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Journal Title: Annals of Medicine and Surgery
Volume: Volume 72
Publisher: Elsevier Ltd | 2021-12-01
Type of Work: Article | Final Publisher PDF
Publisher DOI: 10.1016/j.amsu.2021.103069
Permanent URL: https://pid.emory.edu/ark:/25593/w1xc8

Final published version: http://dx.doi.org/10.1016/j.amsu.2021.103069

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Accessed September 30, 2023 5:27 PM EDT
Cohort Study

Characteristics of healthcare workers with COVID-19: A retrospective descriptive study in a quaternary care center in Riyadh, Saudi Arabia

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ARTICLE INFO

**Keywords:** COVID-19, Saudi Arabia, Occupational health, Pandemic, Healthcare workers, Infection control

ABSTRACT

Background: The aim of this study was to describe the epidemiological and clinical presentation of Healthcare Workers (HCWs) affected by COVID-19.

Methods: A cross-sectional retrospective study was conducted at King Saud Medical City (KSMC), Saudi Arabia (KSA). All KSMC employees who acquired COVID-19 between March 22nd to July 15th, 2020 have been included. Their data has been anonymously analyzed.

Findings: During the study period, among the 12000 HCWs working at KSMC, 9.75% tested positive for COVID-19. The source of HCWs infections was mainly community acquired (85%) which included incidences of transmission in hospital dormitories. Transmission among coworkers was the main source of hospital acquired incidences. Direct patient care was reported in 99.8% of study subjects among the high-risk areas, compared to 3.4% in low-risk areas (p-value < 0.001), 12-h shifts were more common in the medium and high-risk areas, and at least one symptom was reported by 93.1% of HCWs in high-risk areas compared to 81.6% in low-risk areas (p-value < 0.001).

Conclusion: In KSA, for HCWs, reducing lapses in compliance with masking in non-patient care areas should be considered. In KSA the role that hospital dormitories play in the community transmission of COVID-19 among HCWs need further studies.

1. Introduction

Corona Virus Disease-2019 (COVID-19) is an emerging respiratory infection that was first discovered in December 2019, in Wuhan City, Hubei Province, China \[1\]. It is also called Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) which belongs to the larger family of ribonucleic acid (RNA) viruses, leading to infections, from the common cold to more serious diseases, such as Middle East Respiratory Syndrome (MERS-CoV) and SARS-CoV-1 and SARS-CoV-2 \[2\].

As of July 2021, a total of 140 million cases of COVID-19 had been reported globally with total of 4 million deaths in 223 countries, areas, and territories. Health care workers (HCWs) are at the forefront of the COVID-19 outbreak response and as such are exposed to hazards that put them at risk of infection \[3\]. COVID-19 poses an important occupational health risk to HCWs that has attracted global scrutiny \[4\]. To date, a few million HCWs globally have been reported as infected with the SARS-CoV-2 virus that causes the COVID-19. According to the WHO report from January 2021, over 16 million case report forms (CRF) (43% of CRFs received, representing 16% of global COVID-19 cases) included information on occupational status, including HCWs. Within this subset,
HCWs accounted for close to 1.29 million COVID-19 cases, or 8% of cases [5]. This pandemic has challenged the health systems of countries it has affected [6].

In the context of COVID-19, HCWs face an unprecedented occupational risk of morbidity and mortality. Lack of and/or inadequate personal protective equipment (PPE), exposure to infected patients, work overload, poor infection prevention and control practices, and preexisting medical conditions put HCWs at risk for nosocomial COVID-19 infection. Further studies are needed to inform the development of efficacious infection prevention control measures [7]. There is a need for rapid development of sustainable measures that protect HCWs from the pandemic [8].

It is critical that International Communities learn how to protect their HCWs. An increased awareness about personal protection, sufficient PPE and preparedness and response will play an important role in lowering risk of infection for HCWs [9].

Understanding risk factors for this vulnerable group will enlighten the policymakers to set preparedness plans to minimize risk of infection acquisition among healthcare providers [10]. This study was designed to describe the sociodemographic, epidemiological, and clinical presentation of HCWs affected by COVID-19, and to assess the association between those factors and the level of occupational exposure to COVID-19 cases. The outcome of this study is expected to enlighten policy makers about effective management strategies to prevent COVID-19 infection transmission among healthcare providers.

2. Subjects and methods

This was a cross-sectional retrospective study conducted at King Saud Medical City (KSMC) which is a quaternary care center based in the center of the capital city, Riyadh, Kingdom of Saudi Arabia (KSA) and is one of the key Ministry of Health (MoH) facilities dedicated to the care of COVID-19 patients in the central region.

1,170 healthcare workers who had laboratory confirmed SARs-CoV2 infection between 22 March and 15 July 2020 have been included. Their positive test results were actively retrieved from the national Health Electronic Surveillance Network (HESN) if their test was performed inside the study facility, or through self-reporting and test result validation if they were tested in another facility. Upon being reported as positive, the HCW was called and participated in a phone interview by trained infection prevention and control staff. A self-administered survey was also shared with them via a Google sheet link to complete information about their demographic data, living condition, exposure history, work-related data and clinical presentation. Their prognosis has been followed-up, as well. The study investigators retrospectively reviewed the gathered data described above which was registered on the tracing database controlled by KSMC IP&C Department and the Saudi MoH and the follow up of affected HCWs continued till December 2020.

The COVID-19 case definition, post exposure management protocol and return to work criteria were applied in accordance with the latest approved national guidelines for HCWs [11].

If a COVID-19 test was indicated, the study subject had a nasopharyngeal swab was collected at a dedicated COVID-19 employee clinic or the Emergency Department. The test results were analyzed with polymerase chain reaction (PCR) for SARS-CoV-2 in the assigned laboratory.

Any full-time or part-time HCW employed by the hospital, contracted by the services’ companies, or working as an employee of independent facilities physically located within the hospital compound, such as the Riyadh Regional Laboratory and Riyadh Forensic Medicine administration, who reported positive for COVID-19 was eligible to be included in this study. The total number of the study population was around 12,000 employees.

For risk analysis purposes, HCWs were classified into three categories according to their level of occupational exposure to COVID-19 cases: high, medium and low risk. The departments where the participants worked included under each category are listed in Table 1.

The study was approved by The Institutional Review Board at KSMC research center. A waiver of informed consent was granted. Confidentiality of the data has been maintained. A unique serial number was created for each study subject and used in the analysis dataset. Subjects’ identifiers information has been kept in a separate database accessible only for the authorized investigators.

The Statistical Package for Social Sciences (SPSS, version 25) was used for data management and analysis. Categorical variables were presented as number and percent, whereas continuous variables were presented as mean and standard deviation. The associations between the level of occupational exposure and categorical variables were carried out using chi-square test, whereas the Analysis of Variance (ANOVA) -test was used for the associations with continuous variables. A p-value of 0.05 was used to indicate statistical significance. This case series has been reported in line with the PROCESS Guideline [12]. The study is registered with the Research Registry with a unique identifying number (researchregistry7265). https://www.researchregistry.com/browse-the-registry#home.

3. Results

From the beginning of March till the end of July 2020, KSMC

| Direct Patient Care | Yes | 767 (81.9) |
|---------------------|-----|-----------|
| Nurses working hours shift (n=575) | Mean (SD) | 10.71 ± 1.35 |
| 8 h shift | 274 (47.7) |
| 12 h shift | 301 (52.3) |
| Low | 174 (31.6) |
| Medium | 314 (33.5) |
| High | 448 (47.9) |
| Adult ER | 151 (16.1) |
| Adult ICU | 186 (19.9) |
| Pediatric ER | 8 (0.9) |
| Pediatric ICU | 53 (5.7) |
| Isolation wards | 41 (4.4) |
| Respiratory therapy | 9 (1.0) |
| Medium: | Endoscopy | 3 (0.3) |
| Hemodialysis | 29 (3.1) |
| Mortuary | 12 (1.3) |
| Outpatient Dept. | 58 (6.2) |
| Operative room | 33 (3.5) |
| Adult Ward | 126 (13.5) |
| Pediatric wards | 37 (4.0) |
| Radiology | 16 (1.7) |
| Low: | Admin office | 139 (14.9) |
| CSSD | 2 (0.2) |
| Maintenance | 2 (0.2) |
| Security | 5 (0.5) |
| Laboratory | 26 (2.8) |
| Any | 1005 (85.9) |
| Number of symptoms | 1.66 ± 1.11 |
| Fever | 526 (52.0) |
| Cough | 321 (31.7) |
| SOB | 114 (11.3) |
| Other respiratory symptoms | 273 (23.3) |
| GI | 90 (7.7) |
| Aches | 537 (45.9) |
| Loss of smell/taste | 79 (6.8) |
| Yes | 13 (1.1) |
| Death | 3 (0.3) |
| Recovery | 1167 (99.7) |

Table 1: Descriptive characteristics for work-related information, clinical presentation, and outcomes for the study sample.
reported a total of 3546 COVID-19 cases. Fig. 1 shows the confirmed cases of Covid-19 in both HCWs and non HCWs during the weeks 13–29 of 2020. This figure shows that the number of HCWs and non-HCWs increased simultaneously over time.

As shown in Table 2, there were 1170 HCWs included in our study. The average age of the study subjects was 35.68 y (sd 8.09 y) and 67.8% were females. Nearly 36.7% of the participants were Saudis, and HCWs of the Indian nationality were the most prevalent among non-Saudis at 33.8% followed by Filipinos at nearly 17.7%. The majority of HCWs (62.5%) were nurses, followed by 15.8% being physicians. Moreover, very few HCWs in our study travelled outside the country (0.3%). About one third (31.1%) were exposed to a positive case, and 84.4% had community acquired infections.

Table 1 presents the descriptive statistics for the work-related information, clinical presentation and outcomes of the study sample. Out of the 1170 HCWs included in our study, 81.9% of the subjects performed direct patient care, with 52.3% of nurses working 12-h shifts, as compared to 8-h shifts. The distribution of the participants according to the level of risk was as follows: 18.6% persons were in a low-risk environment, 33.5% in a medium risk environment, and 47.9% in a high-risk environment. As for the symptoms, 85.9% of study subjects experienced at least one symptom, with the most frequent symptom being fever (52.0%), followed by aches (45.9%) and cough (31.7%). As for the outcomes, 13 (1.1%) were admitted to the ICU, and death was reported for 3 HCWs (0.3%).

The associations between the different characteristics and the risk level for COVID-19 are reported in Table 3. It was found that HCWs in the high-risk areas were younger (35.55, sd 7.30) compared to low-risk areas (37.83, sd 8.08), p-value <0.001. Similarly, a higher percentage of females and being a nurse were found in the high-risk areas (75.2% and 75.9%, respectively) compared to the low-risk area (48.2% and 52.0%), p-value <0.001. Other variables were not found to be statistically significant in association with the risk level.

Finally, Table 4 presents the associations between level of risk, clinical presentations and outcomes. As expected, direct patient care was reported in 99.8% of study subjects among the high-risk areas (34.47, sd 7.30) as compared to low-risk areas (37.83, sd 8.08), p-value <0.001. Similarly, 12-h shifts were more common in the medium and high-risk areas. As for the symptoms, HCWs in high-risk areas were more likely to have at least one symptom (93.1%) compared to low-risk areas (81.6%) (p-value <0.001). The symptoms that were found to be significantly higher in the high-risk area were shortness of breath, other respiratory symptoms and aches, whereas GI symptoms were significantly higher in medium risk areas and loss of smell and taste were significantly higher in the low-risk areas.

4. Discussion

Our study has described the characteristics of HCWs affected by COVID-19 in KSMC between 22 March and 15 July 2020. During the study period, among the 12,000 HCWs working at KSMC, 9.75% tested positive for COVID-19. Comparing the infectivity rate among HCWs in other Middle Eastern countries between March–June 2020, a national study from Qatar reported almost similar percentage (10.6%), while around half of this percentage (4.3%) was reported from one healthcare center in Oman [13,14]. Overall, 3546 COVID-19 positive cases were taken care of by KSMC during the study period (either admitted or non-admitted patients) which included cases from KSMC employees who represented around 33% of this cohort of positive cases. A much lower percentage of HCWs with COVID-19 was represented out of total cases presented globally, based on WHO CRF data, in the first three months of 2020. HCWs infections slightly exceeded 10% of reported HCW cases in both studies.

Table 2
Descriptive characteristics for demographic, living conditions and exposure history for the study sample.

| Source of infection            | Total N – 1170 |
|-------------------------------|----------------|
| Community Acquired            | 987 (84.4)     |
| Hospital Acquired             | 183 (15.6)     |
| Living in the nursing dorms (n=384) | 146 (38.0) |
| No                            | 238 (62.0)     |

Table 3
Descriptive statistics for work-related information, clinical presentation and outcomes of the study sample.

| Relation to the positive cases | Coworker | Patients | Family | Flatmate | Friends | Source of infection   |
|-------------------------------|----------|----------|--------|----------|---------|-----------------------|
| Hospital Acquired             | 183 (15.6)| 83 (22.7)| 81 (22.1)| 46 (12.6)| 56 (15.3)| Community Acquired    |
| Community Acquired            | 987 (84.4)| 100 (27.3)| 83 (22.7)| 46 (12.6)| 56 (15.3)| Hospital Acquired     |

Fig. 1. COVID-19 confirmed cases, KSMC, KSA. EPI WEEK 13–29, 2020.
cases, declining to less than 5% by early-June 2020 and to approximately 2.5% by September 2020 [4]. The trend of HCW cases is almost simultaneous with the trend of patients with COVID-19 reported by the facility. The peak of cases in our study is also aligned with the national curve of COVID-19 cases in KSA which occurred during June 2020 when the daily COVID-19 incidence approached 5000 cases.

The mean age of our study subjects was 35.68 years, while the median age of HCWs cases reported by WHO in January 2021 was 42 years (interquartile range 27–60 years).

The percentage of women among our study subjects was similar to what was reported by WHO in their January 2021 report (68%).

HCWs presenting with symptoms suggestive for COVID-19 was the main indication for PCR testing among those cases (85.9%). The most common reported symptoms were fever (52.0%) and cough (31.7%). Testing asymptomatic HCWs was related to either a history of unprotected exposure, or as part of mass screening which was performed as a risk-based in a housekeeping dormitory and in the Emergency Department, however we did not apply the routine screening protocol to HCWs to detect COVID in completely asymptomatic HCWs.

The data from our hospital highlights that the source of HCW infections was mainly community acquired (85%) which was considered if there was a known source from the community or if no definite unprotected exposure occurred inside the healthcare facility with either a confirmed COVID-19 patient or confirmed coworkers within 14 days of symptoms onset or a positive test result.

Among the reported HCW cases, some clusters from certain hospital departments were identified in which the index case was probably a coworker rather than a patient. Certain factors have triggered the transmission within those clusters such as, compromised social distancing due to space limitation in offices and the nursing station, sharing meals and break time in staff pantries while not wearing a mask and being a roommate in the dormitory.

Hospital acquired incidences that related to exposure from a patient were linked to caring for an undiagnosed COVID-19 case where suspicion was not raised upon admission, but later confirmed, or performing aerosol generating procedures such as resuscitation on a known COVID-19 case with inappropriate PPE due to lack of compliance with IPC standards. Heavy workload was also a contributing factor to exposures as breaches in adherence to infection prevention precautions were observed in settings with long duty hours.

### Table 3

| Age          | Working area level of occupational exposure | Low N=174 | Medium N=314 | High N=448 | p-value |
|--------------|-------------------------------------------|-----------|--------------|------------|---------|
| Mean (SD)    |                                           | 37.83 ±   | 36.13 ±      | 34.47 ±    | <0.001  |
| Gender       |                                           | 8.08      | 8.50         | 7.30       |         |
| Male         |                                           | 86        | 97 (31.8)    | 106        | <0.001  |
| Female       |                                           | 80        | 208          | 327        |         |
| Nationality  |                                           | 65        | 113          | 146        | 0.44    |
| Saudi        |                                           | 65        | 113          | 146        |         |
| Non-Saudi    |                                           | 109       | 201          | 202        |         |
| Arab non-    |                                           | 12        | 20 (6.4)     | 23 (5.1)   |         |
| Filipino     |                                           | 32        | 50 (15.9)    | 76         |         |
| Indian       |                                           | 57        | 114          | 171        |         |
| Other Asian  |                                           | 7         | 17 (5.4)     | 31 (6.9)   |         |
| Western      |                                           | 1         | 0 (0.0)      | 1 (0.2)    |         |
| Job title    |                                           | 42        | 7 (2.3)      | 1 (0.2)    | <0.001  |
| Engineer     |                                           | 15        | 0 (0.0)      | 1 (0.2)    |         |
| Housekeeper  |                                           | 21        | 15 (4.8)     | 15 (3.4)   |         |
| Nurse        |                                           | 51        | 187          | 337        |         |
| Pharmacist   |                                           | 11        | 64 (23.8)    | 63         |         |
| Physician    |                                           | 11        | 74 (23.8)    | 63         |         |

### Table 4

| Direct Patient Care | Working area level of occupational exposure | Low N=174 | Medium N=314 | High N=448 | p-value |
|---------------------|-------------------------------------------|-----------|--------------|------------|---------|
| Yes                 |                                           | 6         | 314          | 447        | <0.001  |
| No                  |                                           | 3         | 314          | 447        |         |

| Nursing working hours shift n=575 | Working area level of occupational exposure | Low N=174 | Medium N=314 | High N=448 | p-value |
|----------------------------------|-------------------------------------------|-----------|--------------|------------|---------|
| 8 h shift                        |                                           | 51        | 78 (41.7)    | 145        | <0.001  |
| 12 h shift                       |                                           | 0 (0.0)   | 109          | 192        |         |

| Symptoms                           | Working area level of occupational exposure | Low N=174 | Medium N=314 | High N=448 | p-value |
|------------------------------------|-------------------------------------------|-----------|--------------|------------|---------|
| Fever                              |                                           | 71        | 141          | 211        | 0.40    |
| Cough                              |                                           | 37        | 78 (30.4)    | 143        | 0.15    |
| SOB                                |                                           | 18        | 20 (7.8)     | 64         | 0.02    |
| Other respiratory symptoms         |                                           | 32        | 49 (19.1)    | 137        | <0.001  |
| GI                                 |                                           | 12 (8.3)  | 34 (13.2)    | 23         | 0.002   |
| Achs                               |                                           | 62        | 145          | 296        | <0.001  |
| Loss of smell/taste                |                                           | 34        | 16 (6.2)     | 22         | <0.001  |

| ICU admission                      | Working area level of occupational exposure | Low N=174 | Medium N=314 | High N=448 | p-value |
|------------------------------------|-------------------------------------------|-----------|--------------|------------|---------|
| Yes                                |                                           | 3         | 1 (1.0)      | 7 (1.6)    | 0.72    |
| Recovery                           |                                           | 172       | 314          | 447        |         |

### Table 3

| Job title    | Working area level of occupational exposure | Low N=174 | Medium N=314 | High N=448 | p-value |
|--------------|-------------------------------------------|-----------|--------------|------------|---------|
| Admin       |                                           | 12        | 20 (6.4)     | 23 (5.1)   |         |
| Engineer    |                                           | 15        | 0 (0.0)      | 1 (0.2)    |         |
| Housekeeper |                                           | 21        | 15 (4.8)     | 15 (3.4)   |         |
| Nurse       |                                           | 51        | 187          | 337        |         |
| Pharmacist  |                                           | 11        | 64 (23.8)    | 63         |         |
| Physician   |                                           | 11        | 74 (23.8)    | 63         |         |
| Techinician |                                           | 22        | 28 (9.0)     | 27 (6.1)   |         |

| Travelled outside Riyadh | Working area level of occupational exposure | Low N=174 | Medium N=314 | High N=448 | p-value |
|--------------------------|-------------------------------------------|-----------|--------------|------------|---------|
| Yes                      |                                           | 60        | 103          | 159        | 0.74    |
| No                       |                                           | 34 (3.5)  | 32 (3.8)     | 35 (5.5)   |         |
| Coworker                 |                                           | 17        | 33 (31.7)    | 40         | 0.16    |
| Family                   |                                           | 19        | 15 (14.4)    | 39         |         |
| Flatmate                 |                                           | 6 (10.0)  | 18 (17.3)    | 17         |         |
| Friends                  |                                           | 9 (15.0)  | 12 (11.5)    | 23         |         |
| Patients                 |                                           | 9 (15.0)  | 26 (25.0)    | 41         |         |
| Community                |                                           | 146       | 255          | 366        | 0.75    |
| Acquired                 |                                           | 83 (9.9)  | 81 (8.2)     | 81 (7.7)   |         |
| Hospital                 |                                           | 28        | 59 (18.8)    | 82         |         |
| Acquired                 |                                           | 16 (1.1)  | 18 (3.2)     | 28         |         |
| Yes                      |                                           | 4 (22.2)  | 43 (39.8)    | 86         | 0.28    |

| Source of infection | Working area level of occupational exposure | Low N=174 | Medium N=314 | High N=448 | p-value |
|---------------------|-------------------------------------------|-----------|--------------|------------|---------|
| Community            |                                           | 146       | 255          | 366        |         |
| Acquired             |                                           | 83 (9.9)  | 81 (8.2)     | 81 (7.7)   |         |
| Hospital             |                                           | 28        | 59 (18.8)    | 82         |         |
| Acquired             |                                           | 16 (1.1)  | 18 (3.2)     | 28         |         |
| Yes                  |                                           | 4 (22.2)  | 43 (39.8)    | 86         |         |

| Living in the nursing dorms (n=384) | Working area level of occupational exposure | Low N=174 | Medium N=314 | High N=448 | p-value |
|------------------------------------|-------------------------------------------|-----------|--------------|------------|---------|
| Yes                                |                                           | 22        | 43 (39.8)    | 86         | 0.28    |
Moreover, comparing the high-risk group of subjects to low-risk group respectively showed that almost all of the high-risk group versus the low-risk group were directly working in patient care (99.8% vs. 3.4%, p-value < 0.001). 12-hours shifts were reported approximately 60% of the time in the high-risk group including critical care and isolation units (57.0% vs. 0% in the low-risk group: p-value 0.0001). Persons in the high-risk group were more likely to have at least one symptom (93.1%) compared to around 81% in each of low and medium risk groups, p-value <0.001. The clinical prognosis of the study subjects showed that only 1.1% required ICU admission and the overall death rate was 0.03% compared to 99.7% recovery rate, with no significant difference among the three risk groups. This finding was supported by Samah et al. as well as by Kim et al. who found that the occurrence of extreme illnesses and deaths related to COVID-19 in HCWs was significantly lower than the general community [15,16].

As a proactive approach for COVID-19 prevention, a series of infection control measures were activated by the infection control department in collaboration with regulatory and governing bodies at KSMC. The key interventions of the preparedness plan for mitigation of emerging infectious diseases including a bundle of IPC measures for early recognition, isolation, notification, and molecular diagnostic testing for all suspected COVID-19 cases. A dedicated high-level committee chaired by the hospital CEO was formulated to follow up the action plan to decrease the transmission of COVID-19 among HCWs.

Study Limitations: Due to lack of related information, we were unable to study the association between the underlying health conditions, health risk behaviors and acquisition of COVID-19. Also, the effect of HCWs academic and technical competency level to infection prevention measures was not studied. The percentage of infected HCWs could be underestimated as we did not apply routine screening protocols and not all staff with protected exposures were tested. In addition, there is an assumed deficit in self-reporting from those tested outside the study facility.

At KSMC a referral center for COVID-19 patients in the capital city Riyadh, among the 12,000 HCWs, 9.75% tested positive for COVID-19 between March and June 2020. The trend of HCWs cases is almost simultaneous with the trend of patients with COVID-19 reported by the facility. Persons presenting with symptoms suggestive for COVID-19 was the main indication for PCR test among those cases (85.9%). The data from our hospital highlights that the source of HCW infections were mainly community acquired (85%). Among the reported HCWs cases, some clusters from certain hospital departments were identified in which the index case was probably a coworker rather than a patient. Hospital acquired incidences that related to exposure from a patient were linked to caring for an undiagnosed COVID-19 case where suspicion was not raised upon admission. Improved detection of patients with atypical presentations and efforts to reduce high-risk contacts among personnel may reduce the risk for acquisition of SARS-CoV-2. For HCWs, more efforts are needed to reduce lapses in compliance with masking in non-patient care areas. In KSA the role that hospital dormitories play in the community transmission of COVID-19 among HCWs need further studies.

Funding

None.

Availability of data and material (data transparency)

Available on request.

Authors contribution

All authors contributed equally to the design and execution and writing of the paper.
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