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Prevalence of Vaccine Hesitancy Towards Childhood Vaccinations Among Parents in the United Kingdom

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ABSTRACT

Introduction: Vaccine hesitancy poses a significant public health threat, hindering progress in combating vaccine-preventable diseases (VPDs). This study assessed the prevalence of parental vaccine hesitancy in the United Kingdom using the Parent Attitudes about Childhood Vaccines (PACV) scale.

Methods: A cross-sectional survey was conducted with 774 parents of children aged 0-6 years. Vaccine hesitancy was measured through a series of questions about beliefs, attitudes, and intentions regarding childhood vaccinations. Statistical analyses were performed to identify associations between vaccine hesitancy and sociodemographic factors.

Results: A total of 323 parents (41.7%) scored a PACV value ≥50 and were defined hesitant about childhood vaccinations. Those who delayed and refused at least one vaccine for their children, those who were concerned that any of the childhood vaccines might not be safe, those who were worried that their children might experience a serious side effect from a vaccine, those who were worried that a vaccine might not prevent the disease, and those who were unsure about their child's pediatrician all showed significantly higher rates of vaccine hesitancy.

Discussion: The high vaccine hesitancy prevalence was linked to socioeconomic disparities, distrust in healthcare systems, and skepticism toward pharmaceutical companies. Parents expressed concerns about vaccine safety and efficacy, reflecting lingering impacts of the discredited Wakefield study and debates around novel vaccines like COVID-19. Addressing this requires a multifaceted approach, including countering misinformation, and building trust in public health institutions.

Conclusions: The study finds a high prevalence of vaccine hesitancy among UK parents and points to significant vaccine hesitancy determinants including attitudes toward prevention and the communication and media environment. Future public health initiatives should emphasize herd immunity's role and the high efficacy of vaccines in lowering disease transmission at all levels of contracting VPDs. Providers of healthcare might play a significant role in boosting public confidence in scientific and epidemiological findings.

KEYWORDS: *Determinants, Parent attitudes about childhood vaccines (PACV) scale, Prevalence, Vaccine, Vaccine hesitancy, Childhood Vaccinations, Vaccine-Preventable Diseases*

1. INTRODUCTION

Vaccination remains a cornerstone of public health, with a proven track record in preventing and controlling infectious diseases (WHO, 2019a; WHO, 2019b; Dhanda, 2022). However, the re-emergence of vaccine-preventable diseases (VPDs) like measles and Mpox underscores the ongoing need for high vaccination coverage (Abejegah et al., 2024). The rapid development of COVID-19 vaccines demonstrates the power of scientific collaboration in addressing global health emergencies (WHO, 2022).

Despite these successes, VPDs remain a significant public health challenge. Measles outbreaks, such as the 2015 California epidemic, highlight the consequences of insufficient vaccination coverage. Achieving herd immunity requires high vaccination rates, typically exceeding 95% (WHO, 2019c). However, global measles

vaccination rates fall short of this target, leaving millions of children vulnerable.

The United Kingdom has faced a notable decline in childhood vaccination rates, particularly among children aged one to five years. Vaccination rates in England have consistently fallen below the 95% target required for herd immunity against vaccine-preventable diseases (VPDs). In 2022-23, only 91.8% of children completed their primary course of three doses by 12 months, mirroring the stagnant rates of 2021-22 and reflecting a persistent decline from the peak of 94.7% in 2012-13. While the Northeast achieved the national target with 95.1% coverage, London reported the lowest rate at 87.6% (NHS, 2023). These regional disparities mirror broader trends, with MMR vaccination rates for two-year-olds in London falling to 83% in 2018-19. This decline has serious public health implications, including the resurgence of measles (WHO, 2019), with global cases rising over 300% in early 2019 (WHO, 2020), highlighting the need for strengthened vaccination efforts to mitigate VPD risks.

The economic burden of inadequate vaccination is substantial. VPDs can lead to severe complications, increased healthcare costs, and long-term health burdens. Treating a child with pertussis, for example, can cost over £3,000 (Moser et al., 2017). Conversely, vaccines are estimated to save up to £70 billion over the life course of a population by reducing healthcare expenditures and productivity losses (Bloom, Canning & Weston, 2017).

Vaccine hesitancy is a critical factor affecting vaccine uptake. Defined as the delay or refusal of vaccines despite their availability, vaccine hesitancy is influenced by complacency, convenience, and confidence (Larson et al., 2014; MacDonald, 2015). These factors vary across time, place, and populations, disproportionately affecting certain subgroups. Parental vaccine hesitancy, in particular, presents unique challenges. Vaccine-hesitant parents may delay certain vaccines or refuse specific doses, complicating efforts to measure and address their concerns (Obohwemu, 2024). Effective communication strategies that address perceived risks and provide clear, evidence-based information are essential (WHO, 2020; Skolnik et al., 2021; Idowu et al., 2024).

This study contributes to the growing literature on vaccine hesitancy by examining its prevalence among UK parents and identifying factors influencing their decisions. The findings highlight the urgent need for tailored public health interventions to address vaccine hesitancy, rebuild trust in healthcare institutions, and improve vaccine accessibility. By addressing these challenges, public health initiatives can increase vaccination rates and protect communities from the resurgence of vaccine-preventable diseases, including emerging threats like Mpox (Abejegah, Obohwemu & Mdegela, 2024) and resurgent diseases such as measles and rubella (Stewart & Sayer, 2021).

2. MATERIALS AND METHODS

2.1. Study Population

This cross-sectional survey was conducted among 818 parents and guardians of UK children who were 0 to 6 years old. This age range was chosen because it falls within the recommended vaccination dosage sequence for children under the age of seven (CDC, 2021), and because this series includes the immunizations that typically cause doubt (Repalust et al., 2017). Parents/guardians of children between the ages of 0 and 6 were requested to provide information on only one child to prevent data duplication. Usually, this child was the one who needed immunizations (Tsuzuki et al., 2020).

2.2. Sampling Technique

The study adopted a blended sampling strategy, combining convenience and snowball techniques to reach a broad and varied participant group. Initial recruitment was carried out through professional networks and institutional mailing lists, inviting individuals who met the inclusion criteria and were willing to take part. In cases where personal contacts were involved, conscious efforts were made to promote diversity and minimise bias. To widen the reach, snowball sampling was then introduced, with early participants encouraged to refer others who also met the study's criteria—effectively using social connections to expand the sample (Parker, Scott & Geddes, 2019).

Although non-probability sampling methods inherently limit generalisability and carry risks of bias, this approach was well-suited to the exploratory nature of the research. It enabled engagement with individuals who might otherwise be overlooked by more formal recruitment channels. Inclusion criteria were clearly outlined from the outset, and diversity within the sample was actively monitored to reduce the likelihood of homogeneity resulting from network-based referrals.

Ultimately, the sampling strategy was chosen not only for its practicality but for its capacity to foster meaningful participation—particularly among groups less likely to respond to conventional outreach. It aligned with the study's commitment to generating rich, contextually grounded insights while upholding ethical standards and

ensuring accessibility. The methodology reflected a thoughtful balance between pragmatic recruitment and a principled approach to inclusivity, transparency, and academic rigour.

2.3. Data Collection

The data were collected online. Data from the study was collected and managed using Qualtrics, a safe gateway for online electronic data collection provided by the University of Sunderland. The online survey platform was utilized by participants to fill out a questionnaire that asked about sociodemographic factors and other indicators.

2.4. Participant Recruitment

The researchers created a landing page (https://vaccinehesitancy.uk) specifically for this study. Participants learned about the research and the researchers on the homepage. With this strategy, participants were confident that the study team was comprised of academics and not those looking to get personal information for illegal purposes. Participants could click the link on the webpage to go to Qualtrics and access the survey. The weblink was also shared widely across social media platforms. Google adverts were used to speed up the online recruitment process.

As part of the recruitment strategy, a promotional video containing a link to the landing webpage was made by the researcher and shared on social media on 19th November 2021. The video (https://youtu.be/ztgyxhnsyOA) garnered over four thousand (4,000) views on YouTube alone.

Furthermore, the researcher had earlier presented the research proposal at the Public Health England's 2021 Public Health Research and Science Conference (held from Monday 24th May to Thursday 27th May 2021). The video of that presentation was shared on social media on 4th December 2021 and a link to the landing webpage was added to the video's description. The video (https://youtu.be/mrBdzv7bclM) has had over forty thousand (40,000) views on YouTube.

2.5. Study Instrument

For this research, the PACV Scale (see Appendix 1-3) was chosen to identify, in accordance with prior research (Opel et al., 2013), the factors that may influence parents' vaccine hesitancy, including their individual risk tolerance, present health problems, and general attitudes about various health-related behaviors. A pilot study was not necessary because the scale has been extensively validated in high-income settings (Azizi et al., 2017).

The PACV scale has 15 elements, which are split into three subdomains:

1. Behavior
2. Safety and efficacy
3. General attitudes

In accordance with earlier research, questions 1 and 2 are categorized as behavior subdomain, questions 7 through 10 as safety and efficacy subdomain, and questions 3 through 15 as general attitudes subdomain (Opel et al., 2013). A score of 2 was assigned to hesitant responses. Responses that were “not sure” or “don't know” were awarded a score of 1. In response to question 1, ‘‘Have you ever delayed having your child get shot for reasons other than illness or allergy?” and question 2, ‘‘Have you ever decided not to have your child get a shot for reasons other than illness or allergy?”, responses of "don't know" were factored as missing data since it is more probable that they represent poor memory than vaccine hesitancy. Non-hesitant responses received a score of 0.

Except for pregnant women, who obtained a final score of 26 since they could not reply to two questions in the behavior subdomain, the final PACV score varied from 0 to 30 overall. The overall PACV score was adjusted using basic linear transformation into a scale that spanned from 0 (least hesitant) to 100 (most hesitant). According to earlier research (Bianco et al., 2019), the total score was divided into two categories: non-hesitant, with a score of less than 50; and hesitant, with a score of more than 50. In accordance with prior studies (Opel et al., 2013), the scores for each subdomain were added to the overall scores.

The PACV scale questions were divided into three general categories:

1. Contextual influences including policies and regulations, powerful figures, the media and communication landscape, the pharmaceutical sector, historical impacts, and geographical barriers.
2. Individual and social group influences: prior vaccination experience, perceived risks and benefits, confidence in the healthcare system and providers, familiarity with vaccinations, attitudes and convictions about health and disease prevention, and cultural standards (norms).
3. Vaccinations and vaccine-specific concerns: evidence-based risk/benefit evaluations, vaccination schedules, vaccine delivery methods, introduction of new vaccines, vaccine supply reliability, involvement of healthcare professionals, pricing, and tailoring immunizations to meet particular requirements.

Questions with closed-ended answers, yes/no questions, and open-ended questions were all used to elicit responses. The questionnaire also included additional questions on the sociodemographic characteristics of the individuals. Parents were requested to list any vaccinations about which they had reservations. The questionnaire also gave respondents the chance to add further comments.

2.6. Study Variables

Parents' attitudes towards childhood immunizations served as the response variable, whereas sociodemographic factors (for instance, age, gender, level of education, and the number of children) served as the explanatory variable. Education was divided into seven categories: GCSE, diploma, some college but not a graduate, bachelor's, master's, and doctoral degrees). The number of children were divided into four groups (1, 2, 3, 4 or more). Parents with a PACV score below 50 (< 50) were regarded to have positive attitudes toward immunizations and to have provided favorable replies. Parents with a PACV score above or equal to 50 (≥50) were deemed vaccine hesitant because they provided unfavorable reactions.

2.7. Statistical Analysis

With the help of the SPSS program version 26.0, data was input and analyzed. Cronbach's alpha was employed to evaluate the surveys' internal consistency and reliability. Responses to questions were summarized using frequency and percentages.

2.8. Ethical Consideration

The University of Sunderland's ethical committee gave its permission for the study to be executed. Recruitment was entirely voluntary, and no one was coerced into participation. Participants had the option to skip any question(s) they felt uncomfortable with.

Participants received assurances that the information they provided was kept private. The responses were anonymous since there was no way to give names or other personal identification. There was no support for external tracking tools (like Google Analytics) and cookies were immediately deactivated. Additionally, because the required settings were enabled, which remove personally identifying information from a response before saving it in the database, the IP addresses of participants were inaccessible.

The study was executed in compliance with the UK Research Integrity Office Code of Practice for Research, which assures that information is maintained as fully confidential, responses are kept anonymous, and data collection is done only for research reasons (Desmond & Dierickx, 2021).

3. Theoretical Framework

The theoretical foundation for this study lies in understanding vaccine hesitancy as a multifaceted phenomenon influenced by psychological, sociocultural, and systemic factors. This framework builds on the "3 Cs" model, which conceptualizes vaccine hesitancy as driven by complacency, convenience, and confidence (MacDonald, 2015). Complacency refers to the perceived low risk of vaccine-preventable diseases and the resulting lack of urgency to vaccinate. Convenience encompasses access-related factors, including the availability, affordability, and logistics of obtaining vaccinations. Confidence pertains to trust in vaccine safety, effectiveness, and the institutions responsible for vaccine delivery. The model has been widely used to guide vaccine hesitancy research and interventions, offering a structured lens through which to analyze attitudes toward childhood immunizations.

The Parent Attitudes about Childhood Vaccines (PACV) scale was employed as a validated instrument for quantifying vaccine hesitancy. Grounded in behavioral theories, such as the Theory of Planned Behavior (TPB), this scale integrates dimensions that address beliefs about vaccine safety and efficacy, general attitudes toward vaccination, and previous vaccination behaviors (Opel et al., 2011a, 2011b). By assigning weighted scores to hesitant, non-hesitant, and uncertain responses, the PACV scale captures nuanced variations in decision-making, facilitating its use as a predictive tool for vaccination behaviors.

The scoring mechanism of the PACV scale involves converting survey responses into numerical values, with hesitant responses assigned the highest weight, uncertain responses an intermediate weight, and non-hesitant responses the lowest weight. The total score is then normalized on a scale from 0 to 100, representing a continuum from complete vaccine acceptance to maximal hesitancy. Subdomain scores for behavior, safety and efficacy, and general attitudes are also calculated, enabling detailed analysis of specific drivers of hesitancy.

To ensure rigorous statistical analysis, the study design incorporated methods to maintain representativeness and reliability. Sample size calculations were based on achieving sufficient statistical power to detect significant associations between vaccine hesitancy and relevant

demographic and psychosocial factors. Missing data was managed through pairwise deletion, minimizing potential bias in the analysis. Reliability of the PACV scale was confirmed through Cronbach's alpha, demonstrating internal consistency appropriate for the study population.

The theoretical and methodological approach adopted in this study is grounded in established behavioral frameworks and robust statistical techniques. By focusing on the multidimensional nature of vaccine hesitancy, this study aims to provide insights that contribute to the development of effective public health interventions and inform policy initiatives designed to address vaccine-related challenges in diverse populations. The integration of validated tools and rigorous methods ensures the reliability and applicability of the findings to broader public health contexts.

4. RESULTS

4.1. Participants' Characteristics

A total of 818 eligible parents and guardians took part in the survey. Because the study employed convenience and snowball sampling methods—both of which lack a clearly defined sampling frame—it was not possible to calculate an official response rate. Of those who responded, 44 were excluded from the final analysis due to incomplete or inconsistent data, resulting in a final sample of 774 participants.

The missing data varied from one respondent to another, with no discernible pattern across cases. Given that only around 5% of the total sample was affected, and in line with accepted guidance (Petrie & Sabin, 2019), it was considered methodologically sound to exclude these cases from further analysis. This approach helped preserve the integrity of the dataset while maintaining transparency in reporting.

About half of the research participants were White British, one-fifth were White Other, and just a small number were Black British or Black Caribbean, according to an analysis of their sociodemographic features (Table 1). Most of the participants were more socially or politically conservative.

Table 1: Sociodemographic Characteristics of the study participants

Variables	Median (IQR)*	Frequency	Percentages
Marital Status			
Married		369	47.7
Single		201	26.0
Living with a partner		89	11.5
Widowed		59	7.6
Separated		40	5.2
Divorced		15	1.9
Annual household Income			
£20,000 or less		215	28.0
£20,001-£40,000		310	40.3
£40,001-£60,000		186	24.2
£60,001 or more		58	7.5
Number of Children			
One		158	20.7
Two		258	33.7
Three		253	33.1

Four or More		96	12.5
Ethnicity			
White British		392	50.6
White Other		162	20.9
Black African		121	15.6
Black British		52	6.7
Others		30	3.9
Asian		9	1.0
Black Caribbean		8	1.0
Child's Birth Order			
First Child		555	71.9
Not First Child		216	28.1
Relationship			
Father		211	27.4
Mother		295	38.2
Other		265	34.4
Political ideology			
0-4	3 (2)	150	19.7
5		168	22.0
6-10	9 (2)	445	58.3
Social ideology			
0-4	4 (2)	114	14.9
5		176	23.0
6-10	8 (2)	475	62.1

*IQR = Interquartile range

About half of the participants were females (49.5%), over one third were between the ages of 25-34 years (37.8%), while over one quarter of them had bachelor's degree (25.8%). Parental age was classified as 18-24, 25-34, 35-44, 45-54, 55-64, and greater than 64 years.

4.2. Descriptive Data on PACV Items

The reliability and internal consistency of the PACV questionnaire, determined using Cronbach's alpha, revealed a score of 0.74. Descriptive analysis of PACV questions (Table 2) revealed that only about one third of the participants strongly stated their belief that adhering to official immunization guidelines was a wise decision. About a third of them agreed that: "children get more vaccines than are good for them"; "many of the illness that vaccines prevent are severe"; "it was better for children to develop immunity by getting sick than to get a vaccine"; and "it was better for children to get fewer vaccines at the same time". A third of the respondents could rely on the advice they had been given regarding vaccines and another third felt comfortable discussing their vaccination concerns with their children's doctor in an open manner. Similarly, about a third of participating parents expressed concerns that: the safety of any children immunizations is not guaranteed; their children could get severe adverse effects from vaccinations; and the illness might not be prevented by a vaccination. A little above half of the participants indicated that they would be happy to

embrace vaccinations for their next baby if they had one, and similar proportion considered themselves not being hesitant about childhood vaccines. However, four out of every ten of them highly indicated that they trust their children's doctor.

Table 2: Descriptive Data on PACV Items

PACV Questions	N	%
How sure are you that following the recommended vaccine schedule is a good idea for your child?		
0-5	263	34.7
6-7	252	33.2
8-10	243	32.1
Children get more vaccines than are good for them		
Agree	163	21.1
Disagree	461	59.7
Not Sure	148	19.2
I believe that many of the illnesses that vaccines prevent are severe		
Agree	235	30.4
Disagree	403	52.3
Not Sure	133	17.3
It is better for my child to develop immunity by getting sick than to get a vaccine		
Agree	202	26.3
Disagree	453	58.9
Not Sure	114	14.8
It is better for children to get fewer vaccines at the same time		
Agree	266	34.6
Disagree	358	46.6
Not Sure	145	18.8
How concerned are you that your child might have a serious side effect from a vaccine		
Concerned	278	36.1
Not Concerned	366	47.5
Not Sure	126	16.4
How concerned are you that anyone of the childhood vaccines might not be safe?		
Concerned	300	38.7
Not Concerned	348	45.1
Not sure	124	16.1
How concerned are you that a vaccine might not prevent the disease?		

Concerned	305	38.9
Not Concerned	348	45.1
Not Sure	124	16.1
If you had another infant today, would you want him/her to get all the recommended vaccines?		
Yes	322	52
No	297	48
Overall, how hesitant about childhood vaccines would you consider yourself to be?		
Hesitant	235	30.5
Not Hesitant	405	52.5
Not Sure	131	17
I trust the information I receive about vaccines		
Agree	293	37.9
Disagree	354	45.8
Not Sure	126	16.3
I am able to openly discuss my concerns about vaccines with my child's doctor		
Agree	293	38.2
Disagree	352	45.9
Not Sure	122	15.9
All things considered; how much do you trust your child's doctor? Please answer on a scale of 0 to 10		
0-5	201	26.6
6-7	239	31.6
8-10	317	41.8

4.3 Prevalence of Vaccine Hesitancy

The majority of participants (61.6%) had a raw PACV score between 0 and 14, with over half (58.3%) having a transformed PACV score below 50% overall (Fig. 1). This means that 41.7% of the participants were vaccine hesitant, since this proportion of people had a transformed PACV score ≥50.

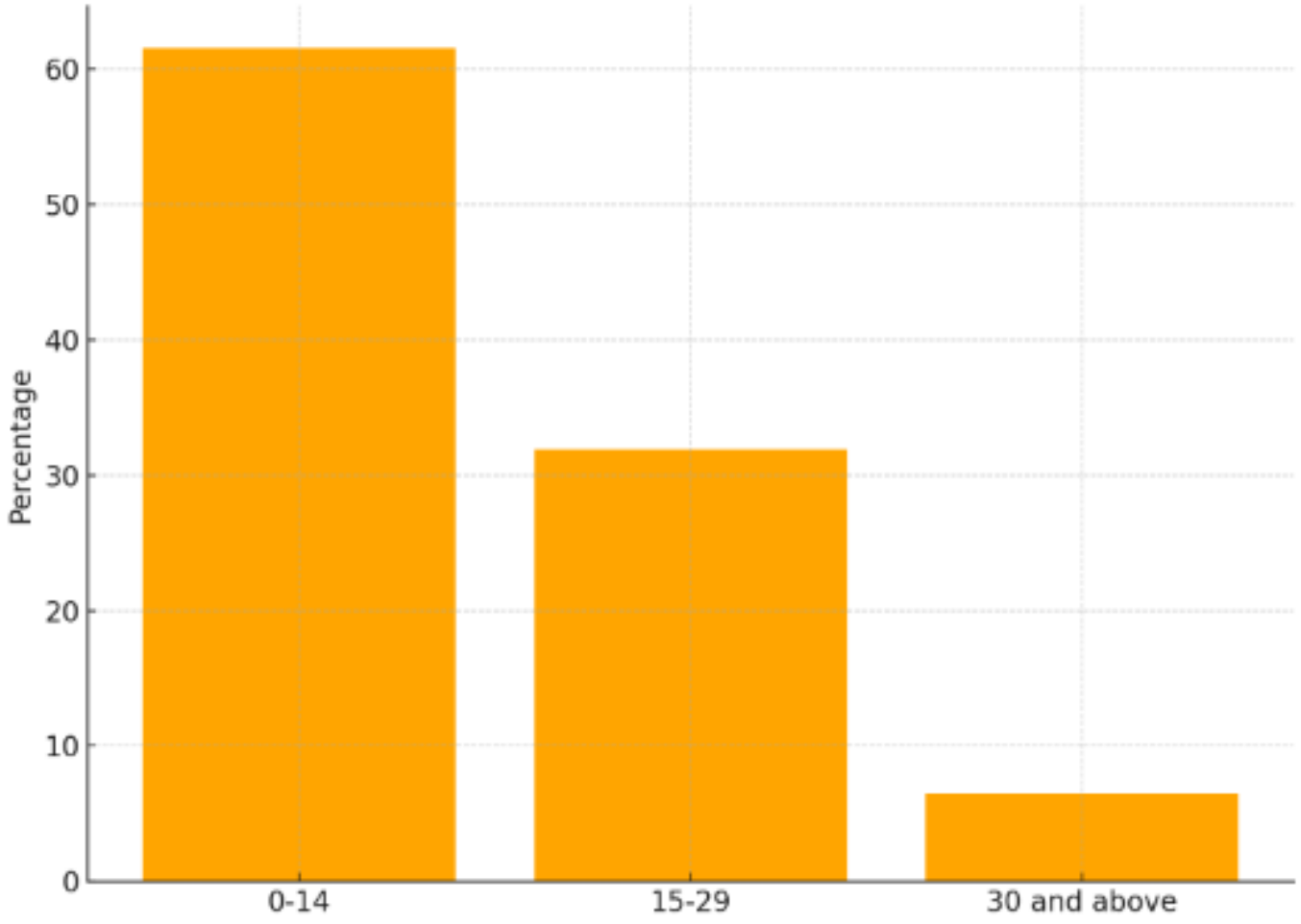

Fig. 1: PACV Raw Score Distribution (%)

This bar chart illustrates the distribution of Parent Attitudes about Childhood Vaccines (PACV) raw scores among study participants, categorized into three score ranges: 0–14, 15–29, and 30 and above. Most participants (61.6%) scored between 0–14, reflecting minimal vaccine hesitancy, while 31.9% fell within the intermediate range of 15–29, indicating moderate hesitancy. A smaller proportion (6.5%) scored 30 or higher, representing high vaccine hesitancy. Over half of the participants (58.3%) had a transformed PACV score below 50%, signifying low vaccine hesitancy, whereas 41.7% were classified as vaccine-hesitant with a transformed score of ≥50. These results underscore the variability in vaccine attitudes within the population, with a significant minority demonstrating hesitancy. This data highlights the importance of addressing specific concerns among hesitant groups to improve vaccination uptake and enhance public health outcomes.

4.4 Vaccines That Prompted Doubt

Participants were asked which vaccines they were most worried about. COVID-19 vaccine topped the list, with over half of the participants ticking this option (Figure 2). About one-fifth of participants were not worried about any specific vaccine. Varicella and MMR vaccines were also mentioned. Participants who identified 'Others' were asked to specify the vaccines, and they mentioned influenza and DTaP.

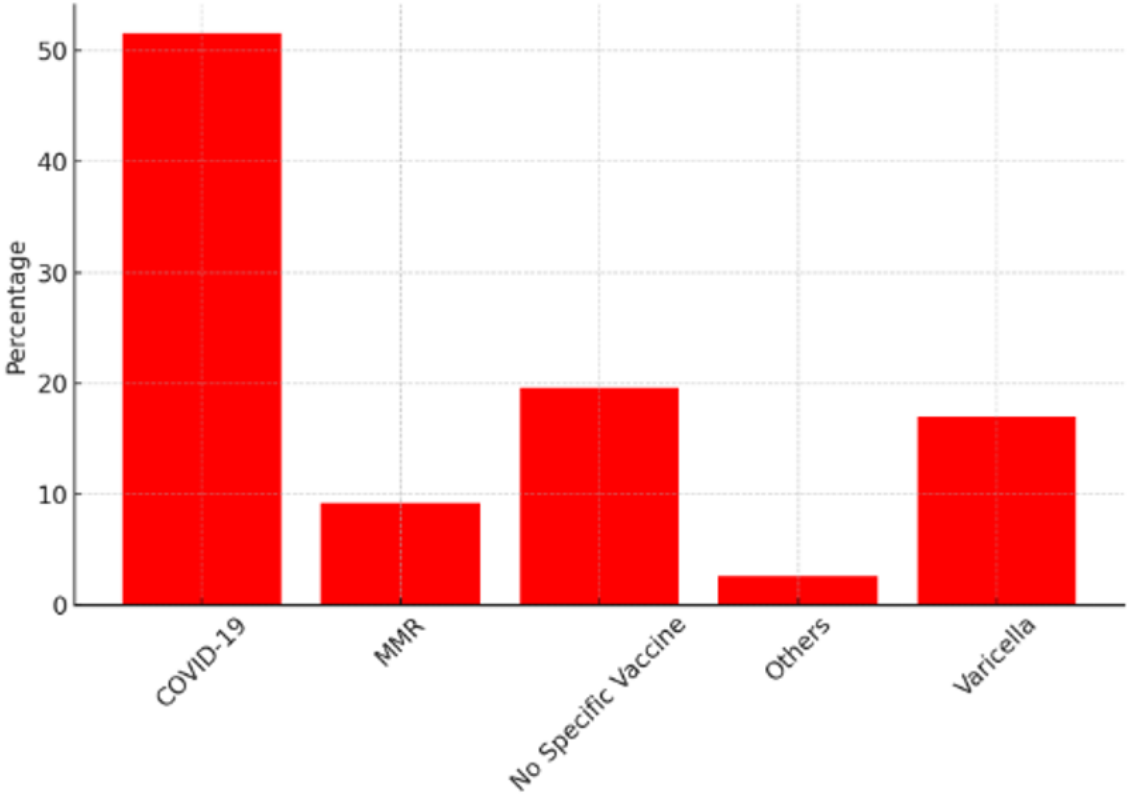

Fig. 2: Vaccines of Concern Mentioned by Participants (%)

This bar chart illustrates the distribution of participant concerns regarding specific vaccines. COVID-19 was the most frequently mentioned vaccine, with 51.6% of participants identifying it as a primary concern. Varicella was the second most cited, with 17% of participants expressing worries. MMR was mentioned by 9.2%, while 19.6% of participants indicated no specific vaccine as a concern. A small proportion (2.6%) identified other vaccines, including influenza and DTaP, as sources of worry. These findings underscore the prominence of COVID-19-related vaccine apprehension among participants, reflecting broader public discourse and skepticism surrounding its development and safety. The data highlight the need for targeted communication strategies to address concerns about specific vaccines and foster greater public confidence in immunization programs.

5. DISCUSSION

Using the PACV scale, this study aimed to assess the prevalence of parental hesitancy toward childhood vaccinations in the United Kingdom and examine its association with maternal and paternal sociodemographic characteristics. The survey reported a vaccine hesitancy prevalence of 41.7% among parents and guardians of 774 children aged 0 to 6 years. This finding is significant as it underscores the potential risk of increased vaccine-preventable diseases (VPDs) due to reduced parental intent to vaccinate. While the PACV scale effectively measures attitudes toward vaccination, previous research has raised concerns regarding discrepancies between expressed intentions and actual behavior (Bianco et al., 2019). Social desirability bias may prompt individuals to overstate their inclination toward vaccination, which could result in overestimated vaccination coverage intentions.

Socioeconomic status is a key determinant of vaccine uptake, with higher socioeconomic groups more likely to embrace vaccination as a preventive measure for their children (Gilkey et al., 2013; Obohwemu, 2023). Additionally, vaccine hesitancy remains a complex, context-dependent phenomenon influenced by factors such as policies, regulations, and cultural norms, which may not be fully captured by the conventional PACV scale (MacDonald, 2015). In the UK, specific influences like the anti-vaccine movement and fluctuating confidence in the NHS require further investigation as potential contributors to parental hesitancy.

Variations in vaccine hesitancy prevalence across studies complicate direct comparisons. For instance, hesitancy rates among parents ranged from 25% to 43.1% in the United States (Siddiqui et al., 2013; Opel et al., 2013; Malik et al., 2020) and were reported at 34.7% in Italy

(Napolitano et al., 2018), and 46% in France (Bocquier et al., 2018). Higher rates were observed in China (60%) and India (83%), with significant drivers including distrust in healthcare providers, inadequate information dissemination, and logistical challenges such as prolonged vaccination schedules (Dasgupta et al., 2018; Fanxing et al., 2020). These findings highlight the global variation in vaccine hesitancy and the complex interplay of cultural, systemic, and informational factors shaping parental decisions.

Concerns over vaccine safety, particularly regarding adverse effects and the necessity of multiple doses, remain prominent among parents. The legacy of the discredited 1998 Wakefield study, which falsely linked MMR vaccines to autism, continues to influence parental perceptions (Grignolio, 2018). Recent debates on the reliability and efficacy of COVID-19 vaccines have further fueled hesitancy, even among healthcare professionals (Gogoi et al., 2022; Kumari et al., 2022). While parental concerns do not necessarily indicate outright distrust in vaccines, they emphasize the importance of addressing safety questions proactively to reinforce confidence in immunization programs.

Healthcare professionals also express reservations about vaccination schedules and new vaccines, despite generally positive attitudes toward immunization. Studies have shown that recommendations from medical experts significantly bolster parental confidence in vaccines (Deml et al., 2022). However, vaccine promotion messages perceived as overly assertive may backfire, inadvertently increasing hesitancy (Nyhan et al., 2014). Therefore, effective communication strategies should emphasize dialogue, address concerns empathetically, and provide clear, evidence-based information.

This study identified key determinants of vaccine hesitancy, including parental beliefs about the ineffectiveness of vaccines and their limited role in protecting children's health. Distrust in the NHS's capacity to deliver effective vaccinations and skepticism toward pharmaceutical companies were significant contributors to hesitancy. Parents often expressed concerns that pharmaceutical companies prioritize profit over public health. Additionally, some parents felt misled by pediatricians, underscoring the need for transparent, accessible public health communication.

A positive association between trust in official sources and vaccination intention was observed, consistent with findings from prior research. Trust in government institutions and healthcare systems plays a critical role in shaping public perception of vaccination campaigns. During the H1N1 pandemic, vaccine acceptance increased alongside trust in the U.S. government's handling of the crisis (Quinn et al., 2009). Conversely, inconsistent messaging or perceived inadequacies in governmental responses can erode trust and reduce vaccine uptake (Khosravi, 2020).

Media influence was another critical factor, with social media emerging as a double-edged sword. While digital platforms can disseminate accurate vaccine information, they also amplify misinformation, contributing to mistrust and hesitancy (Dinga et al., 2021; Özceylan et al., 2021). This study revealed that parents relying on social media for vaccine information were more likely to exhibit hesitancy, highlighting the urgent need for health organizations to combat misinformation through targeted, credible online campaigns.

Certain vaccines, including COVID-19, varicella, MMR, influenza, and DTaP, were more commonly associated with hesitancy. Parents often perceived these vaccines as unnecessary for less severe illnesses. Novel vaccines, such as those for COVID-19 and rotavirus, were particularly susceptible to skepticism, reflecting concerns over their rapid development and long-term safety (Cooper et al., 2021).

This study demonstrated the utility of the PACV scale in quantifying vaccine hesitancy among UK parents. Although the study did not aim to validate the PACV scale, its application highlighted critical elements influencing parental decisions to accept, delay, or refuse vaccinations.

This study offers several notable strengths. The large number of participants provided a solid foundation for statistical analysis, allowing for more confident interpretation across different subgroups. Although the sampling approach was non-probability in nature, combining convenience and snowball techniques enabled the inclusion of individuals from varied sociodemographic backgrounds, enriching the dataset with diverse perspectives that might otherwise have been missed through more formal recruitment methods.

The use of an online survey platform streamlined data collection and gave respondents the flexibility to participate at their convenience—likely contributing to higher engagement. Importantly, the inclusion of a validated tool such as the PACV scale added methodological rigour, ensuring that parental attitudes

were measured consistently and in line with established research standards.

The study also addressed a timely and socially relevant issue, capturing real-world attitudes and behaviours around childhood vaccination. These insights carry practical value, particularly for informing public health strategies and targeted communication efforts.

That said, the methodology is not without limitations. The cross-sectional design restricts the ability to draw causal conclusions, and the online format may have inadvertently excluded individuals with limited digital access or lower levels of digital literacy—such as older adults or first-generation immigrants. Additionally, the reliance on self-reported data introduces the possibility of recall bias and social desirability effects, especially when participants reflect on past decisions or sensitive topics.

The sampling strategy, while pragmatic, also presents challenges. Because participants were recruited through personal and professional networks, there's a risk of reduced variability—individuals with similar backgrounds or views may have been overrepresented. This limits the representativeness of the sample and calls for cautious interpretation of the findings.

Nonetheless, the alignment between PACV scores and reported vaccination status lends credibility to the data and reinforces the value of the PACV tool in identifying attitudinal barriers. Future longitudinal research could build on these findings to explore how parental attitudes shift over time and which interventions prove most effective across different communities.

Taken together, the study balances practical accessibility with methodological care, offering meaningful contributions to the understanding of vaccine hesitancy in the UK context—while acknowledging the boundaries of its design.

These findings emphasize the need for tailored public health interventions to address vaccine hesitancy. Strategies should focus on improving healthcare accessibility, fostering trust in public health institutions, and countering misinformation effectively. Campaigns targeting underserved populations, such as those with lower socioeconomic status or limited health literacy, are particularly critical. Moreover, equipping healthcare professionals with the tools to engage empathetically and effectively with hesitant parents can bolster vaccine confidence and acceptance. By addressing the multifaceted drivers of vaccine hesitancy, these efforts can help bridge gaps in vaccination coverage and protect public health.

6. CONCLUSIONS

This study underscores vaccine hesitancy as a significant public health issue among UK parents, threatening the maintenance of high immunization rates. Parental vaccine hesitancy cannot be fully gauged by children's vaccination status alone, as it overlooks the deep concerns some parents have about vaccines. Addressing these fears, especially among older parents, is crucial to reducing hesitancy. Monitoring trends in vaccine hesitancy over time is essential for developing effective interventions. Future efforts should focus on parent-centered public health initiatives and campaigns that highlight the proven benefits and efficacy of vaccines. These initiatives must overcome the challenge of convincing parents with negative vaccine experiences, which is vital for maintaining immunization coverage. Disseminating official information from public health organizations widely is necessary to build trust and transparency.

Future research should assess past UK vaccination campaigns to evaluate theoretical frameworks and their practical application in health programs. Efforts to address parental reluctance must consider educational levels and emphasize the importance and safety of new vaccines. Tailoring vaccination messages to diverse audiences ensures accessibility and impact. Healthcare professionals need effective training to improve their interpersonal and counseling skills, enabling them to address parental concerns with empathy and evidence-based information. Despite current immunization rates, addressing vaccine safety concerns and combating misinformation are crucial for long-term vaccination uptake.

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The author declares that he has no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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APPENDIX

Appendix 1: The PACV Scale

20. What is the highest level of education that you have reached?

- ☐ 8th grade or less
- ☐ Some high school, but not a graduate
- ☐ High school graduate or GED
- ☐ Some college or 2 year degree
- ☐ 4-year college degree
- ☐ More than 4-year college degree

21. What is your approximate household income?

- ☐ $30,000 or less
- ☐ $30,001-50,000
- ☐ $50,001-75,000
- ☐ $75,001 or more

22. How many children are in your household?

- ☐ One
- ☐ Two
- ☐ Three
- ☐ Four or more

23. What is your race/ethnicity? Please check all that apply.

- ☐ White
- ☐ Black or African American
- ☐ Hispanic/Latino
- ☐ Asian
- ☐ Native Hawaiian or other Pacific Islander
- ☐ American Indian or Alaska Native
- ☐ Other: _____

Thank you!

Seattle Children's HOSPITAL · RESEARCH · FOUNDATION
Treuman Katz Center for Pediatric Bioethics

UW Medicine SCHOOL OF MEDICINE

Parent Attitudes about Childhood Vaccines

READ THIS FIRST:

We are interested in your opinions about childhood shots (vaccines). Your child's doctor or nurse gives shots like MMR (measles, mumps and rubella) or Polio at check-ups to help keep your child from getting sick.

THIS SURVEY IS NOT ABOUT SEASONAL FLU OR SWINE FLU (H1N1) SHOTS.

When filling out the survey, please answer each questions with the child whose appointment is today in mind. The answers to these questions will help us improve how doctors and nurses talk to parents about childhood shots.

Please check only one answer to each of the questions below.

1. Is this child your first born? ☐ **Yes** ☐ **No**

2. What is your relationship to this child? ☐ **Mother** ☐ **Father** ☐ **Other** _____

	Yes	No	*Don't Know*
3. Have you ever delayed having your child get a shot (not including seasonal flu or swine flu (H1N1) shots) for reasons other than illness or allergy?	☐	☐	☐
4. Have you ever decided not to have your child get a shot (not including seasonal flu or swine flu (H1N1) shots) for reasons other than illness or allergy?	☐	☐	☐

5. How sure are you that following the recommended shot schedule is a good idea for your child? Please answer on a scale of 0 to 10, where 0 is *Not at all sure* and 10 is *Completely sure*.

Not at all Sure										Completely Sure
0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
6. Children get more shots than are good for them.	☐	☐	☐	☐	☐
7. I believe that many of the illnesses that shots prevent are severe.	☐	☐	☐	☐	☐
8. It is better for my child to develop immunity by getting sick than to get a shot.	☐	☐	☐	☐	☐
9. It is better for children to get fewer vaccines at the same time.	☐	☐	☐	☐	☐

	Not at all Concerned	Not too Concerned	Not Sure	Somewhat Concerned	Very Concerned
10. How concerned are you that your child might have a serious side effect from a shot?	☐	☐	☐	☐	☐
11. How concerned are you that any one of the childhood shots might not be safe?	☐	☐	☐	☐	☐
12. How concerned are you that a shot might not prevent the disease?	☐	☐	☐	☐	☐

	Yes	No	*Don't Know*
13. If you had another infant today, would you want him/her to get all the recommended shots?	☐	☐	☐

	Not at all Hesitant	Not too Hesitant	Not Sure	Somewhat Hesitant	Very Hesitant
14. Overall, how hesitant about childhood shots would you consider yourself to be?	☐	☐	☐	☐	☐

	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
15. I trust the information I receive about shots.	☐	☐	☐	☐	☐
16. I am able to openly discuss my concerns about shots with my child's doctor.	☐	☐	☐	☐	☐

17. All things considered, how much do you trust your child's doctor? Please answer on a scale of 0 to 10, where 0 is *Do not trust at all* and 10 is *Completely trust*.

Do Not Trust at All										Completely Trust
0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

The last questions are about you. Please check only one answer to each question.

18. How old are you?

- ☐ 18-29 years old
- ☐ 30 years or older

19. What is your current marital status?

- ☐ Single
- ☐ Married
- ☐ Living with a partner
- ☐ Widowed
- ☐ Separated
- ☐ Divorced

Appendix 2: PACV Scoring Instructions

1. Score each of the 15 PACV survey items (Q3-Q17; see attached scored version of PACV). Hesitant responses are assigned a 2, 'don't know or not sure' a 1, and non-hesitant responses a 0. The two items in which the 'don't know' response was excluded as missing data (Q3 and Q4) are scored as 2 for the hesitant response and 0 for the non-hesitant response.

2. Calculate the raw total PACV score by simply summing each item. The total raw score will range from 0 – 30 if all items have responses and Q3 and Q4 are not excluded as missing data. If there is at least one item without a response or Q3 or Q4 are answered as 'don't know' and therefore are excluded as missing data, the total raw score needs to be adjusted. For instance, if there is one response missing or excluded, the total raw score will range from 0 – 28; if there is two responses missing or excluded, the total raw score will range from 0 – 26; etc.

3. Convert the raw score to a 0 – 100 scale using simple linear transformation accounting for items with missing values (see attached score conversion chart).

Appendix 3: PACV Conversion Chart

A		**B**		**C**	
If both Q3 and Q4 are Yes or No and items Q5-Q17 have no missing responses		If either Q3 or Q4 are Don't Know or Q5-Q17 has one missing response		If both Q3 and Q4 are Don't Know or Q5-Q17 has two missing responses	
Raw Score	Converted Score	**Raw Score**	Converted Score	**Raw Score**	Converted Score
0	0	**0**	0	**0**	0
1	3	**1**	4	**1**	4
2	7	**2**	7	**2**	8
3	10	**3**	11	**3**	12
4	13	**4**	14	**4**	15
5	17	**5**	18	**5**	19
6	20	**6**	21	**6**	23
7	23	**7**	25	**7**	27
8	27	**8**	29	**8**	31
9	30	**9**	32	**9**	35
10	33	**10**	36	**10**	38
11	37	**11**	39	**11**	42
12	40	**12**	43	**12**	46
13	43	**13**	46	**13**	50
14	47	**14**	50	**14**	54
15	50	**15**	54	**15**	58
16	53	**16**	57	**16**	62
17	57	**17**	61	**17**	65
18	60	**18**	64	**18**	69
19	63	**19**	68	**19**	73
20	67	**20**	71	**20**	77
21	70	**21**	75	**21**	81
22	73	**22**	79	**22**	85
23	77	**23**	82	**23**	88
24	80	**24**	86	**24**	92
25	83	**25**	89	**25**	96
26	87	**26**	93	**26**	100

27	90	**27**	96		
28	93	**28**	100		
29	97				
30	100				