Impact of Socioeconomic Inequalities on the Spread of COVID-19

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Abstract

Background

To examine the role of medical, economic and social inequalities affecting the prevalence of COVID-19 in Turkey.

Methods

This paper clarifies the medical and socio-economic factors affecting the prevalence of COVID-19 by using clinical and survey data in a binary probit model (BPM). Socio-economic factors affect the prevalence of COVID-19 to different degrees. Socio-economic variables are associated with risk of infection and can increase exposure to and mortality from COVID-19.

Results

The factors that increase the probability that a person will get COVID-19 are gender (males have a 9.4% higher probability), income, household work status, interacting with a COVID-19 case (31.4% higher), using public transportation (6.97% higher), and visiting a hospital (35.7% higher probability for individuals who visited a hospital) or a mosque (15.1% higher). The factors that decrease the probability of testing positive are smoking (14.3% lower for smokers), being employed, having a university education compared to no education (24.7% lower), and wearing gloves (15.4% lower).

Conclusion

In the case of Turkey, the estimations of the BPM show that economic and social variables are important factors for determining COVID-19 prevalence. Inequalities in socio-economic variables affect the prevalence to different degrees. Disparities in education and poverty are more important than being employed or being a smoker for the spread of COVID-19.

Background

According to the World Health Organization (WHO), as of March 15, 2021, there had been 120 383 919 confirmed cases of COVID-19 and 2 664 386 deaths reported globally, and a total of 363 691 238 vaccine doses had been administered. The WHO also confirmed that 291 162 confirmed cases and 29 623 deaths occurred for the same period in Turkey. Many countries introduced extensive and restrictive prevention measures and some countries, such as New Zealand and China, successfully controlled transmission with these measures. In Turkey, a number of restriction measures were taken: 1. Schools and universities were closed and education was continued online. 2. Curfews were imposed on individuals under 18 and over 65. 3. Cafes, restaurants, and hotels were closed, but the restaurants maintained their takeaway services. 4. Public services, except for hospitals, were either stopped or continued in a limited way. 5. Collective activities such as weddings, celebrations, and meetings were banned. 6. Markets and public bazaars remained open, but access was limited to a certain number of
people at any time together with compulsory mask wearing, hand sanitizing on entry, temperature measurement, and a limitation on the time allowed in the market. 7. Most factories remained open with adjustments to working hours, and restricted transportation conditions. 8. Restrictions on intercity transportation were imposed. 9. Mass religious activities such as Friday prayers were banned. However, transmission of COVID-19 continued despite all these measures. According to the Turkish Ministry of Health records, by May 2, 2020, there were a total of 58 209 laboratory-confirmed COVID-19 cases across the country.

Like other respiratory viruses, SARS-CoV-2 can be predicted to have a greater effect on individuals with lower income and socio-economic status. Overcrowded home conditions and insufficient hygiene may be affecting this situation further.

The COVID-19 pandemic has highlighted the worsening health and socio-economic inequalities in many countries, including Turkey. The impact of the pandemic has fallen uncontrollably on the most vulnerable people. Before the pandemic, inequality had already been reaching dramatic levels, and inequalities in the occupational, gender, educational, poverty, and unemployment levels have worsened with the COVID-19 pandemic. A higher risk of transmission is linked to overcrowded housing and an inability to self-isolate. Besides the medical factors, a number of social and economic parameters affect the spread of COVID-19 within the population. The pandemic has provided harsh lessons about the societal vulnerabilities that arise from inequality. Adopting an equity-focused approach to health services should be an essential part of building a better society that is well prepared to overcome the difficulties of a future pandemic.

A wide spectrum of indicators has been postulated to be associated with COVID-19 cases. However, the spread of the virus has been uneven in both prevalence and speed of propagation. Given the role of social factors in the spread of contagious diseases and the known demographic, economic and cultural differences in Turkey, it is important to analyse the contribution of such factors in the spread of COVID-19.

The relationship between COVID-19 and socio-economic indicators has been emphasized as one of the eight primary, urgent research topics in coronavirus studies in the WHO Blueprint published in February 2020. There are several socio-economic issues considered, such as the role of poverty, low income, and poor education. Empirical evidence from these studies suggests how the identification of potential indicators could aid in the formulation of targeted strategies to mitigate future health problems. In this study, ten socio-economic indicators were considered in association with COVID-19 cases in Izmir. At the time of the study there were approximately 500 people in İzmir Bozyaka Education and Training Hospital who had recovered from COVID-19. Socio-economic data were collected between May 2020 and July 2020 from the people treated by the clinic for COVID-19. Medical data for the same patients was taken from the electronic database of the Probel Hospital Information Management System (PHIMS) for the same period. Data were analysed using Stata 16 to estimate the generalized linear model (GLM), which was used to obtain the key socio-economic factors influencing COVID-19 prevalence and the speed.
of its propagation. Our research also examined the impact of employment status and poverty on the prevalence of COVID-19.

There are two main questions to be addressed in this research: what are the critical socio-economic determinants, and how much does each criterion contribute to the spread of disease?

**Methods**

Restrictive measures for the prevention of the spread of COVID-19 were implemented between March 15, 2020 and April 30, 2020 throughout Turkey. Our sample was a total of 560 patients who were hospitalized for COVID-19 during that period. Of these, 215 of were cases confirmed by the polymerase chain reaction (PCR) test while the others were clinically suspected cases who had typical clinical symptoms, including radiological lesions and other laboratory abnormalities, and were treated as being COVID-19-positive.

To avoid obvious bias, health care workers and Umrah visitors were excluded due to the known route of transmission. Of the 215 PCR-positive patients, 175 survived and were accessible; these were included in the study as a COVID-19-positive group. An equal number of individuals, who had a negative PCR test, had not been hospitalized, and had not been suspected of having COVID-19, were randomly selected from hospital and PHIMS records as a COVID-19-negative group. The total number of patients who completed the questionnaire about the socio-economic parameters was 350.

The questionnaire included ten demographic questions: age, gender, marital status, education level, income, smoking status, alcohol use, employment status, and whether any employed people shared accommodation with the respondent. Six questions were about transmission activities: contact with people with COVID-19, use of public transport, hospital visits, going to mosque, shopping in a public bazaar or supermarket, and visiting friends and neighbours. Four questions were about personal protective measures: mask, hand hygiene, social distancing, and going out activities. Finally, four questions were about workplace activities (for those respondents who were employed): means of transport, contact with COVID-19 infection at work, workplace preventive measures, and own precautions after work.

In the BPM model (1), shows the probability of catching COVID-19, is the logistic cumulative distribution function, and are the independent variables. The independent variables chosen can be grouped into three categories: demographic and socio-economic factors, factors related to transmission routes, and factors related to precautionary measures.

\[
\Pr(COVID_i = 1|X_i) = \Lambda(\alpha_i + \beta_1x_i)
\]  \hspace{1cm} (1)

The first group of factors we chose are common in the infectious disease literature. These are age, gender, education, marital status, income, smoking, alcohol use, and employment status of the patient and others in the same household.
Table 1 shows the prevalence of COVID-19 by baseline characteristics of the sample. In the oldest group (65 years and older) and the youngest group (24 years and younger), 67.86% and 47.22% tested positive, respectively. The percentages of males (51%) and females (49%) who tested positive are similar. Most of the cases who tested positive have only compulsory education (118 cases), are unemployed (106 cases), earn minimum wage (111 cases), are married (142 cases), do not use alcohol (157 cases), and do not smoke (131 cases).

Table 1: Prevalence of COVID-19, by patient type
| AGE    | COVID-19 | Total | COVID-19 | Total |
|--------|----------|-------|----------|-------|
|        | Negative | Positive |           |       |
| 0-24   | 19       | 17     | 36       | No education | 8  | 7     | 15 |
|        | 52.78    | 47.22  | 100      |           | 53.33 | 46.67 | 100 |
| 25-34  | 30       | 40     | 70       | Compulsory educ. | 72 | 118   | 190 |
|        | 42.86    | 57.14  | 100      |           | 37.89 | 62.11 | 100 |
| 35-44  | 56       | 43     | 99       | High school | 47 | 32    | 79 |
|        | 56.57    | 43.43  | 100      |           | 59.49 | 40.51 | 100 |
| 45-54  | 34       | 36     | 70       | University | 48 | 17    | 65 |
|        | 48.57    | 51.43  | 100      |           | 73.85 | 26.15 | 100 |
| 55-64  | 27       | 20     | 47       | Total     | 175 | 174   | 349 |
|        | 57.45    | 42.55  | 100      |           | 50.14 | 49.86 | 100 |
| 65+    | 9        | 19     | 28       | EMPLOYMENT |       |       |     |
|        | 32.14    | 67.86  | 100      | Unemployed | 82 | 106   | 188 |
| Total  | 175      | 175    | 350      |           | 43.62 | 56.38 | 100 |
|        | 50.00    | 50.00  | 100      | Employed  | 93 | 69    | 162 |
| GENDER |          |        |          |           | 57.41 | 42.59 | 100 |
| Female | 85       | 81     | 166      | Total     | 175 | 175   | 350 |
|        | 51.20    | 48.80  | 100      |           | 50.00 | 50.00 | 100 |
| Male   | 90       | 94     | 184      | ALCOHOL   |       |       |     |
|        | 48.91    | 51.09  | 100      | No        | 133 | 157   | 290 |
| Total  | 175      | 175    | 350      |           | 45.86 | 54.14 | 100 |
|        | 50.00    | 50.00  | 100      | Yes       | 41 | 18    | 59 |
| MARITAL STATUS | | | | | 69.49 | 30.51 | 100 |
| Single | 61       | 33     | 94       | Total     | 174 | 175   | 349 |
|        | 64.89    | 35.11  | 100      |           | 49.86 | 50.14 | 100 |
| Married| 114      | 142    | 256      | SMOKE     |       |       |     |
|        | 44.53    | 55.47  | 100      | No        | 80 | 131   | 211 |
The second group of factors captures the common transmission routes such as close/direct contact with a COVID-19 case, visiting friends and/or family, going to the hospital, going to a mosque, shopping (at a local market or shopping centre), and using public transport.

Table 2 demonstrates the major channels of transmission. In our sample, 95 people who tested positive were in close contact with a COVID-19 case. Risk of infection also goes up in public places. Most of the positive cases visited a hospital (136 cases) and went shopping (110 cases). Of the 144 people who used public transport, 81 tested positive (56%). Of the 24 people who visited a mosque, 21 tested positive (88%). Of people who visited family and/or friends, 71% tested positive for COVID-19[1].

Table 2: Prevalence of COVID-19, by transmission route

|                      | 175 | 175 | 350 | 37.91 | 62.09 | 100 |
|----------------------|-----|-----|-----|-------|-------|-----|
| **Total**            |     |     |     |       |       |     |
| **INCOME**           |     |     |     |       |       |     |
| Yes                  | 94  | 44  | 138 | 68.12 | 31.88 | 100 |
| **No income**        | 25  | 11  | 36  | 69.44 | 30.56 | 100 |
|                      | 69.44| 30.56|100|**Total**|174|175|349|
| **<min wage**        |     |     |     |       |       |     |
|                      | 13  | 22  | 35  | 37.14 | 62.86 | 100 |
| **min wage**         | 67  | 111 | 178 | 37.64 | 62.36 | 100 |
|                      | 37.64| 62.36|100|**Total**|113|85|198|
| ≥2x min wage         | 52  | 24  | 76  | 68.42 | 31.58 | 100 |
|                      | 68.42| 31.58|100|**Total**|62|85|147|
| ≥3x min wage         | 16  | 7   | 23  | 69.57 | 30.43 | 100 |
|                      | 69.57| 30.43|100|**Total**|175|170|345|
| **Total**            | 173 | 175 | 348 | 49.71 | 50.29 | 100 |

Table 2: Prevalence of COVID-19, by transmission route
| Contact Covid-19 | Negative | Positive | Total | Hospital | Negative | Positive | Total |
|-----------------|----------|----------|-------|----------|----------|----------|-------|
| No              | 153      | 77       | 230   | No       | 70       | 34       | 104   |
|                 | 66.52    | 33.48    | 100   |          | 67.31    | 32.69    | 100   |
| Yes             | 21       | 95       | 116   | Yes      | 105      | 136      | 241   |
|                 | 18.10    | 81.90    | 100   |          | 43.57    | 56.43    | 100   |
| Total           | 174      | 172      | 346   | Total    | 175      | 170      | 345   |
|                 | 50.29    | 49.71    | 100   |          | 50.72    | 49.28    | 100   |

| Public transport | MOSQUE | VISIT |
|------------------|--------|-------|
| No               | 111    | 52    |
|                  | 89     | 63    |
|                  | 200    | 115   |
|                  | 55.50  | 45.22 |
|                  | 44.50  | 54.78 |
|                  | 100    | 100   |
| Yes              | 63     | 123   |
|                  | 81     | 110   |
|                  | 144    | 233   |
|                  | 43.75  | 52.79 |
|                  | 56.25  | 47.21 |
|                  | 100    | 100   |
| Total            | 174    | 175   |
|                  | 170    | 173   |
|                  | 344    | 348   |
|                  | 50.58  | 50.29 |
|                  | 49.42  | 49.71 |
|                  | 100    | 100   |
|                  | 50.29  | 50.29 |
|                  | 49.71  | 49.71 |
|                  | 100    | 100   |

1 Although not reported here, none of the people in the sample performed Umrah, and only two people visited relatives who performed Umrah.

The third group of factors control for the risk of exposure and spread of COVID-19 and are related to precautionary behaviours such as going outdoors, wearing gloves and masks, using sanitizers, and
maintaining a safe distance (social distance).

Table 3 reports whether the people in the sample took protective measures to reduce the risk of getting COVID-19. Most people reported that they kept social distance while outdoors (332 out of 341), wore masks (338 out of 342), and used sanitizers (324 out of 340).

**Table 3:** Prevalence of COVID-19, by precautionary behaviour
|                | WENT OUT |                | MASK |                |     |
|----------------|----------|----------------|------|----------------|-----|
|                | Negative | Positive       | Total| Negative       | Total|
| No             | 10       | 10             | 20   | 3              | 4   |
|                | 50.00    | 50.00          | 100  | 75.00          | 25.00| 100|
| Yes            | 165      | 159            | 324  | 172            | 166  | 338|
|                | 50.93    | 49.07          | 100  | 50.89          | 49.11| 100|
| Total          | 175      | 169            | 344  | Total          | 175  | 167| 342|
|                | 50.87    | 49.13          | 100  | 51.17          | 48.83| 100|

|                | GLOVES   |                | SANITIZER |                |     |
|----------------|----------|----------------|------------|----------------|-----|
|                | Negative | Positive       | Total      | Negative       | Total|
| No             | 83       | 134            | 217        | 13             | 3   | 16|
|                | 38.25    | 61.75          | 100        | 81.25          | 18.75| 100|
| Yes            | 92       | 32             | 124        | 161            | 163  | 324|
|                | 74.19    | 25.81          | 100        | 49.69          | 50.31| 100|
| Total          | 175      | 166            | 341        | Total          | 174  | 166| 340|
|                | 51.32    | 48.68          | 100        | 51.18          | 48.82| 100|

| SOCIAL DISTANCE |     |     |     |
|-----------------|-----|-----|-----|
| No              | 8   | 1   | 9   |
|                 | 88.89 | 11.11 | 100|
| Yes             | 167  | 165 | 332 |
|                 | 50.30 | 49.70 | 100|
| Total           | 175  | 166 | 341 |
|                 | 51.32 | 48.68 | 100|

Results

We used Stata 14.2 to estimate the logit model. Table 4 reports our results. The first column shows the coefficients of the logit model, the second column shows average marginal effects (AMEs), and the third column shows the odds ratios.
| VARIABLES                  | Coefficients | Average Marginal Effects | Odds ratio (OR) | 95% Confidence Interval (OR) |
|----------------------------|--------------|--------------------------|----------------|-----------------------------|
|                            | (1)          | (2)                      | (3)            |                              |
| Age                        | -0.0051      | -0.000555                | 0.9949         | 0.9665–1.0241                |
|                            | (0.0148)     | (0.00160)                | (0.0147)       |                              |
| Gender (Male)              | 0.8816**     | 0.0940**                 | 2.4148**       | 1.0499–5.5541                |
|                            | (0.4250)     | (0.0435)                 | (1.0262)       |                              |
| Marital status (Married)   | -0.3317      | -0.0353                  | 0.7177         | 0.2953–1.7441                |
|                            | (0.4531)     | (0.0472)                 | (0.3251)       |                              |
| Alcohol (Yes)              | -0.0819      | -0.00889                 | 0.9214         | 0.3244–2.6171                |
|                            | (0.5326)     | (0.0580)                 | (0.4908)       |                              |
| Smoke (Yes)                | -1.2251***   | -0.143***                | 0.2937***      | 0.1257–0.6862                |
|                            | (0.4329)     | (0.0505)                 | (0.1272)       |                              |
| Employment (Employed)      | -1.1336**    | -0.122**                 | 0.3219**       | 0.1269–0.8166                |
|                            | (0.4750)     | (0.0494)                 | (0.1529)       |                              |
| Education (Compulsory)     | -0.1993      | -0.0225                  | 0.8193         | 0.1284–5.2277                |
|                            | (0.9455)     | (0.107)                  | (0.7747)       |                              |
| Education (High school)    | -1.0304      | -0.117                   | 0.3569         | 0.0476–2.6755                |
|                            | (1.0278)     | (0.116)                  | (0.3668)       |                              |
| Education (University)     | -2.2474**    | -0.247**                 | 0.1057**       | 0.0131–0.8548                |
|                            | (1.0666)     | (0.116)                  | (0.1127)       |                              |
| Income (< min wage)        | 0.3410       | 0.0379                   | 1.4064         | 0.3053–6.4791                |
|                            | (0.7794)     | (0.0868)                 | (1.0961)       |                              |
| Income (min wage)          | 1.2162*      | 0.138*                   | 3.3745*        | 0.9591–11.8733               |
|                            | (0.6419)     | (0.0713)                 | (2.1660)       |                              |
| Income (≥ 2x min wage)     | 0.3772       | 0.0420                   | 1.4582         | 0.3283–6.4772                |

Standard errors in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1
| VARIABLES                                      | Coefficients  | Average Marginal Effects | Odds ratio (OR) | 95% Confidence Interval (OR) |
|------------------------------------------------|---------------|--------------------------|-----------------|----------------------------|
| (≥ 3x min wage)                               | (0.7608)      | (0.0841)                 | (1.1094)        |                            |
| Income (≥ 3x min wage)                        | 1.2832        | 0.145                    | 3.6081          | 0.4817–27.0247             |
| (1.0274)                                      | (0.115)       | (3.7068)                 |                 |                            |
| House Share with worker (Yes)                 | 1.5468***     | 0.168***                 | 4.6965***       | 2.0784–10.6126            |
| (0.4159)                                      | (0.0415)      | (1.9535)                 |                 |                            |
| Contact Covid-19 (Yes)                        | 2.8996***     | 0.314***                 | 18.1674***      | 7.1520-46.1487            |
| (0.4756)                                      | (0.0393)      | (8.6412)                 |                 |                            |
| Public transport (Yes)                        | 0.6436*       | 0.0697*                  | 1.9032*         | 0.9009–4.0209             |
| (0.3816)                                      | (0.0407)      | (0.7263)                 |                 |                            |
| Shopping (Yes)                                | -2.5187***    | -0.273***                | 0.0806***       | 0.0273–0.2381             |
| (0.5529)                                      | (0.0520)      | (0.0445)                 |                 |                            |
| Hospital (Yes)                                | 3.2980***     | 0.357***                 | 27.0577***      | 7.8792–92.9181            |
| (0.6295)                                      | (0.0566)      | (17.0321)                |                 |                            |
| Mosque (Yes)                                  | 1.3967*       | 0.151*                   | 4.0417*         | 0.8426–19.3876            |
| (0.8000)                                      | (0.0851)      | (3.2334)                 |                 |                            |
| Visit (Yes)                                   | 0.6144        | 0.0665                   | 1.8485          | 0.7705–4.4344             |
| (0.4465)                                      | (0.0477)      | (0.8253)                 |                 |                            |
| Went out (Yes)                                | 0.1675        | 0.0181                   | 1.1823          | 0.2630–5.3159             |
| (0.7670)                                      | (0.0830)      | (0.9068)                 |                 |                            |
| Mask (Yes)                                    | -11.2352      | -1.216                   | 0.0000          | 0.0000 - .                |
| (903.8269)                                    | (97.86)       | (0.0119)                 |                 |                            |
| Social distance (Yes)                         | 11.5758       | 1.253                    | 106,485.5587    | 0.0000 - .                |
| (903.8247)                                    | (97.86)       | (9.6244e + 07)           |                 |                            |
| Gloves (Yes)                                  | -1.4181***    | -0.154***                | 0.2422***       | 0.1117–0.5253             |
| (0.3950)                                      | (0.0396)      | (0.0957)                 |                 |                            |

Standard errors in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1
| VARIABLES       | Coefficients | Average Marginal Effects | Odds ratio (OR) | 95% Confidence Interval (OR) |
|-----------------|--------------|--------------------------|-----------------|-----------------------------|
| Sanitizer (Yes) | 2.2164**     | 0.240**                  | 9.1744**        | 1.1575–72.7141              |
|                 | (1.0562)     | (0.112)                  | (9.6900)        |                             |
| Constant        | -3.8897*     | 0.0205*                  | 0.0003–1.5037   |                             |
|                 | (2.1927)     | (0.0448)                 |                 |                             |
| Observations    | 325          | 325                      | 325             |                             |
| Pseudo R-squared| 0.507        | 0.507                    |                 |                             |

Standard errors in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1

With the AMEs, a marginal effect is computed for each case, and then all the computed effects are averaged. Therefore, AMEs express the average effect of an independent variable $x_i$ on $P(y=1)$. For categorical independent variables, marginal effects show how $P(y=1)$ changes as the categorical variable changes from 0 to 1, after controlling for the other variables in the model.\(^{11}\)

AMEs in column (2) reveal that the factors that increase the probability that a person will get COVID-19 are gender, income, household work status, interacting with a COVID-19 case, using public transportation, and visiting a hospital or a mosque. The factors that decrease the probability of testing positive are smoking (14.3% lower for smokers), being employed, having a university education compared to no education (24.7% lower), and wearing gloves (15.4% lower).

We find that male individuals have a 9.4% higher probability of getting COVID-19, which is in agreement with other studies that show that being male is a high-risk factor.\(^ {12,13}\)

Three major transmission modes contribute to viral transmission of the COVID-19 disease. These are airborne transmission, contact (with contaminated surfaces), and droplets. Crowded and poorly ventilated places are amongst the most important exposure environments.\(^ {14}\) Looking at transmission, visiting a hospital seems to have the highest risk factor (35.7% higher probability for individuals who visited a hospital), followed by contacting a COVID-19 case (31.4% higher), visiting a mosque (15.1% higher), and using public transportation (6.97% higher). Shopping seems to be negatively associated with COVID-19 infection, but we believe this is due to a limitation of the data. Table 2 shows that, of the 233 people who went shopping, 53% tested negative.

Looking at the impacts of precautionary behaviour, we find that wearing gloves is an effective physical intervention against disease transmission. A surprising result is seen for using sanitizers, but in our sample 324 people out of 340 reported to use sanitizers (Table 3). Therefore, it is not possible to estimate the true impact of this preventive measure in our analysis.
Smoking and alcohol use are common health risk factors. We do not find any evidence of a negative impact of alcohol use. Smoking is generally considered detrimental to the immune system, making the patients more vulnerable to infectious diseases. However, the literature on the role of smoking on COVID-19 does not reach a consensus. In a systematic review of five studies based on Chinese patients, it was concluded that smokers show more severe symptoms. However, another review study found that smoking is not associated with severity of the disease in China. Another study found that smokers have a lower risk of confirmed COVID-19 compared to non-smokers, based on data from French patients. The authors argue that there could be a rebound effect for smokers as nicotine receptors are released due to nicotine withdrawal at the time of hospitalization, which explains why other studies find a negative association between smoking and COVID-19 severity. Our results also support the findings in this study.

Socio-economic variables are also associated with risk of infection and can increase exposure to and mortality from COVID-19. People with low socio-economic status are more likely to live in poor housing conditions and are more likely to work in unstable jobs and have less access to healthcare services. In addition, during the pandemic, some sectors allowed work from home, but this is mostly possible for high-income individuals. Lower-income individuals are more likely to work in occupations that are less amenable to remote working, and they face more health risks and a greater risk of exposure to COVID-19. In our sample, lower-income individuals (whose income is equal to the minimum wage) have a 13.8% higher probability of contracting the disease compared to those who have no income. In addition, the probability increases by 16.8% if someone in the household works.

However, our results also suggest that employed people have a lower probability of infection. There could be a number of explanations for this. First, sample characteristics is an important factor. In our sample, 162 individuals out of 350 were working full-time and were defined as ‘employed’. Of these, less than half (43%) tested positive. Unemployed people include those who do not have a job (20 individuals), students (11 individuals), homemakers (90 individuals), retired (47 individuals), and people who were laid-off after the pandemic (20 individuals). Of the homemakers and people laid-off, 60% tested positive and 60% of retirees tested positive.

Second, it is possible that employed people behave more cautiously against the risk of infection. The survey also included questions regarding workplace precautions. The response rate to these questions was not high. Table 5 shows that most of the individuals who responded to work-related questions tested negative. Only 5 of them reported that their workplace did not follow the recommended precautions to protect the health and safety of workers. In our sample, 59 respondents used public transportation to commute to work and 59% of these tested negative. There were not many COVID-19 cases at the workplaces (42 reported “yes”). Lastly, 150 individuals out of 153 said that they took appropriate precautions against infection after they left their workplace.
### Table 5
Prevalence of COVID-19, by workplace precautions

| Workplace precautions | COVID-19 Negative | COVID-19 Positive | Total | COVID-19 case at work | Total |
|-----------------------|------------------|-------------------|-------|-----------------------|-------|
| No                    | 5                | 0                 | 5     | No                    | 77    |
|                       | 100              | 0.00              | 100   | 40                    | 117   |
| Limited               | 7                | 8                 | 15    | 65.81                 | 34.19 |
|                       | 46.67            | 53.33             | 100   | Yes                   | 19    |
|                       | 19               | 23                | 42    |                       |       |
| Yes                   | 85               | 59                | 144   | 45.24                 | 54.76 |
|                       | 59.03            | 40.97             | 100   | Total                 | 96    |
|                       | 59.03            | 40.97             | 100   | Total                 | 96    |
| Total                 | 97               | 67                | 164   | 60.38                 | 39.62 |
|                       | 59.15            | 40.85             | 100   | Own precautions       |       |
| Transport to work     |                  | No                | 3     | 3                     | 3     |
| Shuttle               | 16               | 12                | 28    | 0.00                  | 100.00|
|                       | 57.14            | 42.86             | 100   | Yes                   | 96    |
| Public transport      | 35               | 24                | 59    | 64.00                 | 36.00 |
|                       | 59.32            | 40.68             | 100   | Total                 | 96    |
| Personal car          | 43               | 20                | 63    | 62.75                 | 37.25 |
|                       | 68.25            | 31.75             | 100   |                       |       |
| Walking               | 1                | 3                 | 4     |                       |       |
|                       | 25.00            | 75.00             | 100   |                       |       |
| Total                 | 95               | 59                | 154   |                       |       |
|                       | 61.69            | 38.31             | 100   |                       |       |

**Discussion**

Disparities in socio-economic factors affect the prevalence of COVID-19 to different degrees. Socio-economic variables are associated with risk of infection and can increase exposure to, and mortality from, COVID-19. The factors that increase the probability that a person will get COVID-19 are gender,
income, household work status, interacting with a COVID-19 case, using public transportation, and visiting a hospital or a mosque. The factors that decrease the probability of testing positive are smoking, being employed, having a university education compared to no education, and wearing gloves. It has been suggested that there could be a rebound effect for smokers as nicotine receptors are released due to nicotine withdrawal at the time of hospitalization, which explains why our study and some other studies find a negative association between smoking and COVID-19 severity.\textsuperscript{17}

**Conclusion**

In the case of Turkey, the estimations of the BPM show that economic and social variables are important factors for determining COVID-19 prevalence. Inequalities in socio-economic variables affect the prevalence to different degrees. Disparities in education and poverty are more important than being employed or being a smoker for the spread of COVID-19.

**Declarations**

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**Conflict of interest**

The authors declare that they have no conflict of interest.

**Ethical approval and consent to participate**

The study was approved by Bozyaka Education and Research Hospital Ethical Committee of the University of Health Sciences. All methods were performed in accordance with the relevant guidelines and regulations. Written informed consent was obtained from all of the participants during the survey.

**Consent for publication**

Not applicable

**Availability of data and material**

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

Not applicable

Authors' contributions DÖ, AA and ST designed the study, HÖÖ and FNKK analysed the data. All authors read and approved the manuscript.

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