

Table 1. Summary of Reviewed Articles on Parental Childhood Immunization Knowledge and Attitudes

Author / Year	Country	Design	Aim	Sample / Population	Main Findings
Reich ^[3]	USA	Qualitative	Investigate parental control and ambivalence in managing children's health related to vaccines.	34 parents	This study illustrates how parents manage ambivalence and accept medication in specific contexts while expressing rejection of pharmaceutical interventions, providing insights for engaging parents in healthcare decision-making.
Agrawal et al. ^[4]	India	Cross-sectional	Explore vaccine hesitancy (VH) and confidence in childhood immunization in India.	NA	The review in India identifies factors contributing to VH, including safety concerns, doubts about less common disease vaccines, and suspicions about new vaccines. Challenges include limited awareness and access and socio-economic, educational, and cultural influences. It suggests improved communication, education, awareness, and tailored immunization programs for specific communities or regions to boost vaccine confidence.
Hasnan and Tan ^[5]	NA	Narrative review	Conduct a narrative review of VH in childhood.	NA	VH, a persistent issue undermining immunization programs, particularly in childhood vaccination, was analyzed using a multi-dimensional framework encompassing child and parent / family, clinician, healthcare system and policy, and infectious disease / vaccine domains. Factors contributing to hesitancy included emotional distress, past negative experiences, and misconceptions among families, while clinician attitudes and motivation played a role, along with healthcare system deficiencies such as inadequate monitoring, transparency, and information dissemination.
Olson et al. ^[6]	United States	Systematic review	Review communication interventions and strategies to address parental VH in the US.	Parents in the United States	The study outlines definitions and determinants of VH, using the WHO SAGE Working Group's definition and a determinants matrix to categorize factors influencing vaccine decision-making. Additionally, it presents various communication interventions and strategies to address VH, categorized into informative and educational, reminder and recall, community ownership, skills teaching, support provision, and decision-making facilitation approaches, highlighting their effectiveness in different contexts.
Lorini et al. ^[7]	NA	Systematic review	To identify health literacy and its relationship with vaccination.	NA	The role of HL in predicting VH or acceptance appeared to be influenced by factors such as country, age, and vaccine type. However, the overall relationship remains unclear, highlighting the need for further research, especially longitudinal studies using multiple measurement tools, to understand better HL's role in predicting vaccine uptake.
Deml et al. ^[8]	Switzerland	Observational / Qualitative	Explore doctors' experiences in counseling vaccine-hesitant patients in Switzerland.	6 doctors for interviews 20 doctors for observations	In Switzerland, biomedical doctors navigating VH and under-immunized patients grapple with complex boundaries and paradoxes. While they counsel hesitant patients, doctors face dilemmas surrounding their professional responsibilities and reputation, highlighting the need for improved support for healthcare providers addressing VH in clinical practice.
Matta et al. ^[9]	Lebanon	A national cross-sectional study	To determine the factors, especially the parent-physician communication, associated with parental knowledge, attitudes and practices of their children's vaccination.	Three thousand five hundred parents (father, mother or both)	A better patient-physician communication was significantly associated with higher knowledge, better attitude and practice. Better knowledge was significantly associated with better attitude, whereas better knowledge and attitude were significantly associated with better practice.

Alshammari et al. ^[10]	Saudi Arabia	Cross-sectional study	To assess the awareness and attitudes regarding routine childhood immunization among Saudi parents in Riyadh, Saudi Arabia.	1200 parents	Adherence to the immunization schedule was confirmed important by 93%, while 91% presumed that immunization keeps their children healthy. Additionally, immunization was perceived as important by 94% of parents and only 8% agreed that immunization is prohibited by religion. Females were 1.45 ($P < 0.05$) times more likely to exhibit positive attitudes than males.
Facciola et al. ^[11]	Italy	Cross-sectional survey	Provide an overview of parents' opinions about vaccination and possible reasons for refusal.	parents of pupils aged 13-14 years old	Vaccination coverage rates varied widely among different vaccines, with high coverage for established ones like MMR and DTP but very low coverage for newer vaccines like HPV and meningococcal. Parents' age, education level, favorable physician opinions, and knowledge of vaccine-related harm influenced vaccination decisions, while limited awareness about vaccine composition and disease prevention was observed.
Bianco et al. ^[12]	South of Italy	Cross-sectional survey	To evaluate attitudes about childhood vaccines and vaccine refusal or delay among parents and to assess the role played by the variables mapped as potential determinants to suggest strategies that could improve childhood vaccination rates.	575 parents	Among the 575 parents who completed the survey, 7.7% were defined as VH parents (VHPs) through PACV score, while 24.6% reported having refused or delayed at least 1 dose of vaccine for their child. Parent Attitudes about Childhood Vaccines Survey (PACV) is a measure of the attitudes towards vaccines, and discrepancies between attitudes and actual behavior have been of concern to investigators. The researchers suggest that the inconsistency between PACV score and vaccines refusal / delay could be explained by the fact that VH is considered a complex and context-specific issue, and its determinants could vary among different countries.

Paterson et al. ^[13]	West Yorkshire and Greater Manchester	Semi-structured interviews using an interview topic guide	<i>This study is a reminder of the importance of asking parents their reasons for non-vaccination to identify all reasons, including perhaps unexpected ones.</i>	In total, 1,223 invitation packs were sent to 913 parents	The study highlighted a range of parental concerns and a lack of perceived need for the influenza vaccine for children. The main reasons given for the view that influenza vaccine was not needed for their children was that parents felt that their child was healthy, with a strong immune system, at low risk of catching influenza, that it is better to build their immune system with disease, and the view that if their child were to get influenza that their child would be at low risk of complications. Parents stated they would consider vaccinating their child in future years if they received feedback as to how the childhood vaccination programme had reduced the amount of influenza. Other parents wished to be told why their child's age group was being targeted. Thirty-four percent of parents who did not consent to their child being vaccinated as part of the school programme had actually vaccinated their child elsewhere, intended to have their child vaccinated, or had not vaccinated them due to medical reasons (whether valid or perceived). This finding illustrates the importance of including additional questions or data sources when investigating under-vaccination. Eleven parents interviewed declined the vaccine for religious reasons due to the presence of porcine gelatine in the vaccine. In 2001, the WHO convened a group of Islamic scholars, who issued a statement confirming that: "the transformation of pork products into gelatin alters them sufficiently to make it permissible for observant Muslims to receive vaccines containing pork gelatin and to take medicine packaged in gelatin capsules". Despite this statement, local concerns and hesitation have continued - such as in this study, which found that global statements, such as the one issued by WHO, reflecting the views of multiple Islamic scholars, did not change the minds of some who deferred to their local religious leader over global statements.
Napolitano et al. ^[14]	Naples, Italy	Cross-sectional survey	To assess the prevalence of VH and to identify factors associated among a randomly selected sample of parents.	727 parents	The median of PACV score among participants was 45.8 with a total of 141 parents (34.7%) scored a value ≥ 50 and were defined hesitant about the childhood vaccinations. VH was significantly more common among those who were concerned and among those who were not sure that any one of the childhood shots might not be safe, among those who were concerned that their children might have a serious side effect from a shot, among those who were concerned that a shot might not prevent the disease, among those who delayed and refused at least a shot of vaccine for their children, and in those who are not sure and uncertain in the pediatrician. More than half of parents (53.8%) expressed a desire to receive additional information about the childhood vaccinations.
Goldenberg ^[15]	BOOK	Not specified	Discuss VH, public trust, expertise, and the challenges in promoting vaccination.	NA	Explored the complex issues surrounding VH and trust in vaccination.
Attwell and Navin ^[16]	Not specified	Policy paper	Review the scope, sanctions, severity, selectivity, and salience of childhood vaccination mandates.	NA	To comprehend a vaccine mandate policy, it is crucial to consider its various components: Scope, sanctions, severity, selectivity, and salience. Salience, in particular, reflects the extent of the burdens the state imposes on those who remain unvaccinated.

Musa et al. ^[17]	Bosnia	Qualitative	To identify barriers and drivers to childhood vaccination.	22 parents	Parents of fully vaccinated children reported positive individual and contextual drivers, while parents of delayed / partially vaccinated children had diverse experiences, including organizational challenges and VH. Parents of unvaccinated children faced significant safety concerns and expressed distrust of health workers and mandatory vaccination, highlighting the complex interplay of factors affecting vaccination decisions. Urban-rural differences also emerged, with urban parents more likely to encounter vaccine shortages and receive information leaflets.
Skirrow et al. ^[18]	United Kingdom	Multi-methods study	Investigate women's views on accepting the COVID-19 vaccination during and after pregnancy and for their babies.	10 women in the UK were interviewed, and 1180 women were surveyed	The study found that most women surveyed were willing to accept a COVID-19 vaccine for themselves when not pregnant, but vaccine acceptance decreased during pregnancy and for their babies. Ethnic minority women were more likely to reject the vaccine, and income and ethnicity were identified as critical factors influencing vaccine acceptance.
Gabis et al. ^[19]	NA	Review paper	Investigate beliefs related to vaccination and the autism spectrum.	NA	Despite extensive scientific evidence disproving any link between vaccines and autism, concerns and myths persist among some parents. Factors contributing to this include the timing of autism diagnosis and occasional regression, which coincides with vaccination age. To combat VH and misinformation, it is crucial to disseminate evidence-based studies on autism's causes and provide accessible information through social media and parental organizations.
Geoghegan et al. ^[20]	NA	Review	Review myths and misinformation related to vaccine safety.	NA	Healthcare professionals are essential in influencing vaccine decisions, as VH seriously threatens global health. Common safety concerns include fears of adjuvants, preservatives, inactivating agents, manufacturing residuals, and the number of vaccines, often linked to conditions like autism and developmental delays, despite robust scientific evidence refuting these concerns.
McDonald et al. ^[21]	California, USA	Qualitative	Investigate vaccine decision-making among California homeschooling mothers after removing personal belief exemptions.	24 Homeschooling mothers in California	Mothers were categorized into three groups based on their vaccine attitudes and behaviors: Confident and accepting, hesitant and accepting, and skeptical and refusing. While all participants believed SB-277 infringed on parental rights, their beliefs about vaccine safety, effectiveness, and risk perception varied, influencing their vaccine decision-making.
Verulava et al. ^[22]	Georgia	Survey	Examine mothers' knowledge and attitudes toward child immunization in Georgia.	188 mothers in Georgia	Most interviewed mothers (97%) expressed a positive attitude towards vaccination and believed in its importance for disease prevention. However, 36% of children needed complete vaccination, primarily due to a lack of knowledge about the routine vaccination schedule (25.5%) and limited information about the necessity of multiple doses (18.6%).
Mendel-Van Alstyne et al. ^[23]	USA	Qualitative	Study mothers who are hesitant about vaccines and explore factors affecting their confidence.	61 mothers who are vaccine-hesitant	The qualitative data analysis of focus group discussions revealed several significant themes, including primary health concerns for young children, confidence beliefs and perceptions regarding recommended vaccines, facilitators and barriers to confidence, and reactions to educational materials. These insights provide valuable perspectives on the factors influencing vaccine confidence among parents and caregivers.

GebreEyesus et al. ^[24]	Ethiopia	Community-based cross-sectional study	Evaluate KAP of parents towards infant immunization	Parents in Wadla Woreda, North East Ethiopia	Significant number of parents had good knowledge (65.1%), favorable attitude (57.3%), and good practices (55.3%). Parental education and urban residency positively influenced knowledge and attitudes. Frequency of immunization service utilization associated with accurate knowledge. Overall KAP suboptimal compared to other studies. Recommend targeted health education.
Habib et al. ^[25]	Saudi Arabia	Cross-sectional survey	Explore KAP of Saudi parents towards children's immunization	Parents in various cities in Saudi Arabia	High level of awareness (87.2%), positive attitudes, and good practices. Higher KAP associated with female gender, higher education, and more children. Emphasize the need for continued educational efforts.
ALAmri et al. ^[26]	Saudi Arabia	Cross-sectional study	Assess knowledge and attitudes of Saudi parents regarding childhood immunization	Saudi parents	Majority displayed good knowledge on basic aspects but gaps in detailed knowledge. Positive attitudes with misconceptions. Demographics (gender, residence, education) significantly associated with knowledge and attitudes. Need for targeted educational interventions.
Hussain et al. ^[27]	Pakistan	Cross-sectional study	Evaluate parents' perceptions on child immunization	Parents in Pakistan	Parental knowledge correlated with education and income. Majority acknowledged importance of immunization. Affordability identified as a factor influencing delays in immunization. Need to address knowledge gaps and economic factors.
Pratiwi et al. ^[28]	Indonesia		Assess knowledge among Indonesian parents on rotavirus and vaccines	Parents in five Indonesian provinces	Overall knowledge relatively high, but gaps in awareness about vaccine coverage. Significant variations in knowledge levels associated with demographics. Necessity for targeted health promotion efforts.
Lamiya et al. ^[29]	India (Kerala)		Examine knowledge, attitudes, and practices among mothers in Kerala, India	Mothers in Kerala, South India	Fair knowledge about diseases prevented by vaccines but gaps in specifics. Positive attitude with prevalence of misconceptions and influence of religious myths. Need for intensive awareness campaigns.
Šeškutė et al. ^[30]	Lithuania		Highlight parental knowledge and attitudes regarding vaccines	Postpartum mothers in Lithuania	Majority recognized danger of vaccine-preventable diseases but lacked awareness of vaccine efficacy and safety. Better-informed mothers showed less hesitancy. Need for clear, evidence-based information from healthcare providers.
Kaur et al. ^[31]	India (Chandigarh)		Investigate knowledge, attitudes, and practices of mothers regarding child immunization	Mothers in Chandigarh, India	Majority aware of the need for vaccinations but gaps in specific vaccine knowledge. Predominantly positive attitude. Opportunity for targeted educational interventions to improve full immunization coverage.
Alagsam and Alshehri ^[32]	Jordan		Determine factors influencing parents' KAP toward childhood vaccination	Parents in Jordan	General understanding of vaccine importance but gaps in knowledge about adverse reactions and contraindications. Negative perceptions about vaccine safety. Need for targeted educational programs.
Alsulaiman et al. ^[33]	Jordan	Cross-sectional	Investigate parental willingness to vaccinate children against SARS-CoV-2 in Jordan.	564 parents in Jordan	Factors increasing willingness included younger parental age, higher income, and having health insurance. Among parents vaccinated for COVID-19, only 29.0% were willing to vaccinate their children. Trust in healthcare providers and pediatricians' recommendations boosted willingness, but COVID-19 risk perception had a negative effect.

Tran et al. ^[34]	USA	Not specified	Assess pediatric immunization practices in nephrotic syndrome and provider and parental knowledge.	153 providers and parents	A study found that 44% of healthcare providers adhered to the Advisory Committee on Immunization Practices (ACIP) guidelines for inactive vaccines, and 22% adhered to the guidelines for live vaccines. Additionally, 32% of parents / guardians had knowledge aligned with ACIP guidelines for inactive vaccines, while only 1% had such knowledge for live vaccines, with factors like geographical location and provider recommendations influencing vaccine adherence.
Guzman-Holst et al. ^[35]	Latin America	Systematic review	Review barriers to vaccination in Latin America.	Populations in Latin America	A systematic literature review on vaccination barriers in Latin America and the Caribbean revealed that current vaccination coverage rates in the region are below Pan American Health Organization targets. The most frequently reported barriers included "individual / group influences" and "contextual influences", with factors such as adverse socio-economic conditions, low education levels, lack of disease and vaccine awareness, and cultural beliefs commonly cited as obstacles to vaccination acceptance.
Voo et al. ^[36]	Sabah, Malaysia	Survey	Investigate vaccine knowledge, awareness, and hesitancy among parents residing in Sabah, Malaysia.	405 parents in Sabah, Malaysia	The study found that most parents had good knowledge and awareness of vaccines, with only a tiny percentage (6.8%) exhibiting VH. Parents with higher education levels were more knowledgeable about vaccinations, less vaccine-hesitant, and more likely to ensure their children completed the recommended immunization schedule.
Abdullah et al. ^[37]	Malaysia		Explore factors influencing parents' knowledge and attitudes towards childhood immunization	Parents in Hulu Langat, Malaysia	Inadequate knowledge and negative attitudes among some parents. Predictors for inadequate knowledge and negative attitudes identified. Need for tailored health interventions.
Lewandowska et al. ^[38]	Not specified		Address parental opinions and knowledge regarding child vaccinations	Parents	Majority recognized necessity of vaccinations but concerns about adverse reactions persisted. Need for better health education regarding vaccination programs.
Goss et al. ^[39]	Not specified		Investigate factors influencing parental decisions regarding influenza vaccination	Parents	Doubts about vaccine effectiveness, concerns over side effects, and inconvenience were key barriers. Factors positively associated with vaccination included knowledge of vaccine benefits and impact on transmission. Importance of vaccine's community benefits.
Napolitano et al. ^[40]	Italy (Naples)		Assess parents' knowledge, beliefs, and behaviors concerning rotavirus infection and vaccination	Parents in Naples, Italy	Low awareness about rotavirus infection and vaccine. Awareness linked to physicians as information source. Willingness to vaccinate among majority of parents who hadn't done so. Need for enhanced public education programs.
Giannakou et al. ^[41]	Greece	Online cross-sectional study	Evaluate Greek mothers' knowledge and practices regarding children's vaccinations	Greek mothers	High vaccination rate (98%) among children. Adherence to vaccination recommendations linked to knowledge scores. Influence of pediatricians in vaccination decision-making. Importance of public health initiatives.

Ganczak et al. ^[42]	Poland		Investigate factors influencing parental willingness to vaccinate children against HPV	Parents in Poland	Low detailed knowledge about HPV but high willingness to vaccinate. Employment status, positive attitudes, prior information, and concerns about side effects identified as predictors. Need to improve HPV awareness and address VH.
Zakar et al. ^[43]	Pakistan	Qualitative	Explore parental perceptions and knowledge regarding breastfeeding practices in Rajanpur, Pakistan.	38 mothers and 40 fathers in 12 focus groups	Most participants thought newborns should be given honey, rose blossom, or goat's milk from a family elder or religious person after delivery. No cleaning measures were taken. Participants misunderstood colostrum's advantages, preventing them from giving it to neonates. Participants reported many factors, including insufficient milk syndrome (slow infant growth due to insufficient daily breast milk intake), a mother's high workload, lack of social support, culturally designated advisors, and infant formula company promotion and marketing, which undermined exclusive breastfeeding and encouraged mothers to switch to formula.
Krok-Schoen et al. ^[44]	Ohio, USA	Cross-sectional	Study Ohio Appalachian parents' beliefs about mandatory school vaccinations and vaccine refusal.	337 Ohio Appalachian parents	About 47% of parents believed parents should have the right to refuse mandatory school vaccinations. Furthermore, factors associated with this belief included political affiliation, with Republicans and Independents being more likely to support the right to refuse, and gender, with females more likely to report ever refusing a vaccine for their children, especially if they endorsed the right to refuse.
Ashkenazi et al. ^[45]	Not specified	Cross-sectional	Examine the relationship between parental sources of information and knowledge about the measles vaccine.	399 parents with children	Among respondents aged 25-39, 77% vaccinated their children against measles on time, while 23% exhibited VH. Parents under 30 and those with a single child are vaccinated less frequently. Internet and social media served as significant information sources for 32% regarding measles / measles vaccine and 49% regarding measles outbreaks, with both sources associated with lower knowledge. Multivariate analysis showed knowledge linked to timely vaccination, while internet and social media sources were associated with higher VH (OR 2.52 and OR 2.44, respectively).
Shen and Dubey ^[46]	Canada	Review	Provide clinical guidance for primary care physicians working with parents to address VH.	NA	The study suggests practical tips for healthcare providers, such as starting early, presenting vaccination as the default approach, building trust, providing answers to common vaccine questions, and offering online resources for physicians and parents.
Steffens et al. ^[47]	Australia	Qualitative	Explore how organizations promoting vaccination respond to misinformation on social media.	21 parents	Organizations promoting vaccination on social media have devised strategies to address challenges such as misinformation and anti-vaccine sentiment. These strategies include open and evidence-informed communication, creating safe spaces for dialogue, building community partnerships, and countering misinformation thoughtfully.
Dempsey and O'Leary ^[48]	USA	Narrative review	Provide a narrative review of studies on how providers' vaccine communication affects vaccine attitudes.	NA	Provider communication techniques significantly impact parental attitudes and HPV vaccine uptake. Strong and unambiguous provider recommendations and motivational interviewing for vaccine-hesitant parents can play a crucial role in promoting HPV vaccination among adolescents.

Huber et al. ^[49]	Hungary	Cross-sectional survey	Explore attitudes towards varicella vaccination in parents and healthcare providers in Hungary.	1042 parents and healthcare providers in Hungary	Approximately 53.3% of parents had vaccinated at least one of their children against varicella. Critical determinants of vaccination included having fewer than three children, residing in the capital city, witnessing varicella complications, and having a university degree. Notably, healthcare professionals' recommendations significantly influenced parental vaccination decisions, with 77.8% compliance when recommended by pediatricians, while concerns about vaccine necessity, side effects, and effectiveness drove VH.
Yufika et al. ^[50]	Indonesia	Cross-sectional	Study parents' hesitancy towards vaccination in Indonesia.	956 parents	15.9% of parents were vaccine-hesitant, with the highest hesitancy in the safety and efficacy subdomain. Factors associated with non-hesitancy included having a diploma certificate, working in the health sector, and having heard about Zika, while having heard about Zika was the only factor associated with VH in the multivariate model.