



Systematic Review / Meta-analysis

## Contact dermatitis due to personal protective equipment use and hygiene practices during the COVID-19 pandemic: A systematic review of case reports

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### ABSTRACT

**Background:** Prolonged use of personal protective equipment (PPE) may lead to contact dermatitis during the coronavirus disease 19 (COVID-19) pandemic. This paper aims to identify the causative factors of contact dermatitis from PPE and hygiene practices.

**Methods:** The search was conducted adhering to PRISMA 2020 guidelines. A Delphi process was employed to ensure that the aims of this study were met. PubMed and Web of Science databases were systematically searched through September 12, 2021, using search terms: Contact dermatitis, case report, covid-19. The findings were tabulated as author/year, gender, age, presentation, cause, dermatological diagnosis, testing modality, provided treatment, symptom resolution (time in days), prognosis, and follow-up.

**Results:** The mean age of all individuals was 29.75 years, with 75% females. All cases presented with erythema, with 62.5% reporting pruritus and 37.5% reporting burning facial symptoms. Surgical masks and hand-hygiene products (37.5%) were the most commonly reported causative agent with 25% due to KN95/FFP type 2 use. Allergic contact dermatitis (50%) and irritant contact dermatitis (25%) were common diagnoses. Treatments included creams, emollients, and desloratadine, with restriction of irritant-causing factors. The prognosis was generally good among the cases, with 62.5% presenting complete resolution within a week and 12.5% showing moderate improvement at the fourth month after discontinuing use.

**Conclusion:** This study finds pertinent links between PPE use and contact dermatitis during the COVID-19 pandemic. While many cases are bound to go underreported in literature, well-designed, large-scale studies in the future may help promote these associations in a more comprehensive manner.

### 1. Background

Personal protective equipment (PPE), including face masks and hand sanitizers, is essential for safeguarding healthcare workers (HCWs) and general population members [1]. During the coronavirus disease 19 (COVID-19) pandemic, contact dermatitis was reported among HCWs

across various observational studies [2,3], in addition to single-patient reports. While allergic and irritant contact dermatitis is frequent, other skin lesions may occur among individuals [4]. A systematic review identifies that prolonged PPE use may lead to an increased risk of occupational dermatitis, which comprises allergic contact dermatitis (ACD) and irritant contact dermatitis (ICD). Another review identified

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that 80% of cases occurred due to ICD, with non-specific erythema and pressure contact urticaria [5]. The aim of this systematic review is to identify the causes of contact dermatitis due to personal protective equipment use and hygiene practices by synthesizing cases reported in literature.

## 2. Methods

This systematic review was conducted adhering to the PRISMA 2020 statement guidelines [6]. A Delphi process was employed to ensure that the study objectives were met [7]. A thorough systematic search was conducted across articles published in PubMed and Web of Science from December 2019 until September 12, 2021, with search terms (*Contact dermatitis, case report, covid-19*) listed in Table 1. A manual search was conducted across AMA (American Medical Association Journals), BMJ Case reports, ScienceDirect and Wiley.

Of the total 419 articles identified and post-removal of duplicates/tallying exclusion criteria, 15 full-text articles were analyzed. Seven were excluded as they were not case reports; contact dermatitis did not occur due to PPE use or hand hygiene measures. All of the eight articles that met the inclusion criteria were included in the final paper (Fig. 1).

No funding was obtained for this systematic review and the authors perceived no conflicts of interest. This systematic review was registered with research registry unique identifying number (UIN) of “[reviewregistry1270](#)” in addition the overall AMSTAR 2 quality of this systematic review is low [8].

## 3. Results

A total of 8 case reports were included, classified by author/year, gender, age, presentation, cause, dermatological diagnosis, testing modality, provided treatment, symptom resolution (time in days), prognosis, and follow-up findings (Table 2). The mean age across all cases was 29.75 years, ranging from 3 to 64 years. There were 6 (75%) females. The common presentation among all cases was erythema (100%), with 5 (62.5%) patients who reported itching and 3 (37.5%) patients reporting burning facial symptoms. The causative factors were KN95/FFP type 2 masks among 2 (25%) cases, surgical masks for 3 (37.5%) individuals, and hand sanitizers/hand-hygiene indicators for 3 (37.5%) patients. The common diagnosis was ACD (50%), ICD (25%), contact urticaria (12.5%), frictional dermatitis (12.5%) and aquagenic urticaria (12.5%). Various treatments were administered, including creams, emollients, and desloratadine for ACD, with restriction of irritants for ICD. The prognosis was good among all reported cases after the intervention, with 5 (62.5%) resolved within 3–7 days, and no recurrence during the three months follow-up and 1 (12.5%) patient showing improvement at the fourth month for frictional dermatitis (Table 2).

**Table 1**

Search terms employed.

Keywords used:
<b>Contact dermatitis:</b> “dermatitis, contact”[MeSH Terms] OR (“dermatitis”[All Fields] AND “contact”[All Fields]) OR “contact dermatitis”[All Fields] OR (“contact”[All Fields] AND “dermatitis”[All Fields])
<b>Case report:</b> “case reports”[Publication Type] or “case report”[All Fields]
<b>Covid-19:</b> (“COVID-19” OR “COVID-19”[MeSH Terms] OR “COVID-19 Vaccines” OR “COVID-19 Vaccines”[MeSH Terms] OR “COVID-19 serotherapy” OR “COVID-19 serotherapy”[Supplementary Concept] OR “COVID-19 Nucleic Acid Testing” OR “covid-19 nucleic acid testing”[MeSH Terms] OR “COVID-19 Serological Testing” OR “covid-19 serological testing”[MeSH Terms] OR “COVID-19 Testing” OR “covid-19 testing”[MeSH Terms] OR “SARS-CoV-2” OR “sars-cov-2”[MeSH Terms] OR “Severe Acute Respiratory Syndrome Coronavirus 2” OR “NCOV” OR “2019 NCOV” OR (“coronavirus”[MeSH Terms] OR “coronavirus” OR “COV”) AND 2019/11/01 [PDAT]; 3000/12/31[PDAT])

## 4. Discussion

To the best of our knowledge, this is the first systematic review of case reports to collate evidence of dermatitis due to PPE use during the COVID-19 pandemic. The first case of mask-induced ACD due to polyurethane was reported in 2020 that is used in the production of PPE products, including for the sponge strip inside the mask which, may lead to the reaction of diisocyanates causing ACD or precipitate asthma attacks [9]. While polyurethanes are fully cured polymers and are not believed to be sensitizers, the residual cross-linkers are reported to lead to allergic reactions that may be responsible for a myriad of respiratory symptoms, in addition to ACD [9]. The prolonged use of facial masks and skin problems such as ICD is not uncommon, with reports of various facial skin problems during the previous severe acute respiratory syndrome (SARS) epidemic [10]. Formaldehyde is a frequent contact sensitizer or irritant.

Given that patients, healthcare workers, and the general population are required to wear polypropylene surgical masks, more ACD and ICD are likely to occur in and outside the workplace [10]. Furthermore, filtering half masks of the FFP2 classification is one of the most frequently used healthcare PPE items [12]. The FFP2 masks can trigger contact dermatitis, an inflammatory, non-infectious, intolerant skin reaction induced by chemical, immunological or physical toxins [12].

Current literature suggests that the continuous use of surgical masks among healthcare workers and general population members may cause ACD or ICD, contact urticaria, and exacerbation of acne and skin infections [13]. The causal agents in these scenarios may be flavorings, fragrances, preservatives, medications, and disinfectants [13]. During the COVID-19 pandemic, the high prevalence of occupational dermatoses has been noted in a Chinese cohort of healthcare workers where 74% of respondents reported adverse skin reactions due to hand hygiene practices and PPE use [4]. Reports of a new form of irritant rhinitis to FFP masks (FFP2/N95/KN95) during the COVID-19 pandemic are also present [16]. Our findings highlight the broad occupational dermatosis of single patients and create awareness of the impact that common or rare skin conditions like aquagenic urticaria may have on occupational impact [4]. The risks of ICD have been increased mainly due to overzealous hand hygiene with sanitizers, leading to prolonged exposure of physical or chemical agents, as identified in our study results [14]. Such over-rigorous hand hygiene practices may lead to impairment of keratocytes, disruption of the epidermal barrier, the release of pro-inflammatory cytokines, and delayed-type hypersensitivity reactions, due to activation of the skin’s immune system [14]. As opposed to hand sanitizers and gloves, wearing surgical or other masks as a cause of skin lesions and irritation has been less reported during the COVID-19 pandemic [15]. However, N95 (FF2) masks may lead to increased skin reactions due to constant friction and moisture due to the tighter fit and higher impermeability, compared to surgical masks alone [15]. Our study indicates that depigmentation, presenting as contact leukoderma or vitiligo following koebnerization due to frictional dermatitis, maybe a rare consequence of mask usage [15].

There are certain limitations to this systematic review that must be acknowledged. First, the search was limited to two databases (PubMed and Web of Science), impacting the search process. Published literature, including only case reports, was considered. The results of this study may not be fully generalizable but represent a noteworthy overview in the area of contact dermatitis related to PPE use and COVID-19, serving as a cautionary reminder to health authorities that safety for populations must be a top priority.

## 5. Conclusion

This systematic review describes the links of PPE use and contact dermatitis during the COVID-19 pandemic among eight cases. Given that healthcare workers and the general public must wear face masks and practice hand hygiene more often than before, such incidences of

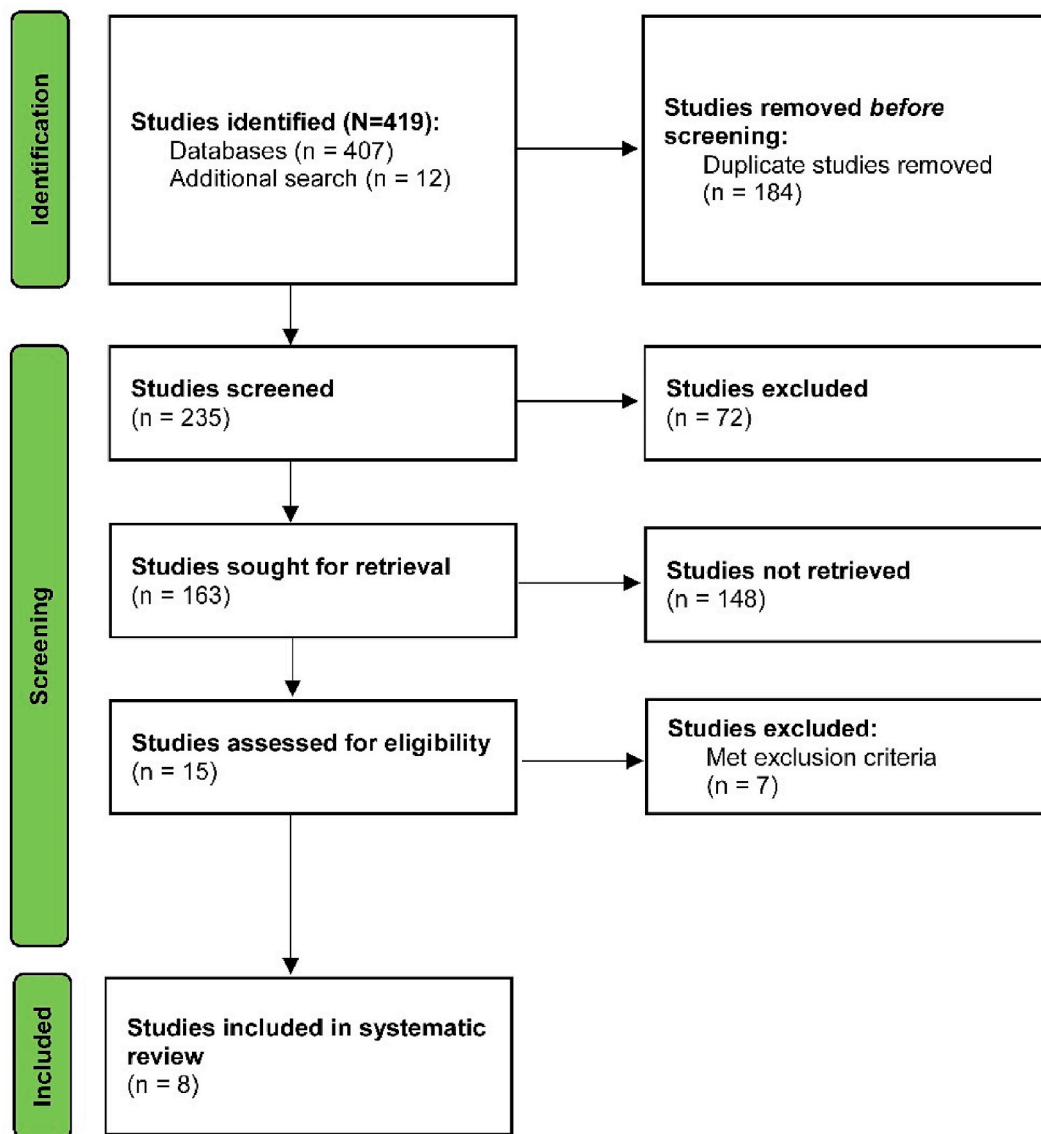


Fig. 1. PRISMA flowchart.

contact dermatitis are not uncommon. Well-designed, higher-powered studies are required in this area to ensure that a better understanding of PPE, hand hygiene, and contact dermatitis is seen. More comprehension of the reasons for such dermatological reactions ought to be made by mitigating unawareness of irritant PPE materials using awareness-increasing platforms. With diligent hand disinfection reinforced during COVID-19, the increased prevalence of contact dermatitis is documented, however, our systematic review highlights the notion that the condition is readily treatable and ought not to cause any deviation from proper hand hygiene and PPE use.

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**Author contribution**

All authors have contributed equally to the conception, data collection, analysis and review of the paper.

**Registration of research studies**

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 Hyperlink to your specific registration (must be publicly accessible and will be checked): <https://www.researchregistry.com/browse-the-registry#registryofsystematicreviewsmeta-analyses/registryofsystematicreviewsmeta-analysesdetails/61b655cacffdee001e881aef/>.

**Table 2**  
Characteristics of included case reports.

Author, Year	Gender	Age	Presentation	Causative factor(s)	Diagnosis	Testing	Treatment	Symptom resolution (time in days)	Prognosis	Follow-up
Xie et al., 2020 [9]	Female	23	Facial symmetrical erythema; Itching	KN95	Mask-induced allergic contact dermatitis (ACD)	On D4, positive patch test reactions to TDI 2.0% pet. MDA 0.5% pet, and HDI 0.1% pet	Oral desloratadine	3	Resolution	No recurrence at 3 months follow-up
Aerts et al., 2020 [10]	Female	38	Burning facial and Periocular erythema; Itching	Polypropylene surgical mask	Occupational airborne allergic contact dermatitis	Positive patch test to formaldehyde 2% aq. on day 4	NR	NR	NR	NR
O'Connell et al., 2020 [11]	Male	64	Erythematous, eczematous patches; Itching	Hand-washing with standard dish soap	Irritant contact dermatitis	NR	OTC products; Cream; Emollients	5	Resolution	NR
Klimek et al., 2020 [12]	Female	41	Reddened, oozing, and later flaky skin rashes; Itchy	FFP2 mask type	Mask-induced allergic contact dermatitis (ACD)	NR	NR	NR	NR	NR
Corazza et al., 2021 [13]	Female	7	Intermittent, erythematous rash, and facial swelling; Itchy	Polypropylene surgical mask	Contact urticaria	Negative patch test results; positive provocation test and a positive stop-restart test	No treatment	NR	Resolution	NR
Alves et al., 2021 [4]	Female	22	Pruriginous vesicular erythema	Rubber domestic gloves and latex gloves, and various PPE	Aquagenic urticaria (AU) and Mask-induced allergic contact dermatitis (ACD)	Positive water provocation test (histamine – 5 mm; diluent – 0 mm); Positive patch test [day (D)4, positive reactions were observed to 2-mercaptobenzothiazole (MBT) (+++) and 1% cobalt chloride (+)]	Topical emollients and corticosteroids, and Ebastine 20 mg twice daily for urticaria	NR	Resolution	NR
Panda et al., 2021 [14]	Male	3	Palmar erythema	Alcohol-based hand sanitizer	Irritant contact dermatitis (ICD)	None conducted	No treatment; restriction of hand sanitizer user	7	Resolution	Complete remittance at one-week follow-up
Sinha et al., 2021 [15]	Female	40	Confluent depigmentation, skin lesions; Burning facial sensations	Surgical masks	Frictional dermatitis	Patch tests on day (D)2 and D4, the semi-open tests with the mask pieces were left in situ for 96 h and read on D4 and D5,	Tacrolimus daily	84	Improvement	After 12 weeks, the depigmented macules showed significant re-pigmentation

## Guarantor

Ivan Cherrez-Ojeda and Zouina Sarfraz are co-guarantors of the study.

## Declaration of competing interest

None declared.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.amsu.2022.103254>.

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