Gender and Age as Determinants of COVID-19 Outcomes

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نتائج الجنس والعمر كمحددات للكوفيد 19

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Abstract:

Background: SARS-CoV-2, first detected in late 2019, rapidly developed into a global health crisis. Evidence consistently shows that males experience more severe COVID-19 outcomes than females, and age plays a significant role in determining disease severity. Findings from this study suggest that males have a slightly higher risk of acquiring the infection and developing severe illness, while young individuals under twenty years of age show greater resistance. Conversely, those aged sixty years and above are more likely to experience severe manifestations, although susceptibility decreases among males older than seventy-five.

Objective: The purpose of this study was to evaluate how gender and age influence COVID-19 infection patterns, disease severity, mortality, and prognosis. Only 198 confirmed cases were analyzed, consisting of 120 males (60.4%) and 78 females (39.6%), from January 2021 to January 2022.

Results: Our results indicated that males were more affected by COVID-19 than females. Younger individuals demonstrated the lowest susceptibility, while elderly patients were the most vulnerable. Infection rates among males beyond the age of seventy-five showed a decline.

Keywords: Male, Female, Age, COVID-19.

الملخص

خلفية البحث: تعد عدوي فيروس كورونا المستجد *(SARS-Cov-2)* من أبرز التحديات الصحية العالمية، وقد اظهرت العديد من الدراسات وجود اختلافات واضحة في شدة المرض ومخرجاته تبعا للجنس والعمر.

هدف الدراسة: هدفت هذه الدراسة الي تقييم تأثير الجنس والعمر على نمط الإصابة بمرض كوفيد-19وشدة المرض ومعدلات الوفيات والتنبؤ بالمآل السريري.

المنهجية: شملت الدراسة 198 حالة مؤكدة مخبريا بتفاعل البوليميراز المتسلسل *(PCR)* خلال الفترة من يناير2021 الي يناير2022، حيث ضمت العينة 120من الذكور (60.4%) و78 من الاناث (39.6%). تم تحليل البيانات باستخدام مربع كأي.

النتائج: أظهرت النتائج ان الذكور أكثر عرضة للإصابة بمرض كوفيد-19 ولتطور الحالات الشديدة مقارنة بالإناث. كما بينت الدراسة ان الفئة العمرية دون العشرين عاما كانت الأقل قابلية للإصابة، في حين ارتفعت معدلات الإصابة وشدة المرض بشكل ملحوظ لدي الافراد الذين تزيد أعمارهم عن 60 عاما. ولوحظ انخفاض في معدلات الإصابة بين الذكور الذين تجاوزت أعمارهم 75 عاما.

الاستنتاج: تؤكد الدراسة ان الجنس الذكري والتقدم في العمر يعدان من العوامل الرئيسية المرتبطة بزيادة شدة المرض كوفيد-19 وسوء المآل السريري، ويحتمل ان تعود هذه الفروق الي عوامل مناعية وهرمونية وبيولوجية معقدة.

الكلمات المفتاحية: الجنس، العمر، كوفيد-19، الذكور، الاناث.

Introduction

COVID-19, caused by the SARS-CoV-2 virus, may lead to severe illness characterized by acute hypoxemic respiratory failure, which can result in death [1]. COVID-19 has been shown to affect males and females differently due to differences in immunological responses [2]. Males are twice as likely as females to develop severe or fatal SARS-CoV-2 infection [3]. Biological, genetic, and hormonal factors contribute to these variations. [3]. Males have higher hospitalization and mortality rates, while females appear to have a higher long-term risk of COVID-19 complications [4].

The gender differences observed during the pandemic may be influenced by both social and biological factors [5]. Socially, females form the majority of the global healthcare workforce and often have primary family caregiving roles, increasing exposure risk [6]. They also have reduced access to social protections and are more likely to work in informal sectors. Biologically, sex hormones—estrogen, progesterone, and testosterone play an important role in regulating the expression of the ACE2 receptor, which SARS-CoV-2 uses to enter host cells. Testosterone tends to upregulate ACE2 the main receptor required for viral entry while estrogen down regulates it, reducing susceptibility in females. Testosterone increases ACE2 expression, while estrogen reduces it, potentially making males more susceptible to infection [7]. On the other hand waning immunity in the elderly (>60 years) increases susceptibility, while reduced testosterone levels in males over 75 years may decrease susceptibility compared to females [8]. Individuals under twenty years of age are generally more resistant to COVID-19, although young males may have a slightly higher risk than young females [9].

Material and methods

Study Design and Patients: A structured questionnaire was used to collect personal information from 198 COVID-19 patients who tested positive by real-time PCR in ICU units at the COVID-19 Isolation Zone (Sugatra Center) in Wad Madani, Gezira State, Sudan. The study was conducted from October 2021 to October 2022. The age-group distribution shows that 50.2% of patients belonged to the highest age category, while the remaining groups constituted 49.8% (Figure 2). Regarding gender, males accounted for 60.4% and females for 39.6% (Figure 1).

Ethical Consideration: Written consent was obtained as part of ethical approval from the Ministry of Health – Department of Epidemics Administration.

Data Analysis: Chi-square tests were used to analyze the data.

Results and discussion.

Results: The data indicate that males had higher hospitalization and mortality rates than females. Figure 1 shows that males comprised 60.4% of cases. Figure 2 demonstrates the relationship between COVID-19 infection and age: individuals over 60 years showed the highest susceptibility, while susceptibility decreased in those over 75 years. Younger individuals under twenty years of age were the least likely to be infected.
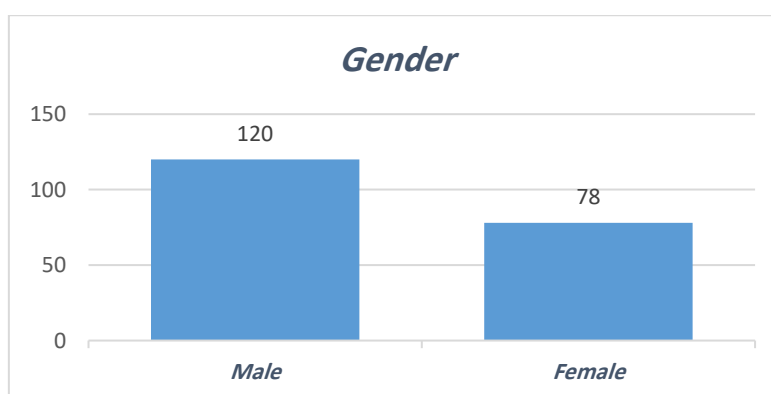

Figure 1: It shows that males are about 60.4%, while females 39,6% and males were more susceptible to COVID-19 than females.
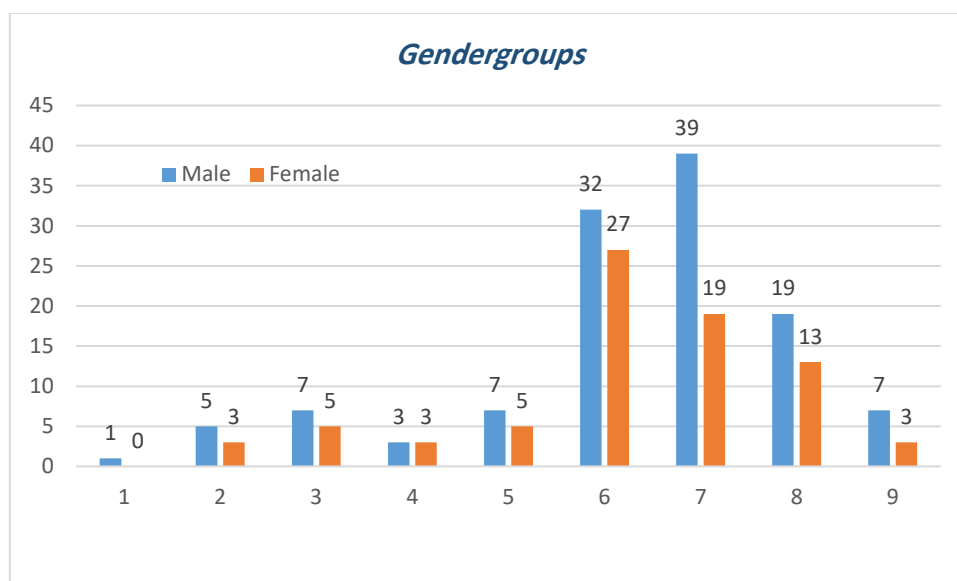
Figure 2: It shows weak susceptibility of children under 20 years to the COVID-19 pandemic, while is increased in the older over 60 years, and it declined in the older over 75.

Discussion: Our results and chi-square analysis confirmed that male gender is a risk factor for infection, severity, and reduced recovery rates. Greater vulnerability in males may be linked to immune response differences, sex hormone effects, and chromosomal influences [10]. SARS-CoV-2 infection begins with binding of the viral spike glycoprotein to host ACE2 and TMPRSS2 receptors [11]. ACE2 expression is influenced by sex hormones. Estrogen and progesterone tend to suppress ACE2 activity, while testosterone increases it [12]. Plasma ACE2 levels are higher in males, which may contribute to greater susceptibility [12]. Testosterone also suppresses immune responses, reduces inflammation control, and lowers T-lymphocyte numbers [13–15]. It inhibits adaptive immunity by suppressing Th2 and Th17 responses, leading to weaker antibody production [16]. Conversely, estrogen enhances immunity and promotes T-helper cell differentiation and cytokine production [19,20]. The increased susceptibility among individuals over 60 years may be related to weakened immunity. Reduced testosterone levels in males over 75 may partially explain their decreased infection rate compared to females [21]. Younger individuals under twenty years of age appear more resistant due to immature hormonal patterns and lower ACE2 expression [22].

Conclusion: Many studies have reported higher susceptibility to COVID-19 in males than females. Gender influences both incidence and severity due to complex interactions among behavioral, genetic, hormonal, and immune factors. Age-related decline in immune function further explains the higher infection rate among older adults. Reduced testosterone levels in males over seventy-five may also contribute to their lower susceptibility compared with younger males. Overall, the study concludes that male gender and advanced age are significant risk factors for severe COVID-19 outcomes.

Conclusion

Many studies have reported higher susceptibility to COVID-19 in males than females. Gender influences both incidence and severity due to complex interactions among behavioral, genetic, hormonal, and immune factors. Age-related decline in immune function further explains the higher infection rate among older adults. Reduced testosterone levels in males over seventy-five may also contribute to their lower susceptibility compared with younger males. Overall, the study concludes that male gender and advanced age are significant risk factors for severe COVID-19 outcomes.

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