











FACTORS ASSOCIATED WITH COVID-19: A COMPARATIVE CASE-CONTROL STUDY IN BENIN

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Benin, COVID-19, risk factors, case-control.

Introduction. Although there are several previous publications related to risk factors of COVID-19 infection in Benin, there are very few data to explain the outbreak risk factors. **Material and methods.** This case-control study, conducted from 14 September to 20 October 2020, aimed to identify the risk factors associated with COVID-19 infection in Benin. Questions on knowledge, attitudes, and practices related to COVID-19, sociodemographic characteristics, nutritional factors, medical history, housing and working conditions of respondents were asked through a questionnaire survey. Bivariate and multivariate logistic regression analyses were conducted to identify the factors associated with COVID-19. The statistical significance was set at 5%. **Results.** In multivariate logistic regression, no handwashing device installed at the home entrance ($ORa=1.86$; 95% CI [1.07-3.21]) or a device delivering only water ($ORa=5.57$; 95% CI [1.98-15.65]), using permanently air conditioning at workplaces ($ORa=5.48$; 95% CI [2.40-12.57]), less knowledge of protective measures ($ORa=1.41$; 95% CI [1.08-1.84]) and no knowledge on the coronavirus incubation period ($ORa=4.19$; 95% CI [2.37-7.44]) were identified as risk factors for COVID-19 infection. **Conclusions.** Based on the findings of this study, a contextual response should prioritize strategies that will raise awareness and population's knowledge of COVID-19 as well as preventive practices.

Cuvinte cheie: Benin, COVID-19, factori de risc, caz-control.

FACTORI ASOCIAȚI CU COVID-19: STUDIUL COMPARATIV CAZ-CONTROL ÎN BENIN

Introducere. Deși există mai multe publicații cu referire la factorii de risc ai infecției COVID-19 în Benin, sunt prezentate însă foarte puține date care să explice factorii de risc în perioada de epidemie. **Material și metode.** Acest studiu caz-control, realizat în perioada 14 septembrie – 20 octombrie 2020, și-a propus să identifice factorii de risc asociați cu infecția COVID-19 în Benin. Respondenților, prin intermediul unui chestionar, le-au fost adresate întrebări privind cunoștințele, atitudinile și practicile legate de COVID-19, caracteristicile socio-demografice, factorii nutriționali, istoricul medical, locuința și condițiile de muncă. Au fost efectuate analize de regresie logistică bivariată și multivariată, pentru a identifica factorii asociați cu COVID-19. Semnificația statistică a fost stabilită la 5%. **Rezultate.** Cu ajutorul regresiei logistice multivariate, au fost identificați drept factori de risc pentru infecția cu COVID-19: lipsa unui dispozitiv de spălat mâinile instalat la intrarea în casă ($ORa=1,86$; 95% CI [1,07-3,21]) sau al unui dispozitiv care furnizează apă ($ORa=5,57$; 95% CI [1,98-15,65]), prezența aerului condiționat la locurile de muncă ($ORa=5,48$; 95% CI [2,40-12,57]), cunoștințe insuficiente despre măsurile de protecție ($ORa=1,41$; 95% CI [1,08-1,84]) și lipsă de cunoștințe privind perioada de incubație a coronavirusului ($ORa=4,19$; 95% CI [2,37-7,44]). **Concluzii.** Pe baza constatărilor acestui studiu, un răspuns contextual ar trebui să prioritizeze strategiile care vor crește gradul de conștientizare și cunoaștere de către populație despre COVID-19, precum și practicile preventive.

INTRODUCTION

Coronavirus disease 2019 (COVID-19) has spread rapidly worldwide, causing a global public health crisis (1). The World Health Organization (WHO) declared the outbreak a Public Health Emergency of International Concern on 30 January 2020, and a pandemic on 11 March 2020 and since then the number of cases have been increasing everywhere on the globe along with consecutive waves (2). At present, in comparison with the USA and Europe, Africa has a lower number of cases and lower daily increase in infection. However, WHO continues to express concern about the impact COVID-19 may have on Africa. This is because, from the perspective of capacity, African countries are in a parlous situation compared to Europe, North America and some parts of Asia (3).

Given that the pandemic is caused by a novel strain of coronavirus with unknown original host, in the early stage of the outbreak, the factors associated with its transmission routes, severity and fatality risks has remained unclear for long (4). Several studies indicate that the susceptibility to infection, being seriously ill and the risk of death are influenced by individual-level characteristics such as sociodemographic factors, behavioral traits and pre-existing medical conditions (4, 5). Responses to African epidemics have been threatened by insufficient infrastructure and weak healthcare systems, including lack of sufficient monitoring to determine the magnitude of the outbreak and insufficient structures to prevent, diagnose and treat diseases (6, 7). Contrary to other continents, there is a dearth of data on the drivers of the pandemic in Africa. *Aim of the study:* we conducted a national case-control study to assess the influence of contextual factors (environmental, socio-cultural, demographic, economic and political) on the dynamic of COVID-19 spread in Benin. The current article, based on data from this national survey aimed to identify risk factors associated with COVID-19 infection in Benin.

MATERIAL AND METHODS

This study was conducted in Benin, a country located in West Africa. Benin is bordered to the West by Togo, in the North by Niger and Burkina-Faso and in the East by Nigeria, which was one of the most affected countries in Africa by

COVID-19. As of February 15, 2022, Benin had 163 deaths out of 26,309 confirmed cases of COVID-19 (8). The survey was carried out in selected health facilities accounting for specific sites for COVID-19 screening and treatment.

A case-control study was conducted from 14 September to 20 October 2020. We considered cases as individuals with a positive reverse transcription-polymerase chain reaction (RT-PCR) test for SARS-CoV-2 and who were undergoing treatment, while controls were those with a negative result and who had no symptoms of COVID-19 prior to enrolment in the study. Cases enrolled in the study were those who were healthy enough to be interviewed (not hospitalized for serious conditions).

The selection method was non-probabilistic. Cases and controls were selected for convenience in two stages. The first stage consisted of a purposive selection of nine screening and treatment sites. These sites were identified in collaboration with the health authorities in the view to have a broad geographic coverage of the country (north, center and south). COVID-19 management sites with the highest attendance in terms of tests performed and people being treated and followed up were preferred. In Benin, there was a total of 84 screening and treatment sites, with a least one per city, and more sites in distributed at a rate of one per commune (77), with three more in Cotonou. Six sites were selected in the southern part of the country to account the higher population density, two in the north and one in the south. The second stage consisted of convenience recruitment of cases and controls screened at the sites. A total of 312 participants were enrolled (104 cases for 208 controls). For each case, two unmatched controls from the same site were selected.

Data were collected using a structured questionnaire about the potential risk factors for COVID-19. The questionnaire consisted of 4 main parts: (i) sociodemographic characteristics (age, sex, educational status, marital status, monthly income, religion, occupational status); (ii) risk factors related to medical history, housing conditions, working conditions, transportation conditions and nutritional factors; (iii) participants' knowledge (mode of transmission, persons at risk, protective measures, incubation period

and existence of asymptomatic people) and adherence to preventive practices (mask wearing, hand washing, objects/surfaces disinfection, social distancing, teleworking and avoiding risk actions like handshake, mask below the chin, touching the face, eyes or the mouth with hands) for COVID-19; (iv) COVID-19 status of respondents (case symptomatic, case asymptomatic or control).

All statistics were performed using IBM SPSS Statistics software version 20.0.0. Descriptive statistics, bivariate logistic regression and multivariate logistic regression were used to identify the factor associated with COVID-19 among respondents. A significance level of 5% was used. To build the initial model, only the independent variables whose p-value at the end of the bivariate analysis was less than or equal to 0.10 were introduced. A backward stepwise multivariate logistic regression was done to obtain the final model.

RESULTS

Description of the sample

A total of 312 (50.96% males and 49.04% females) participants were interviewed. The mean age of the participants was 34.03±11.86 years (34.80±11.89 for cases and 33.64±11.85 among controls). The elders were very few (3.85%). The proportion of symptomatic cases was 56.7% and that of asymptomatic cases was 43.3%. About the educational status, 43.59% went to university, 23.72% secondary school and 13.46% only primary school. Most of them are married (62.7%) and Christians (81.29%) in religion. Civil servant (48.08%) and self-employed person (16.99%) were the most preponderant workers. The quarter of them (25.64%) has an income less than the guaranteed interprofessional minimum wage (40.000 FCFA). About their health status, 24.36% suffered from a disease (not COVID-19) the month before the survey, 3.53% were overweight or obese, 1.28% had a high blood pressure, 0.64% had chronic hepatitis and sickle cell disease, 0.32% had a cancer, 5.77% were suffering from respiratory disorders, 1.60% had a chronic kidney disease and 11.76% were pregnant women or have recently delivered. COVID-19 cases were diagnosed in 12.18% of their family and among their colleagues in 14.74%.

Unadjusted analysis

Table 1 (Appendix 1) presents a comparison between cases and controls regarding socio-demographic characteristics and medical history of the participants in the bivariate analysis. Factors associated with COVID-19 infection were educational status [no formal: OR=3.79 (95%CI; 1.22-11.72, p=0.021); marital status [being married: OR=2.26, 95%CI; 1.34-3.81, p=0.002], monthly income [≥ 300000 FCFA: OR=3.43 (95%CI; 1.55-7.60, p=0.002); recent history of pregnancy [OR=5.03 (95%CI; 1.68-14.97, p=0.002]. No associations were found for age (p=0.066), sex (p=0.055), occupational status (p=0.093), recent illness (p=0.458), confirmed cases in family (p=0.056) or among colleagues (p=0.424), overweight or obesity status (p=0.489), sickle cell disease (p=0.626), respiratory disorders (p=0.610) and chronic kidney disease presence (p=0.219).

Table 2 (Appendix 2) shows the comparison between cases and controls concerning their travel and transports habits. Only using motorcycles taxis was associated with COVID-19 infection (OR: 1.67, 95%CI: 1.03-2.72, p=0.037). No associations were found regarding the travel outside Benin in the last month (p=0.847), municipality of residence (p=0.791), municipality visited inside the sanitary seal (p=0.558), use of individual transport (p=0.120) and use of public transport (p=0.590).

Comparison of working conditions are shown in Table 3 (Appendix 3). There were associations between COVID-19 infection and the type of handwashing device at the home entrance [no device: OR: 1.72 (95%CI: 1.03-2.85, p=0.036) or water supply only: OR: 4.62 (95%CI: 1.84-11.61, p=0.001)] and frequency of using air conditioner [always: OR: 3.38 (95%CI: 1.63-6.97, p=0.001). There were no associations found for the type of house (p=0.409), number of people sleeping in the same room (p=0.115), frequency of using a fan at home (p=0.831) or workplace (p=0.118), frequency of using air conditioner at home (p=0.252), drinking water source at home (p=0.122) or workplace (p=0.231), type of work building (p=0.121), number of people working in the same room (p=0.258), distance between co-workers (p=0.412) and type of handwashing device at workplace (p=0.438).

Table 4 (Appendix 4) presents the practices and

knowledge of participants related to COVID-19. An association with COVID-19 infection was found for the frequency of mask wearing at home [never: 0.44 (95%CI: 0.20-0.98, $p=0.044$) or in public places [never/rarely: 2.99 (95%CI: 1.16-7.68, $p=0.023$), knowledge of persons at risk [OR=0.82, (95%CI: 0.69-0.98, $p=0.029$)], knowledge of the incubation period of the coronavirus [OR=2.89, (95%CI: 1.77-4.72, $p<0.001$)] and knowledge of protective measures [OR=0.73, (95%CI: 0.57-0.94, $p=0.015$)]. There were no associations regarding other practices like going to celebrations or gatherings ($p=0.050$), lowering the mask below the chin ($p=0.562$), touching the face, eyes or mouth ($p=0.113$), greeting with a handshake ($p=0.201$), the type of mask worn ($p=0.517$), the frequency of mask wearing in public transport ($p=0.273$) and at the workplace ($p=0.179$), the frequency of hand washing when leaving a public place ($p=0.320$) or returning to the home ($p=0.340$). There were also no associations with COVID-19 infection for the knowledge

of modes of transmission ($p=0.309$), of symptoms ($p=0.086$), of the existence of asymptomatic cases ($p=0.826$) and of the ability of asymptomatic cases to transmit the virus to others ($p=0.138$).

Adjusted analysis

After multivariate analyses (tab. 5), factors independently associated with COVID-19 infection were:

- absence of a handwashing device at the entrance of home (ORa=1.86, 95% CI [1.07-3.21]) or a handwashing device providing only water (ORa=5.57, 95% CI [1.98-15.65]);
- permanent use of air conditioning (ORa=5.48, 95% CI [2.40-12.57]);
- less knowledge of protective measures against COVID-19 (ORa=1.41, 95% CI [1.08-1.84]);
- no knowledge of the coronavirus incubation period (ORa=4.19, (95% CI [2.37-7.44])).

Table 5. Factors associated with COVID-19 (multivariate final model).

Variables	ORa [IC _{95%}]	p-value
Type of hand washing device at home		
No device	1.86 [1.07-3.21]	0.027
Water supply only	5.57 [1.98-15.65]	0.001
Water supply with soap/ bleach/ hydroalcoholic gel	1	
Frequency of air conditioning use at workplace		
Never	1	
At one time	1.80 [0.79-4.10]	0.164
Always	5.48 [2.40-12.57]	<0.001
NA*	1.19 [0.61-2.31]	0.602
Knowledge of COVID-19 Incubation Period		
Yes	4.19 [2.37-7.44]	<0.001
No	1	
Number of known protective measures against COVID-19	1.41 [1.08-1.84]	0.011

Note: ORa - adjusted Odds Ratio;

*people not working or working in a building where air conditioner couldn't be installed.

DISCUSSIONS

To the best of our knowledge, this is the first study attempting to determine the risk factors driving the COVID-19 infection in Benin. Four main risk factors were identified: absence of handwashing device or handwashing with only water and no soap, permanent use of air conditioning, less knowledge of protective measures and no lack of knowledge on the virus incubation period.

The first risk factor identified is the absence of an adequate handwashing device at the entrance of home. This measure has been recommended by public health authorities across the world to promote handwashing of visitors, at private and public places. It participates for reducing the spread of the coronavirus. In fact, studies have shown that handwashing is associated with a significantly reduced risk of contracting the

coronavirus and is known to disrupt the transmission of respiratory diseases in general (9, 10). This finding indicates the necessity for the public to pay attention to personal protective at home and raise the need for health authorities to continue raising awareness about this life saving measure (11). Handwashing before, during, and after preparing food; before eating food; before touching the face; before and after caring for someone who is sick; after blowing the nose, coughing, or sneezing; after being in a public place; after changing diapers or cleaning up a child who has used the toilet; after using the toilet or latrine; after touching an animal, animal feed, or animal waste and after touching garbage is necessary to halt the spread of COVID-19, along with other COVID suitable behaviors (12). Handwashing is seen as the cornerstone for COVID-19 Prevention. However, it is important to notice, as shown by our data, that handwashing should be performed with soap and not only water and, this needs to be emphasized during campaign of sensitization.

Of note, after successive waves, there is a risk that population become careless about that measure. Therefore, there is a compulsory need that health authorities continue to sensitize populations on the importance of this live saving

measure.

The second factor identified is the use of air conditioning permanently at the workplace. SRAS-CoV-2 is known to survive longer in low temperature environments (13). Also, the SARS-CoV-2 has a longer persistence on surfaces like stainless steel, plastics, glass and highly porous fabrics that are often present in workplaces like offices (14). The risk to contract COVID-19 is higher in crowded and confined spaces (15). It is therefore important, that rooms are adequately ventilated to reduce individual infection risk (16, 17).

The third and fourth factors identified are the lack of knowledge of the incubation period of the coronavirus and the low knowledge of protective measures against COVID-19. Overall, studies have showed that level of knowledge has a positive impact on the practices towards COVID-19 (18). The lack of knowledge on COVID-19 appears as a risk factor that may indicate limited access to credible and timely information about the virus among cases. But in some studies, it has been observed that despite good knowledge, attitudes were not always positive (19). This therefore requires additional education to convey the importance of adherence to prevention measures to reduce the spread of COVID-19.

CONCLUSIONS

1. The COVID-19 pandemic is still affecting people around the world. Because of its dynamic not being the same in all countries or regions, it is important to identify the factors involved in its spread.
2. In the present study conducted in Benin, factors related to hand hygiene, working conditions and knowledge of the COVID-19 have been highlighted. These findings could help to strengthen response strategies implemented across the country. To do so, population's knowledge on COVID-19 need to be improved and preventive practices promoted through the ways available.
3. This national case-control study assessed the influence of some contextual factors on the COVID-19 dynamic in Benin.
4. Further studies need to be conducted to explore a wider range or others contextual factors not taken into account in that study, which could have a positive or negative influence on the COVID-19 spread in Benin.

CONFLICT OF INTERESTS

The authors do not declare any conflict of interest.

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ETHICAL APPROVAL

Administrative authorization was obtained from health authorities as well as ethical approval from National Ethics Committee for Health Research in Benin (N 086/MS/DRFMT/ CNERS/SA

of August 04, 2020). All participants (cases and controls) gave an informed and written consent and the interviews were conducted in strict respect of their privacy and confidentiality.

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Appendix 1: Table 1. Comparison of sociodemographic characteristics and medical history of cases and controls.

Variables	Total N (%)	Cases n (%)	Controls n (%)	OR [IC _{95%}]	p-value
Sex					
Female	153 (49.04)	59 (56.73)	94 (45.19)	1.59 [0.99-2.56]	0.055
Male	159 (50.96)	45 (43.27)	114 (54.81)	1	-
Age (years)					
<30	133 (42.63)	39 (37.50)	94 (45.19)	0.58 [0.33-1.03]	0.066
30-39	87 (27.88)	36 (34.62)	51 (24.52)	1	-
40-49	53 (16.99)	18 (17.31)	35 (16.83)	0.72 [0.35-1.48]	0.383
50-59	27 (8.65)	6 (5.77)	21 (10.10)	0.40 [0.15-1.10]	0.077
≥60	12 (3.85)	5 (4.81)	7 (3.37)	1.01 [0.30-3.44]	0.985
Educational status					
No formal education	15 (4.81)	10 (9.62)	5 (2.40)	3.79 [1.22-11.72]	0.021
Primary	42 (13.46)	13 (12.50)	29 (13.94)	0.85 [0.40-1.78]	0.666
Secondary	119 (38.14)	34 (32.69)	85 (40.87)	0.75 [0.44-1.29]	0.306
University	136 (43.59)	47 (45.19)	89 (42.79)	1	-
Marital status					
Married/ Common-law marriage	195 (62.50)	77 (74.04)	118 (56.73)	2.26 [1.34-3.81]	0.002
Single/widowed	116 (37.18)	26 (25.00)	90 (43.27)	1	-
No answer	1 (0.32)	1 (0.96)	0 (0.00)	-	-
Occupational status					
Self-employed person	53 (16.99)	12 (11.54)	41 (19.71)	3.71 [0.80-17.16]	0.093
Civil servant	150 (48.08)	53 (50.96)	97 (46.63)	0.54 [0.22-1.36]	0.191
Learner	46 (14.74)	15 (14.42)	31 (14.90)	1.02 [0.49-2.11]	0.969
Retired	4 (1.28)	1 (0.96)	3 (1.44)	0.90 [0.37-2.20]	0.815
Job seeker	10 (3.21)	3 (2.88)	7 (3.37)	0.62 [0.06-6.52]	0.690
Housewife	9 (2.88)	6 (5.77)	3 (1.44)	1	-
Retailer	40 (12.82)	14 (13.46)	26 (12.50)	0.80 [0.19-3.57]	0.766
Monthly income (FCFA)					
40000 - 100000	94 (30.13)	24 (23.08)	70 (33.65)	1	-
< 40 000	80 (25.64)	28 (26.92)	52 (25.00)	1.57 [0.82-3.01]	0.175
100000 - 300000	72 (23.08)	20 (19.23)	52 (25.00)	1.12 [0.56-2.24]	0.745
≥ 300000	37 (11.86)	20 (19.23)	17 (8.17)	3.43 [1.55-7.60]	0.002
No answer	29 (9.29)	12 (11.54)	17 (8.17)	2.06 [0.86-4.93]	0.105

Variables	Total N (%)	Cases n (%)	Controls n (%)	OR [I _{C95%}]	p-value
Ill in the last month					
Yes	76 (24.36)	28 (26.92)	48 (23.08)	1.22[0.71-2.10]	0.458
No	236 (75.64)	76 (73.08)	160 (76.92)	1	-
Confirmed cases in family					
Yes	38 (12.18)	18 (17.31)	20 (9.62)	1.96[1.0-3.91]	0.056
No	274 (87.82)	86 (82.69)	188 (90.38)	1	-
Confirmed cases among colleagues					
Yes	46 (14.74)	13 (12.50)	33 (15.87)	1	-
No	266 (85.26)	91 (87.50)	175 (84.13)	1.32[0.66-2.63]	0.424
Overweight or obesity					
Yes	11 (3.53)	5 (4.81)	6 (2.88)	1.70[0.50-5.70]	0.396
No	301 (96.47)	99 (95.19)	202 (97.12)	1	-
High blood pressure					
Yes	4 (1.28)	2 (1.92)	2 (0.96)	2.01[0.28-14.54]	0.489
No	308 (98.72)	102 (98.08)	206 (99.04)	1	-
Chronic hepatitis					
Yes	2 (0.64)	0 (0.00)	2 (0.96)	-	-
No	310 (99.36)	104 (100)	206 (99.04)	-	-
Sickle cell disease					
Yes	2 (0.64)	1 (0.96)	1 (0.48)	2.01[0.12-32.45]	0.626
No	310 (99.36)	103 (99.04)	207 (99.52)	1	-
Cancer					
Yes	1 (0.32)	1 (0.96)	0 (0.00)	-	-
No	311 (99.68)	103 (99.04)	208 (100)	-	-
Respiratory disorders					
Yes	18 (5.77)	7 (6.73)	11 (5.29)	1.29[0.48-3.43]	0.610
No	294 (94.23)	97 (93.27)	197 (94.71)	1	-
Chronic kidney disease					
Yes	5 (1.60)	3 (2.88)	2 (0.96)	3.05[0.50-18.60]	0.219
No	307 (98.40)	101 (97.12)	206 (99.04)	1	-
Pregnant women or recently delivered					
Yes	18 (11.76)	13 (22.03)	5 (5.32)	5.03[1.68-14.97]	0.002
No	135 (88.24)	46 (77.97)	89 (94.68)	1	-

Appendix 2: Table 2. Comparison of travel and means of travel of cases and controls.

Variables	Total N (%)	Cases n (%)	Controls n (%)	OR [IC _{95%}]	p-value
Travel outside Benin in the last month					
Yes	14 (4.49)	5 (4.81)	9 (4.33)	1.12 [0.36-3.42]	0.847
No	298 (95.51)	99 (95.19)	199 (95.67)	1	-
Municipality of residence					
Inside the area of the sanitary seal	222 (71.15)	73 (70.19)	149 (71.63)	1.07 [0.63-1.80]	0.791
Outside the area of the sanitary seal	90 (28.85)	31 (29.81)	59 (28.37)	1	-
Municipality visited inside the sanitary seal					
Yes	202 (64.74)	65 (62.50)	137 (65.87)	0.86 [0.53-1.40]	0.558
No	110 (35.26)	39 (37.50)	71 (34.13)	1	-
Use of individual transport					
Yes	190 (60.90)	57 (54.81)	133 (63.94)	0.68 [0.42-1.10]	0.120
No	122 (39.10)	47 (45.19)	75 (36.06)	1	-
Use of motorcycle taxis					
Yes	110 (35.26)	45 (43.27)	65 (31.25)	1.67 [1.03-2.72]	0.037
No	202 (64.74)	59 (56.73)	143 (68.75)	1	-
Use of public transport					
Yes	31 (9.94)	9 (8.65)	186 (89.42)	0.80 [0.35-1.80]	0.590
No	281 (90.06)	95 (91.35)	(10.58)	1	-

Appendix 3: Table 3. Comparison of housing and working conditions of cases and controls.

Variables	Total N (%)	Cases n (%)	Controls n (%)	OR [IC _{95%}]	p-value
Type of house					
Single-family house	114 (36.54)	41 (39.42)	73 (35.10)	1	-
Common courtyard house	182 (58.33)	57 (54.81)	125 (60.10)	0.81[0.50-1.33]	0.409
Apartment building	15 (4.81)	6 (5.77)	9 (4.33)	1.19[0.40-3.57]	0.760
Temporary building	1 (0.32)	0 (0.0)	1 (0.48)	-	-
Number of people sleeping in the same room*	312	-	-	1.06 [0.94-1.20]	0.335
Frequency of ventilation of the dwelling					
Never	44 (14.10)	12 (11.54)	32 (15.38)	1	-
At some time	138 (44.23)	56 (53.85)	82 (39.42)	1.82[0.84-3.83]	0.115
Always	130 (41.67)	36 (34.62)	94 (45.19)	1.02[0.47-2.20]	0.957
Frequency of using a fan					
Never	162 (51.92)	55 (52.88)	107 (51.44)	1.06[0.62-1.80]	0.831
At some time	101 (32.37)	33 (31.73)	68 (32.69)	1	-
Always	49 (15.71)	16 (15.38)	33 (15.87)	0.99[0.48-2.07]	0.998
Frequency of using air conditioner					
Never	284 (91.03)	92 (88.46)	192 (92.31)	0.58[2.34-1.46]	0.252
At some time	20 (6.41)	9 (8.65)	11 (5.29)	1	-
Always	7 (2.24)	2 (1.92)	5 (2.40)	0.49[0.08-3.14]	0.451
No answer	1 (0.32)	1 (0.96)	0 (0.0)	-	-
Drinking water source					
National supply	186 (59.62)	63 (60.58)	123 (59.13)	1	-
Domestic well	64 (20.51)	15 (14.42)	49 (23.56)	0.60[0.31-1.15]	0.122
Swamp	1 (0.32)	1 (0.96)	0 (0.0)	-	-
Borehole	61 (19.55)	25 (24.04)	36 (17.31)	1.36[0.75-2.46]	0.315
Type of handwashing device at the home entrance					
No device	150 (48.08)	55 (52.88)	95 (45.67)	1.72[1.03-2.85]	0.036
Water supply only	23 (7.37)	14 (13.46)	9 (4.33)	4.62[1.84-11.61]	0.001
Water supply with soap/ bleach/ hydroalcoholic gel	139 (44.55)	35 (33.65)	104 (50.00)	1	-
Type of work building					
Closed	121 (41.72)	41 (43.62)	80 (40.82)	1.31[0.72-2.38]	0.372
Semi-open	89 (30.69)	25 (26.60)	64 (40.82)	1	-
Open	80 (27.59)	28 (29.79)	52 (26.53)	1.38[0.72-2.65]	0.334

Variables	Total N (%)	Cases n (%)	Controls n (%)	OR [IC _{95%}]	p-value
NA*	22 (7.05)	10 (9.62)	12 (5.77)	2.13[0.82-5.56]	0.121
Number of people working in the same room**	245	-	-	0.99[0.99-1.01]	0.258
Distance between co-workers (m)***					
<1	125 (69.83)	40 (74.07)	85 (68.00)	0.74[0.36-1.52]	0.412
≥1	54 (30.17)	14 (25.93)	40 (32.00)	1	
Frequency of using a fan					
Never	179 (73.06)	64 (80.00)	115 (69.70)	2.13[0.83-5.51]	0.118
At some time	37 (15.10)	10 (12.50)	27 (16.36)	1.42[0.45-4.51]	0.552
Always	29 (11.84)	06 (7.50)	23 (13.94)	1	-
NA****	67 (21.47)	24 (23.08)	43 (20.67)	2.14[0.77-5.98]	0.147
Frequency of using air conditioner					
Never	168 (53.85)	45 (43.27)	123 (59.13)	1	-
At some time	39 (12.50)	14 (13.46)	25 (12.02)	1.53[0.73-3.20]	0.258
Always	38 (12.18)	21 (20.19)	17 (8.17)	3.38[1.63-6.97]	0.001
NA****	67 (21.47)	24 (23.08)	43 (20.67)	1.53[0.83-2.79]	0.171
Drinking water source					
National supply	238 (76.28)	75 (72.12)	163 (78.37)	1	-
Domestic well	15 (4.81)	7 (6.73)	8 (3.85)	1.90[0.67-5.44]	0.231
Swamp	1 (0.32)	1 (0.96)	0 (0.0)	-	-
Borehole	31 (9.94)	9 (8.65)	22 (10.58)	0.89[0.39-2.02]	0.779
No water	3 (0.96)	1 (0.96)	2 (0.96)	1.09[0.10-12.17]	0.946
NA****	23 (7.37)	10 (9.62)	13 (6.25)	1.67[0.70-3.98]	0.246
No answer	1 (0.32)	1 (0.96)	0 (0.0)	-	-
Type of handwashing device					
No device	52 (17.93)	19 (20.21)	33 (16.84)	1.28[0.68-2.43]	0.438
Water supply only	30 (10.34)	11 (11.70)	19 (9.69)	1.29[0.58-2.88]	0.528
Water supply with soap/bleach /hydroalcoholic gel	207 (71.38)	64 (68.09)	143 (72.96)	1	-
No answer	1 (0.34)	0 (0.0)	1 (0.51)	-	-

Note: *people not working; ** quantitative variable; ***for more than 1 person in the same room; ****people not working or working in a building where air conditioner couldn't be installed; ***** people not working or itinerant worker.

Appendix 4: Table 4. Comparison of COVID-19-related practices and knowledge of cases and controls.

Variables	Total N (%)	Cases n (%)	Controls n (%)	OR [IC _{95%}]	P- value
Participation in ceremonies					
No	286 (91.67)	100 (96.15)	186 (89.42)	1	-
Yes	26 (8.33)	4 (3.85)	22 (10.58)	0.34 [0.11-1.01]	0.050
Frequency of participation in a sporting event as a spectator*					
	312	-	-	0.79 [0.56-1.12]	0.199
Frequency of participation in a sporting event as a player*					
	312	-	-	0.90 [0.71-1.11]	0.211
Frequency of beach attendance*					
	312	-	-	1.36 [0.93-1.99]	0.094
Frequency of school attendance*					
	312	-	-	0.96 [0.90-1.02]	0.218
Frequency of bank attendance*					
	312	-	-	0.95 [0.84-1.06]	0.336
Frequency of shop attendance*					
	312	-	-	1.00 [0.99-1.01]	0.252
Frequency of hypermarket attendance*					
	312	-	-	1.08 [0.92-1.27]	0.318
Frequency of market attendance*					
	312	-	-	0.96 [0.91-1.01]	0.192
Type of mask					
Cloth mask	179 (57.37)	57 (54.81)	122 (58.65)	0.85 [0.53-1.37]	0.517
Surgical mask/FFP2	133 (42.63)	47 (45.19)	86 (41.35)	1	-
Frequency of mask wearing in the home					
Never	206 (66.03)	63 (60.58)	143 (68.75)	0.44 [0.20-0.98]	0.044
Rarely	41 (13.14)	12 (11.54)	29 (13.94)	0.41 [0.15-1.12]	0.084
Often	37 (11.86)	15 (14.42)	22 (10.58)	0.68 [0.25-1.83]	0.448
Always	28 (8.97)	14 (13.46)	14 (6.73)	1	-
Frequency of wearing a mask on the street					
Never/Rarely	35 (11.22)	16 (15.39)	19 (9.18)	1.80 [0.88-3.66]	0.106
Often/Always	276 (88.78)	88 (84.61)	188 (90.82)	1	-
Frequency of mask wearing in individual transport					
Rarely	6 (1.92)	5 (4.81)	1 (0.48)	8.00 [0.90-70.99]	0.062
Often/Always	104 (33.33)	40 (38.46)	64 (30.77)	1	-
NA**	202 (64.74)	59 (56.73)	143 (68.75)	0.66 [0.40-1.08]	0.102
Frequency of wearing a mask on public transport					
Never/Rarely	9 (2.90)	3 (2.91)	6 (2.90)	1.19 [0.29-4.93]	0.273
Often/Always	179 (57.74)	53 (51.46)	126 (60.87)	1	-
NA**	122 (39.35)	47 (45.63)	75 (36.23)	1.49 [0.92-2.42]	0.272
Frequency of mask use in the workplace					
					0.272

Variables	Total N (%)	Cases n (%)	Controls n (%)	OR [IC _{95%}]	p- value
Never/Rarely	46 (14.79)	18 (17.31)	28 (13.46)	1.41 [0.74-2.71]	0.299
Often/Always	243 (78.14)	76 (73.08)	167 (80.29)	1	-
NA***	22 (7.07)	10 (9.62)	12 (5.77)	1.83 [0.76-4.42]	0.179
No answer	1 (0.32)	0 (0.00)	1 (0.48)	-	-
Frequency of mask wearing in public places					
Never/Rarely	19 (6.09)	11 (10.68)	8 (3.85)	2.99 [1.16-7.68]	0.023
Often/Always	292 (93.59)	92 (89.32)	200 (96.15)	1	-
No answer	1 (0.32)	1 (0.96)	0 (0.00)	-	-
Frequency of mask change					
Once or twice a day	233 (74.68)	79 (75.96)	154 (74.04)	1	-
Every two days or more	78 (25.00)	25 (24.04)	53 (25.48)	0.92 [0.53-1.59]	0.764
No answer	1 (0.32)	0 (0.00)	1 (0.48)	-	-
Lowering of the mask below the chin					
Yes	268 (85.90)	91 (87.50)	177 (85.10)	1.22 [0.61-2.45]	0.562
No	44 (14.10)	13 (12.50)	31 (14.90)	1	-
Frequency of hand washing before entering public places					
Never/Rarely	36 (11.54)	12 (11.54)	24 (11.54)	1 [0.47-2.08]	1.000
Often/Always	276 (88.46)	92 (88.46)	184 (88.46)	1	-
Frequency of hand washing when leaving a public place					
Never/Rarely	198 (63.46)	62 (59.62)	136 (65.38)	1.27 [0.78-2.07]	0.320
Often/Always	114 (36.54)	42 (40.38)	72 (34.62)	1	-
Frequency of hand washing upon returning home					
Never/Rarely	73 (23.40)	21 (20.19)	52 (25.00)	0.76 [0.42-1.34]	0.340
Often/Always	239 (76.60)	83 (79.81)	156 (75.00)	1	-
Frequency of disinfection of objects or surfaces at home					
Never	139 (44.55)	38 (36.54)	101 (48.56)	0.67 [0.32-1.42]	0.301
Once to six times a week	134 (42.95)	52 (50.00)	82 (39.42)	1.13 [0.54-2.37]	0.742
Every day	39 (12.50)	14 (13.46)	25 (12.02)	1	-
Frequency of disinfection of objects or surfaces at the workplace					
Never	115 (39.89)	35 (33.65)	80 (38.46)	0.68 [0.38-1.21]	0.191
Once to three times a week	82 (28.37)	23 (22.12)	59 (28.37)	0.60 [0.32-1.15]	0.125
Every day	92 (31.83)	36 (34.62)	56 (26.92)	1	-
NA***	22 (7.05)	10 (9.62)	12 (5.77)	1.30 [0.51-3.31]	0.588

Variables	Total N (%)	Cases n (%)	Controls n (%)	OR [I _{C95%}]	p- value
No answer	1 (0.32)	0 (0.00)	1 (0.48)	-	-
Frequency of touching the face, eyes or mouth					
Never	13 (4.17)	2 (1.92)	11 (5.29)	1	-
Rarely	95 (30.45)	33 (31.73)	62 (29.81)	2.93[0.61-14.00]	0.178
Often	113 (36.22)	44 (42.31)	69 (33.17)	3.51[0.74-16.58]	0.113
Very often	91 (29.17)	25 (24.04)	66 (31.73)	2.08[0.43-10.07]	0.361
Frequency of handshake greeting					
Never	213 (68.27)	78 (75.00)	135 (64.90)	1	-
Rarely	62 (19.87)	18 (17.31)	44 (21.15)	0.70[0.38-1.31]	0.271
Often	22 (7.05)	5 (4.81)	17 (8.17)	0.51[0.18-1.43]	0.201
Always	15 (4.81)	3 (2.88)	12 (5.77)	0.43[0.12-1.58]	0.205
Number of known modes of transmission					
Number of known symptoms	-	-	-	0.91[0.76-1.09]	0.309
Number of known persons at risk					
Number of known persons at risk	-	-	-	0.87[0.74-1.02]	0.086
Number of known period of the coronavirus					
No	147 (47.12)	67 (64.42)	80 (38.46)	2.89[1.77-4.72]	<0.001
Yes	165 (52.88)	37 (35.38)	128 (61.54)	1	-
Knowledge of the existence of asymptomatic COVID-19 cases					
No	50 (16.03)	16 (15.38)	34 (16.35)	0.93[0.48-1.77]	0.826
Yes	262 (83.97)	88 (84.62)	174 (83.65)	1	-
Knowledge of the existence of the capacity of asymptomatic COVID-19 cases to transmit the virus					
No	52 (16.67)	22 (21.15)	30 (14.42)	1.59[0.87-2.93]	0.138
Yes	260 (83.33)	82 (78.85)	178(85.58)	1	-
Number of known protective measures					
Alcohol use					
Moderate use	227 (88.78)	185 (88.94)	92 (88.46)	1	-
Misuse	33 (10.58)	22 (10.58)	11 (10.58)	1.01[0.47-2.16]	0.989
Addiction	2 (0.64)	1 (0.48)	1 (0.96)	2.01[0.12-32.51]	0.623

Note: *quantitative variable; **people not using this mode of transport; ***people not working