Vaccine Hesitancy: Insights from Parents of Children with Autism Spectrum Disorder and Other Neurodevelopmental Disorders

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Abstract: Vaccine hesitancy presents significant challenges and risks to public health worldwide. Certain groups, such as parents of children with Autism Spectrum Disorder (ASD), are more vulnerable to vaccine hesitancy due to concerns about safety, past controversies, and misinformation surrounding autism and immunization. This research aimed to evaluate various aspects of vaccine hesitancy among parents of children with ASD and other neurodevelopmental disorders (NDDs), highlighting key concerns that may influence their vaccination decisions. The study was based on data collected from a researcher-developed questionnaire examining parental attitudes and concerns regarding childhood vaccination. Participants included 225 parents of children diagnosed with NDD (ASD or other). Results revealed significant differences between the two groups of parents at the item, factor, and total-score levels, with the most prominent discrepancies regarding vaccine-related concerns (safety, side effects, and autism causality) and trust and acceptance of vaccination practices. However, vaccination decisions did not differ significantly by diagnosis, indicating that while attitudes and trust levels vary, vaccination behaviors remain consistent across diagnoses. Implications for practice include the need for tailored health messaging that addresses the specific fears and distrust of parents of children with neurodevelopmental disorders, particularly those with ASD. Effective communication strategies should be employed to provide emotional support, not just information, to improve vaccine acceptance and reduce hesitancy.

Keywords: Vaccination, parental attitudes, ASD, NDD, vaccine hesitancy.

INTRODUCTION

In recent decades, numerous scientific studies have investigated the epidemiology, genetics, and etiology of autism spectrum disorder (ASD). Despite this, various myths and misconceptions about autism persist, including the widely discredited claim that vaccines cause the condition. This misconception remains particularly prevalent among parents of children with ASD, despite the overwhelming scientific evidence refuting any link between vaccines and autism. A simple online search using the words "autism" and "vaccination" yields approximately 44.8 million results in English - highlighting the acuity of societal concerns in this regard.

Vaccine hesitancy is a relatively new term most commonly used to describe the reluctance to accept a vaccine that has been proven safe and effective and made available to protect against an infectious disease [1]. Within this framework, a "vaccine-hesitant" can be defined as anyone who doubts vaccinations or chooses to delay or refuse immunizations, even when they are readily available [2]. Such descriptions are useful for surveillance and public health monitoring; however, they may not fully capture the underlying attitudinal, emotional, and trust-related dimensions that shape parental decision-making.

In the present study, we adopt a broader operationalization of vaccine hesitancy as a multidimensional construct reflecting distinct but related components of parental perspectives on vaccination. Specifically, this construct encompasses vaccine-related concerns, referring to beliefs about vaccine safety, side effects, and perceived risks; trust in vaccines, capturing confidence in vaccination practices, healthcare professionals, and immunization systems; and different vaccination behaviors, such as postponement, compliance under external requirements, or adherence to vaccination schedules. Such formulation allows vaccine hesitancy to be examined beyond observable vaccination behaviors.

The prevalence of vaccine-hesitant parents varies geographically, but in the general population, it ranges from 9% to 15% [3]. Research suggests that parents of children with ASD exhibit greater vaccine hesitancy compared to parents of children with other neurodevelopmental disorders (NDDs). According to Bonsu *et al.* (2021), they are 11.9 times more likely to

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express concerns about vaccines, particularly regarding the belief that vaccine ingredients, such as toxins, contribute to developmental delays [4]. Additionally, a study of Sahni *et al.* (2020) found that up to 40% of parents with children diagnosed with ASD believe that vaccines played a role in causing or contributing to their child's condition [5].

These findings suggest that many parents of children with ASD tend to seek external explanations (e.g., environmental or metaphysical factors) for their child's developmental differences, rather than internal factors such as biological or genetic influences. This inclination may contribute to the persistence of vaccine hesitancy within this population. A study conducted in Italy by Pivetti *et al.* (2020) that examined parents' attitudes towards vaccines, concluded that when trying to explain the unexplained occurrence of autism in their child, parents blamed vaccines and their toxic components to try to rationalize "the mysterious cause of autism" [6]. A link between the misinformation available on social media and vaccination acceptance has also been established: the more people talk about vaccines, the fewer people get vaccinated [7]. Faasse *et al.* (2016) stated that doubts and fears expressed in social media conversations have been shown to make people hesitant about vaccines, and this hesitation causes people to post their doubts and fears on social media [8]. Access to medical information and knowledge does not fully explain attitudes towards vaccines. This aligns with research by Skafle *et al.* (2024), which shows that attitudes toward vaccines are not influenced by the availability of medical information [9]. In two studies [10, 11], parents cited several common reasons for not vaccinating their children: concerns that vaccines could cause harm or overload the immune system; beliefs that their child is not at risk of disease or that the disease is not dangerous; and the notion that it is better to develop immunity naturally rather than through vaccines, or that vaccines may not be effective. A study from Wake (2021) shows similar attitudes [12].

Caregivers are hesitant to vaccinate children due to fears of unwanted effects that vaccination may cause. Concerns about the safety of childhood vaccination and its potential role in long-term adverse effects are among the main reasons for refusing vaccination, according to a systematic review by Goin-Kochel *et al.* (2020), which covered 64 studies [13]. Another study [14] found that parents who oppose vaccinations are more likely to use a wider variety of sources of information - they are more likely to mention "browsing" the Internet. They also have difficulties in assessing the credibility of sources. The results show that parents who vaccinate their children trust their doctors, pharmaceutical companies, or the government. The rest are distrustful and believe that the data provided to them is one-sided and manipulative. This distrust of legitimate sources of information is reflected in vaccination rates, with 11.5 % of parents refusing at least one vaccine recommended by their GP [15]. According to a study by Wilson *et al.* (2008), the majority of parents (71 %) of unvaccinated children say that doctors do not influence their vaccination decisions [16].

While it has been established that a diagnosis of ASD may be associated with an increased risk of vaccine hesitancy, fewer studies focus on the nature and contents of parental concerns in this regard. Given the context above, our study aimed to describe parental attitudes and beliefs related to vaccine hesitancy, with the specific objective of determining whether there were significant differences between two groups of parents: those of children with ASD and those of children with other NDDs.

METHODS

For this study, an empirically developed self-report questionnaire, the Vaccine Hesitancy Questionnaire (VHQ), was used, authored by Svetla Staykova and Desislava Maslinkova. The authors designed this questionnaire to assess key components of vaccine hesitancy. The questionnaire development involved a thorough review of existing literature and pilot testing to ensure its reliability and validity. Based on the literature review, the authors selected items that cover aspects of vaccination, including vaccine-related concerns, trust in vaccination practices, and vaccination behaviors. Content validity was assessed through expert review, in which two specialists in child psychiatry and child clinical psychology evaluated the items for clarity, relevance, and construct representativeness. Based on their feedback, revisions were made to improve the wording and coverage of the items. A pilot study was conducted with 30 participants to assess item clarity, comprehensibility, and preliminary response patterns. As a result, two items were removed: "*I accept mandatory vaccines, but not those that are recommended,*" and "*I am concerned about children's suffering during the injection itself.*" The first item was removed due to conceptual misalignment, as it primarily reflected acceptance of local vaccination policy rather than underlying attitudinal constructs of vaccine hesitancy. The second item was removed due

to weak construct relevance, as it reflected procedural distress rather than vaccine hesitancy-related beliefs or attitudes. The final version of the questionnaire consists of 22 statements, evaluated using a Likert scale with four answer options: Strongly agree, somewhat agree, somewhat disagree, strongly disagree. Higher total questionnaire scores reflect increased vaccine hesitancy. Items reflecting confidence in vaccination (items 1-5, 17-18) were reverse- =coded prior to analysis so that higher scores on all items consistently indicate greater vaccine hesitancy.

A combination of descriptive (frequency distributions, cross-tabulations, graphical representations) and inferential statistical methods (independent-samples T-test) was used to analyze the data. To control for inflation of Type I error due to multiple comparisons, a Bonferroni correction was applied to the item-level independent samples t-tests, with the nominal significance level ($\alpha = 0.05$) adjusted according to the number of items-level tests performed. Given 22 item-level comparisons, the Bonferroni-adjusted significance threshold was set at $p < 0.0023$.

Principal component analysis (PCA) was used as an exploratory technique to examine the questionnaire's dimensional structure and identify patterns of covariance among items. The extracted components are interpreted as representing empirically derived dimensions of vaccine hesitancy-related factors. Results were analyzed at the item, factor, and total-score levels to identify potential differences between the two groups (ASD/other NDD). Statistical analysis was performed with IBM SPSS 21.0.

Data were collected from March 2023 to April 2024 as part of the diagnostic program conducted in the outpatient and inpatient departments of the "St. Nicholas" Child Psychiatry Clinic at University Hospital "Alexandrovska" in Sofia, Bulgaria. Participation in the study was anonymous and voluntary, did not influence the diagnostic or therapeutic processes, and involved no collection of identifiable participant information. Written informed consent was obtained from all participants prior to participation. Given the sensitive nature of the topic, participants were fully informed of the study aims and their right to withdraw at any time without consequences.

RESULTS

Participants` Sociodemographic Characteristics

This study involved parents of 225 children and adolescents (79 girls, 146 boys) aged 1 to 17 years (M = 10, SD = 5.1) diagnosed with neurodevelopmental disorders. Of the children, 129 (57%) were diagnosed with ASD, and 96 (43%) had other NDD (Developmental disorder of speech and language, Developmental disorder of scholastic skills, Intellectual disability, Attention deficit hyperactivity disorder). Of the respondents, 59% were from Sofia, while 41% resided in other locations. The majority of mothers had a higher education (62.7%), 32% finished high school, and 5.3% finished only primary school. Among fathers, the majority had a high school education (47.1%), 46.7% had a university education, and 6.2% had only primary education. Of the total participants, 45% had one child, 45% had two children, 8.4% had three children, and 1.8% had more than three children.

General Trends in Vaccination Attitudes

Initially, general trends in response patterns were examined to better understand vaccine-hesitancy-related attitudes within the studied group. Descriptive analysis revealed a mean total score on the VHQ for all respondents of 49.24 (SD = 14.71, N = 225), indicating a moderate overall tendency in the data. Figure **1** illustrates the approximately normal distribution of scores, with a peak around the mean. Using standard deviation-based classification, responses below 34.53 (Mean - 1 SD) were categorized as 'low,' while scores above 63.95 (Mean + 1 SD) were considered 'high.' This suggests that most participants exhibited moderate responses, with fewer individuals scoring at the extremes.

In comparing the two groups of parents (ASD/other NDD), differences in the distribution of total scores were observed. While the majority of individuals in both groups exhibited moderate vaccine hesitancy (64.3% in the ASD group and 65.6% in the other NDD group), high levels of vaccine hesitancy were considerably more frequent in the ASD group (23.3%) than in the other NDD group (10.4%). Conversely, low levels of vaccine hesitancy were less common in the ASD group (12.4%) compared to the other NDD group (24%).

Figure **2** illustrates the comparison of total scores on the Vaccine Hesitancy Questionnaire between the two groups. The median vaccine hesitancy score is higher in the ASD group (median=57; range=22-86) than in the Other NDD group (median=46; range=22-79), suggesting that individuals in the ASD group exhibit greater vaccine hesitancy. Nevertheless, the ASD group shows a slightly wider interquartile range (IQR=22.50) compared to the other NDD group

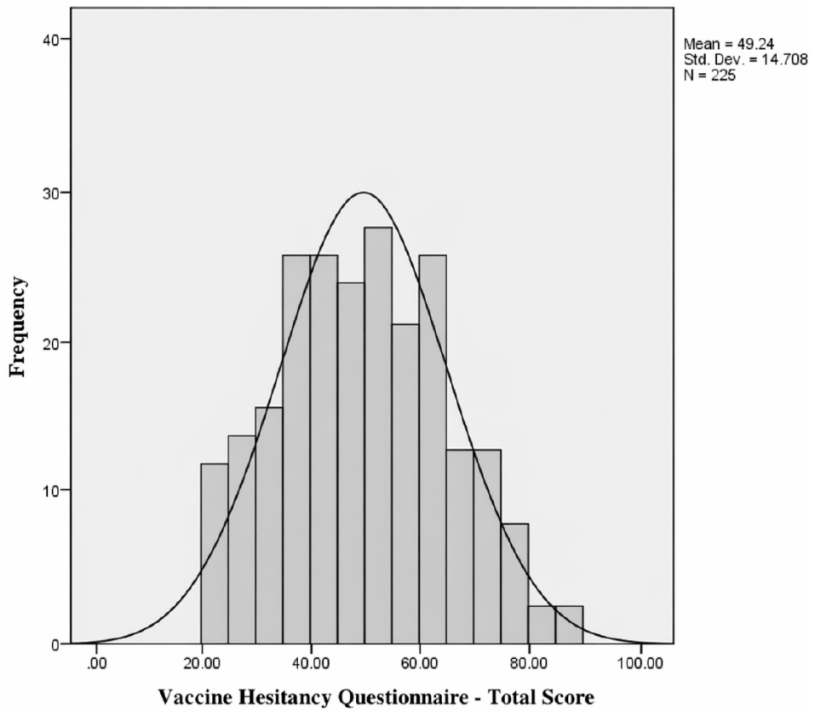

Figure 1: Distribution of total scores on the Vaccine Hesitancy Questionnaire (VHQ) among all participants.

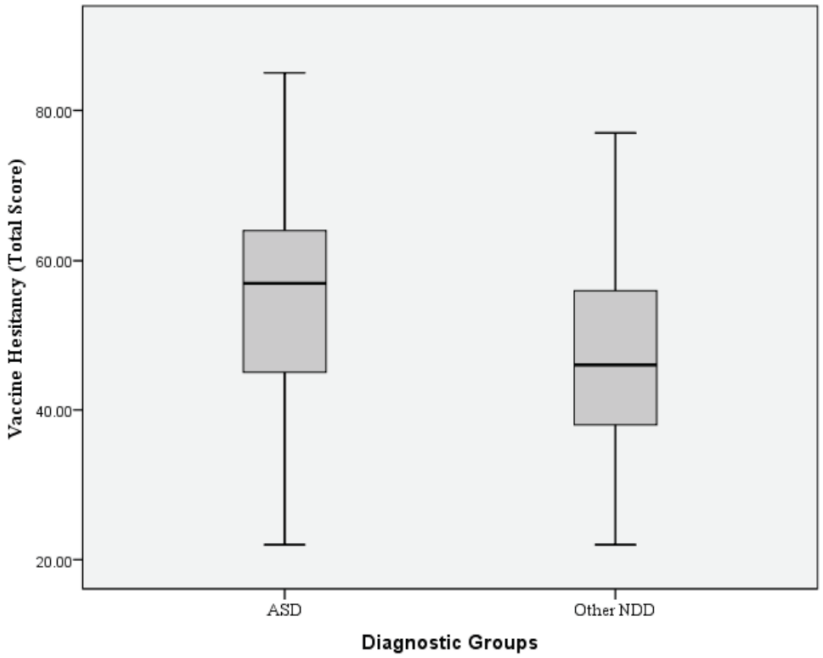

Figure 2: Comparison of Vaccine Hesitancy Total Scores Across Diagnostic Groups.

(IQR=18.75), meaning there is more variability in vaccine hesitancy responses among individuals with ASD.

To determine whether the observed differences are significant, an Independent-Samples T-Test was conducted. Results from comparing questionnaire total scores revealed that higher vaccine hesitancy was significantly more prevalent among parents of autistic children, $t(223) = 3.95$, $p = .000$. Cohen's d was 0.53, indicating a medium effect size.

Diagnosis-Dependent Differences in Vaccination Attitudes (Item-Level)

This study was particularly interested in identifying which aspects of vaccine hesitancy differed most

Table 1: Item-level Differences in Parental Vaccination Attitudes between Parents of Children with Autism Spectrum Disorder (ASD) and other Neurodevelopmental Disorders (NDD)

Statement	ASD Group (Mean ± SD)	Other NDD (Mean ± SD)	Mean Difference	t(df)	95% C.I.	Sig.	Effect size Cohen's d
1. I vaccinate my child to protect him.	1.77±0.88	1.47±0.75	0.30	2.68(223)	(0.08,0.52)	0.008**	0.37
2. I think that in general, vaccinations are safe for children.	2.20±0.94	1.61±0.76	0.59	5.03(223)	(0.36,0.82)	0.000**	0.69
3. I trust the information provided by health professionals.	1.91±0.85	1.55±0.71	0.36	3.38(222)	(0.15,0.57)	0.001**	0.46
4. I am satisfied with the amount of information provided by the health professionals.	2.16±0.96	1.94±0.87	0.22	1.76(223)	(-0.03,0.46)	0.081	
5. I vaccinate my child to protect the wider community.	1.97±0.94	1.89±0.91	0.08	0.67(223)	(-0.16,0.33)	0.502	
6. I am concerned about the increasing number of vaccines recommended for children.	2.98±1.08	2.57±1.00	0.41	2.92(223)	(0.13,0.69)	0.004**	0.39
7. I am concerned that vaccines have not been sufficiently studied for their safety.	2.84±1.04	2.53±0.99	0.31	2.29(223)	(0.04,0.58)	0.027	
8. I worry that children receive too many vaccines in the first two years of life.	2.98±1.02	2.39±1.06	0.60	4.30(223)	(0.32,0.87)	0.000**	0.57
9. I worry that the child's immune system may be weakened by vaccinations	2.68±1.05	2.25±1.00	0.43	3.13(223)	(0.16,0.70)	0.002**	0.42
*10. I am concerned that vaccines can cause autism in healthy children.	2.81±1.08	2.23±0.99	0.59	4.22(214)	(0.31,0.86)	0.000**	0.56
11. I am afraid that vaccines are given to children to protect them from diseases they are unlikely to get.	2.52±1.08	2.40±1.08	0.12	0.85(223)	(-0.16,0.41)	0.396	
12. I prefer children to develop natural immunity to diseases rather than from vaccines.	2.53±1.02	2.32±1.03	0.20	1.48(223)	(-0.07,0.48)	0.142	
13. I am concerned that vaccines for children aim to protect them from diseases that are not serious.	2.22±0.99	2.00±0.95	0.23	1.71(223)	(-0.03,0.48)	0.089	
14. Vaccination is not necessary because others have already vaccinated their children and diseases are under control.	2.00±1.00	1.75±0.99	0.25	1.87(223)	(-0.01,0.51)	0.063	
*15. I am worried that if I vaccinate my child, it will do more harm than good.	2.36±1.04	1.93±0.92	0.44	3.34(216)	(0.18,0.70)	0.001**	0.44
*16. I am concerned about side effects from vaccinating my child.	3.17±0.90	2.64±1.05	0.54	4.02(187)	(0.27,0.80)	0.000**	0.54
17. I am convinced that vaccination is beneficial for children.	2.12±0.85	1.71±0.79	0.42	3.74(223)	(0.20,0.64)	0.000**	0.50
18. Vaccinating my child will make me feel more at ease about his health.	2.10±0.92	1.71±0.77	0.39	3.40(223)	(0.17,0.62)	0.001**	0.46
19. I have postponed vaccinating my child for reasons other than allergies, elevated body temperature, or current infectious illness.	2.47±1.22	2.22±1.20	0.25	1.51(223)	(-0.08,0.57)	0.132	
20. I have administered a vaccine solely due to the requirement of entering a childcare facility or similar.	2.27±1.15	2.13±1.09	0.15	0.97(223)	(-0.15,0.45)	0.335	
*21. I have postponed the administration of a mandatory vaccine due to concerns about its effects on the child.	2.17±1.10	1.80±0.95	0.37	2.70(218)	(0.10,0.64)	0.008**	0.36
*22. A health professional has supported postponing vaccination, agreeing with my fears (when the child is in good health).	2.22±1.19	1.90±1.03	0.33	2.21(218)	(0.40,0.62)	0.028	

*Equal variances not assumed.
**$p < 0.0023$ (Bonferroni-corrected).

between parents, depending on the child's diagnosis. The differences were initially calculated at the item level using an Independent-Samples T-Test. Test statistics, degrees of freedom (df), and p-values are provided to indicate the significance of the observed association.

On the majority of items, there was a notable difference between the two groups, as shown in Table **1**. To provide a measure of the magnitude of these differences, we calculated effect sizes for the statistically significant differences. The most pronounced difference was observed for *vaccination safety* (Item 2), with a medium to large effect size according to Cohen's d. Next in the effect size ranking were concerns about over-vaccination (item 8), concerns about *autism causality* (item 10), concerns about *vaccination side effects* (item 16), and doubts about *vaccination beneficence* (item 17). For the remaining items, effect sizes were small or small to moderate, suggesting that although some differences reached statistical significance, their practical magnitude may be limited and should therefore be interpreted with caution.

The crosstabulation results for Item 2 indicated that parents of children with ASD were less likely to strongly agree that vaccination is safe (24.0%), compared to more than half of the parents of children with other NDD (53.1%). For Item 8, regarding over-vaccination, more than half of the parents in the ASD group (52.1%) provided strong agreement, compared to 39.5% in the other NDD group. The crosstabulation analysis of Item 10 revealed that 58.9% of all respondents in the ASD group agreed that vaccines are related to autism causality (36.4%= "strongly agree", 22.5%= "somewhat agree"). In contrast, participants in the other NDD group most commonly somewhat disagreed with this statement (44.8%), with "strongly disagree" (24.0%) being the next most common response. Positive responses linking vaccines to autism were much less frequently declared in this group, with "strongly agree" being the least common answer (15.6%). Regarding concerns about vaccination side effects, in the ASD group, "strongly agree" (43.4%) was the most common response, followed by "agree" (37.2%), indicating a very strong concern about side effects. In contrast, participants in the other NDD group most commonly selected "somewhat disagree" (35.4%), with "strongly agree" (28.1%) and "agree" (21.9%) being less frequently chosen.

Diagnosis-Dependent Differences in Vaccination Attitudes (Factor Level)

Item-level differences were informative of specific aspects of vaccination attitudes, but they did not allow for a more general interpretation. Observed response patterns suggested the presence of underlying (latent) factor(s) that better explain differences in vaccination attitudes between the two groups. To study this hypothesis, an exploratory factor analysis was conducted, followed by a comparison of the two groups on the identified factors.

Exploratory factor analysis was carried out using the principal component method of extraction with Varimax rotation and Kaiser Normalization. An examination of the Kaiser-Meyer-Olkin measure of sampling adequacy (KMO = .923) indicates that the sample is factorable.

A three-factor solution (Eigenvalue > 1) was considered optimal, explaining 64.7% of the total variance. This solution was further supported by inspection of the scree plot, which revealed a point of inflection after the third component, followed by a leveling off of the subsequent eigenvalues. The retained factors were interpretable and internally coherent.

Factor 1 contained 12 items (items 6-16), which appeared to measure vaccine-related concerns (e.g., "*I am concerned that vaccines have not been sufficiently studied for their safety*"). The Cronbach's alpha coefficient was 0.904, indicating excellent internal consistency reliability.

Factor 2 contained 7 items (items 1,2,3,4,5,17,18), which reflected trust and acceptance of vaccination practices (e.g., "*I am convinced that vaccination is beneficial for children*"). A follow-up reliability analysis found that factor 2 had excellent internal consistency (α = 0.904).

Factor 3 contained 4 items (items 19-22), which reflected hesitancy-related vaccination behaviors (e.g., "*I have postponed the administration of a mandatory vaccine due to concerns about its effects on the child*"). Reliability analysis indicated that factor 3 had good internal consistency (α = 0.824).

Table **3** shows a statistically significant difference in vaccine-related concerns between parents based on their child's diagnosis, with a mean difference of 0.33. The effect size (Cohen's d = 0.34) suggested a small to moderate effect of these differences. The difference in

Table 2: Exploratory Factor Analysis of the Vaccine Hesitancy Questionnaire (VHQ): Varimax-Rotated Three-Factor Solution

	Factor Loading		
	Factor 1 Vaccine-related Fears	**Factor 2 Trust in Vaccines**	**Factor 3 Vaccination Decisions**
1. I vaccinate my child to protect him.		0.736	
2. I think that in general, vaccinations are safe for children.		0.814	
3. I trust the information provided by health professionals.		0.845	
4. I am satisfied with the amount of information provided by health professionals.		0.799	
5. I vaccinate my child to protect the wider community.		0.726	
6. I am concerned about the increasing number of vaccines recommended for children.	0.749		
7. I am concerned that vaccines have not been sufficiently studied for their safety.	0.726		
8. I worry that children receive too many vaccines in the first two years of life.	0.744		
9. I worry that the child's immune system may be weakened by vaccinations	0.717		
10. I am concerned that vaccines can cause autism in healthy children.	0.714		
11. I am afraid that vaccines are given to children to protect them from diseases they are unlikely to get.	0.705		
12. I prefer children to develop natural immunity to diseases rather than from vaccines.	0.739		
13. I am concerned that vaccines for children aim to protect them from diseases that are not serious.	0.793		
14. Vaccination is not necessary because others have already vaccinated their children and diseases are under control.	0.631		
15. I am worried that if I vaccinate my child, it will do more harm than good.	0.650		
16. I am concerned about side effects from vaccinating my child.	0.687		
17. I am convinced that vaccination is beneficial for children.		0.634	
18. Vaccinating my child will make me feel more at ease about his health.		0.708	
19. I have postponed vaccinating my child for reasons other than allergies, elevated body temperature, or current infectious illness.			0.763
20. I have administered a vaccine solely due to the requirement of entering a childcare facility or similar.			0.678
21. I have postponed the administration of a mandatory vaccine due to concerns about its effects on the child.			0.799
22. A health professional has supported postponing vaccination, agreeing with my fears (when the child is in good health).			0.779

Table 3: Comparison of Vaccine Hesitancy Factor Scores between Diagnostic Groups

Factor	Mean Difference	t(df)	95% C.I.	Sig.	Effect size Cohen's d
1. Vaccine-related concerns	0.33	2.49(222)	(0.07,0.60)	0.013	0.34
*2. Trust and acceptance of vaccination	0.42	3.24(216)	(0.17,0.68)	0.001	0.43
3. Hesitancy-related vaccination behaviors	0.14	1.04(222)	(-0.13,0.41)	0.302	

*Equal variances not assumed.

trust and acceptance of vaccines between parents based on their child's diagnosis was also statistically significant, with a mean difference of 0.42. The effect size (Cohen's d = 0.43) suggested a moderate effect. No statistically significant difference in hesitancy-related vaccination behaviors was found between

parents based on their child's diagnosis, with a mean difference of 0.14.

Given that this questionnaire represents a newly developed instrument, the identified factor structure should be considered preliminary and exploratory.

DISCUSSION

The present study identified significantly higher overall vaccine hesitancy among parents of children with ASD compared to parents of children with other NDD, driven by differences in vaccine-related concerns and trust and acceptance of vaccination practices, rather than hesitancy-related vaccination behaviors.

The absence of clear between-group differences in vaccination behavior despite significant attitudinal differences is consistent with the view that vaccine hesitancy is not equivalent to vaccine refusal. The WHO Strategic Advisory Group of Experts on Immunization (SAGE) and subsequent work by Dubé *et al.* describe vaccine hesitancy as a continuum on which parents may accept all vaccines, delay some, accept reluctantly, or refuse selectively [1, 17]. On this view, negative attitudes and low trust may coexist with continued vaccine uptake. One plausible explanation is that vaccination behavior is shaped by factors beyond attitudes alone. Thus, some of the behavioral items in the present study may reflect constrained compliance rather than acceptance, which helps explain why they appear less differentiated.

23.3% of parents in the ASD group exhibited high levels of vaccine hesitancy, which is more than twice the rate of parents of children from other neurodevelopmental diagnostic groups (10.4%). These findings align with previous research - for example, Sahni (2020) reported that 29.5% of parents of children with ASD exhibited vaccine hesitancy, a broader pattern observed across multiple studies. Such results highlight the specific vulnerability of parents of children with ASD to anti-vaccinal beliefs, driven by a complex interplay of micro and macro-level factors [5].

The most important aspects of discrepancy in our study were observed in the domain of vaccine-related concerns, particularly regarding vaccination safety, perceived over-vaccination, potential side effects, and beliefs linking vaccination to autism.

Less than a quarter of the parents in the ASD group were convinced that vaccines are safe for children. Historical backgrounds of such concerns are usually traced back to the pronounced link between the MMR (measles, mumps, rubella) vaccine and autism [18]. Despite being extensively criticized and later disproven [19], such proclamations are believed to have laid the foundation for still-existing fears and negative expectations regarding vaccination, highlighting the profound effect that media and potential misinformation can have on parental decision-making.

Parental causal beliefs linking vaccines to autism have also been extensively documented [6, 13, 20]. Various explanations have been proposed for why this myth persists despite being disproven. One possible rationale has to do with timing - parents often observe the initial symptoms of ASD by the time a child receives his first routine childhood immunizations (such as the MMR vaccine administered between 12 and 15 months). Known as the post hoc ergo propter hoc (“after this, therefore because of this”) fallacy in the vaccine-autism myth, this phenomenon has been described by authors such as Stolle *et al.* (2020) [21]. The temporal correlation between the administration of vaccines and the onset of autism symptoms can lead to parents' mistaken beliefs of causality.

A second major domain contributing to elevated vaccine hesitancy among parents of children with ASD involved reduced trust and acceptance of vaccination practices, including diminished confidence in healthcare professionals and medical authorities. It has been documented that parents of children with ASD tend to exhibit marked distrust in healthcare, often fueled by misinformation and past negative experiences within the system of care [22, 23]. On a macro level, such tendencies reflect a profound crisis of trust in medical authorities that has permeated views and beliefs on a larger scale in many contexts across the world. General distrust in healthcare providers, government agencies, and pharmaceutical companies can often lead to non-scientific attitudes and behaviors that are sometimes even health-jeopardizing [24]. From a psychological perspective, the heightened concerns of parents of children with ASD have also been linked to psychological factors like defense mechanisms and stress coping strategies [23]. Parents of children with ASD tend to experience higher levels of internalized stigma, anxiety, and depression compared to parents of neurotypical children, and such challenges can potentially affect their trust in healthcare systems [25].

Several limitations of the study should be acknowledged. First, participants were recruited from a single site, which may limit the generalizability of the

findings to broader or more diverse populations. Second, as with all self-reported questionnaire data, the results may be influenced by response bias, including social desirability or selective reporting of attitudes and concerns related to vaccination. Moreover, the cultural and healthcare context in which the study was conducted may shape parental perceptions of vaccination; therefore, caution is warranted when extrapolating these findings to populations in different cultural or healthcare settings.

In addition, as a newly conceived scale, the Vaccine Hesitancy Questionnaire has not been extensively used in practice. The proposed factor structure is promising in terms of reliability, but the factors could be strengthened through revisions (rewrites) of some items with lower primary loadings and possibly adding new items. A further consideration is the use of principal component analysis (PCA) as the extraction method. While appropriate for exploratory purposes, PCA does not model latent constructs in the same way as common factor analysis; therefore, the components should be interpreted as empirical dimensions rather than latent factors. Future studies may use factor analytic and confirmatory approaches to further validate the structure. Another limitation is the lack of a control group of parents of typically developing children. Nevertheless, we believe that the study provides valuable insights into the specific concerns and attitudes of parents within the ASD group.

Evidence suggests that addressing hesitancy is challenging, as presenting hard scientific data is rarely effective and offers little emotional reassurance regarding parental concerns. Public health messaging needs to be adapted to address fears and distrust not only through hard science data, especially among the more vulnerable groups of parents, such as those of children with NDDs, especially autism. One recommended approach in this regard is the C.A.S.E (Corroborate, about me, Science, Explain/Advise) method, often cited as an effective framework for counseling vaccine-hesitant parents [17, 26, 27]. This method involves clinicians addressing vaccine safety concerns by first acknowledging and validating the parents' feelings, rather than immediately presenting scientific facts. This empathetic response helps parents feel heard and respected, fostering a respectful and successful discussion [28].

CONCLUSION

Negative attitudes towards vaccination present a significant public health challenge. General mistrust in vaccination practices and heightened concerns of the ASD community may negatively affect parental attitudes and decision-making regarding children's health. Aspects of hesitancy are significantly heterogeneous and diverse, particularly within the ASD community, making this group poignantly vulnerable to deception and misrepresentation. Furthermore, in the wake of the COVID-19 pandemic, there is an increasing need to adopt evidence-based strategies to dispel misconceptions about vaccines and encourage their acceptance. While efforts to combat misinformation and educate parents about the scientific evidence are crucial in addressing vaccine hesitancy, information alone is not sufficient. Individualized emotional support and recognition of the fears and concerns of parents of children with ASD are nonetheless essential. By providing targeted, empathetic, and compassionate support, healthcare professionals can build trust and help parents feel understood and supported in their vaccination decision-making process.

ETHICAL APPROVAL

Written consent was received from parents for the publication.

CONFLICT OF INTEREST AND FUNDING

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be considered as a potential conflict of interest.

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AUTHOR CONTRIBUTION STATEMENT

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

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