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UNDERSTANDING PARENTAL PERCEPTIONS AND THEIR IMPACT ON IMMUNIZATION RATES IN PRIMARY CARE

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ABSTRACT

Background: Vaccine hesitancy is a significant public health concern, affecting immunization rates and increasing the risk of infectious disease outbreaks. Parental attitudes toward childhood vaccines are influenced by multiple factors, including sociocultural, economic, and psychological determinants. Traditional vaccine hesitancy measurement tools often fail to distinguish between general and specific vaccine opposition. This study introduces a novel methodological approach to assess parental vaccine hesitancy by incorporating a hypothetical vaccine as an indicator of underlying attitudes. **Methods:** A representative sample of parents with children aged 0–18 years was surveyed using a structured multi-stage sampling process. Data collection was conducted through computer-assisted personal interviews (CAPI). The study applied a modified version of a previously established sociological methodology, integrating a fictitious vaccine among real ones to assess vaccine hesitancy. Participants were categorized into four groups based on their responses. The reliability of this novel approach was evaluated against traditional vaccine hesitancy indices using chi-square tests and Pearson residuals, with sociodemographic factors also analyzed. **Results:** The study identified a strong correlation ($p < 0.001$, Cramer's $V = 0.592$) between traditional vaccine hesitancy measurements and responses to the hypothetical vaccine. Among respondents classified as vaccine-hesitant using conventional methods, 100% rejected the fictitious vaccine, while acceptance rates increased among those with more favorable vaccine attitudes. Educational attainment was a key predictor, with lower-educated parents significantly more likely to refuse vaccines. Geographic variations also played a role, with higher hesitancy observed in both highly urbanized and rural areas. No significant differences were found between male and female respondents. **Conclusion:** The introduction of a hypothetical vaccine as a tool for measuring parental vaccine hesitancy provides a reliable alternative to traditional methods. This approach effectively identifies vaccine-resistant populations and offers insights into the underlying factors influencing vaccine decisions. The findings underscore the need for targeted educational interventions, particularly among socioeconomically disadvantaged groups, to enhance vaccine uptake and public health outcomes.

INTRODUCTION

Vaccine hesitancy has been identified as one of the top ten global health threats by the World Health Organization (WHO) in 2019.[1] The emergence of the COVID-19 pandemic in 2020 has intensified concerns surrounding this issue, leading to numerous studies aimed at understanding its impact.[2,3,4] Vaccine hesitancy is a multifaceted behavior shaped by historical events, political influences, sociocultural contexts, personal experiences, and knowledge levels.[5] Individual studies on parental vaccine hesitancy often face limitations, such as focusing on specific subpopulations, assessing only certain vaccines, or failing to capture key influencing factors. Additionally, systematic reviews in this domain tend to be complex, mapping out the intricate web of social, cultural, political, and personal variables that affect vaccine acceptance.[5,6] These determinants span multiple disciplines, including sociology, psychology, socio-psychology, economics, and history, with some being unique to certain communities while others remain consistent across diverse populations.[7,8,9,10,11]

As childhood vaccination programs have successfully mitigated the threat of infectious diseases, parental perspectives on immunization have become increasingly relevant in discussions of vaccine hesitancy. Given the multifaceted nature of this phenomenon, several tools have been developed to measure parental vaccine

attitudes.[12] One such instrument, the Parental Attitudes toward Childhood Vaccines (PACV), is grounded in the Health Belief Model[13] and has demonstrated strong psychometric reliability across multiple languages[14], though it remains unvalidated in some regions. Another commonly used measure, the WHO Vaccine Hesitancy Scale[15], effectively identifies vaccine-hesitant parents but may not adequately capture concerns related to perceived risks. Furthermore, a 2020 review by Amelie Dyda revealed that over 100 different survey instruments have been utilized in contemporary research[16], incorporating various theoretical frameworks, such as the Theory of Planned Behavior.[17]

The present study examines parental vaccine hesitancy within a representative sample of parents, aiming to shed light on vaccine-related decision-making processes. The selected study population provides a valuable context for exploring vaccine attitudes due to several factors. Economically, it occupies an intermediate position between high-income and low-income settings, ensuring vaccine availability while also being influenced by disparities in education, literacy, and socioeconomic conditions.[18] Additionally, the national vaccination program includes both mandatory and recommended vaccines, with public insurance covering many of these immunizations. High vaccination rates—often exceeding 90%—have been reported for compulsory childhood vaccines, with certain recommended vaccines also supported by insurance coverage, such as the HPV vaccine introduced in 2014.[19,20] In such a setting, where compulsory vaccination is widely accepted, the perception of non-mandatory immunizations warrants further investigation.[21,22,23,24]

The objective of this study is to introduce a novel methodological approach for assessing parental attitudes toward childhood vaccination. This tool is designed for ease of implementation while providing reliable insights into vaccine perceptions. To explore hesitancy toward non-compulsory immunizations, the study employs a well-established sociological model. The validation process establishes its connection with existing measurement tools, followed by an analysis of the sociodemographic characteristics distinguishing vaccine-supportive and vaccine-hesitant parents.

MATERIALS AND METHODS

Sampling and Data Collection: The data for this study were collected using a structured multi-stage sampling approach to ensure a representative sample. Eligibility criteria required households to have at least one child aged 0 to 18 years. To achieve accuracy in data collection, a computer-assisted personal interviewing (CAPI) method was employed. The selected households were representative based on population distribution in terms of settlement type and geographic region.

Within each household, an adult responsible for at least half of the healthcare-related decisions for the children was chosen as the respondent. For families with multiple children, the parent was asked about one specific child, determined through a random selection process based on birth date proximity to the interview date. This approach ensured an unbiased selection while avoiding the need to gather sensitive data about all children.[25]

A total of 430 households participated in the final sample. The demographic distribution of respondents showed that 92% were female and 8% were male. The average household contained 1.9 children, with an overall household size averaging 3.9 members. The response time for completing the survey ranged between 40 and 45 minutes.

Concept of the Measurement

A methodology originally introduced in 2006 to assess negative biases toward different social groups was adapted for this study to evaluate parental hesitancy toward vaccinations. This approach utilized a fictitious element as a reference point to gauge implicit biases. In the original method, respondents were asked to provide opinions on the acceptance of various nationalities and an entirely fabricated one, allowing researchers to measure underlying preconceptions.[26]

For the current study, a similar technique was applied by incorporating a non-existent vaccine into a list of real vaccines. The fabricated vaccine, labeled under two distinct names, was designed to be plausible due to existing vaccines for related diseases. The aim was to determine whether parents would recognize its fictitious nature or exhibit uncertainty, which could serve as an indirect indicator of vaccine hesitancy.

To validate this new metric, responses regarding the fictitious vaccine were compared to those concerning real vaccines available at the time of data collection. The survey included questions about vaccines for conditions such as rotavirus, varicella, influenza, human papillomavirus, meningococcal infections, and tick-borne encephalitis. Respondents were asked whether they believed each vaccine existed and, if so, whether their child had received it, would receive it, or would not receive it.[27]

For analytical categorization, respondents were divided into four groups: those who correctly identified the fictitious vaccine as non-existent, those who stated their child had not received it and would not, those who indicated their child had or would receive it, and those who were unsure or did not respond.

Concept of the Analysis

To establish the reliability of this novel indicator for vaccine hesitancy, responses regarding the fictitious vaccine were compared to a standard vaccine hesitancy index. This index was developed by aggregating attitudes toward real vaccines. A binary scale was used, with 1 indicating reluctance to vaccinate and 2 indicating

willingness or prior vaccination. The index was only calculated for respondents who acknowledged the existence of at least one real vaccine or were uncertain. A small percentage (2.4%) of respondents who denied the existence of all real vaccines were excluded from the index calculation.[28]

The resulting index values ranged from 1 to 2, with lower scores representing stronger opposition to vaccination. The index was then divided into four categories based on established criteria. Those scoring exactly 1 were classified as 'anti-vaxxers,' those scoring between 1.1 and 1.5 were identified as 'vaccine-hesitant, leaning toward anti-vaxxers,' those scoring between 1.51 and 1.9 were categorized as 'vaccine-hesitant, leaning toward pro-vaxxers,' and those with a score of 2 were classified as 'pro-vaxxers.'

A Chi-square test was used to evaluate the association between the traditional vaccine hesitancy index and the response to the fictitious vaccine. Additionally, 95% confidence intervals were calculated to assess the statistical significance of these associations.

Sociodemographic characteristics were analyzed to identify patterns in vaccine hesitancy. Variables included gender, educational level, settlement type, and the age of the child. Gender was treated as a binary variable (male vs. female). Educational attainment was categorized into four levels: elementary, vocational, secondary, and higher education. Settlement types included urban and rural classifications, while child age groups were divided into 0–3 years, 4–6 years, 7–14 years, and 15–19 years.

Statistical significance in vaccine hesitancy across sociodemographic groups was assessed using standardized Pearson residuals. A residual absolute value of 2 or greater was considered statistically significant at a p-value of 0.05.[29]

RESULTS

Four distinct groups were identified regarding the Piresian vaccine. The first group comprised parents who did not believe the vaccine existed (14.5%). The second group consisted of those who explicitly stated that their child had not received the vaccine and had no intention of doing so, reflecting a strong reluctance toward vaccination (44.8%). The third group included parents whose child had already been vaccinated or planned to receive the vaccine in the future, indicating a more accepting stance (20.6%). The final group encompassed individuals who were uncertain or provided no response (20.1%). For further analysis, only the second and third groups were examined, as they represent individuals with clear stances toward vaccination—either opposition or support.

A separate variable was used to assess vaccine hesitancy, as detailed in the Methods section. The overall distribution of participants revealed that 25.2% fell into the category of staunch vaccine opponents. Additionally, 34.4% were classified as leaning toward vaccine hesitancy but not outright rejecting vaccines. Meanwhile, 21.4% were somewhat supportive of vaccination but still hesitant, and 16.6% were strong supporters of vaccines. A small percentage (2.4%) of participants were removed from the study due to their belief that vaccines, in general, do not exist.

A statistically significant relationship ($p < 0.001$, Cramer's $V = 0.592$) was observed between conventional vaccine hesitancy measurements and attitudes toward the Piresian vaccine. Among those classified as anti-vaxxers by traditional methods, 100% stated that their child had not received and would not receive the Piresian vaccine. This percentage gradually declined across the other groups, with 74% among those categorized as "hesitant but leaning anti-vaccine," 44% among those classified as "hesitant but leaning pro-vaccine," and 15% among strong vaccine supporters. Conversely, when looking at the proportion of parents who stated their child had already received or intended to receive the vaccine, the opposite trend was evident. None of the strong anti-vaxxers had vaccinated their child, while the rate of vaccination increased to 26% among the "hesitant but leaning anti-vaccine" group, 56% among the "hesitant but leaning pro-vaccine" group, and 85% among vaccine supporters. These findings indicate that attitudes toward the Piresian vaccine serve as a useful indicator of vaccine hesitancy, particularly in identifying individuals strongly opposed to vaccination.

Further examination of vaccine attitudes using the Piresian vaccine revealed patterns that closely aligned with those observed through traditional vaccine hesitancy measurements. Beyond comparing the two methods, an additional objective was to determine whether the same social groups exhibited similar divisions based on each approach.

No statistically significant differences in vaccine attitudes were detected between men and women, as indicated by standardized Pearson residuals. The values for all residuals remained below the threshold of two, confirming that gender was not a distinguishing factor in either measurement approach.

A clear trend was identified regarding education levels. Individuals with lower levels of education exhibited significantly higher rates of vaccine hesitancy, with approximately 40% categorized as anti-vaxxers through traditional assessment methods. In contrast, among those with advanced education, this figure dropped to 12%. A similar pattern emerged with the Piresian vaccine, where 88% of parents with lower education reported their child had not been and would not be vaccinated, compared to 55% among those with higher education.

Geographic disparities also played a role in vaccine attitudes. Conventional vaccine hesitancy assessments

revealed that vaccine opposition was more prevalent in rural settings. However, when analyzing responses concerning the Piresian vaccine, a different pattern emerged, with the highest proportion of vaccine-resistant parents observed in urban settings. This discrepancy was explained by combining the proportion of individuals classified as anti-vaxxers with those labeled as "hesitant but leaning anti-vaccine," which ultimately resulted in the highest overall vaccine hesitancy occurring in urban areas.

The age of the child was another influencing factor. Traditional vaccine hesitancy measures indicated that vaccine opposition was most pronounced among parents of older children (15+ years), while those with younger children (ages 6 and under) exhibited lower rates of vaccine hesitancy. A similar but less pronounced trend was observed in the Piresian vaccine responses, where parents of 4- to 6-year-olds demonstrated a lower-than-average reluctance to vaccinate.

Overall, vaccine hesitancy levels varied significantly across different sociodemographic groups. Notably, strong correlations emerged between the results of the conventional vaccine hesitancy assessment and those obtained using the Piresian vaccine, reinforcing the reliability of the latter as an alternative measurement tool.

Table A1: Chi-square-test-related statistics of the crosstabulation of the attitude towards the Piresian vaccine with the objective measurement of vaccine hesitancy.

Chi-Square Value	df	*p*-Value (Two-Sided)	Cramer's V
98.891	3	<0.001 [2.6916×10^{-21}]	0.592

Table A2: Crosstabulation of the attitude towards the Piresian vaccine with the traditional objective measurement of vaccine hesitancy. Cell counts.

	Anti-Vaxxer	Hesitant, Rather Anti-Vaxxer	Hesitant, Rather Pro-Vaxxer	Pro-Vaxxer
Has not gotten the vaccine nor intends to get it	82	77	28	5
Has already gotten the vaccine or will get it	0	27	35	28

Table A3: Crosstabulation of the attitude towards the Piresian vaccine with the traditional objective measurement of vaccine hesitancy. Column percentages.

	Anti-Vaxxer	Hesitant, Rather Anti-Vaxxer	Hesitant, Rather Pro-Vaxxer	Pro-Vaxxer
Has not gotten the vaccine nor intends to get it	100.0%	74.0%	44.4%	15.2%
Has already gotten the vaccine or will get it	0.0%	26.0%	55.6%	84.8%

Table A4: Crosstabulation of the general attitudes towards vaccination with different socio-demographic dimensions. Cell counts.

	Anti-Vaxxer	Hesitant, Rather Anti-Vaxxer	Hesitant, Rather Pro-Vaxxer	Pro-Vaxxer
Sex				
Men	6	12	7	8
Women	102	136	85	63
Education Level				
Elementary	39	29	13	17
Vocation	19	29	21	13
Secondary	41	52	36	25
Higher	10	38	22	17
Type of Settlement				
Capital	17	28	16	7
County town	15	37	18	15
City	32	46	28	29
Village	44	37	30	21
Age of the Child				
Max. 3 years old	21	38	29	28
4–6 years old	9	27	13	11
7–14 years old	55	61	38	28
15–19 years old	23	22	12	4

Table A5: Crosstabulation of the general attitudes towards vaccination with different socio-demographic dimensions. Row percentages.

	Anti-Vaxxer	Hesitant, Rather Anti-Vaxxer	Hesitant, Rather Pro-Vaxxer	Pro-Vaxxer
Sex				
Men	18%	36%	21%	24%
Women	26%	35%	22%	16%
Education Level				
Elementary	40%	30%	13%	17%
Vocation	23%	35%	26%	16%
Secondary	27%	34%	23%	16%
Higher	12%	44%	25%	20%
Type of Settlement				
Capital	25%	41%	24%	10%
County town	18%	44%	21%	18%
City	24%	34%	21%	22%
Village	33%	28%	23%	16%
Age of the Child				
Max. 3 years old	18%	33%	25%	24%
4–6 years old	15%	45%	22%	18%
7–14 years old	30%	34%	21%	15%
15–19 years old	38%	36%	20%	7%

Table A6: Crosstabulation of the general attitudes towards vaccination with different socio-demographic dimensions. Standardized Pearson residuals. (If the standardized Pearson residuals are larger than 2 in absolute value, we interpreted it that the cell is significantly different from the expected value of independence on a 0.05 level.).

	Anti-Vaxxer	Hesitant, Rather Anti-Vaxxer	Hesitant, Rather Pro-Vaxxer	Pro-Vaxxer
Sex				
Men	−1	0.1	−0.1	1.2
Women	1	−0.1	0.1	−1.2
Education Level				
Elementary	3.6	−1.3	−2.3	0.1
Vocation	−0.6	0	0.9	−0.3
Secondary	0.3	−0.5	0.6	−0.4
Higher	−3.4	1.9	0.9	0.7
Type of Settlement				
Capital	−0.1	1.1	0.4	−1.6
County town	−1.9	1.8	−0.2	0.1
City	−0.6	−0.3	−0.4	1.6
Village	2.4	−2.1	0.3	−0.5
Age of the Child				
Max. 3 years old	−2.2	−0.7	0.9	2.4
4–6 years old	−2.1	1.7	−0.1	0.3
7–14 years old	1.8	−0.7	−0.5	−0.7
15–19 years old	2.3	0.1	−0.5	−2.3

Table A7: Crosstabulation of the attitude towards the Piresian vaccine with different socio-demographic dimensions. Cell counts.

	Hasn't Gotten the Vaccine nor Intends to Get It	Has Already Gotten the Vaccine or Will Get It
Sex		
Men	14	10
Women	178	79
Education Level		
Elementary	45	6
Vocation	37	20
Secondary	76	36
Higher	33	27
Type of Settlement		

Capital	43	9
County town	32	22
City	50	31
Village	67	27
Age of the Child		
Max. 3 years old	48	25
4–6 years old	24	21
7–14 years old	84	33
15–19 years old	36	10

Table A8: Crosstabulation of the attitude towards the Piresian vaccine with different socio-demographic dimensions. Row percentages.

	Hasn't Gotten the Vaccine nor Intends to Get It	Has Already Gotten the Vaccine or Will Get It
Sex		
Men	58%	42%
Women	69%	31%
Education Level		
Elementary	88%	12%
Vocation	65%	35%
Secondary	68%	32%
Higher	55%	45%
Type of Settlement		
Capital	83%	17%
County town	59%	41%
City	62%	38%
Village	71%	29%
Age of the Child		
Max. 3 years old	66%	34%
4–6 years old	53%	47%
7–14 years old	72%	28%
15–19 years old	78%	22%

Table A9: Crosstabulation of the attitude towards the Piresian vaccine with different socio-demographic dimensions. Standardized Pearson residuals. (If the standardized Pearson residuals are larger than 2 in absolute value, we interpreted it that the cell is significantly different from the expected value of independence on a 0.05 level.).

	Hasn't Gotten the Vaccine nor Intends to Get It	Has Already Gotten the Vaccine or Will Get It
Sex		
Men	−1.1	1.1
Women	1.1	−1.1
Education Level		
Elementary	3.4	−3.4
Vocation	−0.6	0.6
Secondary	−0.1	0.1
Higher	−2.5	2.5
Type of Settlement		
Capital	2.5	−2.5
County town	−1.6	1.6
City	−1.5	1.5
Village	0.8	−0.8
Age of the Child		
Max. 3 years old	−0.5	0.5
4–6 years old	−2.4	2.4
7–14 years old	1.1	−1.1
15–19 years old	1.6	−1.6

DISCUSSION

Understanding parental perspectives on childhood vaccination—including beliefs, misconceptions, knowledge, and preconceived notions—is essential for increasing immunization rates. However, accurately assessing a parent's level of vaccine hesitancy or identifying individuals with strong opposition to vaccination remains challenging.

Infectious diseases continue to be a significant cause of illness and death, highlighting the necessity of widespread immunization programs. Unfortunately, vaccine hesitancy poses a barrier to these initiatives. The need to comprehend health-related decision-making emerged as early as the 1970s when obstacles to polio immunization led to the development of the Health Belief Model[13] More recently, a framework referred to as the '3C model' was introduced, identifying confidence, complacency, and convenience as key determinants influencing vaccine acceptance.[30] While this model is adaptable across different epidemiological and cultural contexts, accurately measuring vaccine hesitancy remains a challenge. Surveys designed to assess general vaccine acceptance may capture overall hesitancy toward immunization but do not necessarily reflect attitudes toward specific vaccines. On the other hand, studies evaluating hesitancy toward a particular vaccine may yield results influenced by prior knowledge and personal experiences, making them difficult to generalize to other vaccines. To address this limitation, the Piresian approach was developed, offering a standardized tool for evaluating vaccine hesitancy without being influenced by prior exposure to a particular vaccine.

In some regions, multiple childhood immunizations are mandatory and funded by national healthcare systems. As a result, childhood vaccination coverage is typically very high. However, anecdotal reports suggest that a small number of families may attempt to bypass these requirements. In such settings, where parental choice in mandatory immunization is minimal, vaccine hesitancy is more effectively studied through attitudes toward non-compulsory vaccines. The acceptance of voluntary vaccines can provide insight into vaccine hesitancy trends. For instance, the uptake of certain vaccines was notably low before they were integrated into national immunization schedules.[31] Nonetheless, the proportion of parents who actively refuse all optional vaccinations remains relatively small.[32]

To evaluate parental attitudes toward recommended vaccines, a classification system was employed similar to that of Benin et al.[28], dividing respondents into four categories along a spectrum of hesitancy: anti-vaxxers, vaccine-hesitant leaning towards refusal, vaccine-hesitant leaning towards acceptance, and pro-vaxxers. The study collected responses on specific vaccines, providing more practical insights into decision-making rather than relying solely on general opinions about vaccination. A distinguishing feature of the methodology was the introduction of a hypothetical vaccine alongside real vaccines in survey questions. Responses regarding this fictitious vaccine served as a control measure since participants had no prior knowledge or experience with it. Comparing attitudes toward real and hypothetical vaccines demonstrated a significant correlation between traditional vaccine hesitancy measurements and the responses to the fabricated vaccine, supporting its validity as a tool for assessing hesitancy.

Sociodemographic analysis revealed no significant difference in vaccine hesitancy between men and women, a finding that contrasts with research on COVID-19 vaccination attitudes.[33] However, consistent with earlier studies[34], individuals with lower educational attainment were more likely to exhibit vaccine-resistant behaviors. Additionally, the relationship between geographic location and vaccine hesitancy was examined, showing that individuals in both highly populated and sparsely populated areas were more likely to express anti-vaccine sentiments, aligning with findings from similar research.[35]

Despite its strengths, the novel approach of incorporating a hypothetical vaccine has certain limitations. One drawback is that staunch anti-vaccine individuals who recognize the fictitious nature of the vaccine may not respond as expected. However, this aspect can be advantageous, as it highlights individuals with limited vaccine knowledge—making them prime candidates for targeted educational interventions. Another limitation is the dynamic nature of vaccine hesitancy, which can shift due to changing public health conditions, such as disease outbreaks. Furthermore, while this study focused primarily on sociodemographic variables, additional influences on vaccine hesitancy warrant exploration.[36,37,38]

CONCLUSION

In conclusion, the Piresian method represents a novel tool for quantifying parental vaccine hesitancy. It provides a straightforward approach to identifying groups that may benefit from educational efforts aimed at improving vaccine uptake, particularly in cases where new immunization programs are introduced. Notably, data collection for this study occurred before the COVID-19 pandemic. Recent findings indicate that younger parents, particularly those in middle age, exhibit higher levels of vaccine hesitancy.[39] Given the ongoing challenges posed by emerging infectious diseases, the Piresian method offers a promising approach for assessing vaccine hesitancy in populations unfamiliar with new immunizations.

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