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Impact of COVID-19 pandemic on radiographers in the Republic of Cyprus. A questionnaire survey

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ABSTRACT

Introduction: Imaging is essential for the initial diagnosis and monitoring of the novel coronavirus, which emerged in Wuhan, China. This study aims to assess the insight of radiographers on how the COVID-19 pandemic has affected their work routine and if protective measures are applied.
Method: A prospective observational study was conducted among radiographers registered in the Cyprus Society of Registered Radiologic Technologists & Radiation Therapy Technologists. A questionnaire composed of 28 multiple choice questions was utilised, and the data analysis was performed using SPSS software with the statistical significance assumed as p-value < 0.05.
Results: Out of 350 registered radiographers, 101 responses were received. The results showed that there are statistically significant differences regarding the working hours, the feeling of stress, the work effectiveness, the average examination time, the presence of a protocol used among the different workplaces of the participants; a private radiology centre, a private hospital or a public hospital, with a p-value 0.0022, 0.015, 0.027, 0.001, 0.0001 respectively. Also, statistically significant differences were observed in the decontamination methods used for equipment (p-value 0.007), for air (p-value 0.04) and when decontamination takes place (p-value 0.00032) among the different workplaces of the participants. Nonetheless, the majority of radiographers believe that their workplace is sufficiently provided with PPE, cleaning supplies, equipment, and with cleaning personnel and are optimistic regarding the adequacy of these provisions in the next three months.
Conclusion: This study showed that in the Republic of Cyprus, there are protocols regarding protective measures against COVID-19, and the radiographers are adequately trained on how to face an infectious disease outbreak. However, work is needed in order to develop protocols that reassure the safety of patients and medical personnel while managing the excess workload effectively.
Implications for practice: This study indicates the importance of applying protective measures and protocols in the radiology departments in order to minimise the spread of the virus.
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Introduction

Coronaviruses are positive-sense, single-stranded enveloped viruses.[1,2] They are widely dispersed among humans and other animals causing a variety of diseases which can affect the respiratory, the gastrointestinal and the nervous system.[1,2] It is known that there are six coronavirus species which are responsible for human disease; four of them (OC43–CoV, NL63-CoV, HKU1–CoV, 229E-CoV) affect the respiratory system mildly causing symptoms of the common cold in people who do not have any deficiency in their immune system or any underlying disease.[3,4] On the other hand, the other two species (SARS-CoV and MERS-CoV) cause Severe Acute Respiratory Syndrome (SARS) and Middle East Respiratory Syndrome (MERS), respectively, and both of them have been connected with a fatal illness in many cases.[3,5] Since coronaviruses are broadly distributed, their genetic material is constantly evolving due to recombination events, and they are also frequently transmitted between different species (e.g. in human–animal interactions), the emergence of new coronaviruses in a periodic pattern is bound to happen.[5–7]

In Wuhan, China, in December 2019, a cluster of patients presented with symptoms of severe pneumonia of unknown aetiology;

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high fever and respiratory discomfort were among the prevalent symptoms.[3,8,9] This outbreak of pneumonia was caused by the novel coronavirus disease (COVID-19) according to a study conducted by Zhu et al. in 2019.[10] Since human-to-human transmission of the new coronavirus was possible,[10–12] it was spread at alarming rates globally leading the World Health Organization (WHO) to declare the COVID-19 as a pandemic. As of June 30, 2020, there were more than 9,900,000 confirmed cases and 498,000 deaths in 216 countries, areas and territories around the world.[13]

Imaging techniques, and especially Computed Tomography (CT), play a crucial role in early diagnosis and evaluation of the severity and progression of COVID-19.[3,14–17] Studies have demonstrated that some of the imaging findings may be similar to those of other viral and bacterial types of pneumonia and that the acute clinical manifestations and the tracing of patient's previous contacts which will contribute to the final diagnosis.[3,18,19] However, the utilisation of imaging modalities will remain critical to the initial diagnosis and management of COVID-19. Thus, radiographers are professionals who are expected to be in the front line of a clinical setting which could be infected with the new coronavirus strain.[3]

Although there are studies investigating the importance of imaging during the COVID-19 pandemic, there is not any study conducted, at the time of writing, to evaluate the impact of COVID-19 on radiographers. This work aims to assess radiographers' opinion on the effect the COVID-19 pandemic had on their daily work life. It also aimed to assess whether appropriate protective measures are used, in order to minimise the possibility of new infections and consequently, the spread of the virus.

Methods

Study setting and sample

A prospective observational study was performed among radiographers in Cyprus through the Cyprus Society of Registered Radiologic Technologists & Radiation Therapy Technologists. More specifically, the survey asked the participants to identify how and if the pandemic affected their work and what measures were taken to protect themselves from the virus. The study was conducted between May 12, 2020, and May 23, 2020, and included the study group, which were 350 radiography specialists. The participants' responses and views were based on their personal experiences and observations during the COVID-19 pandemic lockdown that was enforced in the Republic of Cyprus, during March, April, and May 2020, since radiographers are front line, healthcare professionals.

Questionnaire

The questionnaire was designed in congruence with recent studies,[3,20,21] and with a relevant online survey of imaging and oncology professionals conducted by the British Institute of Radiology.[22] The questionnaire was designed to capture the opinion of radiographers about the outcomes the COVID-19 pandemic had on their work routine. It also assessed whether they believe that there are adequate protective measures in their workplace. The questionnaire was designed utilising the online application Google Forms, and the specific questions were selected with the guidance of experts in the field to ensure accuracy and validity.

The questionnaire consisted of twenty-eight questions in total, divided into two sections. The first section included seven multiple-choice questions regarding the demographic features of the participants. It included namely gender, age, level of education, the place they were working on during the pandemic lockdown (i.e. oncology, observational or interventional radiotherapy), the occupational license they possess, and years of clinical experience. In the second section, participants had to answer twenty-one questions regarding their experiences and observations during the COVID-19 pandemic lockdown. This section was focused on evaluating three key issues; (i) how did the COVID-19 pandemic affect the work of radiographers, (ii) if a specific protocol was implemented and what COVID-19 personal protective equipment (PPE) was used and (iii) what sort of training and disinfection methodology was used to tackle the spread of COVID-19 in the workplace. Out of these twenty-one questions, nineteen were multiple-choice questions, and two questions had the form of checkboxes so that participants were able to submit more than one answer.

Statistical analysis

Results were analysed statistically using the chi-squared test since categorical variables were tested between them. Statistical significance was assumed as p-value < 0.05 (5% Significance Level). All analyses were conducted using the statistical software SPSS (V26.0.0.0).[23]

Results

One hundred one participants answered the survey, 52 of whom were women, and 49 were men; 53.9% was in the 20–29 age group, 24.5% was in the 30–39 age group, 14.7% was in the 40–49 age group, and 6.9% was in the 50+ age group. Regarding clinical experience, 17.6% had up to a year of clinical experience, 30.4% had up to five years of clinical experience, 14.7% had up to ten years of clinical experience, and 37.3% had more than ten years clinical experience. When it came to their highest educational level, 77.5% had completed an undergraduate degree, 21.6% had completed a masters level degree, and 0.9% had completed a doctorate. Moving on, 33.3% of the participants, worked in hospitals owned by the government. These hospitals acted as the centres of reference and treatment for COVID-19 patients. 35.3% of the participants worked

Table 1
Gender vs working conditions examination.

During COVID-19 pandemic	Males	Females	p-value
Need for increase of breaks	Yes = 44.9% No = 55.1%	Yes = 30.8% No = 69.2%	0.143
Feeling of stress	Extremely stressed = 22.4% Significantly stressed = 16.3% Little stressed = 28.6% Not stressed = 32.7%	Extremely stressed = 26.9% Significantly stressed = 19.2% Little stressed = 38.5% Not stressed = 15.4%	0.238
Reduced effectiveness	Yes = 53.1% No = 46.9%	Yes = 32.7% No = 67.3%	0.039
Increased time of an average examination	Significant = 28.6% Average = 30.6% Small = 20.4% No = 20.4%	Significant = 32.7% Average = 28.8% Small = 23.1% No = 15.4%	0.895

Table 2
Participants place of work vs working conditions examination.

During COVID-19 pandemic	Private radiology centre	Privately-owned hospital	Government-owned hospital	p-value
Need for increase of breaks	Yes = 52.5% No = 47.8%	Yes = 37.1% No = 62.9%	Yes = 32.4% No = 67.6%	0.335
Reduction of working hours per week	Yes = 26.1% No = 73.9%	Yes = 37.1% No = 62.9%	Yes = 76.5% No = 23.5%	0.0022
Feeling of stress	Extremely stressed = 8.7% Significantly stressed = 17.4% Little stressed = 30.4% Not stressed = 43.5%	Extremely stressed = 14.3% Significantly stressed = 17.1% Little stressed = 42.9% Not stressed = 25.7%	Extremely stressed = 44.1% Significantly stressed = 17.6% Little stressed = 32.4% Not stressed = 5.9%	0.015
Reduced effectiveness	Yes = 21.7% No = 78.3%	Yes = 48.6% No = 51.4%	Yes = 41.2% No = 58.8%	0.027
Increased time of an average examination	Significant = 8.7% Average = 17.4% Small = 43.5% No = 30.4%	Significant = 20.0% Average = 42.9% Small = 17.1% No = 20.0%	Significant = 58.8% Average = 20.6% Small = 11.8% No = 8.8%	0.001

in privately owned hospitals, 22.5% worked in private radiology centres, and 8.8% was not employed during the time the survey took place. Finally, 96.1% of the participants had an occupational license to work in Radiology, and 3.9% had an occupational license to work in Radiotherapy and Nuclear Medicine.

Gender vs working conditions examination

To evaluate how the two genders coped with the COVID-19 pandemic, the results were examined to see if there was any correlation between gender and working conditions (Table 1).

A statistically significant result (p-value = 0.039) was observed when comparing the effect of the pandemic to the work effectiveness of the participants indicating that there is a difference between the two genders. In contrast, the other results were statistically insignificant showing that the majority of both genders agreed that there is no need for more breaks, there is an increase in stress levels felt and an increase in the overall examination time when compared to the pre-COVID-19 era.

Participants place of work vs working conditions examination

The results were analysed to examine for correlation between the working location of participants during the COVID-19 pandemic and their working conditions (Table 2).

Statistically significant results were observed when comparing the working place with the reduction of working hours per week (p-value = 0.0022), with the feeling of stress (p-value = 0.015), and with the overall examination time (p-value = 0.001) indicating that especially for the participants working for the governmental hospitals there was a reduction in working hours and an increase in levels of stress felt and in time of an average examination. Also, the

Table 3
Participants place of work vs safety procedures and decontamination methods.

During COVID-19 pandemic	Private radiology centre	Privately-owned hospital	Government-owned hospital	p-value
Presence of protocol	Yes = 65.2% No = 34.8%	Yes = 88.6% No = 11.4%	Yes = 85.3% No = 14.7%	0.0001
Compulsory use of face masks by all patients	Yes = 73.9% No = 26.1%	Yes = 94.3% No = 5.7%	Yes = 85.3% No = 14.7%	0.086
Decontamination training	Yes = 43.5% No = 56.5%	Yes = 57.1% No = 42.9%	Yes = 50.0% No = 50.0%	0.601
Contacting manufacturers/representatives of the imaging equipment for advice on proper decontamination	Yes = 69.6% No = 30.4%	Yes = 42.9% No = 57.1%	Yes = 44.1% No = 55.9%	0.186
Type of decontamination used on the imaging equipment	High-level disinfectant = 87.0% Low-level disinfectant = 13.0% Water & Soap = 0.0%	High-level disinfectant = 82.9% Low-level disinfectant = 14.3% Water & Soap = 2.9%	High-level disinfectant = 76.5% Low-level disinfectant = 20.6% Water & Soap = 2.9%	0.007
When decontamination takes place	After each patient = 69.6% After COVID-19 confirmed patient = 0.0% After COVID-19 suspected patient = 21.7% No need = 8.7%	After each patient = 74.3% After COVID-19 confirmed patient = 14.3% After COVID-19 suspected patient = 11.4% No need = 0.0%	After each patient = 47.1% After COVID-19 confirmed patient = 5.9% After COVID-19 suspected patient = 44.1% No need = 2.9%	0.00032
Type of air decontamination	Air specific disinfectant = 8.7% Aired the place every 4h for 30min = 43.5% Air-conditioning systems off = 13.0% UV air disinfectant = 13.0% No method = 4.3% [a]Other = 17.4%	Air specific disinfectant = 17.1% Aired the place every 4h for 30min = 28.6% Air-conditioning systems off = 22.9% UV air disinfectant = 14.3% No method = 14.3% [a]Other = 2.9%	Air specific disinfectant = 14.7% Aired the place every 4h for 30min = 11.8% Air-conditioning systems off = 38.2% UV air disinfectant = 5.9% No method = 26.5% [a]Other = 2.9%	0.04
Ground decontamination	Yes = 43.5% No = 56.5%	Yes = 57.1% No = 42.9%	Yes = 47.1% No = 52.9%	0.545

[a] Other = Leaving windows and doors open during the entire shift or using a simple general-purpose disinfectant.

Table 4
To what extent do you believe that there is adequate provision at your workplace in the following areas to deal with the current situation today.

	Adequate	Almost adequate	Not adequate	Very inadequate	Do not know/NA
COVID-19 PPE for people in your specific role	51.49%	26.73%	17.82%	1.98%	1.98%
COVID-19 PPE for patients	47.53%	31.68%	13.86%	4.95%	1.98%
COVID-19 testing for people in your specific role	52.48%	18.81%	14.85%	8.91%	4.95%
Antibody testing for people in your specific role	24.75%	23.76%	19.80%	18.81%	12.87%
Cleaning supplies & equipment	61.39%	26.73%	6.93%	2.97%	1.98%
Cleaning staff	52.48%	32.67%	7.92%	4.95%	1.98%

Table 5
How much confidence do you have that there will be adequate provision at your workplace to deal with the situation as you can envision it developing within the next three months.

	Adequate	Almost adequate	Not adequate	Very inadequate	Do not know/NA
COVID-19 PPE for people in your specific role	45.54%	28.71%	12.87%	6.93%	5.94%
COVID-19 PPE for patients	34.65%	37.62%	15.84%	5.94%	5.94%
COVID-19 testing for people in your specific role	40.59%	21.78%	19.80%	7.92%	9.90%
Antibody testing for people in your specific role	24.75%	23.76%	24.75%	10.89%	15.84%
Cleaning supplies & equipment	54.46%	23.76%	12.87%	5.94%	2.97%
Cleaning staff	47.52%	36.63%	5.94%	6.93%	2.97%

comparison between workplace and work effectiveness was a statistically significant result (p-value = 0.027) and showed a difference in the participants' work effectiveness between hospitals (governmental or private) and private radiology centres. On the other hand, a statistically insignificant result was found when comparing the working place with the need for an increase in breaks.

Participants place of work vs safety procedures and decontamination methods

The next important parameter was the evaluation of a possible correlation between where the participant worked during the pandemic and the safety procedures implemented and the decontamination methods used. The results were examined to see if correlations existed between the place of work and existence of a COVID-19 protocol, compulsory use of masks by all patients, the offering of a decontamination training to the participants, contacting the equipment manufacturer or reseller to seek advice on decontamination of equipment and the decontamination method used on. Moreover, the results were examined to see if there was any correlation between the place of work and the type of workplace decontamination implemented, the type of air decontamination implemented, and the existence of ground decontamination (Table 3).

Statistically significant results were observed when comparing the place of work with the existence of a COVID-19 related protocol (p-value = 0.0001), the type of decontamination used on the imaging equipment (p-value = 0.007), time that decontamination took place (p-value = 0.00032) and the type of air decontamination implemented (p-value = 0.04). These results indicated that there is a significant difference regarding the parameters above among private hospitals, hospitals owned by the government and private radiology centres. However, the results with a statistically insignificant result, showed that there was not any significant difference in the answers of the participants.

General participant responses

The participants were asked to indicate which protective measures they had to utilise during the COVID-19 pandemic at their workplace. 88.2% of total participants indicated that they used a surgical mask, 27.5% indicated that they used an N95 face mask, and 31.4% indicated that they used safety goggles. 51% of total participants indicated that they used a disposable waterproof protective apron, 79.4% used disposable protective gloves, 36.3% used a disposable surgical cap, 47.1% used a face shield, and 29.4% used disposable shoe covers.

The participants were asked to indicate to which extent they believed there was currently adequate provision at their workplace in an array of issues and also to indicate how much confidence they have that there will be adequate provision at their workplace to deal with the situation as they envision it developing within the next three months. The results of our participants can be seen in Table 4 and Table 5, respectively.

Discussion

It has been a long time since almost the whole planet has had to face such an ominous threat to human health. As of January 30 2020, an Emergency Committee, convened by the World Health Organization (WHO), declared that the novel coronavirus outbreak meets the criteria for a Public Health Emergency of International Concern.[24] It is now evident that COVID-19 affects the respiratory system primarily, and it is a widespread cause of pneumonia. Radiology departments are front-line regarding the identification, as well as the management and monitoring of suspected and confirmed COVID-19 patients, by using imaging modalities, such as CT and/or X-rays.[25,26] Thus, it is of the essence for radiology departments to take precise and detailed measures in order to protect patients and staff and to prevent further transmission of the disease.[27]

All radiology departments should evaluate and renew their emergency standard plan in order to meet the necessities of this specific viral outbreak.[21,28] The build-up of a specific protocol on the COVID-19 outbreak and the existence of an administrator will, eventually, create a more straightforward algorithm to be followed in demanding and emergency circumstances. This study showed that although only 65.2% of radiology centers have established a protocol concerning the COVID-19 pandemic, the majority of radiology departments in private and government owned hospitals (88.6% and 85.3%, respectively) have done that as well.

Equally important is the immediate education and training of all members of staff in the radiology department.[20] There are specific surveys that state a lack of knowledge of infection control practices.[29] In this study it is demonstrated that regardless their

workplace (i.e. radiology center, private and government owned hospitals) the participants have not received adequate training concerning decontamination methods. An easy way to guide the radiology department through the measures needed to be taken is to simply follow the recommendations of the European Centre for Disease Preventions and Control.[30]

Additionally, all members of the radiology department must use PPE correctly and care for their protection. This equipment should at least consist of the following: face shields, goggles, fluid-resistant surgical masks, N95 masks, surgical caps, disposable fluid-resistant isolation gowns, disposable gloves with coverage over gown cuffs, and shoe covers to name a few.[31] According to this survey, the majority of the participants indicated that they use surgical mask and disposable, protective gloves, whereas less than 50% of them stated that they use disposable surgical cap, face shield and disposable shoe covers. Likewise, the personnel of the radiology department are recommended to avoid unnecessary contact and to keep safe distances from other people. A simple yet effective example of this is for radiographers not to assist patients while placing them on the gantry of the machine, but to allow the person accompanying the patients to do this.[20]

In this survey, a respectable percentage of radiographers in Cyprus believe that their workplace is adequately provided with PPE for themselves and patients, with cleaning supplies, equipment, and cleaning personnel. Similarly, they seem optimistic regarding the adequacy of these provisions in the next three months. Nevertheless, they contested that there is and will not be adequate antibody testing for COVID-19. However, a similar online survey conducted by the British Institute of Radiology, published on May 4, 2020, showed that the majority of British radiographers believed that they are not adequately provided with the equipment mentioned above .[22] Furthermore, they were not satisfied nor convinced that they will be adequately equipped in the immediate future.[22] These answers, from the U.K. radiographers, may be due to the late onset of a lockdown in the U.K. and the slow rate of implementing effective and drastic measures in comparison to other European countries, such as Cyprus.[32]

Moreover, every radiology department is strongly advised to communicate with the manufacturers of the equipment used and to seek advice on the proper disinfection techniques for each one. In this study, most of the participants working in private and government owned hospitals reported that there has not been any communication with the representatives of the equipment to seek advice on proper decontamination. Additionally, there should be sufficient cleaning of all surfaces in the radiology department, adequate decontamination of the floors, air disinfection, and more potent disinfection methods added to the daily cleaning routine.[33] This survey showed that high-level disinfectant is used to decontaminate the equipment, particularly after each patient examination, regardless the workplace of the participants. However, regarding air decontamination various techniques are used among the different workplaces with the most frequent being turning off the air-conditioning system and properly ventilating the place while ground decontamination does not take place in nearly half of the workplaces.

Conclusion

This world health emergency has undoubtedly changed the course of lives of millions of people around the globe, whether they are or not in the medical field. Radiologists and radiographers are among the front-line workers, due to the nature of the disease caused by COVID-19. According to this survey, radiographers in the Republic of Cyprus seem to be following specific protocols concerning protective measures against the novel coronavirus. Also, they seem to be appropriately trained for an infectious disease outbreak. This survey has shown that there are some statistically significant differences regarding decontamination methods used among the different workplaces of the participants.

It is of vital importance to strictly follow and improve strategies[34] on handling this dangerous viral outbreak, especially now, where countries have begun to loosen precaution measures and open their borders to the public. Therefore, radiology departments are required to continue developing and implementing ways which will improve the safety of patients and staff, while successfully managing the workload and being prepared for a possible second outbreak.[25] Communication, collaboration, and education are key issues to be addressed during this challenging period.

Conflict of interest statement

The authors will like to state that they have no conflict of interest.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.radi.2020.10.004.

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