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RESEARCH ARTICLE

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Respiratory syncytial virus immunization with nirsevimab: Acceptance and satisfaction assessment in infants and risk groups in the region of Murcia (Spain)

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ABSTRACT

Respiratory syncytial virus (RSV) is a leading cause of respiratory infections in infants under two years of age, often resulting in bronchiolitis and pneumonia, which contribute to high hospitalization rates. The recent approval of nirsevimab, a long-acting monoclonal antibody, has provided an immunization alternative for infants, addressing the substantial burden of RSV. This study aimed to evaluate acceptance and satisfaction among parents or legal guardians of infants who were candidates for immunization with nirsevimab in the Region of Murcia (Spain) during the 2023–2024 campaign. A cross-sectional survey, encompassing 1692 parents of immunized infants and 219 of non-immunized infants, revealed a high acceptance rate for nirsevimab, with 87% of parents indicating willingness to immunize a future child and 86.6% willing to recommend it. Concerns about safety and side effects were the primary reasons for hesitation among parents who did not immunize their infants. These findings underscore the importance of enhancing educational efforts in future campaigns to address safety concerns, thereby supporting broader RSV immunization coverage in the pediatric population.

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Introduction

Respiratory syncytial virus (RSV) is the leading cause of hospitalization in infants under 2 years of age, particularly due to bronchiolitis and pneumonia.[1,2] Globally, RSV affects approximately 64 million people annually and result in approximately 160,000 deaths.[3] The virus typically follows a seasonal pattern and circulates between October and March.[4–7] Studies suggest that one in three infants develops bronchiolitis in their first year of life, although all infants are vulnerable to severe RSV infection due to their underdeveloped immune systems and small airways.[8–10] Moreover, early-life RSV infection is linked to long-term respiratory issues, such as asthma, which increase respiratory morbidity into adulthood.[11–14]

The burden of RSV infection is substantial in Spain. In 2023, hospital admissions potentially associated with RSV were estimated to cost the healthcare system €87.1 million annually. During the 2022–2023 season, hospitalization rates increased across nearly all age groups, with the highest rates among infants aged 0–5 months, accounting for 72% of all respiratory hospitalizations.[15–17] Hospitalization rates in Spain have been slightly higher than those in countries such as Scotland, England, Finland, and the Netherlands, particularly in infants aged 3–6 months (3.34/1000 persons/month).[18] Notably, 98% of the infants hospitalized for RSV in Spain were previously healthy, and over half were born outside the traditional RSV season, underscoring the unpredictable nature of the virus and the need for timely interventions, regardless of the child's vulnerability.[19,20]

Until 2022, the only preventive measure available for RSV was the monoclonal antibody palivizumab, which was reserved for high-risk groups.[21] However, on October 31, 2022, the European Medicines Agency approved nirsevimab, a long-acting monoclonal antibody, to prevent RSV-related lower respiratory tract infections. Nirsevimab demonstrated a favorable safety profile and provided protection for at least five months after a single dose.[22,23] This, together with the significant burden of RSV in the pediatric population, prompted the Spanish National Immunization Technical Advisory Group to recommend nirsevimab for the 2023–2024 season, targeting all infants under 6 months of age born between April 1, 2023, and March 31, 2024, as well as high-risk infants up to 24 months old.[12]

Spain was among the first countries globally to recommend nirsevimab for widespread use during the 2023–2024 season,[24,25] joining Luxembourg,[26] the United States of America,[27] and France.[28] Immunization coverage in Spain reached 92% among newborns and 88% among infants born before the season, with no new safety concerns reported.[7] The Region of Murcia, one of Spain's 17 autonomous communities with competences in health and vaccination programs, initiated its campaign on September 25, 2023, achieving high coverage rates (93.1% for infants born during the campaign

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and 87.7% for those born before the campaign)[29] and reducing RSV-associated hospitalizations by 86.9% in infants younger than 9 months.[30] Therefore, the decision was made to continue the RSV immunization strategy in Spain for the 2024–2025 season.[7]

Despite the campaign's success, little is known about parental attitudes toward nirsevimab.[31] Understanding these attitudes is crucial for improving communication between families and healthcare professionals (HCPs), as well as public health authorities, in future campaigns. Therefore, the principal objective of this study was to assess the acceptance and satisfaction of parents or legal guardians whose infants received nirsevimab and to explore the reasons some parents declined immunization despite the risks of RSV. The secondary objective was to describe prior knowledge of RSV, sources of information, preferences for alternative RSV prevention strategies, and factors influencing immunization decisions among parents of both immunized and non-immunized infants.

Materials and methods

Study design and data acquisition

A descriptive, observational, cross-sectional, retrospective study was performed on a sample of parents or legal guardians from the target population of the 2023–2024 RSV campaign in the Region of Murcia (Spain). This population included infants aged ≤6 months, residing in the Region of Murcia, born between April 1, 2023, and March 31, 2024, including both healthy infants and those at high-risk of severe RSV disease.[32] Participants were required to have a mobile phone number registered in their file. Questionnaires from participants who provided incorrectly responses regarding their child's date of birth or those with children older than 48 months of age at the end of the data collection period were excluded. Infants listed in the population database of the Region of Murcia were grouped as immunized/non-immunized based on their immunization status available in the VACUSAN, the regional vaccination registry information system.

Between September 28, 2023, and June 1, 2024, on the seventh day following the administration of nirsevimab, parents of immunized infants received a mobile text message with a link to an electronic survey. This survey collected socio-demographic data, as well as information on their degree of satisfaction and acceptance following the administration of the immunizing product (Supplementary Table S1).

Additionally, between April 30, 2024, and July 21, 2024, after the completion of the RSV immunization campaign with nirsevimab, a new survey was sent to parents or legal guardians of non-immunized infants, to collect socio-demographic data and reasons for not administering nirsevimab (Supplementary Table S2). However, approximately halfway through the second data collection period, it was observed that the number of responses obtained via text message from parents of non-immunized infants was low, and the response rate was not comparable to that of the immunized group. Therefore, data collection for this group continued via telephone interviews, which accounted for 46.72% of the responses.

Study endpoints

The primary endpoints were parental acceptance and satisfaction with nirsevimab immunization. To evaluate this aspects, parents were asked about the following: (1) their reasons for choosing nirsevimab immunization, (2) their overall satisfaction with the immunization (measured with a Likert scale where 1 represents the lowest possible score and 5 the highest), (3) their intention to immunize future children, and (4) their reasons for not recommending immunization.

The secondary endpoints included describing prior knowledge of RSV, sources of information (measured on a scale where 1 represents the least important and 7 represents the primary source of information[33]), vaccination history, preferences for alternative RSV prevention strategies, and analysis of factors influencing immunization decisions, among parents of both immunized and non-immunized infants. All secondary variables are described in Supplementary Table S3.

Statistical analysis

Socio-demographic data and other baseline characteristics of parents or legal guardians were described using descriptive statistics. Continuous variables are expressed as means, medians, and measures of dispersion (standard deviation, range, and interquartile range). Categorical variables are described as absolute and relative frequencies. Missing data were excluded when calculating the percentages. Significant differences between the immunized and non-immunized groups were evaluated using the Chi-square test. A contrast of means was also performed to compare the variable of rank of source of information on vaccines/immunizations from least to most important using the Student's t-test.

To analyze the potential factors influencing the decision to immunize children, a univariate logistic regression model was used, considering socio-demographic characteristics and vaccination awareness as potential factors. Significant variables from the univariate analysis ($p < .10$) were included in the multivariate logistic regression model using backward selection. A p-value <.05 was considered statistically significant in all hypothesis tests. The analysis was performed using the SAS v9.4 software (SAS Institute Inc, Cary, United States of America).

Ethics

The study was conducted in accordance with the "Note for Guidance on Good Clinical Practice" of May 1, 1996, the Royal Decree of February 2004, and the most recent Declaration of Helsinki. This study was approved by the Ethics Committee for Research with Medicines of Area 1-Hospital Clínico Universitario Virgen de la Arrixaca in August 2023 (code 2023-9-3-HCUVA). All participants were informed of the purpose for conducting the study and were notified that the completion of the form was voluntary and anonymous. The

first mandatory question required informed consent, regardless of whether the questionnaire was filled electronically or by telephone.

Results

Study population

A total of 12,037 questionnaires were sent out, 10,584 to the parents or guardians of immunized infants (87.93% of all questionnaires) between September 28, 2023 and June 1, 2024, and 1,453 (12.07%) to the parents or guardians of non-immunized ones, between April 20, 2024 and July 21, 2024. Of the 10,584 questionnaires sent to parents of immunized infants, 1700 responses were obtained (16.06% acceptance rate), with eight excluded as invalid (four due to incorrect response regarding the child's age and four due to the children being older than 48 months as of May 3, 2024), resulting in 1692 valid responses. Of the 1,453 questionnaires sent to parents of non-immunized infants, 228 responses were obtained (15.69% acceptance rate), of which 219 were valid (seven and two were invalid due to incorrect responses regarding the child's age and children being older than 48 months as of May 3, 2024, respectively). Therefore, the total number of valid responses was 1,911, with 88.5% from parents of immunized infants and 11.5% from parents of non-immunized infants.

The immunized infants had an average age of 2.3 months (range: 0–48 months), whereas the non-immunized infants had an average age of 9.6 months (range: 0–17 months). Regarding birth details, 8.3% of the immunized infants were premature (<35 weeks) compared with 11.4% of the non-immunized infants. Among the immunized and non-immunized infants, 50.0% and 55.7% had siblings, 3.3% and 3.2% had at least one risk condition, and 48.8%/37.4% ($p = .002$), respectively, had received a vaccine not funded by public healthcare. In the immunized infants with a risk condition, prematurity was the most common, present in 67.9% of cases (vs 28.6% in the non-immunized group), whereas respiratory illness was the most common among non-immunized infants, affecting significantly more non-immunized infants compared to the immunized infants (57.1% vs 12.5%; $p = .014$). Socio-demographic data of all infants are presented in Supplementary Table S4.

Analysis of socio-demographic data of the parents of immunized and non-immunized infants showed that more than half of the respondents (66.7% and 56.6%, respectively) were between 30 and 39 years of age. The majority were male (84.5% and 76.7%, respectively) and Spanish (83.7% and 66.7%, respectively). Among the parents of immunized infants, 60.2% had a university education, and 49.9% were vaccinated against influenza in the previous campaign. In contrast, 36.1% of parents of non-immunized infants had a university education, and 21.5% were vaccinated against influenza in the previous campaign (Supplementary Table S5).

Primary endpoint

Acceptance and satisfaction with nirsevimab

When assessing the level of acceptance and satisfaction among parents regarding RSV immunization, 90.2% of parents chose to immunize their children to protect them at the age when they were most susceptible to RSV, whereas only 15.2% chose immunization because they considered it effective and safe (Figure 1 and Supplementary Table S6). After immunization, 45.4% of parents were completely satisfied with nirsevimab, 37.8% were very satisfied, and 13.7% were moderately satisfied. Among all the parents of immunized infants, 87.0% indicated that they would administer nirsevimab again for a future child, and the majority (86.6%) recommended it. However, 1.71% of the parents of immunized infants stated that they would not administer or recommend nirsevimab. The reasons cited for this decision included concerns about efficacy (58.6%), adverse effects (62.1%), and the belief that other preventive options were available (44.8%) (Table 1).

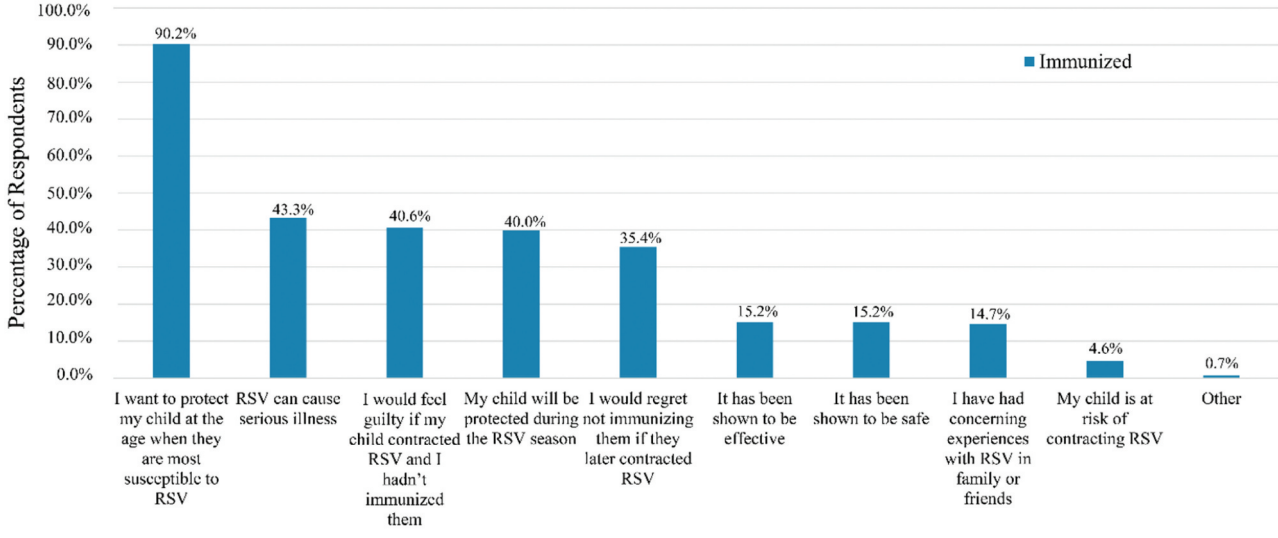

Figure 1. Reasons for acceptance of nirsevimab among parents of immunized infants. RSV, respiratory syncytial virus.

Table 1. Satisfaction with nirsevimab.

	Immunized $N = 1692$
Satisfaction with the administration of nirsevimab, n (%)	
Not at all satisfied	14 (0.8%)
A little satisfied	37 (2.2%)
Moderately satisfied	232 (13.7%)
Very satisfied	640 (37.8%)
Completely satisfied	769 (45.4%)
If you had another child, would you administer nirsevimab again? n (%)	
Yes	1472 (87.0%)
No	23 (1.4%)
Maybe	197 (11.6%)
Would you recommend nirsevimab? n (%)	
Yes	1466 (86.6%)
No	16 (0.9%)
Maybe	210 (12.4%)
Reasons for not administering again/recommending nirsevimab*, n (%)	29 (1.71%)
I consider it ineffective	17 (58.6%)
Due to side effects	18 (62.1%)
I believe that there are other preventive options	13 (44.8%)
I do not consider RSV and bronchiolitis important	3 (10.3%)
Other reason	4 13.8%)

Data are presented as n (%), unless otherwise indicated.
*More than one answer was possible for each respondent ($N = 29$).

Secondary endpoints

Awareness of RSV, vaccines and immunizers

Of the total respondents, 73.8% of parents of immunized infants were aware of RSV compared with 59.8% of parents of non-immunized infants ($p < .0001$). Among the parents of immunized and non-immunized infants, 17.1% and 15.1% had prior experience with bronchiolitis, respectively, with 23.2% and 26.2% of the cases requiring hospital care (Table 2).

Regarding parental awareness of vaccines and immunizers, the source of information about vaccines or immunizers that received the highest rank was the HCP of reference, with a similar average score among parents of immunized vs non-immunized infants (5.0 vs. 5.1 out of 7; $p = .452$). This was followed by public health campaigns (4.1 vs. 4.2 out of 7; $p = .402$). Nonetheless, significantly more parents of immunized infants reported having knowledge about vaccines and immunizers through family and friends (average score of 3.8 vs. 3.3, respectively; $p = .001$), internet researches (3.47 vs. 3.08; $p = .001$), specialized blogs on childcare (2.65 vs. 2.55; $p = .015$), and specialized journals (2.41 vs. 2.29; $p = .006$) (Table 3). Finally, 70.1% of parents of immunized infants reported feeling well-informed, compared with 59.8% of parents of non-immunized infants (Table 3).

Information on nirsevimab and the awareness campaign

When asked about the primary source of information regarding the nirsevimab immunization campaign, the majority of parents of immunized and non-immunized infants reported knowing about having known nirsevimab through their HCP of reference (61.0% vs. 49.3%; $p = .001$), followed by Public Health or health authorities (35.4% vs. 40.2%; $p = .165$), family and friends (20.4% vs. 14.6%; $p = .043$), media (13.9% vs. 5.9%; $p = .001$), social media (11.4% vs. 8.7%; $p = .226$), and printed material at health centers (11.3% vs. 4.6%; $p = .002$). More parents of non-immunized infants appeared to have forgotten the source of information (25.1%) compared with 2.6% of parents of immunized infants ($p < .0001$), or reported learning about nirsevimab through health blogs (5.0% vs. 3.8%, respectively; $p = .400$) or parenting books (1.8% vs. 0.4%; $p = .009$) (Figure 2).

Finally, parents were asked for their opinions regarding the most appropriate time to receive information about RSV and its prevention. It was observed that 56.1% of parents of immunized infants and 40.6% of parents of non-immunized infants stated that the best time to receive information was during pregnancy. On the other hand, 30.3% and 37.0% of parents of infants and non-immunized infants, respectively, preferred receiving information during the child's first health checkup, and 6.3% and 11.0%, respectively, at the time of attempting to become pregnant. When parents were asked about their preferences regarding nirsevimab immunization versus other immunization options (e.g., vaccination of the pregnant mother against RSV), 44.0% of parents of immunized infants indicated no preferences between options, 32.4% preferred immunizing the infants, and 23.6% favored vaccinating the mother. Interestingly, among parents of non-immunized infants, 60.3% preferred vaccinating the mother, 27.4%

Table 2. Parents' awareness of RSV.

	Total $N = 1911$	Immunized $N = 1692$	Non-immunized $N = 219$	P value
Awareness of RSV existence	1380 (72.2%)	1249 (73.8%)	131 (59.8%)	<.001
Previous experiences with bronchiolitis in other children	322 (16.8%)	289 (17.1%)	33 (15.1%)	.454
Hospital care required	83 (23.7%)	67 (23.2%)	16 (26.2%)	.611

Data are presented as n (%), unless otherwise indicated.
RSV, respiratory syncytial virus.

Table 3. Parental knowledge about vaccines/immunizers.

	Total $N = 1911$	Immunized $N = 1692$	Non-immunized $N = 219$	P value
Primary source of information on vaccines				
HCP of reference				.452
Mean (SD)	4.99 (2.22)	4.97 (2.21)	5.08 (2.31)	
95% CI	(4.89, 5.09)	(4.87, 5.08)	(4.77, 5.39)	
Range (Min, Max)	(1.00, 7.00)	(1.00, 7.00)	(1.00, 7.00)	
Median (IQR)	6.0 (3.0, 7.0)	6.0 (3.0, 7.0)	6.0 (3.0, 7.0)	
Public health campaigns				.402
Mean (SD)	4.15 (2.14)	4.14 (2.11)	4.23 (2.41)	
95% CI	(4.05, 4.25)	(4.04, 4.24)	(3.91, 4.55)	
Range (Min, Max)	(1.00, 7.00)	(1.00, 7.00)	(1.00, 7.00)	
Median (IQR)	4.0 (2.0, 6.0)	4.0 (2.0, 6.0)	5.0 (2.0, 7.0)	
Internet searches				**.001**
Mean (SD)	3.43 (2.07)	3.47 (2.04)	3.08 (2.30)	
95% CI	(3.34, 3.52)	(3.38, 3.57)	(2.77, 3.38)	
Range (Min, Max)	(1.00, 7.00)	(1.00, 7.00)	(1.00, 7.00)	
Median (IQR)	3.0 (1.0, 5.0)	3.0 (2.0, 5.0)	2.0 (1.0, 5.0)	
Specialized blogs on child care				**.015**
Mean (SD)	2.64 (1.89)	2.65 (1.85)	2.55 (2.19)	
95% CI	(2.55, 2.72)	(2.56, 2.74)	(2.26, 2.84)	
Range (Min, Max)	(1.00, 7.00)	(1.00, 7.00)	(1.00, 7.00)	
Median (IQR)	2.0 (1.0, 4.0)	2.0 (1.0, 4.0)	1.0 (1.0, 4.0)	
Social Media (Facebook, WhatsApp, etc. . .)				.189
Mean (SD)	2.81 (1.99)	2.81 (1.95)	2.81 (2.26)	
95% CI	(2.72, 2.90)	(2.72, 2.90)	(2.51, 3.11)	
Range (Min, Max)	(1.00, 7.00)	(1.00, 7.00)	(1.00, 7.00)	
Median (IQR)	2.0 (1.0, 4.0)	2.0 (1.0, 4.0)	1.0 (1.0, 5.0)	
Specialized journals				**.006**
Mean (SD)	2.40 (1.83)	2.41 (1.80)	2.29 (2.05)	
95% CI	(2.32, 2.48)	(2.33, 2.50)	(2.01, 2.56)	
Range (Min, Max)	(1.00, 7.00)	(1.00, 7.00)	(1.00, 7.00)	
Median (IQR)	1.0 (1.0, 3.0)	2.0 (1.0, 3.0)	1.0 (1.0, 3.0)	
Family and friends				**.001**
Mean (SD)	3.72 (2.09)	3.77 (2.06)	3.32 (2.27)	
95% CI	(3.63, 3.81)	(3.67, 3.87)	(3.02, 3.63)	
Range (Min, Max)	(1.00, 7.00)	(1.00, 7.00)	(1.00, 7.00)	
Median (IQR)	3.0 (2.0, 6.0)	3.0 (2.0, 6.0)	3.0 (1.0, 5.0)	
Satisfaction with information on vaccines				**<.001**
I don't feel informed at all	139 (7.3%)	93 (5.5%)	46 (21.0%)	
I feel insufficiently informed	454 (23.8%)	412 (24.3%)	42 (19.2%)	
I feel well informed	963 (50.4%)	904 (53.4%)	59 (26.9%)	
I feel perfectly informed	355 (18.6%)	283 (16.7%)	72 (32.9%)	

The primary source of information on vaccines/immunizers was measured on a scale from 1 to 7, with 1 representing the least important and 7 indicating the primary source of information.

RSV, respiratory syncytial virus; SD, standard deviation; 95% CI, 95% confidence interval; IQR, interquartile range.

Student's t-test was performed to compare the rank of source of information on vaccines and immunizations. Satisfaction with information on vaccines was evaluated using the Chi-square test.

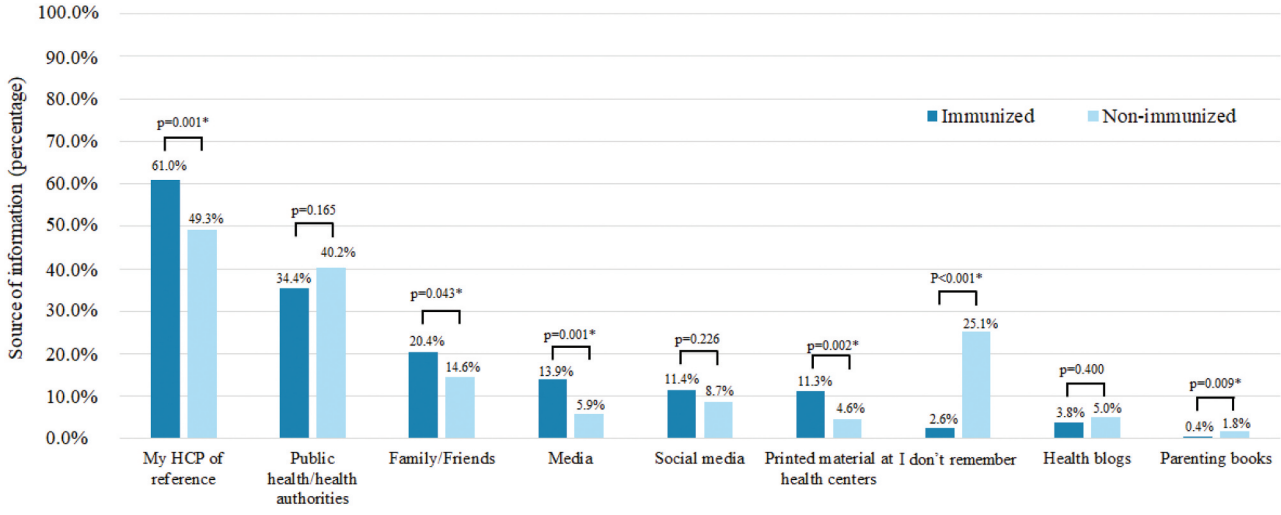

Figure 2. Sources of information on nirsevimab immunization. HCP, healthcare professional. *Statistically significant differences between parents of immunized and non-immunized infants ($p < .05$).

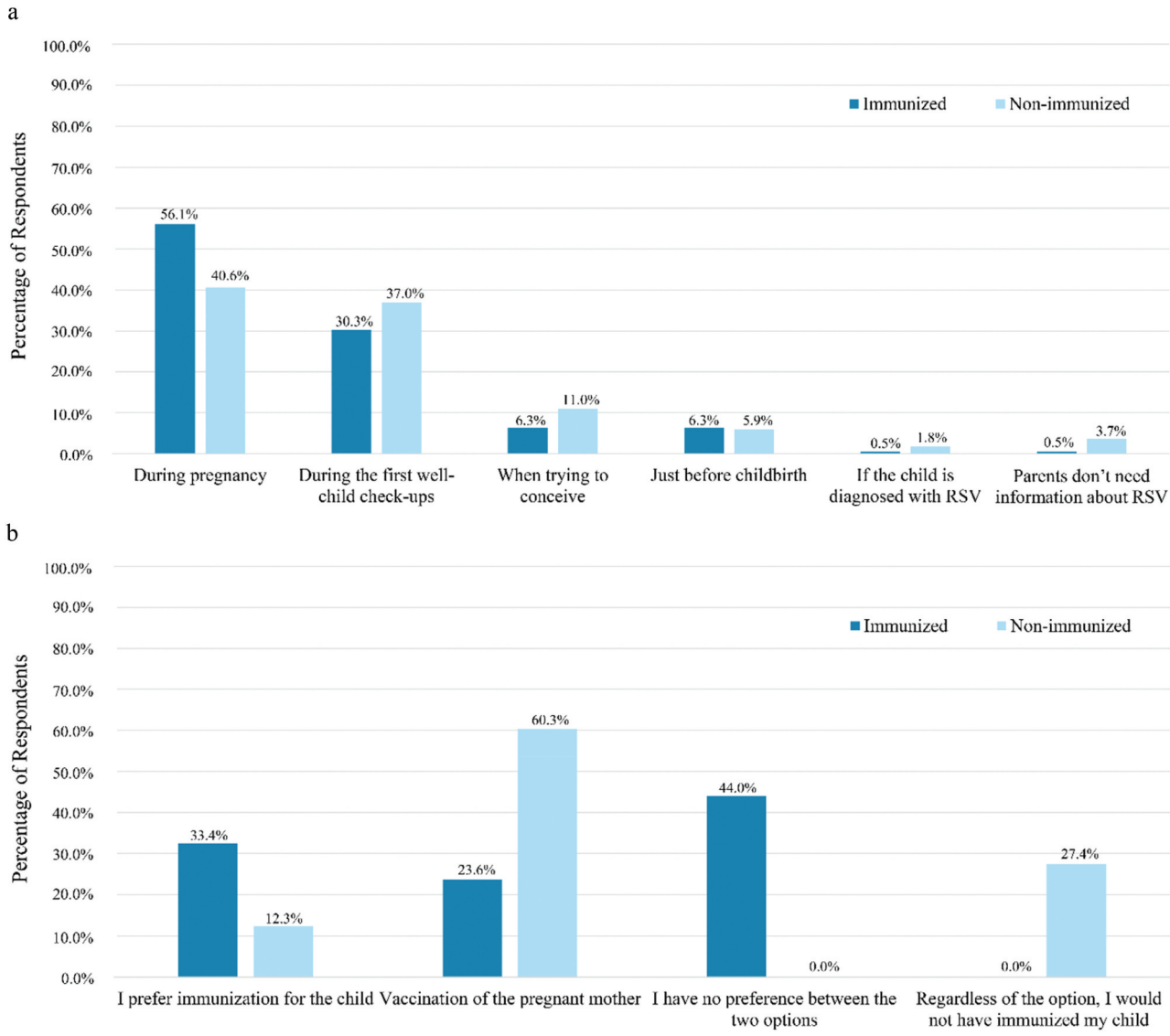

Figure 3. Parental responses regarding the optimal timing for receiving information about respiratory syncytial virus (RSV) and its prevention methods (a) and preferences for child protection if alternative immunization options were available (b).

responded that they would not immunize their children regardless of the option, and 12.3% preferred immunization for the infant (Figure 3a,b).

Nirsevimab administration details

Among parents of immunized infants ($n = 1692$), 70.7% were unaware of the administered dose of nirsevimab, whereas 18.0% identified it as the 50 mg dose of Beyfortus®, and 11.3% identified it as the 100 mg dose. A total of 52.4% of infants received nirsevimab at birth before maternal discharge, 36.9% after the first month of life, and 6.4% within the first month at a health center. Additionally, 82.4% of the immunized infants did not receive any vaccine on the same day (Table 4).

Reasons for nirsevimab refusal

The reasons from parents of non-immunized infants ($n = 219$) indicated that the primary reason for rejecting nirsevimab was concerns about safety or adverse effects (45.2%), followed by concerns about it being a new immunization (35.2%), and insufficient knowledge about RSV immunization (29.7%). Interestingly, 27.4% reported not having received information about the immunization campaign, 5.5% refused nirsevimab because their child had previously been diagnosed with bronchiolitis, 3.7% because they were advised by their pediatrician not to administer it, and only 0.9% because of a lack of doses at the healthcare center at the time of their visit (Table 5).

Factors influencing immunization decisions

A univariate logistic regression model was used to identify factors influencing parental immunization decisions. A multivariate logistic regression model was then performed using the univariate significant variables ($p < .10$; child's age; having siblings; receiving a non-publicly funded vaccine; guardian's age, sex, education, and nationality; prior knowledge of RSV; and main information sources such as the Internet and family). This multivariate logistic regression model with backward selection revealed several variables that had a significant impact on parents' decision to immunize or not: vaccination with a non-funded vaccine ($p < .001$), parents' nationality ($p = .030$), and education level ($p = .030$) (Table 6). For each

Table 4. Nirsevimab administration.

	Immunized $N = 1692$
Dose of nirsevimab administered to your child	
Beyfortus® 50 mg	304 (18.0%)
Beyfortus® 100 mg	191 (11.3%)
Do not know	1197 (70.7%)
When nirsevimab was received	
At birth before discharge from the maternity ward	887 (52.4%)
Within the first month of life at the health center or usual vaccination site	109 (6.4%)
After the first month of life at the health center or usual vaccination site	625 (36.9%)
In the hospital at 6 months of age	71 (4.2%)
On the day your child received nirsevimab, did he also receive any vaccine?	
Yes	298 (17.6%)
No	1394 (82.4%)

Data are presented as n (%), unless otherwise indicated.

Table 5. Reasons behind nirsevimab refusal.

	Non-Immunized $N = 219$	
	n(%)	95%CI
I am concerned about its safety or adverse effects	99 (45.2%)	(38.5–52.1)
I am concerned that it is a new immunization	77 (35.2%)	(28.9–41.9)
I do not know enough about this immunization against RSV	65 (29.7%)	(23.7–36.2)
I am concerned that it might not work or may not be effective enough	31 (14.2%)	(9.8–19.5)
I am concerned about the duration of its protection	23 (10.5%)	(6.8–15.3)
There are already many immunizations for children	44 (20.1%)	(15.0–26.0)
I do not know enough about RSV	51 (23.3%)	(17.9–29.5)
The risk of my child becoming seriously ill from RSV is low	37 (16.9%)	(12.2–22.5)
The risk of my child contracting RSV is low	33 (15.1%)	(10.6–20.5)
I do not think it is important to protect my child against RSV	15 (6.8%)	(3.9–11.1)
I have not received information about the campaign	60 (27.4%)	(21.6–33.8)
My child has previously had bronchiolitis due to RSV	12 (5.5%)	(2.9–9.4)
My child was hospitalized in an unstable condition, and I was advised to wait	8 (3.7%)	(1.6–7.1)
My child's pediatrician contraindicated it	8 (3.7%)	(1.6–7.1)
Over 6 months	10 (4.6%)	(2.2–8.2)
Lack of doses at the health center	2 (0.9%)	(0.1–3.3)
Other	2 (0.9%)	(0.1–3.3)

Data are presented as n (%), unless otherwise indicated.
More than one answer was possible for each respondent.

additional month of the child's age, there was a 44% lower probability of immunization (odds ratio [OR]: 0.66, 95% confidence interval [CI]: 0.63–0.69; $p < .001$). Furthermore, parents who had vaccinated with non-publicly funded vaccines were 152% more likely to immunize their child (OR: 2.52, 95% CI: 1.64–3.87; $p < .001$) (Table 6).

Discussion

Vaccination and immunization campaigns have several key advantages with profound public health impacts. Primarily, these initiatives rapidly increase immunization coverage, particularly in areas with limited healthcare infrastructure, leading to an immediate reductions in disease incidence. Campaigns also enable direct community access to vaccines, reaching populations in remote or underserved areas. In specific situations, such as outbreaks, they allow for swift immunization responses, minimizing disease transmission among high-risk groups.[34]

RSV is the leading cause of severe bronchiolitis-related respiratory illnesses in young infants.[17,35,36] Despite its severity, our previous study (conducted prior to the 2023–2024 nirsevimab immunization campaign in the Region of Murcia) revealed that while a large majority of parents recognized bronchiolitis, only 46.6% were aware of RSV, and only 11.2% knew about nirsevimab immunization.[31]

Following the campaign, our study showed that satisfaction rates among parents whose children received nirsevimab were high, with 83.2% feeling very to completely satisfied with the process. The top five reasons for immunizing their children were centered on the perceived concern about RSV infection and its severity. This concern among parents to protect their children against RSV has also been evidenced in a study in China where 70.6% of parents wanted to vaccinate their children against RSV.[37] Nonetheless, despite the campaign's success in achieving high coverage[32] and effectiveness, only 15.2% cited the demonstrated efficacy and safety as their primary reason for immunization.

Table 6. Factors influencing the parental decision on immunization.

Infants' immunization ($n = 1906$)	Univariate*		Multivariate**	
	OR (95%CI)	P value	OR (95%CI)	P value
Child Characteristics				
Child's age (months)	0.66 (0.64–0.70)	**<.001**	0.66 (0.63–0.69)	**<.001**
Prematurity	–	.172		
Having siblings	0.78 (0.59–1.04)	**.087**	–	.384
Chronic illness	–	.945		
Vaccinated with a non-publicly funded vaccine	1.57 (1.18–2.10)	**.002**	2.52 (1.64–3.87)	**<.001**
Parents/Legal guardians				
Parent's age (vs. 20–29 years)		**<.001**	–	.874
<20 years	–			
30–39 years	0.74 (0.21–12.79)			
40–49 years	–			
>50 years	–			
Parent's sex (male vs female)	0.63 (0.45–0.89)	**.009**	–	.904
Parent's nationality (vs. Spanish)		**<.001**		**.030**
African	0.13 (0.08–0.21)			
South American	–			
European	0.24 (0.12–0.47)			
Central American	4.57 (0.63–33.42)			
Parent's education (vs. University level)		**.001**		**.001**
Secondary	0.46 (0.34–0.63)			
Primary	0.18 (0.11–0.28)			
No education	0.07 (0.03–0.17)			
Prior knowledge of RSV	0.52 (0.39–0.69)	**<.001**	–	.671
Vaccination information (points)				
Primary healthcare professional[1]		.481		
Public health campaigns[1]		.504		
Internet[1]	1.11 (1.03–1.19)	**.006**	–	.750
Health blogs[1]		.313		
Social media[1]		.985		
Specialized journals[1]		.239		
Family[1]	1.11 (1.03–1.19)	**.004**	–	.063

OR, odds ratio; CI, confidence interval; RSV, respiratory syncytial virus.
*A univariate logistic regression model was performed to analyze factors that may influence immunization decision. For clarity, only the OR values of statistically significant factors are presented.
**Using the significant univariate factors ($p < .10$), a multivariate logistic regression model was performed to analyze the factors that ultimately influence knowledge of bronchiolitis.
[1]Scale of 1–7, where 1 indicates the least important vaccination information source and 7 indicates the primary source.

For parents who chose not to immunize their children (11.5% of the total sample), the five top reasons cited for refusal were related to insufficient knowledge and limited information regarding RSV and its immunization. These results strongly indicate that for the 2024–2025 season and future campaigns, it is essential to prioritize clear communication regarding the safety and efficacy of RSV immunization in outreach materials. Additionally, the most common reasons cited by parents of immunized infants for not opting to immunize again or not recommending RSV immunization were concerns about the perceived lack of efficacy after receiving nirsevimab. Although studies have shown that nirsevimab is approximately 83% effective in preventing RSV-related hospitalizations, the presence of different RSV subtypes circulating simultaneously and the transient immunity to RSV may contribute to the perceived or actual declines in immunization efficacy.[38,39] These results strongly highlight the importance of prioritizing clear communication on the safety and efficacy of RSV immunization in outreach materials for future campaigns using the Health Belief Model derived from the data in this study (Figure 4).

In this post-campaign study, parental awareness of RSV increased significantly (72.2%), compared with our previous data,[31] which can be attributed to the effects of the campaign. Parents of immunized infants were notably more knowledgeable about RSV ($p < .0001$), which could stem from various factors: 1) exposure to RSV-related information during the immunization process, 2) increased previous experiences with bronchiolitis cases in other children (17.1% vs. 15.1%), 3) higher satisfaction with general vaccine-related information (70.1% of parents of immunized infants felt well-informed, vs. 58.9% of parents of non-immunized infants), and 4) a higher percentage of parents with university education (60.2% vs. 36.1%). Satisfaction levels and educational background have previously been identified as factors that significantly enhance RSV awareness.[31] Interestingly, although the study of Lee Mortensen et al.[11] demonstrated that higher RSV awareness correlated with increased parental experience (siblings vs only child), the same was not observed in our data. We hypothesized that 1) inexperienced parents might feel more cautious and, therefore, more receptive to recommended immunization guidelines, prioritizing immunization to protect their only child; or 2) experienced parents may have more extensive social networks with other parents and, thus, increased exposure to varying perspectives on immunization, which could lead to encountering conflicting information and potentially causing hesitation.

Another point of interest in comparing parental responses before and after the campaign was the optimal timing for receiving information about RSV. According to Spanish

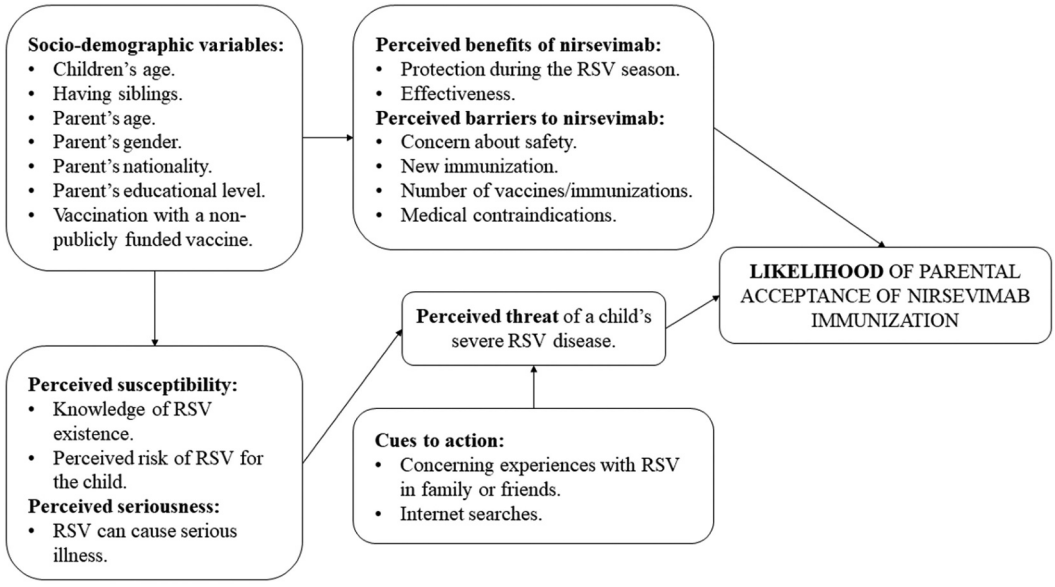

Figure 4. Health belief model (HBM) of parental acceptance of nirsevimab immunization.

guidelines, infants born during the RSV season (October to March) should receive immunization within 24–48 h of birth.[12] Similarly, in France, infants born from September 15, 2023, onwards are advised to receive nirsevimab before discharge from the maternity ward,[28] indicating that timing is critical in preventing severe RSV-related respiratory outcomes. Before the campaign, 42.1% of parents identified "after the birth of the first child" as the ideal time to receive RSV information.[31] However, in this study, 56.1% of parents of immunized infants believed that the ideal time was during pregnancy. Notably, 52.4% of immunizations occurred before discharge from the maternity ward, and 36.9% occurred during the first month of life, suggesting positive shifts in timing practices. Similarly, data from a recent study conducted in the Netherlands showed a high rate of acceptance of any RSV preventive strategy among pregnant women (87%).[40] However, 30.3% of the parents still believed that the ideal time to receive information was during the child's first check-ups. Data from the 2023–2024 campaign in the Region of Murcia revealed that, when infants born during the RSV season were not immunized at the maternity hospital, an average delay of 27.45 days was observed in receiving their nirsevimab immunization.[32] This underscores the continued need for additional educational efforts, not only postnatally but also earlier during the family planning process, to facilitate timely decision-making.

Regarding alternative RSV immunization, the maternal RSV vaccination has been approved by the Food and Drug Administration and European Medicines Agency.[41,42] Clinical data suggest that maternal RSV vaccination reduces the risk of RSV-related infant hospitalization by 68% and severe outcomes by 82% within the first three months and by 57% and 69%, respectively, within six months post-birth.[43] In our study, for most parents immunized infants, a near-equal preference was observed between child immunization and maternal vaccination (44%), suggesting flexibility in their approaches to achieve protection. Interestingly, 60.3% of parents of non-immunized infants preferred maternal vaccination, suggesting that indirect protection through maternal vaccination may be viewed as safer or more acceptable among parents hesitant to immunize. Meanwhile, 27.4% of the parents responded that they would not immunize their children under any circumstances. This reluctance may stem from limited knowledge about RSV (23.3%), a perceived low risk of infection (15.1%), and low perceived severity (16.9%). To address these concerns, robust early education on RSV risks and immunization safety should be implemented to reduce hesitancy. These findings also highlight the need to align parental decision-making with Spanish guidelines, that recommend immunizing the target population of infants regardless of private maternal vaccination during pregnancy.[12]

In the logistic regression, it was noteworthy that the administration of non-publicly funded vaccines was associated with a higher probability of receiving nirsevimab by the infant (OR 2.52 (1.64–3.87); $p < .001$). These data have already been associated with greater vaccination coverage in our region, particularly in new vaccination campaigns such as influenza vaccination for children under 5 years of age.[44] This is likely due to the increased awareness of the importance of vaccines and disease prevention through this tool, as well as the improved information provided by referring healthcare professionals

The results obtained showed a higher percentage of migrant population among parents of non-immunized infants compared with parents of immunized infants (33.3% vs. 16.3%), with a higher percentage being of Moroccan origin. This population may face a language barrier in understanding the information and, as a result, may be less likely to immunize their children. However, in the evaluation of the Region of Murcia campaign,[32] despite that significantly lower coverage of children of immigrants parents as compared with the national population, the difference was smaller among those born during the campaign. This may be due to the fact that immunization was carried out while the mother and baby were still admitted to the hospital prior to discharge. In contrast, immunized children born before the campaign were

immunized in health care centers, which are mostly open in the morning and may interfere with parents' work schedules, which poses an accessibility issue.

The limitations of this study include the substantial higher number of responses from parents who chose to immunize their children, reflecting the higher overall number of immunized versus non-immunized infants. Although the proportion of response rate in each group was similar, this may indicate a self-selection bias, as parents who opted to participate in the survey may have already had greater concerns about RSV. Furthermore, the inverse relationship between child age and increased likelihood of immunization (44% decrease in the likelihood of immunization for each additional month of age) may be a limitation due the study methodology itself. This is because the survey for parents of unvaccinated infants was distributed at the end of the campaign, capturing a higher mean age than the survey for vaccinated infants, which was distributed within seven days of vaccination. Additionally, there may be some uncertainty in responses to the question regarding the "Primary Source of Information on Vaccines," as family members or friends who provided vaccine-related information may also be HCP, not having been specifically asked about this aspect.

In conclusion, this study revealed high parental acceptance and satisfaction with nirsevimab during an immunization campaign conducted in the Region of Murcia during the 2023–2024 season, with most parents willing to recommend nirsevimab and immunize future children. However, hesitations persist, primarily driven by concerns regarding safety and side effects. These results suggest that, while the introduction of nirsevimab has been well received, there remains a need to enhance communication about its safety and efficacy to dispel doubts and increase coverage across broader populations.

As Spain was one of the first countries to implement this immunization strategy, these data can guide other countries in planning similar initiatives. Future campaigns should prioritize targeted educational strategies that address the remaining parental concerns thereby improving immunization coverage and reducing the RSV burden in the pediatric population. This would solidify the role of nirsevimab as a key tool in preventing this disease.

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Disclosure statement

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Data availability statement

The data presented in this study are available on request from the corresponding author.

Ethics approval statement

The study was conducted in accordance with the "Note for Guidance on Good Clinical Practice" of May 1, 1996, the Royal Decree of February 2004, and the most recent Declaration of Helsinki. This study was approved by the Ethics Committee for Clinical Research of Health Area 1-Hospital Clínico Universitario Virgen de la Arrixaca in August 2023 (code 2023-9-3-HCUVA). All participants were informed of the purpose for conducting the study and were notified that the completion of the form was voluntary and anonymous, thereby guaranteeing the respondent's privacy.

Participant consent statement

Informed consent was obtained from all participants involved in the study. The first mandatory question required informed consent, regardless of whether the questionnaire was filled electronically or by telephone.

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