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The Association between Sociodemographic Factors, Lifestyle Score, and Body Mass Index with COVID-19 Infection: A Cross-Sectional Study

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Abstract

Background: *The coronavirus disease 2019 (COVID-19) pandemic is a global health crisis; therefore, the prevention and treatment of this disease is a top priority for health worldwide. COVID-19 infection has been associated with various factors. This study aimed to examine the correlations between COVID-19 infection and various sociodemographic factors, lifestyle score, and obesity.*

Methods: *The present study was a cross-sectional study. Data were collected from students of the Shahroud University of Medical Sciences in 2021. The outcome measures were body mass index (BMI), sociodemographic factors, and lifestyle score, which was evaluated with a validated Walker questionnaire. Logistic regression was employed to investigate the associations between exposure variables and COVID-19 infection.*

Results: *Data from 382 students (43.71% infected with COVID-19) were analyzed. After adjusting for covariates, obese participants were 73% more likely to have COVID-19 infection than participants with normal body weights (OR=1.73; 95% CI: 0.25, 3.22; P-value=0.022). A strong lifestyle score was associated with 8% reduced likelihood of COVID-19 infection compared with a moderate lifestyle score (OR=0.92; 95% CI: 0.86, 0.98; P-value=0.04).*

Conclusions: *Our study revealed that increasing lifestyle score and reducing obesity may be helpful in the prevention of COVID-19 infection. Further research must validate this possible association.*

Keywords: COVID-19, Obesity, Lifestyle, Sociodemographic factors.
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Introduction

Coronavirus disease 2019 (COVID-19), a severe illness caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), initially emerged in Wuhan, China, at the end of 2019. This condition has since evolved into a significant global economic, social, and health crisis[1]. According to the World Health Organization (WHO), over 771 million confirmed cases of COVID-19 and more than 7 million related deaths have been recorded worldwide[2]. In Iran, the first case was reported on February 20, 2020. By June 27, 2024, the Ministry of Health and Medical Education of the Republic of Iran reported over 7,612,530 confirmed cases and more than 146,295 deaths, highlighting the severity of the disease.

The World Health Organization (WHO) has declared COVID-19 a global pandemic that is influenced by various factors, such as lifestyle factors, sociodemographic indices, and genetic components[3–7]. Multiple studies have established a connection between sociodemographic and behavioral variables and an increased risk of contracting COVID-19[8,9]. Factors such as age, sex, ethnicity, education, socioeconomic status, and chronic diseases (e.g., hypertension, obesity, and diabetes) are associated with COVID-19[10,11]. Emerging research indicates that lifestyle factors, particularly dietary patterns, might play a role in reducing disease severity through their anti-inflammatory and immune-modulating effects[12,13].

The ongoing and extensive impact of the COVID-19 pandemic, along with the appearance of new virus variants, underscores the necessity of examining various factors, such as obesity, that affect COVID-19 susceptibility and outcomes. This is particularly crucial for the Iranian population, which faces a significant burden of overweight and obesity, with a prevalence of up to 70%[8,14].

According to past research, overweight and obesity are linked to higher rates of infection, mortality, and hospitalization from COVID-19[15–18]. This correlation extends to other respiratory viruses, such as influenza, where obesity has been associated with increased hospitalization, longer mechanical ventilation duration, and higher mortality rates[19,20]. Studies indicate that obesity heightens vulnerability to infections and serves as a risk factor for COVID-19 mortality[21]. Excessive adiposity negatively affects pulmonary function, contributing to viral pathogenesis, particularly in older obese individuals (>60 years)[22,23]. Research also showed that younger individuals had a significantly lower risk of severe COVID-19 infection[24]. However, young obese individuals hospitalized with COVID-19 are more likely to experience adverse outcomes [17]. Various factors, such as well-being[25], physical activity[26], weight loss[27], comorbidities[28], nutrition[29], and physical inactivity[30], influence obesity and COVID-19 infection risk independent of age and sex.

Therefore, the present study aimed to evaluate the associations of lifestyle factors, sociodemographic factors, and BMI with COVID-19. As Iranian students, it is hoped to contribute to a deeper understanding of these relationships to identify potential strategies for COVID-19 prevention and control.

Materials and Methods

The present study was a single-center, cross-sectional study. In the present study, data were collected from students at Shahroud University of Medical Sciences via systematic random sampling (based on gender and field of study) from May to August 2021. The study was approved by the ethics committee of Shahroud University of Medical Sciences (IR SHMU.REC.1400.122). All participants signed informed consent prior to participation. The students' privacy was maintained via an anonymous identification code, and the electronic data were securely stored on a locked, password-protected computer. The inclusion criteria were as follows: (1) positive real-time reverse transcriptase–polymerase chain reaction (RT–PCR) or rapid antigen test results for nasopharyngeal or oropharyngeal swab samples from participants with COVID-19; (2) studying at Shahroud University of Medical Sciences; and (3) provided consent to participate in the study.

Upon recruitment, the students are invited to participate in this study. The primary data included sociodemographic data, and lifestyle score was collected through questionnaires. Anthropometric indicators were measured**.** First, the students consented to participate in the project and then completed the questionnaires by answering the questions asked by the professional interviewer.

The sociodemographic information questionnaire included age, sex, marital status, academic semester, grade point average, place of residence, household size, parents' education level, income, place of residence (rural or urban), level of compliance with health protocols, infection with COVID-19 by RT-PCR, infection of close contacts with COVID-19, and smoking.

lifestyle score was evaluated via the Walker Health Promotion Lifestyle Questionnaire, the validity of which has been previously established[31]. This questionnaire consists of 54 questions and 6 main dimensions, each measured by several questions: proper dietary pattern and food choices (9 items), physical activity (8 items), health responsibility (preventive measures and taking responsibility for one's health (9 items), stress management (7 items), interpersonal relations (9 items), and self-actualization (featuring a sense of purpose, seeking personal growth, and experiencing self-awareness and satisfaction (12 items)). The questionnaire is scored on a four-point Likert scale ranging from 1 (never) to 4 (always). The minimum possible lifestyle score was 54, and the maximum was 216, with a score between 54 and 90 considered a weak lifestyle. A score between 90 and 135 was considered a moderate lifestyle, and a score above 135 was considered a strong lifestyle.

Anthropometric assessments, including standing height and body weight, were conducted upon admission while the subjects wore light clothing and no shoes. Height was measured with an accuracy of 0.1 cm, and weight was measured with an accuracy of 0.1 kg. BMI was calculated by dividing weight by the square of height (kg/m²). According to the World Health Organization, BMI classifications are as follows: underweight (BMI<18.5 kg/m²), normal weight (BMI 18.5–24.9 kg/m²), overweight (BMI 25.0–29.9 kg/m²), and obese (BMI≥30 kg/m²)[32].

Before data analysis, the normality of the distribution was assessed via the Kolmogorov–Smirnov test. Quantitative variables are presented as the means (standard deviations), and categorical variables are presented as frequencies (percentages). To assess within-group and between-group differences, paired and independent sample t-tests were utilized, whereas qualitative data were analyzed via the chi-square test. Logistic regression was employed to investigate the associations between exposure variables and COVID-19 infection. Three models were used for the primary analysis and for calculating the odds ratio (OR) with a 95% confidence interval (CI). For the BMI, Model 1 was adjusted for age and sex, Model 2 included additional adjustments for age, sex, and lifestyle score, and Model 3 included additional adjustments for age, sex, lifestyle score, parents' education level, income, and infection of close contacts with COVID-19. For the lifestyle score, Model 1 was adjusted for age and sex; Model 2 included additional adjustments for age, sex, and BMI; and Model 3 included additional adjustments for age, sex, BMI, parents' education level, income, and infection of close contacts with COVID-19. Statistical significance was set at P-value<0.05, and all analyses were performed via SPSS version 25.

Results

The study recruitment goal was 440 students or approximately 22% of the students. Among the 440 students contacted by the researchers, 58 were withdrawn from the study because they were not eligible for our study (25 individuals whose coronavirus test results were not confirmed via PCR or rapid antigen test) and refused to participate (33 individuals). The final study group included 382 students (86.81%) (Figure 1).

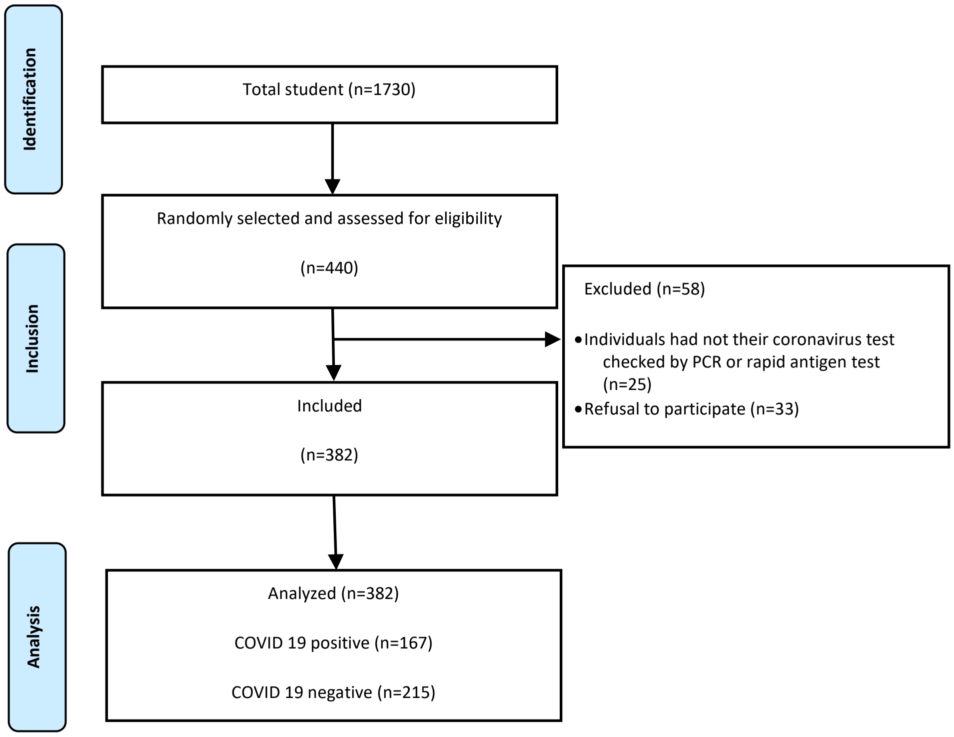

Figure 1. Flow chart of the identification of the included participants

Table 1 shows the baseline sociodemographic data and characteristics of 382 participants (167 with COVID-19 infection and 215 without COVID-19 infection). Additionally, the relationships between the parameters and COVID-19 infection are presented. The mean age of the students was 21.86±3.24 years. Most of the participants were female (57.1%), single (91.6%), urban (93.2%), had a low level of parents' education (66%), and had normal BMI (53.14%).

Descriptive analysis revealed that individuals with COVID-19 infection were older (P-value=0.004), married (0.01), had lower parental education levels (P-value=0.006), and were more likely to have close contacts with COVID-19 infection (P-value<0.001) than individuals without COVID-19 infection. There was no significant difference between the two groups in terms of sex, academic semester, income, place of residence, household size, level of compliance with health protocols, grade point average, or smoking status (P-value>0.05). There was no a statistically significant association between BMI and COVID-19 infection (P-value>0.05). No associations were found between lifestyle, nutrition, stress, physical activity, health responsibility, interpersonal relationships, or self-actualization scores and COVID-19 infection (P-value>0.05, Table 1).

Table 1. Baseline characteristics of study population and association of sociodemographic factors, body mass index, and lifestyle score with COVID-19

		Total N=382	Without COVID-19 N=215 (56.28%)	With COVID-19 N=167 (43.71%)	P-value
Age (years, Mean±SD)		21.86±3.24	21.44±2.52	22.41±3.93	0.004
Gender	Male	164 (42.9%)	93 (56.7%)	71 (43.3%)	0.97
	Female	218 (57.1%)	122 (56%)	96 (44%)	
Marital status	Single	350 (91.6%)	205 (58.6%)	145 (41.4%)	0.01
	Married	32 (8.4%)	10 (41.4%)	22 (58.6%)	
Academic semester (Mean±SD)		4.56±2.53	4.36±2.27	4.82 ±2.71	0.085
Grade point average (Mean±SD)		16.97±1.20	17.23±1.25	16.91±1.13	0.901
Household size (Mean±SD)		4.44±1.1	4.49±1.17	1.003±4.37	0.294
Parents' education level	Low	253 (66%)	140 (36%)	113 (29.5%)	0.006
	Medium	95 (24.8%)	51 (53.7%)	44 (46.3%)	
	High	34 (8.9%)	24 (6.3%)	10 (2.6%)	
Income	Low	179 (46.98%)	111 (62%)	68 (38%)	0.084
	Medium	120 (31.49%)	63 (52.5%)	57 (47.5%)	
	High	82 (21.52%)	40 (48.8%)	42 (51.2%)	
Place of residence	Rural	26 (6.8%)	15 (57.7%)	11 (42.3%)	0.881

	Urban	356 (93.2%)	200(56.2%)	156 (43.8%)	
Level of compliance with health protocols	Low	13(3.4%)	8 (61.5%)	5 (38.5%)	0.136
	Medium	186 (48.69%)	95(51.1%)	9 (48.9%)	
	High	183 (47.90%)	112 (61.2%)	71 (38.8%)	
Infection of close contacts with COVID-19	Low	13 (3.4%)	8 (61.5%)	5 (38.5%)	<0.001
	Medium	186 (48.69%)	95 (51.1%)	9 (48.9%)	
	High	183 (47.90%)	112 (61.2%)	71 (38.8%)	
Smoking	Yes	7 (1.83%)	3 (1.39%)	4 (2.39%)	0.845
	No	375 (98.16%)	212 (98.60%)	163 (97.60%)	
BMI categories	Underweight	56 (14.65%)	33 (58.92%)	23 (41.07%)	0.100
	Normal	203 (53.14%)	146 (71.9%)	38 (28.1%)	
	Overweight	79 (20.68%)	29 (36.7%)	50 (63.3%)	
	Obese	44 (11.5%)	7 (15.9%)	37 (84.1%)	
Lifestyle score	Moderate level	201 (52.61%)	115 (57.21%)	86 (42.7%)	0.639
	Strong level	181 (47.38%)	100 (55.2%)	81 (44.8%)	
Nutrition score (Mean±SD)		19.47±3.79	19.53±3.82	19.40±3.76	0.742
Physical activity score (Mean±SD)		17.71±5.75	17.58±5.40	17.88±5.55	0.614
Stress score (Mean±SD)		13.54±3.04	13.54±3.07	13.53±3.01	0.606
Health responsibility score (Mean±SD)		31.68±6.28	31.52±6.30	31.89±6.26	0.566
Interpersonal relations score (Mean±SD)		21.31±3.85	21.44±3.92	21.14± 3.77	0.447
Self-actualization score (Mean±SD)		31.43±5.48	31.73±5.79	31.05 ±5.04	0.236

After adjusting for covariates, such as BMI and lifestyle score, a statistically significant association of COVID-19 infection with obesity and lifestyle score was found (Tables 2 & 3). When the normal BMI category was used as a reference group, obese participants were 71% more likely to have COVID-19 infection after adjusting for covariates (OR=1.73; 95% CI: 0.25, 3.22; P-value=0.022). No associations were found between other BMI levels and COVID-19 infection (Table 2). A strong lifestyle score was associated with an 8% reduced likelihood of COVID-19 infection compared with a moderate lifestyle score (OR=0.92; 95% CI: 0.86, 0.98; P-value=0.04) in the fully adjusted model (Table 3).

Table 2. Association between body mass index and COVID-19 by adjusted models

		Model 1		Model 2		Model 2	
		OR [95% CI]	P-value	OR [95% CI]	P-value	OR [95% CI]	P-value
BMI levels	Normal	1		1		1	
	Overweight	0.534 (-0.93, 2.00)	0.475	0.558 (-0.918, 2.034)	0.459	0.582 (-0.894, 2.058)	0.419
	Obese	1.71 (0.23, 3.19)	0.023	1.72 (0.25, 3.22)	0.022	1.73 (0.3, 3.16)	0.018

Model 1: Adjusted for age and sex

Model 2: Adjusted for age, sex, lifestyle score

Model 3: Adjusted for age, sex, lifestyle score, parents' education level, income, infection of close contact with COVID-19

Table 3. Association between lifestyle score and COVID-19 by adjusted models

		Model 1		Model 2		Model 3	
		OR [95% CI]	P-value	OR [95% CI]	P-value	OR [95% CI]	P-value
Lifestyle score	Moderate	1		1		1	
	Strong	0.92 (0.86, 0.98)	0.039	0.92 (0.87, 0.99)	0.048	0.91 (0.84, 0.98)	0.042

Model 1: Adjusted for age and sex

Model 2: Adjusted for age, sex, BMI

Model 3: Adjusted for age, sex, BMI, parents' education level, income, infection of close contacts with COVID-19

Discussion

In this cross-sectional analysis, we report the associations of various sociodemographic and lifestyle factor score and BMI with COVID-19 infection. Older age, a low level of parental education, and a high level of infection in individuals in close contact with COVID-19 were directly associated with COVID-19 infection. After adjusting for covariates, obese subjects, compared with subjects with normal body weights and those with moderate lifestyle score, those with high lifestyle score had greater odds of contracting COVID-19. No significant associations were found between other variables and COVID-19 infection.

The current study revealed that obese participants were 71% more likely to have COVID-19 than participants with normal body weights (OR=1.73; 95% CI: 0.25, 3.22; P-value=0.022). Consistent with our study, a meta-analysis indicated that the prevalence of COVID-19 infection is greater among individuals with a BMI>25 kg/m² than among those with a BMI<25 kg/m²[33]. In the U.S., a study revealed that patients under 60 years of age with a BMI between 30–40 (OR (95% CI) 1.8: 1.2–2.7) were more likely to be admitted to acute and critical care than those with a BMI<30[34]. Additionally, a meta-analysis revealed that elderly male patients with high BMIs have greater chances of becoming critically ill[35]. Another study identified sex (male), age, and heart disease as the main risk factors for COVID-19-related death[36]. Previous research has suggested a 30% prevalence of obesity in Middle East respiratory syndrome coronavirus infection[37]. Similarly, another study reported a relationship between weight gain and pneumonia[38].

The mechanisms underlying the association between obesity and increased risk of COVID-19 infection are unclear. First, obesity is well-established as being associated with a higher prevalence of cara diometabolic conditions such as diabetes and hypertension, which complicate the therapeutic outcomes of patients with COVID-19[39,40]. Second, SARS-CoV-2, the virus responsible for COVID-19, shows a high affinity for angiotensin-converting enzyme 2 (ACE2) in host cells, which is crucial for cellular resistance to infections[41]. ACE2 is abundantly expressed in adipose tissue; thus, excessive fat might worsen infection severity[42,43]. Third, obesity impairs respiratory parameters such as compliance, expiratory reserve volume, and functional capacity[44], exacerbating the severity of COVID-19. Additionally, evidence indicates that the immune system's effectiveness against infections is adversely altered in obese individuals[45–47].

The findings of the current study revealed that a strong lifestyle score was associated with an 8% reduced likelihood of contracting COVID-19 compared with a moderate lifestyle score (OR=0.92; 95% CI: 0.86, 0.98; P-value=0.04). These findings highlight the importance of maintaining a healthy lifestyle, which includes following a balanced diet, maintaining a healthy weight, engaging in regular physical activity, and managing stress, particularly during the ongoing COVID-19 pandemic. Adopting these healthy habits not only lowers the risk of contracting COVID-19 but also enhances overall health and well-being [48–52] Conversely, an unhealthy lifestyle is associated with chronic diseases and compromised immune function, thereby increasing the risk of contracting COVID-19[48–52].

In our analysis, age was inversely associated with COVID-19 infection. Previous studies have shown that older individuals have an increased risk for severe COVID-19, which is consistent with other respiratory viruses, such as influenza and respiratory syncytial virus[53–56]. However, in a secondary cross-protocol analysis of four randomized clinical trials, this association was not observed with severe COVID-19, suggesting that behavioral adjustments among older adults may have led to a lower rate of infection, thereby masking a truly higher rate of severe disease in this age group[8].

The strengths of this study include its population-based design, data analysis after adjusting for potential confounders, confirmed COVID-19 infection via RT–PCR or rapid antigen test as an entry criterion, the use of valid questionnaires, and in-person interviews conducted by trained people. However, there are several limitations, such as the inability to establish causality due to the study's cross-sectional design. The sample size was small, and studies with larger sample sizes are recommended to be conducted in the future.

Our study revealed that obesity and lifestyle score are associated with COVID-19. Our findings contribute to the evidence linking lifestyle choices to COVID-19 infection and highlight the critical role of targeted public health interventions. These insights can inform efforts to bolster community resilience to COVID-19 and potential future pandemics, stressing the need for equitable recovery and health promotion strategies.

Ethical Considerations

This study was approved by the ethics committee of Shahroud University of Medical Sciences (Code: IR.SHMU.REC.1400.122). All study protocols were thoroughly explained to the participants to ensure that they fully understood the nature, purpose, and potential risks of the study. Written informed consent was obtained from each participant before their inclusion in the study. The participants were assured that their participation was voluntary and that they could withdraw from the study at any time without any consequences.

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Conflict of Interest

The authors declare that they have no competing interests.

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