



Contents lists available at ScienceDirect

American Journal of Infection Control

journal homepage: www.ajicjournal.org

Major Article

Fear for CoViD-19 and reluctance to work among health care workers during the epidemic, a prospective monocentric cohort study



Marco Moretti MD^{c,*}, Deborah De Geyter PhD^b, Ellen Van Cutsem PhD^b, Sven Van Laere PhD^c, Denis Pierard MD, PhD^b, Sabine Danielle Allard MD, PhD^a

^a Vrije Universiteit Brussel (VUB), Universitaire Ziekenhuis Brussel (UZ Brussel), Department of Internal Medicine and Infectious Disease, Brussels, Belgium

^b Vrije Universiteit Brussel (VUB), Universitaire Ziekenhuis Brussel (UZ Brussel), Department of Microbiology, Brussels, Belgium

^c Vrije Universiteit Brussel (VUB), Interfaculty Center Data processing and Statistics, Public Health Department, Brussels, Belgium

Key Words:

Severe acute respiratory syndrome coronavirus 2
Coronavirus disease 2019
Motivation to work
Fear for SARS-CoV-2
Hospital employees

A B S T R A C T

Background: Health care workers (HCW) are facing the Coronavirus disease 2019 (CoViD-19) epidemic. Consequently, psychological impairments have been reported. However, literature showed controversial results on the relationship between gender, frontline HCW, and psychological impairments. This study aims to investigate CoViD-19 fear and reluctance to work in HCW.

Methods: Employees who worked between April and October 2020 at the UZ Brussel were included. Data were prospectively collected in 2 phases through a survey together with serological tests. Sampling strategy was convenience sampling.

Results: About 2,336 employees completed the study and response rate was 70%. The prevalence of severe CoViD-19 fear in participants increased from 9% to 15%. Employees showing way less motivation rose from 9% to 14%. The seroprevalence was 7.4% and 7.9%. Multivariable analysis found a relation between reluctance to work, study phase, female gender, shortage of personal protective equipment, and poor education on CoViD-19. Furthermore, CoViD-19 fear was related to the study phase, older age, female gender, being second-line HCW, reported exposure to CoViD-19 during work, and insufficient education on CoViD-19.

Discussion: Seroprevalence remained rather stable, but fear and reluctance to work significantly increased. Differences in time of data collection together with epidemiological setting might be responsible for conflicting data reported in literature.

Conclusions: The evolution of the epidemiological setting might influence the results of studies investigating psychological impairments in HCW.

© 2021 Association for Professionals in Infection Control and Epidemiology, Inc. Published by Elsevier Inc. All rights reserved.

* Address correspondence to Marco Moretti, Vrije Universiteit Brussel (VUB), Universiteit Ziekenhuis Brussel (UZ Brussel), Department of Microbiology, Laarbeeklaan 101, 1090 Jette, Brussels, Belgium.

E-mail address: marco.moretti@vub.be (M. Moretti).

Conflicts of interests: All authors declare that they have no competing interests with the content published in this manuscript.

Funding: We declare to have applied for funding to “Wetenschappelijk Fonds Willy Gepts”. Thanks to the received support we could carry out the current study. Grant number: WFWG2021.

Consent for publication: All included participants gave consent for publication through written informed consent. All the authors read, approved the final version of this manuscript, and gave consent for publication.

Availability of data and materials: The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Authors' contributions: MM: concept, study design, data analysis and interpretation, writing and revision; EVC and DDG: study design, data collection, writing and revision; SVL: data analysis and interpretation, writing and revision; DP: concept, study design, writing and revision; SDA: concept, study design, data collection, writing and revision.

INTRODUCTION

Health care workers (HCW) are facing the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) epidemic.^{1,2} Through contact with Coronavirus disease 2019 (CoViD-19) patients, HCW are at increased risk to become infected with SARS-CoV-2, further increasing the diseases' spread.³

In previously published articles, investigators analyzed the psychological burden of HCW due to the epidemic.^{4,5} A previous review reported that 23% of the HCW, who worked during the epidemic, were affected by anxiety.⁴ Another review found an even higher incidence of anxiety and other psychological impairments.⁵ Moreover, a study performed in China, during the peak of the epidemic showed a correlation between reluctance to work in HCW, anxiety, and

psychological distress.⁶ Qualitative and quantitative cross-sectional studies from Europe, China, and Africa found an association with the shortage of personal protective equipment (PPE), inappropriate education on CoViD-19, and higher psychological distress in HCW.⁷⁻¹²

Nevertheless, the motivation loss reported by HCW during the epidemic, its evolution, and the reason why it occurs, has received limited focus. Furthermore, previous studies showed contradictory results.^{4,5,10,13,14} For instance, increased anxiety has been described in female HCW, compared to males.^{4,5} However, another cross-sectional study found significantly higher psychological distress in male HCW.¹³

The current study aims to prospectively investigate fear of CoViD-19 and reluctance to work in employees of the University Hospital Brussels (UZ Brussel), a tertiary Belgian University Hospital, their correlation, and their evolution during the epidemic. Furthermore, predictive factors for CoViD-19 fear and reluctance to work were investigated.

MATERIALS AND METHODS

Study setting (Belgian epidemiological data)

The first case of CoViD-19 in Belgium was reported in early March 2020. Between the end of March and the beginning of April 2020, more than 500 patients were weekly admitted to Belgian hospitals.¹⁵ The presence of CoViD-19 declined progressively and, in May 2020, a first investigation on the employee at the UZ Brussel was performed (phase 1).¹⁶ After the summer, a progressive increase in positive tests for SARS-CoV-2 and hospitalizations were reported. A second investigation was carried out in the months of October 2020 (phase 2), right before the second peak of hospital admissions, with more than 600 patients weekly admitted in the last week of October 2020.¹⁵ Figure 1 pictures the Belgian epidemiological data and the time frames of the current study.

Sampling strategy

As the aim of the study is to analyze psychological impairments in health care workers, all hospital employees during the epidemic

represent the target population of the current study. All employees of the UZ Brussel, working partially or full-time, between April and October, were eligible for study inclusion and were considered as the study frame. Employees not working at the time of participants' recruitment were excluded. Both health care workers, exercising a medical or paramedical profession, as well as non-medical employees were included. Participation in phase 2 of the study was restricted to employees who participated to phase 1. Recruitment of participants occurred via the UZ Brussel e-mail address and the hospital's intranet news sharing platform. The sampling technique of the current study is convenience sampling as the employees of the UZ Brussel voluntarily choose to sign the informed consent and participate in this study.

Measures and variables

The current study comprised 2 simultaneous interventions, namely blood sampling and an online survey, both at phase 1 and phase 2.

Firstly, 2 serum samples were obtained from each participant to assess CoViD-19 seroprevalence. Serological anti-SARS-CoV-2 IgG testing was carried out with a chemiluminescent microparticle assay, detecting the nucleocapsid protein on the AlinityTM i system (Abbott), according to the manufacturer's instructions with 1.40 as a cut-off to define positivity.¹⁷

Second, each study participant underwent a survey. The Qualtrics survey software was used to construct the survey. After the survey was set up, at study enrollment, every participant received a unique number to identify himself. That personal code was maintained until the end of the study to avoid double responses from the same participant. After data collection of both phases, our research team identified potential double identifying numbers and corrected them if necessary. The questionnaire was only available in Dutch. The survey consisted of a demographical and a CoViD-19 related part. To favor anonymity, all demographical questions were asked to the participants in categories with exception of their professions. Age was assessed with the items "<30 years old", "30-50 years old", and ">50 years old". The home situation was evaluated with the items "living alone", "living with partner or children" and "co-housing with others". Based on the profession and the work-related exposition to CoViD-19

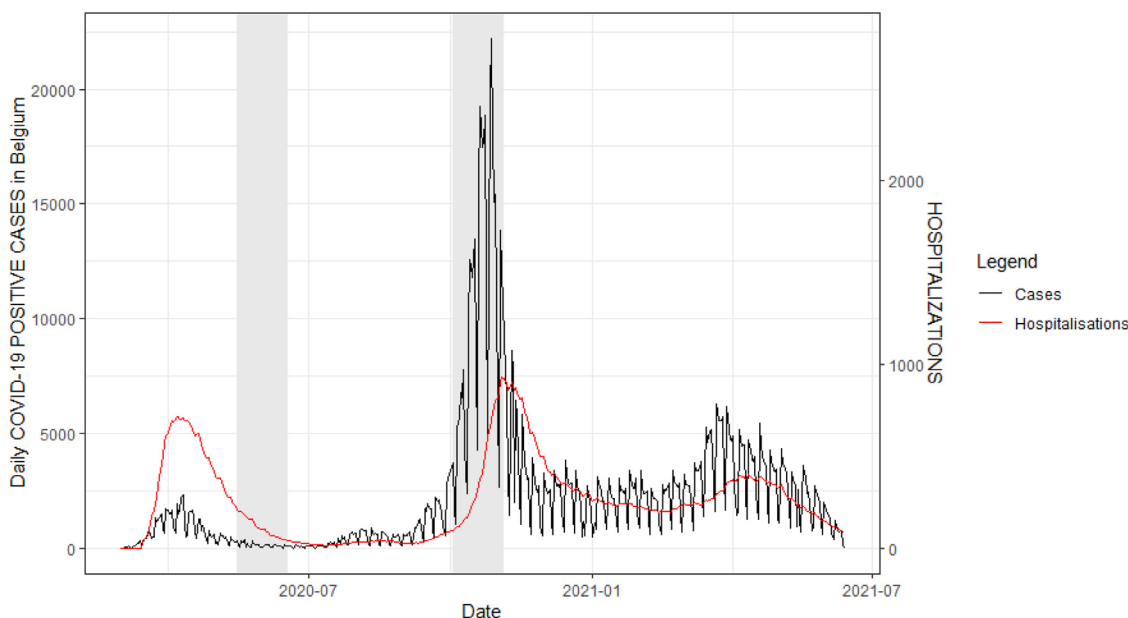


Fig 1. Belgian epidemiological data and study phases; Epidemiological data, cases, and admissions, as reported by the national epidemiological reference center "Sciensano".¹² The time frames of study phases 1 and 2 are indicated as gray bands.

Table 1
Baseline characteristics of participants over the two phases

	Phase 1 – N = 2,661		Phase 2 – N = 2,336	
Gender				
Female	2,008	(75.47%)	1,775	(75.98%)
Male	653	(24.54%)	561	(24.02%)
Age category				
< 30 years	545	(20.48%)	441	(18.88%)
30–50 years	1,277	(47.99%)	1,109	(47.47%)
> 50 years	839	(31.53%)	786	(33.65%)
Living situation at home				
Living with family	2,095	(78.73%)	1,867	(79.92%)
Living alone	301	(11.31%)	261	(11.17%)
Co-housing	265	(9.96%)	208	(8.90%)
Risk category (based on SARS-CoV-2 exposition)				
Low risk	1,140	(42.84%)	1,004	(42.98%)
Medium risk	878	(33.00%)	790	(33.82%)
High risk	643	(24.16%)	542	(23.20%)
Hospital employee's professions				
Medical doctor	445	(16.72%)	354	(15.15%)
Nurse	857	(32.21%)	769	(32.92%)
Para-medical	744	(27.96%)	629	(26.93%)
Non-medical	615	(23.11%)	584	(25.00%)

Phase 1: second column; Phase 2: third column.

SARS-CoV-2, severe acute respiratory syndrome coronavirus 2.

patients, study participants were divided into risk categories: low, medium, or high risk for SARS-CoV-2 infection. Employees were classified as low risk if they had no contacts with patients admitted to the hospital in the context of CoViD-19, medium risk had limited contact and high risk had close contact with admitted CoViD-19 patients.¹⁶ Furthermore, participants were asked to express their perception about some work-related CoViD-19 aspects: (1) whether they feel exposed to SARS-CoV-2 and at risk for transmission during the work by patients or co-workers (yes/no); (2) the availability to PPE at their work (6-point Likert scale ranging from never to always); (3) the perceived level of education received on CoViD-19 (5-point Likert scale ranging from very poor to excellent). At the end of the questionnaire, participants were asked about their fear of CoViD-19 and reluctance to work at the time of the survey. Fear was assessed on a 5-point Likert scale ranging from “not (or no fear)” to “extremely frightened”. Reluctance to work was evaluated on a 5-point Likert scale as well, the answer possibilities ranged from: my motivation to work is “much less” to “far more” than normal. A neutral category was also possible to indicate their motivation was as usual, compared to before the CoViD-19 epidemic (“normal”).

Ethical considerations

The study was conducted following the study protocol, the Declaration of Helsinki, and applicable regulatory requirements. The Ethics Committee of the University Hospital UZ Brussels approved the protocol (Ethics Committee approval number: B143202000091). All study participants voluntarily signed written informed consent.

Statistical analysis

Descriptive statistics were applied to characterize both phases. First, absolute and relative frequencies were used to describe the parameters. Second, a heatmap visualization picturing the total proportion complemented with a McNemar-Bowker test was performed to describe the evolution of CoViD-19 related fear and motivation to work over the two phases. Third, a visual heatmap representation was plotted to describe the relationship between the two previously reported outcomes (fear of CoViD-19 and motivation to work). Fourthly, a “bivariate” analysis was performed for each independent variable towards the outcomes to select the variables of interest for further multivariable analysis. An interaction effect was defined as a

significant difference in the independent variable, remarked between each study phase, during “bivariate” analysis for prediction of the selected outcome. Then, a cumulative link mixed model was performed using the outcomes (fear of CoViD-19 and motivation to work) in function of the phase, the independent variables of interest, and a random intercept per patient. Moreover, an interaction term between phase and the variables of interest was modeled. If the main effect of a variable of interest or the interaction with that variable was statistically significant (P -value < .05), that variable was retained for inclusion in the multivariable analysis. Finally, a backward selection procedure was started in a similar way to the abovementioned models. However, multiple independent variables together with the phase effect were entered as predictors. Backward model selection was performed using the likelihood ratio test. The final multivariable models are reported in this paper using the Wald test of significance.

The conception of the current study was at the beginning of the SARS-CoV-2 epidemic, at that time no clear hypothesis was formulated. The investigators aimed only to assess the seroprevalence and the psychological impairments in employees of the UZ Brussel. Therefore, no sample size calculation was performed. However, the researchers made an effort to enroll as many participants as possible to reach a representative sample.

Analyses were performed using RStudio 1.4.1717 running on R version 4.1.0 through the ordinal R package providing the cumulative link mixed model function.¹⁸

RESULTS

Descriptive characteristics of study participants

Two thousand six hundred sixty-one employees were included in phase 1. Of them, 2336 also participated in phase 2 of the study. The response rate was 70%. Baseline characteristics of the participants can be found in Table 1.

Table 2 illustrates the work-related CoViD-19 characteristics of the UZ Brussel employees. A deviation between the two phases was noted in the perception of being exposed to SARS-CoV-2 during work hours and the availability of PPE. Respectively, 47% and 39% of the participants mentioned exposure to CoViD-19 during working hours at phases 1 and 2. PPE was always available for, respectively, 35% and 58% of participants in phases 1 and 2. Finally, positive serological

Table 2
Work-related CoViD-19 characteristics of participants over the two phases

	Phase 1 – N = 2,661		Phase 2 – N = 2,336	
Perceived exposure to COVID-19 at work*				
No	1,447	(54.40%)	1,428	(61.13%)
Yes	1,213	(45.60%)	908	(38.87%)
Perceived availability to PPE*				
Never	18	(0.68%)	10	(0.43%)
Rarely	81	(3.05%)	27	(1.16%)
Sometimes	291	(10.94%)	93	(3.98%)
Frequently	462	(17.37%)	176	(7.53%)
Very frequent	884	(33.23%)	679	(29.07%)
Always	924	(34.73%)	1,351	(57.83%)
Perceived education level about COVID-19 ¹				
Very poor	50	(1.88%)	39	(1.67%)
Poor	268	(10.08%)	229	(9.81%)
Sufficient	1,384	(52.41%)	1214	(51.99%)
Good	825	(31.02%)	743	(31.82%)
Excellent	123	(4.62%)	110	(4.71%)
Serology for SARS-CoV-2				
Negative	2,463	(92.56%)	2,151	(92.08%)
Positive	198	(7.44%)	185	(7.92%)

Phase 1: second column; Phase 2: third column.

CoViD-19, coronavirus disease 2019; PPE, personal protective equipment.

*One participant left the middle part of the survey blank in both phases.

Table 3
Levels of CoViD-19 related fear and work motivation over the two phases.

		Evolution of CoViD-19-related fear					
		Phase 2					
		Not	Slightly	Moderately	Severely	Extremely	
Phase 1	Not	84	122	30	5	0	10.32%
	Slightly	56	612	328	44	1	44.56%
	Moderately	6	128	550	136	21	36.00%
	Severely	2	11	52	90	14	7.23%
	Extremely	0	3	3	15	23	1.88%
		6.34%	37.50%	41.22%	12.41%	2.53%	
		Evolution of work motivation					
		Phase 2					
		Much less	Less	Normal	More	Far more	
Phase 1	Much less	7	12	7	0	1	1.16%
	Less	16	87	71	6	0	7.71%
	Normal	19	148	1,438	73	16	72.52%
	More	1	27	212	99	16	15.20%
	Far more	0	5	39	21	15	3.42%
		1.84%	11.94%	75.64%	8.52%	2.05%	

Evolution of fear for CoViD-19: upper part of the table; Evolution of motivation to work: lower part of the table.
CoViD-19, coronavirus disease 2019.

tests for SARS-CoV-2 among the employees were 7.4% and 7.9% respectively in phases 1 and 2.

CoViD-19 related fear, motivation to work and their evolution over time

The level of fear due to CoViD-19 and work motivation is described in Table 3 for both phases.

The most prominent fear level in phase 1 was slightly frightened (45%), while this evolved to moderately frightened in phase 2 (41%). Moreover, the number of employees mentioning a severe or extreme fear level evolved from 9% in phase 1 to 15% in phase 2. This evolution in CoViD-19 related fear was found to be statistically significant ($P < .001$).

Over the two phases, most participants had a normal motivation to work. However, the proportion of participants who were much less motivated raised from 9% in phase 1 to 14% in phase 2. On the other hand, the proportion of employees, who were much more motivated, dropped from 19% in phase 1 to 11% in phase 2. This

evolution in motivation to work was found to be statistically significant ($P < .001$).*Relationship between CoViD-19 related fear and motivation to work*

The relationship between fear due to CoViD-19 and work motivation level is shown in Figure Appendix 1. In phase 1, the most frequently observed combination was “slight” level of fear together with “normal” level of motivation. However, in phase 2, this relationship was different. The most frequently found combination was “moderate” level of fear and “normal” level of motivation.

“Bivariate” analysis for each independent variable in function of the outcomes

Variables of interest were investigated through a “bivariate” analysis complemented with a visual representation in the form of a heatmap (Figure Appendix 2 and 3).

Table 4
Multivariable relationships for CoViD-19 related fear and motivation to work

	Beta	SE	OR	95%CI OR	P value
CoViD-19 fear relationships					
<i>Phase</i>					< .001
Phase 1	Ref.				
Phase 2	0.965	0.067	2.626	2.302 - 2.996	<.001
<i>Gender</i>					<.001
Female	Ref.				
Male	-0.874	0.152	0.417	0.310 - 0.562	<.001
<i>Age</i>					<.001
< 30 years	Ref.				
30-50 years	0.602	0.172	1.826	1.303 - 2.559	<.001
> 50 years	1.299	0.189	3.665	2.532 - 5.304	<.001
<i>Risk category</i>					<.001
Low risk	Ref.				
Medium risk	-0.319	0.151	0.727	0.541 - 0.976	.034
High risk	-0.651	0.172	0.522	0.372 - 0.731	<.001
<i>Work exposition to CoViD-19</i>					<.001
No	Ref.				
Yes	0.586	0.098	1.798	1.483 - 2.180	<.001
<i>Educated about CoViD-19</i>					.008
Very poor	Ref.				
Poor	0.313	0.521	1.367	0.492 - 3.798	.548
Sufficient	-0.252	0.488	0.778	0.299 - 2.203	.606
Good	-0.494	0.493	0.610	0.232 - 1.605	.317
Very good	-0.685	0.566	0.504	0.166 - 1.529	.226
Motivation to work relationships					
<i>Phase</i>					< .001
Phase 1	Ref.				
Phase 2	-1.423	0.101	0.289	0.237 - 0.352	<.001
<i>Gender</i>					.038
Female	Ref.				
Male	0.376	0.181	1.456	1.022 - 2.076	.038
<i>PPE availability</i>					.001
Never	Ref.				
Rarely	2.272	0.875	9.701	1.746 - 53.887	.009
Sometimes	1.773	0.831	5.886	1.155 - 29.982	.033
Frequently	2.136	0.824	8.469	1.683 - 42.617	.010
Very frequently	2.380	0.819	10.807	2.172 - 53.765	.004
Always	2.488	0.817	12.032	2.426 - 59.679	.002
<i>Educated about CoViD-19</i>					.044
Very poor	Ref.				
Poor	0.212	0.644	1.236	0.350 - 4.372	.742
Sufficient	0.475	0.605	1.609	0.492 - 5.264	.432
Good	0.860	0.612	2.362	0.711 - 7.844	.160
Very good	1.099	0.704	3.000	0.755 - 11.921	.119

Multivariable relationship of fear for CoViD-19: upper part of the table.

Multivariable relationship of motivation to work: lower part of the table.

CoViD-19, coronavirus disease 2019; PPE, personal protective equipment.

Male workers experienced lower fear compared to females. Employees living alone reported lower fear levels than the other 2 groups. High-risk category workers were more likely to show less fear. Participants, who perceived an exposition to CoViD-19 during their work, independently from the department where they worked, as well as participants reporting lower PPE availability, had a higher fear level. Regarding CoViD-19 education, differences over time between the different levels were observed (interaction effect). Workers with negative serology for SARS-CoV-2 had a lower fear level over time (interaction effect).

Compared to females, male workers had a higher risk to evolve toward a lower motivation level in phase 2 (interaction effect). Over time, older employees were more likely to evolve to a higher motivation level, compared to younger workers (interaction effect). Participants belonging to the medium and high-risk category tended to evolve to a lower motivation level more easily compared to the low-risk category (interaction effect). Likewise, employees who reported feeling exposed to CoViD-19 during their work tended to evolve to a lower motivation more easily (interaction effect). Participants with higher motivation to work reported higher levels of PPE availability

and self-estimated CoViD-19 education. Participants with positive serology for CoViD-19 showed a higher level of motivation.

Multivariable analysis predicting CoViD-19 related fear and motivation to work

In the multivariable analysis fear for CoViD-19 was associated with the phase during which fear was assessed, gender, age, risk category, work exposition to CoViD-19, and the self-estimated education on CoViD-19 (Table 4, upper part). At phase 2, participants reported a significantly higher fear level compared to phase 1, adjusted for all other covariates in the model. Male workers were less likely to have higher fear levels compared to females. Participants belonging to higher risk categories had a lower probability of expressing higher fear levels compared to those belonging to the low-risk category. Employees who felt exposed to SARS-CoV-2 at work had a higher probability of expressing more fear compared to those without exposure. Participants reporting better self-estimated education on CoViD-19 had a lower fear level on average.

Regarding motivation to work, multivariable analysis showed an association with the study phase, the gender, the availability of PPE, and the self-estimated education on CoViD-19 (Table 4, lower part). In phase 2, employees reported lower motivation to work compared to phase 1, adjusted for other covariates in the model. Male workers were more likely to have a higher motivation compared to females. On average, participants who reported higher PPE availability had a higher probability of expressing higher motivation compared to those mentioning PPE shortage. Employees with a better self-estimated CoViD-19 education on average tend to have a higher motivation level.

DISCUSSION

The current prospective interventional study, including 2336 participants, estimated the psychological impairment of the employees, who worked in the University tertiary center UZ Brussel during the CoViD-19 epidemic.

Regarding Belgian epidemiologic data, a substantial higher number of CoViD-19 cases and hospitalization were observed comparing the two phases of the current study (Fig 1). A significant rise in reluctance to work, from 9% to 14%, and severe level of fear for CoViD-19, from 9% to 15%, was observed in this study. The drop of motivation and rise in fear between phases 1 and 2 was also significant in multivariable analysis. A similar fluctuation of fear related to CoViD-19 was observed in a Chinese qualitative study, which showed a higher prevalence of anxiety and fear during the peak of the epidemic.⁹

Two meta-analyses found increased anxiety in female HCW, compared to males.^{4,5} In contrast, a cross-sectional study showed significantly higher psychological distress in male HCW.¹³ In this study, female workers were associated with higher levels of fear for CoViD-19 in multivariable analysis. Reluctance to work was also higher in female participants. Nevertheless, the bivariate analysis showed that male workers lost significantly more frequently their motivation during the study period.

Three cross-sectional studies found higher psychological distress levels in older HCW.^{7,11,13} In our study, older participants were correlated to higher levels of fear for CoViD-19 in multivariable analysis. However, no association could be found between age and reluctance to work whenever adjustment for other covariates was applied. Part of this might be explained by our choice to respect the anonymity of the study participants through questioning age in categories.

An international survey on shortage of PPE identifies reusing of N95 respirator in 45% of the responder, with CoViD-19 fear and anxiety being commonly reported due to this practice.¹⁹ 36% of the internist facing PPE shortage reported lower mental health in another study.⁷ In the current study, a self-reported increase in the availability of PPE can be observed between the two phases. Shortage of PPE may have affected employees at the UZ Brussel at the beginning of the epidemic as only 35% of the responders mentioned having always access to PPE in the first phase of this study. A possible explanation is that protective measures were limited everywhere in Belgium at the beginning of the epidemic. Scarce availability of PPE was associated with reluctance to work in the multivariable analysis.

In this study, a drop in the percentage of self-perceived CoViD-19 exposure during the working hours, from 46% to 39%, was noticed. A possible explanation could be the effect of improved availability of PPE during the study period. The multivariable analysis detected an association of perceived exposure to CoViD-19 and fear due to SARS-CoV-2. No association with motivation to work persisted after adjustment for covariates. Despite the increase in the availability of PPE and the drop in self-reported working exposure, an increase in psychological impairments was reported by study participants. It could be speculated that the timing of the two study phases could have influenced the study results, as the prevalence of CoViD-19 cases and

admitted patients substantially raised in phase 2. The reduction of PPE shortage and work-related exposure might be a possible explanation for the fact that the percentage of seroconversion remained stable during the two study phases.

Two cross-sectional studies observed a more optimistic attitude in frontline HCW.^{10,13} Conversely, another study observed a higher rate of anxiety in frontline compared to second-line HCW⁵. In the current study, frontline workers were associated with a lower fear of CoViD-19. This result seems contradictory, as participants who reported a higher level of exposition to CoViD-19 patients were more likely to have a higher fear. However, increased knowledge on the virus transmission mechanisms and systematic use of PPE, by approaching each patient, might feel frontline HCW less exposed to SARS-CoV-2 than second-line HCW. Furthermore, previous studies reported lower SARS-CoV-2 seroprevalence in intensive care units dedicated to CoViD-19 patients.^{20,21} Employees classified in higher-risk categories were more likely to lose their motivation, compared to low-risk, in bivariate analysis. Finally, front-line workers, who are daily exposed to CoViD-19 patients and therefore often in psychological situations of distress, might be more susceptible to emotional traumas.²² However, at the same time, positive psychological changes might result from the mental elaboration of these traumatic experiences.^{22,23} As previously reported and in line with this study results, higher levels of trauma and post-traumatic growth are both found in front-line workers during CoViD-19 epidemics.²³ Hence, psychological interventions should be addressed to improve the positive coping and wellbeing of this group.

A cross-sectional study detected lower preparedness and education regarding CoViD-19 as a predictive factor for psychological impairments in HCW.¹² In the current study, the multivariable analysis found a correlation between lower self-reported education on CoViD-19, reluctance to work, and fear for CoViD-19. The strength of the current study is the prospective design, which allowed the analysis of the different variables of interest and outcomes during the epidemic. Furthermore, as a large number of participants, comprising also non-medical and paramedical health care profession were included, the applicability of our results is more generalizable. Finally, the results of the serological tests were also considered to assess the real prevalence of CoViD-19 within the hospital and make a distinction between self-reported levels of exposure towards CoViD-19 patients. To the best of our knowledge, this is the first large study combining the assessment of seroprevalence and psychological impairments, in terms of fear for CoViD-19 and reluctance to work, in hospital employees in a prospective manner.

Nonetheless, some limitations should be mentioned. As the current study was monocentric, its applicability could be limited. We did not use validated multidimensional questionnaires to assess fear of CoViD-19 and reluctance to work. However, to the best of our knowledge, no validated survey during the CoViD-19 epidemic could be found in literature and similar questionnaires were used in previous studies to assess fear related to CoViD-19 and motivation to work during the epidemic.^{10,13,14} Furthermore, selection bias could have influenced study results as we included only hospital employees, who worked during the entire study period, excluding participants, who presented only for the second phase of this study.

CONCLUSIONS

In conclusion, a significant rise of fear related to CoViD-19 and reluctance to work between the two study phases was observed. Female workers were more likely to experience fear and a lower motivation to work. Improvement in PPE availability and education on CoViD-19 may enhance the motivation of the hospital employees, while preventing exposure to SARS-CoV-2 during the working hours may lower fear of CoViD-19. Furthermore, frontline workers,

compared to other participants with limited or no contact with CoViD-19 patients, reported less degree of fear in the current study.

The prospective design of the study allowed us to identify a significant loss in motivation in male and frontline workers during the study course, which could be responsible for some conflicting findings reported in literature. We believe that the study's temporal setting plays a crucial role in the study results. Reluctance to work and fear to CoViD-19 in the examined hospital employees grew between the two study phases. However, the seroprevalence of SARS-CoV-2 was stable during the study time frame, and the availability of PPE even improved.

Acknowledgments

We would like to thank the infectious disease study coordinating team of the UZ Brussel for their support and particularly Ms. Virgini Van Buggenhout. Furthermore, we would like to acknowledge all the employees of the UZ Brussel, who participated in the current study.

SUPPLEMENTARY MATERIALS

Supplementary material associated with this article can be found in the online version at <https://doi.org/10.1016/j.ajic.2021.10.042>.

REFERENCES

- Guan W, Ni Z, Hu Yu, et al. Clinical characteristics of coronavirus disease 2019 in China. *New Eng J Med*. 2020;382:1708–1720.
- Moretti M, Van Laethem J, Minini A, Pierard D, Malbrain M. Ventilator-associated bacterial pneumonia in Coronavirus 2019 disease, a retrospective monocentric cohort study. *J Infect Chemother*. 2021;27:826–833.
- Schwartz J, King C, Yen M. Protecting healthcare workers during the coronavirus disease 2019 (COVID-19) outbreak: lessons from taiwan's severe acute respiratory syndrome response. *Clin Infect Dis*. 2020;71:858–860.
- Pappa S, Ntella V, Giannakas T, Giannakoulis VG, Papoutsis E, Katsaounou P. Prevalence of depression, anxiety, and insomnia among healthcare workers during the COVID-19 pandemic: a systematic review and meta-analysis. *Brain Behav Immun*. 2020;88:901–907.
- Batra K, Singh TP, Sharma M, Batra R, Schvaneveldt N. Investigating the psychological impact of COVID-19 among healthcare workers: a meta-analysis. *Int J Environ Res Public Health*. 2020;17:9096.
- Juan Y, Yuan C, Qiuxiang Y, et al. Psychological distress surveillance and related impact analysis of hospital staff during the COVID-19 epidemic in Chongqing, China. *Compr Psychiatry*. 2020;103: 152198.
- Macía-Rodríguez C, de Oña AA, Martín-Iglesias D, et al. Burn-out syndrome in Spanish internists during the COVID-19 outbreak and associated factors: a cross-sectional survey. *BMJ Open*. 2021;11: e042966.
- Nyashanu M, Pfenninger M. Exploring the challenges faced by frontline workers in health and social care amid the COVID-19 pandemic: experiences of frontline workers in the English Midlands region, UK. *J Interprof Care*. 2020;34:655–661.
- Fang M, Xia B, Tian T, Hao Y, Wu Z. Drivers and mediators of healthcare workers' anxiety in one of the most affected hospitals by COVID-19: a qualitative analysis. *BMJ Open*. 2021;11: e045048.
- Wahed WYA, Hefzy EM, Ahmed MI, Hamed NS. Assessment of knowledge, attitudes, and perception of health care workers regarding COVID-19, a cross-sectional study from Egypt. *J Community Health*. 2020;45:1242–1251.
- Leng M, Wei L, Shi X, et al. Mental distress and influencing factors in nurses caring for patients with COVID-19. *Nurs Crit Care*. 2021;26:94–101.
- Afulani PA, Gyamerah AO, Nutor JJ, et al. Inadequate preparedness for response to COVID-19 is associated with stress and burnout among healthcare workers in Ghana. *PLoS One*. 2021;16: e0250294.
- Alnazy E, Khraisat OM, Al-Bashaireh AM, Bryant CL. Anxiety, depression, stress, fear and social support during COVID-19 pandemic among Jordanian healthcare workers. *PLoS One*. 2021;16: e0247679.
- Zhang M, Zhou M, Tang F, et al. Knowledge, attitude, and practice regarding COVID-19 among healthcare workers in Henan, China. *J Hosp Infect*. 2020;105:183–187.
- Belgian national epidemiological reference database "Sciensano". Accessed June 1, 2021. <https://epistat.wiv-isp.be/covid/covid-19.html>.
- De Geyter D, Vancutsem E, Van Laere S. SARS-COV-2 seroprevalence among employees of a University Hospital in Belgium during the 2020 COVID-19 outbreak (COVEMUZ-study). *Epidemiol Infect*. 2021;149:1–24.
- Moretti M, Van Laethem J, De Geyter D, et al. Diagnostic accuracy of screening tests for patients suspected of COVID-19, a retrospective cohort study. *Infect Dis*. 2021;53:855–864.
- Christensen RHB (2019). Regression models for ordinal data. Accessed June 1, 2021. <https://github.com/runehaubo/ordinal>.
- Kea B, Johnson A, Lin A, et al. An international survey of healthcare workers use of personal protective equipment during the early stages of the COVID-19 pandemic. *J Am Coll Emerg Physicians Open*. 2021;2:e12392.
- Kantele A, Lääveri T, Kareinen L, et al. SARS-CoV-2 infections among healthcare workers at Helsinki University Hospital, Finland, spring 2020: Serosurvey, symptoms and risk factors. *Travel Med Infect Dis*. 2021;39: 101949.
- Vivier E, Pariset C, Rio S, et al. Specific exposure of ICU staff to SARS-CoV-2 seropositivity: a wide seroprevalence study in a French city-center hospital. *Ann Intensive Care*. 2021;11:75.
- Cui PP, Wang PP, Wang K, Ping Z, Wang P, Chen C. Post-traumatic growth and influencing factors among frontline nurses fighting against COVID-19. *Occup Environ Med*. 2021;78:129–135.
- Chen R, Sun C, Chen J-J, et al. A large-scale survey on trauma, burnout, and post-traumatic growth among nurses during the COVID-19 pandemic. *Int J Ment Health Nurs*. 2021;30:102–116.