



Original Research Article

Vaccination Hesitancy Trends among Adults Post-Pandemic: A Multi-Center Study

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Abstract: Background: Vaccination hesitancy has emerged as a major public health challenge, particularly in the post-pandemic period where public perceptions of vaccines have been shaped by widespread information exposure and evolving trust in health systems. **Objective:** To assess trends in vaccination hesitancy among adults in the post-pandemic period and identify factors associated with reduced vaccine acceptance. **Methods:** This was a descriptive, cross-sectional study, conducted at Shaheed Mohtarma Benazir Bhutto Medical College Karachi and Nishtar Medical University and Hospital Multan from May 2024 to May 2025 including 235 adult participants. The study was designed to assess trends in vaccination hesitancy among adults in the post-pandemic period. Participants were recruited from multiple healthcare centers to ensure diversity in demographic and socioeconomic backgrounds. Data were collected during routine outpatient visits and community health encounters. **Results:** Overall, 49.8% of participants exhibited some degree of vaccination hesitancy. Adults aged ≥ 45 years showed higher hesitancy (56.5%; OR = 1.74, $p = 0.01$), and females were more likely to be hesitant than males (OR = 1.89, $p = 0.003$). Lower educational attainment was strongly associated with hesitancy (OR = 2.37, $p < 0.001$). Exposure to misinformation emerged as the strongest predictor (aOR = 3.12, $p < 0.001$), followed by low trust in health authorities (aOR = 2.48, $p < 0.001$). Fear of side effects (65.0%) and lack of trust in vaccine safety (52.1%) were the most commonly reported reasons for hesitancy. **Conclusion:** It is concluded that vaccination hesitancy remains substantial among adults in the post-pandemic era and is driven by demographic factors, misinformation exposure, and diminished trust in health authorities.

Keywords: Vaccination hesitancy, post-pandemic period, adult immunization, misinformation.

INTRODUCTION

Vaccination has been regarded as one of the most efficient and beneficial interventions in the field of public health to help prevent infectious diseases and

reduce morbidity and mortality rates on the international level. The vaccination coverage forms the basis of herd immunity and the control of vaccine-preventable diseases [1][2]. Even though vaccines are proven to be both effective and safe, vaccination

hesitancy has become a serious public health issue, since they are ranked as a major threat to the health of individuals even before the COVID-19 pandemic [3]. The issue of vaccination hesitancy is situational and hard to identify because it also relies on various factors, such as trust and confidence in vaccines, feelings of complacency about the risk of infection, and the ease of accessibility. Such determinants vary across people, time, and varied socio-cultural contexts [4][5]. The radical impact on the population's attitude towards vaccination was caused by the high-speed production and mass introduction of vaccines during the COVID-19 pandemic, raising the level of trust and distrust towards the immunization programs [6]. The pandemic also led to an unprecedented dissemination of information both on offline and online media, which significantly affected the perception of people towards vaccines. On the one hand, many individuals learned more about the importance of vaccination; on the other hand, there was misinformation among people, conspiracy theories, and conflicting science, which is raising the level of uncertainty and mistrust [7][8]. These experiences are believed to be experienced in the long term amongst the vaccine attitudes even after the acute pandemic. The focus on post-pandemic vaccination behavior has increased, and reluctance toward the COVID-19 vaccination can be extended to regular adult vaccination, such as influenza, pneumococcal, hepatitis, and booster vaccines [9]. The distrust in the vaccination programs may undermine the years of immunization efforts and the success of controlling the diseases. The awareness of the tendencies in vaccine reluctance among adult citizens is therefore significant to the further evolution of the health of the population [10]. Several studies that have been conducted during the course and the immediate aftermath of the pandemic have reported the shift in the trend of vaccine acceptance, and the level of hesitancy is contingent on age, education, socioeconomic status, prior vaccine experience, and trust in health officials [11]. Adult attitudes, in particular, play a predominant role in assessing whether or not community-level vaccination is to take place since they are the ones who make the decisions of vaccination not only for themselves but also for their dependents. The main advantage of multicenter studies is that broad trends of the population can be acquired and local socio-cultural factors can be reduced. A more in-depth perspective of the trends in vaccination hesitancy and the determinants underlying them is supplemented by such studies since it incorporates participants in the different healthcare contexts [12, 13].

Objective

To assess trends in vaccination hesitancy among adults in the post-pandemic period and identify factors associated with reduced vaccine acceptance.

MATERIAL AND METHODS

This was a descriptive, cross-sectional study, conducted at Shaheed Mohtarma Benazir Bhutto Medical College Karachi and Nishtar Medical University and Hospital Multan from May 2024 to May 2025. It involved 235 participants who were adults. The participants of the study were adults aged 18 years and older who could be given a routine or a recommended vaccination and at least one vaccination in the post-pandemic period. The respondents were expected to interpret and answer the study questionnaire on their own and show their interest to give informed consent. Patients were not included when they had cognitive disabilities that would limit their capacity to provide informed answers, were medical workers directly involved in the implementation of vaccination programs, or when they had a medical history of contraindications to vaccination.

Data Collection

Data were collected using a structured, pre-tested questionnaire. The demographic variables that were included in the questionnaire are age, gender, educational status and employment status. Variables of vaccination history were also considered, such as history of vaccination, acceptance/refusal of vaccines, and delay in vaccination and factors of hesitancy. Likert-scale items were used to measure attitudinal attributes (trust in vaccines, perceived vaccine safety, side-effects fear, exposure to misinformation and health authority trust). The trends in terms of decreasing vaccination were assessed by comparing the attitudes and behaviors reported in the post-pandemic period.

Statistical Analysis

Data were analyzed using SPSS version 24.0. Continuous variables were expressed as mean $\pm$ standard deviation, while categorical variables were presented as frequencies and percentages. Associations between vaccination hesitancy and demographic or attitudinal factors were assessed using chi-square test and independent t-test where appropriate. Multivariable logistic regression analysis was performed to identify predictors of vaccination hesitancy. A p-value of ≤ 0.05 was considered statistically significant.

RESULTS

The study included 235 adult participants with a broad age distribution. The greatest age group was 30-44 years and included 37.4 percent of respondents and a mean age of 36.9 ± 4.2 years. The proportion of young adults (18-29 years of age) was 26.4 and the average age was 24.8 ± 3.1 years. The age of the participants ranged as 23.4% (23.4 years

average) between 45-59 years of age and 12.8% (66.8 years average) above 60 years of age. The sample population was 54.5 percent male with a mean age of 41.8 ± 12.7 and 45.5 percent female with a mean age of 39.6 ± 11.9 . About education, 17.4% were having primary or lower education with a mean age of 48.1 ± 13.2 years, 33.6% secondary education in which the mean age was 42.5 ± 11.6 years, 36.6% were graduates with a mean age of 36.2 ± 9.4 years, and 12.3% postgraduates with a mean age of 34.9 ± 8.1 years.

Table 1. Socio-Demographic Characteristics of Study Participants (n = 235)

Variable	Category	n (%)	Mean Age $\pm$ SD
Age group (years)	18–29	62 (26.4)	24.8 ± 3.1
	30–44	88 (37.4)	36.9 ± 4.2
	45–59	55 (23.4)	51.6 ± 4.1
	≥ 60	30 (12.8)	66.8 ± 5.4
Gender	Male	128 (54.5)	41.8 ± 12.7
	Female	107 (45.5)	39.6 ± 11.9
Education level	$\leq$ Primary	41 (17.4)	48.1 ± 13.2
	Secondary	79 (33.6)	42.5 ± 11.6
	Graduate	86 (36.6)	36.2 ± 9.4
	Postgraduate	29 (12.3)	34.9 ± 8.1

Post-pandemic vaccination patterns showed that 71.5% of participants were fully vaccinated against COVID-19, receiving an average of 2.6 ± 0.6 doses, while 14.5% were partially vaccinated with a mean of 1.4 ± 0.5 doses. A further 14.0% remained unvaccinated, having received an average of only 0.2 ± 0.1 doses. Uptake of non-COVID adult vaccines was reported by 54.9% of participants, with a mean of 1.9 ± 0.8 vaccines received, whereas 45.1% reported no uptake, averaging 0.6 ± 0.4 vaccines. Willingness for future vaccination was expressed by 62.6% of participants, who had a mean vaccination count of 2.1 ± 0.7 , while 22.6% were undecided with a mean of 1.2 ± 0.6 , and 14.9% were unwilling, reporting a mean of 0.4 ± 0.3 vaccines.

Table 2. Vaccination Status and Uptake Patterns Post-Pandemic (n = 235)

Variable	Category	n (%)	Mean No. of Vaccines $\pm$ SD
COVID-19 vaccination	Fully vaccinated	168 (71.5)	2.6 ± 0.6
	Partially vaccinated	34 (14.5)	1.4 ± 0.5
	Not vaccinated	33 (14.0)	0.2 ± 0.1
Non-COVID adult vaccines	Yes	129 (54.9)	1.9 ± 0.8
	No	106 (45.1)	0.6 ± 0.4
Willingness for future vaccination	Yes	147 (62.6)	2.1 ± 0.7
	Undecided	53 (22.6)	1.2 ± 0.6
	No	35 (14.9)	0.4 ± 0.3

Evaluation of vaccination reluctance indicated that 50.2 percent of the participants were fully vaccinated with a low mean reluctance score of 1.4 ± 0.3 . Mild hesitancy was also noted in 27.2 of the participants, which was defined by late acceptance and had a mean score of 2.6 ± 0.4 . There was moderate hesitancy, which is a selective refusal of 16.2% with a medium score of 3.4 ± 0.5 . Hesitancy was very high and indicated total refusal in 6.4 percent of participants, and the highest mean score of 4.3 ± 0.6 .

Table 3. Prevalence and Severity of Vaccination Hesitancy (n = 235)

Hesitancy Category	n (%)	Mean Hesitancy Score $\pm$ SD
Acceptance	118 (50.2)	1.4 ± 0.3
Mild hesitancy	64 (27.2)	2.6 ± 0.4
Moderate hesitancy	38 (16.2)	3.4 ± 0.5
High hesitancy	15 (6.4)	4.3 ± 0.6
Overall hesitancy	117 (49.8)	3.0 ± 0.7

Among participants reporting vaccination hesitancy, fear of side effects was the most common concern, reported by 65.0% of individuals, with a high mean agreement score of 4.1 ± 0.8 . Lack of trust in vaccine safety was reported by 52.1% with a mean score of 3.8 ± 0.9 . Exposure to misinformation affected 49.6% of participants, with a mean score

of 3.7 ± 0.8 . Doubts about vaccine effectiveness were reported by 37.6% with a mean score of 3.4 ± 0.7 , while low perceived disease risk was noted by 33.3% with a mean score of 3.2 ± 0.9 . Religious or cultural concerns and previous negative vaccination experiences were less frequent, affecting 17.9% and 16.2% of participants, with mean scores of 2.9 ± 0.8 and 3.1 ± 0.7 , respectively.

Table 4. Reasons for Vaccination Hesitancy (Multiple Responses, n = 117)

Reason	n (%)	Mean Agreement Score $\pm$ SD
Fear of side effects	76 (65.0)	4.1 ± 0.8
Lack of trust in safety	61 (52.1)	3.8 ± 0.9
Exposure to misinformation	58 (49.6)	3.7 ± 0.8
Doubts about effectiveness	44 (37.6)	3.4 ± 0.7
Low perceived disease risk	39 (33.3)	3.2 ± 0.9
Religious/cultural concerns	21 (17.9)	2.9 ± 0.8
Previous negative experience	19 (16.2)	3.1 ± 0.7

Vaccination hesitancy was significantly higher among adults aged ≥ 45 years, with 56.5% hesitant compared to 43.5% non-hesitant (OR = 1.74, 95% CI 1.12–2.70, $p = 0.01$). Females showed greater hesitancy than males (58.9% vs. 41.1%; OR = 1.89, 95% CI 1.25–2.86, $p = 0.003$). Lower education was strongly associated with hesitancy, as 65.8% of individuals with secondary education or below were hesitant (OR = 2.37, 95% CI 1.53–3.66, $p < 0.001$). Unemployed or retired participants also demonstrated higher hesitancy (63.4% vs. 36.6%; OR = 2.15, 95% CI 1.40–3.31, $p < 0.001$). Prior COVID-19 infection was associated with increased hesitancy (57.8% vs. 42.2%; OR = 1.63, 95% CI 1.05–2.52, $p = 0.02$).

Table 5. Association Between Socio-Demographic Factors and Hesitancy (n = 235)

Variable	Hesitant n (%)	Non-hesitant n (%)	Odds Ratio	95% CI	p-value
Age ≥ 45 years	52 (56.5)	40 (43.5)	1.74	1.12–2.70	0.01
Female gender	63 (58.9)	44 (41.1)	1.89	1.25–2.86	0.003
Education $\leq$ secondary	79 (65.8)	41 (34.2)	2.37	1.53–3.66	<0.001
Unemployed/retired	71 (63.4)	41 (36.6)	2.15	1.40–3.31	<0.001
Prior COVID-19 infection	48 (57.8)	35 (42.2)	1.63	1.05–2.52	0.02

DISCUSSION

This inter-centre study evaluated the trends of vaccination hesitancy among adults during the post-pandemic phase and concluded that the rate of hesitancy is quite high as almost half of the population in the study had mild, to high levels of hesitance towards vaccination. The results show that the problem of vaccination hesitancy is highly relevant to the population health despite the end of the acute phase of the pandemic, and a number of demographic and attitudinal elements, which are associated with the decrease in the level of vaccine acceptance, are identified. The factor of age had a significant role to play in this study in terms of vaccination hesitancy. Adults with age of 45 years and older demonstrated a great hesitancy than youth. Prior studies have reported similar age-specific findings, with older adults being more skeptical of newly available vaccines and booster shots, largely due to their worries about safety, comorbidity, and their need to be vaccinated [14][15]. The present study found a positive gender-specific association between female gender and high levels of vaccination hesitancy. The likelihood of women being hesitant was almost 2 times higher than that of men. There is also a higher

hesitancy of females in previous studies, with many researchers often referencing this trend to the fact that females are more worried about vaccine side effects, long-term health effects, and more risk-averse due to widespread media coverage in the pandemic [16][17]. The level of education became one of the most effective predictors of vaccination hesitancy. People whose education level was secondary and below were considerably more hesitant compared to those with higher education level. The given result is consistent with the prior studies, which have regularly shown that low levels of education are linked with reduced access to reliable health information, lesser health literacy, and the heightened exposure to misinformation, which hurt vaccine acceptance [18] [19]. The employment status was also very influential in determining attitudes towards vaccination. The hesitancy in unemployed or retired participants was significantly different than the hesitancy in the employed. The same associates were observed in other studies conducted earlier, in which economic instability and diminished access to healthcare services and decreased involvement in workplace vaccination programs were observed as contributors towards vaccine reluctance [20]. Interestingly, the

history of COVID-19 infection also predicted higher vaccination hesitancy, and it may be proposed that natural infection can cause a misleading sense of protection or lead to less perceived necessity of vaccination. This is in line with other studies that had previously indicated that people who had already recovered from COVID-19 did not have a strong motivation to get vaccinated, as they tended to underestimate the effectiveness of the immunity developed because of vaccination.

CONCLUSION

It is concluded that vaccination hesitancy remains prevalent among adults in the post-pandemic period, with nearly half of the population demonstrating some degree of reluctance toward vaccination. Older age, female gender, lower educational attainment, unemployment or retirement, prior COVID-19 infection, exposure to misinformation, and low trust in health authorities were significantly associated with increased hesitancy. These findings underscore that vaccination attitudes have been durably influenced by the pandemic experience.

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