

The Impact of Socioeconomic Status on COVID-19 Infection: A Case-Control Study

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Abstract

Background: The COVID-19 pandemic has impacted the socioeconomic situation worldwide, but another issue is the impact of socioeconomic status on the rate of coronavirus infections.

Objectives: This study aims to examine the socioeconomic status of individuals infected with COVID-19.

Methods: This case-control study was conducted on 768 hospitalized patients at 7 hospitals in Tehran, Iran from 2020 to 2021. The study included two groups: a case group of 384 hospitalized COVID-19 patients and a control group of 384 individuals hospitalized. A socioeconomic status questionnaire was used for data collection. The data were analyzed using SPSS v.26 software, descriptive statistical tests, and logistic regression. A significance level of less than 0.05 was considered.

Results: The findings indicated a significant relationship between age (OR = 1.017), marital status (OR = 0.316), and education level (OR = 0.348) with the rate of infection. Individuals over 60 years old, married, and those with higher education had a greater chance of infection. The regression results for two components of economic class and housing status, categorized by housing prices and purchasing ability, were not significant ($P > 0.05$). However, there was a significant relationship between income level ($P < 0.05$, OR = 0.497) and the rate of infections; individuals with lower income had a lower chance of infection.

Conclusion: The researchers concluded that the Hygiene Hypothesis may influence the rate of COVID-19 infection among individuals; however, further research in this area is needed.

Keywords: Hygiene Hypothesis, Coronavirus, COVID-19 Infection, Socioeconomic Status

1. Background

In December 2019, a severe outbreak of Coronavirus Respiratory Syndrome occurred in Wuhan, Hubei Province, China, spreading throughout China and beyond.¹ In less than a few months, over 200 countries were affected by the virus.² According to global statistics, a death rate of 3.4% has been recorded for this disease.³ In Iran, the official announcement of COVID-19 occurred with the confirmation of two cases in Qom on February 19, 2020.⁴ This emerging virus, which is the cause of COVID-19 infection, creates severe and deadly respiratory problems. According to evidence, individuals with a history of vascular disease, diabetes, chronic respiratory disease, hypertension, and cancer have the highest susceptibility to this virus.⁵⁻⁷ Men are more vulnerable compared to women, and one reason for this is the higher likelihood of exposure to the virus due to occupational hazards.⁸ The COVID-19 pandemic has brought about various challenges in health, socioeconomic, and political aspects worldwide.⁹ Studies indicate that the risk of contracting

the disease depends on factors such as age, gender, health status, and individual care.¹⁰ Some ways to control the new coronavirus include monitoring one's health, avoiding crowded places, and boosting the body's immunity.^{5,11} However, due to economic and social reasons, individuals in society need to interact with each other, leading to a high volume of inevitable meetings and travels.¹² As a result, controlling disease has become more difficult.¹³ One of the most effective strategies to control the outbreak of epidemic infections is quarantine, which brings about vast devastation to the lives of individuals in society due to employment restrictions.^{13,14} Limitations lead to a reduction in the workforce in all economic sectors and result in the loss of many jobs.⁹ As economically disadvantaged individuals often work in jobs that cannot be done from home, this disease increases the vulnerability of socially and economically underprivileged individuals.¹⁵

Families who have lost their jobs or face job-related disorders buy less food on average and struggle to access

food due to factors such as high prices, limited variety in stores, difficulty purchasing fresh items, hand sanitizers, and medicines compared to those without occupational disorders.¹⁶ Though these challenges result in the first instance of infectious diseases as a consequence of physical health, they might have deep impacts on mental health and welfare. Fear and concerns of people throughout the world about their safety and the unfavorable socioeconomic outcomes such as unemployment and lack of access to essential commodities resulting from quarantine measures in different aspects,¹⁷ work conditions, unstable income, and lack of financial security in individuals with low socioeconomic conditions,¹⁵ might have various effects on individuals' mental health. Possibly, patients who have limited access to healthcare will experience higher mental stress during this pandemic.¹⁷ In the social hierarchy, individuals occupy different positions based on their job situation, level of education, and income, and their position is summarized precisely in the form of their socioeconomic status. The level of education makes a difference in terms of access to specialized information and the utilization of new knowledge, while a job affects access to scarce goods.¹⁸ Higher incomes signify better health, and healthier people usually have a higher income.¹⁹ In addition, medical care does not exist in isolation. Patients' attitudes toward healthcare providers and the behavior and attitudes of health experts toward minority patients are influenced by discrimination in the broader community. This can affect the performance of healthcare professionals and patients' expectations, such as anticipating dismissal, ridicule, or humiliation. These factors can reduce access to healthcare for minority groups, including patients afflicted with COVID-19.²⁰ Consequently, to prevent the spread of the new coronavirus, there is a need for collaboration among health staff, states, and the public.⁸ Fast supervision of the venues of transmission of COVID-19 is necessary for prevention, intervention, and control. Vaccination alone cannot stop the COVID-19 pandemic; therefore, there is a need for low-cost control strategies based on evidence and control, and we should ensure access to secure diagnosis to determine the true burden of diseases in society.²¹ A study by Jahangard and Sarabadani reviewing the socioeconomic factors affecting Tuberculosis in Iranian provinces indicated that in many cases, spending on macroeconomic costs and further investment in health and treatment services is wrongly considered equal to providing equality in access. While spending per capita heavy costs for health services does not always mean high output and effectiveness of programs. Quality is not merely manifested in mandatory insurance or the construction of modern and equipped hospitals, but it is displayed in the allocation of resources based on need and the distribution of services based on epidemiologic findings. It also involves ensuring relatively equal quality

of services in different regions. According to the results, an increase in per capita income is expected to enhance life standards and, thereby, decrease the rate of disease affliction.¹⁹

2. Objectives

This study was descriptive-analytic and aimed to examine the rate of COVID-19 disease affliction in relation to the socioeconomic situation and the use of health-medical services to prevent infection. The goal is to improve managerial policies for infectious diseases, facilitate public access to health treatment care, and reduce affliction and mortality.

3. Methods

The present study was a case-control study conducted to examine the effect of socioeconomic conditions on individuals' COVID-19 infection in Tehran, Iran, from 2020 to 2021. The population under consideration was all people referred to medical centers under the supervision of the Shahid Beheshti University of Medical Science with coronavirus disease. After obtaining the necessary permits from the relevant authorities (Ethics code: IR.SBMU.RETECH.REC.1399.0938), seven hospitals in different areas of Tehran that admitted Corona patients were selected using the clustering sample method. Initially, socioeconomic status questionnaires were randomly distributed and collected from 384 patients with a positive coronavirus PCR test who were admitted to these hospitals as a case group. The inclusion criterion in the case group was COVID-19 infection. In cases where the patients were unable to complete the questionnaire, their companions were requested to assist in facilitating the process and helping the patient respond to the questions. To select the control group, the samples were matched in terms of age and gender. To ensure the homogeneity of the samples, the control group was selected from the non-coronavirus inpatient wards of the same hospital using a random cluster sampling method (with a number equal to the cases selected from the same hospital), and questionnaires were distributed among them. The criteria for inclusion in the control group were people without a coronavirus infection, and exclusion criteria included underlying diseases such as heart disease, hypertension, and diabetes. The instrument used to measure socioeconomic status in this study was the Socioeconomic Status Questionnaire (SES) or Power View (2013), which included six demographic questions consisting of variables such as age, gender, employment status, and four main components: income, economic class, education, and housing status. According to the research project by Eslami et al, the validity of the form and content of the questionnaire was confirmed by relevant experts. Additionally, the reliability of the questionnaire, as assessed using the Cronbach's alpha

test, resulted in 0.83. The questionnaire utilized a Likert scale of measurement with five options ranging from very low to very high, corresponding to scores of 1 to 5.²² After collecting the questionnaires, the data were analyzed using statistical and inferential tests by SPSS version 26 software. Initially, the responses to questions about socioeconomic status were categorized into three groups by combining very low with low and very high with high. Quantitative data was described using mean and variance, while qualitative data was described using percentage and frequency. To assess the impact of socioeconomic status on COVID-19 infection, logistic regression analysis was conducted.

4. Results

The descriptive results of demographic variables in the experimental group show that the number of women with COVID-19 infection is 51.6%, which is more than men. The minimum age in this study was 18 years, and the

maximum age was 96 years. 21% of patients with the disease infection were less than 45 years, while 46% of those over 60 years had the highest frequency. 90.1% of the interviewees were married, and 29.2% were employed. Among the 28 patients infected with Coronavirus, 6.3% had postgraduate education backgrounds, while individuals with a diploma and below diploma had the highest frequency at 74.5%. Out of the 112 people employed in the experimental group, the highest percentage of frequency belonged to people in freelance work at 13.8%.

In the control group, the number of men, at 48.4%, was lower than that of women. Additionally, within the age range of 18 to 96 years, 33.3% of participants in the control group were under 45 years, 31.8% were between 45-60 years, and 34.9% were over 60 years. 25.8% of individuals were single, and the frequency of employed people, at 28.9%, was lower than those who were not employed. Individuals with diplomas or below, at 84.8%, had the highest frequency (Table 1).

Table 1. Frequency of Demographic Variables in the Experimental and Control Groups

Characteristics		Experimental Group	Control Group
		Frequency (%)	Frequency (%)
Gender	Female	198 (51.6%)	198 (51.6%)
	Male	186 (48.4%)	186 (48.4%)
Age	<45	82 (21.4%)	128 (33.3%)
	45-60	123 (32%)	122 (31.8%)
	>60	179 (46.6%)	134 (34.9%)
Marital status	Single	38 (9.9%)	99 (25.8%)
	Married	346	285 (74.2%)
Education level	Diploma and sub-Diploma	286 (90.1%)	323 (84.1%)
	Associate Degree	22 (5.7%)	13 (3.4%)
	Bachelor	48 (12.5%)	37 (9.6%)
	Master and higher	28 (7.3%)	11 (2.9%)
Employment status	Yes	112 (29.2%)	111 (28.9%)
	No	272 (70.8%)	273 (71.1%)
Job Type	Employee	42 (10.9%)	18 (4.7%)
	Self-employed	53 (13.8%)	82 (21.3%)
	Other	17 (4.4%)	11 (2.9%)

Table 2. Frequency of the Main Variables of Socioeconomic Situation in the Experimental and Control Groups

Characteristics		Experimental Group	Control Group
		Frequency (%)	Frequency (%)
Income level	Insufficient	145 (37.8%)	222 (57.8%)
	To some extent sufficient	168 (43.7%)	108 (28.1%)
	Sufficient	71 (18.5%)	54 (14.1%)
Economic class	Low	153 (39.8%)	201 (52.3%)
	Medium	216 (56.3%)	171 (44.5%)
	High	15 (3.9%)	12 (3.1%)
Home Prices of homeowners	Low	67 (17.4%)	84 (21.9%)
	Medium	142 (37%)	126 (32.8%)
	High	33 (8.6%)	30 (7.8%)
The ability of tenants to buy house	Low	128 (33.3%)	132 (34.4%)
	Medium	10 (2.6%)	11 (2.9%)
	High	4 (1%)	1 (0.3%)
Education level of the interviewee's father	Diploma and sub-diploma	369 (96.1%)	370 (96.4%)
	Above diploma	15 (3.9%)	14 (3.6%)
Education level of The interviewee's mother	Diploma and sub-diploma	378 (98.4%)	378 (98.4%)
	Above diploma	6 (1.6%)	6 (1.6%)

Table 2 shows the frequency of socioeconomic components. The descriptive results of the income variable in the experimental group indicate that 37.8% of the individuals with disease infection announced that the level of income adequacy for living expenses was

insufficient, and 18.5% considered their income level as sufficient. Out of the three economic classes mentioned, 39.8% of the interviewees placed themselves in the lower economic class and 3.9% in the upper economic class. 63% of people with COVID-19 infection had housing,

and they considered their housing price low, while 8.6% announced their housing price as high. Out of 36.7% of the individuals who announced that they do not own housing, 33.1% with the highest frequency declared their ability to buy housing as low.

57.8% of the participants in the control group reported that their income was insufficient, while 14.1% selected the sufficient option. Additionally, 52.3% of individuals identified their economic class as low, and 3.1% identified it as high. Among the two categories of housing status, 62.5% had housing, with 21.9% estimating their housing price as low and 7.8% as high. The 34.4% of people who did not own housing described their financial ability to purchase housing as low.

After conducting descriptive statistics, a logistic regression test was used to assess the impact of socioeconomic conditions on coronavirus infection. The variables considered included gender, age, education, employment status, type of job, income rate, economic class, and housing status on COVID-19 infection.

The results of the regression test for demographic variables showed that COVID-19 infection does not have a significant relationship with gender, indicating that the gender of individuals does not affect coronavirus infection. However, the results for the age variable with an odds ratio (OR) of 1.017, showed a significant relationship between age and infection. This means that the likelihood of contracting coronavirus increases with each year of age. Additionally, the results indicate that the likelihood of infection, with an OR of 0.316, is significantly lower in single individuals compared to married individuals. Moreover, a significant relationship was found between education and COVID-19 infection. In other words, individuals with a high school diploma or below, with an OR of 0.348 and $P < 0.05$, have a lower possibility of disease infection compared to those with postgraduate education. As shown in Table 3, the results did not reveal a significant relationship between individuals' employment status and the type of job they hold.

Table 3. Results of the Logistic Regression Test

Characteristics	P-value	Exp(B)
Gender	1	1
Age	<0.001	1.017
Marital status	<0.001	0.316
Education	0.004	0.348
Employment status	0.847	1.026
Job Type	0.389	1.510
Income level	0.001	0.497
Economic class	0.217	0.609
Father's education level	0.850	0.931
mother's education level	1	1
House price level	0.285	0.725
Ability to buy the house	0.205	0.241

The regression test for the rate of income from the components of the socioeconomic situation showed a significant relationship. According to OR: 0.494 and $P < 0.05$, individuals with lower income are less likely to be infected compared to those with higher income. However, no significant relationships were found between the other two variables of socioeconomic status, including economic class and housing status, with coronavirus infection. Additionally, the results of the regression analysis were not significant for the education level of the interviewee's parents.

5. Discussion

The present research aims to study the effect of socioeconomic conditions on coronavirus infection. Building on previous studies that have reported a higher risk of COVID-19 infection among individuals with low socioeconomic status, low health literacy, and overcrowding, we obtained interesting results. This study revealed a significant relationship between lower infection rates among low-income individuals and low education levels in relation to coronavirus. However, no significant relationship was found between economic class, housing

status, and Coronavirus infection.

The results indicated no significant relationship between coronavirus infection and gender, with men and women equally exposed to risk. This finding is inconsistent with previous studies' results. In the study by Mesri et al., 1,463 patients suspected of having COVID-19 were referred to medical centers in Saveh, with 57% of them being male. Research on the protective effects of additional X chromosomes suggests that genes related to immunity on the X chromosome, along with sex hormones, influence immune responses. Women, possessing natural immune systems and stronger humoral responses, are less susceptible to viral infections than men. Furthermore, the greater job responsibilities of men, which lead to increased presence in the community and exposure to virus carriers, are cited as potential reasons for the higher infection rates among men.^{8,24,25} The results related to gender in the present study are consistent with those of the study by Sheikhi et al., in which 51% of patients were male. However, no significant difference was observed between coronavirus infections and gender. Similarly, in the study by Long Liu et al., no significant difference was noted in the rate of infection by gender. They reported that out of

53 individuals admitted to the Infectious Diseases Department of the Respiratory Unit, 50.9% were women.^{26,27} In addition, Aguilar Palacio et al. conducted a study in which data was collected at the individual and regional residence levels during three pandemic waves in Aragon, Spain. Among the cases, 53.4% were women. Among those who tested positive for COVID-19, 20.5% were women and 20.9% were men. These results indicated that the positivity rate was similar for both women and men.²³

Our study showed a significant relationship between age and the rate of disease infection. As age increases, the likelihood of contracting the coronavirus also increases. This result is consistent with the findings of previous studies.^{23,25,28} In the study by Mesri et al, the average age of patients with a positive coronavirus test was 57 years.²⁵ In the research by Sheikhi et al, the median age was reported as 46 years.²⁶ Aguilar-Palacio et al observed the highest rate of positive coronavirus cases among individuals aged between 45 to 64, with a frequency of 23.84%.²³ The results of the Aryanejad study indicated that being 60 years old is considered a risk factor for coronavirus infection.³⁰ Independent studies have noted that the elderly population often have more underlying diseases, which may contribute to the virus's impact on the lungs. Hypotheses such as changes in the physical properties of lung tissue or age-related immune function decline (immunosenescence) may increase the susceptibility of the elderly to the disease.²⁸⁻³⁰

In the present study, regression results were found to be significant for education. This suggests that the likelihood of infection with the disease is lower for individuals with a high school diploma or below compared to those with higher levels of education. The percentage of participants in our study with a high school diploma or less was higher in the experimental group than in other study groups. In addition, our results showed that married people have a higher likelihood of coronavirus infection than single people. The frequency of married individuals in the experimental group was higher than that of single individuals, which was consistent with the study by Sheikhi et al.²⁶ In contrast, it was inconsistent with Hawkins et al's study.³¹ One of the reasons for the high incidence of the disease in people with low education is the lack of understanding or access to health advice, such as hand hygiene, due to weak skills in reading and writing. People with limited health literacy may be easily misled by inaccurate sources of information. On the other hand, lower levels of education may indirectly affect factors such as poor nutrition and the risk of intensive forms of infection with Coronavirus disease.^{32,33}

Though it seemed that we could achieve similar results with previous studies regarding socioeconomic components such as income rate, economic class, and housing status,³⁴⁻³⁶ the results in Table 3 were not significant for economic class and housing status. No

relationship was found between infection and economic class or housing status among two groups of people: those with housing and those without housing. However, the regression results for the income variable were significant, indicating a lower chance of infection among individuals with lower income. It also showed that individuals with higher income are more likely to be infected. Aguilar-Palacio et al. found that the highest incidence of confirmed cases of COVID-19 was in individuals living in deprived regions. Additionally, individuals with low wages had the highest rate of infection.²³ Wachtler et al, in a study analyzing variables of gender, age, and area in 186839 laboratory-approved cases of COVID-19, reported that during the early stages of the epidemic, data showed a socioeconomic gradient with a higher prevalence in areas with less deprivation. However, this trend changed over time, and in southern Germany, deprived areas experienced the highest rate of damage from the epidemic.³⁴ The results of the retrospective cohort study by Little et al. showed that the heterogeneous burden of COVID-19 disease is higher among younger age groups in areas with high poverty. One of the causes of further infection among the youth in deprived regions is the higher percentage of these individuals in essential jobs, which hinders social distancing.³⁵ Kyu Oh et al. conducted a study to investigate the effect of socioeconomic status (SES) on the risk of contracting COVID-19 in Korea. They collected data on patients with COVID-19 infections during a specific period and extracted the income levels of all individuals. The results of the regression test showed that individuals with the lowest income levels were 1.19 times more likely to be exposed to the risk of experiencing COVID-19 compared to individuals with higher incomes.³⁶ Studies have shown that the socio-economic situation during the COVID-19 pandemic directly or indirectly influences factors such as employment, living conditions, travel, social engagement, and health-related behaviors. It has been noted that an individual's job may expose them to risks, such as working in essential roles that require interaction with others or jobs that involve frequent human contact.^{32,35} However, the results of our study did not show any significant relationship between employment situation and the type of job with COVID-19 infection. However, other studies have indicated that low income can impact life situations, potentially leading to higher infection rates among low-income individuals. Socioeconomic inequalities faced by low-income individuals may expose them to a higher risk of COVID-19 infection due to disparities in living conditions, job opportunities, residing in deprived regions with inadequate housing conditions, and living in densely populated buildings.^{32,35,37}

Brooks et al. conducted a study investigating the Hygiene Hypothesis in relation to asthma and allergies. This hypothesis suggests that the increase in cleanliness,

smaller family sizes, and reduced exposure to microbial risks may explain the global prevalence of asthma. It also proposes that a decrease in microbial exposure (resulting in increased atopic immune responses) leads to a higher incidence of allergies and allergic asthma. The Hygiene Hypothesis is supported by evidence linking overcrowding and unsanitary conditions to a lower incidence of asthma. Environmental exposure to pro-inflammatory microbial factors, such as bacterial endotoxin, contact with domestic animals, and consumption of unpasteurized milk, have been identified as protective factors. Studies conducted in both rural and non-rural settings have shown a significant inverse relationship between local endotoxin levels and asthma.³⁸ In this study, only the infection rate was studied due to the inability to follow up with COVID-19 patients, and the mortality rate study was not conducted.

6. Conclusion

The findings of the current study regarding the level of education and income rates showed that individuals with low education and income are less likely to contract Coronavirus. Highly educated individuals, with greater knowledge about health issues and adherence to hygienic protocols, as well as people with high income or the ability to afford sanitary items such as disinfectants and proper nutrition, are less likely to be infected with COVID-19. Therefore, individuals with low education and income may have a lower risk of COVID-19 infection due to the hygiene hypothesis, which suggests that increased exposure to microbial agents can protect against infectious diseases. To further explore this topic, it is recommended to conduct additional studies on the relationship between socioeconomic conditions and Coronavirus infection.

Research Highlights

What Is Already Known?

People around the world were concerned about unfavorable socioeconomic outcomes such as unemployment resulting from quarantine and lack of financial security during the coronavirus pandemic.

What Does This Study Add?

Individuals with low education and income were less likely to contract coronavirus. This is contrary to our expectation that highly educated individuals with greater knowledge about adherence to hygienic protocols, as well as people with high income and proper nutrition, would be less likely to be infected with COVID-19.

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Author Contributions

Authors contributed equally to this work.

Conflict of Interest Disclosures

All authors declared that they have no conflict of interest.

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