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Role of risk perceptions and vaccine hesitancy on decision-making among low-income mothers in Kenya: a qualitative study

Stephen Gichuhi Kimotho

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Communication, United States International University, Nairobi, Kenya, Kenya

Correspondence to
Dr Stephen Gichuhi Kimotho; sgkimotho@usiu.ac.ke

ABSTRACTS

Introduction Vaccine hesitancy among mothers in low-income communities in Kenya presents a serious obstacle to achieving successful childhood immunisation. The aim of this study was to explore the determinants of vaccine hesitancy among mothers from low-income rural communities, risk perceptions associated with vaccines and how these factors influence decision-making regarding their children's immunisation.

Methods A qualitative descriptive study was conducted in three counties in Kenya (Murang'a, Kiambu and Machakos) using in-depth interviews and focus group discussions with mothers of children under 5 years. Participants were purposively sampled from low-income rural communities and were mothers attending postnatal clinics at various health facilities. Thematic analysis was used to identify key themes and subthemes, coding of transcripts, identification of patterns and organisation of themes into categories.

Results Several critical factors that contribute to vaccine hesitancy among mothers regarding their children's immunisation were identified through thematic analysis. Safety concerns emerged as a primary issue, with mothers expressing fears of adverse reactions such as fever, pain, swelling or other unexpected complications. Misinformation significantly influenced perceptions, including beliefs that vaccines might cause infertility or long-term health problems. Distrust in the health system further exacerbated hesitancy, with mothers questioning the quality, administration and motives of vaccinators. Limited vaccine knowledge also played a role, which led to misconceptions about the severity and risks of vaccine-preventable diseases. Moreover, sociocultural and religious beliefs influenced decision-making, with some mothers viewing vaccines as unsafe or ineffective, driven by cultural norms, reliance on traditional remedies or religious objections.

Conclusions This study provides valuable insights into the complexities of vaccine hesitancy among mothers in low-income communities in Kenya. Furthermore, the results emphasise the complex nature of hesitancy, driven by an interplay of safety concerns, misinformation, distrust, limited knowledge, and sociocultural and religious influences. Addressing these determinants requires interventions that would prioritise clear and accurate communication about vaccine safety, engagement with community and religious leaders, and strengthening trust

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Vaccine hesitancy is a growing global issue and has had a negative impact on public health. Africa has made some progress in vaccination, but hesitancy is still its biggest challenge. Previous research has identified many determinants of vaccine hesitancy, but there is limited understanding of how risk perception affects decision-making among mothers in low-income communities. This study aims to fill this gap by looking at the factors that influence vaccine hesitancy and decision-making among mothers from low-income communities.

WHAT THIS STUDY ADDS

⇒ Vaccine hesitancy among mothers in low-income Kenyan communities is driven by safety concerns, misinformation, distrust in the health system, lack of vaccine knowledge, and sociocultural and religious beliefs. Positive experiences (effective communication—clear and accessible information about vaccines, positive relationships with healthcare providers or supportive narratives from family members) and trust can increase uptake, while negative experiences (negative interactions with healthcare providers—exposure to misinformation or negative social influences, negative narratives or experiences) and negative media reports/publicity can increase hesitancy.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ This study will influence several aspects of vaccination and public health. It gives insights into the factors driving vaccine hesitancy among low-income mothers in Kenya and highlights the need for targeted interventions. Healthcare providers and policymakers can make a big impact in increasing vaccine confidence and uptake by addressing safety concerns, improving communication and building trust in the community. This study is relevant for researchers, practitioners and policymakers and will guide the development of better vaccination strategies and public health policies in similar settings.

in healthcare providers and systems. Additionally, enhancing vaccine knowledge through targeted health education programmes would be crucial for empowering mothers to make informed decisions about their children's health.

INTRODUCTION

Vaccination, as a cornerstone of public health, offers a cost-effective method for preventing childhood disease.[1] In Africa, vaccination programmes have made remarkable strides since the launch of the Expanded Programme on Immunization in 1974.[2] Routine childhood vaccination coverage has significantly improved, with diphtheria-tetanus-pertussis (DTP3) coverage rising from 57% in 2000 to 74% in 2016.[3] In 2020, the overall complete basic childhood vaccination among children aged 12–23 months in East Africa was 69.21% and ranged from 39.5% in Ethiopia, 56.1% in Rwanda, 57.4% in Uganda and 71.8% in Kenya to 85% in Burundi.[4 5] While Kenya has made significant progress in childhood vaccination, achieving a 71.8% vaccination rate for children aged 12–23 months, the number of unvaccinated and undervaccinated infants is still high.[6] Basic vaccination coverage reduced from 77% in 2008 to 70% in 2017.[7] National basic vaccination coverage of 70% is significantly lower than the global target of 90% set by WHO in 2020.[8]

The potential of vaccination programmes is often threatened by vaccine hesitancy, a growing concern globally. Vaccine hesitancy is defined as the delay or refusal of vaccination despite the availability of services. The WHO has identified vaccine hesitancy as a significant threat to public health and emphasised the need for targeted research to understand and address this complex issue.[9]

In Kenya, vaccine hesitancy has been a recurring issue in the media, especially during polio vaccination campaigns. For instance, a significant vaccination incident in Busia, where a poorly administered malaria vaccine left 28 children paralysed,[10] and fuelled public fear and scepticism. This crisis was widely publicised and debated on social media, further exacerbating vaccine hesitancy in the country. Despite assurances from UNICEF and other stakeholders that the polio vaccine is safe and effective, incidents of hesitancy persist.

In the recent past, WHO has expressed concern about the rising opposition to vaccinations, which has continued to hamper efforts to control deadly diseases in the country.[11] Anti-vaccination activism by religious organisations, politicians and community leaders in Kenya continues to further undermine efforts to combat diseases like polio and tetanus, with public statements casting doubt on vaccine safety negatively impacting uptake.[12] According to the 2014 Kenya Demographic and Health Survey, only two out of three Kenyan children are fully immunised, with many in marginalised areas remaining unimmunised.[13 14]

Therefore, this study responds to WHO's call for more research on factors influencing vaccine hesitancy in Kenya and emphasises the need to understand these determinants in order to develop contextualised strategies that would improve vaccination uptake in the country.[12 15] Significant knowledge gaps remain, particularly regarding the factors influencing mothers' child vaccination decisions and the role of risk perceptions, which highlights the need for evidence-based interventions.

To address these gaps, the study set out to explore the determinants of vaccine hesitancy, risk perceptions associated with vaccines, and how these factors influence child vaccination decisions among mothers from low-income communities in Kenya. Specifically, the study sought to answer the following questions: what are the determinants of vaccine hesitancy among mothers from low-income communities in Kenya?, what are the risk perceptions associated with vaccines among mothers from low-income communities in Kenya? and how do risk perceptions associated with vaccines and determinants of vaccine hesitancy influence mothers' decision-making on the vaccination of their children?

Theoretical framework

Parental decisions regarding childhood vaccination are complex and multidimensional, leading to increased vaccine hesitancy, an ambiguous notion with uncertain theoretical background.[16] Vaccine hesitancy encompasses a wide range of behaviours, from reluctance to complete refusal, and can vary based on time, place and specific vaccine.[11 17]

Studies on vaccination decision-making reveal a continuum of acceptance behaviours, from active demand to complete refusal, with vaccine-hesitant parents falling in between.[18] This hesitancy can manifest as refusing some vaccines while accepting others, delaying vaccination or accepting on schedule with reservations. While vaccine hesitancy is often associated with specific behaviours and outcomes, it is more accurately viewed as a decision-making process influenced by various contextual factors.[19 20] Understanding this process is crucial for public health interventions, as even individuals who have not yet refused or delayed vaccination may be more likely to do so in future.[20]

The WHO's 3Cs (confidence, complacency and convenience) model is one of the prominent frameworks for explaining vaccine hesitancy.[21] Confidence refers to trust in vaccine effectiveness, safety, the healthcare system and policymakers. Complacency relates to perceived risks of vaccine-preventable diseases and the necessity of vaccination. Convenience addresses factors affecting vaccine access, including availability, affordability and accessibility. Beyond the 3Cs model, the Strategic Advisory Group of Experts (SAGE) working group identified a broader matrix of determinants influencing vaccine hesitancy and encompassing contextual, individual/group, and vaccine-specific factors.[22] The SAGE Working

Table 1 SAGE Working Group on Vaccine Hesitancy matrix.

Contextual influences arising due to historical, sociocultural, environmental, health system/institutional, economic or political factors	► Communication and media environment ► Influential leaders, immunisation programme gatekeepers and anti- or provaccination lobbies ► Historical influences ► Religion/culture/gender/socioeconomic factors ► Politics/policies ► Geographical barriers ► Perception of the pharmaceutical industry
Individual and group influences arising from personal perception of the vaccine or influences of the social/peer environment	► Personal, family and/or community members' experience with vaccination, including pain ► Beliefs, attitudes about health and prevention ► Knowledge/awareness ► Health system and providers—trust and personal experience ► Risk/benefit (perceived, heuristic) ► Immunisation as a social norm versus not needed/harmful
Vaccine/vaccination: specific issues directly related to vaccine or vaccination	► Risk/benefit (epidemiological and scientific evidence) ► Introduction of a new vaccine or new formulation or a new recommendation for an existing vaccine ► Mode of administration ► Design of vaccination programme/mode of delivery (eg, routine programme or mass vaccination campaign) ► Reliability and/or source of supply of vaccine and/or vaccination equipment ► Vaccination schedule ► Costs ► The strength of the recommendation,knowledge base and/or attitude of healthcare professionals

SAGE, Strategic Advisory Group of Expert.

Group on Vaccine Hesitancy matrix categorises vaccine hesitancy determinants into three domains: contextual influences (historical, sociocultural, environmental, political, etc.), individual and group influences (personal experiences, social/peer environment) and vaccine/vaccination-specific influences.[22] This matrix consolidates determinants derived from research studies, expert consultations, field experience, systematic reviews and surveys of immunisation managers (see table 1).

The 3Cs model and the SAGE Working Group on Vaccine Hesitancy matrix served as a critical lens for understanding the complex interplay of factors influencing vaccine hesitancy among mothers. The 3Cs model allowed for an examination of mothers' trust in vaccine safety and efficacy (confidence), their perceived risk of vaccine-preventable diseases (complacency) and the accessibility of vaccination services (convenience). The SAGE matrix further broadened the scope of inquiry and enabled an analysis of contextual influences (historical, sociocultural and political), individual and group influences (personal experiences and social norms) and vaccine-specific issues (risks, benefits and modes of administration).

METHODOLOGY

To capture factors influencing mothers' child vaccination decisions, a qualitative descriptive study design was employed. This design facilitated the acquisition of rich data and in-depth exploration of the multilayered nature of vaccine hesitancy within the specific context of low-income rural communities in Kenya.

The study was conducted in three counties in Kenya: Murang'a, Kiambu and Machakos. These counties were purposively selected due to their reported vulnerability to polio outbreaks[23] and ongoing polio vaccination campaigns. Murang'a and Kiambu are located in Kenya's Central Highlands, while Machakos lies in the Eastern region. These areas are characterised by a mix of rural and peri-urban communities, with varying socioeconomic conditions and access to healthcare services. The selection of these counties allowed for an examination of vaccine hesitancy among mothers in low-income communities within diverse geographical and socioeconomic contexts.

To gather information-rich data, mothers meeting specific inclusion criteria were purposively sampled. Participants included were mothers of children aged 5 years and below; residing in low-income rural communities within Murang'a, Kiambu and Machakos counties; attending postnatal clinics at various health centres; and willing to discuss their experiences and perspectives on child vaccination decisions. The focus on mothers attending postnatal clinics was strategic, as these mothers frequently face vaccination decisions for their young children, making them ideal for the study. Mothers visiting the clinics for other reasons or with children older than 5 years were excluded. Although men also play significant roles in some communities, they were not included in this study, as research indicates that women predominantly make decisions regarding child vaccination in many developing countries, particularly in Africa.[24]

Three focus group discussions (FGDs) were conducted with 6–12 participants from each of the three counties, following the guidelines by Johnson and Christensen[25] and Onwuegbuzie *et al*.[26] Participants were mothers aged 18–45 with children under 5 years, residing in the three counties and willing to discuss vaccination hesitancy. FGDs were chosen for their effectiveness in preliminary investigations and their ability to provide a comfortable environment for interaction that helps the participants to identify key issues for subsequent in-depth interviews (IDIs) and encourage a broader range of experiences through shared reflections.[27]

While FGDs generate data through group interaction, they can be affected by conformity and polarisation. Therefore, 69 IDIs were conducted with mothers of children under 5 years to complement and triangulate FGD results.[26] Mothers who had participated in FGDs were not included in the interviews. Initially, 18 IDIs were planned per county; however, interviews continued until data saturation was reached at the 23rd interview.[28] Interviews took place at health centres, with oral informed consent obtained, and participants were informed of their rights. Audio recordings were made with consent, alongside field notes, and individual interviews were conducted in private. Questions were translated into Gikuyu for Kiambu and Murang'a residents, and Kikamba for Machakos residents not fluent in Kiswahili or English. Open-ended questions were used to encourage discussions.

The interview guide consisted of open-ended questions designed to elicit rich narratives and detailed descriptions of lived experiences (See online supplemental file 1). These questions were structured to address the research questions and capture the different aspects of risk perceptions, vaccine hesitancy determinants and decision-making processes. For instance, questions like 'what goes through your mind when you bring your child for vaccination?' and 'what concerns do you have about vaccinating your child?' were used to explore the mothers' perspectives on vaccine safety, fears, potential side effects and the impact of social influences.

The guide also included prompts to encourage interaction and diverse perspectives for the FGDs. These prompts helped to uncover shared beliefs and community influences on vaccination decisions. Examples of prompts include 'what are some common beliefs about vaccines in your community?' or 'how do discussions with family and friends influence your decisions about vaccination?'

Pilot testing of the interview guide was conducted at a health centre in Kiambu County with three purposefully sampled mothers, who provided feedback leading to revisions. These mothers were excluded from the main study sample. Three research assistants with undergraduate degrees and qualitative research experience were recruited for data collection and trained on the study's purpose, objectives, data collection methods and rapport building.

Research rigor and ethical permissions

Data were anonymised, securely stored and password-protected to ensure confidentiality. Rigour, as emphasised by Creswell[29] and Lincoln and Guba,[30] was maintained through various strategies: credibility was established through triangulation, member checking and outlier review; transferability was ensured through detailed descriptions and quotations; dependability was maintained through careful transcription and analysis with documented decisions; and confirmability was enhanced through openness to emerging themes,[31] audio recording and a reflective journal.[32]

Ethical permission for the project was obtained from the County Public Health Directors and the National Council for Science and Technology before commencing with this research project.

Data analysis process

The data analysis process of this study was based on the approach outlined by Miles *et al*.[33] This approach involves three concurrent processes: data reduction, data display and drawing conclusions/verification. Data reduction involved transcribing all interview and FGD recordings and translating those conducted in Gikuyu, Kamba or Kiswahili into English. The transcripts were then read and reread to identify key concepts and initial codes. Data display involved organising the identified codes into visual displays, such as matrices and flowcharts, to identify patterns and relationships between themes. Drawing conclusions/verification involved interpreting the patterns and relationships between themes to answer the research questions. The NVivo 20 software facilitated data management, coding, data display and the identification of recurring themes and patterns. Thematic analysis was guided by the research questions and the principles of the 3Cs model and the SAGE Working Group on Vaccine Hesitancy matrix. This process was iterative and allowed for the emergence of unexpected themes and subthemes, ensuring that the analysis captured the nuances of the data.[34]

RESULTS

This study set out to describe the determinants of vaccine hesitancy and risk perceptions associated with vaccines, and to investigate the influence of such risk perceptions on decision-making over vaccination, among mothers from low-income communities in Kenya. The following sections present the findings for each of the research questions.

Determinants of vaccine hesitancy among mothers from low-income communities

Based on the results from this study, the key determinants of vaccine hesitancy that shape mothers' child vaccination decisions fall under three main themes: (1) concerns about vaccine safety and side effects, (2) limited knowledge and awareness about vaccines and (3) sociocultural and religious influences. The following section

delineates these themes and subthemes and also provides illustrative examples from discussions with the mothers.

Concerns about vaccine safety and side effects

This theme encompasses a range of worries and anxieties expressed by mothers regarding the potential risks associated with vaccination, particularly due to fear of adverse reactions; perceptions based on misinformation and rumours; and doubts stemming from safety concerns and distrust of health systems as elaborated and illustrated below. The concerns about vaccine safety and side effects were widespread and mothers across all three counties (Machakos, Kiambu and Murang'a) expressed fears about potential adverse effects, including paralysis and other negative health impacts.

Fear of adverse reactions

This was a dominant concern, with mothers sharing anxieties about vaccines causing harm. Examples include worries about vaccines causing sickness, diarrhoea, rashes and flu-like symptoms. In one case, a mother from Kiambu reported having heard stories of vaccine-related deaths.

> I have heard stories of children getting sick or even dying after receiving vaccines. It makes me scared to vaccinate my own child. (Kiambu—FGD: Participant 3)

In the second excerpt, a mother from Machakos County recounts an incident about her neighbour's child.

> My neighbor's child had a high fever and convulsions after getting a shot. I don't want to risk my child going through the same thing. (Machakos—IDI: Respondent 18)

Misinformation and rumours

Misinformation and rumours circulating within communities and spread through social networks played a role in shaping mothers' perceptions of vaccines seem to have a significant influence on mothers and created additional fears, as did apprehension over adverse reactions like paralysis or sickness. Some of the common misinformation regarding vaccines included that vaccines were being used for population control as observed during one of the FGDs. 'People say that these vaccines are not safe for our children. They say they can cause infertility or other long-term problems' (Murang'a—FGD: Participant 5).

Lack of trust in vaccine quality

Doubts about safety and distrust of health systems increased hesitancy. Mothers expressed distrust of vaccine providers, especially those involved in door-to-door campaigns, and questioned the motives and legitimacy of vaccinators and vaccines. This distrust extended to fears about faulty or unsafe injections from healthcare workers and contributed to concerns about adverse reactions, as one mother from Murang'a observed, 'I have heard stories of expired vaccines being used. How can I be sure that my child is getting a good vaccine?' (Murang'a—IDI: Participant 13). Some mothers also worried about the storage and handling of vaccines, questioning their efficacy and safety due to potential mishandling. 'I worry about how these vaccines are stored and transported. If they are not kept properly, they might not work or even cause harm' (Machakos—FGD: Participant 1).

Limited knowledge and awareness about vaccines

Individual's knowledge and awareness gaps regarding vaccines and the vaccination process itself appeared to contribute substantially to hesitancy among mothers as well. This theme had two subthemes.

Misconceptions about vaccine-preventable diseases

Mothers across the three counties seemed to underestimate the severity and risk of vaccine-preventable diseases—as one mother noted: 'I don't think these diseases are a big threat anymore. They are not as common as they used to be' (Kiambu—FGD: Participant 2). This misconception also led to complacency about vaccination as illustrated by this excerpt from one of the mothers from Machakos: 'We have always survived without these vaccines. I don't see why they are suddenly so important (Machakos—IDI: Respondent 15).

Lack of information about vaccine benefits

Mothers reported limited access to reliable information about the benefits of vaccines as well, and this seemed to hinder their ability to make informed decisions as one of the mothers noted: 'I don't know much about these vaccines. I'm not sure what diseases they protect against or how effective they are' (Murang'a—IDI: Participant 20).

Sociocultural and religious beliefs

Religious objections

A predominant determinant fuelling hesitancy across the three counties was the religious objection among certain faith groups and churches in these regions. As one mother described, 'Some churches like Kavonokya don't allow vaccination due to their faith' (Machakos: Participant 23). These religious belief systems strongly discouraged mothers from consenting to have their children vaccinated. Some mothers expressed concerns about the compatibility of vaccines with their religious beliefs, citing concerns about the ingredients used or the origin of vaccines. 'Our religion does not allow us to use medicines or treatments. I'm not sure if these vaccines are permissible' (Machakos—FGD: Participant 6).

Traditional practices and beliefs

In addition to religious barriers, local social and cultural beliefs opposing vaccination created further hesitancy by portraying vaccines as unsafe or ineffective as illustrated in the subthemes below. Some mothers preferred traditional remedies and practices over modern medicine, including vaccines, due to cultural norms and beliefs. Mothers who held these beliefs often relied on herbal remedies and traditional healers for their children's health and viewed vaccines as unnecessary or

incompatible with their cultural practices as illustrated by these excerpts. 'We have our own ways of protecting our children from diseases. We use herbs and other natural remedies' (Kiambu—FGD: Participant 5).

Family power dynamics

At the interpersonal level, family power dynamics and hierarchies significantly influenced vaccine decision-making. While some husbands were actively engaged in vaccination decisions for their children, others played a minimal role, thereby positioning mothers as the primary decision-makers. As articulated by one participant, 'My husband is completely involved in the decision-making process' (Machakos: Participant 21).

In summary, vaccine hesitancy among mothers from low-income communities in Kenya is a complex, multifactorial issue that encompasses knowledge gaps, safety concerns, ingrained belief systems, family power dynamics, exposure to misinformation and distrust of health systems.

Risk perceptions associated with vaccines among mothers from low-income communities

This section examines the various risk perceptions associated with vaccines as expressed by mothers from low-income communities in Kenya. These perceptions, which stem from a range of sources and experiences, fall under three overarching themes: (1) physical health risks, (2) vaccine quality and administration concerns and (3) positive risk perceptions. The following section presents detailed findings on risk perceptions associated with vaccines that emerged among mothers from low-income communities in Kenya.

Physical health risks

The potential for serious adverse effects was a predominant concern, with fears that vaccines could negatively impact health and cause issues like paralysis. This theme encompasses concerns related to the potential negative impacts of vaccines on children's physical health. Three subthemes emerged under this theme.

Vaccine-induced illness and disability

Mothers expressed fear that vaccines could cause illness, disability or even death in their children. In the following excerpt, a mother describes her experience with her own kid and how she collated the experience with media reports.

> When I went complaining about some puss that had formed at the point of injection—that very night in the news, they brought news of kids whose legs had to be amputated after vaccination… that's why I acted fast.' (Kiambu—FGD: Participant 2)

Side effects and adverse reactions

Mothers were concerned about the potential side effects of vaccines, such as fever, swelling, pain and allergic reactions as illustrated by this excerpt: 'When the baby was injected, he got fever and slept. I was worried that the vaccines may harm my child …" (Kiambu: Respondent 9).

Long-term health consequences

Some mothers expressed concerns about the potential long-term effects of vaccines on their children's health, including infertility and developmental delays as illustrated by the following excerpts: 'The stories about that a vaccine is a family planning scheme sometimes makes me hesitate' (Machakos—FGD: Participant 5).

Vaccine quality and administration concerns

This theme describes mothers' anxieties about the risks associated with quality, efficacy and administration of vaccines. Two subthemes emerged from the data: concern for expired or contaminated vaccines and incorrect administration.

Expired or contaminated vaccines

Mothers expressed concerns about the possibility of their children receiving expired or contaminated vaccines, leading to adverse reactions as one of the mothers from Machakos reported: 'The story about government clearing old stock is so discouraging because people say—the vaccines are expired' (Machakos—FGD: Participant 4).

Incorrect administration

In other cases, mothers worried about the potential for errors in vaccine administration, such as incorrect dosage or injection technique, leading to harm. In the following excerpt, a mother explains in detail an incident of potential for errors in vaccine administration.

> Yes, I have heard about it. The baby was wrongly injected and the leg got swollen and the leg was affected and it had to be amputated and it has been less than a month. It was here in Kiambu or I think Kikuyu area.' (Kiambu—IDI: Respondent 7)

Lack of trust in healthcare providers

Some mothers expressed scepticism about the competence and trustworthiness of healthcare providers, particularly in private facilities. 'People say that private hospitals can use water and say they have injected the baby with vaccine' (Machakos—IDI: Respondent 7).

Positive risk perceptions

While the negative risk perceptions were predominant in the data, there were also instances of positive perceptions regarding vaccines among mothers.

Observed effectiveness

Mothers who had witnessed the positive impact of vaccines on their children's health tended to hold positive perceptions. 'Yes, it works. Because I have been bringing my kids for vaccination and they have not suffered' (Machakos—FGD: Respondent 1).

Trust in healthcare providers and government

Mothers who trust healthcare providers and the government's efforts in providing vaccines were more likely to view vaccination positively. 'I trust them because they are sent by hospital and government can't harm us and it normally announces early enough' (Machakos—IDI: Respondent 3).

Perceived benefits outweighing risks

Even though some mothers acknowledge potential risks associated with vaccines, they still held positive perceptions, if they believed the benefits of vaccination outweighed the risks as illustrated in the following excerpt.

> I just pray, everything (vaccines) goes on well because I need the wellbeing of my baby, If I miss the vaccine then when that disease comes it will get my baby and it will be my fault. I will have let down my baby so I had to overcome that fear. (Kiambu—FGD: Respondent 5)

These positive risk perceptions seemed to play a crucial role in encouraging vaccine uptake and promoting positive health behaviours among the interviewed mothers in low-income communities.

Influence of risk perceptions and determinants of vaccine hesitancy on mothers' decision

This section presents the findings on how mothers' risk perceptions and the determinants of vaccine hesitancy directly influence their decisions about vaccinating their children. This complex interplay led to a range of responses, which can be grouped into three main themes: (1) hesitancy and delayed vaccination, (2) seeking information and reassurance and (3) conditional acceptance. In the following section, I will describe and illustrate these three main themes that emerged, and their corresponding subthemes.

Hesitancy and delayed vaccination

This theme highlights how risk perceptions and hesitancy determinants lead to mothers either delaying or completely avoiding vaccination for their children. The subthemes include are as follows.

Fear of adverse reactions

Mothers' concerns about potential side effects and adverse reactions often lead to hesitancy and delayed vaccination. 'I was afraid because I didn't want to go there. I didn't know what will happen to my kid when injected, how will it react on him' (Kiambu—IDI: Respondent 10).

Concerns about potential adverse effects and the possibility of vaccines causing harm were prevalent among mothers. Indeed, mothers' anxieties about potential side effects played a significant role in delaying or contributing to hesitancy towards vaccination.

Misinformation and rumours

Misinformation and rumours significantly impact mothers' decisions to vaccinate their children and often create doubt and fear. These unverified claims contribute to hesitancy and delays as mothers seek more information or alternatives. As one participant stated, 'People say these vaccines are not safe and can cause infertility or other long-term problems. I had to think twice' (Murang'a—FGD: Participant 5).

Religious objections

In some cases, religious beliefs and doctrines that discourage the use of modern medicine, including vaccines, shape mothers' decisions about vaccines as illustrated in this excerpt: 'I heard that some vaccines contain forbidden substances. I need to consult with our religious leader before making a decision' (Murang'a—IDI: Respondent 16).

Seeking information and reassurance

Mothers from Machakos and rural areas of Murang'a county demonstrated knowledge gaps regarding vaccines and vaccine-preventable diseases. This theme reflects how mothers, because of the knowledge gaps and uncertainty, actively seek information and reassurance to address their concerns and make informed decisions about vaccination. The following subsection will describe and illustrate each of the three subthemes that emerged from the data.

Consulting healthcare providers

Some mothers often relied on healthcare providers to clarify their doubts, address their concerns and provide reassurance about vaccine safety and efficacy. 'I don't know much about vaccination and so when I want to make a decision, I ask the nurse at the clinic to explain to me' (Kiambu—FGD: Participant 4).

Seeking advice from family and friends

Mothers frequently consulted family members, friends and other trusted individuals for advice and support on vaccination decisions. One participant stated, 'My husband helps me make decisions, but as the mother, I am primarily responsible' (Machakos—FGD: Participant 5). The data revealed that advice and experiences from these trusted sources significantly influenced mothers' decisions. Positive endorsements encouraged vaccination, while negative stories deterred it. As another participant noted, 'My sisters remind me of vaccination dates and my mother can take the child when I am busy' (Machakos—FGD: Respondent 1).

Turning to religious leaders

In some cases, mothers consult with religious leaders to seek guidance and clarification on the compatibility of vaccines with their faith. 'I heard that some vaccines contain forbidden substances. I need to consult with our religious leader before making a decision' (Murang'a—IDI: Respondent 6).

Media influence

Media reports, especially those highlighting negative experiences with vaccines, created a lot of anxiety among mothers, had influences on mothers' decisions and often

lead to increased hesitancy and fear. 'I saw on TV that a nurse had injected children with some vaccine and they swelled and their limbs became paralyzed. This really scared me and I kept off from these vaccines' (Machakos—FGD: Participants 2).

Other factors influencing mothers' vaccination decisions

Several additional factors influenced mothers' decisions about vaccinations.

Trust in government and healthcare system:

Mothers who trust the government and healthcare system were more likely to accept vaccines and believed that they were safe and beneficial. 'I trust them because they are sent by the hospital and government can't harm us and it normally announces early enough' (Machakos—FGD: Participant 6).

Observing positive experiences of others:

Mothers who had positive vaccination experiences or had seen positive experiences among family, friends or community members were more likely to vaccinate their own children. 'I have been bringing my kids for vaccination and they have not suffered. I see my child's health improving' (Machakos—FGD).

Distrust from negative experiences

Negative past experiences with healthcare services, such as improper vaccine administration, fostered distrust and led to vaccine hesitancy. 'The baby was wrongly injected and the leg got swollen and had to be amputated. This was really scary' (Kiambu—IDI: Participant 2).

Media influence

Media reports, especially those highlighting negative vaccine experiences, created anxiety and increased hesitancy as can be deciphered from the following comment by one participant: 'I saw on TV that a nurse had injected children with some vaccine, and their limbs became paralyzed. This really scared me' (Machakos—FGD: Participant 2).

The findings indicate that risk perceptions and hesitancy determinants influence mothers' decision-making on vaccination in diverse ways. The analysis reveals that mothers seemed to navigate a complex landscape of information, beliefs and experiences, and all these ultimately shaped their choices regarding vaccination of their children.

DISCUSSIONS

This study investigated the determinants of vaccine hesitancy and associated risk perceptions that shape child vaccination decisions among mothers from low-income communities in Kenya. The study found that vaccine hesitancy is driven by multiple factors, including concerns about safety, misinformation, distrust in the health system, limited vaccine knowledge, and sociocultural and religious beliefs. Mothers who reported positive experiences with vaccines and trust in healthcare providers were more likely to have their children vaccinated. Conversely, negative experiences with vaccines, exposure to negative media reports and social pressures can significantly increase vaccine hesitancy. This discussion section will build on the key findings of this study, examining the determinants of vaccine hesitancy and associated risk perceptions, and their influence on decision-making among mothers from low-income communities in Kenya.

Determinants of vaccine hesitancy

This study identifies several determinants of vaccine hesitancy among mothers in low-income Kenyan communities and aligns with global trends, especially in low- and middle-income countries. These determinants include safety concerns, misinformation, distrust in the health system and limited vaccine knowledge, echoing findings from Larson *et al* who emphasised the context-specific nature of vaccine hesitancy.[35] The study also highlights the role of family power dynamics in vaccination decisions, which is also consistent with existing literature on vaccine hesitancy.[36 37] Furthermore, the fear of adverse reactions and misinformation mirrors global trends observed by Dubé *et al*.[38] Importantly, this study focuses on the interplay of these determinants within a specific sociocultural context, including unique cultural and religious beliefs. For instance, the influence of certain religious denominations, like the Kavonokya in Machakos County, who hold alternative worldviews to Western biomedicine, aligns with Trangerud's typology of religious vaccine scepticism.[39] While the determinants identified are consistent with those found in other populations, the study emphasises the need for culturally sensitive and community-based approaches to address these factors effectively, a perspective that Crosby also highlights.[40]

Risk perceptions associated with vaccines

This study reveals that mothers in low-income Kenyan communities perceive various risks associated with vaccines, including safety concerns, scepticism about efficacy, and anxieties about vaccine quality and administration. These findings align with broader trends of vaccine hesitancy in Africa, where concerns about adverse effects and misinformation are prevalent.[41 42] Ackah *et al*.'s scoping review confirms that mistrust of vaccine manufacturers is a common theme, fuelled by perceptions that foreign pharmaceutical companies prioritise profit over African populations' well-being.[42] Furthermore, the study found that economic development correlates with greater vaccine acceptance in Kenya, indicating that socioeconomic factors may also play a role in shaping risk perceptions.[12] These findings resonate with research by Diks *et al* who emphasised the importance of understanding how local contexts and individual risk assessments influence vaccine-related decision-making.[43]

Influence on mothers' decision-making

Mothers' decisions regarding childhood vaccination are shaped by a complex interplay of risk perceptions, vaccine hesitancy determinants and trust in healthcare providers. The findings demonstrate that positive interactions with healthcare workers and trust in their expertise could significantly strengthen vaccine acceptance, while negative experiences, exposure to misinformation and distrust could amplify hesitancy. Additionally, the findings indicate that family support and community influences are important, as mothers are more inclined to vaccinate their children when encouraged by trusted family members and community leaders. These dynamics are critical in understanding and addressing both individual and collective influences on vaccine decision-making.

These findings align with existing research on vaccine hesitancy in Kenya and the broader African context. For example, Ozawa *et al* highlighted the role of trust in healthcare workers and government agencies in promoting vaccine uptake.[44] The study also emphasised the critical need to address negative perceptions and misinformation. Similarly, Ackah *et al* identified recurring themes of safety concerns, mistrust in healthcare systems and the detrimental influence of misinformation in a scoping review on COVID-19 vaccine hesitancy across Africa.[42] Both studies emphasise the necessity of tailored, context-specific interventions to address these challenges and improve vaccine confidence.

Social networks and interpersonal communication also play a significant role in influencing health behaviours. Trusted figures such as family elders and community leaders, often regarded as knowledgeable and experienced, shape vaccine-related decisions.[45] However, their influence can sometimes lead to a preference for traditional remedies over modern healthcare, complicating efforts to improve vaccine uptake. Engaging these trusted influencers in vaccine advocacy campaigns is therefore critical to overcoming barriers and promoting acceptance.

This study also observed the influence of husbands, particularly in rural settings where women often lack autonomy in decision-making. Desai and Kiersten's research found that men's control over household finances and economic factors, such as the cost of healthcare services, significantly constrain women's agency.[46] Addressing such gender dynamics would be essential for empowering women and improving vaccine uptake in these contexts. The findings of the current study contribute to a growing body of literature that demonstrates the complex nature of vaccine decision-making, encompassing interpersonal relationships, social norms and gender dynamics.

Implications for vaccination strategies

This study highlights the critical need for targeted, evidence-based interventions to address vaccine hesitancy among mothers in Kenya. To strengthen vaccine uptake, specific measures should include the development of comprehensive vaccine safety communication campaigns that leverage culturally appropriate messaging to counter misinformation and build public confidence. Healthcare providers should receive training to enhance their communication skills, enable them to address parental concerns effectively and build trust. Collaborations with religious and community leaders are essential to dismantle cultural and religious barriers and strengthen acceptance through trusted social networks. Additionally, community-based health education programmes should focus on improving vaccine literacy and emphasise the benefits of immunisation and the risks of noncompliance, particularly in marginalised areas. These efforts should be complemented by strong policy measures to improve vaccine accessibility and strengthen monitoring and evaluation frameworks to ensure continuous adaptation and effectiveness of vaccination strategies.

Limitations and future research

This study has several limitations that warrant consideration. The use of purposive sampling, while effective in identifying information-rich participants, may introduce selection bias and limit the diversity of perspectives captured. Additionally, the study's focus on three counties restricts the geographical generalisability of the findings, and the exclusion of fathers, who may play a critical role in vaccination decisions in some contexts, presents a gendered gap in the analysis. These limitations could influence the conclusions by over-representing maternal perspectives and regional nuances, potentially leading to partial insights into vaccine hesitancy. However, the study's strengths lie in its robust qualitative methodology, which provided deep, context-specific insights into the complex interplay of risk perceptions and vaccine hesitancy determinants. The rigorous thematic analysis ensured systematic identification of key themes, supported by rich participant narratives. Future research should be expanded to include diverse geographical regions, explore paternal influences on vaccination decisions and consider longitudinal designs to evaluate the sustained impact of interventions on vaccine uptake. Despite its limitations, this study contributes valuable evidence to inform tailored strategies for addressing vaccine hesitancy in low-income Kenyan communities.

CONCLUSION

Vaccine hesitancy among low-income mothers in Kenya is a complex challenge shaped by safety concerns, misinformation, distrust in the healthcare system, limited vaccine knowledge, and sociocultural and religious influences. While trust in healthcare providers and positive vaccine experiences can facilitate acceptance, negative experiences and pervasive misinformation significantly undermine uptake. Addressing these barriers requires evidence-based, culturally sensitive interventions that prioritise clear and transparent communication about

vaccine safety, counter misinformation effectively and foster trust through meaningful community and religious leader engagement. These strategies are essential to improve vaccine acceptance and safeguard public health in vulnerable populations.

X Stephen Gichuhi Kimotho @KimothoGS

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Ethics approval This study involves human participants. Ethical approvals necessary to carry out this study were obtained from all ethical local committees and they were as follows: (i) National Commission For Science, Technology & Innovation (NACOSTI) Ref No. 229906; (ii) Department of Health and Emergency Services (County Government of Machakos) Ref No. DHES/Research/vol1/1 and (iii) Health Research and Development Unit (HRDU) (County Government of Kiambu) Ref No. Kiambu/HRDU/Autho/2019/08/12/KimothoS. The chief investigator's institution is the United States International University—Africa. Approval for this study was obtained from all local ethics committees listed in the manuscript. Participants gave informed consent to participate in the study before taking part.

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ORCID iD

Stephen Gichuhi Kimotho http://orcid.org/0000-0001-9880-6819

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