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Vaccination coverage against COVID-19 and associated factors in university students in Southern Mexico

Cobertura de vacunación contra COVID-19 y factores asociados en estudiantes universitarios del Sur de México

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Abstract

Objective: The purpose of this study was to assess COVID-19 vaccination coverage among university students in Guerrero, Mexico, and to analyze the factors associated with their acceptance or refusal of the vaccine.

Materials and methods: A cross-sectional survey was used to collect demographic data, vaccination status, perceptions of vaccine efficacy and safety, and postvaccination experiences.

Results: Of the 1052 students surveyed, 97.1% reported having been vaccinated. A higher likelihood of vaccination was associated with having access to medical services (adjusted odds ratio [ORa] = 4.27; 95% CI: 2.06–8.85), perceiving the vaccine as effective (ORa = 2.33; 95% CI: 1.00–5.43), knowing someone who had contracted COVID-19 (ORa = 2.16; 95% CI: 1.04–4.49), and regularly receiving influenza vaccines (ORa = 1.89; 95% CI: 0.92–3.90).

Conclusions: These findings underscore the importance of healthcare access, risk perception, and positive vaccination habits in promoting vaccine uptake. High vaccination coverage in this population reflects positive attitudes toward immunization.

Keywords: Vaccination; COVID-19; Coverage; SARS-CoV-2; Hesitancy.

Resumen

Objetivo: Este trabajo tuvo como finalidad determinar la cobertura de vacunación contra COVID-19 en jóvenes universitarios de Guerrero, México y analizar los factores asociados a su aceptación y/o rechazo.

Materiales y métodos: Se utilizó una encuesta transversal para recopilar datos demográficos, estado de vacunación, percepciones sobre la eficacia y seguridad de la vacuna y experiencias posteriores a la vacunación.

Resultados: De un total de 1052 estudiantes, el 97.1% indicaron que habían sido vacunados. Aquellos jóvenes que: a) tienen acceso a servicios médicos (ORa= 4.27; IC95%: 2.06-8.85), b) consideraron a la vacuna como una protección eficaz (ORa= 2.33; IC95%: 1.00-5.43), c) tuvieron algún amigo con COVID-19 (ORa= 2.16; IC95%: 1.04-4.49) y d) se vacunan contra la influenza frecuentemente (ORa= 1.89; IC95%: 0.92-3.90), tuvieron mayor posibilidad de vacunarse contra COVID-19.

Conclusiones: Estos hallazgos subrayan la importancia del acceso a la atención médica, la percepción del riesgo y la costumbre de vacunarse contra la influenza como factores que favorecen la vacunación. La alta cobertura de vacunación en esta población refleja actitudes positivas hacia la inmunización.

Palabras Claves: Vacunación; COVID-19; Cobertura; SARS-CoV-2; Vacilación.

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Introduction

The COVID-19 pandemic caused a global health crisis due to its high transmission rate and increased mortality. In Mexico, as of June 25, 2023, more than 7,633,355 cases and 334,336 deaths had been reported. In Guerrero, a southern state in Mexico, over 121,250 cases and 6,895 deaths were documented¹. Public health efforts have faced significant challenges in reducing the virus's spread and mitigating its impact on the population, particularly through effective and equitable vaccination strategies. Vaccination among Mexican adults aged 60 to 64 years resulted in a 60.9% reduction in confirmed cases, a 62.7% reduction in hospitalizations, and a 62.6% reduction in COVID-19-related mortality².

The World Health Organization³ has identified vaccine hesitancy as one of the top ten threats to global health, as it can lead to the resurgence of previously controlled or eradicated infectious diseases. People's attitudes toward vaccination are influenced by several factors, including psychological, educational, cultural^{4,5}, social, and political aspects, as well as perceptions of vaccine effectiveness⁶, fear of side effects⁷, uncertainty about the duration of immunity⁸, and trust in the vaccines themselves⁹.

In this context, governments, health authorities, medical professionals, and academic institutions must work together to promote immunization and strengthen public trust through health education and communication. In Mexico, the national COVID-19 vaccination campaign began in late 2020, prioritizing high-risk groups. Frontline healthcare workers were vaccinated first, followed by adults aged 60 and over (with or without comorbidities), individuals aged 50 to 59 with underlying conditions, and subsequently the general population. The campaign officially concluded in July 2022¹⁰. Since then, individuals have received between one and four booster doses.

This study aimed to determine the proportion of university students aged 18 to 29 years who received the COVID-19 vaccine and to identify factors associated with vaccine uptake in Guerrero, Mexico. This age group is particularly relevant because young adults tend to be healthy and less vulnerable to severe illness¹¹. However, they can act as asymptomatic carriers, unknowingly transmitting the virus and contributing to community spread. Understanding their perceptions, attitudes, and willingness to be vaccinated is key to enhancing public health strategies and improving coverage rates established by Mexican health authorities.

Materials and methods

A cross-sectional study was conducted among university students aged 18 to 29 years between April and July 2023. From a total population of 74,538 university students in the state of Guerrero¹², the required sample size was calculated using WinEpi 2.0 software¹³, based on a 95% confidence level and an expected vaccination prevalence of 50%¹⁴, resulting in a minimum sample of 385 participants.

A non-probabilistic snowball sampling technique was employed. Researchers visited both public and private institutions across different municipalities, obtaining authorization from school authorities to inform students about the study objectives, invite participation, and encourage the sharing of the survey with peers. Data were collected via a questionnaire developed by an expert panel and validated through a pilot test to ensure clarity and reliability. The questionnaire was administered digitally and could be completed using a mobile phone or other electronic devices, either through a link shared in WhatsApp groups or by scanning a QR code. Prior to the questionnaire, researchers emphasized their commitment to data confidentiality and the voluntary nature of participation. Informed consent was obtained from all students who agreed to participate.

The questionnaire comprised 46 items covering sociodemographic and economic characteristics, personal and family history of COVID-19, vaccine knowledge, health status, and confidence in the vaccine's efficacy and safety. The dependent variable was assessed by the question: "Have you received the COVID-19 vaccine?" (Yes/No).

Independent variables are: Socioeconomic Level: Estimated using the structured six-item instrument developed by the Mexican Association of Market Intelligence and Opinion Agencies (AMAI). Place of Residence: Defined as the municipality where the respondent has lived in the last five years. The following variables were evaluated using Yes/No responses: Access to medical services, Having a friend or acquaintance who had been ill with COVID-19, Perception of vaccine as effective protection against COVID-19, Frequent influenza vaccination.

Questionnaire responses were compiled into a Microsoft Excel file. Variables were coded, and the dataset was exported in DBF format to the CIETmap SE software¹⁵. Simple frequencies were calculated for categorical variables, and measures of central tendency and dispersion were calculated for continuous variables. Vaccination coverage (%) was calculated as: (Number of vaccinated individuals / Total number of respondents) $\times$ 100

Bivariate analysis was performed to identify factors associated with vaccination by calculating odds ratios (OR) using the Mantel-Haenszel method¹⁶. Participants were categorized into vaccinated and unvaccinated groups. All ordinal and nominal independent variables were dichotomized for analysis relative to the dependent variable. Ninety-five percent confidence intervals (95% CI) were estimated using the Miettinen method. For multivariate analysis, a saturated model initially included all variables statistically significant in the bivariate analysis. Variables that lost significance were sequentially removed using a stepwise approach until the final model was achieved.

Dimensionality reduction and visualization: The t-distributed Stochastic Neighbor Embedding (t-SNE) algorithm was applied using the Orange data mining software to generate a two-dimensional visualization of the surveyed students

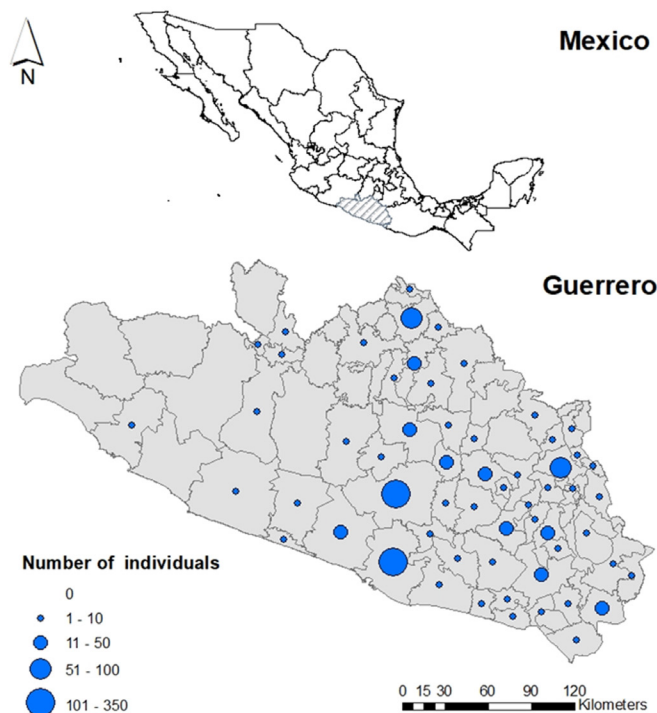
Resultados

A total of 94.8% (1,083 of 1,142) of the selected students participated in the study. The mean age was 21 years (± 3.3), and 66% (716/1,083) were female. Regarding marital status, 92% reported being single, 3.6% married, and 4.2% living in a common-law union. Concerning place of residence, 32.3% of participants lived in Acapulco, 24.2% in Chilpancingo, 5.9% in Taxco, 4.8% in Tlapa, and 3.0% each in Iguala and Ometepepec (Figure 1). Socioeconomic levels were distributed as follows: high, 32.6% (353/1,083); medium, 33.8% (366/1,083); low, 30.8% (334/1,083); and marginal, 2.8% (30/1,083).

Most participants were enrolled in public institutions (89.1%). Among these, the majority were from the Universidad Autónoma de Guerrero (57.5%), followed by the Universidad para el Bienestar (13.4%) and the Tecnológico Nacional de México, campus Chilpancingo (8.1%), among others.

Self-assessed health status revealed that 58.5% (634/1,083) rated their health as good, 25% (266/1,083) as average, 16.2% (175/1,083) as excellent, and 0.7% (8/1,083) as poor. Additionally, 94% (1,018/1,083) reported no chronic illnesses, and 56% indicated regular influenza vaccination.

Figure 1. Residence of study participants



Source: Own elaboration.

Regarding access to healthcare, 55.0% were affiliated with the Mexican Institute of Social Security (IMSS), 11.8% with the Institute of Social Security and Services for State Workers (ISSSTE), 9.1% with the Ministry of Health of Guerrero, and 2.4% with other services. However, 21.7% of students reported having no healthcare affiliation.

In terms of COVID-19 experiences, 63% (681/1,083) reported that a family member had contracted the disease, and 21% (228/1,083) had lost a family member to COVID-19. Additionally, 78.3% (848/1,083) knew a friend or acquaintance who had been infected. Among participants, 41% (444/1,083) reported having contracted COVID-19 themselves, of whom 71.6% (318/444) sought medical attention.

When asked about the nature of the disease and its causative agent, 96.3% (1,043/1,083) correctly identified COVID-19 as a viral disease. In contrast, 2.4% (26/1,083) believed it to be a chronic disease, 0.8% (9/1,083) reported not knowing, 0.3% (3/1,083) stated that COVID-19 did not exist, and 0.2% (2/1,083) attributed it to kidney disease or stress. Additional details on students' knowledge of COVID-19 and vaccination are provided in Table 1.

Table 1. Knowledge about vaccination and COVID-19

Variable	Description	Frequency	Percentage
Impact of COVID-19 on the population	Too much	858	79.2
	Much	193	17.8
	Regular	22	2.0
	Little	8	0.7
	Very little/Nothing	2	0.2
Dangers of COVID-19	Too much	517	47.7
	Much	428	39.5
	Regular	127	11.7
	Little	10	0.9
	Very little/Nothing	1	0.1
Information received on COVID-19 vaccination	Government/Ministry of Health	475	43.9
	Television, radio, newspapers, magazines	253	23.4
	Internet	285	26.3
	School	51	4.7
	Family	16	1.5
Effective protection against COVID-19	Friends	3	0.3
	Yes	976	90.1
	No	107	9.9
Knowledge of vaccine side effects	Yes	915	84.5
	No	168	15.5

Source: Own elaboration.

The overall COVID-19 vaccination coverage was 97.1% (1,052/1,083). The AstraZeneca vaccine was the most common (36.5%; 385/1,052), followed by Pfizer (23.4%; 247/1,052), Sinovac (19.7%; 208/1,052), CanSino (18.7%; 197/1,052), and others (1.3%; 15/1,052). More than half of vaccinated participants (52.4%; 552/1,052) reported at least one side effect. Most had received between two and three booster doses (Table 2).

Table 2. Characteristics of vaccinated individuals

Variable	Description	Frequency	Percentage
Number of booster doses	None	2	0.1
	One	96	9.1
	Two	470	44.6
	Three	437	41.5
	Four or more	47	4.4
Adverse effects due to the vaccine	Yes	552	52.4
	No	500	47.6
Main side effects	None	500	47.5
	Pain at the application site	147	13.9
	Fever	135	12.8
	Muscle and joint pain	116	11.0
	Headache	109	10.3
	Shivers	32	3.0
	Others	13	1.2
	Personal protection	707	67.2
Top reasons to get vaccinated	Family protection	264	25.0
	Compliance with requirements	42	4.0
	Medical recommendation	23	2.1
	Others	16	1.5
	Post-vaccination COVID-19 infection	164	15.5
Post-vaccination COVID-19 infection	Yes	164	15.5
	No	888	84.4

Source: Own elaboration.

The main reason for vaccination was personal protection (67.2%), followed by protecting family members (25%). Other reasons included complying with institutional requirements (4%), medical recommendations (2.1%), and other less frequent motivations (1.5%).

Table 3 shows the results of the bivariate analysis examining factors associated with COVID-19 vaccination. Students in their third year or beyond were more likely to be vaccinated compared to those in earlier years (OR = 2.58; 95% CI: 1.18–5.67). Likewise, those attending public institutions (OR = 2.47; 95% CI: 1.07–5.72) and those with access to medical services (OR = 5.54; 95% CI: 2.74–11.22) had higher odds of being vaccinated.

Table 3. Bivariate associations between key variables and vaccination

Variables	Categories	OR	CI 95%
Gender	Male	0.54	0.26 – 1.09
	Female		
Age	≤21 years old	1.41	0.69 – 2.88
	≥22 years old		
Marital status	Single, widower	1.78	0.61 – 5.13
	Married, free union		
Educational institution	Public	2.47	1.07 – 5.72
	Private		
Type of university studies	Biological and health sciences	0.92	0.39 – 2.15
	Social sciences		
Degree completed	≥ Third grade	2.58	1.18 – 5.67
	≤ Second grade		
Number of people living in the home	≤4	1.10	0.54 – 2.26
	≥5		
Do you have any work?	Yes	0.51	0.25 – 1.04
	No		
Health status	Excellent, good	1.90	0.92 – 3.93
	Regular, deficient		
Access to medical services	Yes	5.54	2.74 – 11.22
	No		
Get vaccinated against influenza	Yes	2.35	1.14 – 4.85
	No		
Family member sick with COVID-19	Yes	1.23	0.60 – 2.54
	No		
Friend or acquaintance sick with COVID-19	Yes	2.35	1.15 – 4.81
	No		
Family member died due to COVID-19	Yes	1.40	0.53 – 3.67
	No		
Well-known person died due to COVID-19	Yes	1.34	0.65 – 2.75
	No		
He suffered from COVID-19	Yes	1.72	0.79 – 3.75
	No		
Intensity of COVID-19	Mild	0.66	0.23 – 1.91
	Moderate or severe		
Presence of COVID-19 symptoms	Yes	1.86	0.83 – 4.15
	No		
She/He sought medical attention (when he became ill with COVID-19)	Yes	3.24	0.92 – 11.48
	No		
Number of times you got sick with COVID-19	None	0.58	0.27 – 1.26
	More than once		

To be continued...

Impact of COVID-19 on the population	Much, too much	1.10	0.14 – 8.31
	Regular, nothing		
Dangers of COVID-19	Much, too much	1.01	0.35 – 2.95
	Very little, regular		
Effective protection	Yes	2.78	1.21 – 6.39
	No		
Know the side effects	Yes	1.61	0.69 – 3.78
	No		
Socioeconomic level	High - medium	3.51	1.77 - 6.95
	Low - Marginal		

Source: Own elaboration.

Health-related factors associated with higher vaccination rates included routine influenza vaccination (OR = 2.35; 95% CI: 1.14–4.85). A good or excellent self-reported health status (OR = 1.90; 95% CI: 0.92–3.93) and having sought medical attention after contracting COVID-19 (OR = 3.34; 95% CI: 0.92–11.48) also showed increased odds, although these associations were not statistically significant.

Social and experiential factors associated with vaccination included: 1) knowing someone who had contracted COVID-19 (OR = 2.35; 95% CI: 1.15–4.81), 2) believing the vaccine to be an effective means of protection (OR = 2.78; 95% CI: 1.21–6.39), and 3) belonging to a medium or high socioeconomic level (OR = 3.51; 95% CI: 1.77–6.95).

Multivariate analysis revealed statistically significant associations for the following variables: access to medical services, having a friend or acquaintance who contracted COVID-19, and perceiving the vaccine as effective protection. Routine influenza vaccination also showed a positive association, although with marginal statistical significance (Table 4).

Table 4. Multivariate analysis of factors associated with vaccination among university students

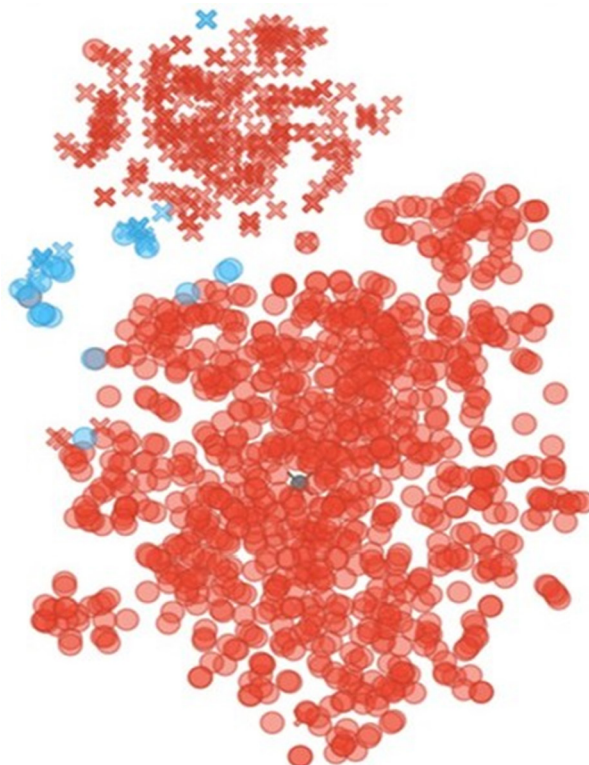
Variable	OR	Adjusted OR*	CI 95%
Access to medical services	4.86	4.27	2.06 – 8.85
Having a friend who has contracted COVID-19	2.25	2.16	1.04 – 4.49
Consider the vaccine as an effective protection against COVID-19	2.59	2.33	1.00 – 5.43
Get vaccinated against influenza frequently	2.41	1.89	0.92 – 3.90

Source: Own elaboration.

Among unvaccinated participants, the main reason for refusal was fear of side effects (31.2%). Other reasons included illness during the campaign (15.6%), lack of access to vaccination centers (15.6%), and distrust of the vaccine (15.6%). Notably, 65.6% of unvaccinated individuals expressed willingness to receive the vaccine in the future.

The output of the t-SNE algorithm for dimensionality reduction and two-dimensional visualization is presented in Figure 2. Students were grouped according to their reported access to healthcare services (Yes vs. No). Red symbols indicate students who reported having received the COVID-19 vaccine, while blue symbols represent those who had not been vaccinated. An “x” denotes students with access to healthcare services, whereas a circle represents those without such access. As shown, the data points cluster according to the access-to-healthcare variable, which is consistent with the associations identified in the multivariate analysis.

Figure 2. Two-dimensional visualization of surveyed students using the t-SNE method.



Note: Red symbols indicate students who reported having received the COVID-19 vaccine, while blue symbols represent those who had not been vaccinated. An “x” denotes students with access to healthcare services, whereas a circle represents those without such access.

Discussion

The high COVID-19 vaccination coverage observed in this study (97.1%) is consistent with findings from Toro et al¹⁷. in Chile (93.4% during May–June 2021) and notably exceeds the 34.0% coverage reported by Baack et al¹⁸. in the United States among individuals aged 18 to 39 (March–May 2021). In Mexico, the World Health Organization¹⁹ reported a 75.0% vaccination rate for at least one COVID-19 vaccine dose as of November 2023. However, this national figure reflects the general population rather than specifically young adults.

A more precise comparison arises from the 2022 National Health and Nutrition Survey by the National Institute of Public Health²⁰, which documented an 84.1% vaccination rate among Mexicans aged 18 to 29. In the South Pacific region of Mexico, encompassing Guerrero, Morelos, Oaxaca, and Puebla, vaccination coverage was 83.3%.

One of the key factors associated with vaccination in our study was access to medical services, a critical component for achieving effective healthcare and disease prevention. In Mexico, health policies stipulate that students enrolled in public education institutions are eligible for optional insurance provided by the IMSS²¹. This may help explain the high vaccination coverage among students, as insured individuals are more likely to receive accurate information about the importance of vaccination and to access vaccines directly through health institutions.

Other important associated factors included having friends or acquaintances who had contracted COVID-19, which may raise awareness of the disease's risks and motivate individuals to seek protection. Additionally, perceiving the vaccine as an effective preventive measure and regularly receiving influenza vaccinations suggest a broader culture of health awareness and a positive attitude toward immunization programs²². Notably, Mexico has a longstanding tradition of adherence to federal immunization campaigns targeting vaccine-preventable diseases²³.

Despite the high coverage, concerns among unvaccinated individuals—primarily fear of side effects and vaccine distrust—remain important challenges. These issues, also reported in other studies, should be addressed by public health authorities¹¹. Designing communication strategies that clearly emphasize vaccine safety and the benefits of immunization is crucial to overcoming hesitancy and fostering trust.

Conclusions

COVID-19 vaccination among young university students not only decreases their risk of severe illness but also enhances community protection by reducing virus transmission. Vaccine hesitancy persists as a significant public health challenge, particularly regarding herd immunity goals. The high acceptance rate observed is encouraging, implying that young adults generally respond well to vaccination campaigns. Targeted efforts remain essential to removing barriers and ensuring comprehensive vaccination across the broader population.

Conflict of interest

Los autores declaran que no existe conflicto de interés derivado de la presente investigación.

Ethical considerations

Ethical approval was granted by the Research Committee of the Guerrero State Health Services (file number 07100724). Participation was voluntary with informed consent obtained from all students. Data confidentiality was maintained, and participant identities were fully protected.

Use of artificial intelligence

The authors declare that they have not used any applications, software, or generative artificial intelligence websites in the writing of the manuscript, in the design of tables and figures, or in the analysis and interpretation of the data.

Authors' contribution

Conceptualization: M.C.A.C., L.A.C.A.; Investigation: M.C.A.C., L.A.C.A.; Acquisition of funds: S.A.R., L.A.C.A.; Project management: M.C.A.C.; Methodology: S.A.R., M.C.A.C.; Resources: S.A.R.; Data curation: L.D.G., S.A.R.; Formal analysis: L.D.G., H.A.S.N.; Software: L.D.G., M.C.A.C.; Validation: M.C.A.C., L.A.C.A., H.A.S.N.; Visualization: L.D.G.; Supervision: L.A.C.A.; Original draft: L.A.C.A.; Review and editing: L.A.C.A., H.A.S.N.

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