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The prevalence and characterstics of cutaneous changes attributed to personal protective measures and equipments used against COVID 19: A multi centre,cross sectional study.

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Abstract
Background: *As a result of the COVID -19 pandemic, health care personnel from all around the world have joined the fight against this highly contagious disease.The development of specific cutaneous symptoms in health care professionals has been linked to frequent hand hygiene procedures and long term use of personal protective gear (N95 masks,goggles,face shields and double layer of gloves).*
Objectives: *To estimate the prevalence, characterstics and risk factors that led to the development of cutaneous manifestations from personal protective measures and devices.*
Methodology:*A cross sectional multi centered online survey was conducted for a duration of 2 months to assess cutaneous symptoms among health care personnel combating COVID -19.The questionnaire was filled out and submitted by the participants voluntarily.Demographic data ,daily PPE wear time,number of times hand hygiene was performed ,site and types of cutaneous manifestation ,etc. were included in the questionnaire.*
Result: *215 HCWs participated in the study out of which 107 (49.8 %) reported an onset of new skin lesions. The study was found significant ($p<0.05$),wherein the duration of wearing PPE kits was > 6 hours. The maximum number of participants reported desquamation of palms (49.5%),followed by nasal bridge hyperpigmentation (39.2%).165 participants using two layer of mask reported facial complaints like nasal bridge hyperpigmentation (22.42%) ,33.4 % developed acne, 28.1 % reported erythema over face. The study was found insignificant over the criteria of age and duration of working in their respective COVID departments.*
Conclusion: *In this study, nearly half of the HCWs developed cutaneous symptoms. As a result, HCWs must be educated on the best methods for preventing skin damage caused by PPE and frequent hand washing.*
Keywords: *Cutaneous manifestation, Personal protective equipments and measures, COVID 19*

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I. Introduction

In December of 2019, a novel coronavirus was discovered in Wuhan ,Hubei Province, China and it quickly swept across the country, gaining international attention (1).The SARS CoV-2 being a highly contagious virus, had spread rapidly over the world , prompting the World Heath Organisation to declare it a pandemic in March of 2020(2). The severe acute respiratory syndrome coronavirus 2 (SARS-C0V-2) was discovered to transmit by respiratory droplets and contact pathways.(3)

Personal protection equipments (PPE) refers to the items that are designed to protect the user from any physical,chemical or biological variables that they may come into contact with at work, hence preventing or reducing unintentional accidents and occupational hazards. Use of PPE has got global attention during COVID - 19 related global public health emergency which started in India when the first case was reported in January 2020 (4) and a second wave that began in middle of March 2021 ,with the highest number of cases in april (5). Healthcare personnel are at a higher risk of infection than the general public because they are exposed to highly contagious droplet nuclei and body fluids, with the danger increasing with the onset of highly infectious epidemics such as Ebola virus infections and SARS.As a result, personal protective equipment (PPE) kits are required for contact precautions and to limit the risk of transmission when treating such patients (6). PPEs are items that protect the mouth ,nose, eyes,ears ,exposed skin and susceptible portions of the body,such as the head and hands ,from extremely infectious and sometimes lethal secretions from patients.

Long term usage of personal protection equipment can create major skin problems due to long term friction,sealing and pressure,as well as physical strain (dehydration,heat and weariness).The skin changes,damage and skin related other adverse effects of PPE in health care workers reduced their working morale and made them anxious .To enhance the morale and productivity of healthcare workers ,constant vigilance regarding infection control and follow up rehabilitative measures are very essential.(7,8,9).It is necessary to conduct effective monitoring of the negative effects caused by PPE kits and personal protective equipments ,as well as to take appropriate preventive actions. The goal of this research is to explore the characteristics of skin damage produced by personal protective equipment and measures.

II. Materials And Methods

Research Design and Participants: To record the prevalence of adverse effects of using personal protective measures and equipments, a quantitative descriptive design was used, targeting the front line workers involved in the providing care to COVID-19 patients. These HCWs worked in different cadres like COVID wards, isolation wards, Intensive care units,Fever clinics etc. These workers were enquired about the number of hours for which PPE kits were worn, the preference and frequency of practising hand hygiene measures, duration and the type of cutaneous lesion present.

Instrument and Data Collection Procedure: The study was conducted during the month of April-May when the whole India was fighting through the second wave of COVID-19 virus.

A cross sectional multicentered survey was conducted through an online form generated through google forms interrogating the study participants regarding the demographics ,the number of hours for which PPE kits were worn ,the preference and frequency of practising hand hygiene measures,duration and type of adverse cutaneous reactions present after practising such measures. The questionnaire was formulated and structured by health care professionals and researchers ,after going through available literature.

The participants were informed about the purpose of the study and prior consent was taken before data collection was started.

Data Assessment : Statistical analysis of the data was done using SPSS Software version 24 and Chi square test was used for analysis of categorical data,with a p value < 0.05 accepted to be significant.

III. Results

This study included a total of 215 HCWs who were dedicated to the treatment of SARSCoV-2 virus infected patients. 146 HCWs (68.3%) were between the ages of 20 and 29,followed by 59 HCWs between the ages of 30-39 (27.4%).The start of cutaneous lesions was reported by 61 % of those between the ages of 30 and 39.

Table 1 Demonstrates the frequency ofcutaneous changes present in different age groups

AGE	FREQUENCY	PERCENTAGE	Skin damage present	Skin damage absent
20-29	146	68.3%	65	81
30-39	59	27.4%	36	23
40-49	6	0.03%	2	4
>50	4	0.01%	1	3

NS ($p>0.05$)

There were 118 HCWs (54.9%) who were females and 97 HCWs (45.1%) who were males. There were 110 doctors (51.2%) , 56 nurses(26%), 37 sanitation workers (17.2 %), and others (0.6%) among them.70 HCWs worked in covid wards (32.6%), 48 (22.3%) in intensive care units , 38 (17.7 %) in isolation wards, and 31 (14.4%) in fever clinics. After working in their designated department 107 people (49.8 %) reported new skin damage.11 HCWs had a history of chronic skin disease such as atopic dermatitis,hand eczema, and allergic dermatitis ,with 7 (63.6 %) reporting an aggravation in the lesions.

151 HCWs reported using both alcohol –based sanitizer and soap to practise hand hygiene ,with 90 (59.6 %) using it more than 10 times per day. Amongst them, 27 % reported desquamation of palms and 13.9 % reported fissuring . There were 16 responses from HCWs who only used soap and 48 responses from HCWs who only used alcohol-based sanitizer .

Hand hygiene preferred	Frequency	Desquamation	Fissure
Both(sanitizer and soap)	151	41(27%)	21(13.9%)
Sanitizer	48	10(20.8%)	3(6.2%)
Soap	16	2(12%)	1(6.2%)

Table2 : Displays the frequency of preferred hand hygiene preferred by HCWs and reported desquamation and fissuring experienced by them

Face shields were used by 80 (37.2 %) of HCWs to prevent droplets from entering their face.59.1 % reported using two layers of gloves.Out of 107 HCWs who reported newly onset lesions ,44 (41.12 %) did not consult a dermatologist,and 32 (29.9 %) reported that their lesions resolved spontaneously.122 (56.7 %) HCWs reported wearing PPE kits for more than 6 hours per day ,with 68 participants reporting the onset of skin lesions ,whose results were found to be significant.

Table 3: Demonstrates the frequency and percentage of skin damage present in relation with the duration of wearing PPE

Duration of wearing PPE	Frequency	Percentage	SKIN DAMAGE PRESENT	SKIN DAMAGE ABSENT
<6 hrs	93	66%	38	55
>=6 hrs	122	34%	68	54

S($p<0.05$) p value-0.03

Desquamation of hands was reported by a majority of 53 participants (49.5 %),followed by 42 (39.2 %) nasal bridge hyperpigmentation, acne in 34 patients (31.7 %), erythema and fissuring of palms by 25 (23.3 %), 8 HCWs reported milaria (7.4%).Papules were reported by 6 HCWs (5.6 %).Erosion, macerartion and vesicles were reported by 1 HCW (1.1%).

Table 4: Demonstrates the frequency and percentage of different types of skin lesion experienced by HCWs while using personal protective equipments and measures.

TYPE OF SKIN LESION	FREQUENCY	PERCENTAGE
DESQUAMATION(PEELING)	53	49.5%
NASAL BRIDGE HYPERPIGMENTATION	42	39.2%
ACNE	34	31.7%
FISSURE	25	23.3%
ERYTHEMA	25	23.3%
MILARIA	8	7.4%
PAPULES	6	5.6%
MACERATION	1	1%
EROSION	1	1%
VESICLES	1	1%

76.7 % reported using two layer of masks ,where 22.42 % reported nasal bridge hyperpigmentation ,16.97 % developed acne and 12.12 % reported erythema over face.

Skin lesion	1 layer of mask	2 layer of mask	>2 layer of mask
Acne	4 (12.12%)	28 (16.97%)	2(11.7%)
Erythema	2 (6.0%)	20(12.12%)	3(17%)
Papules	1(3.03%)	3	2(11.7%)
Nasal bridge hyperpigmentation	2(6.0%)	37(22.42%)	3(17%)

Table 5: illustrates the different types and frequency of skin lesions present while wearing a single,double and multi layer masks

IV. Discussion

The World Health Organization (WHO) developed guidelines for personal protective equipment (PPE) for health care workers (HCWs) treating and caring for COVID 19 patients which included droplet and contact precautions (10).The COVID -19 disease has caused 60.26 million infections and 1.42 million deaths since its debut.(11)

The use of personal protective equipment (PPE) and other protective measures against the new coronavirus infection caused skin injury in 49.8 % of HCWs in this investigation. According to a survey conducted by Yan et al. 71 % of HCWs experienced skin injury as a result of personal protective measures used to avoid infection with the COVID 19 virus (12). Lan et al. found that HCWs who were PPE for more than 6 hours had a higher risk of skin injury in the affected areas than those who wore it for less time(13).According to Singh et al. HCWs with PPE-related skin injury spent an average of roughly 8.76 hours per day in PPE.(14) As a result, a standard guideline should be stated ,in order to reduce the amount of time spent by HCWs ,hence lowering the development of their skin lesions. In our study,41 out of 151 HCWs who used both soap and sanitizer as their preferred hand hygiene approach experienced palm desquamation. A total of 90 participants (out of a total of 151) reported using hand hygiene measures more than 10 time per day ,with 36 of them developing desquamation of palms. According to a similar study conducted by Ibler et al,52 % of medical staff

with hand eczema wash their hands more than 10 times per day.(15) Guerler et al. observed similar findings stating that frequency of hand washing increased significantly from 5-10 times/day to 10-20 times/day among the HCWs in their study before and after the pandemic(16).Long term disinfectant usage also affects the skin microbiome and immunological milieu, resulting in eczema ,fungal infection, bacterial infection and allergic dermatitis.(17) Hands should be washed with lukewarm water and properly dried ,according to Van der Meel et al.(18). Instead of alkaline detergents ,weak acidic or neutral detergents should be used and barrier lotions should be applied often.(12)

Nasal bridge hyperpigmentation was the second most common type of skin rash in this study seen in 39.2 % HCWs ,followed by acne, occurring over the area by N95 mask. A study by Singh et al. on PPE induced facial dermatoses in HCWs found that facial acne was present in 11.63% of patients.(14) Acne was seen in 59.6 % of HCWs wearing N95 masks in a survey by Foo et al.(19) The N95 mask is often worn against the face in a tight fitting manner. Acne can develop as a result of moisture accumulating under the mask which encourages bacterial growth and occlusion of the pilosebaceous duct due to pressure at the contact point (12).

Excessive perspiration with PPE use was noted by 64.5 % of HCWs in a research by Yan et al. (12).Sweat dermatitis was seen in 16.28 % of HCWs with skin injury due to PPE in a research conducted by Singh et al.(12) After a single five hour use, Campbell et al. reported two cases of HCWs with localised midface milaria caused by a filtering facepiece mask.(18) Face masks and PPE gowns promote increased sweating and its accumulation under the PPE when worn for an extended period of time, predisposing to skin barrier breakdown and subsequent infection. Milaria was reported by 8 subjects in our study who used the PPE kit.

V. LIMITATIONS

We were unable to document and verify the adverse effects reported by the PPE and personal protective measures because the findings were based on a self –assessed questionnaire .Since there were more than one exposure factors that could lead to the noted skin reactions, the intensity, pattern or specific source of these adverse effects could not be determined .The sample size of the study was limited ,and it was done only among a few cadres of healthcare workers ,so additional cadres of employees with different duties and responsibilities than the study participants should be considered.

VI. Conclusion

In conclusion,during the COVID-19 pandemic ,widespread increased PPE use and handwashing has elevated the risk of a range of cutaneous injuries or aggravation of prior skin disorders.These can have measurable consequences for HCWs and their adherence to the CDC and WHO ‘s PPE recommendations. The literature frequency describes these injuries. Even unintentional mask manipulation and alteration could put you at danger of over exposure .If the protective cutaneous layers are damaged ,transmission may be increased. To reduce future cutaneous injury and improve overall compliance ,its vital to understand individual skin harm based on PPE type ,assosciated dermatologic diseases, and subsequent treatment and advice.

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