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COVID-19 INFECTION AMONG HEALTHCARE WORKERS IN MARRAKECH, MOROCCO: PREVALENCE AND RISK FACTORS

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ABSTRACT

Background: Healthcare Workers(HCW) are crucial actors in the COVID pandemic, but remains at higher risk of contracting the virus and suffering its complications, while they were in contact with positive patients. The main objective of this study was to determine the prevalence of COVID infection; and describe its clinical, epidemiological and microbiological characteristics among HCW in Marrakech region, Morocco. **Methodology:** the study was performed in Mohammed VI University Center, were all HCW were included, under the occupational health department a consultation was undertaken to identify suspected case according to their symptoms or close contact with a positive case. Then nasopharyngeal swab was collected from suspected cases for SARS -COV -2 detection by RT-PCR. In addition, confirmed cases completed an online questionnaire. **Results:** a total of 676 HCW tested positive for Sars-COV-2 between match 13th and December 5th2020, representing a prevalence of22, 22%. The most reported symptoms were: asthenia (77,9%), headache (72,9%), myalgia (61,7%). Asymptomatic rate was very low in this study (4,7%). 31,23% of positive HCW had the 3 genes of the virus: Rdrp, Nucleocapsid, and Viral Envelope. The Multivariate logistic regression showed that Covid complications, was positively associated with the HCW profile, training workshops, and comorbidity. **Conclusion:** To our knowledge, this is the first study investigating COVID in HCW in Morocco, the study revealed a high prevalence rate compared to similar countries. Heavily involved in the management of patients with COVID-19.

KEYWORDS: COVID-19, SARS-COV-2, Healthcare worker, Polymerase Chain Reaction, Risk factors, Morocco.

INTRODUCTION

The severe acute respiratory syndrome (SARS) coronavirus 2 (SARS- CoV-2) initially emerged in Wuhan, China and has been identified as the causative agent of coronavirus disease 2019 (COVID-19)(Tuite et al., 2020). Since then, the number of cases has grown in a really fast way. The World Health Organization (WHO), declared the disease to be a PublicHealth Emergency of International Concern (PHEIC) on January 30th, 2020. Its pandemic spread presents a substantial medical challenge with an enormous societal and economic toll (C. Wang et al., 2020).

By the date of November 20th2021, more than 258 million cases, and more than 5 million death have been reported worldwide (in 222 countries), and the number of new cases and deaths is still increasing(worldometer,2021.).

In Morocco, the first local transmission case was detected in March 13th, 2020(Kada et al., 2020). On November22th, 2021, the number of confirmed cases has gradually increased to reach 948976 cases, and 14764 deaths (worldometer,2021.).

COVID 19 has proven to be very contagious, its transmission, occurs mainly by inhalation of infectious droplets emitted during talking, sneezing or coughing during close contact(Burke et al., 2020).Long time spent with a positive patient is a risk factor for transmission of infection. Despite some diversity in initial symptoms, fever, fatigue, coughing and headache, anosmia and ageusia remain the main clinical manifestations of COVID 19(Jiang et al., 2020; Zayet et al., 2020). Older age, comorbidities and immunodeficiency are considered risk factors for developing complications(Arentz et al., 2020), although severe symptoms have also been developed by young positive patients (Jordan et al., 2020).

Healthcare workers (HCW) are crucial actors in the pandemic because of their constant and high level of exposure of contracting communicable diseases.

According to several reports(Heinzerling et al., 2020; J. Wang et al., 2020), the infection of HCW with COVID-19 in healthcare settingscan be lead to shortage of personal protective equipment, long-time exposure to large numbers of infected patients, inadequate training for infection prevention and control, and exposure to unrecognized COVID-19 patients.

Reports from Italy indicated that 20% of responding HCW were infected with COVID-19 (The Lancet, 2020).In Spain, HCW infected with COVID-19 accounts for around 12% of all confirmed cases(Anadolu Agency,2020.), Therefore, it is important to establish a protection guidelines for HCW to fight against COVID-19, and to prevent the collapse of the medical system and also to reduce the social panic(Chen et al., 2020).

Because of the important implications of COVID-19 among HCW, and the lack of detailed information about this issue, it is important to well characterize its epidemiology also clinicalcharacteristics in order to informthe decision-makers about appropriate prevention and management strategies.

We report in the present study,the clinical, epidemiological and microbiological characteristics of HCW declared positive for COVID19 since March 2020, and consequently the prevalence of Covid 19 among HCW in the region.

SUBJECTS AND METHODS

Study area

Mohamed VI University Center, with a 1548 bed capacity, employing 3042 HCW, the center is composed from 5 hospitals: - Arrazi hospital (HAR) and Ibn Tofail Hospital (HIT) containing different medical and surgical specialties, Mother and Child Hospital (HME) specialized in obstetrics and pediatrics, Hospital for oncology and hematology (COH), Hospital for psychiatry (HIN), Center for Clinical Research (CRC), and the center's Direction (DG).

All HCW (Medical doctors, nurses, pharmacists, health technicians) working in the hospital between March 13th and December05th, 2020, were included. They excluded workers from thesecurity services, maintenance services, kitchen facilities, cleaning workers and porters as they are not in direct contact with COVID patients.

Ethics statement:

The study was authorized by Mohammed VI University Hospital general directorate, the Oral informed consent was obtained from all HCW for SARS-CoV-2 testing and from SARS-CoV-2–infected HCW for data collection. Data were de-identified before analysis.

Variables and Data collection:

Under the control of the occupational health department a consultation took place (phone, face to face), to identify suspected cases according to their symptoms, or after a close contact with a patient and/or colleague declared positive. Then the suspected cases were scheduled for a nasopharyngeal swab for confirmationthrough Real Time polymerase chain reaction (RT-PCR). An appointment was given the same day, or one day after the call. People were received in a unit fitted out in order to be able to take a nasopharyngeal sample, to be sent to the microbiology laboratory for analyze withPCRfor SARS-CoV-2,

According to the hospital procedure, HCW with positive SARS- CoV-2 PCR are considered a confirmed case of COVID-19 and remained on sick leave until a negative follow-up PCR was obtained. For symptomatic HCW with negative PCR, this test was repeated after 48-72H if symptoms persisted.

Control PCRs among patients with a previous positive PCR were obtained after 14 days and repeated thereafter 7 days until a negative PCR result was obtained. Workers were allowed to return to work when they fulfilled two criteria: symptoms had resolved, and they had a negative follow-up PCR.

The number of HCW according to their profession and department for the study period was obtained from the human resources department. The following data for COVID-19 cases were extracted from the clinical records of the occupational health department: age, sex, profile, department, date of presentation at the outpatient clinic, date of symptom onset, symptoms presented during the infection (Fever, headache, coughing, fatigue, myalgia, anosmia,) duration of sick leave, presence of comorbidities (arterial hypertension, diabetes mellitus, current Psycho Active substance use, cardiovascular disease, and chronic obstructive bronchopulmonary disease or asthma), and completed by and online questionnaire and recorded in an anonymized database.

In addition to these variables, information was collected about the training in COVID-19 prevention, the use of personal protective equipment (PPE), the treatment used during infection and also the use of medicinal plants.

SARS-Cov-2 Detection

The diagnosis ofCOVID-19 was carried out in the laboratory of virology (Mohammed VI University Hospital, Marrakesh) by using real time RT PCR in nasopharyngeal swab.

The automatic viral RNA extraction was performed by Maxwell® RSC Promega extractor and BIOER extractor (SN: BYQ6.637-115). The multiplex PCR KIT for the reaction mixture was Gene finder tm covid-19 plus REAL AMP Kit (REF: IFMR-45). The thermocycler used for amplification was the applied biosystems

QuantStudio™ 5 Real-Time PCR Instrument, 96-Well 0.1 ml Block, REF: A28133).

This was a single-step reverse-transcription real-time PCR kit designed for the qualitative detection of SARS-CoV-2 RNA by real-time reverse transcription and polymerase chain reaction.

The purified nucleic acid was reverse transcribed, by using the GeneFinder COVID- 19 plus Real Amp RT-PCR master mix into cDNA, which was then subsequently amplified in the RT-PCR instrument. During the amplification process, the probe anneals to a specific target sequence located between the forward and reverse primers. In the extension phase of the PCR cycle, the 5' nuclease activity of Taq DNA polymerase degrades the bound probe, causing the reporter dye to separate from the quencher dye, generating a fluorescent signal. Fluorescence intensity is monitored at each PCR cycle by the RT-PCR instrument. The targets wasRdRp gene and N gene: specifics genes of SARS-CoV-2, E gene: detected at beta coronavirus, Human housekeeping gene RNAse P (the target gene for the internal control)

Thus, positive result for SARS-CoV-2, if there was a sigmoidal amplification curve, with Ct values not higher than 40 and taking into account the clinical and epidemiological context (table 1).

Table 1: Interpretation of GeneFinderTM 137 COVID-19 Plus RealAmp Kit.

Sarscov-2 rdrp	Sarscov-2 n	Sarscov-2 e	Rnase p	Result interpretation	Report	Actions
+	+	+	+/-	Sars-cov-2 detected	Positive	Report results to Sender and appropriate Public health authorities
If only one or both targets are positive		+/-	+/-	Sars-cov-2 detected	Positive	Report results to sender And appropriate health Authorities
-	-	-	+(ct≤35)	Sars-cov-2 not detecte	Negative	Report results to sender
-	-	-	-	Invalid result	Invalid	Repeat extraction and Rt-pcr. If additional clinical Sample is unavailable, report Invalid or inconclusive results, Which will request a new Specimen be collected, If clinically indicated

Statistical analysis

We compared frequencies of positive tests according to selected variables by the chi-square test, adjusted odds ratios (OR) and 95% confidence intervals (CI) calculated with a multivariable logistic regression model including as covariates gender, age and occupation, as well as having reported any symptom.

Data were entered in the XL sheet and analyzed accordingly as numbers and percentages. The XL data were converted into SSPS Statistics 22. chi-square test and Fisher exact test was used to compare variables, p-value considered significant if less than <0.05.

RESULTS

1. Prevalence of COVID infection among HCW of Marrakech

From the totalof 3042 HCW,676 tested positive for Sars-COV-2 between March 13 2020 and December 4th 2020, representing 22,22%. Medical doctors and nurses were the most touched with the virus representing 25,66% (278/1083) and 22,12% (8344/1555) respectively. Staff in Mother and Child Hospital (HME) were more touched than the other hospitals, representing 28,09% (168/598) of all infections (Table 2).

Table 2: repartition of positive HCW's according to their Profile and hospital.

	Medical Doctors	Nurses	Others*	Total/ hospital
Arrazi hospital	151/606 (24,91%)	131/575 (22,78%)	12/68 (17,64%)	249/1249 (23,53%)
Mother and Child Hospital	72/197 (36,54%)	92/346 (26,58%)	4/55 (07,27%)	168/598 (28,09%)
Hematology/oncology center	15/79 (18,98%)	19/111 (17,11%)	4/31 (12,90%)	38/221 (17,19%)
Ibn Tofail Hospital	36/148 (24,32%)	83/385 (21,55%)	12/101 (11,88%)	131/634 (20,66%)
Ibn Nafis Hospital	7/41 (17,07%)	17/107 (15,88%)	2/228 (7,14%)	26/176 (14,77%)
Clinical research Center	0/16 (0%)	2/18 (11,11%)	1/12 (8,33%)	3/46 (06,51%)
Center's direction	0/6 (0%)	0/13 (0%)	16/99 (16,16%)	16/118 (13,55%)
Total/profile	281/1093 (25,70%)	344/1555 (22,12%)	51/394 (12,94%)	676/3042 (22,22%)

*others: Engineers, technicians

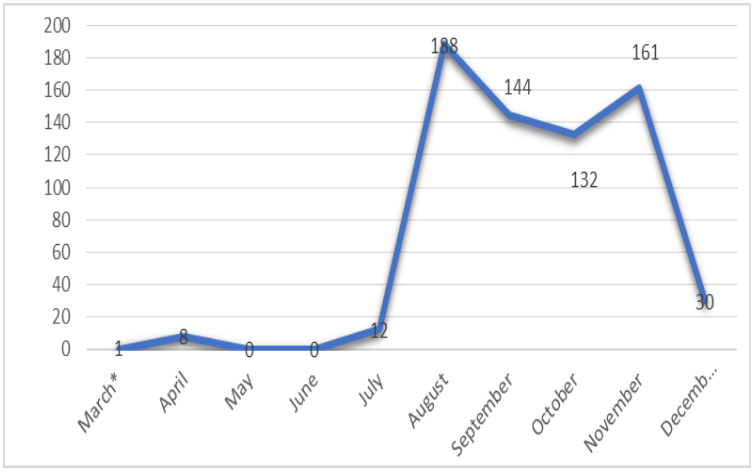

Figure 1: Evolutionof confirmed HCW between 13th March and the 04th December 2020.

According to month, the number of HCW infected, has increased since the last week of July and it continued during the next months, this rising is directly linked to the lockdown relieving measures undertaken by the government and started the 19th July 2020 (Figure 1).

2. Epidemiological profil of infected HCW

Among positive HCW recordedin the study, 555 have completed the questionnaire (representing a rate of participation 82%). In addition, due to some missing/uncompleted data, 491 were included for this second analysis.

Thus, the mean age was 31,69 [21-61] years old, (SD 7,17), there were 64,2%women (n=315), and half of participants was married (52,5%).

According to the Body Mass index (BMI), 1 person of 4 was obese, 80% of participants had not had associated diseases before the diagnosis of Covid 19, while others had respiratory (7,1%), and metabolic (3,7%) diseases. The use of psycho active substances was estimated to 9,7%, limited totobacco smoke and alcohol,while the majority (80%) were simple users.

All HCW confirmed the use of Personal protective equipment: constituted by FFP2 mask and hydroalcoholic solution (64,8%), or a combination of the forecited plus gown,gloves and face shields (35,0%) according to the procedure determined by the Moroccan ministry of health

The most initial common COVID symptoms were asthenia (n= 379, 77,9%), headache (n= 357, 72,9%), myalgia (n= 303, 61,7%), and fever (n= 262, 53,49%), and overall, more than 90% reported at least one of the aforementioned symptoms, while only 4,7% (n=23) were asymptomatic.

In front of those symptoms, 67,4% has promptly suspected COVID, and confined themselves from their family/ colleagues as a preventive measure. The expressed feelings were: fear (26,6%), anguish (23,4%) and also surprise (24,8%).

The median duration between the onset of symptomatology and confirmation was 4 days [0-21] (SD= 3,214).

Our HCW declared positive, doubted the source of contamination from patients (28,7%), colleagues (15,1%), family members (8,1%) and friends (0,4%) while 23,1% had no idea.

Half of positive HCW haven't transmit the disease (56,4%), but 34,2% to their family member and only 3,5% to their colleagues. And it was transmitted to less than 4 persons (37,3%).

Table 3: Biological and Radiological profil among participants.

Modality	Variable	Participants (N=491)
Diagnostic confirmation	No (clinical signs)	15(3,1%)
	RT-PCR	461(93,9%)
	Thoracic CT Scan	11(2,2%)
	Rapid test	4(0,8%)
Complementary exams Pulmonary impairment	No	404(81,3%)
	RT-PCR	13(2,6%)
	Thoracic CT Scan	67(13,6%)
	Rapid test	7(1,4%)
	No impairment	63(12,3%)
	Minimal (< 10%)	28(5,7%)
	Moderate (10%-25%)	16(3,3%)
	Important (26%-50%)	3(0,6%)
	Severe (51%-75%)	2(0,4%)
	Critic (>75%)	0(0%)
Genetic material	Viral envelope (E)	180(36,51%), Mean 24,27, [15-42] SD=6,40
	Nucleocapsids (N)	470 (95,33%) Mean 28,93 [14-42] SD=6,64
	RNA-dependent RNA polymerase (RdRP)	433 (87,82%) Mean 27,76 [15-44] SD=6,818
	All parts (Rdrp-N-E	154 (31,23%) Mean 26,43 [14-39] SD=6,78

Almost all participants (93,3%) had the diagnosis confirmed by the PCR test, the genetic material was the Viral envelope among 36,51% the mean threshold cycle was 24,27. The nucleocapsids was presents among approximatively all positive cases (95,33%) where the mean threshold cycle was 28,93 and the Rdrp was detected in 87,82% cases, the mean threshold cycle was 27,76. The all parts of the virus was detected in 31,23% of positive case (Table 3).

Among positive cases who used the thoracic CT scan a complementary test, no pulmonary impairment was detected in 12,3%, while the minimal (<10%) and moderate (10%-25%) was detected in 5,7% and 3,3% cases respectively (table 3).

3. Risk factors

We further classified our HCW based on disease severity: for the non-complicated group, (who may have mild symptoms without evidence of breathlessness or hypoxia) to the complicated group (patients with severe disease of pneumonia with severe respiratory distress or SpO2, or acute respiratory distress syndrome, sepsis and septic shock)(Gómez-Ochoa et al., 2020).

Table 4: Baseline Characteristics and Univariate analysis of risk factors between the Complicated and Non-complicated cases.

Modality	Variable	Non complicated (n=374)	Complicated (n=117)	Unajusted Odds ratio (CI 95%)	P Value
Age	-	31,84 y/o	31,19 y/o		
Gender	Men	147(39,3%)	88(75,2%)	1,965(1,230-3,138)	0,005**
	Women	227(60,7%)	29(24,8%)	1	
Profile	MD	167(44,7%)	27(23,1%)	1	-
	Nurses	171(45,7,6%)	78(66,8%)	2,82(1,73-4,59)	0,000***
	Others	36(9,6%)	12(10,1%)	2,06(0,955-4,451)	0,062*NS*
training	No	141(37,7%)	61(52,1%)	2,30(1,38-3,83)	0,001***

	Therapeutic Management	144(38,5%)	27(23,1%)	1	
Comorbidity	No	317(84,8%)	78(66,7%)	1	-
	Metabolic	15(4%)	10(8,6%)	2,70(1,17-6,26)	0,02*
	Respiratory	29(5,3%)	15(12,8%)	3,04(1,49-6,22)	0,002**
	Other	22(5,9%)	14(12%)	2,58(1,26-5,28)	0,009**
Period	2sd tr	108(28,9%)	58(45,3%)	2,06(1,34-3,18)	0,001***
	Td	257(68,7%)	61(52,1%)	1	
Normal life	Yes	142(38,0%)	33(28,2%)	1,55(1-2,45)	0,05*
	No	232(62,0%)	84(71,8%)	1	
NS non signifiant* p < .05; ** p < .01; *** p < .001.					

Among the complicated group men represented 75,2% with an OR 1,965 (p value = 0,005) compared to women. Nurses were more at risk (OR 2,82) to have complications compared to Medical doctors with a significative statistical difference (p value = 0,000).

Since the start of Covid, every hospital had organized different training workshops: therapeutic management (T.M) of covid patients, and wearing Personal Protective Equipment. those who didn't participate were more at risk to have complication OR 2,30(p value = 0,001) followed by those who have assisted to wearing PPE (OR=1,73) compared to the reference group (TM+ PPE).

The univariate logistic regression showed that respiratory comorbidities such as asthma represented a risk factor OR 3,04 (p value = 0,002), also patients with metabolic diseases such as Diabetes mellitus were more at risk OR 2,70 (p value = 0,02) compared with participants who had not had a comorbidity. While covid being suspected participants who continued their normal life without taking preventive measures were at risk OR 1,55 compared to those who get confined before confirming the disease (table 4).

The clinical characteristics on the univariate logistic regression showed that symptoms that represented risk factors were anosmia (OR 2,04), ageusia (OR1,75), digestive disorders such as diarrhea, vomiting (OR2,13) with a statistically significant difference (p=0,002), (p=0,009) and (p=0,000) respectively.

The more patients delayed the interval between the onset of symptoms and the test, the more they were at risk for complications: between 1-2 days (OR 1,17), more than 3 days (OR 1,87) compared to those who took less than one day to get tested (table 5).

On one hand, those who got complicated took more time to have symptoms disappeared:2-4 weeks (OR 2,94), and more than 4 weeks (OR4,50) compared to the reference group less than a week, with a statistically significant difference (p=0,002), (p=0,000) respectively.

Table 5: Clinical Characteristics and Univariate analysis of risk factors between the Complicated and Non-complicated cases.

Modality	**Variable**	**Non complicated (n=374)**	**Complicated (n=117)**	**Unajusted Odds ratio (CI 95%)**	**P Value**
Rhinorrhea	No	238(63,6%)	46(39,3%)	1	
	Yes	103(27,5%)	71(60,7%)	1,70(1,10-2,63)	0,01**
Cough	No	138(36,9%)	55(47,0%)	1	
	Yes	236(63,1%)	62(53,9%)	1,51(1-2,30)	0,05*
Asthenia	No	280(74,9)	99(84,6%)	1	
	Yes	94(25,1%)	18(15,4%)	1,84(1,06-3,21)	0,03*
Respiratory distress	No	32(8,6%)	23(19,7%)	1	
	Yes	342(91,4%)	94(80,3%)	2,61(1,46-4,68)	0,001***
Anosmia	No	196(52,4%)	81(69,2%)	1	
	Yes	178(47,6%)	36(30,8%)	2,04(1,31-3,17)	0,002**
Ageusia	No	162(43,3%)	67(57,3%)	1	
	Yes	212(56,7%)	50(42,7%)	1,75(1,15-2,66)	0,009**
Digestif	No	138(36,9%)	65(55,6%)	1	
	Yes	236(63,1%)	52(44,4%)	2,13(1,40-3,25)	0,000***
Interval between onset of symptom and test	<1 day	19(5,1%)	1(0,9%)	1	1
	>3 days	140(37,4%)	40(34,2%)	1,87(1,08-3,24)	0,02*
Transmission to others	No	218(58,3%)	59(50,4%)	1	-

	Family member	116(31,0%)	52(44,4%)	1,65(1,07-2,56)	0,02*
Remission	< 1 week	102(27,3%)	17(14,5%)	1	-
	2-4 weeks	53(14,2%)	26(22,2%)	2,94(1,46-5,90)	0,002**
	>4 weeks	60(16,0%)	45(38,4%)	4,50(2,36-8,55)	0,000***
Persisting signs	No	182(48,7%)	25(21,4%)	1	-
	Cough, asthenia, myalgia	50(13,4%)	31(26,5%)	4,51(2,44-8,33)	0,000***
	>4signs	97(25,9%)	51(43,6%)	3,82(2,23-6,55)	0,000***
NS non signifiant * p < .05; ** p < .01; *** p < .001.					

On the other hand, the complicated group had more than 3 persisting signs compared to the un-complicated, such as cough, asthenia and myalgia (OR 4,51), and also those who had more than 4 signs: cough, asthenia, myalgia and anosmia (OR 3,82) with a statistically significant difference (table 5).

On multivariate analysis of factors associated with COVID-19 infection, there was a significant association between the profile of HCW and COVID-19 infection (adjusted odds ratio [aOR] 2,17 [95% CI 1.15 to 4.13]; p=0,01, training worshops (aOR 2,76[95% CI 1.47 to 5.18]; p=0,002), metabolic comorbidity (OR 3,15[95% CI 1.05 to 9,43]; p=0,04), anosmia (aOR 2,20[95% CI 21.04 to 4.62]; p=0,03) and persisting at leat 3 signs such as cough, asthenia and anosmia (aOR 3,10[95% CI 1.33 to 5.23]; p=0,009.

Table 6: Multivariate analysis of factors associated with COVID-19 complications among HCW.

Modality	Variable	Non complicated (n=374)	Complicated (n=117)	ajusted Odds ratio (CI 95%)	P Value
Profile	MD	167(44,7%)	27(23,1%)	1	-
	Nurses	171(45,7,6%)	78(66,8%)	2,17(1,15-4,13)	0,01**
training	No	141(37,7%)	61(52,1%)	2,76(1,47-5,18)	0,002*
	PPE	144(38,5%)	27(23,1%)	1	
Comorbidity	No	317(84,8%)	78(66,7%)	1	-
	Metabolic	15(4%)	10(8,6%)	3,15(1,05-9,43)	0,04*
	Others	22(5,9%)	14(12%)	2,66(1,09-6,49)	0,03*
Month	2sd tr	108(28,9%)	58(45,3%)	2,28(1,27-4,11)	0,006**
	Td	257(68,7%)	61(52,1%)	1	
Anosmia	No	196(52,4%)	81(69,2%)	1	
	Yes	178(47,6%)	36(30,8%)	2,20(1,04-4,62)	0,03*
Persisting signs	Cough, asthenia, anosmia	50(13,4%)	31(26,5%)	3,10(1,33-5,23)	0,009**
	>4 signs	97(25,9%)	51(43,6%)	2,64(1,33-5,23)	0,005**

DISCUSSION

HCW are at higher and continued risk of contamination to SARS-COV-2, the present study showed that 22,22% were infected with the virus, this finding remains high compared to others, in the study of Breazzano et al. in New York, USA, among 75859 HCW screened, the prevalence was 11%(Breazzano et al., 2020), another study in Oman, estimated the percentage of infected hospital staff was 4,3%(Al Maskari et al., 2021)while in India 16% of HCW were positive in a tertiary care center(Dev et al., 2021)but when compared to general populations, HCW rates were higher, this gap may be due to workplace exposures(Gómez-Ochoa et al., 2020).

Based on the RT-PCR tests of positive cases 64,2% of infected HCW were women, and it is similar to that reported in Oman(Al Maskari et al., 2021)and higher than the percentage in Iran (53,5%)(Sabastian et al., 2021), but men were at higher risk of complications (UOR 1,96), same findings was revealed in a meta-analysis wherebeing male is considered a risk factorevident in this study, same results was found in morocco, while among the most severe patients hospitalized in Intensive care unit were male (AOR 3,19)(Aidaoui et al., 2020). this may be lead to the delay between the onset of symptoms and test, differences in the immune system, lifestyle factor, and personal hygiene habits(Jutzeler et al., 2020).

As a group, participants were found to be a generally younger working age population (mean age = 31,51), compared to a meta-analysiswhere in 119,883 HCW positive, the mean age was 38,37(Gholami et al., 2021). But many studies suggested that coronavirus infected older people, this is explained by the presence of higher

levels of angiotensin converting enzyme 2 in older people alveoli(Benrahma et al., 2020).

The exponential increaseof positive numbers after mid-July, is directlylinked to the lockdown relieving measures undertaken by the government that started the 19th July, and also coincided with the period after Eid Adha(Feast of sacrifice),which is an important religiousfestival for Muslims characterized by large social gatherings andfamily visits, this result is consisting with Al Maskari *et al*., (2021) findings, where the number of cases increased due to Eid al Fit.

Even though than infection rate among medical doctors were 25,20%, and nurses 22,12%, those latter wereat higher risk of complications compared to othersaccording to the multivariate logistic regression. Although other studies found that the infection among nurses was more than MD representing 38% and 4,3% respectively (Al Maskari et al., 2021; Sebastian et al., 2021), nurses accounted 51,3% of infected HCWs(Jutzeler et al., 2020). The high number of SARS-COV-2 positive nurses, could be explained by the larger time spent with Covid patients,performing occupations at the bedside such as drug administration, and clinical surveillance.

Many staff continued to work since the onset of Covid symptoms, as they were perceived as normal flu or cold, this delay lead on one hand tothe spread of the virus to colleagues, family members and friends and the other hand the installation of covid complications. but those who self-isolated since the onset of symptoms, were capable of stopping transmission among their collogues and family members, same findings was reported in Italy were the beforecited, to reduce direct contact with their partners and/or children slept in different rooms, and used separate bathrooms, consequently they did not represent a major risk of transmission for relatives (Lorenzo & Carrisi, 2020).

Therapeutic management and PPE training workshops, have been associated with decreased risk of Covid-19 complications, this finding is consistentwith Chou et al., (2020)review.

These findings indicates that common morbidities, such as Diabetesassociated with Covid, complicate this disease, which is consistent with other studies(Hernández-Garduño, 2020; Ji et al., 2020). Diabetics are more vulnerable to bacterial, mycotic, parasitic, and viral infections(van Crevel et al., 2017).The potential mechanisms involved on the correlation between this metabolic disease and COVID, include chronic inflammation, increased coagulation activity, and immune response impairment(Hodgson et al., 2015).

Amongst the most frequent reportedsymptoms in HCW with COVID19 were: asthenia, headache,myalgia, those findings are consistent with different studies where they confirmed that having one of those symptoms would identify at least 90% of Covid cases. Anosmia were associated with complications, because this symptom was associated with an increased delay to consultation(Gómez-Ochoa et al., 2020;Jary et al., 2020). The proportion of asymptomatic case were very low in this current study (4,7%), compared to other studies, where it was 40%(Gómez-Ochoa et al., 2020; Jary et al., 2020).

In this current study, the number of Covid HCWs that were hospitalized due to a Covid complication is 59, and 7 were admitted in the Intensive Care Unit, majoritarilythose whoreported persistent chronic problems, those findings are consistent with the National Institute for Health Research, UK, results where asthenia(53%), and respiratory problems (Cough) (43%), and more than 3 symptoms(55%), 60 days after the onset of COVID(Carfì et al., 2020),same reported in our study where those symptoms persisted for more than 4 weeks. In general for the uncomplicated group, symptoms disappeared in less than 2 weeks, same results is reported in study in France, where the majority of participants (73%) recuperated their smell(Slama et al., 2020).

The radiological profile in this current study did not reveal any correlation between the pulmonary impairment and complications, because on the 112 participants had a thoracic CT, half of them had no impairment, 1 of 4 had less than 10%, However, the association between the extent of the radiological lesions thus estimated and the complication of the disease has not been established.

The detection of COVID-19 infection is based on RT-PCR test that plays an important role, but it might be insufficient to accurately estimate the overall infected population, like other beta coronaviruses, the SARS-CoV-2 genome encodes four major structural proteins. The structural proteins are involved in various viral processes, including virus particle formation. The structural proteins include spike (S), envelope (E), membrane protein (M), and nucleoprotein (N)(Malik, 2020)The biological profile revealed that 31,33% of HCW had the 3 genes, this rate is eight times higher, compared to general population in Morocco, according to a study in Casablanca, morocco, where it was only 4%. According to the same study Rdrp, N and was detected in 31%, 22% respectively, while in our study 87,82% had the Rdrp only , and 95,33% had N gen(Benrahma et al., 2020). HCW with the 3 genes had the highest viral loads, and took longer time to tested negative, compared to those who had 1 gen. this findings is consistent with a study in a Italy among HCW where they found that this group took one more week, to have a negative PCR(Cariani et al., 2020).

Health workers may be considered a particularly high-risk group for developing psychiatric disorders after the onset of the epidemic such as the fear of infection, those Psychological factor may be risks of covid infection.(Brooks et al., 2020)

A study in the north of morocco that evaluated the psychological burden of HCW, showed that among HCW anxiety and depression were very high: 77,4% and 73,9% respectively (Belayachi et al., 2021), another study conducted in Settat, Morocco showed that 83,4% has the burnout syndrome(Chokri et al., 2021) the study found that healthcare professionals who were directly involved in the care of COVID-19 patients experienced higher levels of burnout(Chokri et al., 2021)

CONCLUSION

To our knowledge, this is the first study investigating clinical, biological characteristics of COVID among Health care workers in Morocco, the study revealed a high prevalence rate compared to similar countries, and also among Moroccan general population. The study allowed us to focus on several aspects in the diagnosis of Covid cases.

Itorder to reduce new cases and prevent complications, it is important to invest as much as possible in protecting the physical and mental health of healthcare workers by encouraging vaccination, reinforce PPE, and generalize rapid antigenic testing among new hospitalized patients prior to entrance into congregate care facilities since the test is inexpensive. Not to forget implementing psychological support resources to strengthen their resilience and their ability to work under pandemic conditions such as in the case of COVID-19(Trani et al., 2021)

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All authors declare that there are no conflicts of interest

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