



# Impelling Factors for Contracting COVID-19 Among Surgical Professionals During the Pandemic: A Multinational Cohort Study

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## Abstract

**Background:** Medical workers, including surgical professionals working in coronavirus disease 2019 (COVID-19) treating hospitals, were under enormous stress during the pandemic. This global study investigated factors endowing COVID-19 amongst surgical professionals and students.

**Methods:** This global cross-sectional survey was made live on February 18, 2021 and closed for analysis on March 13, 2021. It was freely shared on social and scientific media platforms and was sent via email groups and circulated through a personal network of authors. Chi-square test for independence, and binary logistic regression analysis

were carried out on determining predictors of surgical professionals contracting COVID-19.

**Results:** This survey captured the response of 520 surgical professionals from 66 countries. Of the professionals, 92.5% (481/520) reported practising in hospitals managing COVID-19 patients. More than one-fourth (25.6%) of the respondents (133/520) reported suffering from COVID-19 which was more frequent in surgical professionals practising in public sector healthcare institutions ( $P = 0.001$ ). Thirty-seven percent of those who reported never contracting COVID-19 (139/376) reported being still asked to practice self-isolation and wear a shield without the diagnosis ( $P = 0.001$ ). Of those who did not contract COVID-19, 75.7% (283/376) were vaccinated ( $P < 0.001$ ). Surgical professionals undergoing practice in the private sector (odds ratio (OR): 0.33; 95% confidence interval (CI): 0.14 - 0.77;  $P = 0.011$ ) and receiving two doses of vaccine (OR: 0.55; 95% CI: 0.32 - 0.95;  $P = 0.031$ ) were identified to enjoy decreased odds of contracting COVID-19. Only 6.9% of those who reported not contracting COVID-19 (26/376) were calculated to have the highest “overall composite level of harm” score ( $P < 0.001$ ).

**Conclusions:** High prevalence of respondents got COVID-19, which was more frequent in participants working in public sector hospitals. Those who reported contracting COVID-19 were calculated to have the highest level of harm score. Self-isolation or shield, getting two doses of vaccines decreases the odds of contracting COVID-19.

**Keywords:** COVID-19; Surgical professionals; Medical students; Multinational; Burnout

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## Introduction

The coronavirus disease 2019 (COVID-19) pandemic has posed immense challenges to various health systems and governments over the last 2 years. For many healthcare professionals (HCPs), elective and emergency surgery delivery remained imposing. According to a study published by the International Journal of Infectious Diseases from 37 countries, 570,000 HCPs contracted the virus, and 2,500 died [1]. In the United

Kingdom (UK) in the early months of 2021, nearly 52,000 HCPs were off sick due to COVID-19, and between March and December 2020, 850 healthcare workers are estimated to have died; almost 3,000 healthcare workers have succumbed to the infection in the United States around the same time [2].

However, the circumstances of confronting COVID-19 at work are variable and impact surgical services and personal life. While most surgical professionals follow established surgical principles globally, their attributes are not similar, including place of work, associated infrastructure and teams, and availability of personal protective equipment (PPE) [3].

In this global study, we have appraised various factors associated with contracting COVID-19 and their implications among surgical professionals, including medical students. The study’s primary aim was to determine the association between age, gender, place of work, and redeployment outside the usual place of work with contracting COVID-19; the secondary aim was to study its association with the level of harm experienced by surgical professionals.

## Materials and Methods

### Survey

A questionnaire-based survey in the English language was designed by The Upper Gastrointestinal Surgeons - Global Level of Harm Steering Committee, formed by 12 international surgical faculties (Supplementary Material 1, www.jocmr.org). It followed good practice in conducting and reporting survey research, recommended by the EQUATOR network guidelines [4]. The survey was developed and circulated via Google Forms® and Survey Monkey®. It was made live on February 18, 2021, and closed for analysis on March 13, 2021. It was freely shared on all social and scientific media platforms on WhatsApp®, Facebook®, Twitter®, LinkedIn®, etc. It was also sent via email groups and circulated through authors’ networks.

### Ethics

We used the NHS Health Research Authority online decision tool to detect the need for ethical approval [5]. Participants in this survey were invited to a collaborative authorship model. They consented for their names to be used in relevant documents and for the data collected to be analyzed and used for publications. The decision was such that this survey does not require NHS REC (research ethics committee) approval. The study was conducted in compliance with the ethical standards of the responsible institution on human subjects as well as with the Helsinki Declaration.

### Level of harm score

We adapted the overall composite level of harm score (OCLHS) which has four levels of harm (LH), ranging from 1 (LH1, no harm) to 4 (LH4, severe harm).

**Table 1.** Basic Demographics, Roles, and Specialties

| Variables                         | No. (%)    |
|-----------------------------------|------------|
| <b>Sex</b>                        |            |
| Male                              | 415 (79.8) |
| Female                            | 105 (20.2) |
| <b>Age</b>                        |            |
| < 35                              | 183 (35.2) |
| 35 - 50                           | 275 (52.9) |
| > 50                              | 62 (11.9)  |
| <b>Role</b>                       |            |
| Consultant/equivalent             | 298 (57.3) |
| Senior trainee/equivalent         | 170 (32.7) |
| Junior trainee/equivalent         | 37 (7.1)   |
| Allied health professional        | 12 (2.3)   |
| <b>Scope of practice</b>          |            |
| Public sector                     | 329 (63.3) |
| Private sector                    | 74 (14.2)  |
| Both                              | 117 (22.5) |
| <b>Subspecialty</b>               |            |
| General/upper GI/lower GI surgery | 439 (84.4) |
| Trauma and orthopedics            | 14 (2.7)   |
| Breast surgery                    | 13 (2.5)   |
| Cardiothoracic surgery            | 7 (1.3)    |
| Others                            | 47 (9.03)  |

GI: gastrointestinal.

### Statistical analysis

By adopting SPSS (v.26), descriptive characteristics were explored via frequencies and ratios. Since all of our variables were categorical in their character, the Chi-squared test was employed with a two-sided P-value < 0.05 regarded as statistically significant. By adopting those variables that exhibited respective P < 0.05 on the Chi-square test for independence, binary logistic regression analysis was carried out to determine predictors of contracting COVID-19 amongst surgical professionals.

## Results

### General

As much as 88.1% of the respondents (458/520) were aged less than 50 years with the majority (63.3%) (329/520) reporting practising in the public sector. General surgery professionals constituted as much as 84.4% of the respondents (439/520) with 89.6% (466/520) taking on-call emergency duties (Table 1).

As much as 92.5% of respondents (481/520) reported practising in hospitals that were managing COVID-19 patients

**Table 2.** Relationship of Vaccination Status With Contraction of COVID-19

| COVID-19 status | Vaccination status   |
|-----------------|--|
| Negative        | Negative: 88/131 (67.2%); Single dose: 137/188 (72.9%); Double dose: 148/189 (78.3%) |
| Positive        | Negative: 42/131 (32.1%); Single dose: 48/188 (25.5%); Double dose: 39/189 (20.6%)   |

Asymptotic significance (two-sided) "P" for Pearson Chi-square  $P < 0.001$ . COVID-19: coronavirus disease 2019.

and 46.9% (244/520) reported being redeployed into areas outside their usual scope of practice with 42.3% (220/520) befalling to self-isolation without symptomatic COVID-19 and/or COVID-19 confirmation as per local protocols.

### Gender and age

More than one-fourth (25.6%) of the respondents (133/520) reported suffering from COVID-19. Gender ( $P = 0.239$ ) and age ( $P = 0.708$ ) exhibited statistically insignificant relation.

### Scope of practice and redeployment outside scope of work

As much as 61.7% of those who reported not contracting COVID-19 (232/376) were consultants ( $P = 0.025$ ) with 68.4% of those who reported contracting COVID-19 (91/133) indicated practising in the public sector ( $P = 0.001$ ). Of those who reported not contracting COVID-19, 56.9% (214/376) had not been redeployed outside their scope of work ( $P = 0.004$ ).

There was no statistically significant relation between contracting COVID-19 and either practising in a hospital admitting COVID-19 patients ( $P = 0.92$ ) or being assigned on-call duties ( $P = 0.905$ ).

Of those who reported being diagnosed with COVID-19, 30.8% (41/133) were practising in the UK, while only 28.5% of the total respondents (148/520) denoted the UK as their country of practice: a sample positivity ratio of 41/148 (27.7%) ( $P = 0.86$ ). Surgical professionals not redeployed outside their respective scope of work had a statistically significant probability of not contracting COVID-19 with 77.5% of those not redeployed outside the scope of work (214/276) not diagnosed with COVID-19 ( $P = 0.004$ ). As much as 85.1% of those practising in the private sector (63/74) reported not being diagnosed with COVID-19 during the pandemic ( $P = 0.001$ ).

### Self-isolation or shield without COVID-19 diagnosis

Around 37% of those who did not contract COVID-19 (139/376) reported being asked to practise self-isolation and wear a shield without the diagnosis. In contrast, as much as 44% of those who later came out to contract COVID-19 (59/133) were never asked to self-isolate or wore a shield before confirming their diagnosis ( $P = 0.001$ ).

### Vaccination

Of those who did not contract COVID-19, 75% (285/377) were

vaccinated against severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) ( $P < 0.001$ ) with 36.2% of respondents (188/520) receiving only one dose, whereas 36.3% (189/520) received two doses (Table 2).

### Predictors of surgical professionals contracting COVID-19

Surgical professionals practising only in the private sector are less susceptible to contracting COVID-19 (OR: 0.33; 95% CI: 0.14 - 0.77;  $P = 0.011$ ). Getting two doses of vaccines also decreases the odds of contracting COVID-19 (OR: 0.55; 95% CI: 0.32 - 0.95;  $P = 0.031$ ) (Table 3).

### Physical health and level of harm

A total of 75.2% of professionals who contracted COVID-19 (100/133) reported changes in their physical health. Amongst those who did not contract COVID-19, only 6.9% (26/376) experienced a change in their physical health requiring an absence from work of more than 2 weeks, with a consequent impact on the services ( $P < 0.001$ ). Only 6.9% of those who reported not contracting COVID-19 (26/376) were calculated to have the highest OCLHS ( $P < 0.001$ ).

### Discussion

The COVID-19 pandemic took everybody by surprise with the novelty and mutating ability of the causative agent equipping it to be elusive to a definitive antiviral treatment [6], the depth and breadth of the negative effect of the subsequent lockdown [7] and the psychological burden instituted on humans throughout the planet [8, 9], surgical professionals being no exception [10-12]. With the understanding that surgical professionals would be prone to psychological burnout and enhanced associated harm due to the pandemic secondary to a plethora of perceived reasons including but certainly not limited to increased working hours predisposing to burnout, increased associated morbidity and mortality precipitating psychological trauma, the pressure of family members secondary to either them contracting the disease or suggesting containment of one's exposure towards COVID-19 patients triggering depression and second-guessing among the surgical professionals, the TUGS "level of harm" collaborative group pursued delineating a global snapshot of psychological burnout and the associated physical harm being conceived by surgical professionals practising throughout the world. In this study, we aimed to determine those factors which predisposed a surgical professional to contract COVID-19 with

**Table 3.** Odds of Surgical Professionals Contracting COVID-19

| Parameters   | OR   | 95% CI      | P-value |
|--|------|-------------|---------|
| Professional role  |      |             |         |
| Consultant   | 0.34 | 0.27 - 4.38 | 0.409   |
| Non-consultant   | 0.58 | 0.04 - 7.46 | 0.675   |
| Scope of practice  |      |             |         |
| Public sector (ref.)                                       |      |             |         |
| Both private and public                                    | 1.12 | 0.71 - 2.0  | 0.494   |
| Private sector   | 0.33 | 0.14 - 0.77 | 0.011*  |
| Redeployment outside the scope of work                     |      |             |         |
| Yes (ref.)   |      |             |         |
| No   | 1.09 | 0.47 - 1.09 | 0.116   |
| Asked to self-isolate or shield without COVID-19 diagnosis |      |             |         |
| Yes (ref.)   |      |             |         |
| No   | 0.48 | 0.32 - 0.73 | 0.001*  |
| Vaccination against SARS-CoV-2                             |      |             |         |
| No (ref.)  |      |             |         |
| One dose   | 0.74 | 0.44 - 1.25 | 0.256   |
| Two doses  | 0.55 | 0.32 - 0.95 | 0.031*  |

\*P < 0.05. CI: confidence interval; COVID-19: coronavirus disease 2019; OR: odds ratio; SARS-CoV-2: severe acute respiratory syndrome coronavirus 2.

the understanding that if such predictors are identified, the global scientific community can take steps to protect the precious workforce and productivity from being affected by this enervating global healthcare catastrophe.

Gender and age came out to exhibit statistically insignificant relations with contraction of COVID-19 recognizing the equivalent buoyancy of female surgical professionals as well as those who are young. However, Sobotka et al [13], recognizing working women to be more predisposed to catching COVID-19, and Mukherjee et al [14], acknowledging men to be more predisposed to worsened prognosis, attempt to lay down a counter-narrative on a general level *vis-a-vis* the association of gender. Omori et al, by undertaking a rigorous convoluted mathematical modeling approach, uncovered differences in the propensity to acquire COVID-19 but those differences did not predispose the patients to worsened outcomes [15].

It is our understanding that consultants, secondary to their limited and controlled exposure to COVID-19 positive patients when compared to those experienced by residents and other surgical professionals, are more protected from contracting COVID-19. We were unable to come across any such studies where the respective association has been explored and thus undertaking larger and more robust cross-sectional surveys is suggested to further explore the effect of surgical professional level on the odds of contracting COVID-19.

The same hypothesis is maintained when we assess the increased predisposition of surgical professionals practising in the public sector to contract COVID-19 when compared with those practising in the private sector (OR: 0.33 (95% CI: 0.14 - 0.77), P = 0.011). One can simply not deny the simple enhanced risk of contraction which comes with greater exposure [16]. Greater

availability of protective resources and a stricter adherence to guidelines in the private sector are also suggested to be among the underlying causes, Symvoulakis et al being able to conclude a statistically significant adherence to COVID-19 recommendations and practices among private sector physicians [17].

The protective effect of anti-SARS-CoV-2 vaccination is recognized as an axiom [18-20], the principle held its ground when it was assessed in the light of surgical professionals, too, in our study. Although, interestingly, the statistically significant relation does not hold true for those who received only a single dose (OR: 0.74 (95% CI: 0.44 - 1.25), P = 0.256), those surgical professionals who received two doses of anti-SARS-CoV-2 vaccination enjoyed a considerable protection from contracting COVID-19. Ebinger et al concluded that the protection awarded by a single dose of anti-SARS-CoV-2 vaccine to a patient who has previously recovered from COVID-19 is equivalent to that awarded by a couple of doses to such a person who has never contracted COVID-19 [21]. Chadeau-Hyam et al via their exploration underscored the significant protection offered by boosters [22]. After recognizing that we did not ask for previous COVID-19 infections, larger and more comprehensive multi-center explorations are suggested to be pursued so as to further traverse the intricate associations between previous COVID-19 infection(s), inoculation of boosters and the risk of contracting symptomatic COVID-19, specifically among surgical professionals.

Further analysis uncovered a statistically insignificant relation of COVID-19 positivity status with professional fulfillment. One can hypothesize, therefore, that despite the associated psychological effect which invariably comes along with the COVID-19 positivity, surgical professionals, via their globally recognized second-to-none perseverance [23], do withstand the

pressure and continue to pursue their professional goals as well as keep on tending to the patients. That being indicated, a significant effect on the physical health of those surgical professionals who contract COVID-19 was revealed with an impact on the surgical work as well as a predisposition of increased OCLHS. OCLHS is developed as a scale which combines the outcome of psychological burnout, inferred from the Stanford professional fulfillment index [24], and the self-reported physical level of harm score [25]. This finding, we believe, should prompt the global scientific community to join hands in taking steps to create a safe, comforting environment for healthcare workers in general and surgical professionals in specific with an emphasis on identifying those surgical professionals who are most prone to experiencing deterioration in their physical health if COVID-19 is contracted, state-of-the-art automated machine learning predictive modeling would be most helpful in this regard, so that timely interventions may be carried out so as to minimize the potential worsening effect on the physical health. Gupta et al developed an Extra Tree Classifier algorithmic model that predicted burnout among healthcare workers with an accuracy of 84% [26]. Almayyan explored several datasets so as to develop machine learning predictive models for burnout among frontline workers and obtained accuracies ranging from 92.8% to as high as 98% [27].

We recognize several limitations to this study. Essentially, being a cross-sectional survey, the study is inherently unable to develop a causative temporal relationship between variables. What if a surgical professional having a higher OCLHS is more prone to contracting COVID-19 and independently less privileged to receive two doses of anti-SARS-CoV-2 vaccination? Such intricate correlations essentially warrant deeper and more robust research explorations. We were unable to receive responses from surgical professionals practising in the middle east, north and south Americas as well as Australasia. Studies being carried out by surgical research groups from these respective areas are suggested with their findings compared with our exploration. Moreover, with nurses rationally recognized to be exposed to significant psychological stress during a pandemic, we recognize that their response should have been explored, too. That being indicated, our research exploration is, to the best of our knowledge, the very first attempt to elucidate those predictors which predispose surgical professionals to contracting COVID-19. We were also able to explore the relations of those predictors with the OCLHS.

As a future directive, we aim to pursue the current state-of-the-art for automated machine learning to develop algorithmic models that predict psychological burnout and OCLHS among surgical professionals with a considerably high validity and accuracy. Such predictive models would go a long way in timely detecting and effecting intervening so as to significantly curtail the devastating psychological effect of a global healthcare catastrophe on the exceptionally significant surgical workforce.

## Conclusions

High prevalence of respondents got COVID-19, which was more frequent in participants working in public sector hospitals. Those who reported contracting COVID-19 were calculated to have the highest level of harm score. Self-isolation or shield, getting two doses of vaccines decreases the odds of contracting COVID-19.

## Supplementary Material

**Suppl 1.** Questionnaire survey.

**Suppl 2.** GLOHASP collaborative authorship.

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We are grateful to all participants from 66 countries for taking part in this global survey, who are all collaborative authors included in Supplementary Material 2 ([www.jocmr.org](http://www.jocmr.org)). The respective abstract was presented at the 2022 International Surgical Congress of the Association of Surgeons of Great Britain & Ireland (ASGBI).

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## Conflict of Interest

The authors declare that they have no conflict of interest.

## Informed Consent

Informed consent has been obtained.

## Author Contributions

Wah Yang and Ali Haider Bangash: conception and design, analysis and interpretation, data collection, writing the article and critical revision of the article; Johnn Henry Herrera Kok, Chandra Cheruvu, Chetan Parmar, Arda Isik, Michail Galanis and Francesco Di Maggio: conception and design, data collection, writing the article and critical revision of the article; Mohamed Abouelazayem and Samik Kumar Bandyopadhyay: conception and design, data collection; Yirupaiahgari K.S. Viswanath: conception and design, data collection, writing and critical revision of the article.

## Data Availability

Any inquiries regarding supporting data availability of this study should be directed to the corresponding author.

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