

# Assessment and Impact of the Risk of Exposure of Portuguese Biomedical Scientists in the Context of COVID-19: An Exploratory Study

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**Abstract:** The purpose of this study was to assess Biomedical Scientists' risk of COVID-19 exposure and stress appraisals concerning contact with infected patients. The 233 participants (76.4% females) completed online versions of the WHO's Risk Assessment and Management of Exposure Survey and the Stress Appraisal Measure. Participants worked mainly in outpatient settings (45%), and in emergency services (28%). 22.9% of participants were exposed to COVID-19 via the community vector, and 39% through occupational exposure. Although 94.9% reported using personal protective equipment, 83.6% were at high risk of infection. Participants reported moderate perceptions of stress and threat, but also moderate perceptions of control over the situation.

**Keywords:** risk exposure; stress appraisal; biomedical scientist; COVID-19.

## 1. Introduction

Pandemic transmission of coronavirus disease (COVID-19) due to severe respiratory syndrome coronavirus 2 (SARS-CoV-2) is a new and emerging public health concern. Data strongly suggest that the transmission of this virus from person to person is more frequent during close contact with an infected person [1], particularly in the early stages of unsuspected infections, when viral loads tend to be high [2]. Health professionals are in the frontline in the fight against this pandemic, hence, they have one of the highest risks of being infected [3] and, in such case, they may introduce or amplify outbreaks in their health units and in the community [4]. In Portugal, it is estimated that 11% of health professionals have developed COVID-19 in their workplace [5].

Frontline health professionals need their risk of exposure in a professional context thoroughly assessed to prevent the transmission of the disease [6]. According to the Centers for Disease Control and Prevention (CDC) [7], a healthcare professional is at high risk of exposure to the COVID-19 virus, when (i) has had close contact with a person infected by the virus in the community; (ii) provided direct support to a patient with COVID-19 (e.g., during a physical examination, performing aerosol-generating procedures, sample collection, radiological examinations) without the use of adequate personal protective equipment (PPE) or without the proper execution of hand hygiene after these interactions; (iii) contacted the infected secretions of a COVID-19 patient or a contaminated patient care environment, without the use of adequate PPE or without proper hand hygiene. Biomedical scientists are particularly prone to risk, given the close prox-

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imity to the virus and disease due to the need for specimen collection and analysis. Thus, a survey of their risk of exposure and its impact can support a set of recommendations for the prevention and control of infection by the new Coronavirus, avoiding the spread of this scourge and increasing the availability of these professionals, as key players in providing health care.

The risk exposure in a professional context is a stressful situation that can affect the health and well-being of biomedical scientists. According to Lazarus [8], stress is a process that emerges as a consequence of the individual's interpretations of the situation; these are called cognitive appraisals. These appraisals refer to the extent to which the situation is central to our wellbeing and whether important personal goals are at stake (primary appraisals) and the extent to which we have the necessary resources to cope with the situation (secondary appraisals). Hence, it is vital to identify these cognitions as they may influence the perception of stress and motivate the development of an adaptive set of emotions and behaviors.

Therefore, the purpose of the present study is to assess (i) the risk of biomedical scientists' exposure after close contact with patients infected with the COVID-19 in a professional context and (ii) the perceptions these professionals. Concerning the latter, it is hypothesized that participants with high risk of exposure will have significantly higher stress appraisals and lower control appraisals over the situation.

## 2. Materials and Methods

This cross-sectional study was conducted among biomedical scientists who work in Portuguese health institutions, public or private, with the potential for direct or indirect exposure to patients or their secretions and biological material contaminated by the SARS-CoV-2. Ethical approval was obtained from the Ethics Board of Lisbon School of Health Technology, Polytechnic Institute of Lisbon.

A convenience sampling procedure was used. An adequate number of participants was determined with a sample size calculator for prevalence survey [9]. For a maximum error of 2% in the estimation of the risk of exposure to COVID-19, with a confidence interval of 95%, 142 participants were needed. The prevalence was estimated based on the number of Biomedical Scientists infected with COVID-19 and registered with the Direção-Geral de Saúde (DGS), the Directorate-General for Health (07 to 13 May 2020), representing about 1.5% of the 7000 biomedical scientists working in health institutions in the country [10]. A total of 233 Portuguese biomedical scientists (76.4% females) were recruited through social networks and professional associations. Data were collected via a self-administration on-line questionnaire, which included the WHO's Risk Assessment and Management of Exposure Survey [11] and the Stress Appraisal Measure (SAM) [12].

### 2.1. Instruments for Data Collection

#### 2.1.1. WHO's Risk Assessment and Management of Exposure Survey [11]

*Community exposure to COVID-19:* Biomedical scientists were considered community exposure to COVID-19 if the participant responded "yes" to having a history of staying in the same household or classroom environment with a confirmed COVID-19 patient or having a history of traveling together in close proximity (within one meter) with a confirmed COVID-19 patient in any kind of conveyance.

*Occupational exposure to COVID-19:* Exposure to COVID-19 was assessed by a "yes" response to performing any of the following activities on a COVID-19 patient: providing direct care to a COVID-19 patient, performed/present when aerosol-generating procedures were performed on COVID-19 patients and had direct contact with the environment where confirmed COVID-19 patient was cared for.

*Risk categorization of healthcare workers exposed to the COVID-19.* Biomedical scientists exposed to the COVID-19 were further categorized as "high risk for COVID-19 virus infection" and "low risk of COVID-19 virus infection." Biomedical scientists were con-

sidered *high risk for COVID-19 infection* if the participant did not respond “always, as recommended” during healthcare interaction with a confirmed COVID-19 patient to any of the following IPC measures: wearing of single-use gloves, medical masks, face shield or goggles/protective glasses, disposable gown, removing and replacing PPE according to protocol, performing hand hygiene (before and after touching a COVID-19 patient, before and after any clean or aseptic procedure, after exposure to body fluids, after touching patient surroundings) and decontaminating high touch surfaces at least 3 times daily.

It also included if a healthcare worker did not respond “always, as recommended” during aerosol-generating procedures (AGPs) on COVID-19 patient to any of the following IPC measures: wearing of single-use gloves, N95 mask (or equivalent operator), face shield or goggles/protective glasses, disposable gown, waterproof apron, removing and replacing PPE according to protocol, performing hand hygiene (before and after touching a COVID-19 patient, before and after any clean or aseptic procedure, after exposure to body fluids, after touching patient surroundings), decontaminating high touch surfaces at least 3 times daily, whether the healthcare worker had any type of accident with body fluid/respiratory secretions of a COVID-19 patient. Any other response by the HCW was considered low risk to COVID-19.

#### 2.1.2. Stress Appraisal Measure (SAM) [12]

SAM consists of 28 items that represent the participants' thinking in relation to a specific situation, in this case, working in a context of exposure to COVID-19. It measures three primary cognitive appraisals (threat, challenge and centrality) and three secondary appraisals (control-by-same, control-by-others and uncontrollability). Answers are given in 5-point Likert scales (1 = not at all, 2 = slightly, 3 = moderately, 4 = considerably, 5 = extremely). In this study all scales demonstrated appropriate internal consistency, with  $\alpha$ -Cronbach values ranging from .72 to .86, exception for challenge which had a  $\alpha$ -Cronbach of .57.

#### 2.2. Data Analysis

Descriptive statistics were calculated for all variables. Absolute and relative frequencies were used for categorical variables. Exposure to COVID-19 virus and risk of COVID-19 infection were calculated according WHO's Risk Assessment and Management of Exposure Survey indications. Means and standard deviations were computed for cognitive appraisal variables. Independent *t*-tests were used to compare these variables in participants with high and low risk of infection.

### 3. Results

Participants worked in a range of workplaces mainly in outpatient settings (45%) and in emergency services (28%), but sometimes in more than one organizational structure (Figure 1).

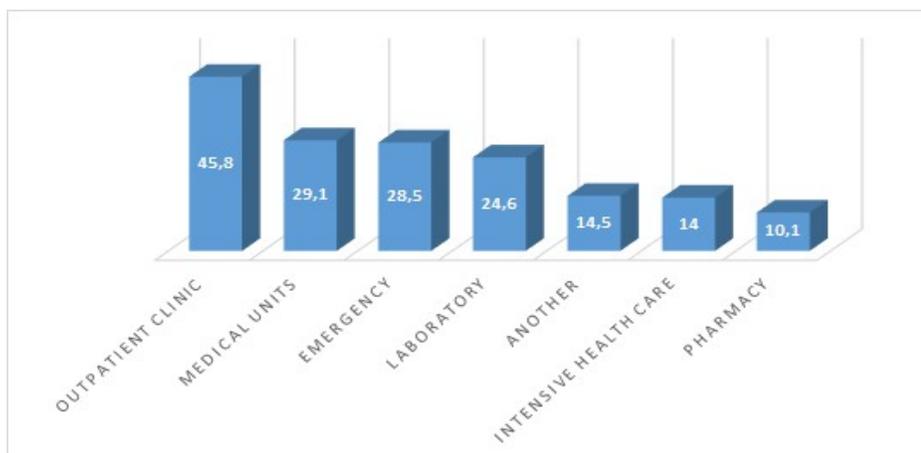


Figure 1. Workplaces of the participants.

The most represented professions among respondents were biomedical scientists in radiology (28.5%), clinical analysis (26.3%), cardio pneumology (12.3%) and pharmacy (10.1%) (Figure 2).

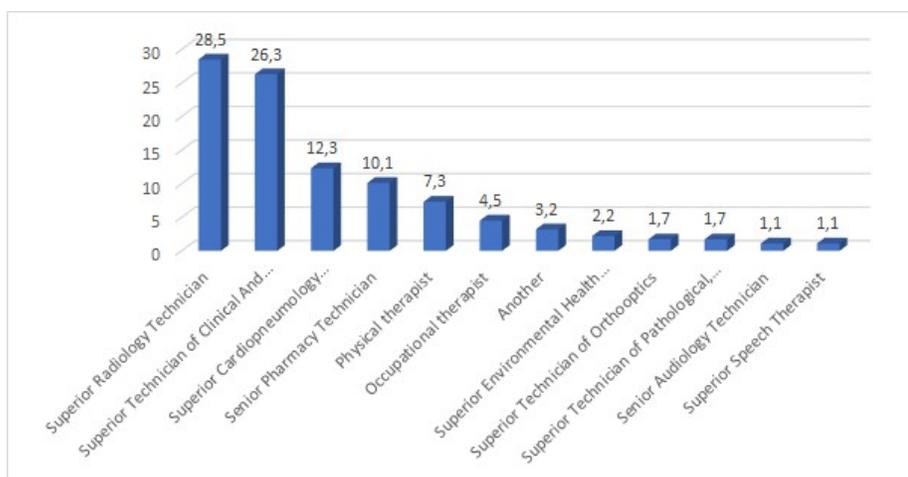
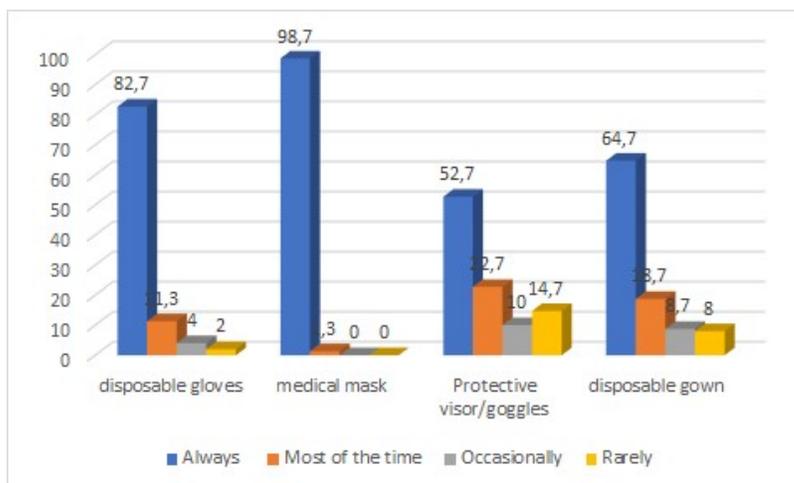


Figure 2. Biomedical scientists' profession.

Concerning exposure, 22.9% of participants reported community exposure to COVID-19, while 39% were exposed in a professional context. Half of the respondents directly provided some health care to a confirmed patient with COVID-19. The majority of the participants reported using personal protective equipment (PPE) while providing health care or diagnostic and therapeutic tests to a COVID-19 patient (Figure 3).



**Figure 3.** Frequency of use of PPE by biomedical scientists.

According to the exposure risk categorization to COVID-19, 83.6% of the respondents were classified “high risk” and 16.4% as “low risk.

Concerning cognitive appraisals, responses were all in the moderate range, with mean scores varying between  $2.94 \pm 0.88$  for Challenge and  $3.63 \pm 0.68$  for Controllable-by-self. There were no significant differences in cognitive appraisals between high risk and low risk of exposure participants (Table 1). In addition, perceptions of stress were significantly associated with threat appraisals ( $r = .74, p < .01$ ) and centrality ( $r = .74, p < .01$ ) and uncontrollability ( $r = .49, p < .01$ ).

**Table 1.** Cognitive appraisals and stress perceptions (means and standard deviations) of biomedical scientists as a function of risk exposure to patients with COVID-19.

Variables	Risk			t-value	p-value
	All	Low (n = 23)	High (n = 115)		
Threat	3.10 (0.88)	3.01 (1.01)	3.12 (0.86)	-0.58	.59
Challenge	2.94 (0.88)	3.14 (0.99)	2.90 (0.86)	1.20	.23
Centrality	3.31 (0.91)	3.29 (1.11)	3.32 (0.88)	-0.12	.90
Uncontrollability	2.69 (0.82)	2.80 (0.91)	2.67 (0.80)	0.65	.52
Controllable-by-others	3.02 (0.93)	3.20 (0.84)	2.98 (0.94)	1.02	.31
Controllable-by-self	3.63 (0.68)	3.73 (0.62)	3.60 (0.69)	0.80	.42
Stress	3.40 (0.81)	3.41 (0.78)	3.39 (0.82)	0.10	.92

#### 4. Discussion

Results suggest that biomedical scientists have high risk of exposure to COVID-19 infection, either through direct contact with patients infected with COVID-19 or while handling biological substances. These results are similar to those presented by Ashinyo et al. [13] who estimated an occupational risk of 80.4%. Yet, these results also unveil a complex and textured reality. In fact, the risk of exposure may differ according to variables such as the specificities of the workplace (e.g., pharmacy, clinic, hospital intensive care unit). This could either hamper or promote certain types of tasks and procedures, resulting in distinct exposure to risk. Notwithstanding the overwhelming majority of the surveyed biomedical scientists facing high occupational risk, the respondents’ cognitive appraisals suggest moderate perceptions of stress and threat, but also moderate perceptions of control over the situation. These moderate appraisals are likely to be the psychological outcome of an increasing level of protection provided by PPE-related measures in place during data collection. The unpredictable and contingent nature of the

COVID-19 pandemic, however, may foster in the participants a sense of lack of control over the situation. This pattern of results highlights the intricacies of the concept of risk as a multidimensional outcome of objective conditions and subjective appreciations [14-15]. Surprisingly, cognitive appraisals did not significantly differ between participants with high or low risk of exposure. Exposure and inadequate or non-use of PPE have been associated with increased infection risk [16]. However, the unequal samples sizes of subgroups are a limitation.

## 5. Conclusions

The vast majority of Biomedical Scientists is at high risk of occupational exposure. However, perceptions of stress and threat are moderate, possibly filtered by a general sense of safety. In fact, the risk can be reduced by consistent and appropriate use of PPE, which is reported by the majority of the health professionals for disposable gloves and medical masks. Recommendations for protection rules must reinforce concrete measures of support and working conditions offered by healthcare organizations alongside the adoption of a policy encouraging the development of personal agency.

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