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ORIGINAL PAPER

Assessment of Knowledge and Perceptions of Health Workers Regarding COVID-19: A Cross-Sectional Study from Cyprus

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Abstract
The COVID-19 disease is presently a matter of global public health concern as it could be potentially fatal. Health workers have at the moment, inadequate knowledge of prevention measures, and their erroneous practices may directly increase the risk of spread. As a result, matters are complicated further as far as the chain of infection is concerned. The present cross-sectional study was conducted with 494 Health Worker participants in Cyprus between the 1st and 20th of May and the data were collected via an online questionnaire. The survey was created using information from a previous study as well as current directives published on the WHO website. The statistical software SPSS 22.0 was used for data analysis. The ANOVA test was used for the comparison of quantitative variables, while the Kruskal–Wallis test was used in cases of non-parametric distribution. The Pearson or Spearman coefficients were used to test correlation and the levels of materiality were set to 0,05. Women constituted 66,7% of the participants and 44,8% of all participants were between the age of 30–39 years old. The majority (75,4%) of the participants were Nursing Officers and 44,5% held postgraduate qualifications. HWs appeared to have a positive perception ($\bar{x} = 3.58$, SD = 0.53, MR = 1–5) regarding the course of the pandemic and their knowledge of the virus was found to be generally satisfactory. The findings of the current study indicate that in case of a similar global public health crisis, certain educational interventions should be implemented. This could be achieved with the use of an appropriate strategy. As a result, all demographic-working strata of health professionals would be well-educated and informed.

Keywords Coronavirus disease 2019 · Knowledge · Perception · Healthcare workers · Infectious disease transmission

Abbreviations
HWs Health workers
WHO World Health Organization

Background

The coronavirus disease (COVID-19), internationally known as the SARS-COV2 virus, is a matter of global public health concern as it could be potentially fatal [1]. The COVID-19 pandemic has affected and continues to affect, several countries in varying degrees of severity. In order to control the pandemic, patients were isolated, and extensive prevention measures were taken, particularly aimed at protecting vulnerable groups of the population, including children, health care providers, and the elderly [1, 2].

In Cyprus, 1013 confirmed cases and 19 deaths have been reported on October 3, 2020 [3]. Many health workers are included in these numbers, a fact, that further complicates the chain of infection, and must be addressed immediately [4]. It is a fact that health workers may have poor knowledge regarding prevention measures, resulting in practices that may directly increase the risk of spread [5]. Aoyagi et al. [6] conclude that risk perception is a factor statistically proven to significantly affect HWs' willingness to work during a pandemic. The present cross-sectional study aims to explore the knowledge and perceptions of health-care professionals concerning COVID-19 at a time when the number of cases is declining, and lockdown measures are being eased in the country. To our knowledge, no such study has been carried out in Cyprus so far. Taking into consideration the fact that the knowledge of health professionals regarding disease control and prevention is of the utmost importance, further research was required. The results of such research

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can be used to develop strategic models of improvement and enrichment of the protection data available to date regarding health-care professional exposure.

Methods

Study Design and Setting

The current cross-sectional study follows the guidelines of the STROBE Statement-Checklist of items that should be included in reports of cross-sectional studies [7]. Data collection was conducted within 20 days (1st May–20th May) via an online questionnaire (questionstar.com), which was shared on official websites for HWs in the Republic of Cyprus.

Sampling and Sample Size

In order to calculate a representative sample size of the target population (N = 20,456, [8]) an estimated response of 30%, a confidence interval of 95%, and a margin error of 5% were set through Raosoft. The required sample of the resulting study, based on the calculation mentioned above, was 377 subjects, while the final sample of the study was 494 HWs.

Study Instrument

An expected relative limitation on measurement tools was identified through the existing literature as researchers seek to assess and interpret the knowledge/perceptions of health workers about the COVID-19 disease mainly using self-made scales. One of the most documented scales of international literature is the one created by Bhagavathula et al. [9] which was also chosen as a measurement tool for the quantitative results of this study. The Bhagavathula et al. [9] questionnaire consists of 23 closed-ended questions based on the WHO information material about newly emerging anaerobic viruses, including COVID-19 [10]. The questionnaire was modified with the consent of the authors.

Aiming to produce more detailed results, following the translation of the questionnaire in Greek, questions were added in coordination with, and under the guidance of, 6 experienced researchers. The final version of the questionnaire contained 34 questions and was divided into four parts to include the following areas: (a) Demographic and labor characteristics of the participants (9 questions about age, occupation, education etc.), (b) Information on the Novel Coronavirus (2 information clarification questions and 4 questions on a 4-point Likert scale related to the information source), (c) General knowledge regarding the Novel Coronavirus (7 true/false questions), (d) Specialist knowledge regarding the Novel Coronavirus (7 multiple choice questions focusing on modes of transmission, ways of protection/prevention and origin of the virus) and finally (e) Perceptions about the Novel Coronavirus (5 questions with a 4-point Likert scale related to participants' beliefs about the disease).

Statistical Analysis

Normal distributed variables are expressed as a mean (standard deviation); while variables with skewed distribution are expressed as a median (interquartile range). Qualitative variables were expressed as absolute and relative frequencies. Students'-tests or the Mann–Whitney test were used for the comparison of means between two groups, Analysis of variance (ANOVA) and the Kruskall–Wallis test was applied for the comparison of means of continuous variables among more than two groups. The Bonferroni correction was used to control for type I error. Pearson and Spearman correlations coefficients were used to explore the association of two continuous variables. Correlation coefficients between 0.1 and 0.3 were set to low, between 0.31 and 0.5 moderate, and those over 0.5 high. Multiple linear regression analyses were used depending on knowledge and perception scores. The regression equation included terms for demographics and work-related factors. Adjusted regression coefficients (β) with standard errors (SE) were computed from the results of the linear regression analyses. Regarding General knowledge scores, log transformations were utilized in the regression analysis. All reported p values are two-tailed. Statistical significance was set at $p < 0.05$ and analyses were conducted using the SPSS statistical software (version 22.0).

Results

Questionnaire Validity Test

A pilot implementation within the context of the weighting process of the questionnaire was considered necessary to be conducted. Furthermore, the translated questionnaire was given to 20 randomly selected HWs. Following the analysis of the pilot application, no lack of understanding was observed, and therefore, there were no further modifications of the questionnaire.

Demographic and Labor Characteristics

The demographic and labour characteristics of the participants are presented in Table 1. The sample consisted of 494 HWs. 66.7% of the participants were women, and 44.8% of all participants were aged 30–39. Most of the participants (75.4%) were Nursing Officers. 52.0% of participants had

Table 1 Characteristics of the respondents ($N=494$)

Demographic and labor data	N (%)
Gender	
Male	164 (33,3)
Female	328 (66,7)
Age	
18–29	109 (22,1)
30–39	221 (44,8)
>40	163 (33,1)
Occupation	
Nurse	371 (75,4)
Physician	46 (9,3)
Paramedic staff	75 (15,2)
Years of work	
Less than 5	88 (17,9)
6–10	148 (30,1)
More than 10	256 (52)
Educational level	
Diploma	8 (1,6)
Degree	217 (44,1)
Master's	219 (44,5)
Ph.D.	47 (9,6)
Currently working	
Yes	424 (86)
No	43 (8,7)
Yes, but from home	22 (4,5)
Other	4 (0,8)
Frontline worker*	
Yes	305 (72,3)
No	117 (27,7)
Because of COVID-19 how many hours do you work per week*, average value, (SD)	42 (12,3)
Under normal circumstances, how many hours did you work*, average value, (SD)	39 (7,3)

*Concerns those who are currently working (not from home)

been working for over 10 years, and 44.5% held postgraduate qualifications. Also, 86.0% of participants were employed at the time, and 72.35% were considered frontline health professionals. The average working hours were 42 h/week (SD = 12,3 h) due to COVID-19, while under normal conditions they were 39 h/week (SD = 7.3 h).

Information Sources and Knowledge of Participants on COVID-19

As far as the participants' awareness regarding COVID-19 is concerned, almost all the participants (99,8%) had heard about the virus and 47,0% had attended a lecture/discussion about COVID-19. The most common sources of information that the participants used were the official government websites, followed by news broadcasts and mass media.

The participants' responses concerning their knowledge of COVID-19 are presented in Table 2. The percentage ratio of correct answers to general knowledge questions ranged from 86,9% to 98,3%. Specifically, 86,9% of the participants correctly answered that in an open-air wet market, the disinfection of equipment and working areas at least once daily is recommended. Moreover, 89,9% reported that even in areas where an outbreak is observed it is safe to consume food products when appropriately prepared and thoroughly cooked. In addition, 98,3% of the participants correctly replied that in accordance with the WHO (World Health Organization) guidelines, washing hands is not only necessary when hands are visibly dirty.

Furthermore, the percentage ratio of correct answers to specific knowledge questions ranged from 34,5% to 95,5%. In particular, 34,5% of participants responded that the carrier responsible for transmitting COVID-19 to humans is still unknown whilst 36,4% stated that the incubation period (asymptomatic stage) of COVID-19 is in fact 2–14 days. Additionally, 95,5% of participants correctly identified that skin rash is not actually a symptom of COVID-19 and 91,9% were aware of how the virus affects humans (pneumonia, respiratory failure, and/or death).

The points questions were subsequently classified into two categories (General knowledge, Specific knowledge). Participants scored 1 point for a correct response and 0 points for an incorrect one. Higher scores indicate a more informed level of knowledge regarding COVID-19 (Range 0–7). The average General knowledge score was 6,4 points (SD = 1,0) including two people (0,4%) scoring zero and 298 people (60,3%) scoring 7 in the case of correct responses to all questions. The average score regarding participants' Specific knowledge based on their responses to multiple-choice questions was found to be 4 points (SD = 1,4 points). In particular, two individuals (0,4%) scored zero for all incorrect responses whilst 16 people (3,2%) achieved a score of 7 for responding correctly to all questions.

Perceptions of Participants Towards COVID-19

Table 3 illustrates participant responses regarding perceptions towards COVID-19. In particular, 30,5% of the participants rarely felt fear whilst 33,3% felt tired most of the time. In addition, 30,2% of the participants always felt that the virus would be defeated over time and 38,8% felt that social isolation is an effective measure. Furthermore, 38,7% of the participants believed that adequate and appropriate protective equipment was readily available. The participants' scores were then calculated as follows: 1 point was earned for responses of 'rarely', whilst responses of 'always' earned 5 points each. A total value for the sum of points gained was

Table 2 Knowledge of healthcare workers regarding COVID-19

General knowledge for COVID-19 (correct answer)	N (%)
Symptoms may occur from 2 or 14 days after exposure (Yes)	461 (93,9
If an individual is infected with the virus there is no chance of surviving (No)	474 (97,3)
Individuals who receive the flu vaccine are adequately vaccinated and protected (No)	475 (97,7)
Even in areas where there is an outbreak, it is safe to eat products if they are cooked well and appropriately prepared (Yes)	435 (89,9)
If an individual has symptoms of fever, cough and difficulty breathing, he/she must seek medical advice promptly and report his/her medical and travel history to health service providers (Yes)	434 (90,2
For individuals working in a wet market, disinfection of all equipment and workplaces at least once a day is recommended (Yes)	412 (86,9)
According to WHO guidelines, hand washing is necessary only when hands are visibly soiled (No)	469 (98,3)
Total	**Mean ± SD (range)**
General knowledge score	6,4 ± 1,0 (0–7)
Specific knowledge for COVID-19 (correct answer)	**N (%)**
Incubation period in days (2–14)	179 (36,4)
All the following are symptoms of COVID-19 except (Skin rash)	470 (95,5)
COVID-19 is transmitted to humans through (Unknown)	169 (34,5)
COVID-19 transmission occurs through (All the above)	229 (46,7)
Complications of COVID-19 (All the above)	451 (91,9)
What is the current treatment of COVID-19 (Supportive care)	249 (51,4)
Reduce the risk of transmission by (All of the above)	260 (53,1)
Total	**Mean ± SD (range)**
Specific knowledge score	4,0 ± 1,4 (0–7)

Table 3 Perceptions of healthcare workers towards COVID-19

	Rarely N (%)	Occasionally N (%)	Sometimes N (%)	Frequently N (%)	Always N (%)
I feel fear	150 (30,5)	109 (22,2)	142 (28,9)	64 (13)	26 (5,3)
I feel tired	56 (11,5)	80 (16,4)	156 (32)	162 (33,3)	33 (6,8)
I feel like the virus will be defeated over time	14 (2,9)	35 (7,2)	96 (19,7)	195 (40)	147 (30,2)
I believe social isolation works well as a measure	16 (3,3)	14 (2,9)	63 (12,9)	205 (42,1)	189 (38,8)
There is appropriate and adequate protective equipment available	29 (6)	55 (11,3)	165 (34)	188 (38,7)	49 (10,1)
Total				**Mean ± SD (range)**	
Perception score				3,58 ± 0,53 (1–5)	

deduced with higher values denoting more positive perceptions regarding COVID-19 (Range 1–5). Total scores ranged from 1,60 to 5,00 with an average of 3,58 points (SD = 0,53).

Distribution of Knowledge Scores Among Healthcare Workers Based on Demographic and Labor Data

Table 4 illustrates the knowledge scores of healthcare workers according to demographic and labor data. A multiple linear regression was carried out with knowledge score as the dependent variable and demographic and labor data as the independent variable. The analysis was conducted using logarithmic transformations. General knowledge scores varied significantly depending on participants' occupation and years of work experience. Applying the Bonferroni correction showed that participants working for less than 5 years had a significantly higher score, indicating greater general knowledge when compared to participants working for 6–10 years. ($p = 0{,}004$). Moreover, doctors scored significantly higher than nursing officers ($p = 0{,}004$) and paramedic staff ($p < 0{,}001$). In addition, a significantly higher general knowledge score was observed among participants who were working but were not considered frontline healthcare professionals.

Table 4 Distribution of knowledge scores among healthcare worker depending on demographic and labor data

	General knowledge score/specific knowledge score				
	SD/SD	P Mann–Whitney test/P Student's t test	β/β++	SE/SE+++	P/P
Gender		0,36/0,06			
Male	6,3 (1,2)/4,2 (1,4)				
Female	6,5 (0,9)/4 (1,3)		0,01/−0,13	0,00/0,13	0,06/0,30
Age		0,57+/**0,02+**			
18–29	6,4 (0,8)/3,9 (1,4)		0,02/0,03	0,01/0,27	0,15/0,90
30–39	6,4 (1)/4 (1,3)		0,01/−0,15	0,01/0,17	0,10/0,37
>40	6,3 (1,1)/4,3 (1,4)				
Occupation		**0,00+/<0,00+**			
Nurse	6,4 (0,8)/3,9 (1,3)		−0,03/−1,20	0,01/0,21	**<0,00/<0,00**
Physician	6,8 (0,4)/5,3 (1,1)				
Paramedic staff	5,9 (1,7)/4 (1,4)		−0,07/−1,11	0,01/0,25	**<0,00/<0,00**
Work experience (in years)		**0,02+**/0,08+			
Less than 5	6,5 (0,9)/3,8 (1,3)		−0,00/−0,31	0,01/0,26	0,59/0,24
6–10	6,2 (1,2)/4 (1,5)		−0,02/−0,15	0,01/0,18	**0,01**/0,39
Greater than 10	6,4 (0,9)/4,2 (1,3)				
Educational level		0,19/**<0,00**			
Diploma/degree	6,4 (0,9)/3,7 (1,3)				
Master's/Ph.D.	6,5 (0,9)/4,3 (1,3)		0,00/0,44	0,00/0,12	0,50/**<0,00**
Currently working		0,85+/0,19+			
Yes	6,4 (1)/4,1 (1,3)		−0,00/−0,08	0,01/0,21	0,55/0,70
No	6,5 (0,7)/3,9 (1,5)		−0,01/0,02	0,02/0,36	0,57/0,96
Yes, from home	6,3 (1)/4,5 (1,3)				
Frontline worker*		**0,03**/0,59			
Yes	6,3 (1,1)/4,1 (1,4)				
No	6,6 (0,6)/4 (1,2)				

*Concerns those who are currently working outside home

+ANOVA

++Regression coefficients

+++Standard errors

Specific knowledge scores varied significantly depending on the age and occupation of the participants. Following the Bonferroni correction, participants over 40 years of age had a significantly higher score, indicating greater specific knowledge, compared to participants who were between the age of 18–29 years old ($p = 0{,}050$). Furthermore, doctors yielded a significantly higher specific knowledge score compared to nursing officers ($p < 0{,}001$) and paramedic staff ($p < 0{,}001$). Additionally, a considerably higher specific knowledge score was produced among participants with a Master's/Doctorate.

Table 5 shows participants' perception scores according to their demographic and labor data. A multiple linear regression with perception score as the dependent variable and demographic and labour data as the independent variable was conducted and analyzed using logarithmic transformations. The analysis was done using logarithmic transformations. Perception scores were found to vary considerably depending on age, occupation, and years of work experience. Applying the Bonferroni correction, participants over 40 had scored significantly higher values, indicating more positive perceptions towards COVID-19 in comparison to both participants who were between 18 and 29 years old ($p = 0.004$) and participants who were between 30 and 39 years old ($p = 0.002$). Furthermore, physicians yielded a significantly higher score than nursing officers ($p = 0.022$) whilst participants with more than 10 years of work experience earned a higher score than participants with less than 5 years of work experience ($p = 0.025$). In addition, considerably higher perception scores indicating more positive perceptions regarding COVID-19, were held in particular by men and participants who were occupied but were not considered frontline healthcare professionals.

Table 5 Distribution of perception scores among healthcare workers based on demographic and labor data

Perception score					
	SD	P Student's t test	β^{++}	SE^{+++}	P
Gender		**<0,001**			
Male	3,7 (0,5)				
Female	3,5 (0,5)		−0,24	0,05	**<0,001**
Age		**0,001+**			
18–29	3,5 (0,5)		−0,09	0,11	0,395
30–39	3,5 (0,5)		−0,18	0,07	**0,009**
>40	3,7 (0,5)				
Occupation		**0,027+**			
Nurse	3,5 (0,6)		−0,08	0,09	0,347
Physician	3,8 (0,4)				
Paramedic staff	3,6 (0,5)		−0,03	0,10	0,738
Work experience (years)		**0,016+**			
Less than 5	3,5 (0,5)		−0,13	0,11	0,213
6–10	3,5 (0,5)		−0,03	0,07	0,688
Greater than 10	3,6 (0,5)				
Educational level		0,231			
Diploma/degree	3,5 (0,5)				
Master's/Ph.D.	3,6 (0,5)		0,01	0,05	0,914
Currently working		0,097+			
Yes	3,6 (0,5)		0,10	0,08	0,229
No	3,4 (0,5)				
Remotely (from home)	3,7 (0,5)		0,21	0,14	0,152
Frontline worker*		**0,017**			
Yes	3,5 (0,5)				
No	3,7 (0,6)				

*Concerns those who are currently working outside home

+ANOVA

++Regression coefficients

+++Standard errors

Correlation Between Knowledge and Perception Scores

The Pearson and Spearman correlation coefficients were applied in order to analyze correlations between the three scores (general knowledge, specific knowledge, perceptions). The analysis revealed a significant positive correlation between general knowledge and specific knowledge. Consequently, the better the participants' general knowledge regarding COVID-19, the better their specific knowledge. On the contrary, no significant correlation was deduced between the participants' knowledge and perceptions.

Discussion

COVID-19 is unquestionably a global concern, particularly among HWs. The present study investigates the level of knowledge and perception of HWs during an international health crisis such as the current pandemic. Participants contributing in the study appeared to have a relatively good level of general knowledge (x = 6.4, SD = 1.0, MR = 0–7), and a moderate level of specific knowledge (x: = 4, SD = 1.4, MR = 0–7) about COVID-19, at a time when a reduction in the number of cases and easing of social isolation measures throughout the country was experienced. In particular, HWs were observed to have excellent knowledge regarding the symptomatology of the virus as well as effective hand washing. On the contrary, HWs appeared to lack knowledge on the incubation period of the virus, modes of transmission and on the possible origin of the virus. The present findings are also supported by those of another study conducted by Bhagavathula et al. [9] where a significant proportion (61%) of HWs had poor knowledge on the ways the virus is transmitted. Furthermore, results produced in the current study, indicate a possible link between factors such as age and occupation with poor knowledge and negative

perception of the virus. This deduction is in agreement with that of the study conducted by Bhagavathula et al. [9] where both knowledge and perceptions regarding COVID-19 have been shown to vary considerably according to the demographic and occupational category of each healthcare professional. On the other hand, occupation and educational background of participants were found to be independently related to the general knowledge score. Specifically, nurses and paramedics scored significantly lower in their general knowledge than doctors. In addition, participants with 6–10 years of work experience achieved a considerably lower general knowledge score in comparison to participants whose work experience was less than 5 years. However, a similar study conducted by Zhou et al. [4], supports that HWs with 5–9 years of work experience were less likely to feel tired in relation to other age groups, indicating that the specific age group played a fundamental role in coping with public health emergencies.

Occupation and educational background of participants were found to be independently related to their respective specific knowledge score. Nurses' specific knowledge scores were lower by 1.20 points overall compared to doctors' scores whilst paramedics' scores were 1.11 points lower than nurses'. Additionally, knowledge scores of participants with a master's degree were higher by 0.44 points, i.e. their level of knowledge was higher compared to that of participants with a Diploma/Degree. Results of several previous studies [4, 9, 11–13] further support that there is a substantial link between demographic characteristics of HWs and their level of knowledge and perceptions. Conclusively, in the case of a global public health crisis such as the current one in addition to implementing educational interventions to continuously support HWs [9, 12–16] it is recommended that they are conducted in an appropriate strategic manner. This would ensure a high level of knowledge among all HWs regardless of their demographic group.

Finally, according to the findings of the present study, no significant correlation between the perceptions and knowledge of the participants was deduced. Gender and age of the participants, however, were both found to be independently related to their perception score. In particular, women's perception scores regarding COVID-19 were 0.24-points lower, i.e. more negative when compared to men's scores. Additionally, participants between the ages of 30 to 39-years old scored 0.18-points lower in relation to participants over the age of 40. Furthermore, the results of this study support the fact that participants mostly understand the risk of the virus as they produced high perception scores overall ($\bar{x} = 3.58$, SD = 0.53, MR = 1–5). Findings of previous similar studies [4, 9, 11, 13, 17], such as the study conducted by Maleki et al. [11], where a high percentage (92.1%) of HWs reported fear that their loved ones might contract the virus, are in agreement with the current findings.

Conclusions

A moderate to a satisfactory level of knowledge in addition to positive perceptions among healthcare professionals regarding COVID-19 are revealed in this research. Furthermore, both knowledge and perceptions appear to vary considerably according to the demographic and occupational level of each healthcare professional. In conclusion, the results of the current study support that, in case of a similar global public health crisis, certain strategic educational interventions should be implemented in order to ensure that all demographic-working strata of health professionals are well-educated and informed.

Limitations

While data presented in the current study may contribute to the enrichment of existing literature, it is nonetheless necessary to acknowledge its limitations in order for it to contribute to the progress of future research. The present research, similar to other analogous studies [11, 17], was conducted online due to the need for rapid results and in order to minimize possible exposure to the virus. The online method of data collection however, may have likely increased selection bias to some extent. Furthermore, applying a measurement scale that was not pre-planned may have possibly increased the likelihood of Information Bias [18]. Finally, discriminatory errors identified in this paper should cause some uncertainties regarding the generalization of results presented in this study.

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Data Availability The data sets used and/or analyzed during the current study are available by the corresponding author on reasonable request.

Compliance with Ethical Standards

Conflict of interest The authors responsibly declare that they have no conflicting interests.

Ethics Approval and Consent to Participate The protocol of the current study has been approved by the University of Nicosia and has received all the necessary permits for its preparation. (Cyprus National Bioethics Committee No.: EPC OP 2020.01.85). The online questionnaire of

the study ensured voluntary participation, participants' consent, the provision of information regarding the purpose of the survey as well as confidentiality and anonymity.

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