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Determinants of COVID-19 vaccine uptake amongst traders in Wakulima Market, a cross-sectional study in Nairobi City County, Kenya

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Abstract

Introduction: *COVID-19 has been recognized as one of the greatest public health challenges, resulting in increased mortality worldwide. Various strategies have been implemented to address the challenge, including the development of COVID-19 vaccine to prevent its further spread. The study aimed at assessing the contextual, individual, and perceptual factors influencing COVID-19 vaccine uptake among traders in Wakulima Market, Nairobi, Kenya.* ***Methods:*** *this study employed a cross-sectional study design that used both quantitative and qualitative approaches. Quantitative data were collected using structured questionnaires administered to 353 traders, while qualitative data were gathered through key informant interviews with 30 county health officials. Quantitative data were analysed using SPSS version 25, whereby descriptive and inferential statistics were computed. Qualitative data from key informant interviews were analyzed using a thematic analysis approach.* ***Results:*** *the study found that if perceptual factors, individual factors, and contextual factors were held constant at zero, COVID-19 vaccine uptake amongst traders would be 2.938. Multiple linear regression revealed that a unit increase in contextual factors would lead to a 0.143 rise in the COVID-19 vaccine uptake among the traders (p=0.004). On the other hand, a unit increase in individual factors led to a 0.135 increase in the COVID-19 vaccine uptake among the traders (p=0.005) while a unit increase in perceptual factors led to a 0.149 increase in the COVID-19 vaccine uptake among the traders (p=0.002).* ***Conclusion:*** *the results indicated that individual, contextual, and perceptual factors influence COVID-19 vaccine uptake among the traders. This suggests the need to implement strategies aimed at enhancing vaccine uptake among the traders.*

Introduction

The emergence of the SARS-CoV-2 virus in Wuhan, China, in December 2019 rapidly evolved into a global health crisis [1,2]. Countries developed various public health interventions aimed at minimising the spread of the virus. The strategies included case detection and isolation, implementation of quarantine procedures, cross-border control, and testing measures. Furthermore, countries and organizations implemented various restrictions, including limiting public gatherings, maintaining social distancing, and closing educational institutions and businesses [3-5].

However, despite these efforts, COVID-19, a disease caused by the SARS-CoV-2 virus, continued to spread and affect the lives of the general population [5-7]. In this view, pharmaceutical companies like Pfizer-BioNTech, Moderna, AstraZeneca, Johnson & Johnson, and Novavax developed the COVID-19 vaccine aimed at providing artificially acquired immunity and ensuring that COVID-19 does not result in severe disease and death.

Strategies were implemented to raise awareness and promote the uptake of the vaccine worldwide. Various studies highlighted various strategies aimed at promoting the adoption of vaccination programs for the general population. The World Health Organization, in collaboration with various healthcare organizations, was involved in implementing awareness programs by disseminating health literacy information on the COVID-19 vaccine [8,9]. Among the strategies employed were social media, radio, television, community mobilization programs, and advocacy initiatives [3-5,8].

During the implementation of these strategies, there was increased evidence of hesitancy as well as poor uptake of the COVID-19 vaccine. Previous studies showed that a lack of trust in the benefits and significance of the vaccine, as well as social and cultural beliefs related to the vaccine, and side effects associated with the vaccine, were among the factors contributing to hesitancy [3,8]. Kenya was one of the countries with a poor uptake of the COVID-19 vaccine. According to the Ministry of Health in Kenya, only 44% of the eligible population

got at least one vaccine dosage as of April 8th, 2023, with a complete vaccination schedule consisting of two doses for most available vaccines. Studies highlighted poor uptake of the COVID-19 vaccine among the general population, contributed by vaccine unavailability, individual factors such as illiteracy, vaccination perception, and acceptability, and household-level factors including location [10]. Furthermore, other studies reported increased misinformation and conspiracy theories regarding the COVID-19 vaccine among the people, where the masses were being misinformed that the vaccine is a strategy aimed at eliminating Black people across the continent [11,12].

Traders are among high-contact populations, as they are involved in frequent interactions with customers, producers, and various known and unknown individuals in marketplaces. The nature of their role exposes them to contracting the COVID-19 disease. While studies have focused on investigating vaccine hesitancy as its associated factors among the elderly, people living with HIV and other comorbidities, and other categories of individuals susceptible to COVID-19 [7,13-15]. There is a scarcity of literature focusing on the traders, despite their increased exposure risk. This study, therefore, aimed at investigating the factors or determinants of the acceptance and uptake of the COVID-19 vaccine among traders in Wakulima Market, Nairobi, Kenya.

Methods

Study setting: the study was conducted at Wakulima Market, in Nairobi, Kenya. Wakulima Market is situated in Muthurwa within Nairobi´s Central Business District. The traders at the market sell various farm products such as potatoes, vegetables, fruits, and maize. It is one of the city's largest markets, with an estimated population of 3,000 traders [16]. The rapid growth in traders has been attributed to rural-urban migration, whereby many people seek employment and a livelihood in urban areas. The other factor was the strategic location of the market. The high population density within the small market enhances extensive contact among people through trade, leading to a high potential for exposure to SARS-CoV-2, the virus causing COVID-19, justifying the importance of this study.

Study design: this cross-sectional study employed mixed-methods approaches where both qualitative and quantitative data were used to investigate the determinants of COVID-19 vaccination uptake among traders in Wakulima Market, Nairobi City County, Kenya. The approach enabled the researcher to comprehensively investigate the determinants of vaccine uptake, capturing both the broad patterns and detailed perspectives of the traders.

Study population: the study focused on the traders involved in various business activities at Wakulima Market in Nairobi, Kenya. The inclusion criteria were being a trader aged 18 years or older and being willing to provide informed consent. The study also engaged the health officials in the county (immunization assistants and public health officials involved in the COVID-19 vaccination campaign) as key informants to provide other essential information for the study.

Sample size: the sample size for the study was calculated using Yamane´s formula of 1967 [17].

$$n = \frac{N}{1+N(e)^2}$$

Where: N = population size; n = sample size; e = margin error of the study set at ±5%; sample size was:

$$n = \frac{3000}{1+3000\ (0.05)^2} = 3535\ respondents$$

Three hundred and fifty-three respondents, which was 12% of the target population. A total of 30 officials from the health sector were recruited as the Key Informant Interview (KII) respondents to participate in face-to-face interviews.

Sampling: the study employed a systematic random sampling technique to recruit participants, particularly the traders at the market. A list of

registered traders was obtained from the market administration. The sampling interval was calculated by dividing the total number of traders in the market (N=3000) by the sample size of the study (n=353), resulting in a sampling interval of 8. Each trader was assigned a random number, and a random number generator was used to select a starting point between 1 and 8. Thereafter, the traders were selected until the desired sample size was attained. This approach ensured that everyone in the population had an equal chance of being selected. This helped produce a representative sample that accurately reflected the entire population. Furthermore, this strategy was essential as sampling reduced the possibility of selection bias, which occurs when particular groups or people are systematically over- or under-represented in a sample.

For the qualitative component, purposive sampling was used to select 30 key informants. This included county health officers, sub-county public health officers, and market administrators directly involved in COVID-19 vaccination programs. These participants were selected based on their specific roles and expertise in vaccination implementation and market operations. Purposive sampling is important because of its capacity to target specific individuals or groups who bring unique viewpoints or knowledge to the study issue [18].

Data collection: the quantitative data were collected using the questionnaires distributed to traders to leverage their broad reach and yield generalizable results. The questionnaires consisted of closed-ended questions to maintain uniformity in responses, aiding comparative analysis. Concurrently, interviews were conducted to obtain in-depth insights from the key informants. Prior to data collection, pre-testing was conducted among 20 traders from a nearby village market. The village shares common characteristics with the study setting, which enabled the researcher to obtain results that enhanced the data collection tool. Upon identifying the errors, the researchers had to revise the tools by adding some questions, revising others, and removing some irrelevant questions. The reliability index was computed using the internal consistency method. The reliability test was conducted using the Cranach´s Coefficient Alpha, whereby a value of 0.7 and above was accepted as an indicator of the reliability of the tools.

Data analysis: quantitative data were analysed using SPSS version 25.0. Descriptive statistical methods, such as percentages, frequencies, and tables, proved beneficial as they facilitated the straightforward presentation of results through visual aids when needed. Additionally, the research involved correlation and regression analyses to determine the relationship between the variables under study. The regression model outlined below was employed to illustrate the association between the study variables: $Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \varepsilon$, where: Y = COVID-19 vaccine uptake; X_1 = contextual factors; X_2= individual factors; X_3 = perceptual factors; β_1, β_2, and β_3 = coefficients of determination; ε = error term.

Qualitative data were analysed using thematic analysis. Audio recordings from the 30 KIIs were transcribed into written text and reviewed by the research assistants and the researchers. Systematic coding was performed on the transcripts to identify key phrases and sentences, which were later sorted into various themes guided by the research objectives.

Ethical consideration: ethical approval for this study was obtained from the Amref Ethics and Scientific Review Committee (Approval No: ESRC P1249-2022). A research licence (Licence No: NACOSTI/P/22/20352) was obtained from the National Commission for Science, Technology, and Innovation (NACOSTI). Administrative approval was also obtained from the Nairobi City County Government. Written informed consent was obtained from all participants prior to their involvement in the study. The participants were assured of their right to voluntary participation, confidentiality, respect, and privacy.

Results

A total of 353 questionnaires were distributed to the selected traders. Out of these, 256 were completed and returned, yielding a response rate of 72.5%. The primary reasons for non-response included the unavailability of selected traders during the data collection period and some individuals declining to participate or withdrawing due to time constraints imposed by their business activities. A larger portion, 146 (57%), of the participants were female, whereas 110 (43%) were male. The mean age of respondents was 43.67 years (SD = 15.02). The majority of the respondents (62.9%) had a secondary school education; details of demographic information are shown in Table 1.

Vaccination: the study found that almost half of the population at Wakulima Market had not received the COVID-19 vaccines (43%, N=110).

Contextual factors influencing vaccine uptake: In participants were asked to rate their level of agreement with various statements concerning the contextual factors that affect the adoption of COVID-19 vaccines. The respondents strongly agreed that trust in the healthcare system influenced the uptake (mean = 4.6719) and that religious beliefs negatively impacted uptake (mean = 4.6250). Respondents agreed that vaccine accessibility affected uptake (mean = 2.4609) and that literacy, among other literacy barriers, also affected the uptake (mean = 2.1680). The findings suggest that the participants understood how contextual factors impact the uptake of COVID-19 vaccines (Table 2).

The study further engaged the key informants to understand the contextual factors influencing vaccine uptake amongst traders in Wakulima Market, Nairobi City County. Most of the KII pointed out that the availability and accessibility of accurate and reliable vaccine information play a crucial role. They argued that traders in the Wakulima market had limited access to information due to educational disparities or limited internet access and further explained that providing clear and concise information in local languages and utilizing various communication channels improved vaccine awareness, understanding, and uptake. Additionally, some KII participants held that a lack of trust and confidence in vaccines affected the uptake, as traders had specific concerns or doubts about the safety and efficacy of the vaccines. Most of the KII participants pointed out how health literacy levels among traders vary, impacting their ability to comprehend health-related information. Visual aids, simple language, and interactive educational materials can enhance understanding and facilitate informed decision-making regarding vaccination.

Individual factors: the study also investigated individual factors influencing COVID-19 vaccine uptake among the traders (Table 3). The results indicate that the respondents strongly agreed that underlying health conditions prevented uptake (mean = 4.6289) and that vaccine confidence affected the uptake (mean = 4.5156). In addition, the respondents agreed that previous vaccine experiences influenced the uptake rates (mean = 4.4764) and that concerns about vaccine safety deterred people from uptake (mean = 4.4687). Furthermore, the respondents agreed that trust in the vaccine (mean = 4.2734) and knowledge and awareness of the vaccine also affected the uptake (mean = 4.2344). Working hours´ convenience was found to prevent hospital visits (mean = 4.1758). The results suggest that the respondents were aware of individual factors influencing their decision to take the COVID-19 vaccine.

The qualitative results confirmed these findings, as most of the KII indicated that individual perceptions of personal risk regarding COVID-19 influenced vaccine uptake. Specifically, traders who believed they were at a higher risk of contracting the virus or experiencing severe illness were more motivated to get vaccinated. A male KII said that the level of knowledge and awareness about COVID-19 vaccines among individual traders was crucial, as those who had access to accurate information, understood the benefits of vaccination, and were aware of the vaccination process were likely to get

vaccinated. Some KII pointed out that individual attitudes and concerns towards vaccines contributed to vaccine hesitancy, where most traders had reservations about the safety, efficacy, or side effects of COVID-19 vaccines, and rejected uptake. A few KII indicated that previous experiences with vaccines influenced individual attitudes towards COVID-19 vaccination, in that traders with positive experiences with vaccines in the past were open to receiving the COVID-19 vaccine. Further, a few KII held that individual health beliefs and practices shaped vaccine acceptance for some traders, explaining that some traders prioritized traditional or alternative health practices over vaccines. Some of the KII held that the influence of family, friends, and trusted individuals within personal networks affected individual decisions regarding vaccination, where positive endorsements and recommendations from close contacts who had already been vaccinated encouraged individuals to follow suit. A few KII held that time constraints and work commitments affected uptake, where traders had demanding work schedules, which created time constraints and barriers to accessing vaccination services.

Perceptual factors: the results indicated that the respondents strongly agreed that the fear of side effects lowered the uptake (mean = 4.5547). Furthermore, the respondents agreed that the perceived risk and severity made traders fear the uptake (mean = 4.4922) and that vaccine misinformation and myths were prevalent in the market (mean = 4.4453). In addition, it was agreed that vaccine efficacy influenced the uptake (mean = 4.3828), medical experimentation negatively affected the uptake (mean = 4.3125), and health literacy affected uptake among traders (mean = 4.2344). On the contrary, the respondents disagreed that waiting times during injection lowered uptake (mean = 2.2773). The results imply that the respondents were aware of the aspects of perceptual factors influencing the COVID-19 vaccine uptake (Table 4).

The KII unanimously held that risk perception associated with COVID-19 could impact vaccine uptake, where traders who perceived themselves or their close contacts as being at a higher risk of contracting the virus were more likely to get vaccinated (Table 5). Furthermore, most KII held that perceptions about the effectiveness and efficacy of COVID-19 vaccines influenced acceptance and uptake; those traders who had confidence in the vaccines' ability to protect against infection, reduce the severity of illness, and prevent transmission were motivated to vaccinate. In addition, some of the KII held that perceptions of vaccine safety played a significant role in vaccine acceptance and uptake, and traders concerned about the potential side effects or adverse reactions of the vaccines were hesitant to get vaccinated. Additionally, most KII held that peer influence and social norms influenced uptake, where traders who observed their peers, friends, or influential individuals within the market getting vaccinated perceived vaccination as good and followed suit.

Coefficients of Determination: Table 6 presents the results of a multiple linear regression analysis examining the influence of contextual, individual, and perceptual factors on COVID-19 vaccine uptake among traders. The unstandardized and standardized coefficients indicate the strength and direction of each predictor's relationship with the dependent variable (Table 6).

According to the regression model, holding the three independent factors (perceptual, individual, and contextual factors) constant at zero, COVID-19 vaccine uptake among traders would be 2.938. The results further indicate that with the three variables, a unit rise in contextual factors would lead to a 0.143 rise in the COVID-19 vaccine uptake amongst traders. A unit rise in individual factors would lead to a 0.135 increase in the COVID-19 vaccine uptake amongst traders, whereas a unit increase in perceptual factors would lead to a 0.149 increase in the COVID-19 vaccine uptake amongst traders.

At a 95% significance level, perceptual, individual, and contextual factors were significant

determinants of COVID-19 vaccine uptake among traders, with significant values of 0.002, 0.005, and 0.004, respectively. Furthermore, the results indicated that perceptual factors were the most significant determinants of the COVID-19 vaccine uptake amongst traders, with a significance value of 0.002, followed by contextual factors with a significance value of 0.004, and the individual factors were the least influential, with a significance value of 0.005.

Discussion

The study found that 57% of the participants were vaccinated, while 43% were not vaccinated, which is contrary to the strategic plan of ensuring 100% vaccination to enhance the prevention of COVID-19 among the population, including traders. Traders, being in close contact with various people, are required to be among those with a higher vaccination rate. Traders, being in close contact with various people, are required to be among those with a higher vaccination rate. The study found that contextual factors influenced COVID-19 vaccine uptake among the traders in Kenya. It was found that social and cultural factors, peer networks, and trust in the healthcare system were among the contributing factors to poor uptake of the COVID-19 vaccine. Besides having access to information on COVID-19, these traders still had reservations concerning the COVID-19 vaccination. Similar findings were reported in previous studies, which highlighted various factors such as peer influence, whereby social and cultural factors restricted the general population from taking up the vaccine. Among the cultural aspects were religious teachings and beliefs that prevented the use of scientifically designed vaccines [19-21].

Individual factors, such as underlying health conditions, significantly predicted vaccine uptake. This is consistent with the findings from previous studies that reported hesitancy in uptake of COVID-19 vaccine among the people living with HIV, diabetes, high blood pressure, and other healthcare conditions [13-15,22,23]. The hesitancy is attributed to misinformation that the vaccine may interfere with their already weak immune system due to their health condition [13,23]. This suggests the need for implementing strategies to address misinformation among the people. Other individual factors identified were previous vaccine experience, as well as vaccine concerns and fears. Studies have shown that the vaccination was associated with some short-term side effects such as nausea, fever, headache, pain at the injection site, and others [14,24,25]. These effects were found to contribute to the fear of taking the second dose, resulting in hesitancy in uptake. However, these side effects were temporary, and the vaccine was demonstrated to be effective in preventing severe COVID-19 infection [10,25].

Perceptual factors were identified as strong determinants of vaccine uptake. The fear of side effects, as well as the perceived risks and severity, substantially lowered vaccine uptake. Additionally, the myths and misinformation regarding the vaccine were also determinants of hesitancy in vaccine uptake. These findings were consistent with previous studies that reported that various individuals were resistant to getting the vaccine, as they were afraid of developing some side effects. Furthermore, other studies revealed common misinformation spreading across various social media platforms. Some of the conspiracy theories spreading misinformation included the portrayal of COVID-19 vaccines as a population control strategy aimed at eliminating Black people in Africa [26,27] and associating COVID-19 vaccination with satanism [11,27]. Other studies highlighted that misinformation was being spread that the COVID-19 vaccine was a birth control measure, that once one gets vaccinated, they may not be able to have children in the future [4,28]. This was a setback to the reproductive population, as they were afraid of getting the vaccine due to such misinformation. Such misinformation may have an influence in contributing to poor uptake of the vaccine, highlighting the need for effective interventions to provide reliable information to the general population about COVID-19 vaccination.

Limitations: the study targeted the traders involved in various business activities at Wakulima Market in Nairobi, Kenya. As such, the findings obtained in this study may not be applied to the general population of the people in Kenya. Also, various business activities could mean different exposure levels, but this was not considered in the study. low response rate where the study targeted 353 but recruited 256, a response rate of 72%.

Conclusion

The study found that 57% of the participants were vaccinated, whereas 43% were not. The study found various factors ranging from contextual, individual, as well as perceptual factors that were serving as determinants to COVID-19 vaccination among the traders. Among the contextual factors affecting COVID-19 uptake, it was found that social and cultural factors, peer networks, and trust in the health care system were among the determinants of vaccine uptake. Among the individual factors, the study found that the concerns about the safety of the vaccine, underlying health conditions, previous vaccine experience, and trust in the vaccine were determinants of vaccine uptake. On the other hand, perceptual factors such as vaccine misinformation and myths, fear of side effects, perceived risks, and severity were also among the determinants of vaccine uptake. There is a need for the government in Kenya, in collaboration with healthcare organisations, to implement targeted interventions for categories of people who may be prone to COVID-19 infection and prove to other public health challenges with targeted educational programs, to enhance their understanding and promote uptake of the COVID-19 vaccine.

What is known about this topic

- *COVID-19 rapidly spread across the globe, leading to an international health crisis; notable global health challenges necessitated the development and distribution of COVID-19 vaccines as a critical measure to control the spread of the virus*
- *Widespread vaccination coverage leads to the attainment of herd immunity on a global scale.*

What this study adds

- *Contextual, individual, and perceptual elements significantly impacted COVID-19 vaccine uptake among market traders at Wakulima Market, Nairobi, Kenya;*
- *COVID-19 vaccine uptake is low among traders at Wakulima Market in Nairobi City County, Kenya.*

Competing interests

The authors declare no competing interests.

Authors' contributions

Collins Opande: conception and design of the study, full research protocol development, data collection, analysis, and led the draft and final write-up; Joachim Osur: substantial contributions to conception and design, critically reviewing of protocol, tools, and the manuscript for important intellectual content, and approval of manuscript for publishing; Nzomo Mwita: substantial contributions to conception and design, critically reviewing of protocol, tools and the manuscript for important intellectual content and approval of manuscript for publishing; Virginia Maria Thonyiwa: substantial critical reviewing and editing of manuscript. All the authors read and approved the final version of this manuscript.

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AMIU Graduate School and the Nairobi City County Government.

Tables

Table 1: demographic characteristics of the participants in traders at Wakulima Market in Nairobi City County, Kenya, January to February, 2023 (n=256)

Table 2: contextual factors influencing vaccine uptake at Wakulima Market in Nairobi City County, Kenya, January to February, 2023 (n=256)

Table 3: individual factors influencing vaccine uptake at Wakulima Market in Nairobi City County, Kenya, January to February, 2023 (n=256)

Table 4: perceptual factors influencing vaccine uptake at Wakulima Market in Nairobi City County, Kenya, January to February, 2023 (n=256)

Table 5: key informant interview themes on determinants of COVID-19 vaccine uptake at Wakulima Market in Nairobi City County, Kenya, January to February, 2023 (n=30)

Table 6: multivariate regression analysis of factors influencing vaccine uptake among traders at Wakulima Market in Nairobi City County, Kenya, January to February, 2023 (n=256)

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Table 1:demographic characteristics of the participants in traders at Wakulima Market in Nairobi City County, Kenya, January to February, 2023 (n=256)

		Frequency	**Percentage**
Gender			
	Female	146	57
	Male	110	43
Marital status	Single	100	39
	Married	73	29
	Divorced	33	13
	Widower	13	5
	Widow	37	15
Educational level			
	Post-secondary	45	17.8
	Primary	48	18.8
	Secondary	161	62.9
Duration in market			
	1-5 years	154	60
	6-10 years	102	40
Income level			
	Above Ksh 20,000	50	19.5
	Ksh 0 - 10,000	111	43.4
	Ksh 10,001 - 20,000	94	36.7

Summary of the demographic characteristics of 256 traders; currency values are denoted in Kenyan Shillings (Ksh); percentages are calculated from the total sample size (n=256)

Table 2: contextual factors influencing vaccine uptake at Wakulima Market in Nairobi City County, Kenya, January to February, 2023 (n=256)

	SD N (%)	D N (%)	N N (%)	A N (%)	SA N (%)	Mean	Std. deviation	Skewness	Kurtosis
Trust in the healthcare system affects the uptake	2(1)	2(1)	0(0)	70(27)	182(71)	4.6719	0.60208	-2.752	11.687
Religious beliefs negatively impact the uptake	2(1)	4(2)	0(0)	76(30)	174(68)	4.6250	0.65079	-2.538	9.282
There is sufficient access to information on vaccination/vaccines	2(1)	0(0)	0(0)	94(37)	160(63)	4.6016	0.57857	-2.118	9.607
Social and peer networks are lower than the uptake rates	4(2)	2(1)	0(0)	98(38)	152(59)	4.5313	0.69663	-2.427	9.226
Cultural factors negatively affect the uptake	55(22)	101(40)	15(6)	43(17)	42(16)	2.6719	1.40648	0.488	-1.170
Vaccine availability influences the uptake	58(23)	107(42)	17(7)	45(18)	29(11)	2.5312	1.31916	0.614	-0.895
Vaccine accessibility affects the uptake	57(22)	114(45)	18(7)	44(17)	23(9)	2.4609	1.25809	0.696	-0.681
Literacy barriers affect the uptake	68(27)	127(50)	20(8)	32(13)	29(11)	2.1680	1.06601	0.991	0.309

Responses were collected on a 5-point Likert scale: SD: strongly disagree, D: disagree, N: neutral, A: agree, SA: strongly agree; values are presented as frequency (N) and percentage (%); the mean, standard deviation (Std. Deviation), skewness, and kurtosis summarize the distribution and central tendency of the responses for each statement

Table 3: individual factors influencing vaccine uptake at Wakulima Market in Nairobi City County, Kenya, January to February, 2023 (n=256)

	SD	D	N	A	SA	Mean	Std. deviation	Skewness	Kurtosis
	N(%)	N(%)	N(%)	N(%)	N(%)				
Underlying health condition prevents uptake	0(0)	0(0)	0(0)	95(37)	161(63)	4.6289	0.48404	-0.537	-1.725
Vaccine confidence affects the uptake	0(0)	5(2)	3(1)	103(40)	145(57)	4.5156	0.62603	-1.413	3.011
Previous vaccine experiences lower uptake rates	0(0)	9(4)	1(0)	104(41)	140(55)	4.4688	0.69098	-1.576	3.302
Vaccine safety concerns make people fear uptake	2(1)	4(2)	0(0)	116(45)	134(52)	4.4687	0.66199	-1.846	6.464
Trust in the vaccine lowers the uptake	2(1)	22(9)	2(1)	108(42)	122(48)	4.2734	0.90934	-1.515	1.998
Knowledge & awareness of the vaccine affects the uptake	2(1)	12 (5)	2(1)	148(58)	92(36)	4.2344	0.75651	-1.515	3.764
Working hours convenience prevents hospital visits	8(3)	16(6)	8(3)	115(45)	109(43)	4.1758	0.98038	-1.567	2.345

Responses were collected on a 5-point Likert scale; SD: strongly disagree; D: disagree; N: neutral; A: agree; SA: strongly agree; values are presented as frequency (N) and percentage (%); the mean, standard deviation (Std. Deviation), skewness, and kurtosis summarize the distribution and central tendency of the responses for each statement

Table 4: perceptual factors influencing vaccine uptake at Wakulima Market in Nairobi City County, Kenya, January to February, 2023 (n=256)

	SD	D	D	A	SA	Mean	Std. Deviation	Skewness	Kurtosis
	N (%)	N (%)	N (%)	N (%)	N (%)				
Fear of side effects lowers the uptake	0 (0)	0 (0)	6 (2)	102 (40)	148 (58)	4.5547	0.54317	-0.663	-0.705
Perceived risk and severity make traders fear the uptake	2 (1)	2(1)	6 (2)	104 (41)	142 (56)	4.4922	0.66269	-1.764	5.706
Vaccine misinformation and myths is widespread in the market	2 (1)	4(2)	2 (1)	118 (46)	130 (51)	4.4453	0.67223	-1.751	5.821
Vaccine efficacy influences the uptake	0 (0)	4 (2)	10 (4)	126 (49)	116 (45)	4.3828	0.64011	-0.910	1.390
Medical experimentation negatively affects the uptake	0 (0)	4 (2)	16 (6)	132 (52)	104 (41)	4.3125	0.65977	-0.769	0.913
Health literacy affects uptake among traders	0 (0)	20 (8)	4 (2)	124(48)	108 (42)	4.2344	.85391	-1.384	1.906
Waiting time during injection lower uptake	80 (31)	104 (41)	20 (8)	25 (10)	27 (11)	2.2773	1.28842	0.945	-0.234

Responses were collected on a 5-point Likert scale; SD: strongly disagree; D: disagree; N: neutral; A: agree; SA: strongly agree; values are presented as frequency (N) and percentage (%); the mean, standard deviation (Std. Deviation), skewness, and kurtosis summarize the distribution and central tendency of the responses for each statement

Table 5: key informant interview themes on determinants of COVID-19 vaccine uptake at Wakulima Market in Nairobi City County, Kenya, January to February, 2023 (n=30)			
Theme	**Determinant**	**Summary**	**Verbatim quote**
Contextual factors	**Information access**		
	Trust in the healthcare system		
	Religious and social influence		
Individual factors	Underlying health conditions		
	Vaccine safety		
Perceptual factors	Fear of side effects		
	Misinformation		
	Perceived risk and knowledge		
Summary of themes and categories on determinants of COVID-19 vaccine uptake from KII			

Table 6: multivariate regression analysis of factors influencing vaccine uptake among traders at Wakulima Market in Nairobi City County, Kenya, January to February, 2023 (n=256)					
	Unstandardized coefficients		**Standardized coefficients**		
Model	**B**	**Std. error**	**Beta**	**T**	**Sig.**
1 (constant)	2.938	0.246		11.945	0.000
Contextual factors	0.143	0.049	0.177	2.926	0.004
Individual factors	0.135	0.041	0.168	2.853	0.005
Perceptual factors	0.149	0.050	0.181	2.982	0.002
Dependent variable: COVID-19 vaccine uptake among traders					