



# An Updated Analysis on the Risk Factors Associated with COVID-19 Transmission

Zafar Rasheed<sup>1\*</sup>, Homaidan Alhomaidan<sup>2</sup>, Ali Shariq<sup>3</sup>, Mohammad Alkhowailed<sup>4</sup>, Fuhaid Alqossayir<sup>2</sup>, Naila Rasheed<sup>1</sup>, Abdullah Alkhamiss<sup>5</sup>, Ruqaih Alghsham<sup>5</sup>, Almonther Hershan<sup>6</sup>, Sami Alharbi<sup>7</sup>, Suliman Alsagaby<sup>8</sup>, Sharifa Alduraibi<sup>9</sup>, Sami H. Alharbi<sup>10</sup>, Waleed Al Abdulmonem<sup>5\*</sup>

<sup>1</sup>Department of Medical Biochemistry, College of Medicine, Qassim University, Buraidah, Saudi Arabia; <sup>2</sup>Department of Family and Community Medicine, College of Medicine, Qassim University, Buraidah, Saudi Arabia; <sup>3</sup>Department of Microbiology, College of Medicine, Qassim University, Buraidah, Saudi Arabia; <sup>4</sup>Department of Dermatology, College of Medicine, Qassim University, Buraidah, Qassim, Saudi Arabia; <sup>5</sup>Department of Pathology, College of Medicine, Qassim University, Buraidah, Saudi Arabia; <sup>6</sup>The University of Jeddah, College of Medicine, Department of Medical Microbiology and Parasitology, Jeddah, Saudi Arabia; <sup>7</sup>Pulmonary Department, King Fahad Specialist Hospital, Ministry of Health, Buraidah, Saudi Arabia; <sup>8</sup>Department of Medical Laboratories, Central Biosciences Research Laboratories, College of Science in Al Zulfi, Majmaah University, Al Majma'ah, Saudi Arabia; <sup>9</sup>Department of Radiology, College of Medicine, Qassim University, Buraidah, Saudi Arabia; <sup>10</sup>Department of Medicine, King Fahad Specialist Hospital, Ministry of Health, Buraidah, Saudi Arabia

## Abstract

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**\*Correspondence:** Dr. Waleed Al Abdulmonem, Department of Pathology, College of Medicine, Qassim University, Buraidah, Saudi Arabia.  
E-mail: dr.waleedmonem@qu.edu.sa

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**BACKGROUND:** The coronavirus disease 2019 (COVID-19) is a global public health disaster and knowledge of its associated risk factors provides protection/slowdown against its transmission.

**AIM:** This study was undertaken to investigate all major risk factors associated with transmission of the COVID-19 infection.

**METHODS:** The data on the risk associated factors for the COVID-19 transmission were collected from the Texas Medical Association, Center for Disease Prevention and Control, World Health Organization, and Health and Safety Executive. The collected data were combined, analyzed, and presented as percentage mean  $\pm$  SD.

**RESULTS:** The collective data showed that among games such as playing football and basketball are highly risky followed by swimming in public pool and playing at the beach. Whereas, playing golf and tennis are not risky ( $p < 0.05$ ). Moreover, the carryout food from the restaurants is much safer as compared with eating at buffet, in restaurants ( $p < 0.01$ ). The data on social gathering showed that religious places, sports stadium, music concert, cinema halls, amusement parks, attending funerals, and wedding showed a higher risk of spreading COVID-19. The data on general outing showed that going to gymnasium, traveling by bus or plane, and visiting in salon are highly risky ( $p < 0.01$ ) for COVID-19 infection. Moreover, hugging, shaking hands, and kissing are also highly risky for the COVID-19 infection.

**CONCLUSIONS:** This study provides the collective information on the risk factors associated with the COVID-19 transmission. The findings can contribute to the concerned authorities to formulate the preventive measures to limit spread of the COVID-19 infection.

## Introduction

The coronavirus disease 2019 (COVID-19) is a multi-systemic infection caused by a member of an enveloped RNA virus called severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and the novelty of the genetic sequence and structural composition of this virus played a significant role in the COVID-19 pandemic within a brief time span [1]. The primary case of COVID-19 was initially reported from People's Republic of China in December 2019, where they discovered that an unknown virus was responsible

for causing life-threatening pneumonia among the residents of Wuhan city, which is the capital of Hubei province located in the central China [2]. Latter on January 30, 2020, the World Health Organization (WHO) announced it as a pandemic. Since then the cases gradually increased throughout the world with almost 77.6 million people getting infected and a death toll rising up to 1.71 million worldwide till December 23, 2020 [3].

To encounter the rapidly spreading of the COVID-19 infection, several preventive measures have been undertaken and these measures were aimed

to create awareness among the general population in context of psychological impact and false myths that were associated with this disease. The mode of transmission of this virus is mainly through respiratory droplets from an infected person sneeze or cough the expiratory droplets which acts as a vehicle to transport this virus in the surrounding environment [4]. These droplets can be either inhaled by other people within close proximity or can settle on the surfaces from where it can potentially infect other people [5].

Various preventive measures to control the spread of this infection were implemented by the concerned authorities. Social distancing, face covering, and personal hygiene are considered as the key preventive measure to reduce human interactions and control the spread of infection within a community [6]. Events, in which increase number of public gather at a same place and time or under same roof such as religious gatherings, cultural celebrations, conferences, and music concerts, should be restricted as there is a risk of spreading of infection [6]. Various studies also proved that restriction on traveling and promoting quarantine leads to positive outcomes in controlling the spread of the COVID-19 infection [7], [8]. The studies on the risk associated with EBOLA virus transmission model, which was also a Public Health Emergency of International Concern by the WHO, revealed that a combined approach of patients isolation, contact-tracing with quarantine, and sanitary funeral practices should be executed with utmost urgency to slowdown the infection rate [9].

In this study, we provided collective information on the risk associated with the spread of this pandemic from several authenticated sources such as the Texas Medical Association (TMA), Center for Disease Prevention and Control (CDC), WHO, and Health and safety executive (HSE) and presented them all together under a single umbrella. To the best of our knowledge, this is first study that showed the complete analysis on the risk factors that include social gathering in games, restaurants, religious places, music concert, cinema halls, amusement parks, attending funerals, wedding, gymnasium, salon, traveling by bus or plane, or so on and were correlated with the association of the spread of infection by grading them from low to high. Knowing about these activities from a single study definite all of help us to decline the spread of infection and will also assist the concerned authorities to design the control strategies against the pandemic.

## Methods

The data on risk associated factors for the COVID-19 spreading were collected from the four different sources the TMA, CDC, WHO, and HSE from

January 2020 to October 2020 [10], [11], [3], [12]. The data on social gathering in games, restaurants, religious places, movie theater, camping, music concert, amusement parks, attending funerals, wedding, gymnasium, salon, traveling by bus or plane, pumping gasoline, grocery shopping, doctors waiting rooms, visiting library, hair salon, etc., were collected, combined, analyzed, and presented as percentage mean  $\pm$  SD using the prism GraphPad statistical software (version-5, San Diego, CA, USA) and the data were compared by one-way ANOVA analysis followed by Tukey's *post hoc* analysis or two-way ANOVA followed by Bonferroni *post hoc* tests as described previously with some modifications [13]. Briefly, the homogeneity of variances was tested using Brown–Forsythe or Bartlett's tests, and in a case of unequal SDs, Brown–Forsythe or Welch test was applied. If data were not normally distributed, the comparisons were carried out by non-parametric one-way ANOVA followed by Tukey's *post hoc* analysis or two-way ANOVA followed by Bonferroni *post hoc* tests and  $p < 0.05$  was considered significant.

## Results

### *Risk of the spreading COVID-19 in sport events*

Analysis of the collected data from TMA, CDC, WHO, and HSE showed that the playing football and basketball have a higher risk for the spreading of the COVID-19 infection followed by swimming in public pools, playing at the beach, playing golf, and tennis (Figure 1). Importantly, the data also pointed out that playing tennis

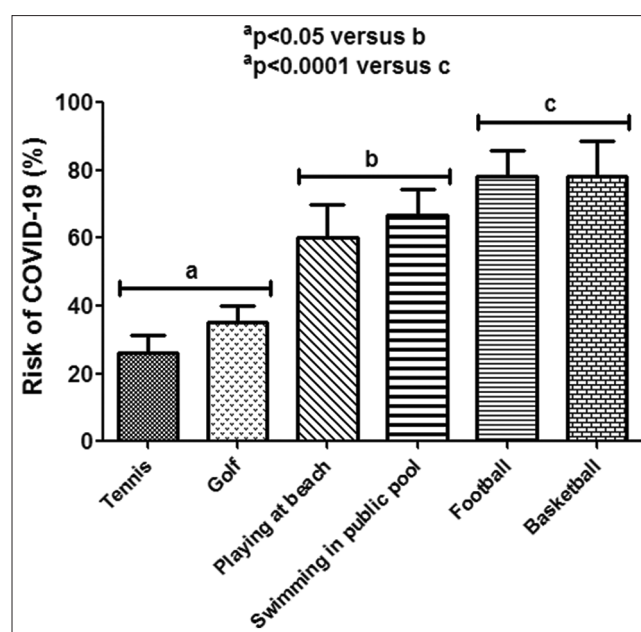


Figure 1: Risk of the COVID-19 spreading by playing games.

and golf are much safer compared to playing other games such as swimming, basketball, and football ( $p < 0.05$ ).

### Risk of the spreading COVID-19 by taking food

Risk of transmission of the COVID-19 infection from eating food was also analyzed from the data collected. The data showed that eating at buffet and in the restaurant is highly risky for the spreading of COVID-19 infection when compared with the food takeout from the restaurant ( $p < 0.01$ ). Interestingly, eating at buffets, restaurants, and at the bars are almost equally risky for the COVID-19 spreading ( $p > 0.05$ ). Food takehome from the restaurants was found to be the most safest ways among all studied risk factors (Figure 2).

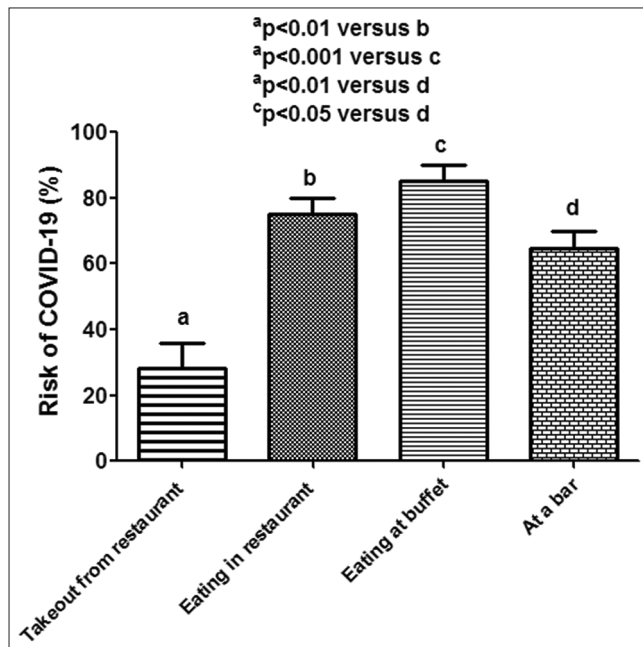


Figure 2: Risk of the COVID-19 spreading by taking food.

### Risk of the spreading COVID-19 by social gathering

The data on social gathering at the religious places, sports stadium, music concert, gathering in the cinema halls, amusement parks, attending funerals, and wedding ceremonies showed highly risky for the spread of COVID-19 infection as compared with the social gathering in the separate camps ( $p < 0.05$ ). Whereas gathering with relatives and friends is also risky but safe as compared to other gatherings such as visiting at religious places, sports stadium, music concert, movies theaters, and amusement parks (Figure 3).

### Risk of the spreading COVID-19 by general outing

The data on general outing showed that going to the gymnasium (gym), traveling by bus or plane,

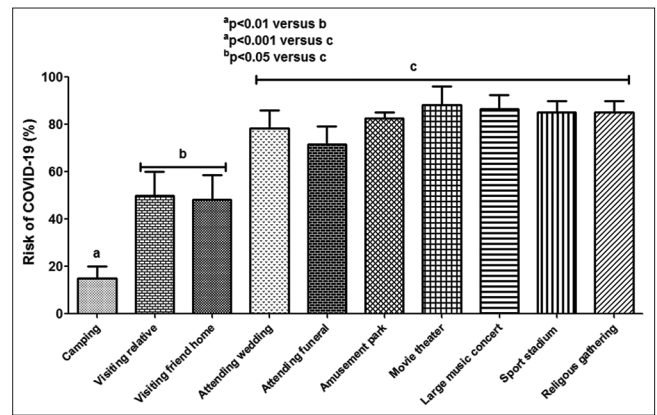


Figure 3: Risk of the COVID-19 spreading by social gathering.

and visiting in the hair salon are highly risky during the COVID-19 pandemic. Whereas riding bikes, running or walking, and going to the grocery stores and gasoline pumping are much safe as compared to other factors such as doctors visit, going to library, museum, mall, schools and kids daycare centers (Figure 4).

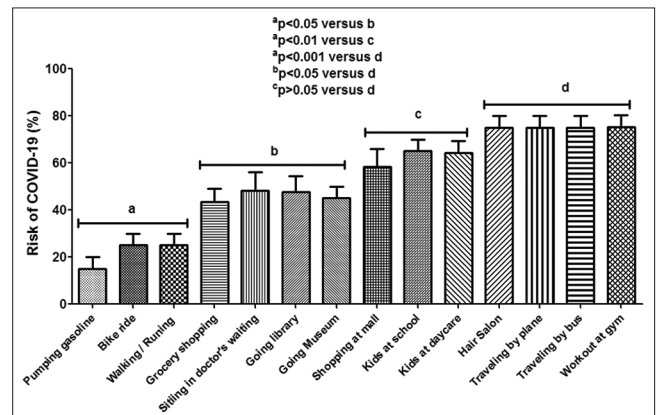


Figure 4: Risk of the COVID-19 spreading by general outing.

### Risk of the spreading COVID-19 by hugging, shaking hands, and kissing

Transmission of the COVID-19 infection was found to be highest by kissing followed by shaking hands and hugging (Figure 5). The data gathered from TMA, CDC, WHO, and HSE showed that all these three factors are highly risky for the spread of COVID-19 infection.

## Discussion

This study determined the major risk factors associated with the transmission of COVID-19 infection. Social distancing has been considered as a vital technique to prevent transmission of the COVID-19 infection and it has been accomplished by various means, including voluntary compliance to lock down at the level of certain regions or the entire country



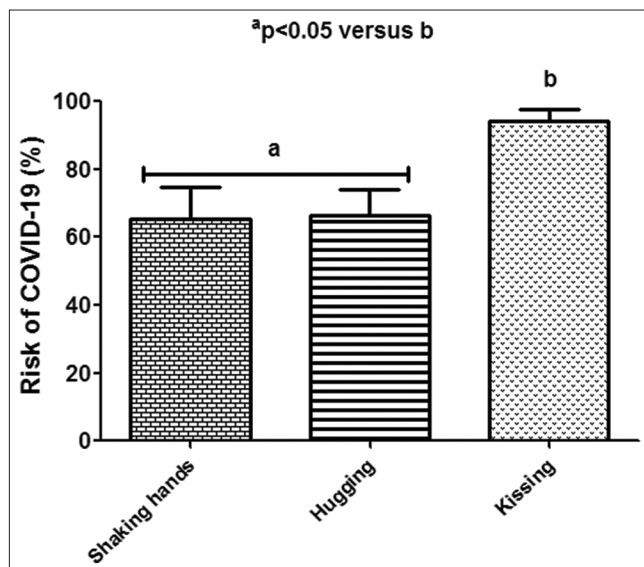


Figure 5: Risk of the COVID-19 spreading by hugging, shaking hands, and kissing others

as per recommendation of the WHO [14]. In most of the countries, the lockdown has now being waved off, leading to the initiation of daily activities and businesses but in general, the more a person interact with others or the lengthier interaction can increase the risk of being infected by the COVID-19 [15]. In this study, the data on the risk factors associated with the COVID-19 transmission were collected from different online sources such as TMA, CDC, WHO, and HSE and were combined, analyzed, and presented. Our analysis on the risk of the COVID-19 spreading in sport events showed that the playing football and basketball are highly risky for spreading of the COVID-19 infection followed by swimming in public pools, playing at the beach, playing golf, and tennis. Importantly, the playing tennis and golf were found to be safer compared to playing other games such as swimming, basketball, and football.

The data of this study also determined that the eating at buffet and in the restaurant is highly risky for the COVID-19 transmission as compared with the food takeout from the restaurant. These findings have been well supported by the studies showing the impact of social distancing in the transmission of this viral infection [15]. It is important to understand that there is no such interactive activity which can ensure a zero percent risk of contracting this viral infection; however, certain interactive activities if performed by undertaking precautions and preventive measures can significantly reduce the potential risk of getting infected and the spread of the COVID-19 in the community [14], [15].

The CDC published a report on their website showed that social gathering always enhances the chances of spreading the COVID-19 infection as an asymptomatic person has ability to transmit infection [11]. We also studied the association of various interactive social gathering such as gathering at the religious places, sports stadium, music concert,

gathering in the cinema halls, amusement parks, attending funerals, and wedding ceremonies shows a higher risk of the COVID-19 transmission. Moreover, our data also pointed out that the gathering with relatives and friends was also risky for the transmission of COVID-19 infection but comparatively much safer as the gathering at the religious places, sports stadium, music concert, movies theaters, and amusement parks. These findings pointed out that social distancing plays an important role in preventing the transmission of COVID-19 infection. It is important to point out that the clinical presentation of this viral infection was not found to be same in every human who was exposed as it depends on various factors such as age, chronic illness such diabetes, and immune status of a person [16].

Besides these, the basic preventive measures such as hand hygiene, avoiding touching of face with unwashed hands, and wearing a mask also played a fundamental role in the transmission of this viral infection [3], [11], [12], [13], [14]. Furthermore, our data on the general outing showed that going to the gymnasium, traveling by bus or plane, and visiting in the hair salon are highly risky for the COVID-19 transmission. On the other hand, certain places such as barbershops linked with close contact between people, in which there is an increased risk of getting infected by COVID-19. In our study, we revealed a high risk of the COVID-19 association with a visit to a barbershop. These findings have also been well supported by the previous reports showing higher rate of the COVID-19 infection among the barbers [17], [18]. To reduce the chances of getting infected, staff working in barbershops should be screened for the COVID-19 symptoms before starting their working shift as instructed by the CDC [19]. In addition, they must wear personal protective equipment such as gloves, mask, and face shield and the limiting the number of clients at a specific time should be allowed in accordance with space and seating capacity [19].

It is well documented that the physical activity has a beneficial role in strengthening the immune system [20] and regular exercise also plays a role in the prevention of a low-grade inflammation [21]. During lockdown pandemic period, the levels of physical activity were declined and were found to be linked with the increased risk of various health problems such as depression, coronary disease, obesity, and diabetes [22], [23]. We found out that exercising in the gym has also been highly associated with a high risk of the COVID-19 transmission. In support of this, the WHO mentioned various online practical home-based exercises such as stretching, bridges, squats, and chair dips, being performed for 10–15 repetitions up to 5 times with a minute rest between sets [24]. Traveling between countries was reported to be one of the major risk factors for the spreading of the COVID-19 infection [25]; for this reason, restrictions of flights between countries throughout the world were undertaken. We found out a high risk of being infected with the COVID-19 while

traveling through plane or bus. These results are well supported by the recent studies revealed that when all seats were occupied in a jet aircraft, then the risk of contracting the COVID-19 from a nearby passenger was about one in 7000; however, if the middle seat was kept empty, it reduces that risk to about one in 14,000 [26]. In short, the combined analysis from the data of TMA, CDC, WHO, and HSE showed that among games, playing football and basketball are highly risky followed by swimming in the public pool and playing at the beach. Whereas playing golf and tennis are relatively safe. Moreover, the carryout food from the restaurants is much safer as compared with eating at buffet and in restaurants. The data on the social gathering showed that religious places, sports stadium, music concert, cinema halls, amusement parks, attending funerals, and wedding showed highly risky for the COVID-19 transmission. Whereas gathering with relatives and friends is also risky but much safer as compared with the gathering at other places. The data on general outing showed that going to gymnasium, traveling by bus or plane, and visiting in salon are also highly risky, whereas riding with bike, running or walking, and going to the grocery stores and gasoline pumping are much safer as compared to other going out factors such as doctors visit, going library, museum, mall, schools, and kids daycare centers. Moreover, hugging, shaking hands and kissing are also highly risky for transmission of the COVID-19 infection.

## Conclusions

This study provides the collective details of the risk factors associated with the spreading of the COVID-19 infection. Playing football, basketball, swimming in public pool, playing at the beach, eating food in restaurants, social gathering at religious places, sports stadium, music concert, cinema halls, amusement parks, funerals, wedding, going to gymnasium, traveling by bus or plane, doctors visit, going library, museum, mall, schools and kids daycares, hugging, shaking hands, and kissing were found to be risky for transmission of the COVID-19 infection. This study contributed to the health authorities such as Ministry of Health, health associated workers to formulate the preventive measures to limit the COVID-19 transmission.

## Authors' Contributions

Zafar Rasheed: Data collection, interpretation, validation, and manuscript drafting. Homaidan T Alhomaidan: Conceptualization, data collection and interpretation, and manuscript drafting. Ali Shariq:

Conceptualization, data interpretation, and manuscript drafting. Mohammad Alkhowailed: Data collection and interpretation and manuscript drafting. Fuhaid Alqossayir: Data collection and interpretation and manuscript drafting. Naila Rasheed: Data collection, interpretation, validation, and manuscript drafting. Abdullah Alkhamiss: Data interpretation and manuscript drafting. Ruqiah Alghasham: Manuscript revision. Almonther A. Hershman: Data interpretation and manuscript drafting. Sami Alharbi: Data interpretation and manuscript drafting; Suliman A. Alsagaby: Data interpretation and manuscript drafting. Sharifa K Aldurabi: Data interpretation and manuscript drafting. Waleed Al Abdulmonem: Data collection and interpretation and manuscript drafting.

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