Original Article

Assessing the COVID-19 Vaccine Hesitancy: Validation of the Moroccan Version of the C19-VHS Questionnaire and Analysis of Sociodemographic Factors

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ABSTRACT

Background

Vaccine hesitancy has been a major obstacle in the fight against COVID-19. ***Objective:*** This study aims to explore the factors influencing COVID-19 vaccine hesitancy among a sample of 800 Moroccan participants aged 18 and older.

Methodology

The COVID-19 *Vaccine Hesitancy Scale* (C19-VHS), translated and validated in Arabic, was used to measure various aspects of this hesitancy. The translation methodology included a two-step translation process, followed by back-translation and cultural validation. A confirmatory factor analysis (CFA) revealed a unidimensional structure explaining 63.98% of the variance, with a Cronbach's alpha of 0.903, indicating excellent internal consistency.

Results

The results show that vaccine hesitancy is influenced by several sociodemographic factors. A negative correlation with age suggests that older individuals are less hesitant. In contrast, education level and health status are positively correlated with hesitancy. A majority of participants expressed moderate to strong vaccine hesitancy, while only 2% fully accepted vaccines.

Conclusion

These findings highlight the need for targeted awareness strategies to improve perceptions of vaccine efficacy and safety. Specific interventions are essential to strengthen trust in vaccines and increase vaccine uptake among the Moroccan population.

Keywords

Vaccine Hesitancy; COVID-19 Vaccine; C19-VHS, Coronavirus; Vaccine Acceptance; Morocco

INTRODUCTION

Coronavirus disease 2019 (COVID-19) is currently recognized as a serious global threat to public health. Even with various interventions (e.g., social distancing, travel restrictions, and increasing hygiene measures), the spread of the virus (SARS-CoV-2) frequently rebounded following the loosening of restrictions[1]. Vaccination proved to be a cornerstone in controlling the pandemic; however, its impact depends on vaccine accessibility—a challenge that is particularly significant in Africa—and on public acceptance[2].

Vaccine hesitancy is a considerable barrier to vaccine coverage, defined by the World Health Organization (WHO) as the reluctance or refusal

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to vaccinate despite the availability of vaccine services [3]. A meta-analysis shows that 14.3% of individuals refuse a COVID-19 vaccine, while 22.1% are uncertain[4]. Over time, willingness to receive vaccination tends to decrease, whereas refusal becomes more common [4]. This hesitancy is traced back to various factors; including employment status, political views, gender, age, education, income, as well as concerns about vaccine safety and efficacy. Besides, the novelty of the disease, and suspicion in governments are crucial factors as well[5].

The aim of this research is to measure the vaccine acceptance of the Moroccan population towards COVID-19 and to determine the sociodemographic and psychological factors associated with participants' vaccine decision. Beliefs, perceptions and attitudes towards vaccination were recorded using the COVID-19 Vaccine Hesitancy Scale (C19-VHS) after translated and validated. The implications will inform evidence-based recommendations for interventions to enhance vaccine acceptance and increase uptake in public health practices.

MATERIALS AND METHODS

Study Population and Sampling

The study was conducted on a representative sample of 800 participants, recruited using stratified random sampling to ensure fair representation across different age groups and sociodemographic characteristics. This method helped reduce sampling bias. The inclusion criteria were: (i) being 18 years of age or older, (ii) residing in the province of Kenitra, and (iii) having the ability to understand and respond to the questionnaire in Arabic. Participants were also required to provide informed consent before participating, after being informed about the nature and objectives of the study, as well as the confidentiality of their responses.

Data collection took place from February 1, 2022, to March 27, 2023, following approval from the Ministry of Health and Social Protection. The protocol was validated by an ethics committee, and all responses were anonymized to ensure participant confidentiality.

Measurement Instrument

The Vaccination Hesitancy Scale for COVID-19 (C19-VHS) is a validated instrument originally developed in English to measure various aspects of vaccine hesitancy.

Translation and Cultural Adaptation

The translation process of the C19-VHS questionnaire followed a rigorous procedure. First, it was translated from English to Arabic by two independent translators. Next, a panel of experts compared the two versions to produce a consensus version that retained the original meaning of the items while adapting to Arabic linguistic and cultural nuances. This version was back-translated into English by a third independent translator to verify the accuracy of the translation. Finally, a committee of experts, including epidemiologists, psychologists, and public health specialists, validated the final Arabic version, making necessary adjustments to ensure its validity and relevance for the target population.

Validation of the Arabic Questionnaire (Appendix 1)

A pilot study was conducted with 50 representative participants to test the clarity, comprehension, and relevance of the C19-VHS questionnaire items in Arabic. Feedback led to minor adjustments to improve readability. Content validity was confirmed by a group of experts, ensuring comprehensive coverage of relevant dimensions of vaccine hesitancy. Exploratory Factor Analysis (EFA) validated the theoretical structure of the questionnaire using appropriate fit indices (KMO, Bartlett). Reliability was assessed using Cronbach's alpha, with scores above 0.7 indicating satisfactory internal consistency.

The questionnaire was administered in person by trained interviewers in public places and health centers to collect reliable and representative data.

Statistical Analysis

Descriptive analyses were used to summarize demographic data and C19-VHS scores. Comparative analyses were conducted using Student's t-tests and ANOVA to compare levels of vaccine hesitancy across sociodemographic variables, followed by post-hoc tests (Tukey) to identify specific differences. Finally, multivariate logistic regression was used to identify predictive factors of vaccine hesitancy, with odds ratios and 95% confidence intervals reported.

RESUT

1. Characteristics of the Study Population

The results presented in **Table 1** reveal statistically significant differences between subgroups for each variable studied ($p < 0.05$). A female predominance was observed (54.5% women vs. 45.5% men), while the most represented age group was 31-40 years (28.7%),

followed by 41-50 years (24.8%). The level of education showed a high proportion of participants with advanced education, with 31.7% having pursued higher education and 30.7% holding a baccalaureate degree. Regarding marital status, married individuals constituted 50.5% of the sample, compared to 49.5% who were single, divorced, or widowed, with a significant difference between these groups. Finally, the geographic distribution highlighted a strong concentration in urban areas (91.1%), contrasting with 8.9% of participants from rural areas. These results underscore notable disparities between the different categories studied, supported by p-values < 0.01.

Table 1 : Sociodemographic Characteristics of Participants

Characteristic	Categories	Percentage	P-value
Gender	Female	54,5 %	< 0,01
	Male	45,5 %	
Age Group	18-25 years	11,9 %	< 0,01
	26–30 years	18,8 %	
	31–40 years	28,7 %	
	41–50 years	24,8 %	
	51 years and above	15,8 %	
Education Level	Illiterate	07,9 %	< 0,01
	Primary School	13,9 %	
	Secondary School	15,8 %	
	Baccalaureate	30,7 %	
	Higher Education	31,7 %	
Marital Status	Married	50,5 %	< 0,01
	Others (Single, Divorced, Widowed)	49,5 %	
Place of Residence	Urban	91,1 %	< 0,01
	Rural	08,9 %	

Results from **Table 2** show statistically highly significant differences between the studied subgroups ($p < 0.01$), indicating a non-random distribution of the participants socioeconomic characteristics. The distribution of participants based on employment status is nearly equal between the unemployed and the employed, highlighting the absence of a strong disparity between these two groups. On the other hand, the distribution of family income reveals that a majority of participants have limited resources, with more than half earning less than 3,000 dirhams per month and a significant proportion reporting an income below 6,000 dirhams. These disparities, confirmed by a p-value < 0.01, indicate a marked and statistically significant socioeconomic disparity within the studied sample.

Table 2: Socioeconomic Characteristics of Participants

Characteristic	Categories	Percentage	P-value
Employment Status	Employed	50,5 %	< 0,01
	Unemployed	49,5 %	< 0,01
Monthly Family Income (2019)	Less than 3,000 dirhams	51,5 %	< 0,01
	3,000 – 6,000 dirhams	18,8 %	< 0,01
	6,000 – 12,000 dirhams	23,8 %	< 0,01
	12,000 – 25,000 dirhams	05,9 %	< 0,01

Results from **Table 3** reveal that 64.4% of participants rated their health status as good or very good, while 35.6% described it as fair, poor, or very poor, indicating a significant proportion in precarious health conditions. Additionally, 62.4% of participants reported no comorbidities, while 37.6% reported at least one. Among the latter, diabetes and hypertension (14.9% each) were the most frequent, followed by asthma and pregnancy (4.0% each). These disparities, supported by a p-value of less than 0.01, confirm notable and statistically significant differences between the studied groups.

Table 3: Health Status and Comorbidity Characteristics of Participants

Characteristic	Categories	Percentage	P-value
Health Status	Good or Better (Good, Very Good)	64,4 %	< 0,01
	Fair or Worse (Fair, Poor, Very Poor)	35,6 %	< 0,01
Comorbidities	No Comorbidity	62,4 %	< 0,01
	Asthma	04,0 %	< 0,01
	Pregnancy	04,0 %	< 0,01
	Diabetes	14,9 %	< 0,01
	Hypertension (HTA)	14,9 %	< 0,01

2. Validation of the COVID-19 Vaccine Hesitancy Scale (C19-VHS)

a. Test-Retest Reliability

The C19-VHS questionnaire was administered to 50 participants and then redistributed after two weeks. The results showed an intraclass correlation coefficient (ICC) close to 1, proving that the participants' responses were consistent and reproducible between the two administrations. This confirms the reliability of the questionnaire for stably and accurately measuring the targeted characteristics.

b. Construct Validity

The Kaiser-Meyer-Olkin (KMO) index obtained for this analysis was 0.845, which is considered excellent, indicating that the data were suitable for Principal Component Analysis (PCA) (**Table 4**). Additionally, Bartlett's test of sphericity confirmed that the correlations between the variables were not zero, justifying the use of PCA. The high Chi-square value (467.405) with a very low significance level (0.000) demonstrates that the relationships between the variables were strong enough to allow the extraction of significant factors.

Table 4: KMO Index and Bartlett's Test of Sphericity for the C19-VHS Questionnaire

KMO Measure of Sampling Adequacy		0,845
Bartlett's Test of Sphericity	Chi-square	467,405
	Df	36
	Sig.	0

c. Principal Component Analysis (PCA)

The Principal Component Analysis **(Figure 1)** revealed that the first two components have eigenvalues greater than 1, making them significant for interpretation. The first component, with an eigenvalue of 4.681, explains 52.008% of the variance, while the second component brings the total to 65.137%, capturing the majority of the information contained in the data. The sums of squared extraction loadings confirm that the first two components are the primary sources of variance in the data. After rotation, Component 1 represents 47.685% of the variance, and Component 2 explains 17.452%.

A confirmatory principal component analysis shows that the first component has an eigenvalue of 4.479 and alone explains 63.982% of the total variance, suggesting unidimensionality.

This indicates that the various items of the C19-VHS questionnaire likely measure a major common factor, corresponding to a general attitude toward vaccination (beliefs about safety, efficacy, or perceived risks of vaccines).

These results confirm the psychometric robustness of the questionnaire and reinforce the idea that it assesses a dominant dimension related to vaccine hesitancy.

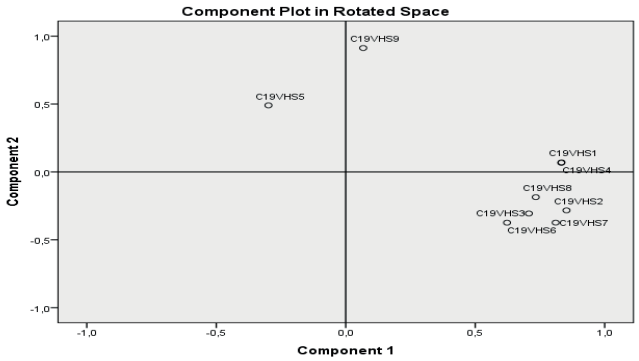

Figure 1: Principal Component Analysis (PCA) of the C19-VHS Items

d. Results of Varimax Rotation

The results of the Varimax rotation reveal that **Factor 1** captures a principal dimension of vaccine hesitancy, referred to as **Trust and Positive Perception of COVID-19 Vaccines**. The high factor loadings on this factor (ranging from 0.715 to 0.897) indicate a strong correlation between the variables, highlighting that this factor groups perceptions related to vaccine efficacy, their importance for individual and community health, trust in vaccination programs, and the intention to follow medical recommendations (Table 5).

This consistency demonstrates that **Factor 1** represents a coherent and principal dimension of attitudes toward COVID-19 vaccines. The strong association of the items with **Factor 1** after Varimax rotation indicates that this factor is a reliable measure of trust and positive attitudes toward COVID-19 vaccines. For example, the item **C19VHS2**, with the highest loading (0.897), emphasizes the perceived importance of vaccine efficacy, while **C19VHS7** and **C19VHS1** highlight the personal importance and protection offered by the vaccines.

Table 5: Factor Loadings Representing the Correlations Between Variables and the Retained Factor of the C19-VHS Questionnaire

Items	Factor 1	Dimension
C19-VHS2	0,897	Trust and Positive Perception of COVID-19 Vaccines
C19-VHS7	0,88	
C19-VHS1	0,782	
C19-VHS4	0,777	
C19-VHS3	0,768	
C19-VHS8	0,763	
C19-VHS6	0,715	

e. Reliability Test of Retained Items After Purification

The obtained Cronbach's alpha is 0.903, indicating excellent internal reliability of the questionnaire. This demonstrates that the 7 items are strongly correlated with each other and consistently measure the dimension of **"Trust and Positive Perception of COVID-19 Vaccines".** This high internal consistency reinforces the validity of the questionnaire for assessing this dimension, ensuring that the responses to the different items are aligned and reliable **(Table 6).**

Table 6: Reliability Test Results of the C19-VHS Questionnaire

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	Number of Items (N)
0,903	0,905	7

3. Results of Responses to Items in the Dimension "Trust and Positive Perception of COVID-19 Vaccines"

The results in **table 7** reveal a significant polarization of opinions regarding COVID-19 vaccines. Nearly 23.8% of participants strongly disagree about the importance of vaccines for their health (**C19-VHS1**), and 23.8% remain neutral. Only 12.9% strongly agree, reflecting a lack of clear consensus.

Regarding vaccine efficacy (**C19-VHS2**), 22.8% strongly disagree and 19.8% disagree. The majority of responses fall in the neutral category (26.7%), while only 5.9% of participants strongly agree, indicating a trend toward skepticism.

For community health (**C19-VHS3**), 33.7% of participants remain neutral, while negative responses (strongly disagree and disagree) reach 35.7%, compared to 30.7% positive opinions. This reflects general indecision about the collective value of vaccination.

The idea that all vaccines in the government program are beneficial (**C19-VHS4**) also receives significant neutral responses (41.6%). Only 15.8% of participants agree, and a mere 1% strongly agree, indicating widespread distrust.

Perceptions of the reliability of vaccine information (**C19-VHS6**) are largely skeptical, with 23.8% strongly disagreeing, 27.7% disagreeing, and only 19.8% expressing positive opinions.

Regarding the effectiveness of vaccination as a means of personal protection (**C19-VHS7**), 29.7% strongly disagree, and only 12.9% strongly agree.

Finally, 14.9% of participants strongly disagree or disagree, while a majority (26.7%) agrees, and 22.8% strongly agree. This indicates a positive intention to follow the recommendations of doctors and healthcare providers regarding COVID-19 vaccination (**C19-VHS8**).

These results highlight widespread skepticism and a significant tendency toward neutrality. It is essential to strengthen communication, improve the transparency of information, and promote evidence-based educational campaigns to build trust in vaccines.

Table 7: Results of Responses to Items in the Dimension "Trust and Positive Perception of COVID-19 Vaccines"

Item	Responses				
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
C19-VHS1	23,8 %	19,8 %	23,8 %	19,8 %	12,9 %
C19-VHS2	22,8 %	19,8 %	26,7 %	24,8 %	05,9 %
C19-VHS3	14,9 %	20,8 %	33,7 %	21,8 %	08,9 %
C19-VHS4	18,8 %	22,8 %	41,6 %	15,8 %	01,0 %
C19-VHS6	23,8 %	27,7 %	28,7%	08,9 %	10,9 %
C19-VHS7	29,7 %	15,8 %	19,8 %	21,8 %	12,9 %
C19-VHS8	14,9 %	14,9 %	20,8 %	26,7 %	22,8 %

4. Results of the C19-VHS Questionnaire Scores

The results in **Table 8** of the COVID-19 vaccination questionnaire reveal a majority of skeptical or uncertain attitudes among participants. Approximately 37.6% of participants exhibit strong vaccine hesitancy, while 24.8% show moderate hesitancy. Only 2% of participants demonstrate strong acceptance of vaccines. This distribution highlights the prevalence of hesitancy and concerns, particularly related to distrust in vaccines and confidence in health authorities. The results also show that 35.6% of participants have moderate vaccine acceptance, suggesting that additional information and clear communication could influence their decision. The high proportion of neutral and negative responses underscores the importance of targeted initiatives to build trust and vaccine acceptance, particularly through factual and transparent messaging.

Table 8: Results of the C19-VHS Questionnaire Scores

Questionnaire Scores	Percentage
Strong Vaccine Hesitancy	37,6 %
Moderate Vaccine Hesitancy	24,8 %
Moderate Vaccine Acceptance	35,6 %
Strong Vaccine Acceptance	02,0 %

5. Correlation Between COVID-19 Vaccine Hesitancy and Sociodemographic Parameters

The analysis of correlations between the C19-VHS (Vaccination Hesitancy Scale) score and sociodemographic parameters highlights significant relationships to better understand the factors influencing hesitancy toward COVID-19 vaccination **(Table 9).**

First, gender has almost no impact, with a near-zero correlation (0.001), indicating that being male or female does not significantly alter the level of vaccine hesitancy. Additionally, a slight negative correlation (-0.077) between age and vaccine hesitancy suggests that older individuals are slightly less hesitant.

Regarding education level, a weak positive correlation (0.05) reveals that more educated individuals show a slightly higher degree of hesitancy, a counterintuitive result that may reflect specific beliefs or excessive caution.

On the other hand, marital status is negatively correlated (-0.111), indicating that married or partnered individuals are less hesitant to get vaccinated. In contrast, neither employment status (0.008) nor family income (0.000) has a notable influence on vaccine hesitancy.

In terms of health, individuals with chronic conditions (0.083) or those who perceive their health as good (0.114) show slightly higher hesitancy. These results indicate that certain health and sociodemographic factors exert a limited influence.

Table 9: Correlation between COVID-19 Vaccine Hesitancy and Sociodemographic Parameters

Variables	C19-VHS Scores
Gender	0,001
Age	-0,077
Education Level	0,05
Marital Status	-0,111
Employment Status	0,008
Total Family Income in 2019	0,000
Health Status	0,114
Presence of Chronic Conditions	0,083
Vaccination Against Any Disease	0,134

DISCUSSION

This study aimed to validate the Moroccan version of the *COVID-19 Vaccine Hesitancy Scale* (C19-VHS) and assess its reliability and validity in measuring vaccine hesitancy within the Moroccan population. The primary objective was to provide a robust tool for understanding the factors influencing vaccine hesitancy in Morocco, while also comparing these findings with similar studies conducted in other countries to identify universal and context-specific trends.

The comparison between the validation of the Moroccan version of the C19-VHS and that conducted in Malaysia highlights several aspects, particularly reliability. According to the results, our study demonstrated very high temporal stability of the results, with an intraclass correlation coefficient (ICC) close to 1 in the test-retest framework. This indicates that the Moroccan questionnaire reproducibly measures vaccine hesitancy, thereby strengthening the reliability of the results. Although the Malaysian study did not report a test-retest, it highlighted strong internal consistency, with a Cronbach's alpha of 0.953, similar to our Cronbach's alpha of 0.903. Both studies thus demonstrate excellent

reliability of the instrument in distinct contexts.

In terms of construct validity, our study revealed a unidimensional structure explaining 65.137% of the total variance. This approach suggests that vaccine hesitancy is unidimensional in the Moroccan context. In contrast, the Malaysian study confirmed this unidimensional structure, with 9 items explaining nearly 64% of the variance [6]. However, an Israeli study identified two distinct factors: "lack of trust" (Factor 1) and "risk perception" (Factor 2). This suggests that in this population, vaccine hesitancy is perceived more complexly, divided between concerns about vaccine safety and reliability (Factor 1) and an assessment of risks associated with the vaccine or the disease (Factor 2)[7].

Another point of comparison concerns the prediction of vaccine acceptance. In the two-factor study, lower hesitancy was a significant predictor of vaccine uptake (OR = 1.16, 95% CI 1.11–1.21, p < .001), after adjusting for demographic and pandemic-related variables. These results show a direct influence of vaccine hesitancy on actual vaccination behavior, which is a crucial point for public health policies [7].

Furthermore, the results of our study corroborate and provide new insights into COVID-19 vaccine hesitancy, particularly in the context of previous findings observed in France and other countries[8]. The first key observation of our study lies in the strong association between categorical refusal of vaccination and certain sociodemographic characteristics, such as being female, having a low level of education, and a lower adherence to recommended vaccinations in the past. This trend is consistent with previous studies that have shown these characteristics are often predictive of greater vaccine hesitancy due to underlying distrust in healthcare systems and a low perception of the severity of COVID-19.

Our results show a categorical refusal of vaccination at 37.6%, which aligns with the refusal rate observed in other studies conducted in France at the beginning of the pandemic [9]. A similar study conducted in July 2020 found that approximately 29% of the working population would refuse to get vaccinated against COVID-19, highlighting the persistence of this reluctance over time. Moreover, this reluctance showed no significant association with information about the collective benefits of herd immunity or recommendations from a general practitioner, reinforcing the idea that vaccine refusal is often motivated by pre-existing beliefs and strong decisional certainty.

The most frequently cited reasons for refusing vaccination were: general opposition to vaccines, safety concerns or the belief that a rapidly developed vaccine is too risky, the perception that COVID-19 is not severe and that the vaccine is therefore unnecessary, a lack of overall trust, doubts about vaccine efficacy, the belief of being already immune, and uncertainties about the origin of the vaccine [5,10].

Additionally, one of the key findings of our study is the inverted U-shaped relationship between age and vaccine hesitancy, with maximum vaccine acceptance observed at the extremes of the age spectrum (18-24 years and 55-64 years). This suggests that younger adults and older adults, who are at higher risk of virus transmission and severe disease, respectively, are more inclined to get vaccinated. These results align with previous studies showing that younger, more mobile populations are generally more willing to participate in collective efforts to limit virus transmission[11]

On the other hand, the study revealed that participants with a low perception of the severity of COVID-19 were more likely to refuse the vaccine[12,13]. This highlights the importance of individual risk perception related to the disease in vaccination decisions, particularly among those without underlying chronic conditions. These findings reaffirm the conclusions of previous studies that identified vaccine complacency as a key factor in anti-vaccination behavior, a phenomenon fueled by a reduced perception of personal risks associated with COVID-19 [14].

CONCLUSION

In summary, our data demonstrate that vaccine hesitancy towards the COVID-19 vaccines is mainly determined by the perceived effectiveness of the vaccines, their geographical origin and place of administration. Clear and transparent dialogue on vaccine safety and its effectiveness is essential step to enhance the acceptance rate.

Furthermore, targeting young adults in vaccination campaigns is crucial, as they play a key role in limiting virus transmission. In addition, adults are generally more willing to accept vaccination. However, a strict age-based prioritization could delay the achievement of herd immunity. Finally, although our study was conducted in a context of limited knowledge about

vaccines, it emphasizes the importance of continuously monitoring concerns related to vaccine safety and trust in manufacturers.

Consent for Publication

The author reviewed and approved the final version and has agreed to be accountable for all aspects of the work, including any accuracy or integrity issues.

DISCLOSURE

The author declares that they do not have any financial involvement or affiliations with any organization, association, or entity directly or indirectly related to the subject matter or materials presented in this review paper. This includes honoraria, expert testimony, employment, ownership of stocks or options, patents, or grants received or pending royalties.

Data Availability

Information for this review paper is taken from freely available sources.

Authorship Contribution

All authors contributed significantly to the work, whether in the conception, design, utilization, collection, analysis, and interpretation of data or all these areas. They also participated in the paper's drafting, revision, or critical review, gave their final approval for the version that would be published, decided on the journal to which the article would be submitted, and made the responsible decision to be held accountable for all aspects of the work.

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