Barriers, refusal and a hypothetical monetary incentive for Covid-19 vaccination in Mexican adults

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Abstract

Objective. To estimate vaccine uptake and assess sociodemographic conditions associated with vaccination barriers and refusal and to explore the effect of a monetary incentive to overcome them. **Materials and methods.** We used data from adults from the 2021 National Continuous Health and Nutrition Survey conducted during August-October 2021. We evaluated if an hypothetical monetary incentive between 50-650 MXN (~2.5-31 USD) would overcome barriers or refusal. **Results.** 73.9% were vaccinated with at least one dose, 7.5% refused, 4.8% reported barriers and 13.8% were ineligible at the time of the survey. Refusal and barriers were more frequent in men, older age, lower education and socioeconomic status, unemployed and informal workers. In people with barriers and refusal, the hypothetical incentive increased the acceptance in 57.6% (95%CI 50.7,64.4%) and 17.4% (95%CI 13.2,21.7%) in people with barriers and refusal, respectively. **Conclusion.** Understanding the reasons for barriers and refusal is crucial for future Covid-19 vaccination campaigns or epidemics. A monetary incentive might increase vaccination uptake, although, cost-effectiveness analyses are needed.

Keywords: covid-19 vaccines; vaccination refusal; vaccines; vaccination hesitancy; health surveys

Carnalla M, Basto-Abreu A, Stern D, Colchero MA, Shamah-Levy T, Alpuche-Aranda CM, Bautista-Arredondo S, Barrientos-Gutiérrez T. Barreras, rechazo y un hipotético incentivo monetario para la vacunación contra el Covid-19 en adultos mexicanos. Salud Publica Mex. 2023;65:265-274.
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Resumen

Objetivo. Estimar la aceptación de la vacunación, evaluar las características sociodemográficas asociadas con barreras y rechazo a la vacunación, explorar el efecto de un incentivo monetario para superarlos. **Material y métodos.** Se utilizaron datos de adultos de la Encuesta Nacional de Salud y Nutrición Continua 2021 realizada durante agosto-octubre 2021. Se evaluó si un incentivo monetario entre 50-650 MXN (~2.5-31 USD) ayudaría a superar las barreras o rechazo. **Resultados.** El 73.9% de los adultos se vacunó con al menos una dosis, 7.5% se negó, 4.8% reportó barreras y 13.8% no era elegible al momento de la encuesta. El rechazo y las barreras fueron más frecuentes en hombres, mayor edad, menor nivel educativo y socioeconómico, desempleados y trabajadores informales. En personas con barreras y rechazo, el incentivo hipotético aumentó la aceptación en 57.6% (IC95% 50.7,64.4%) y 17.4% (IC95% 13.2,21.7%) en personas con barreras y rechazo, respectivamente. **Conclusión.** Entender las razones de rechazo y barreras es crucial para las futuras campañas de vacunación Covid-19 y otras epidemias. Un incentivo monetario podría aumentar la aceptación de la vacunación, aunque se necesitan análisis de costoefectividad.

Palabras clave: vacunación covid-19; rechazo a vacunas; vacunas; vacilación a la vacunación; encuesta de salud

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Vaccine acceptance is a critical step toward achieving population protection against Covid-19. In 2020, before vaccines were available in Mexico, 62.3% of the population reported willingness to be vaccinated.[1] In December 2020, the first vaccines were provided to health care workers, followed by the adult population staggered by age, starting with ages 60 and older to then reach younger groups decade by decade. By December 13th, 2021, before the application of boosters, the Health Ministry in Mexico reported 87% coverage of at least one dose in adults 18 years and older.[2] Compared to the expected uptake rates, the proportion of people who received a vaccine suggests an increase in vaccine acceptance from 2020 to 2021.

Despite significant achievements in coverage, 12% of the 18 years and older population had not been vaccinated by the end of the campaign, according to the Ministry of Health.[3] However, to what extent uptake was hindered by refusal or barriers is unclear. In 2020 in Mexico, vaccine refusal was associated with being female, older, and having lower educational and socioeconomic status.[1] However, before vaccination distribution, no data existed to understand the reasons behind hesitancy beyond sociodemographic characteristics. Prior studies in other countries have documented mistrust in the vaccine approval process, perceived lack of vaccine effectiveness, and belief in conspiracy theories as the main drivers for vaccination hesitancy and refusal.[4] Logistical barriers could also play a significant role as barriers for people willing to get vaccinated. Therefore, distinguishing barriers (lack of time, inability to move to the vaccination site, or leave the workplace) from refusal due to personal beliefs is essential to design interventions to expand vaccination uptake in Mexico.

Previous policies to improve vaccines acceptability relied on providing information and education to the population, with meager success, probably due to the flawed assumption that lack of knowledge is the main obstacle to healthy behavior change.[5] Novel approaches from behavioral economics rely on motivating individuals by influencing decisions by considering systematic cognitive biases (or heuristics) rather than through a deliberate, "conscious" process.[6] One common application of this approach relies on offering incentives (financial or not), relaxing restrictions and lowering costs (financial or not) of vaccination. The core idea is to amplify the tangible and concrete advantages of vaccination, in addition to the less quantifiable and uncertain benefit of protection, which may not be persuasive enough for certain individuals. Studies in high-income countries have found that monetary incentives increase vaccination uptake,[7,8] but others found no effect.[9,10] Evidence about this approach is still lacking in low-and middle-income countries, where the effect might differ.

In this paper we aimed to estimate vaccine uptake in 2021 in a representative sample of eligible Mexican adults and, taking advantage of post-vaccination data to assess sociodemographic and socioeconomic conditions associated with vaccination barriers and refusal. Secondly, we investigate the hypothetical effect of a financial incentive to overcome barriers or refusal in the adult Mexican population.

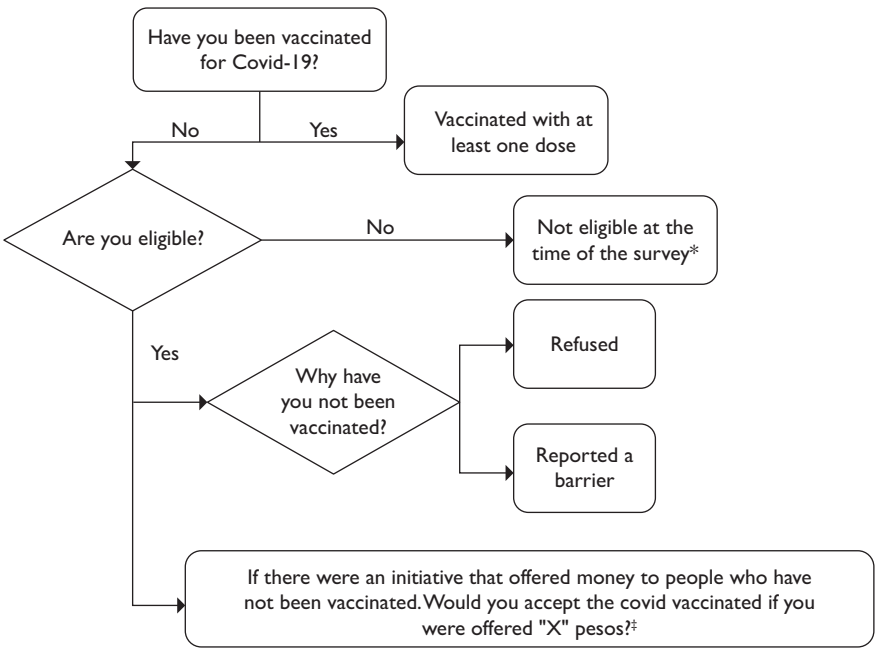
Materials and methods

Study design

The 2021 National Continuous Health and Nutrition Survey (Ensanut) was conducted from August to November 2021 to document the Mexican population's health status and health service-seeking behaviors, including aspects related to the impact of the Covid-19 pandemic and vaccination. Ensanut has a probabilistic, multistage, stratified, and clustered sampling design to represent the national, regional, and rural/urban levels.[11] Of the 16 747 households selected, 12 619 completed the questionnaire (75.4% response rate). The survey includes information on 43 724 household members, answered by the head of the household. In this analysis, we included household members aged 18 and older because minors were not eligible for vaccination at the survey time (n=31 004). We excluded 46 participants because of missing vaccination status for a final sample of 30 958 participants. The study was approved by the Ethics, Research, and Biosafety Committees of the National Health of Public Health (CI-450-2021).

Outcomes

Vaccine eligibility and vaccination status were self-reported and cross-validated with the official certificate when available. Although all adults 18 and older were eligible for vaccination at the time of the survey, vaccine availability was heterogeneous across geographic regions. We classified participants as "ineligible" if the vaccine had not arrived in their municipality at the time of the survey, "vaccinated" with at least one dose, or "unvaccinated". The unvaccinated were further asked to report the reason. We categorized as "barriers" the reasons outside the individual's control and "refusal," the reasons reflecting an unwillingness to be vaccinated. The list of reasons is reported in supplementary table I.[12] We constructed four groups for the final analysis: 1) vaccinated; 2) refused; 3) reported barriers; 4) ineligible (figure 1).



*We classified respondents as "ineligible" if they reported not being eligible due to their age or if the vaccination campaign had not yet arrived in their locality at the time of the survey.
‡ "X" is a random amount between 50 and 650 pesos (roughly between 2.5 and 32.5 USD).

Figure 1. Flowchart of the questionnaire applied to classified participants. Mexico, 2021

Monetary incentives

Unvaccinated participants were asked if a small monetary incentive would help to change their vaccination status with the following question: "If there were an initiative that offered money to people who have not been vaccinated. Would you accept the covid vaccinated if you were offered "X" pesos?" (figure 1). The amount was randomly assigned between 50 and 650 MXN (approximately 2.5 to 31 USD). We categorized the answers as "incentive would change status" as "Yes" if they answered yes and "No" if they answered no or did not know. We excluded 28 who did not answer (21 in group 2 and 7 in group 3).

Covariates

Based on Mexico's national vaccination strategy eligibility, we categorized age in the same age groups as the national vaccination strategy (18-29, 30-39, 40-49, 50-59, 60 years and older).[13] The socioeconomic status was previously constructed using principal component analysis. The index included housing characteristics (construction material of the floor, walls, and roof, number of bedrooms, running water), assets and appliances ownership (refrigerator, washing machine, microwave, stove, water heater, tv, cable, radio, cellphone, and computer), and car ownership. We categorized the index in tertiles: low, middle, and high. Education was categorized using the maximum level of education completed (elementary school or less, middle school, high school, and graduate or postgraduate). Employment status was categorized as unemployed (includes all non-paid work, housework, and individuals unable to work due to disability), student, retired, formal worker, and informal worker. The area of residence was defined as rural (<2 500 inhabitants) or urban (>2 500 inhabitants). The nine country regions were: North-Border (Chihuahua, Coahuila, Nuevo León, Tamaulipas), Central-Pacific (Colima, Jalisco, Michoacán), Central-North (Aguascalientes, Durango, Guanajuato, Querétaro, San Luis Potosí, Zacatecas), Center (Hidalgo, Tlaxcala, Veracruz), North-Pacific (Baja California, Baja California Sur, Nayarit, Sinaloa, Sonora), South-Pacific (Guerrero, Morelos, Oaxaca, Puebla), and Peninsula (Campeche, Chiapas, Quintana Roo, Tabasco, Yucatán).

Statistical analysis

We estimated the prevalence of the four vaccination groups (vaccinated, refused, reported barriers, ineligible) by age group. We analyzed the factors associated

with barriers or refusal to get vaccinated among those eligible and described their distribution. Several studies analyze the factors adjusting for every covariate, but without a theorical framework, multiple adjusted models can result in uninterpretable associations.[14] In this study, to estimate the association between age, sex, education, socioeconomic status, and employment and the outcome (refusal or barrier to be vaccinated), we constructed five Directed Acyclic Graph (DAG)[15] using information from the 2020 study about barriers/refusal in Mexico[1] (supplementary figure 1).[12] DAGs are visual representations of the association between the exposure and outcome, helping to identify the presence of confounding and other bias. The theoretical foundation of the DAGs are explained elsewhere.[14,16,17] We fitted one multinomial logistic regression model for each variable adjusted by the minimal sufficient adjustment set, for a total of five models. We report the exponentiated coefficients as relative probabilities of barriers or refusal using vaccinated as the reference group, given the calculation of the probability ratio estimated by the model.[18]
E.g.:

$$\text{Probability of barriers}_{\text{females}} \quad \frac{\Pr(\text{Barriers}|\text{female})}{\Pr(\text{Vaccinated}|\text{female})} = \frac{0.052}{0.872} = 0.059$$

$$\text{Probability of barriers}_{\text{males}} \quad \frac{\Pr(\text{Barriers}|\text{male})}{\Pr(\text{Vaccinated}|\text{male})} = \frac{0.061}{0.842} = 0.072$$

$$\text{RPR} = \frac{\text{Probability of barriers}_{\text{females}}}{\text{Probability of barriers}_{\text{males}}} = \frac{0.059}{0.072} = 0.82$$

Relative probability ratio (RPR)= 0.82. It means that women had 18% less the relative probability to report barriers than men.

To evaluate the acceptance of a monetary incentive the groups that refused and reported barriers for vaccination, we used a logit model with acceptance of the incentive as the outcome (yes/no). We categorized the incentive amount in 50-pesos intervals (~2.5 USD)—because of the non-linear association with the probability of acceptance—and adjusted by age, sex, education, socioeconomic status, and employment. To evaluate if the effect of the incentive differed between refusal and barriers, we included an interaction term between the monetary incentive amount and a variable indicating if the respondent reported having a barrier or refused to vaccinate. We present the estimated marginal effects of refusal or barriers. All estimations considered the sampling design (weights, strata, clusters) using Stata17.

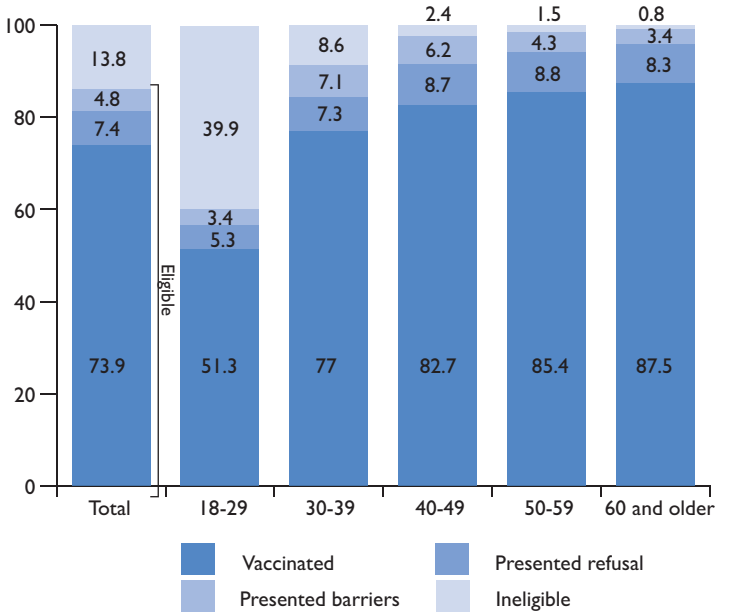
Results

The total vaccinated population with at least one dose was 73.9%. The proportion of vaccinated people increased with age. The overall refusal was 7.4%, and 4.8% reported barriers. Refusal was similar across ages, except for 18-29-year-old, which was lower but also were more likely ineligible at the time of the survey, and the groups 30-39 and 40-49 experienced the highest barriers (figure 2). Among people who reported barriers, the main reasons for not receiving a vaccine shot were being ill or having a medical contraindication (24.9%) and were not allowed to leave work (23.5%). Among those who refused, the main reasons were a perception of adverse health consequences (40.3%) and the decision to wait and see how the situation evolves (15.7%) (supplementary table 2).[12]

Among the eligible population for vaccination, 85.8% (95%CI 84.7, 86.8%) were vaccinated with at least one dose, 5.6% (95%CI 5.1, 6.2%) reported barriers, and 8.6% (95%CI 7.9, 9.4%) refused vaccination (table I). The younger age groups experienced the highest prevalence of barriers. Refusal prevalence was similar across all age groups. Women reported lower refusal than men and a similar prevalence of barriers. Informal employees, unemployed, and people living in rural areas experienced the highest prevalence of barriers and refusal, which decreased as education and socioeconomic status improved. Center, Central-Pacific, and South-Pacific had the highest prevalence of barriers, and Central-Pacific, Peninsula, and South-Pacific had the highest refusal prevalence.

Table II shows the sociodemographic factors associated with barriers or refusal in comparison to being vaccinated, among eligible adults. Older age groups had a lower relative probability of barriers and refusal than those 18-29 years. Men were more likely to report barriers or refusal to vaccination than women. Higher education and socioeconomic status had a lower relative probability of barriers and refusal to vaccination compared to elementary school or less and low socioeconomic status, respectively. Informal employees and unemployed had approximately two times the relative probability of reporting barriers or refusing than retired individuals.

The mean hypothetical monetary incentive offered was 346.4 pesos (~17 USD) and was similar between the groups reporting barriers and refusal and by sociodemographic characteristics, which confirms that the amount was randomly assigned (supplementary table 2).[12] Incentives significantly improved the likelihood of vaccination acceptance in both groups (figure 3). However, the hypothetical incentive was three times more effective among people who reported barriers (57.6%, 95%CI 50.7, 64.4%) than those who refused the vaccine (17.4%, 95%CI 13.2, 21.7). We found no difference across the amounts offered. The logit model for incentive acceptance is shown in supplementary table III.[12]



Note: Eligibility was self-reported.
Ensanut: *Encuesta Nacional de Salud y Nutrición*

FIGURE 2. OVERALL DISTRIBUTION AND BY AGE GROUP OF VACCINATION STATUS, REFUSAL, AND BARRIERS IN THE ADULT POPULATION BETWEEN AUGUST AND NOVEMBER 2021. MEXICO, ENSANUT 2021

Table 1
CHARACTERISTICS OF ELIGIBLE ADULTS 18 AND OLDER BY VACCINATION STATUS. MEXICO, ENSANUT 2021

	Sample size n	*Weighted N (millions)*	*Vaccinated % (95%CI)*	*Barriers % (95%CI)*	*Refusal % (95%CI)*
Total	27 073	76.7	85.8 (84.7,86.8)	5.6 (5.1,6.2)	8.6 (7.9,9.4)
Age (years)					
18-29	5 026	15.0	85.5 (83.7,87.0)	5.7 (4.9,6.7)	8.8 (7.5,10.4)
30-39	5 482	17.2	84.2 (82.4,85.9)	7.7 (6.7,8.9)	8.0 (6.8,9.4)
40-49	5 601	16.4	84.7 (83.1,86.3)	6.3 (5.4,7.4)	8.9 (7.8,10.2)
50-59	4 825	12.3	86.7 (85.2,88.1)	4.4 (3.6,5.3)	8.9 (7.8,10.1)
≥60	6 139	15.9	88.2 (86.8,89.4)	3.5 (2.8,4.2)	8.3 (7.4,9.4)
Sex					
Men	12 401	36.4	84.2 (82.9,85.4)	6.1 (5.5,6.8)	9.7 (8.8,10.6)
Women	14 672	40.3	87.2 (86.1,88.3)	5.2 (4.6,5.9)	7.6 (6.9,8.4)
Employment					
Unemployed	9 181	24.5	83.5 (81.9,85.0)	6.4 (5.6,7.4)	10.1 (9.0,11.2)
Student	852	2.6	96.9 (95.2,98.0)	1.5 (0.9,2.5)	1.6 (0.8,3.4)
Retired	1 443	4.2	93.6 (91.8,95.0)	1.8 (1.1,2.9)	4.6 (3.5,6.1)
Formal employee	7 526	23.1	92.6 (91.6,93.4)	3.5 (3.0,4.2)	3.9 (3.3,4.6)
Informal employee	8 071	22.3	78.6 (76.8,80.3)	8.1 (7.2,9.0)	13.3 (12.0,14.8)

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Education					
Elementary or less	8 776	22.2	77.7 (75.8,79.6)	8.2 (7.2,9.2)	14.1 (12.7,15.6)
Middle school	7 570	20.4	84.3 (82.8,85.7)	6.4 (5.6,7.3)	9.3 (8.2,10.6)
High school	5 427	16.3	89.2 (87.8,90.5)	5.0 (4.1,6.0)	5.9 (4.9,6.9)
Graduate/Postgraduate	5 300	17.7	94.5 (93.4,95.4)	2.1 (1.7,2.7)	3.4 (2.6,4.3)
Low	8 158	21.3	76.0 (73.6,78.2)	9.9 (8.8,11.1)	14.1 (12.4,16.0)
Middle	8 933	24.3	85.9 (84.4,87.3)	5.7 (4.9,6.6)	8.4 (7.5,9.4)
High	9 982	31.1	92.4 (91.3,93.4)	2.6 (2.2,3.1)	5.0 (4.1,6.0)
Rural	5 988	15.0	78.5 (75.3,81.4)	7.9 (6.7,9.2)	13.6 (11.4,16.1)
Urban	21 085	61.7	87.6 (86.4,88.6)	5.1 (4.5,5.7)	7.4 (6.7,8.1)
Region					
North-Pacific	3 444	8.1	90.1 (88.0,91.9)	3.9 (3.0,5.1)	6.0 (4.9,7.4)
North-Border	2 270	11.1	90.2 (87.9,92.0)	3.5 (2.5,5.0)	6.3 (5.1,7.8)
Central-Pacific	2 034	7.7	78.0 (73.1,82.3)	7.6 (5.6,10.4)	14.4 (11.1,18.5)
Central-North	5 936	9.4	85.8 (84.2,87.3)	6.2 (5.3,7.3)	8.0 (7.0,9.0)
Center	2 209	8.0	84.4 (78.7,88.7)	7.7 (5.2,11.4)	7.9 (5.8,10.8)
Mexico City	2 598	6.0	92.5 (90.6,94.0)	3.1 (2.4,4.1)	4.4 (3.2,6.0)
State of Mexico	2 420	9.1	88.8 (86.7,90.6)	5.1 (4.0,6.5)	6.1 (5.0,7.5)
South-Pacific	2 485	9.0	81.3 (76.5,85.3)	6.8 (5.3,8.6)	11.9 (9.1,15.4)
Peninsula	3 677	8.4	81.2 (77.4,84.5)	6.5 (5.1,8.2)	12.3 (9.5,15.7)

CI: Confidence Interval. The row percentages sum 100%
Ensanut: *Encuesta Nacional de Salud y Nutrición*

Table II

Adjusted multinomial logistic models for barriers or refusal to Covid-19 vaccination compared to vaccinated among eligible adults 18 years old and older. Mexico, Ensanut 2021

	Barriers vs Vaccinated (n=1 564 vs n=23 149) RPR (95%CI)	*p value*	*Refusal vs Vaccinated (n=2 360 vs n=23 149) RPR (95%CI)*	*p value*
Model 1: Age (years)*				
18-29	Ref.		Ref.	
30-39	1.24 (0.99, 1.54)	0.06	0.81 (0.64, 1.03)	0.09
40-49	0.98 (0.78, 1.23)	0.85	0.88 (0.71, 1.08)	0.23
50-59	0.66 (0.52, 0.85)	0.001	0.86 (0.69, 1.07)	0.17
≥60	0.49 (0.38, 0.64)	<0.001	0.75 (0.61, 0.93)	0.01
Model 2: Sex‡				
Men	Ref.		Ref.	
Women	0.82 (0.72, 0.95)	0.007	0.76 (0.69, 0.83)	<0.001
Model 3: Employment§				
Retired	Ref.		Ref.	
Unemployed	2.20 (1.30, 3.6)	0.003	2.01 (1.50, 2.78)	<0.001
Student	0.55 (0.26, 1.18)	0.13	0.34 (0.15, 0.76)	0.009

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Formal employee	1.14 (0.26, 1.18)	0.58	0.79 (0.55, 1.14)	0.21
Informal employee	2.23 (1.37, 3.65)	0.001	2.30 (1.64, 3.22)	<0.001
Model 4: Education[#]				
Elementary or less	Ref.		Ref.	
Middle school	0.55 (0.45, 0.67)	<0.001	0.53 (0.45, 0.63)	<0.001
High school	0.42 (0.32, 0.54)	<0.001	0.31 (0.24, 0.39)	<0.001
Graduate/Postgraduate	0.21 (0.15, 0.30)	<0.001	0.20 (0.14, 0.27)	<0.001
Model 5: Socioeconomic status[&]				
Low	Ref.		Ref.	
Middle	0.66 (0.54, 0.80)	<0.001	0.73 (0.61, 0.88)	0.001
High	0.39 (0.31, 0.48)	<0.001	0.59 (0.47, 0.75)	<0.001

Ensanut: *Encuesta Nacional de Salud y Nutrición*
RPR: relative probability ratio.
* Adjusted by sex, employment, and socioeconomic status.
‡ Unadjusted.
§ Adjusted by age, sex, and education.
# Adjusted by age, sex, and socioeconomic status.
& Adjusted by age, sex, employment, and education.

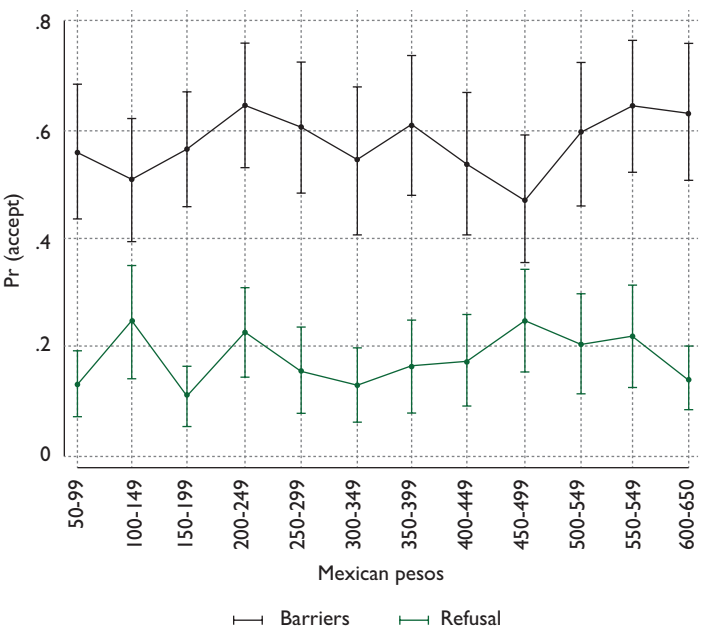

FIGURE 3. PREDICTED PROBABILITY OF ACCEPTANCE OF MONETARY INCENTIVE BY BARRIERS AND REFUSAL AT 50 PESOS RANDOM INCREMENTS IN MEXICO, AUGUST TO NOVEMBER 2021. ADJUSTED BY AGE, SEX, EDUCATION, SOCIOECONOMIC STATUS, AND EMPLOYMENT

Discussion

In Mexico, between August and November 2021, 14.2% of adults eligible for vaccination did not receive a Covid vaccine: 8.6% refused, and 5.6% reported a barrier. The main reason for refusal was the fear of adverse health outcomes and for reporting barriers was a medical contraindication. Factors associated with barriers and refusal included being male, older, lower education, low socioeconomic status, working in the informal sector, or being unemployed. Our results suggest that monetary incentives, even as small as 50 MXN (~2.5

USD), could reduce the proportion of unvaccinated adults—especially among those who reported barriers to access the vaccine.

In Mexico, vaccines were not available on demand, which could have imposed important barriers to vaccination. The Mexican government acquired vaccines as they were available in the international market, which, as in most middle-income countries, access to vaccines was gradually in limited quantities. Thus, depending on availability, the vaccination strategy was prioritized by group of ages (starting with older groups) and gradually moved across the nation.[13] Eligible individuals had access to the vaccine only in specified schedules in vaccination centers, within the period when it was available in their locality (usually a week for each age group). Hence, vaccination barriers could have played an important role in vaccine uptake. We found that the most prevalent barriers were people reporting an illness or a medical contraindication and not being allowed to leave work. By April 2022, Mexico implemented a vaccination strategy to increase booster coverage in those at higher risk of severe Covid-19 outcomes, to complete vaccination schemes, or make up for previous missed vaccination opportunities, including short-term vaccination sites (clinics or supermarkets), vaccination in rural areas, hotels, penitentiaries, schools, and malls.[19] Strategies like this could increase uptake in people with barriers (e.g., taking lunch time or when running errands as an opportunity to get vaccinated) but might not increase vaccine uptake among people who refuse vaccination due to personal beliefs.

The main reason for refusing the vaccine was fear of adverse health outcomes. A similar finding has been reported in the UK,[20] Switzerland[21] and the USA,[22] as well as in other low- and middle-income countries, like South Africa.[23] In the Latin American context, people crossing the border from Mexico into Guatemala also reported that the main reasons for refusing vaccination was fear of side effects and distrust in vaccines,[24] a main concern that was also reported in Puerto Rico.[25] Vaccine refusal is an important public health problem that has no easy solution. A review of interventions in Latin communities early after the introduction of vaccines showed that specific marketing campaigns using radio, television, and social media, mobile vaccination stations in workplaces, shopping malls, and grocery stores could reduce hesitancy and refusal.[26] Still, impact evaluation of these programs was rarely reported. An online experiment that included people from Argentina, Brazil, Chile, Colombia, Mexico, and Peru showed that information about the safety and efficacy of vaccines and social approval increased the willingness to vaccinate.[27] While results were heterogenous among countries, it highlighted that only safety and efficacy campaigns might be insufficient.

Our study showed that monetary incentives could reduce vaccination barriers and refusal. On average, 60% of eligible people who reported barriers would vaccinate if a small incentive were to be provided. Interestingly, any level of monetary incentive, starting with 50 MXN (2.5 USD), would effectively change people's vaccination status. To provide context, the minimum daily salary in Mexico is 172.9 pesos (8.6 USD);[28] thus, the incentive represents nearly 1/3 of a daily salary. Thus, it could be an effective tool to relax constraints imposed by opportunity costs -when they compensate for direct costs or loss of income or time. However, if the barrier motive was another than just loss of money (e.g., getting fired), the incentive might be ineffective regardless of the amount. Among people who refused to be vaccinated, the incentive would change the status of only about 20% of the people, three times lower than in the barriers group. Changing people's beliefs and misconceptions about vaccines will require more complex interventions than monetary incentives. Monetary incentives seem less effective and probably also less ethical when they motivate people to use services they deliberately reject because of their beliefs.[29] More research is needed to understand the role of non-monetary incentives such as free transportation or free meal in influencing vaccination uptake.

We found that increasing the incentive amount from 50 to 650 MXN did not significantly increase the probability of overcoming barriers or refusal. In theory, higher amounts of cash should persuade more people; however, we did not find this result. One explanation is that we did not test high enough amounts to observe a higher effect with higher amounts our top was 650 MXN or roughly US$32. In Germany, 50€ (~US$53) increased 5 pp vaccination uptake and 2 pp with 25€ (~US$26) among the undecided.[8] Another possibility is that the full incentive's impact is observed at very low amounts; therefore, the marginal effect of increasing cash is negligible. One study in Malawi showed that the incentive amount was not associated with the likelihood of HIV (Human Immunodeficiency Virus) testing, in line with this hypothesis. The author proposed that any amount could work as an excuse for people to access services they wanted but were afraid to access because of stigma; therefore, the monetary incentive worked more as a nudge than as the opportunity cost compensation.[30] Another reason could be that we did not have enough power to observe differences across different amounts. However, the monetary incentive in our case was hypothetical; the acceptance rate could be different in real-life circumstances.

Our study is not without limitations. First, our study relies on cross-sectional data collected from August to October 2021 and vaccination rates at that point were still increasing. Thus, the self-reported vaccination rate reported in our analysis will need to be updated once the national campaign of primary vaccination is completed among all age groups (≥18 years and older). Second, we are relying on responses of the key informant of the household for the vaccination status, including refusal and barriers, of each individual which can lead to misclassification, but when available, the vaccination was confirmed with the official certificate, which reduces the error for vaccination. In addition, results from sensitivity analysis where we included responses only for the key informant, show similar results but wider confidence intervals due to a small sample size (results not shown). Third, we classified barriers as those reasons outside the individual's will and refusal as reasons due to beliefs, which adds difficulty for comparison for specific refusal and barriers rates, as previously mentioned, but not for specific reasons and associated variables. Fourth, the context of how the incentive for vaccination is offered could influence the acceptance of the vaccine. To minimize this bias, we first provided background information that Covid-19 vaccines offered in the country are safe and effective based on scientific evidence, and then asked if they would accept the monetary incentive.

Reasons for refusal and barriers to Covid-19 vaccination in Mexico are similar compared to other countries. Understanding barriers and reasons for refusal is crucial for future Covid-19 vaccination campaigns-in case additional boosters are needed-or future epidemics. A monetary incentive might increase vaccination uptake, especially among eligible people who reported barriers to access vaccination. However, cost-effectiveness analysis should be conducted before implementing large-scale incentive programs.

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