A Case-Control Study of Factors Associated with SARS-CoV-2 Infection Among Healthcare Workers in Colombia.

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Abstract

Background: Healthcare Workers (HCW) are repeatedly exposed to SARS-CoV-2 infection. The aim of this study was to identify factors associated with SARS-CoV-2 infection among HCW in one of the largest cities in Colombia.

Methods: We conducted a case-control study, where cases had a positive reverse transcription-polymerase chain reaction and controls had a negative result. Participants were randomly selected and interviewed by phone. Analyses were performed using logistic regression models.

Results: A total of 110 cases and 113 controls were included. Men (AdjOR 4.1 95%CI 1.7-10), Nurses (AdjOR 11.2 95%CI 1.1-119.6), not using a high-performance filtering mask (AdjOR 2.2 95%CI 1-5.1) and inadequate use of personal protective equipment (AdjOR 4.8 95%CI 1.1-19.6) were identified as risk factors. Conversely, graduate (AdjOR 0.1 95%CI 0.01-0.5) and postgraduate (AdjOR 0.05 95%CI 0.004-0.5) education, feeling scared or nervous (AdjOR 0.5 95%CI0.2-0.9), not wearing any of gloves, hat and googles/face shields (AdjOR 0.1 95%CI0.02-0.4), and the use of high-performance filtering or a combination of fabric plus surgical mask (AdjOR 0.2 95%CI 0.1-0.8) outside the workplace were protective factors.

Conclusion: This study highlights the protection provided by high-performance filtering mask or double masking among HCW. Individual factors and the difficulties of wearing other protective equipment needs to be considered in designing, implementing and monitoring COVID-19 biosafety protocols for HCW.

Introduction

Over 55 millions of people were infected worldwide by the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) in 2020 (1). In previous coronavirus pandemic outbreaks, SARS-CoV-1 in 2003 and the Middle East Respiratory Syndrome in 2012, between 10–20% of infected people were Healthcare Workers (HCW) (2, 3). In the current pandemic, the prevalence among HCW varies between countries from 2 to 30% (4). The Coronavirus Infection Disease (COVID-19) caused by SARS-CoV-2, affects people's lives and threatens their biological (5, 6), physiological (7, 8), family and social health (9, 10). HCW are repeatedly exposed to the virus leading to an increased risk of the disease (11) and sequelae (12) compared to the general population. Hence, COVID-19 could reduce the workforce availability to respond to this emergency.

The first case of SARS-CoV-2 in Colombia was reported in March 2020. Seven months later, the Colombian National Institute of Health has informed over 16,500 infected HCW, most of whom were associated to the workplace (13). In a descriptive study of HCW in Cali, one of the largest cities in Colombia, 65% of infections were related to the workplace and the most affected were women and nursing assistants (14). To date, there is scarce evidence in Latin America, concerning risk factors for the infection particularly among HCW, who are exposed to both, workplace and community transmission. Studies are mostly from Asia, Europe and North America (15–18). They have focused on nurses and

medical staff, and they have mainly evaluated the presence of symptoms and the exposures to occupational factors, including aerosol-generating procedures (15). Cultural differences and availability of resources between countries and institutions, limit a direct extrapolation of previous findings. Less is known about the effect of factors related to potential community transmission or the risk among other hospital workers. Moreover, there is controversy abound the appropriate types of masks for HCW in community settings (19). Therefore, the aim of this study was to determine the factors associated with SARS-CoV-2 infection among HCW in Cali, Colombia.

Subjects And Methods

Study design

We conducted a case-control study in HCW who served in health care institutions in Cali, Colombia. Participants were identified by merging the database of positive reverse transcription-polymerase chain reaction (RT-PCR) results with the routine surveillance system of COVID-19 (event code 346) or acute respiratory infections (event codes 345 and 348), who were reported with or without symptoms (as part of cluster investigations), between June 10th and July 25th, 2020. This time framework matches the first peak of the epidemic curve in Cali. Cases and controls were randomly (simple random sampling without replacement) selected from those identified as HCW with a positive and negative test, respectively. The outcome status was confirmed with the database of epidemiological investigation of COVID-19 in hospitals compiled by the local health authorities of Cali and during the telephone interview. Sample size was estimated as 111 participants for each group with 80% power, 95% level of confidence, 18% of exposure among controls, Odds Ratio (OR) of 2.5, 1:1 allocation ratio, and 10% of withdrawal.

HCW were defined as those working in healthcare environments regardless of whether they were directly or indirectly involved in clinical activities such driving an ambulance or worked in a hospital or in homecare. Potential participants were contacted by phone and eligibility criteria were confirmed. Eligibility criteria were: 18 years or older, not being pregnant or having a coagulopathy, and working in a health care institution that have the potential to assist COVID-19 patients, or being in contact before they had a RT-PCR test with infectious materials such as body fluids and contaminated surfaces and supplies. The study protocol was approved by the Universidad Javeriana Cali Ethics Committee, and inform consent was obtained online for all participants.

Data collection

Data was collected by two trained researchers via telephone and using a structured questionnaire. The questionnaire included sociodemographic, clinical and lifestyle factors six months before the test result, while psychological factors referred to one month before the test. Occupational, exposure to COVID-19 cases, social behavior and personal protection equipment (PPE) factors referred to two weeks before the RT-PCR test. Height, weight and compliance to recommended PPE use were self-reported. The exposure to

a positive person was evaluated by the question: “To your knowledge, were you in contact with a person diagnosed with COVID-19, at least 2 weeks prior to the test?” A high-performance filtering mask was considered as the use of N95, P100 or M3. The use of medicines included hydroxychloroquine, ivermectin, vitamins, nutritional supplements and hormonal contraceptives before the test. Interviewers were blinded to the case status. At the end of each interview, blindness was broken to confirm the status of each participant as to prevent potential misclassification bias due to controls having a positive test after their report to the surveillance system.

Statistical analysis

Normality assumption was checked using Shapiro Wilk test. Then, study groups were described and compared using median (interquartile range) and relative frequencies for quantitative and qualitative variables, respectively. Body Mass Index (BMI) was estimated from self-reported weight and height and categorized as obese ($\geq$ 30 kg/m^2), overweight (25 to < 30 kg/m^2) and not overweight nor obese (< 25 kg/m^2). Epidemiological weeks were calculated based on the date of the test result. To account for correlation among exposures in multiple analysis, new variables were defined. The use of surgical hats, googles/face shields, and gloves were grouped as single PPE. As HCW may have work in more than one hospital area, these were classified according to risk as “high-risk” if working in COVID-19-designated zones and any of emergency room, inpatient ward or intensive care unit (ICU), as “middle risk” if did not work in a COVID-19-designated zone but in emergency or ICU, and as “low risk” if did not work in COVID-19-designated zone nor emergency nor ICU.

Mann-Whitney *U*-test and Chi-Square or Fisher test were used for comparisons as appropriate. Multiple Logistic regression models were fitted using the backward strategy and the likelihood ratio test. A variable remained in the model when partial F had a $P \leq 0.10$, when confounding effect was observed, or by its clinical relevance on the outcome (i.e; epidemiological weeks and hospital area). Model fit was evaluated by Hosmer and Lemeshow test. Calibration, specificity, and collinearity was also checked. The final model was selected considering the highest explicative ability measured by PseudoR^2. Analyses were performed using Stata version 15 (StataCorp. LP, College Station,TX).

Results

A total of 316 cases and 597 controls were selected to reach the target sample size. Among those eligible, 7/117 cases and 19/132 controls declined to participate. Finally, 110 cases and 113 controls were included (Fig. 1). RT-PCR was ordered because of symptoms in 59.2% of participants and the remaining 40.8% as part of contact tracing or institutional screening. A contact with a positive case was reported in 74% of participants; among them 61.2% have had contact with patients, 46.7% with coworkers and 14.5% with family members or friends. At the time of the interview, all HCW reported to wear some type of facemask in both the institutional and community settings. There were not differences between groups in the epidemiological week of being tested ($p = 0.18$).

Men and women using hormonal contraceptives were more frequent among cases compared to controls. The difference in the use of hormonal contraceptives was observed mainly in symptomatic women (OR = 2.05 95% Confidence Interval (CI) 0.75–5.64). Oral contraceptives were the most common type of hormonal contraception (82%). Level of education, the number of members in the household and feeling scared or nervous were also statistically significantly different between groups (Table 1). Regarding occupational factors, working in high-risk areas and doing night shifts were more frequent among cases than controls with statistical significance. Conversely, keeping distance from positive cases was less frequent among cases than controls (Table 2). For PPE, seldom wearing gloves face shield/googles or surgical hat at the workplace compared to always wearing them was protective. In addition, the use of high-performance mask or a combination of fabric plus surgical mask outside work reduced infection. By contrast, not using PPE properly every time and receiving training for the use of PPE had a statistically significant association to the RT-PCR result (Table 3)

Table 1
Association between sociodemographic, clinical, lifestyle and psychological characteristics with SARS-CoV-2 infection among HCW

Characteristics	Negative RT-PCR n = 113	Positive RT-PCR n = 110	Unadjusted OR (95%CI)	P value
Sociodemographic				
Age, years	30(26–34)	30(27–34)	0.98(0.95–1.02)	0.40
Gender, n (%)				
Female, not taking hormonal contraceptives	82(72.6)	57(51.8)	Ref	
Female, taking hormonal contraceptives	11(9.7)	16(14.6)	2.09(0.90–4.84)	0.08
Male	20(17.7)	37(33.6)	2.66(1.40–5.04)	< 0.01
Socioeconomic stratum, n (%)				
Low (1–2)	37(32.7)	31(28.18)		
Middle (3–4)	56(49.56)	68(61.82)	1.44(0.80–2.63)	0.22
High (≥ 5)	20(17.70)	11(10)	0.65 (0.27–1.57)	0.35
Ethnicity, n (%)				
Afro-colombian or indigenous	21(18.6)	24(21.8)	Ref	
No ethnic group identified	92(81.4)	86(78.2)	0.82(0.42–1.58)	0.55
Race, n (%)				
White	37(32.7)	31(28.2)	Ref	
Mestizo	63(55.8)	62(56.4)	1.17(0.65–2.12)	0.59
Black	13(11.5)	17(15.5)	1.56(0.66–3.71)	0.31
Highest educational level, n (%)				
Non-college education	50(44.2)	62(56.4)	Ref	
College graduate	40(35.4)	36(32.7)	0.72(0.40–1.30	0.28
Postgraduate education	23(20.4)	12(10.9)	0.42(0.19–0.93)	0.03
Marital status, n (%)				
Married or in common law	41(36.3)	45(40.9)	Ref	

HBP: High Blood Pressure, DM: Diabetes Mellitus

Characteristics	Negative RT-PCR n = 113	Positive RT-PCR n = 110	Unadjusted OR (95%CI)	P value
Single or Divorced	72(63.7)	65(59.1)	0.82(0.48–1.41)	0.48
Number of members in household, n (%)				
<=1	24(21.2)	37(33.6)	Ref	
> 2	89(78.8)	73(66.4)	0.53(0.29–0.97)	0.04
Epidemiological weeks, weeks	27(25–28)	27(26–28)	1.11(0.95–1.30)	0.18
Clinical, Life Style and Psychological risk factors				
Obesity, n (%)				
Not overweight nor obese	53(47.7)	44(40.4)	Ref	
Overweight	41(36.9)	49(45.0)	1.44(0.81–2.56)	0.22
Obese	17(15.3)	16(14.7)	1.13(0.51–2.5)	0.76
Chronic disease, n (%)				
No	100(88.50)	95(86.36)	Ref	
Yes (HBP, DM, Asthma Hypothyroidism)	13(11.50)	15(13.64)	1.21(0.54–2.68)	0.63
Medication intake, n (%)				
Vitamins or supplements (yes)	20(26.55)	20(18.88)	0.61(0.32–1.16)	0.14
Chloroquine or Ivermectin (yes)	14(12.4)	7(6.4)	0.48(0.19–1.24)	0.13
Smoking habit, n (%)				
No	92(81.42)	85(77.27)	Ref	
Former or current smoker	21(18.58)	25(22.73)	1.28(0.67–2.47)	0.44
Alcohol intake, n (%)				
Never	32(28.3)	44(40.0)	Ref	
Monthly intake	71(62.8)	57(51.8)	0.58(0.33–1.04)	0.07
Weekly intake	10(8.8)	9(8.2)	0.65(0.24–1.8)	0.41
Feeling scared or nervous, n (%)				
Never	41(36.3)	57(51.8)	Ref	

HBP: High Blood Pressure, DM: Diabetes Mellitus

Characteristics	Negative RT-PCR n = 113	Positive RT-PCR n = 110	Unadjusted OR (95%CI)	P value
Sometimes	72(63.7)	53(48.2)	0.53(0.31–0.9)	0.02
Insomnia, n (%)				
Never	49(43.4)	52(47.3)	Ref	
Sometimes	64(56.6)	58(52.7)	0.85(0.5–1.45)	0.56
HBP: High Blood Pressure, DM: Diabetes Mellitus				

Table 2
Association between occupational, exposure and social behavior factors and SARS-CoV-2 infection among HCW

Characteristics	Negative RT-PCR n = 113	Positive RT-PCR n = 110	Unadjusted OR (95%CI	P value
Occupational factors				
Occupation, n (%)				
Nursing Assistant	31(27.4)	38(34.5)	Ref	
Nurse	18(15.9)	19(17.3)	0.86(0.39–1.91)	0.71
Physician	25(22.12)	18(16.36)	0.58(0.27–1.27)	0.17
Other healthcare professionals[a]	12(10.62)	10(22.7)	0.68(0.26–1.78)	0.43
Technicians	12(10.62)	15(13.64)	1.01(0.42–2.49)	0.96
Administrative Staff	15(13.3)	10(9.1)	0.54(0.21–1.37)	0.19
Workplace risk area, n (%)				
Worked in a COVID-19 zone (yes)	47(41.6)	52(47.3)	1.25(0.74–2.13)	0.39
Worked in a high-risk area (yes)	54(47.8)	70(63.6)	1.91(1.12–3.27)	0.02
Number of institutions working, n (%)				
1	104(92.0)	101(91.8)	Ref	
≥ 2	9(8.0)	9(8.2)	1.03(0.39–2.7)	0.95
Work hours per day, hrs	10(8–12)	12(8–12)	1.1(0.98–1.22)	0.10
Night shifts, n (%)				
No	61(53.98)	42(38.18)	Ref	
Yes	52(46.02)	68(61.82)	1.89(1.11–3.23)	0.02
SARS-COV-2 Exposure and Social Behavior Factors				
Contact with a positive case, n (%)				
No contact	29(25.7)	29(26.4)	Ref	
Yes, family or work colleagues	42(37.2)	22(20.0)	0.52(0.25–1.09)	0.08
Yes, patients	42(37.2)	59(53.6)	1.4(0.73–2.69)	0.30

[a]mainly dentists and physiotherapists

Characteristics	Negative RT-PCR n = 113	Positive RT-PCR n = 110	Unadjusted OR (95%CI	P value
Kept distance from the positive case (< 1 meter), n (%)				
Does not apply	29(25.66)	29(26.36)	Ref	
No	74(65.49)	79(71.82)	1.06(0.58–1.95)	0.83
Yes	10(8.85)	2(1.82)	0.20(0.04–0.99)	0.05
Shared Closed Spaces with the Positive Case, n (%)				
Does not apply	29(25.7)	29(26.4)	Ref	
No	15(13.3)	5(4.5)	0.33(0.11–1.04)	0.06
Yes	69(61.1)	76(69.1)	1.1(0.6–2.03)	0.76
Shared more than 15 minutes with the positive case, n (%)				
Does not apply	29(25.7)	29(26.4)	Ref	
No	17(15.0)	14(12.7)	0.82(0.34–1.98)	0.66
Yes	67(59.3)	67(60.9)	1(0.54–1.85)	1
Was exposed to secretions of the positive case, n (%)				
Does not apply	29(25.7)	29(26.4)	Ref	
No	71(62.8)	56(50.9)	0.79(0.42–1.47)	0.45
Yes	13(11.5)	25(22.7)	1.92(0.83–4.48)	0.13
Was in contact with positive case belongings, n (%)				
Does not apply	29(25.7)	29(26.4)	Ref	
No	53(46.9)	42(38.2)	0.79(0.41–1.53)	0.49
Yes	31(27.4)	39(35.5)	1.26(0.63–2.53)	0.52
Was in contact with surfaces around the positive case, n (%)				
Does not apply	29(25.7)	29(26.4)	Ref	
No	25(22.1)	12(10.9)	0.48(0.2–1.13)	0.09
Yes	59(52.2)	69(62.7)	1.17(0.63–2.18)	0.62
Handwashing with alcohol, n (%)				

[a]mainly dentists and physiotherapists

Characteristics	Negative RT-PCR n = 113	Positive RT-PCR n = 110	Unadjusted OR (95%CI	P value
Always	91(80.5)	89(80.9)	Ref	
Sometimes /few times	22(19.5)	21(19.1)	0.98(0.5–1.9)	0.94
Handwashing with soap, n (%)				
Always	98(86.7)	97(88.2)	Ref	
Sometimes /few times	15(13.3)	13(11.8)	0.88(0.4–1.94)	0.74
Shared spaces at work, n (%)				
Cafeteria (yes)	42(37.2)	38(34.5)	0.89(0.52–1.54)	0.68
Resting places (yes)	14(12.4)	22(20.0)	1.77(0.85–3.66)	0.13
Elevator (yes)	29(25.7)	23(20.9)	0.77(0.41–1.43)	0.40
Shared food with peers, n (%)				
No	88(77.9)	84(76.4)	Ref	
Yes	25(22.1)	26(23.6)	1.09(0.58–2.04)	0.79
Means of transportation to work, n (%)				
None or private	84(74.34)	77(70)	Ref	
Taxi, Ridesharing, Public transportation	29(25.66)	33(30)	1.24(0.69–2.23)	0.47
Outings besides work, n(%)				
To the bank (yes)	14(12.4)	23(20.9)	1.87(0.91–3.86)	0.09
To the supermarket/store (yes)	81(71.7)	66(60)	0.59(0.34–1.03)	0.07
To the drugstore (yes)	8(7.1)	4(3.6)	0.5(0.14–1.69)	0.26
Social gatherings at own house, n (%)				
Never	70(61.9)	67(60.9)	Ref	
Few/ seldom times	30(26.5)	31(28.2)	1.08(0.59–1.97)	0.80
Sometimes/ always	13(11.5)	12(10.9)	0.96(0.41–2.26)	0.93
Social gatherings at someone else's house, n (%)				
Never	67(59.3)	65(59.1)	Ref	

[a]mainly dentists and physiotherapists

Characteristics	Negative RT-PCR n = 113	Positive RT-PCR n = 110	Unadjusted OR (95%CI	P value
Few/ seldom	35(31.0)	34(30.9)	1(0.56–1.79)	1
Sometimes/ always	11(9.7)	11(10.0)	1.03(0.42–2.54)	0.95
[a]mainly dentists and physiotherapists				

Table 3
Association between personal protection equipment at work and in the community and SARS-CoV-2 infection among HCW

Characteristics	Negative RT-PCR n = 113	Positive RT-PCR n = 110	Unadjusted OR (95%CI	P value
Use of High-performance filtering mask, n (%)				
Always	51(45.13)	47(42.73)	Ref	
Not always or another mask	62(54.87)	63(57.27)	1.1(0.65–1.86)	0.72
Gloves, n(%)				
Always	58(51.3)	72(65.5)		
Not always	55(48.7)	38(34.5)	0.56(0.32–0.95)	0.03
Face shield or goggles, n (%)				
Always	65(57.5)	77(70.0)		
Not always	48(42.5)	33(30.0)	0.58(0.33–1.01)	0.05
Surgical hat, n (%)				
Always	52(46)	73(66.4)	Ref	
Not always	61(54)	35(33.6)	0.43(0.25–0.74)	< 0.01
Shoe covers, n (%)				
Always	18(15.93)	21(19.09)	Ref	
Not always	95(84.07)	89(80.91)	0.80(0.40–1.60)	0.53
Coveralls, suit, or anti-fluid gown, n (%)				
Always	19(16.81)	13(11.8)	Ref	
Not always	94(83.19)	97(88.2)	1.51(0.71–3.22)	0.29
Gowns including disposable gowns, n (%)				
Always	52(46.02)	48(43.6)	Ref	
Not always	61(53.98)	62(56.4)	1.10(0.65–1.87)	0.72
Used PPE properly, n (%)				
Many times	108(95.6)	97(88.2)	Ref	
Sometimes /few times	5(4.4)	13(11.8)	2.89(1-8.42)	0.05

Characteristics	Negative RT-PCR n = 113	Positive RT-PCR n = 110	Unadjusted OR (95%CI	P value
Training PPE support, n (%)				
None	20(17.7)	9(8.2)	Ref	
< 2 hours	60(53.1)	62(56.4)	2.3(0.97–5.44)	0.06
≥ 2 hours	33(29.2)	39(35.5)	2.63(1.05–6.54)	0.04
Type of facemask outside of work, n (%)				
Surgical mask	69(61.06)	79(71.82)	Ref	
High-performance or fabric plus surgical mask	27(23.89)	12(10.91)	0.39(0.18–0.82)	0.01
Only fabric mask	17(15.04)	19(17.27)	0.98(0.47–2.02)	0.95

In the multivariate model, gender was an independent factor associated with infection: being a man or a woman using hormonal contraceptives, although the later did not reach statistical significance. To be a nurse was significantly associated with a positive RT-PCR, but the confidence interval was wide. Other healthcare professionals, physicians, and administrative staff showed an increased risk when compared to nursing assistants; however, p-values were above 0.05. A statistically significant association was observed between PPE use and the RT-PCR result when HCW did not always wear a high-performance filtering mask or did not use PPE properly. Receiving training remained in the model as a risk for infection but without statistically significance. The protective factors were postgraduate education, the use of a high-performance mask outside the workplace, not wearing any of surgical hat, face shields/goggles or gloves, and feeling scared or nervous sometimes. (Table 4).

Table 4
Multiple regression model of factors associated with SARS-CoV-2 infection in HCW. (Model also adjusted by epidemiological week and hospital area)

Characteristics	Adjusted OR (95% CI)	P value
Gender		
Female, not taking hormonal contraceptives	Ref	
Female, taking hormonal contraceptives	2.72(0.91–8.13)	0.07
Male	4.13(1.70-10.05)	< 0.01
Highest educational level,		
Non-college education	Ref	
College graduate	0.06(0.01–0.53)	0.01
Postgraduate education	0.05(0.005–0.47)	< 0.01
Number of members in the household		
<=1	Ref	
> 2	0.47(0.21–1.04)	0.06
Feeling scared or nervous		
Never	Ref	
Sometimes	0.45(0.22–0.91)	0.03
Alcohol intake		
Never	Ref	
Monthly intake	0.50(0.23–1.07)	0.08
Weekly intake	0.58(0.16–2.16)	0.42
Occupation		
Nursing Assistant	Ref	
Nurse	11.24(1.05-119.63)	< 0.05
Physician	8.36(0.81–85.36)	0.07
Other healthcare professionals[a]	11.44(0.88–148.70)	0.06
Technicians	2.49(0.71–8.67)	0.15
Administrative Staff	3.99(0.91–17.66)	0.07

[a]mainly dentists and physical therapists

Characteristics	Adjusted OR (95% CI)	P value
Use of High-performance filtering mask		
Always	Ref	
Not always or another face mask	2.27(1.02–5.05)	0.04
Always wear a hat, face shield/goggles or gloves		
Yes, all three of them	Ref	
Yes, only two	0.69(0.25–1.96)	0.49
Yes, only one	0.35(0.13–0.98)	< 0.05
None	0.10(0.02–0.41)	< 0.01
Used PPE properly		
Yes	Ref	
No	4.82(1.18–19.65)	0.03
Type of facemask outside of work		
Surgical mask	Ref	
High-performance or fabric plus surgical mask	0.27(0.09–0.80)	0.02
Only fabric mask	0.84(0.32–2.20)	0.73
Training PPE support,		
None	Ref	
< 2 hours	2.73(0.83–8.92)	0.10
≥ 2 hours	3.42(0.97–12.01)	0.06
[a]mainly dentists and physical therapists		

Discussion

This study sought to identify factors associated with SARS-CoV-2 infection among HCW to improve interventions aimed at reducing the risk in these front-line workers. After considering a wide range of characteristics, we found sociodemographic, lifestyle, psychological factors, and PPE use in and outside the workplace were the most relevant to have a positive RT-PCR. In particular, the results highlight the effectiveness of PPE in this population, demonstrating a greater protective effect of high-efficiency masks when compared to other types of masks when use in and outside the workplace. However, we observed unexpected results regarding the impact of PPE usage training as well as the effectiveness of some PPE elements such as surgical hats, face shields/googles and gloves.

In this study, all HCW wore some type of facemask at work. Based on our results, those always-wearing high-performance filtering masks had a better protection when compared to those wearing them occasionally or wearing other types of facemasks. This is in line with a previous meta-analysis suggesting that N95 mask could be more strongly associated with protection from viral transmission than surgical masks (20). However, low certainty evidence suggests that surgical masks and N95 respirators offer similar protection against coronavirus in non-aerosol-generating care (21). One study even reported an increased risk of N95 compared to surgical mask, but that study only adjusted for age as a potential confounder (22). Different types of masks, manufacturer standards, and the evaluation of potential confounders may explain discordances between studies.

There is not clear recommendation for the type of mask that HCW need to wear in “low risk” areas in the hospitals or even outside the workplace. For example, the evidence comparing the efficacy of N95 respirators to surgical masks in the outpatient setting is scarce (19, 23). Our results suggest that fabric and surgical masks performed similarly, while wearing high-performance filtering masks or a combination of fabric plus surgical mask reduces the risk of infection compared to the use of surgical mask exclusively (24). A recent experiment demonstrated that the combination of the fabric mask covering the surgical mask blocked 92.5% of the cough particles, which double the filtration capacity of each mask alone (25). Therefore, HCW could be advised to wear high-performance mask even when they are not directly taking care of COVID-19 patients, or in case of a shortage, low resource settings or high cost of high-performing masks, a combination of fabric plus surgical mask as an alternative. In any case, emphasis needs to be given to the proper use of PPE as previously stated (15, 26, 27). PPE fit is an important component in their functional efficacy. Surgical masks and fabric masks do not require special fitting. Nonetheless, it has been shown that even non-fit-tested N95 respirators were significantly more protective than surgical masks (28).

It is expected that the use of PPE including face masks, hats, gowns, shoe covers, gloves, or face shields are associated with decreased risk, but there are not necessarily so when included in multiple regression models (29). In general, the evidence for the effectiveness of face shields in preventing transmission of viral respiratory diseases is limited (23). Controversially, our study reported a greater risk among those who always wore face shields/goggles, gloves and surgical hats. We believe that certain behaviors for example, sharing reusable PPE e.g; face shields, without appropriate cleaning and disinfection protocols, or relaxing their use while taking rest, might contribute to the transmission. PPE could also provide a false sense of security resulting in self-contamination during patient´s care and doffing process (30). It has been reported that half of HCW correctly remove their PPE, and very few dispose them in the proper location (31, 32). Common reported errors are doffing gown from the front, removing face shield, and touching potentially contaminated surfaces during doffing (33). Glove and gown removal simulations showed that self-contamination of skin or clothing occurred in 46% of simulations (34). Then, respiratory hygiene programs including adequate training activities and on-site PPE monitoring strategies, are required to decrease the risk of inappropriate use of PPE. In this regard, an unexpected finding of our study was the almost significant association between being trained and being positive. More than 50% or

HCW had received PPE training for less than 2 hours, which could be insufficient and might explain, at least in part, this result.

We also showed a differential effect of gender and hypothesized about the potential role of hormonal contraceptives intake in infection. Our results support a greater risk of having a positive RT-PCR among men. Testosterone suppresses the innate immune responses (35), and seems to increase renin-angiotensin protein system and angiotensin converting enzyme (ACE) activity, while estrogen decreases them (36). Additionally, ACE2 is also present in testicles (37). These findings may suggest that a differential expression of ACE2 between males and females and could explain, at least in part, the gender differences in COVID-19 susceptibility. On the other hand, a previous meta-analysis showed that women are about 50% more likely than men to adopt and practice non-pharmaceutical interventions (38), suggesting a better compliance with biosafety measures among women. The greater risk of SARS-CoV-2 among men was also reported in HCW in India (26); however, some studies in the general population have reported a greater risk among women (17, 39). Differences in the amount and type of contact patterns could explain these discrepancies, as could be the case of women having predominant roles as caregivers in the general population.

Notably, we observed a differential but no significant risk among women according to the use of hormonal contraceptives. Like testosterone, progesterone generally inhibits inflammatory innate immune responses by promoting an anti-inflammatory state and suppressing the activation of macrophages and dendritic cells (40). This anti-inflammatory environment contributes to a greater bacterial burden of *Mycobacterium tuberculosis* (41) (40) and might play a similar role in SARS-CoV-2. However, estrogens at low dose have an immune stimulatory activity, which is the case of oral contraceptives (42). Therefore, combine birth control pills, might contribute to symptomatic infections (43). This could explain the higher prevalence of cases particularly among those symptomatic women who had used hormonal contraceptives. However, we did not evaluate whether the contraceptive was progestogen or combined based. Therefore, this specific result should be considered as exploratory and requires further evaluation.

Psychological factors such as feeling scared or nervous showed a protective effect. Notwithstanding stress is a negative consequence of the pandemic, our study supports that certain amount of stress might confer protection. Despite we did not evaluated the source of stress, anxious individuals are less confident in their abilities to managing threated situations (44). Therefore, they are more sensitive to feedback and to be hyper vigilant in monitoring their surroundings and themselves which leads to strategic actions to avoid harm (45). However, it is not clear whether this apparent protective effect observed before the first peak of cases could persist through the duration of the pandemic. On the other hand, the greater risk among less-educated adults compared to university graduated is consistent with a previous report (46). We also observed a trend to a lower risk among those living with more than two persons in the household. One reason could be that HCW adhere more to biosafety measures if they feel responsible for their family. On the contrary, comorbidities previously associated with severity (47–49) were not associated with the infection in our study (50).

Despite nursing assistants represented the largest proportion of HCW among those who tested positive (14), our study reports a greater risk among nurses when compared to them; however, the precision of this estimation was low. Nurses directly care positive patients and practice procedures including bronchial aspiration. Other healthcare professionals such as respiratory therapists and physicians are also at high risk of exposure. Administrative staff are not expose to such procedures; however, they could be less supported concerning the use of PPE and biosafety measures. Other occupational characteristics previously reported as risks factors were not independently associated, such as sharing spaces for food consumption (51), night shift (52) or daily work hours (18).

Strategies to minimize potential biases included blindness of interviewers to prevent the observer bias, and confirming the participant status to avoid misclassification of cases and controls were implemented. However, we acknowledge that recall bias could have been present, though we anticipate its impact to be non-differential given that the time between the RT-PCR results and the interview were similar between groups. The proportion of proper PPE use may have been overestimated in both cases and controls, since this variable was self-reported. The quality of training, whether donning and doffing procedures were both included, or whether training prioritize certain PPE, was not evaluated and warrants further studies. This study was performed close to the first peak of cases in Colombia when personal and institutional biosafety measures were reinforced to prevent contagion. This might explain the homogeneity of cases and controls in certain COVID-19 related exposures and PPE use. In this context, the sample size could be insufficient to detect small differences between the groups. Residual confounding could also be present for certain variables such as the type of alcoholic beverage or number of mask layers. Other variables as the reuse or sharing PPE, doffing practices, or the prevalence of the infection in the place of residence were not evaluated. The employed workforce tends to have fewer sick people and may behave differently regarding the PPE use, which limit the extrapolation of our result to the general population.

In conclusion, high-performance filtering masks used in and outside workplace were protective for SARS-CoV-2 infection among HCW independent of the level of exposure. Gender, level of education together with occupational and personal characteristics, influence the risk of infection and need to be considered when planning public health and hospital infection prevention strategies. As the pandemic progresses, the quality of training and monitoring strategies of PPE use becomes more relevant for HCW both in and outside the workplace. Further research is warranted 1) to identify the types of errors that might occur in using PPE, 2) to evaluate and improve adherence to recommended protocols for PPE donning and doffing, 3) to identify effective means, contents and quality standards of training, and 4) to identify the potential risk of hormonal contraceptives in symptomatic SARS-CoV-2 infection.

Abbreviations

ACE: Angiotensin Converting Enzyme

CI: Confidence Interval

COVID-19: Coronavirus Infection Disease 2019

DM: Diabetes Mellitus

HCW: Health Care Worker

HBP: High Blood Pressure

PPE: Personal Protection Equipment

ICU: Intensive Care Unit

OR: Odds Ratio

RT-PCR: Reverse Transcription-Polymerase Chain Reaction

SARS-CoV-2: Severe Acute Respiratory Syndrome Coronavirus 2

Declarations

Ethical approval and consent to participate: Informed consent was obtained from all participants. All methods were carried out in accordance with relevant guidelines and regulations. The study protocol was approved by the Universidad Javeriana Cali Ethics Committee.

Consent for publication: Not applicable

Data availability: The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Conflict of interest: None declared

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Authors' contributions: MR-L: Conception and design of the study, data collection, funding acquisition, statistical analysis, data interpretation, writing of the article and review and approval of the final version. LO: conception and design of the study, data collection, funding acquisition, statistical analysis, data interpretation, review and approval of the final version BP: Conception and designed of the study, funding acquisition, data collection and interpretation, review and approval of the final version. MS: Conception and designed of the study, data collection and interpretation, review and approval of the final version. EV & LR: Data collection, review and approval of the final version. GA: Conception and designed of the study, data collection and interpretation, review and approval of the final version. LA & JH: Data collection and interpretation, review and approval of the final version.

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References

1. Progressier. The Coronavirus App 2020 Available at: https://coronavirus.app/map. (accessed 1 January 2021).
2. World Health Organization. Summary of probable SARS cases with onset of illness from 1 November 2002 to 31 July 2003 2003. Available at: https://www.who.int/csr/sars/country/table2004_04_21/en/ (accessed 1 January 2021).
3. World Health Organization. Epidemic and pandemic-prone diseases MERS situation update, January 2020 2019. Available at: https://applications.emro.who.int/docs/EMCSR246E.pdf?ua=1. (accessed 1 January 2021).
4. Harrison D, Muradali K, El Sahly H, Bozkurt B, Jneid H. Impact of the SARS-CoV-2 pandemic on health-care workers. Hosp Pract 2020: 48; 4:161-4 https://doi.org/10.1080/21548331.2020.1771010
5. Azer SA. COVID-19: pathophysiology, diagnosis, complications and investigational therapeutics. New Microbes New Infect. 2020; 37:100738. https://doi.org/10.1016/j.nmni.2020.100738
6. Wu L, O'Kane AM, Peng H, Bi Y, Motriuk-Smith D, Ren J. SARS-CoV-2 and cardiovascular complications: From molecular mechanisms to pharmaceutical management. Biochem Pharmacol. 2020;178:114114. https://doi.org/10.1016/j.bcp.2020.114114
7. Aksoy YE, Koçak V. Psychological effects of nurses and midwives due to COVID-19 outbreak: The case of Turkey. Arch Psychiatr Nurs. 2020;34(5):427-33. https://doi.org/10.1016/j.apnu.2020.07.011
8. Luo M, Guo L, Yu M, Jiang W, Wang H. The psychological and mental impact of coronavirus disease 2019 (COVID-19) on medical staff and general public - A systematic review and meta-analysis. Psychiatry Res. 2020;291:113190. https://doi.org/10.1016/j.psychres.2020.113190
9. Solis J, Franco-Paredes C, Henao-Martínez AF, Krsak M, Zimmer SM. Structural Vulnerability in the U.S. Revealed in Three Waves of COVID-19. Am J Trop Med Hyg. 2020;103(1):25-7. https://doi.org/10.4269/ajtmh.20-0391
10. Fisayo T, Tsukagoshi S. Three waves of the COVID-19 pandemic. Postgrad Med J. 2020. http://dx.doi.org/10.1136/postgradmedj-2020-138564
11. Barrett ES, Horton DB, Roy J, Gennaro ML, Brooks A, Tischfield J, et al. Prevalence of SARS-CoV-2 infection in previously undiagnosed health care workers in New Jersey, at the onset of the U.S. COVID-19 pandemic. BMC Infect Dis. 2020;20(1):853. https://doi.org/10.1186/s12879-020-05587-2
12. Ngai JC, Ko FW, Ng SS, To KW, Tong M, Hui DS. The long-term impact of severe acute respiratory syndrome on pulmonary function, exercise capacity and health status. Respirology. 2010;15(3):543-50. https://doi.org/10.1111/j.1440-1843.2010.01720.x
13. Instituto Nacional de Salud. COVID-19 en personal de salud en Colombia | Boletín No. 52 | 21-10-2020 2020. Available at: https://www.ins.gov.co/Noticias/Paginas/coronavirus-personal-salud.aspx. (accessed 13 January 2021).

14. Torres M, Holguín J, Alarcón L, Arturo G, Luna A, Murillo S, et al. Análisis descriptivo de los casos positivos para COVID-19 del sector salud, Santiago de Cali-Colombia 2020. Gaceta Sanitaria. 2020;34:285-6
15. Gómez-Ochoa SA, Franco OH, Rojas LZ, Raguindin PF, Roa-Díaz ZM, Wyssmann BM, et al. COVID-19 in Healthcare Workers: A Living Systematic Review and Meta-analysis of Prevalence, Risk Factors, Clinical Characteristics, and Outcomes. Am J Epidemiol. 2021;190(1): 161-175 https://doi.org/10.1093/aje/kwaa191 .
16. Iversen K, Bundgaard H, Hasselbalch RB, Kristensen JH, Nielsen PB, Pries-Heje M, et al. Risk of COVID-19 in health-care workers in Denmark: an observational cohort study. Lancet Infect Dis. 2020;20(12): 1404-8 https://doi.org/10.1016/S1473-3099(20)30589-2
17. Liu T, Liang W, Zhong H, He J, Chen Z, He G, et al. Risk factors associated with COVID-19 infection: a retrospective cohort study based on contacts tracing. Emerg Microbes Infect. 2020;9(1):1546-53. https://doi.org/10.1080/22221751.2020.1787799
18. Ran L, Chen X, Wang Y, Wu W, Zhang L, Tan X. Risk Factors of Healthcare Workers with Corona Virus Disease 2019: A Retrospective Cohort Study in a Designated Hospital of Wuhan in China. Clin Infect Dis. 2020; 71(16):2218-2221. https://doi.org/10.1093/cid/ciaa287
19. Chou R, Dana T, Jungbauer R, Weeks C. Update Alert 3: Masks for Prevention of Respiratory Virus Infections, Including SARS-CoV-2, in Health Care and Community Settings. Ann Intern Med. 2020. https://doi.org/10.7326/L20-1292
20. Chu DK, Akl EA, Duda S, Solo K, Yaacoub S, Schünemann HJ, et al. Physical distancing, face masks, and eye protection to prevent person-to-person transmission of SARS-CoV-2 and COVID-19: a systematic review and meta-analysis. Lancet. 2020;395(10242):1973-87. https://doi.org/10.1016/S0140-6736(20)31142-9
21. Bartoszko JJ, Farooqi MAM, Alhazzani W, Loeb M. Medical masks vs N95 respirators for preventing COVID-19 in healthcare workers: A systematic review and meta-analysis of randomized trials. Influenza Other Respir Viruses. 2020;14(4):365-73. https://doi.org/10.1111/irv.12745.
22. Piapan L, De Michieli P, Ronchese F, Rui F, Mauro M, Peresson M, et al. COVID-19 outbreak in healthcare workers in hospitals in Trieste, North-east Italy. J Hosp Infect. 2020; 106(3):626-8. https://doi.org/10.1016/j.jhin.2020.08.012
23. Garcia LR, Jones AE, Anderson TN, Fisher CL, Seeley KML, Beeson EA, et al. Facial protection for healthcare workers during pandemics: a scoping review. BMJ Glob Health. 2020;5(5):e002553 https://doi.org/10.1136/bmjgh-2020-002553
24. Xiao J, Fang M, Chen Q, He B. SARS, MERS and COVID-19 among healthcare workers: A narrative review. J Infect Public Health. 2020;13(6):843-8. https://doi.org/10.1016/j.jiph.2020.05.019
25. Brooks JT., Beezhold DH., Noti JD., et al. Maximizing Fit for Cloth and Medical Procedure Masks to Improve Performance and Reduce SARS-CoV-2 Transmission and Exposure, 2021. Center for Disease Control and Prevention Morbidity and Mortality Weekly Report. 2021;70. Available at: https://www.cdc.gov/mmwr/volumes/70/wr/mm7007e1.htm

26. Chatterjee P, Anand T, Singh KJ, Rasaily R, Singh R, Das S, et al. Healthcare workers & SARS-CoV-2 infection in India: A case-control investigation in the time of COVID-19. Indian J Med Res. 2020;151(5):459-67. https://doi.org/10.4103/ijmr.IJMR_2234_20
27. Chou R, Dana T, Buckley DI, Selph S, Fu R, Totten AM. Epidemiology of and Risk Factors for Coronavirus Infection in Health Care Workers: A Living Rapid Review. Ann Intern Med. 2020;173(2):120-36. https://doi.org/10.7326/M20-1632
28. MacIntyre CR, Wang Q, Cauchemez S, Seale H, Dwyer DE, Yang P, et al. A cluster randomized clinical trial comparing fit-tested and non-fit-tested N95 respirators to medical masks to prevent respiratory virus infection in health care workers. Influenza Other Respir Viruses. 2011;5(3):170-9. https://doi.org/10.1111/j.1750-2659.2011.00198.x
29. Chou R, Dana T, Buckley DI, Selph S, Fu R, Totten AM. Update Alert 3: Epidemiology of and Risk Factors for Coronavirus Infection in Health Care Workers. Ann Intern Med. 2020;173(6):W123-W4. https://doi.org/10.7326/L20-1005
30. Reddy SC, Valderrama AL, Kuhar DT. Improving the Use of Personal Protective Equipment: Applying Lessons Learned. Clin Infect Dis. 2019;69(Suppl 3):S165-S70. https://doi.org/10.1093/cid/ciz619
31. Zellmer C, Van Hoof S, Safdar N. Variation in health care worker removal of personal protective equipment. Am J Infect Control. 2015;43(7):750-1. https://doi.org/10.1016/j.ajic.2015.02.005
32. Katanami Y, Hayakawa K, Shimazaki T, Sugiki Y, Takaya S, Yamamoto K, et al. Adherence to contact precautions by different types of healthcare workers through video monitoring in a tertiary hospital. J Hosp Infect. 2018;100(1):70-5. https://doi.org/10.1016/j.jhin.2018.01.001
33. Phan LT, Maita D, Mortiz DC, Weber R, Fritzen-Pedicini C, Bleasdale SC, et al. Personal protective equipment doffing practices of healthcare workers. J Occup Environ Hyg. 2019;16(8):575-81. https://doi.org/10.1080/15459624.2019.1628350
34. Tomas ME, Kundrapu S, Thota P, Sunkesula VC, Cadnum JL, Mana TS, et al. Contamination of Health Care Personnel During Removal of Personal Protective Equipment. JAMA Intern Med. 2015;175(12):1904-10. https://doi.org/10.1001/jamainternmed.2015.4535
35. Conti P, Younes A. Coronavirus COV-19/SARS-CoV-2 affects women less than men: clinical response to viral infection. J Biol Regul Homeost Agents. 2020;34(2):339-43. https://doi.org/10.23812/Editorial-Conti-3
36. Komukai K, Mochizuki S, Yoshimura M. Gender and the renin-angiotensin-aldosterone system. Fundam Clin Pharmacol. 2010;24(6):687-98. https://doi.org/10.1111/j.1472-8206.2010.00854.x
37. Hindson J. COVID-19: faecal-oral transmission? Nat Rev Gastroenterol Hepatol. 2020;17(5):259. https://doi.org/10.1038/s41575-020-0295-7
38. Moran KR, Del Valle SY. A Meta-Analysis of the Association between Gender and Protective Behaviors in Response to Respiratory Epidemics and Pandemics. PLoS One. 2016;11(10):e0164541 https://doi.org/10.1371/journal.pone.0164541
39. Jing QL, Liu MJ, Zhang ZB, Fang LQ, Yuan J, Zhang AR, et al. Household secondary attack rate of COVID-19 and associated determinants in Guangzhou, China: a retrospective cohort study. Lancet

Infect Dis. 2020;20(10):1141-50. https://doi.org/10.1016/S1473-3099(20)30471-0

40. Hall OJ, Klein SL. Progesterone-based compounds affect immune responses and susceptibility to infections at diverse mucosal sites. Mucosal Immunol. 2017;10(5):1097-107. https://doi.org/10.1038/mi.2017.35
41. Hall OJ, Limjunyawong N, Vermillion MS, Robinson DP, Wohlgemuth N, Pekosz A, et al. Progesterone-Based Therapy Protects Against Influenza by Promoting Lung Repair and Recovery in Females. PLoS Pathog. 2016;12(9):e1005840. https://doi.org/10.1371/journal.ppat.1005840
42. Klein SL, Flanagan KL. Sex differences in immune responses. Nat Rev Immunol. 2016;16(10):626-38. https://doi.org/10.1038/nri.2016.90
43. Channappanavar R, Fett C, Mack M, Ten Eyck PP, Meyerholz DK, Perlman S. Sex-Based Differences in Susceptibility to Severe Acute Respiratory Syndrome Coronavirus Infection. J Immunol. 2017;198(10):4046-53. https://doi.org/10.4049/jimmunol.1601896
44. Eysenck, MW. Derakshan, N. New perspectives in attentional control theory. Personality and Individual Differences.2011; 50(7): 955-60. https://doi.org/10.1016/j.paid.2010.08.019
45. Cheng BH, McCarthy JM. Understanding the dark and bright sides of anxiety: A theory of workplace anxiety. J Appl Psychol. 2018;103(5):537-60. https://doi.org/10.1037/apl0000266
46. Rezende LFM, Thome B, Schveitzer MC, Souza-Júnior PRB, Szwarcwald CL. Adults at high-risk of severe coronavirus disease-2019 (Covid-19) in Brazil. Rev Saude Publica. 2020;54:50. http://dx.doi.org/10.11606/s1518-8787.2020054002596
47. Wang J, Li Z, Cheng X, Hu H, Liao C, Li P, et al. Epidemiologic Characteristics, Transmission Chain, and Risk Factors of Severe Infection of COVID-19 in Tianjin, a Representative Municipality City of China. Front Public Health. 2020;8:198. https://doi.org/10.3389/fpubh.2020.00198
48. Wang J, Zhu L, Liu L, Zhao XA, Zhang Z, Xue L, et al. Overweight and Obesity are Risk Factors of Severe Illness in Patients with COVID-19. Obesity (Silver Spring). 2020;28(11):2049-55. https://doi.org/10.1002/oby.22979
49. Vardavas CI, Nikitara K. COVID-19 and smoking: A systematic review of the evidence. Tob Induc Dis. 2020;18:20. https://doi.org/10.18332/tid/119324
50. Ariza BE, Torres YX, Salgado D, Cepeda M, Gomez C, Castellanos JC, et al. Seroprevalence and seroconversion rates to SARS-CoV-2 in interns, residents, and medical doctors in a university Hospital in Bogota, Colombia. Infectio. 2021;25(3): 145-52 http://dx.doi.org/10.22354/in.v25i3.938
51. Çelebi G, Pişkin N, Çelik Bekleviç A, Altunay Y, Salcı Keleş A, Tüz MA, et al. Specific risk factors for SARS-CoV-2 transmission among health care workers in a university hospital. Am J Infect Control. 2020;48(10):1225-30. https://doi.org/10.1016/j.ajic.2020.07.039
52. Bai YW, Xuan. Huang, Qimin. Wang, Han. Gurarie, David. Ndeffo-Mbah, Martial . Fan, Fei. Fu, Peng. Horn, Mary Ann. Xu, Shuai. Mondal, Anirban. Jiang, Xiaobing. Zhao, Hongyang. SARS-CoV-2 infection in health care workers: a restrospective analysis and a model study. 2020. medRxiv 03.29.20047159 https://doi.org/10.1101/2020.03.29.20047159

Figures

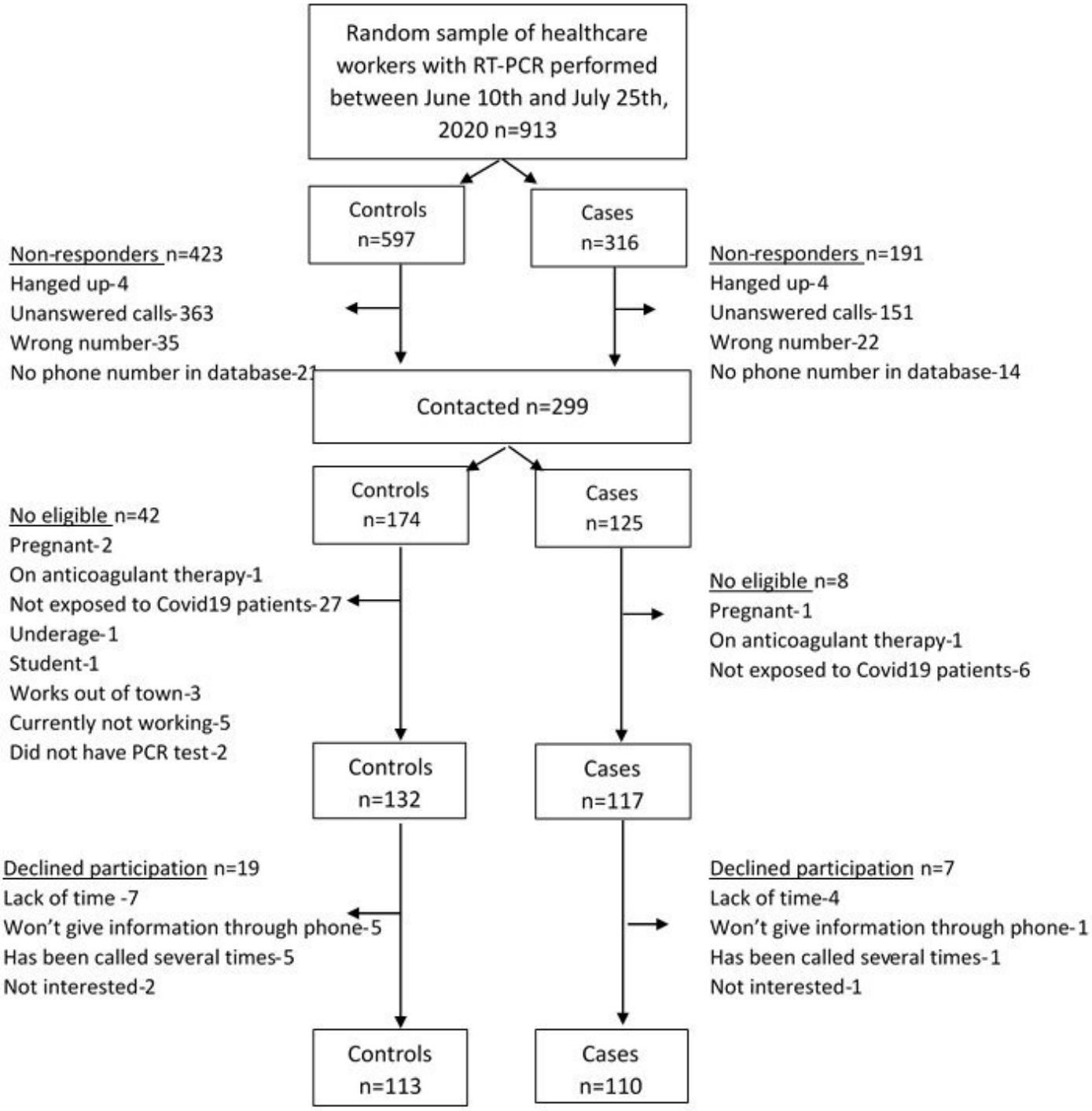

Figure 1

Flowchart of the study participants