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Landscape of Vaccine Hesitancy (2015–2025) Across General, Selected, and High-Risk Saudi Populations: A Scoping Review

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Abstract

Introduction: In Saudi Arabia, vaccine hesitancy (VH) has continued to hinder herd immunity. Hence, this scoping review charted VH determinants and pandemic impacts, based on studies conducted in Saudi Arabia from 2015 to 2025 across general, selected, and high-risk Saudi populations.

Methods: Following the PRISMA-ScR guidelines, a search was conducted in PubMed, Embase, and CINAHL to retrieve and include relevant records published in English or Arabic from 2015 to 2025.

Results: The 53 included cross-sectional studies represented 47,076 participants. General VH ranged from low to high rates across target populations. Routine childhood vaccines (RCV) maintained high acceptance. In contrast, COVID-19, influenza, and HPV vaccines experienced higher VH, associated with low confidence and high complacency, driven primarily by vaccine safety concerns and low perceived disease severity, respectively, which were intensified by infodemics. Meanwhile, the COVID-19 pandemic triggered initial acceptance, followed by post-pandemic stabilisation of VH toward new vaccines across the different cohorts.

Conclusion: While RCV has maintained acceptance, trust in newer vaccines has eroded due to perceived low risk and safety concerns, which were intensified by infodemics.

Keywords: Hesitancy; COVID-19; Vaccine; Saudi Arabia; Review

Introduction

Immunisation is a successful public health intervention that saves millions of lives against infectious diseases (1). However, maintaining adequate vaccination coverage and preventing resurgences are challenging, particularly due to VH, which is a pivotal barrier hindering herd immunity (1).

The World Health Organisation (WHO) defined VH as a delay or refusal to vaccinate, despite the availability of vaccines, driven by eroded confidence, perceptions of low disease risk (complacency), and vaccination access-related barriers (convenience) (1), influenced by an interplay of biological concerns and infodemics (1-3), highlighting the need for accurate, evidence-based information for shifting individuals toward positive intent to vaccinate (2).

In the Middle East, the COVID-19 pandemic highlighted significant disparities, depending on economic status and infrastructure (4). However, Saudi Arabia (KSA), as a high-income country (HIC), achieved high vaccination rates (5), while immunisation remains a core pillar of the Saudi Vision 2030 healthcare transformation (6). Nonetheless, VH in the KSA remains a significant public health challenge (7).

Recently, two systematic reviews outlined patterns of parental VH in KSA (8, 9), indicating knowledge gaps in VH of both old and new vaccines among general, selected, and high-risk populations. Thus, exploring VH trends in parallel with their determinants and the impact of the COVID-19 pandemic remains critical for developing relevant strategies that align with KSA public health objectives. This task could be effectively captured through a scoping review (10). Hence, this review charted VH prevalence and its determinants (according to the WHO SAGE 3Cs model), as well as

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the impacts of the COVID-19 pandemic, based on studies conducted in KSA from 2015 to 2025 across general, selected, and high-risk Saudi populations. This review was guided by two research questions: the key reported determinants of VH in Saudi Arabia (2015–2025) and the most-cited reasons for hesitancy toward RCV versus newer vaccines.

Method

This scoping review was conducted in accordance with the PRISMA-ScR (Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews) and the JBI Manual for Evidence Synthesis (10) in response to the PCC framework (Population, Concept, Context) and the research questions. The pre-specified protocol was registered in the Open Science Framework (OSF) registry (Project ID: jqkm8, https://osf.io/nt8fr). Ethical approval is not required because the evidence was charted from the existing literature.

Search strategy

The keywords combined the controlled vocabulary (*MeSH* terms) and free-text terms to construct the query string in line with the PCC framework.

("Vaccination Hesitancy"[MeSH] OR "Vaccine hesitancy" OR "vaccination hesitancy" OR "Vaccine Hesitancy Scale" OR "parental vaccine hesitanc*" OR "vaccine uptake in children" OR "vaccine acceptance" OR "Prevalence of vaccination" OR "Parental attitudes" OR "Hesitancy about vaccine*" OR "Hesitancy about vaccination" OR "vaccination hesitance" OR "vaccine hesitance" OR "parental vaccination hesitanc*")

AND ("Saudi Arabia"[MeSH] OR "Saudi Arabia" OR "Saudi Arabian" OR "Saudi Arabian population")

Research records were identified in PubMed/MEDLINE, Embase, and CINAHL Complete. Additionally, grey literature sources were searched, including MedRxiv, SSRN, OpenDissertations, the Public Health Agency website of Saudi Arabia, and Google Scholar. For extra records, backward citation tracking was employed by screening the reference lists of all included studies. The search strategy was not refined by timeframe, publication type, study design, country, or language. They were defined in alignment with the PCC framework (Table 1).

Table 1: Eligibility criteria according to the PCC framework

Criteria	Inclusion	Exclusion
Population	Saudi citizens only [Any age, any health status, or any gender]	Non-Saudi populations
Concept	Measured VH (any vaccine), hesitancy determinants	Vaccine refusal or denial without addressing VH. Vaccine coverage rates or immunisation logistics without measuring VH, lacking determinants of hesitancy
Context	Conducted in KSA (any region or any setting)	Not conducted in KSA or in multi-country settings without Saudi-specific disparity.
Study design	Cross-sectional surveys, cohort studies, quantitative, qualitative studies, mixed-method studies	Reviews, editorials, commentary, conference abstracts, case reports, and grey literature without primary data.
Language	Published in English or Arabic	Published in other languages
Publication timeline	From January 2015 to December 2024 in peer-reviewed journals	Before 2015 or after 2025, inaccessible full-text version

Study selection

It was performed through record retrieval, duplicate removal, title and abstract screening according to the prespecified eligibility criteria, and full-text screening. Records with inaccessible full texts, irrelevant data on VH, or a lack of hesitancy determinants were excluded. The comprehensive version was retained in case of overlapping versions of the same study. A PRISMA-ScR flowchart was generated in Covidence (11). Two independent reviewers were involved in all stages, resolving conflicts by consensus or with a third reviewer. Inter-rater reliability was calculated via Covidence.

Data extraction

Table 2 demonstrates the prespecified data. One reviewer extracted all relevant data using a pre-finalised Excel form, while a second independent reviewer verified the extracted data against a random 20% sample of the studies. Any discrepancies were resolved by consensus or with a third reviewer. Non-reported data were marked as NR.

Table 2: Data extraction blueprint

Domain	Particulars	Dictionary
Study metadata	Study ID, location, design, analysis mode, income level	●Study ID: first author + publication year ●Location: nationwide or regional ●Design: Cross-sectional or other ●Analysis mode: descriptive (answer the What only), analytical (answer the Why only), or Mixed (answer both what and why).

Population and context	Sample size (N), population type, demographics, age, nationality	●N: final analysed. ●Population type: general, selected, or high-risk. ●Demographics: subgroups under selected or high-risk (e.g., parents). ●Extract age as mean, median, or range ●Specify nationality as Saudi/Non-Saudi (n, %)
Exposure	Vaccine(s) of interest	●Vaccine(s) studied (e.g., COVID-19, HPV).
Outcome(s)	Definition, measurement tool, quantitative/qualitative findings	●How VH was defined and measured (e.g., Likert scale, binary). ●Prevalence rate as %, mean scores, or primary theme if qualitative.
Hesitancy determinants	WHO 3Cs framework (Confidence, complacency, convenience)	●Categorize reasons by: Confidence, Complacency, and Convenience.
Pandemic effect	Shifts and spillover effects	●Shifts: Temporal changes in sentiment (before vs during/after) or intensity of concern. ●Spillover: Impact of COVID-19 vaccine attitudes on other vaccines (e.g., HPV).
Key Authors conclusion	Key determinants, older vaccines versus new ones	●Key reported determinants of VH by the study authors ●Most cited reasons by authors of study for hesitancy toward old established vaccines versus newer vaccines
Notes	Limitations	●Study limitations (e.g., small sample size, bias)

Evidence synthesis

The study designs, geographic contexts, and population characteristics (e.g., total size, types, demographics, age, and nationality), along with the specific vaccine studied and the methods used to measure outcomes, were synthesised thematically. Data on VH outcomes, including prevalence, determinants, and pandemic impacts, were thematically synthesised by vaccine type for each population category (general, selected, high-risk). When applicable, data were further broken down by demographics within each population.

Results

This review provides a ten-year landscape (2015–2025) of VH across general, selected, and high-risk populations.

Appendix A shows the number of retrieved records across the datasets and timeframe of the search strategy, and Fig. 1 shows the results of the search strategy and study selection. Reviewer agreement of 92.6% ($\kappa = 0.84$) and 92.1% ($\kappa = 0.79$) was achieved at the title-abstract screening stage and the full-text screening stage, respectively.

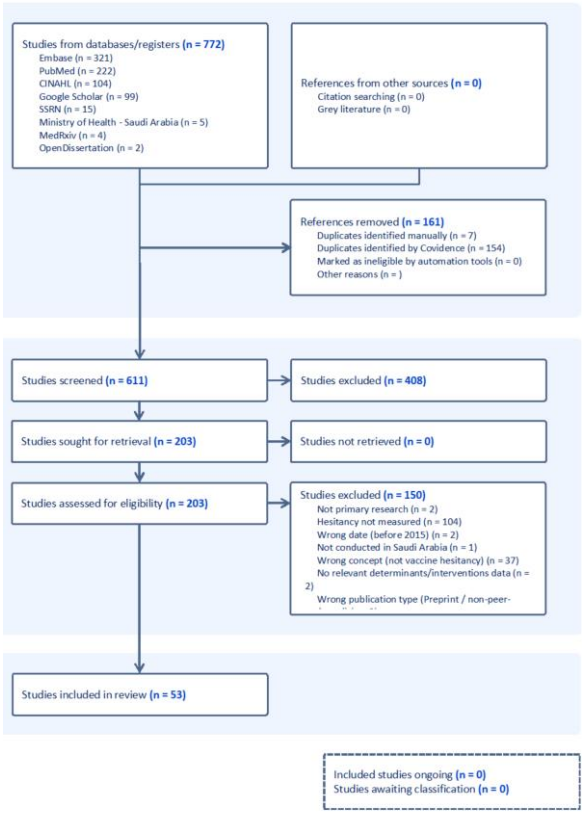

Figure 1: PRISMA flow chart

Following independent verification of the extracted data, a high level of consistency was achieved.

Appendix B shows the baseline study characteristics. All the included studies (n=53) were conducted in KSA and published in peer-reviewed journals. A total of 26 studies were nationwide, while 27 were regional [Riyadh (n=14), Aseer (n=3), Jazan (n=2), Jeddah (n=2), Qassim (n=2), Taif (n=1), Hafr Al-Batin (n=1), Al-Ahsa (n=1), and Makkah (n=1)]. Thus, regional evidence remained more concentrated in Riyadh (n=15), indicating research centralisation within KSA (Appendix B). On the other hand, all studies were cross-sectional, with the predominance of analytical studies (50 out of 53) (Appendix B).

The included studies enrolled 47,076 participants [Saudi citizens: 41,917 (89.04%), non-Saudi citizens: 4,719 (9.96%)] across general (n=18), selected (n=29), and high-risk (n=6) groups. Further, the selected population segment was subdivided into parents (n=22), HCWs (n=3), older adults (> 50 years, n=2), married adults (n=1), and medical college undergraduate students (Medical students) (n=1), while high-risk population segment was subdivided into patients with chronic kidney disease (CKD patients, n=1) and diabetic patients (diabetics) (n=1), pregnant women (n=2), dental patients (n=1), and adults recovered from COVID-19 (Recovered adults, n=1). Moreover, participants' ages ranged from 15 to 92 years, with a majority (n=51) aged ≥18 years (Appendix B).

VH was defined in various ways across the included studies as a mean VHS score (<3), a 60% threshold for hesitant responses across items, or a VHS total score of ≥25. Additionally, studies used a broad range of validated instruments, including the 5Cs scale, the Oxford COVID-19 Vaccine Hesitancy Scale, the Vaccination Attitudes Examination (VAX) Scale, the CoV-HERSA spectrum tool, and the Behavioural and Social Drivers (BeSD) model. Complexity increased further by incorporating external psychological factors, with hesitancy assessed using constructs such as the Health Belief Model (HBM), the Fear of COVID-19 Scale (FCV-19S), and the COVID-19-Anxiety Questionnaire. Custom, multi-item instruments also varied from single questions about hypothetical vaccine efficacy to detailed 30-item questionnaires tailored to specific cultural and contextual factors. (Appendix B).

Among the general population, the COVID-19 VH prevalence fluctuated between low and high rates (low - 82%) (12-25) (Appendix C).

Among the selected population, parental COVID-19 VH ranged from low to high rates (9%-76%) (26-39). Similarly, the parental influenza VH ranged from low to high rates (up to 66.8%) (27, 39-42), whereas the parental RCV VH ranged from a low to moderate rate (3.1%-47.1%) (28, 30, 31, 39-45). Similar to parental RCV VH, parental HPV VH fluctuated from low to moderate (40, 46). Among older adults (> 50 years), COVID-19 VH ranged from moderate to high rates (33.3% and 56.14%) (47, 48), which is higher than the global rates (27.7 %) (49), while the COVID-19 VH was moderate to high among HCWs ((30% and 33.7%) (47, 48), resembling global rates (49). Conversely, the influenza VH among HCWs remained low (12%) (50). Similarly, HCWs showed a low RCV VH (12%) (50). Married adults demonstrated low (4.4%) RCV VH but moderate (38.5%) COVID-19 VH (51). Conversely, medical students exhibited high (59.1%) HPV VH (52).

Among high-risk populations, CKD patients, diabetics, and dental patients showed moderate COVID-19 VH (27.7%, 29%, and 48.1%, respectively) (53-55)whereas recovered adults showed high COVID-19 VH (99.1%) (56). In pregnant women, evidence of COVID-19 VH was described as low (15.7%) in one study and high in another (57, 58).

Among the general population, low safety-driven confidence in the COVID-19 vaccine (13-19, 21-25) and influenza vaccine (24, 59-62). Similarly, parental low safety-driven confidence in the COVID-19 vaccine (27, 29-39, 63), RCV (30, 31, 39-45), influenza vaccine (27, 39, 41, 42) and HPV vaccine (46). Likewise, low safety-driven confidence in the COVID-19 vaccine was found among older adults (47, 48) and HCWs (64, 65). Again, low safety-driven confidence also remained a consistent determinant of VH toward influenza and RCV among HCWs (50), as well as toward the COVID-19 vaccine among married adults (51), RCV among married adults (51), and HPV vaccine among medical students (52). Among high-risk populations, low safety-driven confidence remained a consistent determinant of COVID-19 VH among pregnant women (57, 58), CKD patients (54), and recovered adults (56). However, the findings among recovered adults (56) remain somewhat fragmented.

In the general population, complacency to COVID-19 (13, 18, 20, 24) and influenza (60-62) vaccines was mainly driven by perceived low risk. Among the selected populations, parental COVID-19 (28, 31, 32, 34, 38) and influenza (39-41) VH was associated with high complacency, primarily driven by a low perceived risk. However, parental RCV VH was associated with high complacency, driven mainly by preference for natural immunity (39-41, 44). In contrast, parental HPV VH was associated with high complacency, driven by uncertainty of vaccine risks (46). The COVID-19 VH was associated with high complacency, driven by perceived low risk among older adults (47, 48) and HCWs (64, 65). Similarly, both influenza and RCV VH among HCWs were associated with high complacency, driven by perceived low risk (50). The COVID-19 and RCV VH among married adults were associated with high complacency, driven by unnecessary vaccination (51), while HPV VH was associated with high

complacency driven by low vaccine awareness among medical students (52). COVID-19 VH was associated with high complacency, driven by a preference for natural immunity among pregnant women [54], dental patients [13], and recovered adults (56), as well as perceived low risk among CKD patients (54) and diabetics (53).

Convenience-related barriers were less commonly reported, with the exception of not knowing the vaccination facility location for pediatric influenza (29, 31, 63), RCV (30, 31, 40, 43), and HPV vaccines (46, 52).

The pandemic altered vaccination behaviours among the general population. In 2021, government mandates played a key role, lowering refusal rates from 59.3% to 40.7% and increasing vaccine uptake from 11.4% to 70%, resulting in a 58% acceptance rate. However, acceptance declined by 64.7% in the second wave compared to the first one, and it continued to decline, reaching 24.1% after restrictions were lifted and anxiety was relieved (12-14, 17-22, 24, 25). Additionally, a history of routine influenza vaccination, experience with COVID-19 infection, and loss of relatives due to COVID-19 positively spilt over into COVID-19 vaccine acceptance. Conversely, a history of refusing other vaccines and a low perceived risk intensified by infodemics negatively spilt over, increasing VH (12-22, 24, 25).

Regarding the pandemic's effect on influenza VH, increased health awareness, heightened fear of infection, and recognition of the importance of vaccination during the pandemic contributed to greater acceptance and uptake of the influenza vaccine. Conversely, pandemic-related misinformation, mistrust, and reduced perceived risk due to the lifting of restrictions increased hesitancy toward influenza vaccination (24, 59, 60, 62). Prior routine or influenza vaccination behaviours enhanced willingness and improved knowledge of COVID-19 vaccines, even though influenza vaccination uptake remained low in some populations. Conversely, scepticism and safety concerns surrounding COVID-19 vaccines negatively spilt over, undermining influenza vaccine acceptance (59, 60, 62).

In the selected population, the pandemic created selective scepticism among parents regarding COVID-19 vaccines. That is, parents maintained significantly higher trust in routine vaccines than in the new COVID-19 vaccine. Neither increased vaccine availability nor the emergence of new variants proved sufficient to overcome this parental hesitancy to vaccinate their children (26-29, 31-37, 39, 63). Parental VH toward routine and influenza immunisations significantly increased complacency or resistance toward COVID-19 vaccines, with precautionary behaviours often serving as markers of deep-rooted scepticism rather than protective measures. Concerns over vaccine novelty and complex schedules further eroded trust, leading many parents to vaccinate only to comply with mandates, fundamentally altering the landscape for childhood immunisation programs (26, 27, 29, 31, 33-35).

Parental RCV VH was 14.8% pre-pandemic (43), even in regions with 96-98% coverage (42). The pandemic increased COVID-19 VH (27%) and RCV VH (6%) (28), with parental hesitancy rising by 50% (31). Conversely, vaccine uptake sharply increased from 32.1% to 79.5% by the peak of the pandemic (30). Furthermore, pandemic awareness increased influenza vaccine intent while trust in routine immunisations persisted, although fear of infection and novel VH, fueled by infodemics, disrupted schedules (30, 31, 40, 41, 45). Despite these challenges, mandatory school-entry requirements maintained routine uptake, even as a significant preference gap remains between influenza (36.2%) and COVID-19 vaccine acceptance (24%)(39, 42).

Regarding the parental influenza VH, the vaccine hesitance baseline was low before the pandemic (42). During the pandemic, parental willingness to vaccinate their children increased from 29.8% to 47.3% (40), and influenza VH (39%) remained significantly lower than COVID-19 VH (74%) (27). Post-pandemic, the pandemic established VH as a critical institutional priority (39). Infodemics and delayed approvals drove a cautious wait-and-see approach to childhood vaccinations, despite rising intent for influenza shots and synergistic uptake with COVID-19 vaccines (26, 27, 39). Concurrently, fear of nosocomial infection reduced routine healthcare visits, with optional vaccines seeing higher refusal rates than mandated ones (41, 42). However, the pandemic impact on parental HPV VH showed a persistent widespread misunderstanding because this vaccine is newly introduced (46).

Among older adults, the pandemic drove COVID-19 vaccine refusal up to 56% and hindered second-dose uptake, while influenza VH further reduced acceptance. Additionally, digital-only campaigns failed to reach older adults with lower digital literacy (47, 48). Among HCWs, a history of routine influenza vaccination increased HCWs' willingness to receive the COVID-19 vaccine by 88.4% during the pandemic. Practising safety measures also enhanced COVID-19 vaccine acceptance (64, 65). On the other hand, 12% of HCWs reported that their perspective on vaccination changed negatively due to infodemics, and reluctance toward relatively newer vaccines (e.g., HPV) was higher than established ones (50). Among married adults, COVID-19 VH grew (> 5%), predicting lower childhood immunisations during the pandemic (51). However, the pandemic impacts on HPV VH among medical students were not reported.

Among high-risk populations, recovered adults resisted vaccination due to reliance on natural immunity, reinforcing hesitancy (56). Conversely, some pregnant women and diabetics showed a surge in vaccination acceptance due to real-world clinical evidence (53, 57) to protect themselves (57).

Additionally, prior influenza vaccination behaviour among people with diabetes was not transferred into COVID-19 vaccine acceptance (53). Conversely, CKD patients and some pregnant women developed increased complacency as perceived susceptibility dropped following restrictions lifting (54, 58). Thus, these pregnant women exhibited sustained higher VH (58), while uncertainty regarding immune response to the primary vaccines shifted attention of CKD patients toward booster doses (54). Furthermore, dental patients were confused by conflicting reports of health officials and infodemics, becoming (55), and reducing booster dose uptake (55).

Discussion

This scoping review provides a ten-year landscape (2015–2025) of VH across general, selected, and high-risk Saudi populations, based on 53 included studies conducted in KSA and published in peer-reviewed journals.

The search strategy and study selection in this review could be reproducible since they strictly followed the prespecified eligibility criteria (12-48, 50-65) besides the high percentage of reviewers' agreement during the title-abstract screening stage, the full-text screening stage, and the consistent data extraction highlight robust methodological quality (10). Among the 53 included studies, 14 studies were conducted in Riyadh, indicating research centralisation, which is a frequent global research pattern, even in HICs (66). Additionally, all the included studies were cross-sectional, with 50 out of 53 studies being analytical and descriptive, enabling this review to identify associations between VH prevalence and its underlying determinants (67). Moreover, the included studies enrolled 41,917 (89.04%) Saudi participants across general, selected, and high-risk groups, with a majority aged ≥18 years, which enabled this review to identify additional VH pockets within specific demographic subgroups (68). However, VH measurements exhibited notable heterogeneity due to inconsistent classification thresholds, which hindered direct comparisons across studies.

Although KSA maintained its status as an HIC throughout the 2015-2025 period (66), VH persisted across routine, mandatory, and optional vaccines in diverse demographic settings, indicating a distinct contextual paradox. However, this pattern has also been observed in other HICs, as reported by the WHO (69).

Among the general Saudi population, the COVID-19 and Influenza VH prevalence rates ranged from low to high, resembling those patterns of COVID-19 and influenza VH across HICs (70, 71).

Among the selected population, parental COVID-19 and influenza VH ranged from low to high rates, whereas the parental RCV and HPV VH ranged from low to moderate rates. Regarding the high HPV VH, it could be because the HPV vaccine is still new in the KSA, albeit parental HPV VH in the KSA is still consistent with those in HICs (72). However, the parents are substantially hesitant to vaccinate their children with newer vaccines, while their acceptance of established paediatric immunisations remains relatively stable. Consistently, these patterns align with global rates of parental VH toward established and newer vaccines (8).

Among older adults (> 50 years), COVID-19 VH ranged from moderate to high rates, which is higher than the global rate of 27.7 % (49), while COVID-19 VH was moderate to high among HCWs, resembling global rates (49). Conversely, influenza VH among HCWs remained low (12%), which was lower than the global rate of 36.57% (71). Similarly, HCWs showed a low RCV VH, which could not be compared with relevant global data due to the scarcity of specific pooled evidence of RCV VH among HCWs. On the other hand, married adults demonstrated low RCV VH but moderate COVID-19 VH. At the same time, medical students exhibited high HPV VH, which remained contextual evidence in KSA and could not be compared with relevant global data due to the scarcity of specific pooled evidence.

Among high-risk populations, CKD patients, diabetics, and dental patients showed moderate COVID-19 VH. In contrast, recovered adults showed high COVID-19 VH, which could not be compared with global data, as relevant pooled evidence remains limited. In pregnant women, evidence of COVID-19 VH remains conflicting (low or high).

Among the general population, low safety-driven confidence in the COVID-19 vaccine and influenza vaccine resembles global rates (70, 73). Similarly, parental low safety-driven confidence in the COVID-19, RCV, influenza, and HPV vaccines resembles the global evidence (74-77). Likewise, low safety-driven confidence in the COVID-19 vaccine among older adults and HCWs is consistent with global evidence (78, 79). Again, low safety-driven confidence also remained a consistent determinant of VH toward influenza and RCV among HCWs, as well as toward the COVID-19 vaccine among married adults, RCV among married adults, and HPV vaccine among medical students, which could not be compared to the relevant global data because of the limited pooled evidence. Among high-risk populations, low safety-driven confidence remained a consistent determinant of COVID-19 VH among pregnant women, CKD patients, and recovered adults, which could not be compared to the relevant global data because of the limited pooled evidence. However, the findings among recovered adults remained somewhat fragmented due to a limited local literature base.

VH driven by complacency varies widely across different groups and vaccine types, shaped by distinct perceptions. The most common reason is a perceived low risk of disease, which contributes to COVID-19 and influenza VH among the general population,

parents, older adults, and HCWs, as well as RCV hesitation among HCWs and COVID-19 among diabetic and CKD patients. Alternatively, a preference for natural immunity leads certain groups, such as parents, pregnant women, dental patients, and recovered adults, to hesitate on RCV and COVID-19 vaccines. Other factors include concerns about vaccine risks for parental HPV vaccination, beliefs that vaccination isn't necessary for married adults concerning COVID-19 and RCV, and a lack of awareness of the HPV vaccine among medical students. Finally, across the different Saudi populations, convenience generally was not an obstacle to vaccination, except for unawareness of where to access influenza, RSV, and HPV vaccines.

The pandemic significantly altered vaccination behaviours. Initially, mandates raised COVID-19 vaccination rates to 70% in 2021, but acceptance fell to 24.1% after restrictions were lifted. Although routine vaccinations encouraged acceptance, pandemic infodemics increased hesitancy for both COVID-19 and influenza, often leading parents to adopt selective scepticism toward new vaccines. Additionally, heightened health awareness helped some high-risk groups increase their vaccination rates. However, reliance on natural immunity and misinformation caused others to refuse vaccines, undermining trust in long-standing immunisation programs. These trends were not only a special case in KSA but also resembled those experienced globally from 2019 to 2023 (80).

A significant gap exists in localized research on VH for both established and new vaccines, especially within high-risk and selected groups. Comparing local pandemic insights to global evidence was difficult because of substantial contextual differences and the absence of a standardised framework like the WHO SAGE 3 Cs model. Additionally, the current evidence base suffers from methodological shortcomings, such as heavy reliance on small, cross-sectional, self-reported online surveys, which may introduce selection and reporting biases.

Conclusion

Despite comprehensive coverage and free access to vaccines, VH persists, fluctuating and often high across different populations.

Parental and HCW hesitancy towards RCV generally remained low to moderate, but attitudes were much more variable for newer or optional vaccines. Notably, parents, HCWs, and medical students showed high VH toward influenza and HPV vaccines.

Low safety-driven confidence and high complacency were the main determinants of VH toward all vaccine types. The high complacency was mainly driven by a low perceived risk of infection and a preference for natural immunity among the general population, parents, and high-risk groups such as pregnant women, dental patients, and COVID-19 recovered adults. On the other hand, barriers related to convenience are quite rare across all populations, mostly limited to specific knowledge gaps about vaccination sites for pediatric, influenza, and HPV vaccines.

The VH decreased during periods of high transmission due to government mandates. However, it returned after peak transmission as restrictions relaxed and perceived risks declined. Interestingly, the pandemic caused bidirectional behavioural spillover effects. That is, individuals who regularly received influenza vaccines were more likely to accept COVID-19 vaccines quickly, while early refusal of COVID-19 vaccines mitigated trust in routine and seasonal immunisations.

Authors' contributions

Basim Alkhlfan contributed to the methodology, data extraction, literature synthesis, and drafting; Ibrahim Alasafrah contributed to methodology, data extraction, and drafting; Ahmed Al Hashim contributed to the methodology and drafting; Candace Hernandez contributed to the methodology and drafting; Kenneth A. Knapp contributed to study design, conceptual framework, and editing. All authors read and approved the manuscript submission.

Availability of data and materials: Appendices A, B, and C

Conflict of interest: The authors declare no conflict of interest

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