

# Investigation of Surgical Smoke Exposure and Well-Being Levels of Operating Room Workers in the COVID-19 Pandemic

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## Abstract

This study was conducted to determine operating room workers' thoughts and personal well-being levels about surgical smoke exposure during the COVID-19 Pandemic. This descriptive study was conducted between May-June 2022. The research was completed with 82 operating room employees in a public hospital in Istanbul. Research data were collected using a questionnaire about sociodemographic characteristics, surgical smoke, and the Personal Well-Being Scale. Descriptive statistics were used in the analysis of the data. 89% of the individuals included in the study thought they were exposed to surgical smoke. Individuals exposed to surgical smoke; had a headache (45.1), cough (11%), burning in the throat (31.7%), eye irritation (56.1%), tearing (34.1) and respiratory problems (20.7%). Employees use surgical masks (74.4%), aspiration catheters (59.8%), gowns (74.4%), goggles (74.4%), filters (35.4), and filtration masks (6.1) to protect themselves from surgical smoke. In addition, it was determined that they wanted to receive education about surgical smoke (93.9%). It was determined that the mean score of the Personal Well-Being Scale was  $\bar{X} = 41.76$ . In the pandemic process, it has been determined that the measures taken to prevent surgical smoke in operating rooms are insufficient, the employees experience many symptoms, and their well-being is low. Efforts should be made to reduce and possibly eliminate fumes from the operating room. Cost-effective forms of smoke extraction need to be investigated. There is also a need for studies on the sequelae of exposure to operating room smoke in personnel who have been exposed to operating room smoke for a long time.

**Keywords:** Operating room, COVID-19, Pandemic, Surgical smoke

## INTRODUCTION

Operating rooms are equipped with high-tech equipment, and many surgical techniques and methods are used, where these happen as a team effort. However, operating rooms use vehicle supplies, and fast and risky procedures may risk patient and employee health [1-3]. One of these risks is surgical smoke [3, 4]. Cautery smoke, plume, aerosol, bioaerosol, and surgical air smoke, are defined by various names such as pollutants, and energy-based devices used in operating rooms (electrocautery, laser, ultrasonic tools, high fast drills, testress). During the use of high heat, burning protein and other organic matter and surrounding tissue in tissues as a result of necrosis in cells occurs when fat and protein are broken down and evaporated. is working on [1, 2, 5, 6]. 95% of odorous and visible surgical smoke is water; but the remaining 5% consists of dead and living cellular material, blood fragments, viruses, bacteria and toxic gas [6-10]. Bacteria in surgical smoke and viruses can live for up to 72 hours and can travel up to 1 meter away from the study area as the particle size increases [9, 11]. Surgical smoke is mutagenic and carcinogenic, although smelly, causing various health problems for patients and operating room staff taste [1, 3, 7]. In the operating room, workers who are exposed to components emitted by surgical smoke for a long time;

headache, dizziness, nausea, vomiting, cough, sneezing, burning in the throat, eye irritation and tearing, odor in the hair, difficulty in breathing, hypoxia, airway inflammation, weakness, weakness, conjunctivitis, dermatitis, myalgia, cramps, anemia, rhinitis, asthma, anxiety and hepatitis as health problems are seen [2, 3, 9, 11].

The pandemic of Coronavirus disease 2019 (COVID-19), caused by Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), is affecting our global healthcare system. SAR-CoV-2 is mainly spread through respiratory droplets

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(particles larger than 5 µm) produced by coughing and sneezing [12-16]. Still, another potential mode of transmission as aerosols (those smaller than 5 µm) cannot be ruled out [17]. SARS-CoV-2 has been identified not only in the respiratory system but also in the gastrointestinal tract, blood, and peritoneal fluid of COVID-19 patients [18, 19]. Therefore, potentially infectious surgical smoke can be generated during operations and pose health risks to surgical personnel [19]. There is currently no evidence that COVID-19 is transmitted through surgical smoke, however, it has not been finalized [20]. Surgical smoke damaging effects for years to be known despite evidence from the perioperative team and its members. Generally, this effect right. It shows that they don't know about it and do not comply with the smoke evacuation guidelines [7, 21]. This situation, due to the Pandemic, of course, affects the personal well-being of health workers and nurses. Personal well-being is a term that describes how an individual feels about his or her life. At the same time, it includes the emotional reactions of individuals, their satisfaction with their living spaces, and the subjective evaluation of the quality of life in general [22]. Because nurses who work one-on-one with patients with COVID-19 recently worked with these patients, and the risk of being infected is uncertain, a study that determines their well-being in this period could not be reached.

This research was conducted to determine the opinions and personal well-being levels of doctors, nurses and health technicians working in the operating room of a public hospital about exposure to surgical smoke during the COVID-19 pandemic.

## MATERIALS AND METHODS

This research, one in Istanbul public the hospital from November 2021 to January 2022, descriptively has been made. The universe of the research is the operating room of the relevant hospital. Health employees (doctors, nurses, and health technicians) created a sample to your choice without going the universe to the whole to be reached studied. In the operating room total of 102 (38 doctors, 45 nurses, 19 health technicians) health workersexist. Individuals with a research permit or report a total of 82 healthcare professionals who agreed to participate in the study had completed.

### Research Data

The risks, symptoms, and risks of surgical smoke were prepared in line with the relevant literature on protection data collection form using a questionnaire by the method collected [5, 9, 22]. The data collection form collects the identifying information of individuals including questions (age, gender, job, education status, working year, operating room type), information about surgical smoke, experienced symptoms, and studied measures taken for surgical smoke reinforcement in the unit consisting of questions.

### Personal Well-Being Index-Adult (KIOI-Y) Form

International Wellbeing Group and which is one of the most widely used scales in the field of positive psychology, the psychometric properties of the Personal Well-Being Index Adult (KIOI-Y) form were examined by Meral (2014) on an adult sample in Turkey [22]. It is a thematic and 11-point Likert-type (0-10) measurement tool that aims to measure subjective well-being over the satisfaction levels of individuals in eight living areas by the structure of the concept. The lowest score that can be obtained from the 11-point Likert-type scale (0: Not satisfied at all - 5: Undecided - 10: Completely satisfied) without reverse coded items is 0, and the highest score is 80. The score obtained from the scale corresponds to the average of eight sub-domains, and the increase in score corresponds to the increase in the perception of personal well-being. Filling out data forms took 5-7 minutes. For the research to be implemented, the study included a Nearby Foundation University Ethics committee approval from Scientific Research Ethics Committee (Date: 22.08.2022, Decision: 2022/34) units and health workers. Written permission was obtained. The statistical Package for Social Sciences (SPSS) 25.0 program was used in hand-made data. Data analysis, such as mean, percentage, frequency descriptive statistics, and (The Independent samples) "t" test used.

## RESULTS AND DISCUSSION

To research includes made health of its employee's age averaged  $37.01 \pm 15.21$ . Of individuals, 67.1% of women, 50 % of nurses, and 62.2% of graduates to education owners, 52.2% of them have worked in the operating room for 16 years or more and determined (Table 1).

**Table 1.** Health of its employee's introductory properties (n=82)

Feature	Variable	Number (n)	(%)
Gender	Woman	24	(35.8)
	Male	43	(64.2)
Age	20-30	15	(18.3)
	31-40	35	(42.7)
	41-50	28	(34.1)
	51 and above	4	(4.9)
Job	Doctor	23	(37.3)
	Nurse	41	(31.3)
	Health technician	18	(31.3)
Education Status	High School - Associate license	6	(7.3)
	License	25	(30.5)
	graduate	51	(62.2)
In the operating room Study year	0-5 years	18	(22)
	6-10 years	8	(9.8)
	10-15 years	18	(22)
	16 years and above	38	(46.3)
Total		82	(one hundred)

Views of healthcare professionals on surgical smoke during the COVID-19 Pandemic distribution are given in **Table 2**. 64.6% of individuals who underwent surgery while knowing smoke, and 91.5% of surgical smoke did not receive any training on surgical smoke relating to any article. They stated that they did not read, and 89% of healthcare workers think that they are exposed to surgical smoke. Surgical from the smoke be protected 70.7% for prevention 31.7% of them found that the measures they took were inadequate. 37.2% of the employees stated that there was no equipment for smoke evacuation in the COVID-19 Pandemic operating room, and 58.5% of them stated that no additional precautions were taken during the pandemic period. 43.9% were not sure of the existence of any protocol for surgical smoke in the hospital. It was stated that 79.3% of the health workers did not receive any training on surgical smoke in the hospital, and 93.9% of the workers did not receive training on this subject. The signs and symptoms that occur in healthcare workers exposed to surgical smoke are shown in **Table 3**. Headache (45.1), cough (11%), burning in the throat (31.7%), eye irritation (56.1%), tearing (34.1) and respiratory problems (20.7%) in workers have been found to live.

**Table 2.** Health of its employees surgical into the smoke-oriented opinions (n=82)

Opinions		Number (n)	(%)
COVID-19 Pandemic in the process of surgical smoke about Do you have any information?	Yes	(53)	(64.6)
	Sure I am not	(3)	(3.7)
	No	(26)	(31.7)
COVID-19 Pandemic in the process of surgical smoke about education you received, is it?	Yes	(7)	(8.5)
	No	(75)	(91.5)
COVID-19 Pandemic in the process surgical smoke about scientific article did you read	Yes	(24)	(29.3)
	No	(58)	(70.7)
COVID-19 Pandemic in the process of surgical into smoke-exposed that you stay think are you	Yes	(73)	(89)
	No	(9)	(11th)
COVID-19 Pandemic in the process of surgical into the smoke-exposed stay your frequency what it is?	No time	(9)	(11th)
	Sometimes	(28)	(34.2)
	Stylish stylish	(45)	(54.8)
COVID-19 Pandemic in the process of surgical from the smoke to be protected oriented precaution taking are you	Yes	(58)	(70.7)
	No	(24)	(29.3)
COVID-19 Pandemic in the process of surgical smoke for you receive of the measures sufficient is thinks are you	Yes	(25)	(30.5)
	Sure I am not	(31)	(37.8)
	No	(26)	(31.7)
COVID-19 Pandemic in the process in the operating room	Yes	(15)	(18.3)
	Sure I am not	(22)	(26.8)

smoke evacuation device there is, is it?	No	(45)	(54.9)
	Yes	(17)	(20.7)
COVID-19 Pandemic in the process of hospital smoke evacuation. Is there a protocol?	Sure I am not	(36)	(43.9)
	No	(29)	(35.4)
COVID-19 Pandemic in the process at hospital surgical smoke about education is given.	Yes	(13)	(15.9)
	Sure I am not	(4)	(4.9)
Surgical smoke about education receive whether...or are you	No	(65)	(79.3)
	Yes	(77)	(93.9)
	No	(15)	(6.1)

As a result of the evaluation of the research data, the mean score of the Personal Well-Being Index total score of the health workers was  $\bar{X} = 41.76 \pm 5.60$ , and it was at a low level. (7.12±1) were found to be satisfied (**Table 3**).

**Table 3.** Signs and symptoms of healthcare workers exposed to surgical smoke (n=82)

Symptom and Results	Number (n)	(%)
Top pain	(37)	(45.1)
Nausea	(12)	(14.6)
in the throat combustion	(26)	(31.7)
Cough	(9)	(11th)
Eyelash irritation	(46)	(56.1)
Eyelash to live	(28)	(34.1)
Respiratory problems	(17)	(20.7)
Sneeze	(2)	(2.4)
Irritability	(10)	(12.2)
Top turning	(11th)	(16.4)
Vomiting	(11th)	(16.4)
Weather way inflammation	(12)	(14.6)
Weakness	(9)	(11th)
hypoxia	(2)	(2.4)
Conjunctivitis	(10)	(12.2)
rhinitis	(10)	(12.2)
Asthma	(10)	(12.2)
Your wife pain	(2)	(2.4)
Anemia	(2)	(2.4)
nasopharyngeal lesion	(2)	(2.4)
Dermatitis	(3)	(3.6)

\* Suddenly, more choices marked

Surgical masks (74.4%), aspiration catheters (59.8%), gowns (74.4%) and goggles (74.4%), filters (23.2), filtration masks (6.1), and they wanted to be educated about surgical smoke (93.9%) (**Table 4**).

**Table 4.** Protection of healthcare workers from surgical smoke oriented they received measures (n=67)

Measures	Number	%
Surgical mask	61	74.4
Aspiration catheter	49	59.8
Apron	61	74.4
Glasses	61	74.4
Filter	19	23.2
Filtration mask	5	6.1

\*Suddenly, more choices marked

**Table 5.** Personal Well-Being Scale Mean Scores, Internal Consistency Coefficients (n=82)

Personal Well-Being Index Items			Cronbach Alpha
	$\bar{X}$	SD	
How satisfied are you with your living conditions?	2.79	1.51	.78
How satisfied are you with your health status?	5.68	2.01	
How satisfied are you with your achievements in life?	7.41	1.30	
How satisfied are you with your relationships with other people?	7.12	1.16	
How safe do you feel?	2.79	1.51	
How satisfied are you with your relations with society and being a part of society?	4.42	1.26	
How confident do you feel about your future?	4.42	1.26	
How satisfied are you with your spiritual life (religious, spiritual life, etc.)?	7.09	1.00	
<b>Personal Well-Being Scale Total Score Average</b>	41.76	5.60	

p &lt; 0.05

It was found that there was no statistically significant relationship between the mean scores of the personal well-being of healthcare workers and exposure to surgical smoke during the pandemic, taking precautions to prevent surgical smoke, thinking that the measures taken were sufficient, and the presence of a smoke evacuation device in the operating room ( $p > 0.05$ ) (Table 5).

Concern about the presence of live elements in surgical smoke and the subsequent risk of contamination to surgical personnel was expressed in several articles published in the 1980s. These living particles are viruses, bacteria, fungi, and living body cells (the more significant concern is live tumor cells). The COVID-19 Pandemic has rekindled these concerns about the presence of the COVID-19 virus and the possibility of transmission to surgical personnel during coagulation devices. So far, there have been no reports of the presence of the COVID-19 virus in surgical smoke, and the contagious potential, if found, is unknown [23].

The increasing usage of developing technology also increased the risk of exposure to surgical smoke in those working in the operating room [8, 10, 21]. When the studies in the literature are examined, it has been stated that the ventilation of the operating rooms and the use of surgical masks are not sufficient and ineffective in preventing exposure to surgical smoke [24, 25]. Although the long-term effects of exposure to surgical smoke are not fully known, it is stated that operating room workers are at higher risk for occupational diseases than other workers due to the harmful substances in the smoke [4, 26].

In our research, operating room employees, doctors, nurses, and health technicians stated that they experienced symptoms related to surgical smoke. These symptoms are headache (45.1%), cough (11%), burning in the throat (31.7%), eye irritation (56.1%), tearing (34.1%), and respiratory problems (20.7%). Our research results are meaningful and consistent with the studies in the literature [14, 15, 24, 26, 27]. Based on these results, it can be said that health workers experience at least one symptom.

In a study, health workers surgical from the smoke were protected by 70.7% for prevention 31.7% of them found that the measures were insufficient. 37.2% of the employees stated that there was no equipment for smoke evacuation in the COVID-19 Pandemic operating room, 58.5% of them stated that no additional precautions were taken during the pandemic period, and 43.9% were not sure of the existence of any protocol for surgical smoke in the hospital. It was stated that 79.3% of the health workers did not receive any training on surgical smoke in the hospital, and 93.9% of the workers did not receive training on this subject. Wanted to be determined. When the studies in the literature are examined, It is recommended to minimize exposure to prevent the harmful effects of surgical smoke, use an effective smoke evacuation system, take necessary precautions to prevent inhalation of smoke, and provide training for operating room personnel in this regard [6, 28].

As a result of the research, it was determined that the employees were provided with a surgical mask (74.4%), aspiration catheter (59.8%), apron (74.4%), and goggles (74.4%), filter (23.2%), filtration mask (6.1) and they wanted to be educated about surgical smoke (93.9%). It was observed that they were not sure about the adequacy of the precautions while taking precautions to prevent surgical smoke. In the studies in the literature, the most for protection from surgical smoke, it is recommended to use personal protective equipment such as masks, gowns, and glasses [4, 6, 29]. It was observed that studies used protective equipment such as surgical masks, gloves, surgical gowns, and glasses at similar rates to protect against surgical smoke [2, 5, 21]. Surgical masks are the most standard equipment used to protect against microorganisms and aerosol body fluids during the procedure. However, it is known that surgical masks do not protect against surgical smoke since the particle size in surgical smoke is smaller than 0.1  $\mu\text{m}$ .

For this reason, masks with high filtration properties are used to prevent the passage of particles below 0.1 µm and to protect against airborne infectious agents [1, 27, 30]. In addition, the ventilation of operating rooms is not sufficient to prevent the side effects of surgical smoke. For this reason, high filtration masks and a surgical smoke evacuation system are recommended to protect from surgical smoke. In addition, surgical team members should wear personal protective equipment such as glasses and gowns [6, 21].

## CONCLUSION

Surgical fumes endanger employee safety in operating rooms with a risky working environment. Raising awareness on this issue is important in terms of protection. Awareness about protection from surgical smoke is as important in terms of institutional as it is for operating room workers. It is recommended to organize trainings on the subject for protection from surgical smoke, to take necessary precautions for institutions to have smoke evacuation systems, to determine surgical smoke protocols and written instructions, to use protective equipment appropriately, to make all these arrangements by institutions and to transfer and control them to employees through repeated trainings.

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