Effect of Socioeconomic Status on Risk of Developing COVID-19: a Community-based Case-control Study

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Abstract

Background

Most of the studies regarding the relationship between socioeconomic status and occurrence of COVID-19 are usually ecological studies and have limitations due to ecological fallacy. The aim of this study is to investigate the relationship between socioeconomic status and individual-level risk of developing COVID-19.

Methods

We conducted a community-based, age and gender matched, case-control study in a district of Istanbul. The case group was defined as all confirmed COVID-19 cases (n=232) that were reported to the district health directorate in a week of August 2020. Control group was defined as people who were matched with cases in terms of age and gender and selected randomly from the directory of the same primary care provider in the district in 1:1 ratio. Participants were communicated via telephone. The socioeconomic status score was measured by Turkish Socioeconomic Status Index which considers three dimensions of it: education, occupation, and income.

Results

168 cases (72.4% response) and 168 controls are included in the study. 48.8% of participants are female and the mean age is 37.66±15.32 for each group. The mean socioeconomic status score is 70.28±7.09 for cases and 69.25±7.46 for controls (p=0.201). 15.2% (n=25) of cases and 22.4% (n=37) of controls is in lower socioeconomic status group (p=0.091). Neither bivariate nor logistic regression analysis revealed a statistically significant difference between study groups.

Conclusions

Our findings indicate that socioeconomic status is not a significant predictor of COVID-19 occurrence at individual-level. The disease seems to be a common threat to all individuals of the global community.

Introduction

In December 2019, a new respiratory system infectious disease thought to be first spread from a live animal market in Wuhan China, soon became a pandemic. The causative agent is defined as SARS-CoV-2 from the family of viruses known as coronaviruses. The disease, called COVID-19, initially started as smaller clusters in many countries. As of February 2020, COVID-19 cases increased rapidly in most of Europe, the United States, Australia, Asia, and Africa. World Health Organization declared a global pandemic on March 11, 2020. COVID-19 has affected 220 countries, caused 78,194,947 million cases and 1,736,752 million deaths by December 25th, 2020 [1] and continues to harm everyday life worldwide.
A better understanding of the factors that influence the risk of developing an infection, would benefit the planning of current health care services and provide necessary information to prevention or modelling studies for both current and future epidemics. Available statistical data show that higher age, male sex and pre-existing chronic diseases are significant risk factors for the negative effects of COVID-19, but the roles of socioeconomic factors are not fully understood yet. Studies regarding the relationship between Socioeconomic Status (SES) and occurrence of COVID-19 disease are usually ecological studies and have limitations due to ecological fallacy. On the other hand, most individual-level studies are hospital-based and more focused on ethnic and racial disparities than SES.

Socioeconomic factors are considered major determinants in life expectancy, well-being, and health. SES is a combination determined by variables such as education level, occupation, income level and reveals inequalities between individuals towards privileges or resources.

It is well-known that low socioeconomic status increases all-cause morbidity and mortality. Previous studies suggest a link between low socioeconomic level and increased risk of infectious diseases and impaired immune responses. People of low socioeconomic status should be considered high-risk populations in the event of an epidemic. Their status can affect the prognosis and severity of the disease also.

Early research on the social epidemiology of COVID-19 indicates the impact of socioeconomic status on infection and deaths, as people of lower SES facing more harm. Although it is known that many diseases are more common among those who suffer from conditions such as poor housing conditions, overcrowded living, lack of financial security it is difficult to say similar relationship for COVID-19 since the socioeconomic characteristics of COVID-19 patients are not routinely recorded.

There are other risk factors better known than SES for COVID-19 transmission and disease development such as older ages, pre-existing chronic diseases (especially heart diseases, hypertension, diabetes, and COPD) and smoking. The increased ACE-2 enzyme, which also enables coronaviruses to enter the cells, is suspected reason in disease mechanism. In diabetes, high blood sugar also damages the person's immune system and the low immune system is more susceptible to infections. Smoking is also known for increasing risk of developing a variety of viral infections and their complications. To understand the effect of SES on COVID-19 infection, it is necessary to control the confounding effects of such known factors.

It is difficult to determine the risk of developing infections between different social groups. One of the main problems here is that information about ethnicity and socioeconomic status is not available adequately in routine health data. Besides, the sizes of different social groups in the population are not completely known. However, to effectively prevent further spread with appropriate interventions, identify people who are more prone to develop disease or become severely ill and to better treat them; it is critical to understand socioeconomic factors at every dimension of the epidemic. Epidemiologic studies on the issue would be useful for identifying the most vulnerable groups and planning more
For this reason, the aim of this study is to identify the effect of socioeconomic status on the risk of developing COVID-19.

**Methods**

To identify the effect of socioeconomic status on the risk of developing COVID-19, we conducted a community-based, age and gender matched, case-control study in September 2020 in the Uskudar district of Istanbul, Turkey. With more than 500 thousand dwellers, Uskudar is the eighth-most populated district among 39 districts in Istanbul. COVID-19 incidence in the district was similar to other districts in the time of the study.

Assuming 44.4% prevalence of lower socioeconomic status among the population [18] and anticipated 1.93 risk ratio for developing COVID-19 [19], the minimum required sample size was calculated as 320 for 80% power, 95% confidence level, and 1:1 case-control ratio.

The case group was defined as all confirmed COVID-19 cases (n=232) that were reported to Uskudar District Health Directorate of Istanbul, Turkey from 19 August to 25 August. Control group was defined as people who were matched with cases in terms of age and gender and selected randomly from the directory of the same primary care provider in the district in 1:1 ratio. Random selection of controls was done via software developed by researchers for this specific purpose in Python programming language. When information of primary care provider is not available, controls were selected from the directory of a random primary care provider in the same neighborhood. When neighborhood information is not available, controls were selected from the directory of a random primary care provider in the district. Potential participants were communicated via telephone calls, informed, and included in the study if they have accepted to participate. They were called up to 3 consecutive days if they could not be reached. Controls were resampled until all cases were matched with a control.

Researchers entered data into a structured and online data collection form. Collected data consisted of age, gender, size of household, education levels of households, occupations of households, total net monthly income of the household, pre-existing chronic disease, and amount of smoking (pack-year).

Socioeconomic status score (SES score) was measured by Turkish Socioeconomic Status Index (TÜSES) and an online calculator (Available at tyap.net/ses) developed by Social Structure Studies Program research group.[18] This scale considers three dimensions of socioeconomic status: education, occupational prestige, and income. The scale uses the highest educational level and occupational prestige among households and mean monthly income per household. Occupational prestige has been operationalized with a score that represents the prestige of 133 occupation categories in the society as it is indicated in a preliminary study. Distinctly from many other alternatives, this scale is based on household, and its validity and reliability are controlled in the Turkish population.

In a previous study on a representative sample from Turkey, defined 44.4% of the population as lower SES group, following 38.8% as lower-middle, following 14.6% as upper-middle and last 2.2% as upper SES.
Some participants hesitated to give information about their income, and some others do not know the exact amount of income of other households. To overcome this issue, we followed the guidance of Galobardes & Demarest [20] while asking a question about income. We first asked the exact total amount of all households’ incomes. In the case that participant hesitates to answer we asked if it is higher or lower than the minimum wage. Following their answer, we prompted income intervals. After detecting the interval, we tried to narrow the interval until the participant feels fine. Before data analysis, income intervals transformed into an average value of its lower and upper boundaries.

Data were analyzed in SPSS v22 software. Continuous variables (age, years of completed education, smoking pack-year, household size, occupational prestige score, monthly income per household, and SES score) were summarized with mean and standard deviation for both study group. Counts and percentages are given for other variables. Differences between study groups are tested by t-test for continuous and chi-square test for categorical variables. To identify the change in risk of developing COVID-19 odds ratio is calculated for categorical variables. Three cases have not provided income data and hence a SES score could not be calculated for them. Thus, these 3 pairs are excluded for income-related comparisons. Conditional logistic regression was conducted to identify the influencing factors on the odds of developing COVID-19. The statistical significance threshold was considered as 0.05.

This study is approved by the Ministry of Health General Directorate of Healthcare in 25.08.2020 and by the ethical commission of Istanbul Medipol University in 03.09.2020 (No: 664). All methods were carried out in accordance with relevant guidelines and regulations.

**Results**

A total of 168 cases (72.4% response rate) and 168 controls are included in the study.

Demographic characteristics of participants by study groups are given in Table 1. Because cases and controls are matched by age and gender there is no difference between the age and gender distribution of the groups and 48.8% of participants are female and 51.2% are male and mean age is $37.66 \pm 15.32$ for each of the study groups.
Table 1.
Demographic characteristics of participants by study groups

|                | Cases |          | Controls |          |
|----------------|-------|----------|----------|----------|
|                | Mean  | S.D.     | Mean     | S.D.     |
| **Age**^a      | 37.66 | 15.32    | 37.66    | 15.32    |
| **Gender**^a   |       |          |          |          |
| Male           | 86    | 51.2     | 86       | 51.2     |
| Female         | 82    | 48.8     | 82       | 48.8     |
| **Total**      | 168   | 100.0    | 168      | 100.0    |
| **Education**^b|       |          |          |          |
| Illiterate     | 11    | 6.5      | 11       | 6.5      |
| Primary school | 24    | 14.3     | 28       | 16.7     |
| Secondary school | 84  | 50.0     | 65       | 38.7     |
| University     | 49    | 29.2     | 64       | 38.1     |
| **Total**      | 168   | 100.0    | 168      | 100.0    |

^a Matching variable.

^b Comparison between groups: χ² = 4.722 p = 0.193

The percentage of university graduates is higher among controls than cases (38.1% and 29.2% respectively) however there is no statistically significant difference between the educational level of case and control groups.

Table 2 summarizes the distribution of participants’ pre-existing chronic diseases by study groups. Percentage of people who have any pre-existing chronic diseases in cases (20.8%) is not significantly different than in controls (20.2%) (p = 0.893).
Table 2.
Distribution of participants’ pre-existing chronic diseases by study groups

|                          | Cases |          | Controls |          | χ²   | p     |
|--------------------------|-------|----------|----------|----------|-------|-------|
|                          | n     | %        | n        | %        | b     |       |
| Allergy                  | 0     | 0        | 2        | 1.2      | N/A   | -     |
| Asthma or COPD           | 8     | 4.8      | 1        | 0.6      | N/A   | -     |
| Cancer                   | 1     | 0.6      | 0        | 0        | N/A   | -     |
| Diabetes                 | 8     | 4.8      | 12       | 7.1      | 0.85  | 0.35  |
| Heart diseases           | 6     | 3.6      | 3        | 1.8      | N/A   | -     |
| Hepatitis                | 1     | 0.6      | 1        | 0.6      | N/A   | -     |
| Hypertension             | 17    | 10.1     | 15       | 8.9      | 0.13  | 0.71  |
| Thyroid diseases         | 4     | 2.4      | 0        | 0        | N/A   | -     |
| Rheumatic diseases       | 1     | 0.6      | 3        | 1.8      | N/A   | -     |
| Kidney diseases          | 0     | 0        | 4        | 2.4      | N/A   | -     |
| Other                    | 1     | 0.6      | 3        | 1.8      | N/A   | -     |
| **One or more**          | **35**| **20.8** | **34**   | **20.2** | 0.02  | 0.89  |
| **None**                 | **133**| **79.2** | **134**  | **79.8** |       |       |
| **Total**                | **168**| **100** | **168**  | **100**  |       |       |

a Since participants may have more than one disease, the sum of counts of individual diseases are not equal to count for “One or more”.

b Comparisons are in-between disease’s presence and absence. For variables other than Diabetes, Hypertension and “One or more” groups, χ² tests are not applicable because 50% of expected values are smaller than five.

Mean smoking pack-year was 2.52 ± 7.93 for cases and 3.73 ± 8.23 for controls, and the difference between groups is not statistically significant (t = -1.379 p = 0.169).

Distribution of variables that contribute to the socioeconomic status by study groups is summarized in Table 3. Although cases have slightly lower educational years, occupational prestige scores and slightly higher household size, monthly income per household and socioeconomic status score than controls; no statistically significant difference can be detected for any of those variables between two groups.
Table 3.
Components of the socioeconomic status by study groups

|                        | Cases       |            | Controls    |            | t   | p   |
|------------------------|-------------|------------|-------------|------------|-----|-----|
|                        | Mean        | S.D.       | Mean        | S.D.       |     |     |
| Educational years      | 10.15       | 4.34       | 10.38       | 4.48       | 0.384 | 0.701 |
| Household size         | 3.65        | 1.65       | 3.55        | 1.32       | 0.062 | 0.536 |
| Occupational prestige score | 32.26       | 29.86       | 34.43       | 29.49       | 0.671 | 0.503 |
| Monthly income per household | 6,659.61    | 5,710.34    | 5,550.00    | 6,421.92    | 1.659 | 0.098 |
| Socioeconomic status score | 70.28       | 7.09       | 69.25       | 7.46       | 1.280 | 0.201 |

*These calculations are based on 165 pairs of cases and controls. Others are based on 168 pairs.*

Table 4 presents the categorical SES data of the study groups. As it is seen from the Table 4, distribution of cases and controls by socioeconomic status groups which are formed by thresholds defined in the study of Sunar & Kaya [18], does not reveal any significant difference in terms of developing COVID-19.

Table 4.
Distribution of participants by socioeconomic status groups and study groups

|                | Cases       |            | Controls    |            | \(\chi^2\) | p    | OR (95% CI) |
|----------------|-------------|------------|-------------|------------|------------|------|-------------|
|                | n           | %          | n           | %          |            |      |             |
| Lower          | 25          | 15.2       | 37          | 22.4       | 2.860      | 0.091 | 0.62 (0.35 - 1.08) |
| Lower-Middle   | 78          | 47.3       | 71          | 43.0       | 0.600      | 0.439 | 1.19 (0.77 - 1.83) |
| Upper-Middle   | 44          | 26.7       | 39          | 23.6       | 0.402      | 0.526 | 1.18 (0.71 - 1.93) |
| Upper          | 18          | 10.9       | 18          | 10.9       | 0.000      | 1.000 | 1.00 (0.50 - 2.00) |
| Total          | 165         | 100.0      | 165         | 100.0      |            |      |             |

*Each group in comparison with all other groups combined.*

We analyzed the study data by logistic regression to understand the probable predictors for the occurrence of COVID-19 cases. Results of logistic regression analysis are presented in Table 5. As it is seen from the table none of the factors of interest seems to be a significant predictor of being a COVID-19 case.
Table 5.
Predictors of being a COVID-19 case by logistic regression analysis

| Independent variables                  | B    | SE   | Wald  | p   | β    | 95% CI  |
|----------------------------------------|------|------|-------|-----|------|---------|
|                                        |      |      |       |     |      | Lower   |
|                                        |      |      |       |     |      | Upper   |
| Pre-existing chronic disease           | -0.005 | 0.340 | 0.000 | 0.988 | 0.995 | 0.511  |
|                                        |      |      |       |     |      | 1.938   |
| Smoking (pack-year)                    | -0.020 | 0.016 | 1.708 | 0.191 | 0.980 | 0.950   |
|                                        |      |      |       |     |      | 1.010   |
| Education years                        | -0.032 | 0.041 | 0.593 | 0.441 | 0.969 | 0.894   |
|                                        |      |      |       |     |      | 1.050   |
| Household size                         | 0.075  | 0.085 | 0.776 | 0.378 | 1.078 | 0.913   |
|                                        |      |      |       |     |      | 1.273   |
| Occupational prestige score            | -0.006 | 0.006 | 1.104 | 0.293 | 0.994 | 0.982   |
|                                        |      |      |       |     |      | 1.006   |
| Monthly income per household           | 0.000  | 0.000 | 0.013 | 0.908 | 1.000 | 1.000   |
|                                        |      |      |       |     |      | 1.000   |
| Socioeconomic status score             | 0.037  | 0.031 | 1.366 | 0.243 | 1.037 | 0.975   |
|                                        |      |      |       |     |      | 1.103   |

Dependent variable: 0-Control, 1-Case

Discussion

As it was stated at the introduction of this paper several studies have reported a close relationship between the frequency of COVID-19 cases and old age, pre-existing chronic conditions and smoking habits, but the roles of socioeconomic factors are not fully understood yet.[2]

According to our findings of a community-based case-control study, there is no statistically significant difference between COVID-19 cases and matched controls with regard to the pre-existing chronic conditions and smoking habits of the individuals. The distribution of the pre-existing chronic diseases and frequency of smoking are similar for both case and control groups. It is known that pre-existing chronic diseases influence the prognosis of COVID-19 and contributes to high fatality rates. Because their relationship with the occurrence of the COVID-19 is not clear, our finding regarding the pre-existing chronic conditions is reasonable.

Another important finding of our study is the lack of a significant difference between SES levels of the cases and controls. This finding was against our expectation and also not compatible with other study findings which indicate associations between neighborhoods with a large dependent youth population, densely populated, low-income, and predominantly colored neighborhoods, and COVID-19 test positivity rate.[5, 6, 21, 22] However, most of these studies have ecological design and comparisons are not done at the individual level. We conclude that community-based, matched case-control and individual-level data collection structure of our study makes our findings trustworthy.
Association of SES with several health problems including infectious diseases has a long history and it is the source of the discipline Social Epidemiology.[23] SES is a composite index and a multidimensional measure determined by variables such as education level, occupation, income level. It is an important variable during the investigation of public health problems, however, there are measurement difficulties due to its complex nature. In this study, we used a scale that has high validity and reliability which makes our findings meaningful. This scale takes all the three essential dimensions of socioeconomic status into consideration: education, occupational prestige, and income.

Education has influences on Socioeconomic Status in many ways. As education level increases, the level of social and health awareness of the individuals and household increases. Within the scope of an infectious disease outbreak, individuals with limited health literacy which is associated with a lower level of education may overlook the measures to be taken to contain the epidemic and may be misled by misinformation. Effectiveness of public health communication during the pandemic also depends on people's ability to access and understand messages. Furthermore, lower levels of education can be indirectly associated with many factors that may suppress the immune system such as increased smoking and malnutrition.[9] Most of the professions with higher status and income can be attained through education.

Occupations of people may put them at risk due to the nature of the work. An occupation that requires constant face-to-face interaction with people may ease the spreading of or receiving an infection through droplets. Moreover, people in some occupations are more likely to suffer work-related stress, burnout, job insecurity and unemployment that all can lead to impaired immune and inflammatory system responses. [9, 11] It is shown that severe COVID-19 cases are more likely to be workers and less likely to be people working in their own work.[9]

The income level of the person or household is the major determining factor for nutrition, housing, and health expenditures. The low-income level can cause crowded households, more deprived neighborhoods, and poor housing conditions. It is known that these households are subjected to increased risk of transmission of many pathogens such as tuberculosis bacillus, Helicobacter Pylori or Ebstein-Barr virus. [2, 9] Impoverished population groups have difficulties in adopting preventive measures, such as social isolation, and if infection occurs, they have limited access to health services.[4] For a family struggling in poverty, a new economic recession due to the pandemic and measures to cover it can worsen physical and social conditions, thereby making them even more vulnerable to the impact of COVID-19.[9]

As a result, although several study findings support the well-known public health cliché “People with low SES are under high risk of infectious diseases”, we did not find any significant SES difference between COVID-19 cases and their age and gender matched controls.

However, this result should be concluded carefully since our study has some limitations as it is true for all studies. The most important limitation of our study is its cross-sectional nature. Longitudinal study designs, especially, follow-up studies are needed to investigate cause-effect relationships. However, it was not possible to organize and conduct a follow-up or cohort study under pandemic conditions. Another
limitation is the size of our sample. Our sample size is representative for investigating the effect of SES but not sufficient for making subgroup conclusions for all the “pre-existing conditions”. Besides these limitations, community-based design of this study makes the results more valuable and meaningful.

Conclusion

Our findings indicate neither protective nor worsening effect of socioeconomic status on risk of developing COVID-19. The disease should be seen as a common threat to society. As Burström and Tao have stated, scientific studies of inequalities in Coronavirus disease 2019 (COVID-19) are lacking at present, but it is reasonable to assume that disparities in social determinants of health have contributed to some early observations and result in differential exposure to the virus, differential vulnerability to the infection and differential consequences of the disease.[24] We urge that community-based follow-up studies should be conducted to generate reliable evidence about the effects of SES on COVID-19 occurrence.

List Of Abbreviations

SES: Socioeconomic Status

Declarations

Ethics approval and consent to participate:

This study is approved by the ethics committee of Istanbul Medipol University in 03.09.2020 (No: 664) after the regulatory approval of the Ministry of Health General Directorate of Healthcare in 25.08.2020. All methods were carried out in accordance with relevant guidelines and regulations.

Due to safety restrictions regarding ongoing pandemic, participants were approachable only via telephone calls. Therefore, the consents of participants are obtained verbally through that telephone calls. Interviewers first read the information script which explains the study’s aim and method, rights of participants, and data privacy. Interviewers asked study questions only to those who clearly give consent.

Consent for publication:

Not applicable.

Availability of data and materials:

The dataset used and analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests:
The authors declare that they have no competing interests.

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**Authors’ contributions:**

Conception and design: HK, OH; Literature review: HK, OH, Şİ, BK, FK, SN, BÖ; Data collection: Şİ, BK, FK, SN, BÖ, MAS, YT; Data analysis: HK, Şİ, BK, FK, SN, BÖ; Interpretation: HK, OH, Şİ, BK, FK, SN, BÖ, MAS, YT; Creation of new software used in the work: HK; Drafting and revising: HK, OH, Şİ, BK, FK, SN, BÖ. All authors read and approved the final manuscript.

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**References**

1. World Health Organization. WHO Coronavirus Disease (COVID-19) Dashboard. 2020. https://covid19.who.int/. Accessed 2 Dec 2020.

2. Niedzwiedz CL, O’Donnell CA, Jani BD, Demou E, Ho FK, Celis-Morales C, et al. Ethnic and socioeconomic differences in SARS-CoV-2 infection: prospective cohort study using UK Biobank. BMC Med. 2020;18:160. doi:10.1186/s12916-020-01640-8.

3. Figueroa JF, Wadhera RK, Mehtsun WT, Riley K, Phelan J, Jha AK. Association of race, ethnicity, and community-level factors with COVID-19 cases and deaths across U.S. counties. Healthc (Amst). 2020;9:100495. doi:10.1016/j.hjdsi.2020.100495.

4. Souza CDF de, Machado MF, do Carmo RF. Human development, social vulnerability and COVID-19 in Brazil: a study of the social determinants of health. Infect Dis Poverty. 2020;9:124. doi:10.1186/s40249-020-00743-x.

5. Whittle RS, Diaz-Artiles A. An ecological study of socioeconomic predictors in detection of COVID-19 cases across neighborhoods in New York City. BMC Med. 2020;18:271. doi:10.1186/s12916-020-01731-6.

6. Lieberman-Cribbin W, Tuminello S, Flores RM, Taioli E. Disparities in COVID-19 Testing and Positivity in New York City. Am J Prev Med. 2020;59:326–32. doi:10.1016/j.amepre.2020.06.005.

7. Price-Haywood EG, Burton J, Fort D, Seoane L. Hospitalization and Mortality among Black Patients and White Patients with Covid-19. N Engl J Med. 2020;382:2534–43. doi:10.1056/NEJMsa2011686.

8. Richardson S, Hirsch JS, Narasimhan M, Crawford JM, McGinn T, Davidson KW, et al. Presenting Characteristics, Comorbidities, and Outcomes Among 5700 Patients Hospitalized With COVID-19 in the New York City Area. JAMA. 2020;323:2052–9. doi:10.1001/jama.2020.6775.
9. Khalatbari-Soltani S, Cumming RC, Delpierre C, Kelly-Irving M. Importance of collecting data on socioeconomic determinants from the early stage of the COVID-19 outbreak onwards. J Epidemiol Community Health. 2020;74:620–3. doi:10.1136/jech-2020-214297.

10. Holuka C, Merz MP, Fernandes SB, Charalambous EG, Seal SV, Grova N, Turner JD. The COVID-19 Pandemic: Does Our Early Life Environment, Life Trajectory and Socioeconomic Status Determine Disease Susceptibility and Severity? Int J Mol Sci 2020. doi:10.3390/ijms21145094.

11. Mattos Dos Santos R. Isolation, social stress, low socioeconomic status and its relationship to immune response in Covid-19 pandemic context. Brain Behav Immun Health. 2020;7:100103. doi:10.1016/j.bbih.2020.100103.

12. Mikolai J, Keenan K, Kulu H. Intersecting household level health and socio-economic vulnerabilities and the COVID-19 crisis: An analysis from the UK. SSM Popul Health. 2020:100628. doi:10.1016/j.ssmph.2020.100628.

13. Kaiser JC, Stathopoulos GT. Socioeconomic correlates of the SARS-CoV 2 and Influenza H1N1 outbreaks. Eur Respir J 2020. doi:10.1183/13993003.01400-2020.

14. Leung JM, Niikura M, Yang CWT, Sin DD. COVID-19 and COPD. Eur Respir J 2020. doi:10.1183/13993003.02108-2020.

15. Guan W-J, Ni Z-Y, Hu Y, Liang W-H, Ou C-Q, He J-X, et al. Clinical Characteristics of Coronavirus Disease 2019 in China. N Engl J Med. 2020;382:1708–20. doi:10.1056/NEJMoa2002032.

16. Haybar H, Kazemnia K, Rahim F. Underlying Chronic Disease and COVID-19 Infection: A State-of-the-Art Review. Jundishapur J Chronic Dis Care 2020. doi:10.5812/jjcdc.103452.

17. Bauer CM, Morissette MC, Stämpfli MR. The Influence of Cigarette Smoking on Viral Infections. Chest. 2013;143:196–206. doi:10.1378/chest.12-0930.

18. Sunar L, Kaya Y, Otrar Y. Türkiye sosyoekonomik statü endeksi geliştirme projesi. 2016. https://app.trdizin.gov.tr/publication/project/detail/TVRVMk16WTI.

19. Prats-Uribe A, Paredes R, Prieto-Alhambra D. Ethnicity, comorbidity, socioeconomic status, and their associations with COVID-19 infection in England: a cohort analysis of UK Biobank data; 2020.

20. Galobardes B, Demarest S. Asking sensitive information: an example with income. Soz Praventivmed. 2003;48:70–2. doi:10.1007/s000380300008.

21. van Dom A, Cooney RE, Sabin ML. COVID-19 exacerbating inequalities in the US. The Lancet. 2020;395:1243–4. doi:10.1016/S0140-6736(20)30893-X.

22. Wang Z, Tang K. Combating COVID-19: health equity matters. Nat Med. 2020;26:458. doi:10.1038/s41591-020-0823-6.

23. Berkman LF, Kawachi I. Social epidemiology. Oxford: Oxford University Press; 2000.

24. Burström B, Tao W. Social determinants of health and inequalities in COVID-19. Eur J Public Health. 2020;30:617–8. doi:10.1093/eurpub/ckaa095.