. We used questionnaire data to characterize Israeli nurses' symptomatology while wearing face masks when working 8- to 12-hour shifts during the COVID-19 pandemic.

Ethical approval was granted by the institutional review board before initiation of this longitudinal study. All participants provided informed consent on the introductory web page before the survey enrollment. The web-based survey was created with the Qualtrics platform and the American Association for Public Opinion Research reporting guidelines. The survey was anonymous and confidential and participants could terminate the survey at any time. The survey was distributed electronically over a 2-week period across medical centers in Israel to full-time nurses (8- to 12-hour shift) in respiratory wards or dedicated departments for suspected or confirmed COVID-19. The survey was distributed on April 5, 2020, for 2 weeks during the early spring in Israel where seasonal allergens are widely dispersed. This period also corresponds to when initial social distancing and quarantine regulations were implemented in Israel.

Demographic data were self-reported by 1824 participants, including sex, age, and geographic location of responders' affiliated medical center, including 301 nurses with reported allergic rhinitis, further self-classified as intermittent ( $n = 233$ ) or persistent ( $n = 68$ ) (Figure 1). The nurses scored their allergic rhinitis symptom severity before and after wearing face masks for 1 week at work; symptomatology data were collected once upon enrollment in the study and again after the nurse had worn one of the mask configurations for 1 week. Of 301 nurses, the

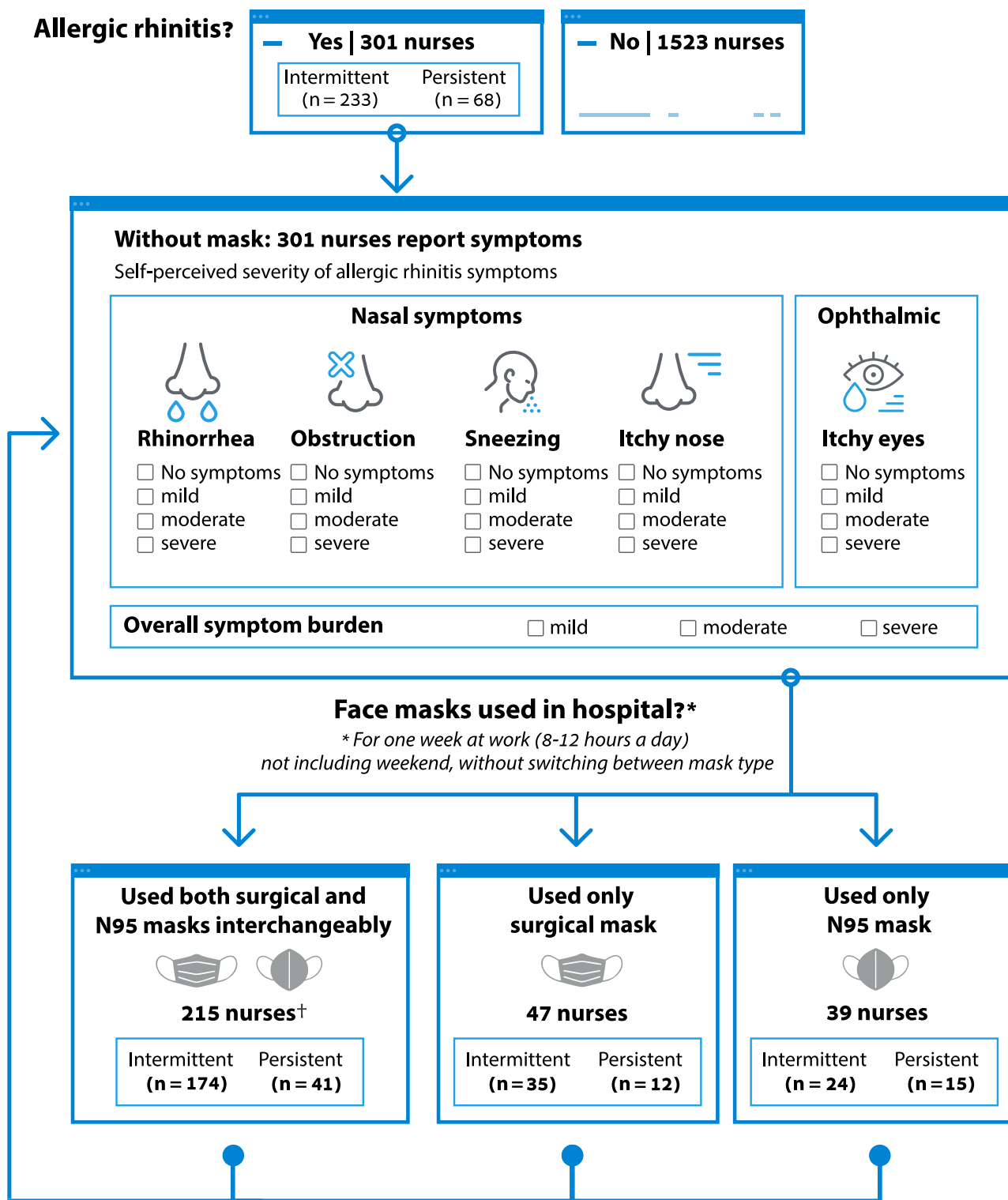
minority typically use only 1 type of mask, either a surgical mask ( $n = 47$ ) or an N95 mask ( $n = 39$ ), whereas most ( $n = 215$ ), for the purposes of this study, used 2 types of face mask (surgical mask and N95) for 1 week each (Figure 1). The nurses in this group reported their symptoms after 2 consecutive weeks of wearing one mask type for the first week and then the other mask type for the second week. The participants scored the severity of their individual allergic rhinitis symptoms (none, mild, moderate, or severe) of watery rhinorrhea, sneezing, nasal obstruction, and itchy nose and eyes. In addition, nurses ranked a separate score of overall perceived symptom burden of rhinitis as either mild, moderate, or severe (Figure 1).

To assess the difference in the distribution of symptom severity with the use of masks, we performed  $\chi^2$  tests in Prism 8 software (Graphpad, San Diego, Calif).

Of 1824 nurses (82.6% females), 301 responders (16.5%) reported having allergic rhinitis. The mean respondent age was  $34.3 \pm 12.9$  years for both sexes. Among 215 nurses who used 2 types of face mask (surgical mask and N95) for 1 week each, the proportion of nurses reporting mild overall symptom burden (42.3%) decreased significantly after wearing a surgical mask (29.3%;  $P = .0049$ ) or an N95 respirator (25.1%;  $P = .0001$ ) as compared with no mask (Figure 2). Similarly, the proportion of nurses reporting severe overall symptom burden (20.5%) decreased significantly after wearing a surgical mask (13.0%;  $P = .0388$ ) or an N95 respirator (12.6%;  $P = .0272$ ) as compared with no mask (Figure 2). Similar analysis for a separate, small group of nurses who used surgical masks exclusively ( $n = 47$ ) showed marked improvement in the proportion of mild overall symptom burden ( $P = .0042$ ) but no significant change in severe symptomatology ( $P = .3233$ ) (Figure 2). A group of nurses using N95 masks exclusively ( $n = 39$ ) showed significant improvement in overall severe symptom burden ( $P = .0278$ ), but no significant improvement in mild overall symptom burden ( $P = .177$ ) (Figure 2). Additional analysis dividing the 301 nurses with reported allergic rhinitis on the basis of self-classified intermittent ( $n = 233$ ) versus persistent ( $n = 68$ ) disease showed no improvement in overall symptom burden among nurses with persistent allergic rhinitis regardless of the type of mask used (Figure 2). Despite the demonstrable improvement in overall allergic rhinitis symptom burden observed in the intermittent group, specific analysis of ophthalmic symptomatology showed no improvement following wearing a mask (Figure 2).

Rationalization for face mask usage during the current pandemic is for reducing transmission of severe acute respiratory syndrome coronavirus 2. In addition to preventing pathogen penetration, face masks potentially lower the burden of other inhaled airborne particles including allergens and air pollutants.<sup>2</sup>

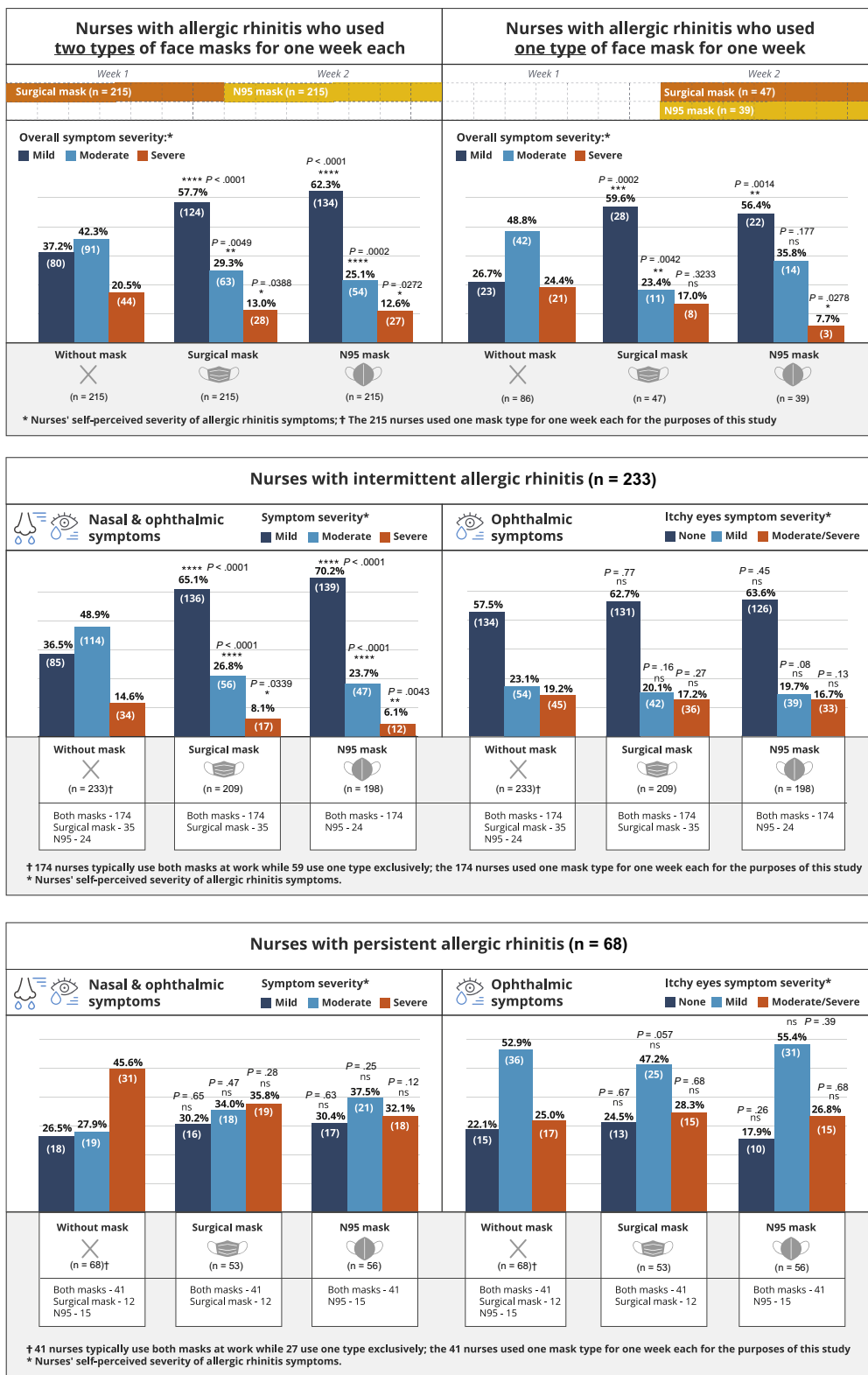
Inhaled airborne allergens such as pollen (10-100  $\mu\text{m}$ ), fungal spores (2-50  $\mu\text{m}$ ),<sup>3</sup> and house-dust mites feces (10-40  $\mu\text{m}$ )<sup>4</sup> play a significant role in triggering IgE-mediated immunologic responses in typical allergic rhinitis symptoms. Standard surgical masks filter particles larger than 3  $\mu\text{m}$ ,<sup>5</sup> whereas N95 respirators can filter particles as small as 0.04  $\mu\text{m}$ .<sup>6</sup> Our data show a significant reduction in self-reported allergic rhinitis symptoms among nurses wearing face masks (N95 or surgical mask) during the COVID-19 pandemic (Figure 2). These findings are



**Nurses' reported symptoms after wearing a surgical or an N95 mask or both interchangeably**

<sup>†</sup> 215 nurses typically use both masks at work while 86 use one type exclusively; the 215 nurses used one mask type for one week each for the purposes of this study

**FIGURE 1.** A visual representation of allergic rhinitis symptom characterization and periodicity questions as well as face mask utilization queries provided to nurses in the questionnaire.



**FIGURE 2.** Nurse categorization of allergic rhinitis symptom severity. The nurses scored their overall allergic rhinitis symptom severity before and after wearing face masks for 1 week for each mask type at work. Of 301 nurses, the minority typically use only 1 type of mask, either a surgical mask (n = 47) or an N95 mask (n = 39), whereas most (n = 215), for the purposes of this study, used 2 types of face mask (surgical mask and N95) for 1 week each for a total of 2 weeks. Nurses with intermittent allergic rhinitis showed a significant improvement in overall symptoms burden after wearing face mask, but no change in specific ophthalmic symptomatology regardless of the type of face mask used. Nurses with persistent allergic rhinitis showed a higher proportion of severe symptomatology and no change in symptoms severity after wearing either a surgical mask or an N95 face mask. P value vs no mask; enrollment period: April 5-19, 2020.

consistent with the intended function of face masks in reducing the burden of inspiratory particles, including common allergens.

Despite enhanced small particle obstruction, N95 respirators provided no additional reductions in allergic rhinitis symptoms over standard surgical masks, findings potentially attributable to unfiltered airflow through imperfect mask seal edges or allergen exposure when not wearing personal protective equipment. Masks with dense fabric fibers (eg, N95) may increase breathing effort and negative pressure of the inspiratory phase, leading to high pressure drops through face masks or respirators, increasing flow of unfiltered air and particle penetration through face seal leakage.<sup>7</sup>

Face masks increase the temperature and humidity of breathed air between masks and airway orifices, which may inhibit nasal responses to allergen provocation.<sup>8,9</sup> In addition to obvious physical filtration properties, face masks may reduce allergic rhinitis symptoms through altering the humidity and temperature of breathed air. Allergens not eliminated by face mask filtration may provoke milder allergic responses under face mask-wearing conditions.

Other behavioral modifications during the lockdown potentially contributed to reported decreases in allergic rhinitis symptoms. Recommendations by health authorities to stay home and avoid crowded places likely reduced exposure to allergens and other environmental pathogens, especially during the spring season of the survey enrollment period. Therefore, the observed improvement in symptoms among nurses with intermittent (ie, seasonal) allergic rhinitis could be due to reduced exposure to seasonal provoking allergens and not due to mask wearing. However, the lack of ophthalmic symptom improvement in the presence of significant improvement in nasal symptoms among nurses with intermittent allergic rhinitis highlights the potential contribution of face masks in lowering exposure of allergens to the upper airway even though the eye's conjunctiva remains exposed to provoking allergens. To further investigate the potential contribution of face masks for allergic rhinitis symptom improvement, a larger study with a substantial control group is required.

Our results reveal that face mask usage may reduce allergic rhinitis symptom severity in chronically affected individuals with intermittent disease. The study supports the hypothesis that face masks may reduce atopic allergic responses. Proposed mechanisms include the physical filtration of face masks and the potentially modified physiological response to allergens by breathing humid and hot air. Mask utilization based on personal allergen profiles can be considered a preventive measure to minimize exposure of the respiratory system to provocative allergens in high-risk environments. Further research will help to

delineate the contribution of face masks, in addition to common pharmacological and desensitization treatment strategies, in reducing allergic rhinitis symptoms by either direct or indirect pathophysiological mechanisms.

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