OBJN
Online Brazilian Journal of Nursing
ISSN: 1676 - 4285 | www.objnursing.uff.br

Submission: 26-Mar-2026
Approved: 26-May-2026

ASSOCIATION BETWEEN HAND HYGIENE AND SARS-COV-2 INFECTION AMONG HEALTHCARE PROFESSIONALS: A CROSS-SECTIONAL STUDY*

ASSOCIAÇÃO ENTRE HIGIENE DAS MÃOS E INFECÇÃO PELO SARS-COV-2 EM PROFISSIONAIS DE SAÚDE: ESTUDO TRANSVERSAL

ASOCIACIÓN ENTRE LA HIGIENE DE MANOS Y LA INFECCIÓN POR SARS-COV-2 EN PROFESIONALES DE LA SALUD: ESTUDIO TRANSVERSAL

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How to cite: Santos MA, Silva GO, Mendes DFA, Melo DS, Mendonça KM, Tipple AFV. Association between hand hygiene and SARS-CoV-2 infection among healthcare professionals: a cross-sectional study. Online Braz J Nurs. 2026;25(1):e20266991. https://doi.org/10.17665/1676-4285.20266991

RESUMO

Objetivo: Analisar a associação entre a adesão à higienização das mãos, o conhecimento sobre os cinco momentos e a infecção pelo SARS-CoV-2 em profissionais da saúde. **Método:** Estudo transversal realizado com 364 profissionais da saúde sintomáticos para a COVID-19. A amostragem foi não probabilística. Realizaram-se entrevistas individuais e a coleta de amostras por *swab* de nasofaringe e orofaringe. Utilizou-se a regressão logística múltipla para analisar as associações entre a adesão à higienização das mãos, o conhecimento dos cinco momentos e a positividade para o SARS-CoV-2. **Resultados:** Os participantes apresentaram idade média de 37,1 anos, sendo 73,6% do sexo feminino. Os técnicos de enfermagem (33,8%) compuseram a maior parcela dos participantes, seguidos pelos enfermeiros (17,0%). A prevalência de infecção pelo SARS-CoV-2 foi de 33,8%. A adesão à higienização das mãos foi de 90,1%, e o conhecimento dos cinco momentos atingiu 74,5%. A ausência de adesão e de conhecimento sobre os cinco momentos da higiene das mãos aumentou, respectivamente, em 111% (*Odds ratio*: 2,11) e 72% (*Odds ratio*: 1,72) a chance de infecção pelo SARS-CoV-2. **Conclusão:** Constatou-se que a falta de adesão à higiene das mãos e o desconhecimento acerca dos cinco momentos aumentam em 2,11 e 1,72 vezes, respectivamente, a chance de infecção pelo SARS-CoV-2.

Descritores: Higiene das Mãos; Conhecimento; Infecções por Coronavírus; SARS-CoV-2; Pessoal de Saúde; Atenção à Saúde.

ABSTRACT

Objective: To analyze the association between adherence to hand hygiene, knowledge of the five moments, and SARS-CoV-2 infection among healthcare professionals. **Method:** A cross-sectional study conducted with 364 healthcare professionals with symptoms suggestive of COVID-19. Sampling was non-probabilistic. Individual interviews were conducted, and samples were collected via nasopharyngeal and oropharyngeal swabs. Multiple logistic regression was used to analyze the associations between adherence to hand hygiene, knowledge of the five moments, and SARS-CoV-2 positivity. **Results:** Participants had a mean age of 37.1 years, with 73.6% being female. Nursing technicians (33.8%) made up the largest share of participants, followed by nurses (17.0%). The prevalence of SARS-CoV-2 infection was 33.8%. Adherence to hand hygiene was 90.1%, and knowledge of the five moments reached 74.5%. Lack of adherence and lack of knowledge regarding the five moments of hand hygiene increased the odds of SARS-CoV-2 infection by 111% (Odds ratio: 2.11) and 72% (Odds ratio: 1.72), respectively. **Conclusion:** It was found that non-adherence to hand hygiene and the lack of knowledge about the five moments increase the odds of SARS-CoV-2 infection by 2.11 and 1.72 times, respectively.

Descriptors: Hand Hygiene; Knowledge; Coronavirus Infections; SARS-CoV-2; Health Personnel; Health Care.

RESUMEN

Objetivo: Analizar la asociación entre la adherencia a la higiene de manos, el conocimiento sobre los cinco momentos y la infección por SARS-CoV-2 en profesionales de la salud. **Método:** Estudio transversal realizado con 364 profesionales de la salud sintomáticos para la COVID-19. El muestreo fue no probabilístico. Se realizaron entrevistas individuales y la recolección de muestras mediante hisopado nasofaríngeo y orofaríngeo. Se utilizó la regresión logística múltiple para analizar las asociaciones entre la adherencia a la higiene de manos, el conocimiento de los cinco momentos y la positividad para el SARS-CoV-2. **Resultados:** Los participantes presentaron una edad promedio de 37,1 años, siendo el 73,6% de sexo femenino. Los técnicos de enfermería (33,8%) constituyeron la mayor proporción de los participantes, seguidos por los enfermeros (17,0%). La prevalencia de infección por SARS-CoV-2 fue del 33,8%. La adherencia a la higiene de manos fue del 90,1%, y el conocimiento de los cinco momentos alcanzó el 74,5%. La ausencia de adherencia y de conocimiento sobre los cinco momentos de la higiene de manos incrementó, respectivamente, en un 111% (*Odds ratio*: 2,11) y un 72% (*Odds ratio*: 1,72) la probabilidad de infección por SARS-CoV-2. **Conclusión:** Se constató que la falta de adherencia a la higiene de manos y el desconocimiento acerca de los cinco momentos aumentan en 2,11 y 1,72 veces, respectivamente, la probabilidad de infección por SARS-CoV-2.

Descriptores: Higiene de Manos; Conocimiento; Infecciones por Coronavirus; SARS-CoV-2; Personal de Salud; Atención de la Salud.

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What is already known:

- Hand hygiene is an essential measure to prevent healthcare-associated infections, including SARS-CoV-2.
- Adherence to hand hygiene among healthcare professionals remains variable and frequently insufficient across different care settings.
- International evidence suggests an association between low adherence to prevention measures and SARS-CoV-2 infection.

What this article adds:

- Healthcare professionals who do not adhere to hand hygiene showed a higher likelihood of SARS-CoV-2 infection.
- The lack of knowledge about the five moments of hand hygiene was also associated with a higher probability of infection among healthcare professionals.
- Adherence to and knowledge of good hand hygiene practices are fundamental in the prevention of SARS-CoV-2 infection.

INTRODUCTION

Healthcare professionals' hands constitute the primary vehicle for the transmission of pathogenic microorganisms during the care process, which can compromise patient safety and lead to adverse events, such as Healthcare-Associated Infections (HAIs). Such infections result in prolonged hospitalization, increased healthcare costs, and rising morbidity and mortality. On the other hand, the spread of microorganisms via hands can also lead to worker illness, constituting another critical aspect of HAIs. Evidence highlights hand hygiene (HH) as a cost-effective measure to reduce the incidence and impact of HAIs[1], contributing to safer care for both patients and professionals[2,3].

Despite its relevance, adherence to HH among healthcare professionals remains a global challenge, especially in low- and middle-income countries[4]. Average adherence to the practice has been estimated at 40.0% in high-income countries and 20.0% in low-income countries. Studies demonstrate that HH adherence in Brazil is also low across different settings, such as among home care nursing teams (14.4%)[5] and Intensive Care Units (ICUs) (47.8%)[6], as well as among nursing professionals, physicians, and physical therapists working in emergency care units (54.2%)[7].

HH is established as one of the main strategies to mitigate the transmission of Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) in community and healthcare environments[3,8]. SARS-CoV-2 is a zoonotic agent belonging to the order Nidovirales and the family Coronaviridae, exhibiting significant tropism for human respiratory epithelial cells, and is the causative agent of COVID-19. The most common route of transmission occurs via respiratory droplets (particles with a diameter greater than 5–10 μm) released during coughing, sneezing, talking, or singing by infected individuals[9]. Aerosol transmission (particles with a diameter of less than 5 μm) may manifest during aerosol-generating procedures[10], compounding occupational risk. Additionally, transmission can occur through contact with fomites, when contaminated droplets deposit on surfaces and objects, maintaining viral viability for hours or days, followed by direct contact with the oral, nasal, and ocular mucosae—a process in which hands play a decisive role[9,10].

Observational investigations point to associations between low HH adherence and SARS-CoV-2 positivity among healthcare professionals[11,12]. Failure to adhere to HH has been correlated with higher odds of seropositivity for anti-SARS-CoV-2 antibodies[11], corroborating the relevance of the practice within occupational health. Conversely, other research has not identified a statistically significant association between HH adherence and SARS-CoV-2 infection[13]. Since these studies[11,12] were conducted abroad and considering the scarcity of national investigations analyzing this correlation among healthcare professionals in Brazil—especially regarding the relationship between knowledge of the five moments for HH recommended by the World Health Organization (WHO)[14] and the occurrence of infection—this research is highly pertinent.

Given the identified scientific gap, the importance of HH in controlling the cross-transmission of SARS-CoV-2 in the healthcare context, and the low adherence to this practice among healthcare professionals, this study aimed to analyze the association between adherence to hand hygiene, knowledge of the five moments, and SARS-CoV-2 infection among healthcare professionals. The findings of this investigation aim to add evidence supporting the regular practice of HH as a preventative measure against HAIs, as well as to inform healthcare management and the formulation of public policies aimed at controlling this condition.

METHOD

Study design

An analytical cross-sectional study, structured and reported in accordance with the Strengthening the Reporting of OBservational studies in Epidemiology (STROBE) guidelines[15].

Setting

The study was conducted in Goiânia, the capital of the state of Goiás (Midwest region of Brazil), during the period of the Public Health Emergency of National Importance arising from human coronavirus infection (2019-nCoV), which ended on April 22, 2022. At the time of data collection, the municipality had approximately 32,290 higher education and mid-level healthcare professionals, according to records from the National Registry of Health Establishments (CNES).

Participant recruitment took place between May 20 and October 31, 2021—the initial phase of the pandemic when vaccination was not yet available—within the scope of the "*Tenda Triagem Covid-19*" (COVID-19 Screening Tent) project. This initiative consisted of a testing center proposed and coordinated by the Faculty of Nursing (FEN)

of the Federal University of Goiás (UFG), with the participation of the Institute of Tropical Pathology and Public Health, the Institute of Biological Sciences, the *Hospital das Clínicas*, and the Faculties of Medicine and Pharmacy, in partnership with the Municipal Health Department and funded by the Ministry of Education (MEC). In addition to providing services to the community, the project integrated teaching, research, and extension activities.

Prior to the start of activities, all members of the "*Tenda Triagem Covid-19*" project team underwent training with a workload of approximately 20 hours, covering the study's operational procedures, data collection, and biosafety protocols[16].

Participants

The study population consisted of healthcare professionals who presented with signs and/or symptoms suggestive of COVID-19 and who voluntarily sought care at the project. Healthcare professionals were defined as those working directly or indirectly in healthcare delivery at different levels of complexity, possessing specific training for the performance of duties inherent to the sector. Thus, the following higher education professionals were included: nurses, physicians, physical therapists, biomedical scientists, dental surgeons, pharmacists, and others (social workers, physical educators, nutritionists, speech-language pathologists, and psychologists). Among mid-level and/or technical professionals, the inclusion comprised: nursing technicians, laboratory technicians, pharmacy technicians, oral health technicians, community health workers, and other technical-operational professionals (radiology technicians and occupational safety technicians). Inclusion criteria were: (i) age over 18 years; (ii) being a healthcare professional, according to the aforementioned definition; (iii) working in health establishments providing direct or indirect patient care; and (iv) presenting signs and/or symptoms of COVID-19. Individuals with a self-reported acute respiratory condition were considered symptomatic, characterized by a feeling of fever or fever, accompanied by cough, sore throat, rhinorrhea, and/or dyspnea, as well as neurological or gastrointestinal manifestations indicative of SARS-CoV-2 infection[17]. As an exclusion criterion, the presence of incomplete information in the interview record instruments was established, characterized by missing data greater than 30%.

Sampling and sample size

Non-probabilistic convenience sampling was adopted. Recruitment was carried out through online dissemination of the "*Tenda Triagem Covid-19*" project on institutional websites of universities, municipal health departments, and health services. A graphic material (*folder*) containing the title, objectives, and a telephone contact to schedule participation was produced. Professionals who scheduled appointments were initially considered eligible and reported to the location exclusively reserved for data collection. After confirmation of eligibility criteria, information collection proceeded. Sample size calculation was performed for cross-sectional prevalence studies, considering a 95% confidence interval (α=0.05), an unknown population size, and an expected SARS-CoV-2 positivity rate among healthcare professionals of 11%, based on previous evidence[18]. The minimum established sample size was 151 participants. Of the total 1,101 individuals recruited, 411 did not meet the eligibility criteria. Of these, 49 refused to undergo the qRT-PCR test, 195 declined the interview, and 82 were excluded due to an excess of missing data (> 30%).

Data collection

The testing center was set up in the parking lot of a classroom building at UFG, and screening took place in two modalities: in a drive-thru format, intended for symptomatic professionals who arrived in their own vehicles (with screening, interview, and testing conducted inside the car after confirmation of criteria); and for those who sought the service by other means of transportation, whose participants were seated in chairs spaced 3 meters apart, wearing mandatory masks, and subsequently directed to a specific area for the interview and testing.

The project team worked in a weekly rotation system for screening and testing activities. Professionals were informed about the methods, objectives, benefits, and potential risks of the research. Upon signing the consent form, they were interviewed by trained team members using a structured script with closed-ended questions and a Likert-type scale. The average application time was 10 minutes.

The instrument addressed sociodemographic data, signs and symptoms of COVID-19, knowledge of the five moments for hand hygiene recommended by the WHO, adherence to the practice in recent days, prior participation in educational processes on the topic (without period limitation), and other potential risk factors for SARS-CoV-2 infection and was prepared based on relevant scientific literature.

Following the interview, participants were directed to nasopharyngeal secretion collection via a combined swab (nasal and oral), following the guidelines of the Ministry of Health protocol, with an average duration of 5 minutes. The molecular test by reverse transcription followed by polymerase chain reaction (qRT-PCR), capable of amplifying viral RNA sequences, was processed using the IDT® kit. Samples were analyzed within up to 72 hours in laboratories belonging to the project network: Multiuser Center for Research in Bioinputs and Health Technologies (CMBiotecs/IPTSP/UFG), Rômulo Rocha Laboratory (LRR/FF/UFG), and Laboratory of Clinical Analysis and Health Education (LACES/ICB/UFG).

Variables

The dependent variable was SARS-CoV-2 infection, identified and categorized based on the qRT-PCR result into 0 ("Negative") and 1 ("Positive"). The independent variables, obtained through self-report in the structured script, comprised: hand hygiene adherence (no/yes); hand hygiene with soap and water (no/yes); hand hygiene with 70% alcohol-based preparation (no/yes); knowledge about the five moments of hand hygiene recommended by the

WHO (no/yes); participation in continuing education on the topic (no/yes); and increase in hand hygiene frequency after the advent of the COVID-19 pandemic (no/yes). Variables related to the use of soap and water and 70% alcohol were originally collected on a Likert-type scale (with options "never", "sometimes", and "always") and were recoded as "yes" only for those who answered "always", to reflect the regularity of the practice. The synthetic variable "hand hygiene adherence" was constructed by combining two items: performing the practice before patient care (no/yes) and after patient care (no/yes), with professionals who reported performing it systematically in both situations being considered adherent.

Adjustment covariates included: age (years); sex (male/female); self-declared race/skin color (white, mixed-race, black, and other [yellow or indigenous]); monthly family income (in Brazilian reals); level of practice (mid-level/technical or higher education); occupation (according to pre-defined professional categories); employment bond (public/private/other); weekly workload; number of employment bonds; length of professional practice (years); provision of direct patient care, regardless of sector (no/yes); presence of flu-like syndrome (no/yes); manifestation of signs and/or symptoms of COVID-19 (no/yes); and count of signs and/or symptoms presented from the predefined list (no/yes).

For the descriptive characterization of the setting, information regarding the availability of institutional supplies for hand hygiene was gathered: liquid soap, paper towels, and 70% alcohol-based preparation (no/yes).

Statistical analysis

Data were processed and analyzed using STATA software, version 17.0, through descriptive and inferential statistics. The normality of quantitative variables was tested using the Kolmogorov-Smirnov test with Lilliefors correction. Due to the absence of a normal distribution, such variables were described using the median, 25th percentile (P25), 75th percentile (P75), minimum and maximum values, in addition to mean and standard deviation (SD). Qualitative variables were expressed as absolute (n) and relative frequencies (%). The prevalence of SARS-CoV-2 infection was calculated by dividing the number of positive tests by the total sample, multiplying the result by 100, and presented as a percentage accompanied by the respective 95% Confidence Interval (95% CI).

To verify the association between hand hygiene adherence, knowledge of the five moments, and SARS-CoV-2 infection, bivariate analyses were performed using Pearson's chi-square test or the likelihood ratio test. In the multiple logistic regression step, all variables of interest related to hand hygiene were entered jointly into the model and adjusted by the remaining covariates (age, sex, income, level of practice, employment bond, weekly workload, number of bonds, and professional category) to control for potential confounding factors. The results of the final model were expressed as adjusted Odds Ratio (aOR), 95% CI, and regression coefficient (β). Statistical significance was evaluated using the Wald test, adopting a threshold of $p<0.05$.

Ethical aspects

This study is part of an anchor project approved by the Research Ethics Committee of the *Hospital das Clínicas* of the Federal University of Goiás, under opinion no. 4.031.936/2020 and Certificate of Presentation for Ethical Appreciation (CAAE) 31542620.7.0000.5078. Free and informed consent was obtained from all participants.

RESULTS

A total of 364 healthcare professionals who met the eligibility criteria were included in the study. The mean age of the participants was 37.1 years (standard deviation = 10.8), with the majority being female (73.6%). Regarding occupational characteristics, the largest share comprised nursing technicians (33.8%) and nurses (17.0%). The mean length of work experience was 5.9 years (standard deviation = 6.8), and the majority (84.9%) reported working on the frontline of the COVID-19 response. Detailed sociodemographic and occupational characteristics are described in Table 1.

Table 1 – Sociodemographic and occupational characteristics of healthcare professionals with symptoms suggestive of COVID-19 (n=364). Goiânia, GO, Brazil, 2021

Variables	
Sociodemographic	
Age (years)	
Mean (standard deviation)	37.1 (10.8)
Median (P25–P75)	36 (27-45)
Minimum–Maximum	18-69
Sex, n (%)	
Female	268 (73.6)
Male	96 (26.4)
Race/skin color (self-declared), n (%)	
White	166 (45.6)
Mixed-race	165 (45.3)
Black	25 (6.9)

Variables	
Indigenous	8 (2.2)
Monthly family income (R$)	
Mean (standard deviation)	7,232.4 (5,786.9)
Median (P25–P75)	5,000 (4,000–9,000)
Minimum–Maximum	800–40,000
Occupational	
Level of practice, n (%)	
Mid-level/technical	170 (46.7)
Higher education	194 (53.3)
Occupation, n (%)	
Mid-level/technical level	
Nursing technician	123 (33.8)
Laboratory technician	6 (1.6)
Pharmacy technician	13 (3.6)
Oral health technician	8 (2.2)
Community health workers	12 (3.3)
Other mid-level/technical professionals*	8 (2.2)
Higher education level	
Nurse	62 (17.0)
Physician	39 (10.7)
Physical therapist	19 (5.2)
Biomedical scientist	8 (2.2)
Dental surgeon	13 (3.6)
Pharmacist	18 (4.9)
Other higher education professionals†	35 (9.6)
Employment bond, n (%)	
Private	137 (37.6)
Public	212 (58.2)
Other	15 (4.1)
Weekly workload	
Mean (standard deviation)	40.0 (11.0)
Median (P25–P75)	40 (36-44)
Minimum–Maximum	12-70
Number of employment bonds	
Mean (standard deviation)	1.2 (0.5)
Median (P25–P75)	1 (1-1)
Minimum–Maximum	1-3
Length of professional practice (years)	
Mean (standard deviation)	5.9 (6.8)
Median (P25–P75)	3 (2-7)
Minimum–Maximum	0.1-40
Provides direct patient care (frontline)	
No	55 (15.1)
Yes	309 (84.9)

Source: prepared by the authors, 2021.
P25=25th Percentile; P75=75th Percentile; R$=Brazilian Reais. *Includes radiology technicians (n=6) and occupational safety technicians (n=2); †Includes social workers (n=4), physical educators (n=4), veterinarians (n=7), nutritionists (n=4), speech-language pathologists (n=5), and psychologists (n=12).

The prevalence of SARS-CoV-2 infection in the total sample of healthcare professionals was 33.8% (95% CI: 29.1–38.8; 123/364). Global adherence to hand hygiene was reported by 90.1% (328/364) of participants. Practice before patient care was indicated by 90.1%, while after patient care was reported by 86.0%. Hand hygiene with soap and water was described by 78.0% of professionals, and with 70% alcohol-based preparation by 77.7%. Knowledge

regarding the five moments of hand hygiene recommended by the WHO was affirmed by 74.5% of the sample (Table 2).

Table 2 – Variables related to hand hygiene among healthcare professionals with symptoms suggestive of COVID-19 (n=364). Goiânia, GO, Brazil, 2021

Variables	n (%)
Hand hygiene adherence	328 (90.1)
Before patient care	328 (90.1)
After patient care	313 (86.0)
Institutional supplies for hand hygiene	
Liquid soap	332 (91.2)
Paper towels	320 (87.9)
70% alcohol	337 (92.6)
Hand hygiene with soap and water	284 (78.0)
Hand hygiene with 70% alcohol	283 (77.7)
Knowledge of the five moments of hand hygiene	271 (74.5)
Participation in continuing education in HH	305 (83.8)
Increased HH frequency during the COVID-19 pandemic	347 (95.3)

Source: prepared by the authors, 2021.
COVID-19: Disease caused by the novel coronavirus.

In the bivariate analysis between hygiene practices and SARS-CoV-2 infection, it was observed that individuals with a positive result for the virus had lower knowledge of the five recommended moments compared to negative ones (67.5% versus 78.0%; p=0.029) and lower adherence to the practice (85.4% versus 92.5%; p=0.030). Furthermore, a lower proportion of professionals who increased hand hygiene frequency after the advent of the pandemic was found among those who tested positive compared to negatives (90.2% versus 97.9%; p=0.001) (Table 3).

Table 3 – Bivariate analysis of the association between low hand hygiene adherence, lack of knowledge of the five moments, and SARS-CoV-2 infection among healthcare professionals with symptoms suggestive of COVID-19 (n=364). Goiânia, GO, Brazil, 2021

Variables	SARS-CoV-2		p-value*
	Negative (n=241)	Positive (n=123)	
HH adherence, n (%)**			0.030
No	18 (7.5)	14 (14.6)	
Yes	223 (92.5)	105 (85.4)	
HH with soap and water, n (%)			0.062
No	46 (19.1)	34 (27.6)	
Yes	195 (80.9)	89 (72.4)	
HH with 70% alcohol, n (%)			0.664
No	52 (21.6)	29 (23.6)	
Yes	189 (78.4)	94 (76.4)	
Knowledge of the five moments of HH, n (%)			0.029
No	53 (22.0)	40 (32.5)	
Yes	188 (78.0)	83 (67.5)	
Continuing education on HH, n (%)			0.778
No	40 (16.6)	19 (15.4)	
Yes	201 (83.4)	104 (84.6)	
Increased HH frequency after the pandemic, n (%)			0.001
No	5 (2.1)	12 (9.8)	
Yes	236 (97.9)	111 (90.2)	

Source: prepared by the authors, 2021.
SARS-CoV-2=Severe Acute Respiratory Syndrome Coronavirus 2; HH=Hand hygiene; *Wald chi-square test; **Variable with missing data; valid percentage presented.

The multiple logistic regression analysis demonstrated that the odds of SARS-CoV-2 infection increased by 111% among healthcare professionals who reported not adhering to the hand hygiene technique (aOR: 2.11; 95% CI: 1.03–4.44). Additionally, an increase of 72% in the odds of infection was observed in individuals who reported lacking knowledge about the practice (aOR: 1.72; 95% CI: 1.03–2.85) (Table 4).

Table 4 – Multiple logistic regression analysis of the association between low hand hygiene adherence, lack of knowledge of the five moments, and SARS-CoV-2 infection among healthcare professionals with symptoms suggestive of COVID-19 (n=364). Goiânia, GO, Brazil, 2021

Variables	Multiple regression		
	aOR	**95% CI**	**p-value***
HH adherence, n (%)			
No	2.11	1.03-4.44	0.042
Yes	1.00		
HH with soap and water, n (%)			
No	1.66	0.94-2.80	0.057
Yes	1.00		
HH with 70% alcohol, n (%)			
No	1.17	0.68-1.99	0.573
Yes	1.00		
Knowledge of the five moments of HH, n (%)			
No	1.72	1.03-2.85	0.037
Yes	1.00		
Continuing education on HH, n (%)			
No	1.00	0.54-1.86	0.991
Yes	1.00		
Increased HH frequency after the pandemic, n (%)			
No	1.02	0.55-1.89	0.955
Yes	1.00		

Source: prepared by the authors, 2021.
SARS-CoV-2=Severe Acute Respiratory Syndrome Coronavirus 2; aOR=Adjusted Odds Ratio; HH=Hand hygiene; 95% CI=95% Confidence Interval; β=Regression coefficient; *Wald chi-square test.

DISCUSSION

This study demonstrated that self-reported non-adherence and lack of knowledge regarding the five moments for HH among healthcare professionals were associated with an increased likelihood of testing positive for SARS-CoV-2, in addition to highlighting a high prevalence of viral infection among the participants.

The results revealed that global adherence to HH before and after patient contact was high. However, one in five professionals was unaware of the five moments recommended by the WHO. It was observed that lower rates of adherence and knowledge of these steps increased the probability of SARS-CoV-2 infection.

The prevalence of SARS-CoV-2 infection among healthcare professionals was significant (33.8%). Previous investigations point to variations in infection prevalence within this group, primarily driven by population characteristics, occupational risk, and methodological differences—such as sampling criteria and types of diagnostic tests used. A global systematic review with meta-analysis that included approximately 284,000 healthcare professionals from 27 countries identified a COVID-19 prevalence of 11% in this segment (95% CI: 9–13%)[19], a result lower than that found in the present study. This finding denotes the significant vulnerability of Brazilian healthcare professionals to SARS-CoV-2 infection. The high prevalence observed is a cause for concern for global health, as the illness of these workers directly affects the stability and capacity of health services[18].

Studies conducted in Brazil also reveal wide variation. Research carried out in São Paulo showed a prevalence of 19.12% for anti-SARS-CoV-2 antibodies among 2,204 healthcare professionals[20]. Another study, also in the state of São Paulo, with 295 professionals symptomatic for COVID-19, found 43.37% positivity[21]. An investigation conducted in Ribeirão Preto (SP) recorded a prevalence of 12.7%[22], while another nationwide study reported 31.95%[23]. It is noted that all the aforementioned Brazilian studies, in line with our findings, exceed the global average demonstrated in the meta-analysis, highlighting the high occupational impact of the disease in the country[14].

A high rate of adherence to HH was verified before and after patient care. Literature demonstrates that adherence to this practice increased significantly during the onset of the COVID-19 pandemic, both among healthcare professionals and in the general population[1,24,25].

Among healthcare professionals, a systematic review

encompassing 10 studies with 2,377 participants and approximately 3.5 million HH opportunities identified a global adherence rate of 74.0% during the pandemic, a value higher than pre-pandemic indices[1]. It is noteworthy that the majority of studies included in this review used observational methods, considered the gold standard[14,26] for this type of evaluation, which may justify the higher rate obtained in the present study (90.1%), whose data were self-reported. This divergence reinforces the influence of social desirability bias—frequent in investigations measuring socially approved behaviors, such as HH—whose habitual tendency is the overestimation of responses[27].

In hospital environments, adherence rates rose from pre-pandemic levels (46%–56%) to peaks exceeding 60%–95% during periods of heightened health alert[1,25,28]. Despite the initial increase, adherence tends to decrease over time, especially when institutional attention and behavioral interventions are attenuated[29,30]. Longitudinal studies demonstrate that, after the easing of the pandemic or the end of restrictions, rates return to levels close to previous ones[29,30], highlighting the need for continuous continuing education actions and indicator monitoring to sustain high levels of adherence[30,31], with a view to patient safety and occupational health.

Adherence tends to be higher in scenarios of perceived high risk—such as ICUs and clinical wards for infectious diseases—and among more exposed professionals[1,25], suggesting greater diligence regarding one's own health in these environments. The main barriers pointed out include the inappropriate use of gloves, fatigue, resource scarcity, and declining motivation[32]. Regarding the high adherence rates identified in this research, the influence of the adequate provision of supplies is also presumed, as recommended by Collegiate Board Resolution (RDC) No. 42/2010[33] of the Brazilian Health Regulatory Agency (Anvisa), combined with the wide dissemination of health guidelines[26]. Regarding supplies, very similar frequencies of use were verified between soap and water and 70% alcohol-based preparation, both being recommended and possessing biocidal action on the lipid envelopes of the virus[34].

Regarding knowledge of the five moments of HH—indicators proposed by the WHO[14] as a strategy to optimize adherence[35]—the majority of participants reported familiarity with the guidelines, which corroborates the high percentage of reference to continuing education, a factor that positively impacts practice. It is emphasized that professionals who reported not knowing the five moments presented a 72% higher chance of infection, underscoring the urgency of institutionalized continuing education strategies to foster a safety culture. Pre-pandemic research already pointed to persistent gaps in theoretical mastery regarding the five moments[1].

Notwithstanding the high adherence rate reported in the pandemic context—expressively superior to that described in the literature in pre-pandemic periods[1]—it was found that individuals with a positive diagnosis for COVID-19 had lower adherence to HH when compared to uninfected ones. Analogous results were described by El-Sokkary et al.[36], who observed lower HH adherence among infected healthcare professionals compared to uninfected ones, as well as by Huang et al.[37], who identified a direct association between the high incidence of infected professionals and low HH frequency. Thus, although traditionally the focus of HH rests on patient safety, the present findings corroborate the relevance of this measure for occupational protection. The valuation of this perspective can act as a driver for better adherence rates, embodying an individual attitude with collective ramifications.

Lower adherence rates among the infected may be related to the knowledge deficit regarding the five moments, which was also associated with COVID-19 positivity. Considering the indicators of fragility in knowledge and adherence prior to the pandemic period[1], it is inferred that there is a positive correlation between lower levels of theoretical/practical preparation and the amplified probability of occupational infection by SARS-CoV-2. Such evidence reinforces that neglected HH fosters viral dissemination and elevates the risk of contamination, whereas its effective implementation acts to mitigate transmission[28].

This study presents limitations that must be weighed when interpreting the findings. The cross-sectional design prevents the establishment of temporal cause-and-effect nexuses between variables. The adoption of non-probabilistic convenience sampling restricts the generalization of results to the entire professional category, as does the delimitation of the sample to symptomatic individuals. Furthermore, data collection relied entirely on self-reporting, making the data susceptible to recall and response biases—specifically regarding HH, whose measurement through direct observation would confer greater accuracy. The numerical restriction in certain professional subcategories also precluded stratified sensitivity analyses.

Conversely, the study presents relevant strengths, such as addressing a topic of high criticality for patient safety and worker health, filling a gap in the national literature by simultaneously analyzing adherence and knowledge of the five moments recommended by the WHO in association with SARS-CoV-2 infection in the Brazilian context. The findings have the potential to subsidize the formulation of institutional continuing education policies and HAI prevention protocols.

It is considered that this investigation mobilized complementary dimensions of professional behavior—the theoretical mastery of guidelines and their effective embodiment in daily practice—allowing for the mapping of the gap between knowledge and action and its direct repercussion on worker illness. The analysis of this panorama contributes to discerning whether the mere provision of information is sufficient or whether multifaceted strategies aimed at behavioral change and the overcoming of structural barriers are mandatory.

CONCLUSION

A high prevalence of SARS-CoV-2 infection was identified among healthcare professionals with symptoms suggestive of COVID-19 (approximately three in every ten professionals), highlighting the significant impact of the disease on occupational health. Furthermore, a statistically significant association was found between lower levels of knowledge and adherence to hand hygiene and an in-

creased probability of infection, corroborated by a higher proportion of non-adherence among individuals who tested positive and the increased odds of infection demonstrated in the multivariate analysis.

*Article extracted from the Master's Dissertation entitled "Associação entre adesão à higienização das mãos e infecção pelo SARS-CoV-2 em profissionais da saúde suspeitos de COVID-19" [Association between hand hygiene adherence and SARS-CoV-2 infection among healthcare professionals suspected of COVID-19], presented to the Graduate Program in Nursing and Health at the Federal University of Goiás, Goiânia, Goiás, Brazil, in the year 2022.

CONFLICT OF INTEREST

The authors declare no conflict of interests.

FUNDING

This research received financial support from the Ministry of Education, Brazil.

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Data analysis: Santos MA, Tipple AFV.
Data interpretation: Santos MA, Silva GO, Mendes DFA, Melo DS, Mendonça KM, Tipple AFV.
All authors are responsible for the textual writing and critical review of the intellectual content, the final version published, and all ethical, legal, and scientific aspects related to the accuracy and integrity of the study.

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