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RESEARCH ARTICLE

# Knowledge, attitudes, and perception susceptibility towards the COVID-19 pandemic in the Latin American region

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**Highlights**

- Knowledge of COVID-19 has been associated with improved attitudes and behavior in addressing the spread of COVID-19.
- Attitudes, perception susceptibility, and perceived risk may potentially influence people's non-compliance with government protocols and practices towards COVID-19.
- Informed people have a better understanding of adopting control measures and preventive strategies related to COVID-19.
- Psycho-educational strategies must be implemented as part of prevention and health promotion to increase healthy practices.

## ABSTRACT

**BACKGROUND:** Latin American countries have been strongly affected by COVID-19. Due to the alarming prevalence of cases, we explored which psychosocial elements may influence poor compliance with mandatory control measures among the population.

**OBJECTIVE:** We aimed to assess the Latin American population's knowledge, attitude, and susceptibility perception during the early coronavirus outbreak.
**METHOD:** We collected data from 600 self-selected participants through a web-based cross-sectional survey evaluating demographic information. The respondents were between 16 to 77 years old. Most of the participants were female (n= 382), graduated professionals (56.8 %), citizens living in any country in South America (72.2%).

**RESULTS:** Logistic regression showed that knowledge is highly related with age (p=0.010*), attitude is related with marital status (p=0.017*), perception susceptibility is related with education (p=0.049*), marital status (p=0.001**) and occupation (p=0.001**). Our study identified that people reported adequate knowledge by identifying expected symptoms and the coronavirus transmission process. There is a significant perceived susceptibility to contracting the mentioning virus (57.7%), displaying stigmatized behavior (59.1%), fear of contracting the virus from others (70.2%), and concern regarding serious consequences after the COVID-19 disease (72.3%). Additionally, we found that people distrust the National Health administration's response (61.57%), preparedness for the disease (73.8%), and suggesting insufficient measures to deal with COVID-19 disease (61.3%).

**CONCLUSION:** Within the framework of government regulations, it is suggested that guidelines be considered to expand strategies and provide reliable knowledge to facilitate positive attitudes towards protection measures against COVID-19. Communication strategies would serve both to contain psychological reactions and the perception of risk of contagion and educational actions to ensure compliance with public control measures among the population.

**KEYWORDS:** Attitudes, COVID-19, health communication, knowledge, perception, public health, primary prevention.

## INTRODUCTION

The emergence of the new coronavirus, nominated as 2019-nCoV by the World Health Organization, has dominated the news worldwide in recent months. In late December 2019, unexplained cases of pneumonia appeared in Wuhan, China, whose rapid transmission capacity has disrupted many countries worldwide [1,2]. In fact, when this study was written, the coronavirus had already reached pandemic proportions with 5.5 million confirmed cases worldwide [2,3].

Strict restrictive measures were imposed to mitigate the proliferation of the virus in each country; Indeed, many procedures were implemented following the strategies of Asian and later European countries. Similarly, in many South American countries, protocols were proposed ranging from sanitization behaviors, movement restrictions, and suspension of total activities, like those reported in Peru [4]. It should be noted that most previous studies on epidemics, especially during its development, are based on descriptive studies [5,6,] which leave aside theoretical foundations on risk perception and the role of the individual in addressing the disease. Consequently, it is helpful to understand the subjective conception of contagion risk and the psychological and socio-cultural factors associated with compliance with disease control protocols.

Given the importance of identifying behavioral factors influencing non-compliance with government protocols and attitudes around COVID-19, psychological elements would help explain the ineffective mitigation of the spread of the pandemic in South America. In this regard, Sander Van Der Linden's model of socio-psychological determinants [7], proposes not only cognitive elements (e.g., people's knowledge and understanding of risk), but emotional and experiential variables (e.g., subjective experiences), as well as socio-cultural conceptions (e.g., social interpretation of risk, culture, and values). This approach points to subjective differences (e.g., gender, education, ideology); and finally, the model considers personal knowledge about effective measures to explain the attitudes variability and the pandemic perception among the population [7].

The exploration of the level of adoption of health measures and the acceptance of policies to mitigate the rapid spread of the virus in Western culture urges particular attention. When this study was conducted in South America, the number of cases of COVID-19 were increased exponentially (Figure 1). Cases of contagion and death are beginning to overtake various European and Asian countries, becoming the new epicenter of the world. For instance, Peru reported more than 191,758 cases; Brazil has more than 676,494 cases, surpassing several European countries such as Russia with 467,673 cases or Spain with 288,390 patients [3]. Mexico has more than 113,619 cases, which is less than Chile's 127,745 cases [3].

The proportion of deaths is beginning to significantly exceed countries previously reported as severely affected, as is the case of Spain (28,000 deaths). It is important to consider that since the first report of COVID-19 in China, the policies adopted in several Latin American countries have been deployed with a delay of 1 to 2 months. A particular case of analysis at the Latin American level in Peru, whose social, health, and protection policies (social distancing, hand washing, border closures, among others) were implemented early on, yet the results were not successful compared to other countries that proceeded in the same direction [4].

In this context, it should be noted that public health and safety policies respond to the governmental system of each country, public health regulations appear to be ineffective in preventing the proliferation of the virus. In addition to the complex process of containing the spread of the virus, behavioral problems arise as a limiting factor in the general population. One of the notable differences between developed and Latin American countries is their capacity to respond to the crisis. While in Asian countries, the level of follow-up to control measures was undeniable, some social groups in Latin American countries may have difficulties adhering to such measures. Notably, certain behaviors of non-compliance with protection measures are evident [8]. Thus, the vulnerability in Latin America due to poverty and extreme poverty, poor access to social and health systems, and insufficient preventive strategies may affect health outcomes. The above elements contribute to the adherence or rejection to imposed policies, yet they are not the only associated factors; access to education and accurate information on COVID-19 has an essential role to play.

Knowledge about virus transmission and management appears to be vital for containing levels of mass spread. In parallel, it is widely known that people exposed to an epidemic experience multiple adverse effects [9,10]. Hence, understanding people's conceptions regarding risk could substantially influence the response to the existing threat [1,11,12]. Considering the increasing rate of infected individuals remarkably in Latin America, ignoring the human factors implicit in the pandemic dissemination becomes very difficult. Furthermore, comparing other types of risks such as environmental accidents and

natural disasters, infectious diseases, and limiting food access and health due to quarantine trigger conflicting attitudes in the population that require exploration [5].

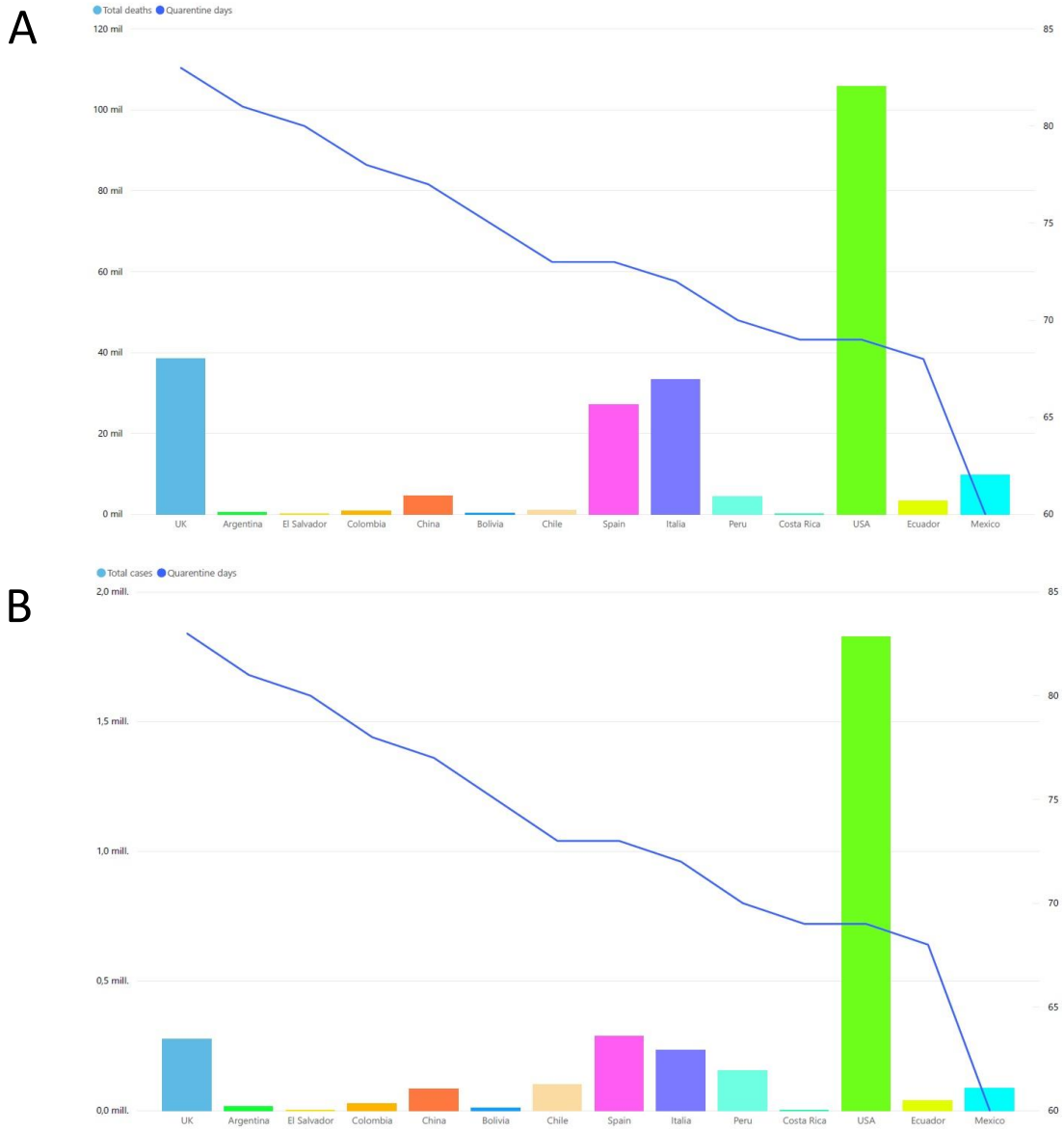


**Figure 1.** Total death (A) and people infected (B) in Latin American countries through days of lockdown. Last actualization date: May 31.

Attitude is associated with disease knowledge [13]. The literature states that more excellent knowledge of COVID-19 promotes better attitudes and practices against its proliferation. Consequently, health-educational strategies would significantly increase healthy practices [13,14], given that a supportive attitude towards the adoption of safety and health protection protocols has a significant impact on the proliferation of the disease [15], and the adoption of preventive health behaviors [16]. A recent study conducted during COVID-19 across Europe, America, and Asia with a relatively large sample (n=6991) describes that subjective factors such as risk perception, values, and personal and cultural experiences may predict avoidable risk behaviors the spread of the pandemic. The aforementioned study points out the importance of understanding subjective risk perception in order to manage public health risk [15].

The perceived risk in a critical situation is usually codified based on personal constructs [8], relating to personality, mental health, lifestyles, and perceptions regarding how the pandemic progresses in a particular community. Data on risk perception in global samples demand further exploration of the population's perception of the coronavirus [15,17,18]. In

addition, it is noted that "risk perception" is being studied with greater interest lately in response to previous epidemics [15]. Confronted by these factors, we propose examining subjective psychological mechanisms that would serve as predictors of risk behavior. This study explores the interacting dynamics of knowledge, perception, and attitude within the Latin American population in the face of COVID-19. We consider that this study offers a significant contribution given the limited number of studies carried out in Latin American contexts.

## MATERIALS AND METHOD

### Participants

This is a descriptive, cross-sectional study conducted online through March 15 and May 17 of 2020. The sample was defined at convenience and in a non-probabilistic way. An initial selection of 600 individuals was recruited during the time window. The mean age was 33.48 ± 11.268, ranging from 16 to 77 years old, and 63.7% were females. The survey questions were adapted and modified from previously published literature regarding viral epidemics [11, 12, 19-25]. The test respondents commented that the questions were easily understood, and the average completion time was 10 min. Informed consent was obtained before starting the survey. Respondents were assured that their responses would be confidential and reminded that their participation in the survey was voluntary. Their knowledge and attitude were evaluated against facts published by WHO [2,3]. We receive responses from Mexico, Peru, Colombia, Nicaragua, and other countries.

### Instrument: Knowledge, Attitude and perception questionnaire

Zegarra-Valdivia et al. previously describe this questionnaire [4]. Briefly, this instrument is divided into six sections as follows: a) knowledge about coronavirus (COVID-19) infection, b) transmission and c) perception of disease severity, d) perceived susceptibility, e) prevention attitudes, and f) behavioral response to COVID-19 infection. All the answers were displayed as Likert scale, agree, not sure/maybe, and disagree; yes, no, or do not know, or very likely, probable, and unlikely or high, middle, and low. A score of one was assigned to a correct answer and a value of zero to an incorrect answer or "do not know" responses. The total score of a + b is considered the total knowledge score, c + e was the total score of attitudes against COVID-19, and d + f was the perception susceptibility. We consider that the cut-off was at least 70% of the total knowledge and attitude score. Regarding perception susceptibility, the cut-off was >30%. We use these cut-off points to divide the sample between less/more knowledge, less/more positive attitude against COVID-19, and less/more frequent perception susceptibility.

### Ethical Statement

All participants were informed about the aims of this study and gave written informed consent. This study followed ethics guidelines and was approved by the local ethics committee. All data were collected in an anonymous database.

### Data Analysis

Sociodemographic characteristics of the participants included in the study sample were compared with chi2 tests and the percentages of answers. Reliability was measured by Cronbach alpha. Relation between variables was assessed with Pearson Correlation. One-way ANOVA compared the total knowledge, attitude, and perception scores between sociodemographic variables. The effect of gender, age group, educational level, marital status, occupation, and Latin American region was assessed through binary logistic regression using the total punctuation of the three sections as described above. Statistical analysis was performed through the SPSS software, version 24 (SPSS, Inc., USA) and GraphPad Prism 6 software (San Diego, CA, USA). Results were significant with *p < 0.05 and **p<0.01.

## RESULTS

### Background characteristics in Latin American participants (Table 2).

The study sample included 600 subjects; the majority of the participants were female (n= 382). We did not find a statistically significant difference between age group (p= 0.565), educational level (p= 0.781), marital status (p= 0.608), occupation (p= 0.067) and Latin American Region (p= 0.958) by gender.

More than 43% of the respondents were 21 to 30 years old. The majority of participants are from South America (72.2%), graduates (56.8 %), single (59.5%), and professionals (67.2%), with similar percent distribution between males and females.

**Table 1.** Alpha de Cronbach and correlation between Knowledge, Attitude, and Perception scores.

| | Cronbach's Alpha | N° of elements | 95% Interval Confidence | |
|---|---|---|---|---|
| | 0.839 | 94 | 0.82 | 0.857 |
| | **Pearson Correlation** | **Knowledge (1)** | **Attitude against COVID-19 (2)** | **Perception of susceptibility (3)** |
| 1 | Correlation | 1 | .137** | 0.071 |
| | P-value | | 0.001 | 0.083 |
| 2 | Correlation | .137** | 1 | .137** |
| | P value | 0.001 | | 0.001 |
| 3 | Correlation | 0.071 | .137** | 1 |
| | P value | 0.083 | 0.001 | |

**Table 2.** Sociodemographic characteristics

| | | Gender | | | | |
|---|---|---|---|---|---|---|
| | | **% Male (n= 218)** | **% Female (n= 382)** | **% All (n=600)** | ***X²*** | **P value** |
| **Age group** | | | | | | |
| | **16-20 years** | 7.3 | 6.5 | 6.8 | | |
| | **21-30 years** | 40.4 | 44.8 | 43.2 | | |
| | **31-50 years** | 41.3 | 40.6 | 40.8 | | |
| | **>51 years** | 11 | 8.1 | 9.2 | 2.035 | 0.565 |
| **Educational level** | | | | | | |
| | **Primary school** | 0.9 | 1 | 1 | | |
| | **High school** | 10.6 | 11.5 | 11.2 | | |
| | **technician** | 13.3 | 9.9 | 11.2 | | |
| | **graduate** | 55 | 57.9 | 56.8 | | |
| | **postgraduate** | 20.2 | 19.6 | 19.8 | 1.753 | 0.781 |
| **Marital Status** | | | | | | |
| | **Single** | 61.5 | 58.4 | 59.5 | | |
| | **Married** | 23.9 | 22.8 | 23.2 | | |
| | **cohavitating** | 9.2 | 12.6 | 11.3 | | |
| | **Widower** | 0.5 | 1.3 | 1 | | |
| | **Diverced** | 5 | 5 | 5 | 2.706 | 0.608 |
| **Occupation** | | | | | | |
| | **Student** | 9.6 | 11.5 | 10.8 | | |
| | **Professional** | 72.9 | 63.9 | 67.2 | | |
| | **Independent** | 17.4 | 24.6 | 22 | 5.401 | 0.067 |
| **Latin American region** | | | | | | |
| | **South America** | 71.6 | 72.5 | 72.2 | | |
| | **Central America** | 7.3 | 6.8 | 7 | | |
| | **North America** | 21.1 | 20.7 | 20.8 | 0.86 | 0.958 |

$X^2$: Chi-square test

**Knowledge about symptoms and transmission ways in COVID-19 disease (Table 3)**

The sample does not discriminate between the most frequent symptoms of the disease and includes other disease manifestations. Thus, more than half of the study sample correctly identified the most frequent symptoms like fever (96.5%), fatigue (65.8%), and dry cough (89.2%) along with others as just as sore throat (78.5 %), joint and muscle pain (57.3%). A certain consensus is also observed among the subjects in recognizing the shortness of breath/shortness of breath (94.8%); However, this has not been confirmed as part of the diagnosis [26]. Diarrhea (57.5%), runny nose (57.2%), and nasal congestion (59.7%) were not recognized as part of the disease. The majority of the population (85.3%) knew the incubation period. All the differences between de answers were significant (p ≤0.001**).

**Table 3.** Knowledge about COVID-19 symptoms and transmission ways

| What are the most frequent symptoms of coronavirus (COVID-19)? | Yes | No | I don't know | $X^2$ | P-value |
|---|---|---|---|---|---|
| 1.- Fever | **96.5** | 3.2 | 0.3 | 1078.03 | ≤0.001** |
| 2.- Runny nose | 29.5 | **57.2** | 13.3 | 176.89 | ≤0.001** |
| 3.- Sore throat | **78.5** | 13.5 | 8 | 553.53 | ≤0.001** |
| 4.- Joint and muscle pain | **57.3** | 30.5 | 12.2 | 185.77 | ≤0.001** |
| 5.- Shaking chills | 33.3 | **45.2** | 21.5 | 50.41 | ≤0.001** |
| 6.- Shortness of breath/shortness of breath | **94.8** | 2.7 | 2.5 | 1021.21 | ≤0.001** |
| 7.- Diarrhea | 28.3 | **57.5** | 14.2 | 175.75 | ≤0.001** |
| 8.- Fatigue | **65.8** | 22 | 12.2 | 293.89 | ≤0.001** |
| 9.- Dry cough | **89.2** | 6.3 | 4.5 | 841.99 | ≤0.001** |
| 10.- Nasal congestion | 24.5 | **59.7** | 15.8 | 193.99 | ≤0.001** |
| 11.- Weightloss | 6.2 | **70.5** | 23.3 | 399.49 | ≤0.001** |
| 12.- Stomach discomfort | 13.7 | **66.5** | 19.8 | 300.43 | ≤0.001** |
| 13.- Difficulty to sleep | 15.2 | **61.7** | 23.2 | 222.51 | ≤0.001** |
| 14.- Incubation period is 5–14 days | **85.3** | 7.7 | 7 | 730.12 | ≤0.001** |
| **Which of the following situations are means of transmission / spread of coronavirus (COVID-19)?** | | | | | |
| 1.- Coughing or sneezing near people infected with the coronavirus (COVID-19) | **73.3** | 24.3 | 2.3 | 475.56 | ≤0.001** |
| 2.- Go to areas / countries affected by coronavirus (COVID-19) | **90.5** | 8 | 1.5 | 886.17 | ≤0.001** |
| 3.- Touching objects or surfaces that have been in contact with someone who has the virus | **93.5** | 3.3 | 3.2 | 977.41 | ≤0.001** |
| 4.- Shake hands with someone who has an active case of coronavirus (COVID-19) | **86.7** | 9 | 4.3 | 769.96 | ≤0.001** |
| 5.- Being on the same plane with someone with coronavirus (COVID-19) | **68.2** | 23.7 | 8.2 | 349.23 | ≤0.001** |
| 6.- Eating food prepared by someone infected or exposed to the coronavirus (COVID-19) | **65.8** | 20.7 | 13.5 | 289.81 | ≤0.001** |
| 7.- Participate in blood transfusions | 19.3 | **56.2** | 24.5 | 143.17 | ≤0.001** |
| 8.- By relating to people who were in a hospital or emergency room | 33 | **53.7** | 13.3 | 146.44 | ≤0.001** |
| 9.- Relating to cases identified by doctors | **78.3** | 14.2 | 7.5 | 550.75 | ≤0.001** |
| 10.- For relating to cases identified during evaluations at entry points to my country | **72.2** | 16 | 11.8 | 408.73 | ≤0.001** |

a: Statistically significant difference ($P<0.001$** ), $X^2$ square test.

Participants correctly reported means of transmission/ spread of COVID-19, including; Touching objects or surfaces that have been in contact with someone who has the virus (93.5%), going to areas/countries affected by COVID-19 (90.5%), shaking hands with someone who has an active case of coronavirus (86.7%). In addition, subjects identified situations unrelated to contagion: participating in blood transfusions (56.2%) and by relating to people who were in a hospital or emergency room (53.7%).

**The severity of COVID-19 and prevention measures (Table 4)**

The majority of respondents (93%) considered COVID-19 highly contagious, with symptoms similar to flu and influenza (83.8%). Regarding the mortality

ratio, they do not assess that it is worse than influenza or tuberculosis (75.2%) or causes permanent physical damage to patients (78%). However, when comparing the impact of COVID-19 with influenza or the common cold, more than half of the interviewees indicated that the coronavirus would cause a more significant impact (74.3%). There is insufficient confidence in the national or local authorities (61.5%) and preparedness for the disease (73.8%).

Poor understanding of the precautionary measures is evident. Although some form of prevention is recognized, such as hand washing (99.2%), have special care with people who have symptoms of COVID-19 (97.8%), to avoid crowded places (97.7%), to separate/ isolate patients with coronavirus (97.7%) and personal hygiene (96.5%). Other essential measures were not fully considered, such as checking symptoms on websites (p=0.683), despite the WHO not recommending its use (WHO, 2020a). Furthermore, antibiotics are not recognized as the first line of action against the disease (79.5 %), a sign of the population's knowledge of the treatment. At that time of the pandemic, there was no vaccine or specific treatment. It draws attention that 28.2% believe it exists.

**Table 4.** The severity of COVID-19 and prevention measures

| **Severity of the coronavirus (COVID-19).**<br>**The coronavirus:** | **Agree** | **Not sure / Maybe** | **Disagree** | $X^2$ | **P value** |
|---|---|---|---|---|---|
| 1.- It can be cured | **69** | ----- | 31 | 86.64 | ≤0.001** |
| 2.- It is highly contagious | **93** | ----- | 7 | 443.76 | ≤0.001** |
| 3.- Coronavirus mortality rate is worse than influenza or tuberculosis | 24.8 | ----- | **75.2** | 152.01 | ≤0.001** |
| 4.- COVID-19 causes permanent physical damage to patients | 22 | ----- | **78** | 188.16 | ≤0.001** |
| 5.- You have symptoms similar to common flu and influenza | **83.8** | ----- | 16.2 | 274.72 | ≤0.001** |
| 6.- My community/country does not have a coronavirus vaccine | **71.8** | ----- | 28.2 | 114.40 | ≤0.001** |
| 7.- My community/country does not have adequate medicine or treatment for the disease | 48.7 | ----- | 51.3 | 0.42 | 0.514 |
| 8.- Hospitals in my community / country have not taken adequate infection control measures | 38.7 | ----- | **61.3** | 30.82 | ≤0.001** |
| 9.- Coronavirus impact is worse compared to influenza or common flu | **74.3** | ----- | 25.7 | 142.10 | ≤0.001** |
| 10.- The authorities of my country are prepared to face the disease | 26.2 | ----- | **73.8** | 136.32 | ≤0.001** |
| 11.- The response of the health authorities of my country/community is effective | 38.3 | 0.2 | **61.5** | 345.31 | ≤0.001** |
| **Knowledge about contagion prevention / precaution measures** | | | | | |
| 1.- Washing hands vigorously (soap/water) for 20 seconds helps prevent/transmit disease | **99.2** | ----- | 0.8 | 580.16 | ≤0.001** |
| 2.- Special care should be (COVID-19) in my community. | **97.8** | ----- | 2.2 | 549.12 | ≤0.001** |
| 3.- Personal hygiene | **96.5** | ----- | 3.5 | 518.94 | ≤0.001** |
| 4.- Healthy life style | **82.8** | ----- | 17.2 | 258.72 | ≤0.001** |
| 5.- Daily temperature monitoring | **57.5** | ----- | 42.5 | 13.50 | ≤0.001** |
| 6.- Avoid traveling abroad. | **92.8** | ----- | 7.2 | 440.32 | ≤0.001** |
| 7.-Use of face mask | **58.2** | ----- | 41.8 | 16.01 | ≤0.001** |
| 8.- Clean environment | **91.8** | ----- | 8.2 | 420.01 | ≤0.001** |
| 9.- Stay home if it's not okay | **90.3** | ----- | 9.7 | 390.42 | ≤0.001** |
| 10.- Seek medical attention if not okay | **89.3** | ----- | 10.7 | 371.30 | ≤0.001** |
| 11.- Avoid crowded places | **97.7** | ----- | 2.3 | 545.30 | ≤0.001** |
| 12.- Separation / isolation of patients with coronavirus (COVID-19) | **97.7** | ----- | 2.3 | 545.30 | ≤0.001** |

| | | | | | |
|---|---|---|---|---|---|
| 13.- Sending passengers with coronavirus symptoms (COVID-19) to a hospital or referral center for examination | **79.8** | ----- | 20.2 | 213.60 | ≤0.001** |
| 14.- You used a disinfectant at home or work. | **92.8** | ----- | 7.2 | 440.32 | ≤0.001** |
| 15.- Check symptoms on websites | 49.2 | ----- | 50.8 | 0.16 | 0.683 |
| 16.- Wore something to clean objects that may have come in contact with someone with coronavirus (COVID-19) | **81.7** | ----- | 18.3 | 240.66 | ≤0.001** |
| 17.- Avoid restaurants or shops | 47.2 | ----- | 52.8 | 1.92 | 0.165 |
| 18.- Cancel appointments in hospitals or doctor's offices | **54.8** | ----- | 45.2 | 5.60 | 0.018* |
| 19.- Avoid public transportation | **85.7** | ----- | 14.3 | 305.30 | ≤0.001** |
| 20.- Antibiotics are the first-line treatment for the management of coronavirus (COVID-19) | 20.5 | ----- | **79.5** | 208.86 | ≤0.001** |
| 21.- Preparation of raw meats and other foods with different knives | 26.3 | ----- | **73.7** | 134.42 | ≤0.001** |

a: Statistically significant difference (*P<0.001*** ), $X^2$ square test

**Perceived susceptibility to COVID-19 (Table 5)**

Table 5 shows perception susceptibility, where 60.8% consider that there is a stigma about COVID-19; 69.3% respond to preventive measures to avoid the disease, and 50.5% values that the problems derived from the pandemic will not pass quickly compared to the 33.2% who do not know about it. 72.3% of participants believe that getting COVID-19 will have severe consequences in their life, 68.7% feels upset about thinking about the disease, and 50% believe that the situation will not pass quickly.

One of the greatest fear among the evaluated population is being in contact with people who have returned from abroad (68.2%), followed by eating out (65%), visiting hospitals (64.8%), and having contact with people with flu symptoms (56.3%). Concern for medical services personnel is evident (75.2%), considering that one of the groups most susceptible to contagion, followed by people over 60 years of age (66%) and taxi drivers (58.3%). The perception susceptibility to contract disease is 57.7%, and surely 16.5%.

Besides, the different places where people may infect with COVID-19 infection highlight countries affected by COVID- 19 (68.4%) and public transport (58.3%) as places of infectiousness. In addition, the likelihood of having a significant outbreak of coronavirus from person to person in my community (50.7%) and the concern that you or your family members will get the virus (45.5%) pose a high-risk susceptibility.

Finally, the perception of treatment efficacy is middle (62.7%); the spread of COVID-19 around the community is relatively high, 50.7%, and the concern of family members getting sick (45.5%).

**Differences in Knowledge, Perception, and Attitude scores between sociodemographic variables**

To analyze differences between Knowledge, Perception, Attitude scores, and sociodemographic variables, we use one-way ANOVA. Firstly, we compared regions of Latin America. Figure 2A evidences significant differences around the perception of susceptibility by region (F: 6.521, p=0.002*). Post-hoc analyses show that North Americans have a reduced score in perception susceptibility compared with South Americans (p <0.05) and Central Americans (p <0.01).

Additionally, marital status reveals differences around the attitude against COVID-19 (F: 3.523, p= 0.007*). Tukey scrutiny exhibits that widowers had lower scores compared with single (p <0.05) and married participants (p <0.01*). Differently, the perception of COVID-19 susceptibility was different (F: 2.760, p= 0.027*) between singles and cohabitants (p <0.05). Other groups do not reflect array differences (see Figure 2B).

Under other variables such as occupation (Figure 2C), we found significant differences in knowledge (F: 3.411, p= 0.034*), Attitude (F: 3.447, p=0.032*), and Perception (F: 11.682, p <0.001**). Independent workers score lower in knowledge than professionals (p <0.025*). Regarding attitude, students score low (p <0.043*) compared to professionals. Similarly, students score lower compared to independent workers (p <0.001**), as well as professionals (p <0.002*). Knowledge is associated with the level of instruction (F: 3.864, p= 0.004*), in the case of postgraduate, who score higher compared to secondary instruction level (p <0.042*), and technician (p <0.013*). Finally, to differentiate the perception of susceptibility (F: 3.473, p= 0.008*), postgraduate level displays a reduced score compared to high school (p <0.008*). Other variable does not have differences (Figure 2D).

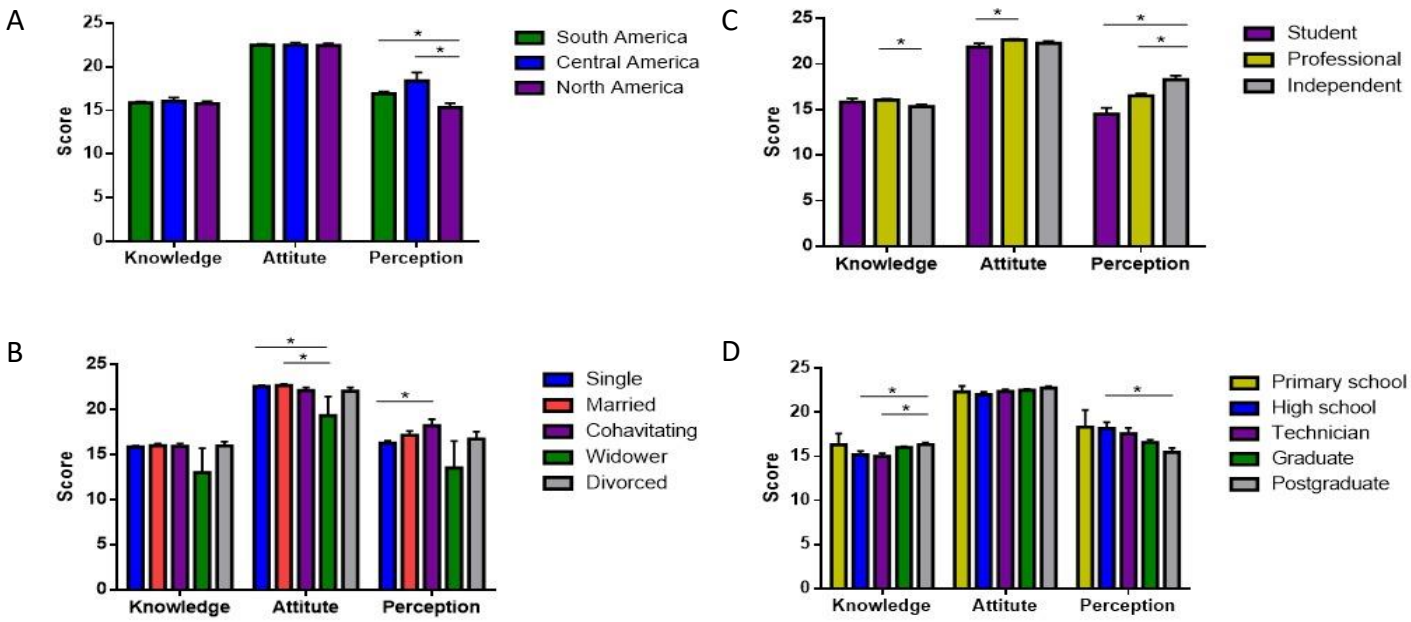


**Figure 2.** Comparison between Knowledge, attitude, and perception of vulnerability against COVID-19 and sociodemographic variables, by Latin American (A), marital status (B), occupation (C), and educational level (D).

**Table 5.** Perceived susceptibility to COVID-19

| Perception and perceived susceptibility or response | Yes | No | I don't know | $X^2$ | P value |
|---|---|---|---|---|---|
| 1.- Do you think there is a stigma related to the coronavirus (COVID-19) | **60.8** | 23 | 16.2 | 208.39 | ≤0.001** |
| 2.- Thinking that I could become infected with coronavirus (COVID-19) makes me nervous/anxious | **54.8** | 40 | 5.2 | 234.01 | ≤0.001** |
| 3.- Nothing I do can stop the risk of catching me | 16.2 | **69.3** | 14.5 | 350.17 | ≤0.001** |
| 4.- If I contracted the coronavirus (COVID-19), it would have severe consequences for me or my relatives | **72.3** | 18.5 | 9.2 | 418.51 | ≤0.001** |
| 5.- I get upset when I think about the coronavirus (COVID-19) | 24.7 | **68.7** | 6.7 | 366.24 | ≤0.001** |
| 6.- Coronavirus (COVID-19) problems will pass quickly | 16.3 | **50.5** | 33.2 | 105.07 | ≤0.001** |
| **Are you afraid of:** | | | | | |
| 1.- Fear of being in contact with people with flu symptoms (e.g. cough, runny nose, sneezing, fever) | **56.3** | 35.5 | 8.2 | 210.07 | ≤0.001** |
| 2.- Fear of eating out (for example, street vendor centers, food courts) | **65** | 30.2 | 4.8 | 328.51 | ≤0.001** |
| 3.- Fear of being in contact with people who have just returned from abroad | **68.2** | 26 | 5.8 | 364.21 | ≤0.001** |
| 4.- Fear of visiting hospitals | **64.8** | 29.8 | 5.3 | 321.93 | ≤0.001** |
| **Perceived susceptibility to coronavirus infection (COVID-19), Evaluate the possibility of contracting the disease:** | **Very likely** | **Probable** | **Unlikely** | | |
| 1.- Oneself | 16.5 | **57.7** | 25.8 | 167.71 | ≤0.001** |
| 2.- My relatives | 20.5 | **68.7** | 10.8 | 345.49 | ≤0.001** |
| 3.- People over 60 years | **66** | 31.2 | 2.8 | 360.37 | ≤0.001** |
| 4.- Adults | 37.5 | **59.7** | 2.8 | 295.39 | ≤0.001** |
| 5.- Children | 21 | **61** | 18 | 207.48 | ≤0.001** |
| 6.- Medical services personnel | **75.2** | 22.7 | 2.2 | 510.33 | ≤0.001** |
| 7.- Food vendors | 45.7 | **49.3** | 5 | 217.96 | ≤0.001** |

| | | | | | |
|---|---|---|---|---|---|
| 8.- Food handlers | 40.7 | **53.2** | 6.2 | 213.33 | ≤0.001** |
| 9.- General public | 40.3 | **57.2** | 2.5 | 282.19 | ≤0.001** |
| 10.- Taxi drivers | **58.3** | 38.7 | 3 | 283.24 | ≤0.001** |
| **Where are people likely to get coronavirus (COVID-19)?** | | | | | |
| 1.- Home | 2.3 | 41.3 | **56.3** | 279.72 | ≤0.001** |
| 2.- Health institutions | **46.7** | 32.8 | 20.5 | 61.69 | ≤0.001** |
| 3.- Public transport | **58.3** | 20.2 | 21.5 | 168.91 | ≤0.001** |
| 4.- Markets or shops | **50** | 33.2 | 16.8 | 99.01 | ≤0.001** |
| 5.- Countries affected by the coronavirus (COVID-19) | **63.2** | 14.2 | 22.7 | 246.81 | ≤0.001** |
| **What do you think the percentage of:** | **High** | **Middle** | **Low** | | |
| 1.- Efficacy of treatments for coronavirus (COVID-19) | 20.8 | **62.7** | 16.5 | 234.01 | ≤0.001** |
| 2.- Likelihood of having a significant outbreak of coronavirus (COVID-19) from person to person in my community | **50.7** | 39.7 | 9.7 | 162.12 | ≤0.001** |
| 3.- Concern that you or your family members will get the virus | **45.5** | 42.3 | 12.2 | 121.87 | ≤0.001** |
| 4.- Having effective medications or remedies available | **19.3** | 50.3 | 30.3 | 88.92 | ≤0.001** |

a: Statistically significant difference (*P<0.001*** ), $X^2$ square test

**Distribution of sociodemographic factors associated with Knowledge, Attitude, and Perception of susceptibility in Latin Americans (Table 6)**

In Table 6, we show the Odds Ratio regarding sociodemographic variables and binary logistic regression. Younger people (21 to 30 years old) evidenced lower COVID-19 symptoms-related knowledge and transmission compared to adults over 51 years old (OR= 0.396; 95% IC: 0.195 – 0.802; p <0.01*). The attitude towards the disease (less vs. more positive attitude) is facilitated by occupation (p =0.041*).

Regarding marital status, both married (OR= 2,779; 95% IC: 1.199 – 6.442, p =0.017*) and singles participants (OR= 2,318; 95% IC: 1.004 – 5.352; p <0.05*) rate high in positive attitude. Similarly, educational level, occupation, and marital status define the perception of susceptibility among participants. Secondary level instruction is related to increased perception susceptibility (OR= 3,004; 95% IC; 1.005 – 8.979; p <0.05). Compared to widowers (OR= 0.011; 95% IC: 0.001 – 0.174; p <0.01) and student (OR= 0.184; p <0.01) who scored lower in perception susceptibility.

**DISCUSSION**

This study intended to explore the mechanisms underlying the South American population's knowledge, perception, and attitude towards COVID-19. The spread of the virus in these countries and the alarming incidence of infected and deceased people place Latin America at the greatest risk worldwide. Although many countries implemented different public health policies, the uneven progression of COVID-19 and the economic impact on this region is promoting the reopening of many countries

At the beginning of the crisis, many people in Latin America did not fully adhere to government policies; this is especially evident in the rapid increase in the number of people infected despite confinement or social distance (Figure 1). Although Latin America is a multiethnic region, with significant socioeconomic, educational, and sociological differences, culture and tradition maintain a certain similarity, especially problems linked to corruption, access to public health, and economic informality.

**Table 6.** Distribution of sociodemographic variables associated with Knowledge, Attitude, and Perception of susceptibility in Latin Americans

| Sociodemographic Variables | Knowledge | | | | | | | | Attitudes | | | | | | | | Perception of susceptibility | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Less accurate | | More accurate | | $\chi^2$ p-value | OR | 95% CI | p-value | Less positive | | More positive | | $\chi^2$ p-value | OR | 95% CI | p-value | Less frequent | | More frequent | | $\chi^2$ p-value | OR | 95% CI | p-value |
| | N | (%) | N | (%) | | | | | N | (%) | N | (%) | | | | | N | (%) | N | (%) | | | | |
| **Gender** | | | | | | | | | | | | | | | | | | | | | | | | |
| Male | 118 | 51.4 | 100 | 45.9 | 0.495[a] 0.270 | 1.129 | 0.776 – 1.547 | 0.603 | 60 | 27.5 | 158 | 72.5 | 0.514[a] 0.261 | 1.102 | 0.754 – 1.610 | 0.615 | 41 | 39.4 | 177 | 81.2 | 0.502 0.270 | 0.823 | 0.521 – 1.301 | 0.405 |
| Female | 218 | 57.1 | 164 | 42.9 | | 1 | | | 116 | 30.4 | 266 | 69.6 | | 1 | | | 63 | 60.6 | 319 | 83.5 | | 1 | | |
| **Range of Age** | | | | | | | | | | | | | | | | | | | | | | | | |
| 16-20 | 22 | 53.7 | 19 | 46.3 | 7.194 0.066 | 0.544 | 0.212 – 1.401 | 0.207 | 11 | 26.8 | 30 | 73.2 | 0.820 0.845 | 1.324 | 0.463 – 3.792 | 0.601 | 8 | 19.5 | 33 | 80.5 | 1.272 0.736 | 0.785 | 0.201 – 3.060 | 0.727 |
| 21-30 | 160 | 61.8 | 99 | 38.2 | | 0.396 | 0.195 – 0.802 | **0.010*** | 72 | 27.8 | 187 | 72.2 | | 1.175 | 0.545 – 2.536 | 0.680 | 48 | 18.5 | 211 | 81.5 | | 0.751 | 0.255 – 2.211 | 0.603 |
| 31-50 | 129 | 52.7 | 116 | 47.3 | | 0.635 | 0.334 – 1.205 | 0.165 | 76 | 31 | 169 | 69 | | 0.881 | 0.439 – 1.767 | 0.721 | 41 | 16.7 | 204 | 83.3 | | 0.605 | 0.224 – 1.637 | 0.322 |
| >51 | 25 | 45.5 | 30 | 54.5 | | 1 | | | 17 | 30.9 | 38 | 69.1 | | 1 | | | 7 | 12.7 | 48 | 87.3 | | 1 | | |
| **Education** | | | | | | | | | | | | | | | | | | | | | | | | |
| Primary | 4 | 66.7 | 2 | 33.3 | 7.929 0.094 | 0.517 | 0.086 – 3.115 | 0.471 | 2 | 33.3 | 4 | 66.7 | 2.837 0.585 | 1.008 | 0.161 – 6.312 | 0.993 | 0 | 0 | 6 | 100 | 6.676 0.154 | >33 | | 0.999 |
| High School | 42 | 62.7 | 25 | 37.3 | | 0.679 | 0.349 – 1.322 | 0.255 | 24 | 35.8 | 43 | 64.2 | | 0.737 | 0.360 – 1.509 | 0.404 | 6 | 9 | 61 | 91 | | 3.004 | 1.005 – 8.979 | **0.049*** |

| | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Technician | 46 | 68.7 | 21 | 31.3 | | 0.522 | 0.269 – 1.015 | 0.056 | 22 | 32-8 | 45 | 67.2 | | 0.761 | 0.377 – 1.540 | 0.448 | 10 | 14.9 | 57 | 85.1 | | 1.269 | 0.528 – 3.048 | 0.594 |
| Graduate | 184 | 54 | 157 | 46 | | 1.003 | 0.637 – 1.580 | 0.989 | 98 | 28.7 | 243 | 71.3 | | 0.8557 | 0.511 – 1.438 | 0.559 | 62 | 18.2 | 279 | 81.8 | | 1.2900 | 0.721 – 2.307 | 0.392 |
| Postgraduate | 60 | 50.4 | 59 | 49.6 | | 1 | | | 30 | 25.2 | 89 | 74.8 | | 1 | | | 26 | 21.8 | 93 | 78.2 | | 1 | | |
| **Marital status** | | | | | | | | | | | | | | | | | | | | | | | | |
| Single | 203 | 56.9 | 154 | 43.1 | 2.456 0.652 | 1.8422 | 0.782 – 4.341 | 0.162 | 97 | 27.2 | 260 | 72.8 | 11.076 **0.026*** | 2.3188 | 1.004 – 5.352 | **0.049*** | 68 | 19 | 289 | 81 | 9.852 **0.043*** | 0.1655 | 0.021 – 1.311 | 0.088 |
| Married | 71 | 51.1 | 68 | 48.9 | | 1.8399 | 0.786 – 4.305 | 0.160 | 35 | 25.2 | 104 | 74.8 | | 2.7779 | 1.199 – 6.442 | **0.017*** | 22 | 15.8 | 117 | 84.2 | | 0.1722 | 0.022 – 1.367 | 0.096 |
| Cohabitating | 39 | 57.4 | 29 | 42.6 | | 1.9388 | 0.753 – 4993 | 0.170 | 27 | 39.7 | 41 | 60.3 | | 1.4443 | 0.574 – 3.626 | 0.436 | 10 | 14.7 | 58 | 85.3 | | 0.1688 | 0.020 – 1.442 | 0.104 |
| Widower | 4 | 66.7 | 2 | 33.3 | | 1 | 1.37 – 7.278 | 1 | 3 | 50 | 3 | 50 | | 1.1778 | 0.185 – 7.519 | 0.862 | 3 | 50 | 3 | 50 | | 0.0111 | 0.001 – 0.174 | **0.001**** |
| Divorced | 19 | 63.3 | 11 | 36.7 | | 1 | | | 14 | 46.7 | 16 | 53.3 | | 1 | | | 1 | 3.3 | 29 | 96.7 | | 1 | | |
| **Occupation** | | | | | | | | | | | | | | | | | | | | | | | | |
| Student | 37 | 56.9 | 28 | 43.1 | 3.501 0.174 | 1.4088 | 0.706 – 2.811 | 0.332 | 24 | 36.9 | 41 | 63.1 | 6.402 **0.041*** | 0.7444 | 0.362 – 1.531 | 0.422 | 22 | 33.8 | 43 | 66.2 | 18.628 **≤0.001**** | 0.1844 | 0.074 – 0.458 | **≤0.001**** |
| Professional | 216 | 53.6 | 187 | 46.4 | | 1.2771 | 0.811 – 1.993 | 0.295 | 105 | 26.1 | 298 | 73.9 | | 1.3855 | 0.863 – 2.222 | 0.178 | 70 | 17.4 | 333 | 82.6 | | 0.504 | 0.243 – 1.043 | 0.065 |
| Independent | 83 | 62.9 | 49 | 37.1 | | 1 | | | 47 | 35.6 | 85 | 64.4 | | 1 | | | 12 | 9.1 | 120 | 90.9 | | 1 | | |
| **Latin American Region** | | | | | | | | | | | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South America | 242 | 55.9 | 191 | 44.1 | 0.355 0.837 | 1.108 | 0.730 – 1.681 | 0.631 | 127 | 29.3 | 306 | 70.7 | 0.016 0.992 | 1.003 | 0.639 – 1.576 | 0.989 | 71 | 16.4 | 362 | 83.6 | 3.368 0.186 | 1.446 | 0.860 – 2.431 | 0.164 |
| Central America | 22 | 52.4 | 20 | 47.6 | | 1.264 | 0.611 – 2.613 | 0.528 | 12 | 28.6 | 30 | 71.4 | | 1.029 | 0.462 – 2.292 | 0.944 | 5 | 11.9 | 37 | 88.1 | | 1.890 | 0.638 – 5.597 | 0.250 |
| North America | 72 | 57.6 | 53 | 42.4 | | | | | 37 | 29.6 | 88 | 70.4 | | 1 | | | 28 | 22.4 | 97 | 77.6 | | 1 | | |

a: Statistically significant difference (*P<0.001*** ), Binary logistic regressio

The factors mentioned above may influence the knowledge, attitude, and perception susceptibility among Latin American citizens regarding COVID-19. In our study, 90% of people around Latin America correctly identified fever as the primary symptom (96.5%), followed by shortness of breath (94.8%), dry cough (89.2%), and sore throat (78.5%). They also know that the incubation period is between 5 - 14 days (85.3%).

Regarding transmission, touching objects (93.5%), going to areas identified as potentially infected (90.5%), shaking hands with infected people (86.7%), and coughing or sneezing (73.3%) are clearly recognized as transmission ways. Contacting people previously diagnosed with COVID-19 is also a mean identified transmission (78.3%).

Despite knowledge of COVID-19 symptoms and transmission, the disease is correctly recognized. Insufficient knowledge might affect people's behavior against protective measures. Some coronavirus-related symptoms are not fully identified, such as diarrhea (57.5%), stomach discomfort (66.5%), or runny nose (57.2%). Where those symptoms, potential feature of other organ infections reported by WHO. People do not recognize coughing or sneezing, among others, as means of transmission (24.3%), nor being near someone infected by COVID-19 (23.7%).

Analyzing the attitude against the disease, people fail to grasp the unknown nature of the virus entirely. They believe that COVID-19 can be cured (69%), have flu-like symptoms or influenza (83.8%), and do not cause permanent physical damage (75.2%). On the other hand, they indicated that it is highly contagious (93%), the mortality rate is worse than influenza/flu (75.2%) as well as its impact (74.3%). People who report that their environment is unsafe in hospitals (61.3%) in their community/country having inadequate infection control measures lead participants to consider that their health authorities are not working effectively (61.5%).

Preventive measures are correctly identified, incorporating washing hands (99.2%), taking special care if a person has symptoms of coronavirus (97.8%), avoiding crowded places (97.7%), or staying at home if they do not feel well (90.3%). However, all basic measures are not adequately recognized as the use of facemasks (58.2%), daily temperature monitoring (57.5%), checking their symptoms (49.2%), avoiding restaurants/shops (47.2%), and having a healthy lifestyle (17.2%). These findings demonstrate that the attitude against COVID-19 is not fully understood and probably not appropriately recognized by the participants.

What is noteworthy to find is that more than half of respondents (60.8%) score high in perceived susceptibility, alongside existing stigma (54.8%) related to the coronavirus resulting in fearful attitude and anxiousness of becoming infected. The limiting information leads people to believe that they can stop the risk of catching the disease (69.3%), the condition will not pass quickly (50.5%); predicting severe consequences if someone contracted COVID-19 (72.3%). Among the reasons for concern, contact with people who had just returned from abroad (68.2%) and fear of eating out (65%) were mentioned. Participants also noted that medical service personnel (75.2%), taxi drivers (58.3%), and people over 60 (66%) are the most susceptible to infection.

Similar studies in Africa found adequate Knowledge in population from Ethiopia, Nigeria, Cameroon, Uganda, Rwanda, Ghana, Democratic Republic of Congo, Sudan, and Sierra Leone (Reviewed by Nwagbara et al., [27]). However, the attitude was not always positive when preventive practices were poor. Another study with the Chinese population shows that knowledge was highly correlated with a lower likelihood of negative attitudes and preventive practices towards COVID-19 [28]. For instance, community-based health interventions, knowledge promotion, and health campaigns are necessary to increase the knowledge of COVID-19 and increase positive attitudes and appropriate practices to avoid contagiously and eliminate misconceptions.

To our knowledge, this is the first KAP study developed early in Latin America due to the novel COVID-19 pandemic. The results of this study reflect that the behavioral response of the Latin American population is not sufficient to fight the disease. Misconceptions and insufficient understanding of the disease could explain unsafe behavior. For this reason, several organizations consider them the population most affected by the pandemic.

**Limitations**

This study has some constraints mainly related to the methodology, whose transversal design restricts the establishment of causal inferences. Similarly, other biases can be considered, for example, in the sample collection process, since it was focused on those subjects' response in the time window considered in the recruitment of participants around that period to show the specific knowledge, attitude, and perceptions in the participants early in the breakdown due to the pandemic.

Additionally, concerning the sample, an online survey method was used to avoid possible transmission, which made the sampling of our study voluntary and carried out through an online system. Therefore, a specific selection bias is considered. Only people who had access to an Internet connection could participate in the study through a computer or mobile phone, limiting people who did not have such technological devices. In the absence of low-income people, we will have limitations in understanding their responses to the pandemic. The sample size is another limitation, as is the current wave of misinformation in social media may result in poorer responses [6].

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JZV and RAG make substantial contributions to conception and drafting. JZV and BNC work together in the survey. BNC and JZV work in the analysis and interpretation of data. All authors contribute writing, editing, and reviewing the final manuscript.

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**Conflict of Interest Statement**

The authors declare that the research was conducted without any commercial or financial relationships that could be construed as a potential conflict of interest.

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