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Investigating the predictors of COVID-19 vaccine decision-making among parents of children aged 5–11 in the UK

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ABSTRACT

Background: The global effort to combat the COVID-19 pandemic highlights the pivotal role of vaccination in public health, particularly considering emerging severe acute respiratory syndrome-coronavirus-2 variants. While priority has been given to immunising vulnerable populations, children remain a significant unvaccinated group, prompting NHS England to include them in their new vaccination strategy. The role parents play in child healthcare decisions, specifically regarding COVID-19 vaccination, is crucial, and the Health Belief Model (HBM) provides a framework for understanding parental vaccination behaviour.

Methods: To investigate the predictors influencing parental decision-making for COVID-19 vaccination in children aged 5–11, an online cross-sectional survey was conducted amongst parents ($n = 206$) living in the UK aged > 18, with one or more children aged 5–11. The present study measured HBM constructs, demographic factors, vaccine hesitancy and vaccine decision-making self-efficacy. Binomial logistic regression was used to analyse the responses of 206 participants using the child vaccination status (vaccinated vs. unvaccinated) as the outcome variable.

Findings: The regression model significantly predicted child vaccination status, identifying perceived barriers, cues to action and parent age as significant predictors. Higher cues to action and older parent age increased the likelihood of child vaccination, while greater perceived barriers decreased it. The model achieved 80.8 % overall accuracy by correctly identifying 87.6 % of vaccinated cases and 69.4 % of unvaccinated cases, demonstrating high accuracy in predicting parental vaccination decisions.

Conclusion: The present study contributes to our understanding of the factors shaping parental decision-making regarding COVID-19 child vaccination, highlighting the impact of perceived barriers, cues to action and parent age. Future public health campaigns should address the specific barriers faced by parents, emphasise external cues to action and tailor messaging to acknowledge age-related differences in parental vaccine decision-making. By addressing the aforementioned factors influencing parental behaviour regarding child vaccination, future interventions can increase the number of children vaccinated against COVID-19, preventing transmission, protecting from severe illness and contributing to the NHS vaccination strategy.

1. Introduction

The global struggle against the COVID-19 pandemic highlights the crucial role of vaccination in public health, mitigating the transmission of severe acute respiratory syndrome-coronavirus-2 (SARS-CoV-2) and easing healthcare burdens [1,2]. However, a deliberate focus on immunising the elderly, vulnerable individuals and healthcare workers [3], has led to a lesser focus on immunising children, a substantial portion of the unvaccinated population [4]. Recent evidence conducted an analysis of electronic records and found that of all children and young people included (n = 3,433,483), those aged between 5–11 had the lowest vaccine uptake, with 11 % (n = 192,994) receiving the first vaccine and only 0.2 % ($n = 4152$) receiving the second vaccine [5]. This is concerning due to emerging SARS-CoV-2 variants and associated risks [6], prompting NHS England to introduce a strategy to enhance overall vaccination uptake, coverage and reduce disparities [7]. Parents play a crucial role in child healthcare decisions, particularly regarding COVID-19 vaccination [8]. Therefore, understanding the factors shaping parental decision-making regarding child vaccination is essential.

The Health Belief Model (HBM) provides a useful framework for

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understanding parental vaccination behaviour in the context of COVID-19 [9]. According to the HBM, parents are more likely to vaccinate their children if they perceive them as susceptible to COVID-19, view the illness as severe and believe that the benefits of vaccination outweigh potential perceived barriers, such as safety concerns. The model has expanded to include health motivation, cues to action and self-efficacy as additional predictors. High health motivation, relevant cues to action, such as GP recommendation, and high self-efficacy increase the likelihood of parents vaccinating their children against COVID-19.

Recent studies link COVID-19 vaccine acceptance to the HBM, with key constructs such as perceived severity, susceptibility, barriers and benefits influencing parents' intention to vaccinate their children [10,11,12]. A notable gap exists between intention and behaviour, with a recent survey revealing that only 31.5 % of eligible children received a vaccine compared with 60.9 % parental intent [13]. The present study aimed to extend previous research by investigating the predictors of parental COVID-19 vaccination behaviour.

When applying the HBM to children's COVID-19 vaccination, understanding demographic influences on parental vaccine decision-making is important. A recent systematic review indicated that factors such as parent's sex (male), age (older), socio-economic status (higher) and ethnic background (white) markedly influence parental vaccine willingness [14]. However, a noticeable gap between parental and child vaccination decisions exists, with parents often more willing to accept vaccination for themselves [15]. Thus, for health promotion campaigns to be effective, concerns within diverse parent demographic groups should be adequately considered and addressed, aligning with the NHS England vaccination strategy.

Vaccine hesitancy and vaccine decision-making self-efficacy (VDSE) significantly impact parental vaccination decisions. Vaccine hesitancy, recognised by the World Health Organisation as a public health threat, involves concerns about side effects, safety, efficacy, newer vaccines, social media, misinformation, distrust in institutions and political affiliations [16,17,18,19]. Previous research exploring the link between vaccine hesitancy and parental attitudes consistently identified diminished confidence in vaccine safety and efficacy, distrust in government, perception of children's lower susceptibility, and inadequate community and family support as primary factors driving parental resistance to COVID-19 vaccination for children aged 5–11 [20]. Regarding VDSE, which indicates confidence in obtaining, interpreting and acting on health information, the COVID-19 vaccination approval and recommendation process, and the short window of time available to get children vaccinated [21], may have left parents feeling less confident about their decision, thus lowering self-efficacy. A recent study adapted the decision-making self-efficacy scale to measure COVID-19 vaccination intention for children, and a positive association between VDSE scores and parental confidence in deciding to vaccinate children < 5 years old was revealed [22]. To the best of our knowledge, at the time of publication of the present study, this scale has only been used once for predicting COVID-19 vaccination intention for children < 5 years old; using the same scale to predict actual behaviour of COVID-19 vaccination in a different child age group (5–11 years old) would add to its validity.

The aim of the current study was to be the first one to examine predictors influencing parental decision-making regarding COVID-19 vaccination of children aged 5–11 in the UK. By extending the application of the HBM to measure actual behaviour, and by incorporating additional predictors including demographic factors, vaccine hesitancy and VDSE, the present study aligns with the vaccination strategy of NHS England. It was hypothesised that higher levels of perceived susceptibility, severity and benefits, cues to action, health motivation, VDSE, and lower levels of perceived barriers and vaccine hesitancy are associated with parents' decisions to get their children vaccinated against COVID-19 (hypothesis 1). Additionally, associations between demographic factors such as male sex, older parent age, a greater number of children, personal COVID-19 vaccination and the likelihood of their children being vaccinated against COVID-19 were predicted (hypothesis 2). The present study could refine current vaccination strategies and inform effective public health campaigns to increase COVID-19 vaccination among children, ultimately influencing the rest of the population by reducing opportunities for viral transmission in the general population, and by significantly lowering the number of severe cases of COVID-19 and the risk of emerging COVID-19 variants [5].

2. Materials and methods

2.1. Design

The present study employed a cross-sectional questionnaire design with 12 predictor variables comprising constructs from the HBM (6), demographic variables (4) and evidence-based constructs (2) shown to influence parental vaccine decision-making. The predictors included: Perceived susceptibility, severity, benefits and barriers, cues to action, health motivation, parental vaccination status, parent sex and age, number of children, vaccine hesitancy and vaccine decision-making self-efficacy. One categorical outcome variable was included: Child vaccination status (vaccinated vs not vaccinated).

2.2. Participants

Initially, a total of 207 participants living in the UK (response rate, 54.2 %; age range, 24–60 years old; mean $\pm$ SD, 42.5 $\pm$ 6.9) were included in the present study. Two respondents were excluded listwise from the analysis due to missing values, with the data of 205 participants finally included in the analysis. The age range of the children was 5–11 years old ($n = 328$; mean $\pm$ SD, 8.2 $\pm$ 2.0). Demographic data are presented in Table 1. The eligibility criteria of the respondents were the following: i) >18 years old, ii) UK residency; and iii) parenting at least one child aged 5–11. None of the participants received any financial incentives; participants from the University of Derby were provided with course credit. Participants were recruited through online spaces, including parenting forums and the social media platforms X, Reddit, Facebook and Mastodon.

2.3. Demographic questionnaire

Participants were asked to state their age, sex and ethnicity, and provide the same information for their child or children too. Questions regarding parental vaccination status and number of children parented were also included. The questionnaire can be found in Appendix A.

HBM

To measure the constructs of the HBM, questions were adapted from an existing scale used in prior research [23]. Two questions were removed due to their focus on intention and not past behaviour which the present study investigates; one on schools ('the likelihood of vaccinating my children against COVID-19 will increase if the vaccine will be administered by the educational system') and one measuring intentions ('I intend to vaccinate my children against COVID-19 this coming winter if there is an approved vaccine'). The remaining questions were modified to reflect past behaviour; for example, 'I believe that if my children will get vaccinated, the likelihood of them getting infected with COVID-19 will decrease' was modified to 'I believe that because my children are vaccinated, the likelihood of them getting infected with COVID-19 will decrease'. Terms used in the US were replaced with UK terms ('nursery' instead of 'kindergarten') and questions were edited to reflect that the choice to vaccinate may be made as a shared decision between parents (E.g., 'I believe that because my children are vaccinated against COVID-19, the likelihood of us (the parents) losing workdays will decrease'). The modified scale consisted of a total of 13 items shown in round brackets across six subscales: Perceived susceptibility (2), perceived severity (3), perceived benefits (3), perceived barriers (2), cues to action (2) and health motivation (1). Each question was rated on a 6-point Likert scale ranging from 1 ('Strongly Disagree') to 6 ('Strongly

Agree'). The questions on perceived severity were reverse scored. Cronbach's alpha for this scale was.79 indicating very good internal consistency [23]. The modified scale can be found in Appendix B.

2.4. Vaccine hesitancy

To measure vaccine hesitancy, the Vaccine Hesitancy Scale (VHS) was used [24]. The VHS consists of 10 items across two subscales: i) Lack of confidence; and ii) risk. Participants were required to indicate how much they agreed with each of the statements on vaccination using a 5-point Likert scale, ranging from 1 ('Strongly Disagree') to 5 ('Strongly Agree'). An example item was 'new vaccines carry more risks than older vaccines'. The total score range was 22–38, with higher scores indicating lower overall COVID-19 vaccine hesitancy. Cronbach's alpha was reported as.92, indicating excellent internal consistency. The VHS can be found in Appendix C.

2.5. VDSE

The VDSE scale was used in the present study as it provides a vaccine specific measure of self-efficacy [22]. This scale consists of 11 items. Participants were asked to rate how confident they were that they could 'get the facts about the benefits of vaccines' and 'express your concerns about vaccines to their healthcare provider'. Answers were scored on a five-point Likert scale, ranging from 0 ('Not at all confident') to 4 ('Very confident'). The total score range was 0-44, with higher scores indicating higher VDSE. Cronbach's alpha for this scale was.91, indicating excellent internal consistency. The VDSE scale can be found in Appendix D.

2.6. Outcome measure: vaccination behaviour

To ascertain whether parents and/or their child or children had received a COVID-19 vaccine, parents were asked to respond with 'yes' or 'no' to the following questions: 'I vaccinated my child against COVID-19′ and 'I vaccinated myself against COVID-19′.

2.7. Procedure

The online survey was developed using Qualtrics XM software (Provo UT; version June/July 2023), and was run between 12th of June and 17th of July 2023. The present study adhered to the British Psychological Society Code of Human Research Ethics and the BPS Ethics guidelines for internet mediated research, and was approved by the University of Derby College of Health, Psychological and Social Care Research Ethics Committee (approval no. ETH2223-4548). All participants provided informed consent to participate in the study and completed the demographic questionnaire, followed by the HBM, VHS and VDSE scales. Finally, participants were asked questions about the outcome measure. Participants took on average 25 min to complete the survey.

2.8. Data analysis

Statistical analysis was performed using SPSS (version 28; IBM Corp.). As the aim of the present study was to investigate the predictors that influence parental decision-making regarding COVID-19 vaccination of children, a binomial logistic regression was conducted; HBM constructs, demographic factors, vaccine hesitancy and VDSE were used as the predictor variables, and child vaccination status (vaccinated vs unvaccinated) was used as the outcome variable.

3. Results

3.1. Data screening

To ensure the robustness of the analysis, checks for outliers and multicollinearity were conducted. Z-Scores exceeding +/-3, indicating potential outliers, were observed for perceived severity (n = 2), perceived barriers (n = 1), health motivation (n = 11), vaccine decision self-efficacy (n = 2) and vaccine hesitancy (n = 2). However, as these scores fell within the expected range for the survey scales, signifying legitimate data points, data removal was not required. Multicollinearity was assessed through Pearson Product Moment correlations, revealing all correlation coefficients to be < .8, indicating no issues. Consequently, a binomial logistic regression analysis was deemed suitable for analysis and subsequently carried out.

3.2. Inferential statistics

To test hypotheses 1 and 2, a binomial logistic regression was conducted to examine the predictors of child vaccination status, using perceived susceptibility, perceived severity, benefits and barriers, cues to action, health motivation, vaccine self-efficacy, vaccine hesitancy, parental vaccination status, parent age and sex, and the number of children as predictors. The categorical outcome variable was child vaccination status (vaccinated vs unvaccinated). Given the majority of the respondents were of British origin (85.3 %), parent ethnicity was not included in the regression model. To investigate whether sex was a significant predictor of parental vaccine-decision making, this variable was transformed into a dichotomous predictor by excluding the small sample size of 11 participants who did not identify as either male or female (n = 195).

Binomial logistic regression significantly predicted child vaccination status, ($\chi^2 = 98.263$; $P < .001$), explaining 39.9–54.4 % of the variance in child vaccination status. Notably, binomial logistic regression correctly predicted 87.6 % of cases where parents did vaccinate their children against COVID-19, and 69.4 % of cases where parents did not vaccinate their children against COVID-19. The overall accuracy of the model was 80.8 %. This indicates the model possesses a strong ability to correctly identify parents who did vaccinate their children in the entire cohort. It is noteworthy that the data were skewed in favour of those parents reporting vaccinating their children against COVID-19 ('yes', n = 129 vs 'no', n = 76) which can contribute to higher sensitivity at the expense of specificity. The −2 Log Likelihood value (−2LL) was large (156.714), suggestive of a poor model fit. However, the Hosmer and Lemeshow test was non-significant ($P = .187$) indicating that the model was able to accurately predict the data. Table 2 is a classification table containing key statistics.

Perceived barriers ($P < .001$), cues to action ($P = .046$) and parent age ($P = .001$) emerged as significant predictors of parental COVID-19 vaccine decision-making, indicating that the probability of a child being vaccinated increased with higher parent age and cues to action, while it decreased with more perceived barriers. No other predictors reached statistical significance ($P > .05$).

To summarise, the binomial logistic regression model significantly and accurately predicted child vaccination status, achieving 80.8 % overall accuracy by correctly identifying 87.6 % of vaccinated and 69.4 % of unvaccinated cases. Significant predictors of parental COVID-19 vaccine decision-making included perceived barriers, cues to action and parent age. The findings of the present study indicate that by removing perceived barriers, providing more cues to action and tailoring interventions to specific parent age groups could enhance overall COVID-19 child vaccination rates.

4. Discussion

In December 2023, NHS England initiated a comprehensive vaccination strategy to shape the future delivery of NHS vaccination and immunisation services [7]. This strategic framework acknowledges the need to integrate the operational model for COVID-19 vaccinations with existing programmes such as the influenza vaccination program. Moreover, emphasis has been placed on the importance of transparent

and consistent national communication, specifically catering to pregnant women and families with young children, outlining the accessibility and the advantages of vaccination. The present study aimed to augment the NHS England vaccination strategy by expanding our understanding of the factors that influence parental vaccine decision-making regarding COVID-19 vaccination for children aged 5–11 in the UK. The results of the current study partially support hypothesis 1 and 2, revealing perceived barriers, cues to action and parent age as significant predictors of parental vaccine decision-making.

The findings of the present study carry significant implications for guiding the design of future public health campaigns as they highlight the influential role of perceived barriers in shaping parental vaccine decision-making. Items included in the present study reflected barriers pertaining to time constraints, workday loss, concerns about vaccine-induced immunity duration and potential vaccination side effects. However, it is anticipated that parents have weighed up immunity against potential side effects, given the rapidly changing information available to them. For example, newer COVID-19 variants have led to immunity from vaccination waning more rapidly, with the Omicron (B.1.1.529) variant, first detected in the UK in November 2021, leading to higher chances of vaccine escape and re-infection [25]. It is important to acknowledge that other perceived barriers associated with parental COVID-19 vaccine refusal have been identified in prior research, such as parental educational level, financial considerations, access to transport, side effects, vaccine confidence and the impact of social media platforms [10,12,17]. The identification of these specific barriers affecting parental COVID-19 vaccine decision-making lays the foundation for developing more targeted public health interventions, increasing the effectiveness of public health campaigns by directly addressing the barriers identified in the present study and in previous research. For instance, in response to barriers related to parental educational level and potential side effects, public health campaigns could strategically focus on educating parents about the safety and efficacy of COVID-19 vaccination. This targeted approach aims to enhance knowledge, build trust and ultimately boost childhood COVID-19 vaccination uptake.

The use of the HBM in the current study enabled additional constructs to be considered, providing a more comprehensive understanding of parental COVID-19 vaccine decision-making. Our findings highlight the significant role of cues to action as a predictor variable in this decision-making process. Parents reporting a higher frequency of cues to action are more likely to affirm that they have vaccinated their children against COVID-19. More specifically, items assessing the impact of friends and family expressing support for vaccinating children, as well as the recommendation of healthcare professionals were included in the current study. This emphasises the influence of external cues to action on parental behaviour, offering a more sophisticated understanding that extends beyond the traditional HBM. A recent systematic review explored the relationship between HBM constructs and COVID-19 vaccination intention [26]. The study found that cues to action, alongside perceived benefits and barriers, emerged as marked predictors of vaccination intention for both primary series and booster vaccines. Notably, when analysed by study population, cues to action exhibited a dominant influence amongst parents. The findings of that study align with those of the present study with both cues to action and perceived barriers cited as key influences of parental vaccine decision-making, with the current study indicating that this influence extends beyond intention to behaviour. These insights carry significant implications for the design of effective public health interventions. To enhance cues to action and bolster COVID-19 vaccination uptake among children, strategic emphasis within public health campaigns should be placed on fostering supportive networks within communities. Facilitating positive discussions among friends and families regarding the advantages of vaccinating children can act as a potent cue. Moreover, targeted initiatives should be undertaken to enhance the role of healthcare professionals in recommending and endorsing childhood vaccinations, recognising their role as trustworthy sources of information related to COVID-19 vaccination [27]. In short, public health campaigns should prioritise and tailor strategies to address key barriers parents may encounter when contemplating the vaccination of their children against COVID-19. By leveraging external cues and addressing perceived barriers, campaigns can effectively enhance parental vaccine acceptance and uptake among children.

The influence of parent age on vaccine decision-making emerged as a significant factor in the current study, consistent with previous research which revealed that parent age influences parental willingness to vaccinate their child or children against COVID-19 [14]. To the best of our knowledge, the present study is the first to investigate the factors influencing the behaviour of parents of children aged 5–11 in the UK. One potential explanation for age-related disparities in vaccine decision-making concerns differences in risk perception. While existing research indicates that parents are more inclined to vaccinate their children if they perceive a heightened danger in abstaining [10,11,28], younger parents may view COVID-19 as less severe for children due to the nature of the milder symptoms in younger age groups. This perception might contribute to a decreased likelihood of vaccinating their children, particularly if concerns about vaccine safety and efficacy outweigh the perceived virus-associated health risks.

The role of social media in shaping parental attitudes regarding COVID-19 vaccination should also be taken under consideration. Younger parents, being more likely to engage with social media, encounter diverse sources of conflicting information or misinformation contributing to vaccine hesitancy. The Royal Society for Public Health (2019) indicated that 50 % of parents with children $<$ 5 years old frequently or occasionally encounter negative messages about vaccines on social media [29]. This highlights an urgent need to address health misinformation on social media platforms and implement targeted education initiatives for both parents and children regarding the safety and efficacy of vaccines. In that way, the impact of misinformation can be mitigated, and parents can be empowered to make informed decisions about vaccinating their children against COVID-19. Social media can also be used to endorse COVID-19 vaccination uptake using a range of persuasive communication techniques [30], such as credible sources; referring to authoritative information sources such as the NHS and UK Health Security Agency. Additionally, encouraging young parents to avoid relying on social media platforms for sourcing health-related information and to visit reliable online sources could help reduce vaccine hesitancy and increase parental willingness to vaccinate their children against COVID-19.

4.1. Limitations and future research

The present study also has limitations. Firstly, parent ethnicity was not included as a predictor variable within the binomial logistic regression as the majority of the sample was of White British origin; this is a common issue affecting survey recruitment conducted via social media. Previous research has shown that parents that self-report as Black, Asian, Chinese, Mixed or Other are 2.7 times more likely to reject a COVID-19 vaccine than White British, White Irish, and Other White participants [31]. Hence, the extent to which the findings of the present study can be generalised to other parental populations is limited. Secondly, while the current study identified perceived barriers and cues to action as significant predictors of COVID-19 vaccine decision-making among parents of children aged 5–11, the barriers holding the most significance in different parent groups were not specified. Thirdly, the data included in the binomial logistic regression were skewed in favour of those parents reporting vaccinating their children against COVID-19 which likely influenced the higher sensitivity and lower specificity observed. Additional studies relieved of time constraints would include a larger cohort size addressing this issue. Taken together, future research should employ diverse sampling strategies, such as targeted outreach to underrepresented groups to maximise inclusivity. Moreover, a qualitative approach would complement the quantitative findings presented in

our study as it will enable in-depth insight into the barriers faced by different types of parents when deciding to vaccinate their child or children against COVID-19. Importantly, this would allow vaccination strategies and public health interventions to address the specific concerns of different parental groups increasing COVID-19 vaccine uptake among children. Lastly, it should be noted that this study collected data largely from social media sources. Therefore, individuals with which English is not their first language and/or have limited information technology skills may have difficulty participating, potentially influencing the representation of vaccine hesitancy within the sample.

5. Conclusion

Understanding the factors influencing parental decision-making regarding COVID-19 vaccination of children aged 5–11 in the UK is crucial for increasing vaccine uptake in children, reducing community transmission and mitigating the risk of emerging SARS-CoV-2 variants that could strain healthcare systems. The present study emphasised the importance of perceived barriers, cues to action and parental age as significant predictors in this decision-making process. The identification of these predictors offers insights for future research, with a multifaceted approach required to enhance overall COVID-19 child vaccination rates. To this end, future public health campaigns should adopt a strategic framework. Firstly, initiatives must be designed to target specific barriers confronting parents, encompassing issues of accessibility, dispelling misinformation and alleviating concerns about vaccine safety. By directly addressing these barriers, future health promotion campaigns can contribute to a more informed and confident parental decision-making process. Secondly, healthcare professionals play a critical role as trusted sources of information. Future campaigns could maximise their impact by fostering greater collaboration with the community, which would enhance the visibility and credibility of external cues to action, guiding parents towards informed choices in favour of COVID-19 vaccination for their children. Lastly, future interventions should be tailored to address the unique needs and perspectives of different parent age groups. By identifying and targeting these differences, public health campaigns will maximise their effectiveness by addressing the specific concerns of both older and younger parents.

CRediT authorship contribution statement

Stephanie A. Davey: Writing – review & editing, Writing – original draft, Visualization, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Claire Hampson:** Writing – review & editing, Writing – original draft, Validation, Supervision. **Michaela E. Christodoulaki:** Writing – review & editing, Supervision. **Daniel Gaffiero:** Writing – review & editing, Writing – original draft, Visualization, Supervision, Project administration, Methodology, Investigation, Formal analysis, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.vaccine.2024.05.069.

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