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# Factors associated with COVID-19 vaccine acceptance and hesitancy in children: a comprehensive survey

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## Abstract

**Background** The COVID-19 pandemic has underscored the significance of immunizations, particularly among susceptible populations such as children. This study examines the factors that influence parents' decision to accept or hesitate in vaccinating their children in an urban environment.

**Methods** A one-year cross-sectional study was carried out at a paediatric hospital in Tehran, Iran. The objective is to target a demographic of 226 children, aged 5 to 18, residing in metropolitan locations, over the period of June to August 2023. An extensive survey, built upon previous research, analyzed the variables that influence the reluctance and acceptance of vaccines. Data on demographics, vaccination status, and variables influencing hesitation or acceptance were collected.

**Results** Out of the 226 participants, 22.1% of the children had received vaccinations. There was a correlation between parents getting vaccinated and greater rates of child vaccination (100% vs. 92.9%,  $p = 0.073$ ). Significant relationships were seen between age, parental education, and past COVID-19 hospitalizations. The main motivations for vaccination were to guarantee safety (66%) and to avert serious illness (60%). The primary reasons for hesitancy were primarily attributed to worries regarding potential harmful effects (58%), lack of trust in the vaccine (19.9%), and uncertainties regarding its efficacy (15.9%).

**Conclusions** The research emphasizes key factors that have a significant impact on the COVID-19 vaccination of children, such as age, previous hospitalization experiences, and parental attitudes. To boost vaccination rates in this demographic, it would be beneficial to address parental concerns regarding vaccine safety and enhance educational outreach regarding the advantages of vaccines. Public health programs should prioritize clear and open information and precise treatments to decrease vaccine reluctance.

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## Introduction

The emergence of COVID-19, caused by the novel coronavirus SARS-CoV-2, was officially documented in December 2019 in Wuhan, China [1, 2]. In their most recent weekly report, WHO recorded over 770 million COVID-19 cases and 6 million fatalities worldwide as of September 24, 2023 [3]. Iran's first confirmed case was announced in February 2020, and the first vaccination day was February 9 of the following year [4]. As of October 2023, Nearly 67% of Iran's estimated population (reported till 2020) completed a primary series vaccination, and there have been over 146,000 deaths with more than 7 million verified cases [5].

Children and adolescents are among the most susceptible to severe infections during the COVID-19 pandemic, especially those aged six months to 4 years, according to the Centers for Disease Control and Prevention (CDC), since COVID-19 is one of the leading cause of death for children aged 0 to 19 [6]. Notably, COVID-19 has resulted in significantly more deaths in children and adolescents yearly than any known vaccine-preventable disease [7]. The global COVID-19 pandemic and its associated infection risks have prompted an urgent need for vaccination as a cost-effective preventive measure [7, 8]. Given the continuous emergence of new disease variants, the risk of disease transmission remains a significant global health concern [9]. In a study on U.S. children, among adolescents aged 12 to 17 years, monthly hospitalization rates were about six times higher among the unvaccinated than fully vaccinated adolescents, indicating that vaccines were highly efficient in preventing severe COVID-19 illness [10].

Preliminary estimations have indicated a notable decline in the rate of COVID vaccination in the 5–11 age group compared to the 12–18 age group. Still, despite the potential benefits of vaccination, parents are frequently hesitant to vaccinate their children. This hesitancy mostly arises from various factors, including fear of adverse effects, distrust in the healthcare system, and insufficient education [11–15]. It is within this context that the term 'vaccine hesitancy' comes to the forefront, defined by MacDonald et al. as the 'delay or refusal of vaccination influenced by factors such as convenience, confidence, and complacency' [16]. An Iranian study of 1093 participants who completed an online questionnaire revealed that the three reasons for parents' hesitation were concern for an adverse effect, negative impact on growth and infertility [17]. Another case-control study conducted in Iran found that children with greater socioeconomic class, COVID-19 infection in the past, and a lack of underlying sickness were the three primary categories who were more likely to receive vaccinations [18].

Globally, reasons for vaccine hesitancy among parents include concerns about vaccine safety, distrust in the healthcare system, and fear of potential side effects [19; 13]. However, vaccine hesitancy is not uniform across populations. Cultural, social, and healthcare contexts significantly influence parental decisions. In Iran, these factors may play an even more pivotal role, shaped by healthcare policies and public distrust. A recent Iranian study highlighted that vaccine hesitancy in children is strongly associated with parental trust in the healthcare system and concerns over side effects. While research on pediatric COVID-19 vaccination is growing, studies specifically examining hesitancy among Iranian parents remain limited. Lower trust in healthcare systems and misinformation contribute to high hesitancy rates, particularly among parents with lower education levels [19]. Additionally, parents' education level plays a critical role, with higher-educated parents less hesitant to vaccinate [11].

Iran's unique cultural and societal context further shapes vaccine hesitancy. Religious beliefs, past healthcare experiences, and misinformation contribute to parents' reluctance. A recent study found that concerns about fertility were particularly prominent [17]. The varying levels of healthcare access across different regions may also influence parental decisions. Understanding these factors is crucial for developing targeted public health strategies to increase vaccination rates.

This study aims to fill the knowledge gap by exploring factors related to vaccine acceptance and hesitancy among Iranian parents of children aged 5 to 18. By examining the demographic, social, and psychological factors involved, this research can provide insights that inform public health interventions to reduce hesitancy and improve vaccination rates among children in Iran.

## Material and method

### Study Design and Population

This cross-sectional study was conducted from June to August 2023 at a tertiary pediatric referral hospital in Tehran, Iran. The study targeted parents of children aged 5–18 years who visited the hospital for non-critical reasons. The sample size of 226 was calculated using the Cochrane formula, assuming a vaccine hesitancy rate of up to 60% [14], with a margin of error of 0.05 and an effect size of 0.065, to achieve a statistical power of 80%. Recruitment was based on voluntary participation after obtaining informed consent. To ensure a representative sample, all eligible parents visiting the clinic during the study period were invited to participate. Exclusion criteria included chronic medical conditions in children, such as diabetes, epilepsy, and rheumatologic disorders,

to maintain focus on general pediatric cases and reduce variability related to medical vulnerabilities.

### Data collection

Participants completed a validated 27-item questionnaire assessing demographic characteristics, vaccination history, and attitudes toward COVID-19 vaccination. The questionnaire was designed to elicit reasons for both vaccine acceptance and hesitancy. Reliability of the questionnaire was confirmed with Cronbach's alpha values of 0.547 and 0.664 for unvaccinated and vaccinated groups, respectively.

### Bias and confounders

The study relied on self-reported data, which poses risks of recall bias and social desirability bias. To mitigate these, the questionnaire focused on recent vaccination decisions and was designed with clear, neutral wording to minimize misreporting. Anonymity was assured to encourage honest responses. Potential confounders, such as parental education, child's age, and family history of COVID-19, were controlled through multivariable logistic regression. Additionally, the exclusion of children with chronic illnesses reduced the impact of health-related confounders.

### Statistical analysis

Data analysis was performed using SPSS Statistics version 26. Descriptive statistics summarized demographic data, while chi-squared tests and independent t-tests were used to compare categorical and continuous variables. Multivariable logistic regression assessed predictors of vaccination status, with adjusted odds ratios (OR) and 95% confidence intervals (CI) calculated for key variables. Statistical significance was set at  $p < 0.05$ .

### STROBE compliance

This study followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines. Potential confounders, including sociodemographic factors and previous health history, were controlled for in the statistical analysis to ensure the validity of the results.

### Results

The demographic characteristics of the study participants are provided in Table 1. Out of the 226 participants, 22.1% of the children were vaccinated against COVID-19. Children with a history of COVID-19 hospitalization ( $p = 0.006$ ) and those whose family members had been hospitalized due to COVID-19 ( $p = 0.005$ ) were more likely to be vaccinated. Additionally, a significant association was observed between children's age and vaccination

status ( $p < 0.001$ ), indicating higher vaccination rates among older children.

Parental vaccination status exhibited a consistent but non-significant trend with child vaccination ( $p = 0.073$ ). While 81.7% of the participants reported that both parents were vaccinated, this was not a definitive predictor of child vaccination. Other demographic factors, such as previous COVID-19 diagnosis ( $p = 0.328$ ) and parental education levels (father:  $p = 0.250$ ; mother:  $p = 0.080$ ), showed no statistically significant relationship with child vaccination.

### Reasons for vaccination and hesitancy

Tables 2 and 3 display the reasons behind parents' decisions to vaccinate or not vaccinate their children, as determined from the collected questionnaire data. The primary motivations for vaccinating children included ensuring their safety (66%) and preventing severe illness (60%). A smaller proportion cited trust in health authorities (36%) and adherence to public duty (28%) as influential factors.

The most frequently reported reasons for vaccine hesitancy were concerns about side effects (58%), lack of trust in the vaccine (19.9%), and waiting for confirmation about its safety and efficacy (15.9%). Misinformation and uncertainty surrounding the vaccine were less common but notable barriers.

### Predictive analysis

Logistic regression analysis highlighted age (OR: 1.05, CI: 1.02–1.09,  $p = 0.023$ ) and history of hospitalization due to COVID-19 (OR: 2.15, CI: 1.23–3.75,  $p = 0.006$ ) as significant predictors of vaccination. Parental vaccination status and educational attainment, although included in the model, did not emerge as significant predictors (Table 4).

### Discussion

This study investigated the determinants of COVID-19 vaccine acceptance and hesitancy among parents of children referred to the Children's Medical Center in Tehran, Iran. Our findings reveal several significant insights into parental attitudes towards vaccinating their children against COVID-19, which are crucial for developing targeted public health interventions.

Our results are consistent with other studies conducted in Iran, such as the study by Mollaie et al. (2023), which found that parental concerns over vaccine safety were the primary drivers of vaccine hesitancy [17]. Similarly, global studies have consistently shown that parents with higher education levels are more likely to accept COVID-19 vaccines for their children, as education is linked to greater trust in medical recommendations and a better understanding of vaccine benefits [19].

**Table 1** Baseline Demographic of the Study Population

Variable	Total N (%)	Vaccinated N (%)	Unvaccinated N (%)	P-value
Age (yr.)	221 (97.7)	50 Mean = 12.31 Std. Deviation = 3.51	171 Mean = 9.33 Std. Deviation = 2.68	< 0.001
Female sex	97 (46.6)	23 (46)	74 (46.8)	> 0.999
Male sex	111 (53.4)	27 (54)	84 (53.2)	
Urban residency	204 (100)	45 (100)	159 (100)	-
Previous COVID-19 diagnosis	84 (39.3)	16 (33.3)	68 (41)	0.328
Previous diagnosis of COVID-19 in family members	132 (62.3)	24 (50)	108 (65.9)	0.090
History of hospitalization of the child due to COVID-19	23 (10.5)	0 (0)	23 (13.5)	0.006
History of hospitalization of family members due to COVID-19	51 (23.2)	4 (8.2)	47 (27.5)	0.005
History of death of relatives due to COVID-19	42 (19.7)	7 (15.2)	35 (21)	0.386
Routine vaccination after the birth	214 (99.1)	49 (100)	165 (98.8)	> 0.999
Parents vaccination against COVID19	206 (94.5)	49 (100)	157 (92.9)	0.073
Father's education level	219 (100)			0.250
Illiterate		2 (4)	7 (4.1)	
High school graduate or associate degree		26 (52)	96 (56.8)	
College or undergrad		11 (22)	48 (28.4)	
Master's degree or higher		11 (22)	18 (10.7)	
Mother's education level	220 (100)			0.080
Illiterate		3 (6)	11 (6.5)	
High school graduate or associate degree		21 (42)	99 (58.2)	
College or undergrad		19 (38)	52 (30.6)	
Master's degree or higher		7 (14)	8 (4.7)	

**Table 2** Vaccinated Questionnaire

Phrase	Agreed (%)
I felt safe when my child was vaccinated.	33 (66)
I believe that vaccines prevent the occurrence of serious infectious diseases.	30 (60)
COVID-19 is a serious disease.	28 (56)
My child's doctor recommended to get the COVID-19 vaccine.	8 (16)
I trust the health authorities of the country.	18 (36)
Getting the vaccine is a public duty.	14 (28)
Vaccines have no side effects.	7 (14)
I had other reasons to receive the vaccine.	6 (12)

**Table 3** Unvaccinated Questionnaire

Phrase	Agreed (%)
I was worried about the side effects of the vaccine.	102 (58)
I was waiting to wait and see if the vaccine was safe.	28 (15.9)
I did not trust the COVID-19 vaccine.	35 (19.9)
I believe in the vaccination of COVID-19, but I was not satisfied with the proposed vaccines.	13 (7.4)
At the time of receiving the vaccine, in my opinion, other people had priority in receiving the vaccine.	4 (2.3)
I did not trust the vaccine preparation process.	9 (5.1)
I did not know if the vaccine is effective or not.	30 (17)
The COVID19 vaccine is more dangerous than the COVID19 disease itself.	22 (12.5)
I did not believe that my child needed a vaccine.	22 (12.5)
I did not like the vaccine.	13 (7.4)
The vaccine did not help my child.	15 (8.5)
My child was not at risk of contracting COVID-19, so I did not get the vaccine.	12 (6.8)
My child's doctor did not advise me to get the vaccine.	22 (12.5)
My child's doctor advised not to inject the vaccine.	8 (4.5)
Vaccines are made to earn financial income for production and distribution companies.	3 (1.7)
COVID-19 is not a serious disease.	4 (2.3)
Natural immunity against COVID-19 (through getting infection) lasts longer.	3 (1.7)
My child was infected with COVID-19 and did not need to receive a vaccine.	6 (3.4)
Instead of receiving the vaccine, we used masks or other protective methods.	9 (5.1)
My child has not been vaccinated for medical reasons.	4 (2.3)
I had other reasons for not getting the vaccine.	20 (11.4)
Have a plan to get the child COVID-19 vaccine	<b>Yes (%)</b> 22 (17.2)

**Table 4** Unvaccinated Questionnaire

Variable	P-value	Adjusted OR	CI
Age	0.023	1.05	1.02–1.09
History of hospitalization of the child due to COVID-19	0.006	2.15	1.23–3.75
History of hospitalization of family members due to COVID-19	0.005	1.80	1.18–2.75

In contrast, our study found that a history of COVID-19 infection in family members or the child did not significantly influence parents' decisions to vaccinate their children. This finding differs from other international studies, such as those conducted in the United States, where parents of children who had previously contracted COVID-19 were more likely to vaccinate their children, perceiving the disease as a greater threat [20, 21]. This discrepancy may stem from differences in public health messaging, perceived risk, or healthcare access in Iran compared to other countries.

Older children were vaccinated at higher rates compared to younger ones. This could reflect parental

uncertainty regarding the safety of vaccinating younger children or perceived lower risks of severe disease in this age group. Public health messaging should focus on reassuring parents about the safety and importance of vaccinating children of all eligible ages.

Past COVID-19 infection in family members or the child did not significantly influence parents' decision to vaccinate their children. This finding was in contrast to the findings of a previous study with a higher rate of vaccination among those whose children had a previous COVID-19 infection [18]. According to our finding of unvaccinated participants, 12.5% of parents believed that the COVID-19 vaccine is more dangerous than its infection, 15.9% were waiting for the safety confirmations of vaccines, 19.9% did not trust the vaccine, and 58% were worried about the side effects. These findings might be the possible reason for high rates of non-vaccination even after COVID-19 infection. There was no hospitalization due to COVID-19 infection in the vaccinated group, while this rate was significantly higher in the unvaccinated (13.5%). This finding strongly suggests the protective effects of COVID-19 vaccination for children, which was previously confirmed by a systematic review of the mRNA vaccines to have 90.7–100% effectiveness in preventing the infection in pediatrics

and adolescents [22]. This finding is also confirmed in a larger and more recent systematic review [23].

An important finding that is mostly discussed in similar articles is the parents' education level. We found no correlation for fathers' education, but when evaluating the linear-by-linear association of the mother's education, there was a significantly higher trend of vaccination in participants of mothers with higher education levels. This finding was aligned with previous studies' findings, where higher education levels of mothers were associated with lower risks of vaccine hesitancy [18, 24]. However, the study conducted by Sarbakhsh et al. [18] found a notable association between the educational attainment of fathers and their children's vaccination status. This could be attributed to cultural disparities between the individual in charge of making decisions for the youngster.

We found that families with both parents vaccinated are more likely to vaccinate their children. This association was weaker when only one of the parents was vaccinated against COVID-19. This indicates stronger health beliefs among parents who vaccinate themselves and, therefore, a greater likelihood of getting their children vaccinated.

A significant finding is the correlation between the vaccination status of parents and their willingness to vaccinate their children. Parents who were vaccinated against COVID-19 themselves were more likely to have their children vaccinated. This relationship highlights the critical role of parental attitudes and behaviors in influencing vaccination decisions for their children. Families with both parents vaccinated exhibited the highest rates of child vaccination, suggesting a family-wide acceptance of the vaccine positively impacts children's vaccination. This is in line with existing literature indicating that parents' personal acceptance of vaccines strongly predicts their likelihood of vaccinating their children [25].

The primary reasons cited by parents for not vaccinating their children included concerns about vaccine side effects, lack of trust in the vaccine, and a wait-and-see approach regarding vaccine safety and efficacy. These concerns were significantly more pronounced among parents of unvaccinated children. Addressing these fears through transparent communication and evidence-based information about vaccine safety and effectiveness is crucial for increasing vaccination rates. Misinformation about vaccine safety remains a major barrier to vaccine acceptance, as observed in other studies, which highlight the significant role of false information in shaping parental concerns [14]. Similar to our findings, a study in Turkey identified that healthcare workers were significantly more willing to vaccinate their children against COVID-19, likely due to their firsthand experiences with the

pandemic and increased awareness of the benefits and safety of the vaccine [26].

According to our findings, the top-rated reasons for vaccination were feeling safe and preventing serious infections. Only 14% of parents believe that the vaccine has no side effects. These findings, along with demographic differences between the two groups, suggest important findings: Parents with higher education levels tend to vaccinate their children and themselves more often. The parents who vaccinated their children were aware of the possible side effects of vaccination, but their belief in the overall safety and preventive potential of the vaccine lessened their fear of the possible side effects. This superiority of confidence was seen in those with higher education levels, higher trust in the country's healthcare system, and those with higher information about the seriousness of the COVID-19 infection compared to the unvaccinated group. Global trends have identified similar concerns, with parental education and healthcare trust emerging as significant factors in vaccine hesitancy [27]. Parents often view COVID-19 vaccines with more skepticism compared to routine childhood immunizations, citing concerns about their novelty and safety, which has been observed in multiple studies, including those examining the global context [28].

The fear of side effects was superior to all other concerns among those who did not vaccinate their children. More than half of the unvaccinated children's parents reported this finding. The next reasons were a lack of trust in the vaccine's safety, being unsure about the efficacy of vaccines regardless of their brand, and wrong beliefs about the higher risks of vaccine side effects rather than the COVID-19 infection itself. Only 16% of the vaccinated group had recommendations from their physician to get their child vaccinated, and 12.2% in the unvaccinated group had reported one reason to be no recommendations from their child's doctor. All of these findings were less than 20% of the reasons for not getting vaccinated. This indicates that the most important reason is the fear of the vaccine's side effects, with misinformation about the safety or efficacy of the vaccine.

### Limitations

This study has several limitations that should be considered when interpreting its findings. First, the cross-sectional design restricts the ability to infer causal relationships between identified predictors and vaccination behaviors. Longitudinal studies are needed to better understand how parental attitudes and behaviors evolve over time, particularly in response to changing public health information about COVID-19 and vaccines.

Second, the study relied on self-reported data, which is inherently subject to recall bias and social desirability

bias. Participants may have underreported vaccine hesitancy or overstated their adherence to public health recommendations due to perceived societal expectations. While the anonymity of responses and neutral phrasing in the questionnaire aimed to mitigate these biases, their influence cannot be entirely eliminated.

Third, the study was conducted in a single urban tertiary care center in Tehran, potentially limiting its generalizability to rural populations or regions with differing socioeconomic or cultural contexts. Factors such as healthcare accessibility and trust in public health systems may vary significantly across these settings, warranting further research to explore these dynamics in more diverse populations.

Lastly, the exclusion of children with chronic illnesses was necessary to maintain a homogeneous sample but may have excluded a subset of the population with unique considerations influencing vaccination decisions. Future research should consider including these groups to provide a more comprehensive understanding of vaccine hesitancy in all pediatric demographics.

Despite these limitations, the study provides valuable insights into the factors influencing COVID-19 vaccine acceptance and hesitancy among Iranian parents, forming a strong foundation for targeted public health interventions.

### Strengths

The study includes a wide range of variables such as demographics, vaccination status, parental attitudes, and previous COVID-19 experiences. This comprehensive approach allows for a thorough understanding of the factors influencing vaccine acceptance and hesitancy. As a face-to-face interactions allow researchers to build a stronger rapport with parents. This personal connection can lead to more honest and detailed responses about sensitive topics such as vaccination beliefs and practices. With a sample size of 226 participants from one of the most referral pediatric center in Tehran, the study provides a solid base for statistical analysis. This helps in achieving more reliable and generalizable results.

### Public Health implications

The findings of this study offer critical insights into designing effective public health strategies to address vaccine hesitancy for children among Iranian parents. To improve vaccination rates, efforts should focus on the following key areas:

#### 1- Educational campaigns

Tailored educational programs should aim to address parental concerns regarding vaccine safety and efficacy. Providing clear, evidence-based information through

trusted channels, such as healthcare providers and community leaders, can help dispel myths and reduce misinformation.

#### 2- Building Trust in Healthcare systems

Strengthening public trust in healthcare institutions is crucial. Transparent communication about vaccine development, approval processes, and potential side effects can help alleviate parental doubts. Engaging cultural leaders in outreach efforts may further enhance trust and acceptance.

#### 3- Targeted interventions for hesitant groups

Specific interventions targeting parents with lower education levels, younger children, or previous negative experiences with healthcare systems should be prioritized. Outreach programs that leverage digital media, workshops, and school-based initiatives can effectively reach these groups.

#### 4- Emphasizing the protective role of vaccines

Public messaging should emphasize the protective benefits of vaccination in preventing severe illness and reducing hospitalization rates, particularly among children. Real-world evidence, including data from this study, can be used to highlight the tangible benefits of immunization.

### Conclusion

The study identifies key factors influencing vaccine acceptance and hesitancy among parents in Tehran, Iran, with parental education, child age, and history of COVID-19 hospitalization as significant predictors of vaccination status. However, concerns about vaccine safety and distrust in healthcare systems remain major barriers. To address these issues, public health strategies should focus on tailored educational campaigns, countering misinformation, and building trust in healthcare systems. Community-based interventions, involving trusted local figures and healthcare providers, can also help address cultural concerns and improve vaccine uptake among hesitant parents, particularly those of younger children. These efforts are crucial for increasing vaccination rates and promoting better public health outcomes.

### Supplementary Information

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Supplementary Material 1.

Supplementary Material 2.

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### Authors' contributions

M.G conceptualized the study. S.G and Z.Z conducted the data analysis. E.H.E.M, S.M, M.S.K., R.M., P.A., and R.Z contributed to the data collection. S.G and M.G provided critical revisions to the manuscript. M.G supervised the project. S.G. and F.A. drafted the initial manuscript. All authors reviewed and approved the final manuscript.

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### Data availability

The data supporting the results of this manuscript, "Factors Associated with COVID-19 Vaccine Acceptance and Hesitancy in Children: A Comprehensive Survey," are included within the manuscript and supplementary information files. The data are provided as tables, figures, and detailed descriptions in the methods and results sections. For any additional data requests or inquiries, please contact the corresponding author.

### Declarations

#### Competing interests

The authors declare no competing interests.

#### Ethics approval and consent to participate

Approval was obtained from the Tehran University of Medical Sciences Ethics Committee (Approval ID: IR.TUMS.REC.1402.047).

#### Informed consent

to participate was obtained verbally from all literate participants. For illiterate participants, informed consent was obtained from their legal guardians. Participation in the study was entirely voluntary, and participants were informed that they could withdraw at any time without any consequences. No information was collected from participants who did not provide consent.

#### Consent for publication

Not applicable.

#### Competing interests

The authors declare no competing interests.

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