Original research

Pan American Journal of Public Health

Unintended pregnancy and its impact on childhood rotavirus immunization in Peru

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Suggested citation Echaiz JF, Blas M, Kancherla V. Unintended pregnancy and its impact on childhood rotavirus immunization in Peru. Rev Panam Salud Publica. 2018;42:e96. https://doi.org/10.26633/RPSP.2018.96

ABSTRACT

Objective. *To examine the association between unintended pregnancy and inadequate rotavirus immunization in Peruvian children.*

Methods. *Utilizing cross-sectional observational data from the 2012 Demographic and Health Survey (DHS), logistic regression analysis was used to estimate adjusted odds ratios (aORs) and 95% confidence intervals (CIs) for the association between unintended pregnancy and inadequate rotavirus immunization among children.*

Results. *Of 9 620 pregnancies in the five years preceding the survey, 5 396 of them (56.1%) were reported as unintended, of which 2 981 were mistimed (30.9%) and 2 415 (25.1%) were unwanted. A total of 5 187 children (54.9%; 95% CI = 53.8%–56.1%) were recorded to have inadequate rotavirus immunization. Maternal literacy status was found to be a significant effect modifier of the association between pregnancy intention and rotavirus immunization (P value = 0.006). Among children born to illiterate mothers, unintended pregnancy was significantly associated with increased odds of inadequate rotavirus immunization (aOR = 2.6; 95% CI = 1.2–4.4), as compared to children from intended pregnancies. Deficient rotavirus immunization was significantly predicted by inadequate polio, pneumococcal, and influenza vaccinations; having a television in the household; and less maternal education. In contrast, having received breast-feeding education was protective against inadequate rotavirus immunization. Among literate mothers, there was no association between pregnancy intention and rotavirus immunization.*

Conclusion. *Our study provides evidence that improving literacy among mothers could increase rotavirus vaccination uptake among children from unintended pregnancies.*

Keywords Rotavirus; immunization; pregnancy, unplanned; Peru.

Rotavirus, which is an RNA virus, is the most common cause of severe diarrhea affecting children aged 5 years or less in the world (1). The most recent evidence from surveillance examining hospitalizations due to diarrhea in Latin American and the Caribbean, using standardized definitions and diagnostic assays by the Pan American Health Organization (PAHO) from 2005 to 2007, showed that the median percentage of positive stool specimens among 11 PAHO countries was 31.5% (range, 24%–47%) and that the mortality risk from rotavirus in children under the age of 5 was 1 in 2 874 (2). Peru was not part of the aforementioned surveillance. In 2004, the World Health Organization (WHO) had estimated the mortality due to rotavirus in Peru to be 691 child deaths, with a mortality rate of 23 deaths per 100 000

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children less than 5 years old (3). Rotavirus infection is a preventable public health concern. Timely rotavirus immunization is important for vaccine efficacy and also for herd immunity, yet data are lacking about rotavirus immunization compliance as well as factors associated with immunization practices in Peru.

The rotavirus vaccine coverage in Peru was estimated by the World Health Organization (WHO) and United Nations Children's Fund (UNICEF) at 41% in 2009 and increased to 75% in 2010, but these figures were low as compared to other countries in Latin America and the Caribbean (e.g., Bolivia (76%), Ecuador (97%), and Nicaragua (98%)) (3, 4). We found only one study in Peru that examined immunization schedule compliance, which found that low birthweight and late first dose were two factors that were significantly associated with low rotavirus immunization compliance (5).

Rotavirus vaccination practices have been studied in other low-income countries. Incomplete vaccinations (including incomplete rotavirus vaccination) in children less than 18 months of age have been found to be significantly associated with prematurity, malnutrition, inadequate housing, and poor prenatal care (6). Other risk factors found in other low-income populations are home delivery, lack of prenatal care, mother misperceptions on vaccine indications, no postnatal care, low maternal educational level, and young maternal age (7, 8).

Inadequate immunization of children continues to be a public health problem worldwide, especially in developing countries. In addition, unwanted pregnancy has been found to be associated with incomplete basic immunization of a child (9). However, the exact nature of the association between unintended pregnancy and inadequate rotavirus immunization has been largely underresearched, especially in low-income countries such as Peru.

The purpose of this study was to examine the association of self-reported pregnancy intention with inadequate rotavirus immunization, and to assess the effect of other sociodemographic and health factors on this association.

MATERIALS AND METHODS

We performed a secondary analysis of data from the Demographic and Health Survey (DHS) conducted in Peru between the months of March and December of 2012. The DHS is a nationally representative complex survey that uses stratification and sample weights. The Phase 6 Core Questionnaire was used in Peru for the year 2012. Subjects were selected in strata based on provincial location, and clusters of households were carefully chosen. The 2012 sample comprised 28 376 households, with 24 552 women between 15 and 49 years of age. A total of 27 488 households were interviewed and, of the total number of eligible women, 23 888 (97.3%) completed the interview.

The outcome of our study was inadequate rotavirus immunization, defined as either: i) a child older than 4 months of age at the time of the interview who had not received the recommended two doses of rotavirus vaccine or ii) a child 4 months or younger who had not received the first dose of the vaccine. The primary exposure of interest was unintended pregnancy (if the woman reported that at the time of her pregnancy with one of the children born in the last five years preceding the survey, and alive at the time of the survey, she either wanted to postpone it or did not want to become pregnant with more children at all).

Several potential covariables were examined, including history of other types of vaccinations, which were selected based on prior studies on important childhood immunizations (6, 7).

Inadequate polio immunization was defined as: i) lack of the recommended first dose of polio vaccine in a child younger than 4 months of age; ii) lack of the first or second doses in a child between 4 and 6 months of age; or iii) lack of any of the three doses of the polio vaccine in a child 6 months or older.

Inadequate Bacillus Calmette–Guérin (BCG) immunization was defined as a child older than 1 month of age at the time of the interview who had not received the recommended BCG vaccine.

The inadequate measles immunization variable refers to a child older than 12 months of age at the time of the interview who had not received the recommended first dose of measles vaccine or measles, mumps, and rubella (MMR) vaccine.

Inadequate influenza immunization was defined as a child older than 6 months of age at the time of the interview who had not received the recommended two doses of influenza vaccine.

Finally, inadequate pneumococcal immunization was defined as: i) a child less than 4 months of age at the time of the interview who had not received the recommended first dose of pneumococcal vaccine; ii) a child between 4 and 12 months of age at the time of the interview who had not received the recommended first dose or second dose of pneumococcal vaccine; or iii) a child older than 12 months at the time of the interview who had not received either the recommended first, second, or third doses of pneumococcal vaccine.

Other vaccines (including pentavalent, viral hepatitis B, diphtheria/pertussis/tetanus, and *Haemophilus influenzae* type b) were not considered for analysis because children might have received either the pentavalent vaccine or individual components depending on availability, limiting our ability to determine timely completion of vaccination.

We examined birthweight, breast-feeding, place of birth of the child, wealth index, and maternal literacy as potential covariables in our study.

Birthweight was categorized using the standard WHO classification. Very low birthweight was defined as less than 1 500 g, low birthweight as less than 2 500 g, normal birthweight between 2 500 and 4 000 g, and high birthweight as more than 4 000 g.

The duration of breast-feeding, when applicable, was classified as: i) child was never breast-fed or ii) child was breast-fed.

The place of birth of a child was classified as follows: i) MINSA (Peru's subsidized health care under the Ministry of Health) if a child was born in any facility under the administration of that system; ii) EsSalud (social security) when a child was born in any EsSalud facility; iii) private if the child was born in a private hospital or private clinic; iv) home if the child was born at the mother's house; or v) other if a child was born at a local government facility (nonhospital), nongovernmental organization, church, non-health-system venue, midwife's home, air force facility, or any other place not listed above.

The wealth index is a DHS measure calculated using data on a household's ownership of selected assets; materials used for housing construction; and types of water access and sanitation facilities. This approach separates all interviewed households into five wealth quintiles: poorest, poor, middle, rich, and richest.

A woman was categorized as illiterate if she was unable to read. No data on ability to write was collected by the DHS.

Statistical analysis

We performed all analyses using sampling weights, and we adjusted for clustering and stratification relevant to the DHS sampling scheme. We compared the maternal and infant characteristics of those who were reported to have received rotavirus immunization and those who did not, using the Rao-Scott chi-square test, with the *P* value significant at less than 0.05. Logistic regression was used to assess unadjusted and adjusted odds ratios (ORs) and 95% confidence intervals (CIs) for the association between unintended pregnancy and inadequate rotavirus immunization among children. Interaction between unintended pregnancy and area of residence (urban vs. rural), maternal education, age, marital status, and literacy status was examined using the Breslow-Day test at the 0.05 significance level. Confounding was defined as a meaningful change (using a threshold of 10%) in the odds ratio for unintended pregnancy upon removal of the potential confounder. Multicollinearity of variables was checked using condition indexes and variance-decomposition proportions. Data analysis was done using complex survey procedures in SAS version 9.4 software (SAS Institute Inc., Cary, North Carolina, United States of America).

Ethics

The DHS Program distributes unrestricted survey data files for legitimate academic research. This study was approved by the Emory University Institutional Board Review.

RESULTS

A total of 23 888 women between the ages of 15 and 49 years were interviewed in the 2012 DHS for Peru. They had given birth to a total of 47 261 children, of which 44 590 (94.9%) were alive at the time of the survey. Of those 47 261 children, 9 620 of them were born in the five years preceding the survey and, of them, 175 (1.7%) had died before the time of the survey. Of the 9 445 children alive at the time of the survey, 5 187 of them (54.9%; 95% CI = 53.8%–56.1%) were reported to have inadequate rotavirus vaccination.

We compared 31 child and maternal characteristics among children with and without adequate rotavirus vaccination (Table 1). We found that children born to older women had higher odds of inadequate rotavirus vaccination (OR: 1.2; 95% CI 1.1–1.4) as compared to those born to younger mothers. Children born at home had 41.0% higher odds of not receiving adequate rotavirus immunization as compared to those born in the Ministry of Health (MINSA) network ($P < 0.0001$). Third or higher birth order children had 23.0% higher odds of inadequate rotavirus immunization as compared to first-born children ($P = 0.005$). Alternately, there were lower odds of inadequate rotavirus vaccination for children who were registered in Peru's national registry of identification (RENIEC), children with Seguro Integral de Salud (SIS, Peru's subsidized comprehensive health

TABLE 1. Selected childhood, maternal, and other factors associated with inadequate rotavirus vaccination in Peruvian children, using data from the 2012 Demographic and Health Survey (N = 9 445)[a]

Factor	Inadequate rotavirus vaccination (n = 5 187) N (weighted %)	Adequate rotavirus vaccination (n = 4 258) N (weighted %)	Crude odds ratio	95% confidence interval	*P* value[b]
Child factors					
Child's place of birth					
Home	994 (62.2)	566 (37.8)	1.4	1.2–1.6	< 0.0001
Other[c]	99 (62.0)	61 (38.0)	1.4	0.9–2.2	0.14
Private	323 (56.2)	250 (43.8)	1.1	0.9–1.4	0.44
EsSalud[d]	632 (55.4)	515 (44.6)	1.1	0.9–1.3	0.5
MINSA[e]	3 139 (53.8)	2 866 (46.2)	1	Reference	
Birth order					
1st	1 624 (52.9)	1 459 (47.1)	1	Reference	
2nd	1 374 (55.8)	1 114 (44.2)	1.1	0.9–1.3	0.126
3rd or higher	2 189 (58)	1 685 (42)	1.2	1.1–1.4	0.005
Registered in RENIEC[f]					
Yes	4 763 (54.6)	4 077 (45.4)	0.5	0.4–0.6	< 0.0001
No	422 (72.3)	180 (27.7)	1	Reference	
Child had SIS[g]					
Yes	2 193 (50.9)	2 220 (49.1)	0.7	0.6–0.8	< 0.0001
No	2 971 (59.1)	2 031 (40.9)	1	Reference	
Any vaccine in immunization campaign					
Yes	1 506 (62.8)	973 (37.2)	1.6	1.4–1.8	< 0.0001
No	3 524 (52.2)	3 282 (47.8)	1	Reference	N/A
Other immunizations					
Polio inadequate	1 563 (85.8)	223 (14.2)	6.6	5.3–8.2	< 0.0001
Polio adequate	3 483 (47.8)	4 035 (52.2)	1	Reference	
BCG[h] inadequate	503 (71.5)	199 (28.5)	2.2	1.7–2.7	< 0.0001

(Continued)

TABLE 1. (Con.)

Factor	Inadequate rotavirus vaccination (n = 5 187) N (weighted %)	Adequate rotavirus vaccination (n = 4 258) N (weighted %)	Crude odds ratio	95% confidence interval	*P* value[b]
BCG adequate	4 514 (53.8)	4 052 (46.2)	1	Reference	
Measles inadequate	592 (70.2)	231 (29.8)	1.7	1.3–2.1	< 0.0001
Measles adequate	3 728 (58.7)	2 816 (41.3)	1	Reference	
Influenza inadequate	3 708 (66.5)	1 908 (33.5)	3.8	3.3–4.4	< 0.0001
Influenza adequate	880 (34.5)	1 848 (65.5)	1	Reference	
Pneumococcal inadequate/incomplete	4 450 (82.9)	960 (17.1)	19.4	16.6–22.7	< 0.0001
Pneumococcal adequate	737 (20)	3 298 (80)	1	Reference	
Maternal factors					
Pregnancy intention					
Unintended pregnancy	2 905 (55.1)	2 396 (44.9)	0.98	0.9–1.04	0.53
Intended pregnancy	2 282 (56.1)	1 862 (43.9)	1	Reference	
Mother's age (years)					
15–24	1 399 (51)	1 345 (49)	0.8	0.7–0.9	0.002
25–34	2 352 (55)	1 923 (55)	1	Reference	
35 and older	1 436 (59.2)	990 (40.8)	1.2	1.1–1.4	0.02
Mother's education					
None	200 (58.6)	147 (41.4)	1.2	0.9–1.6	0.21
Primary	1 704 (57.7)	1 310 (42.3)	1.2	0.98–1.4	0.08
Secondary	2 241 (54.9)	1 881 (45.1)	1.03	0.9–1.2	0.67
Higher	1 042 (54)	920 (46)	1	Reference	
SIS during pregnancy					
Yes	2 738 (50.4)	2 831 (49.6)	0.8	0.7–0.9	0.001
No	1 294 (56.2)	1 028 (43.8)	1	Reference	
Breast-feeding education					
Yes	2 766 (52.8)	2 549 (47.2)	0.8	0.7–0.9	< 0.0001
No	2 421 (58.8)	1 709 (41.2)	1	Reference	
Other factors					
Rotavirus included in immunization schedule					
Yes (2009 and after)	2 824 (42.4)	3 916 (57.6)	0.09	0.08–0.1	< 0.0001
No (before 2009)	2 363 (89.3)	342 (10.7)	1	Reference	
Television in the home					
Yes	3 765 (54.9)	3 229 (45.1)	0.97	0.85–1.11	0.68
No	1 194 (55.6)	949 (44.4)	1	Reference	

Source: Prepared by the authors, based on the study results.
[a] Selected variables are shown to reduce table size; omitted information is available by request.
[b] Rao-Scott chi-square test.
[c] Other = nongovernmental organization, local church, local air force facility, or other facility.
[d] EsSalud = Peru's social security.
[e] MINSA = Ministry of Health.
[f] RENIEC = Peru's national registry of identification.
[g] SIS = Seguro Integral de Salud, Peru's subsidized comprehensive health insurance.
[h] BCG = Bacillus Calmette–Guérin.

insurance), children whose mothers had SIS, children whose mothers had received breast-feeding education, and children who were vaccinated against rotavirus in 2009 (the year rotavirus vaccine was introduced in the national schedule) or after (Table 1).

Pregnancy intention was examined as our primary exposure. Overall, there were 9 620 pregnancies in the five years preceding the survey, of which 4 224 (43.9%, 95% CI = 42.8%–45.1%) were desired or wanted at the time the woman became pregnant (Table 1). The remaining 56.1% of pregnancies were reported as unintended, with 2 981 women (30.9%, 95% CI = 29.9%–32.1%) reporting it as a mistimed pregnancy, and 2 415 (25.1%, 95% CI = 24.1%–26.2%) reporting the pregnancy as unwanted. Unintended pregnancy was more common in women aged 15 to 24 years old, with 63.6% of them reporting unintended pregnancies, compared to 49.5% in those 25–34 years old and 53.0% in those 35 years or older. Also, unintended pregnancy was more common among those with a high school education (71.1%) (data not shown). Our unadjusted analysis showed no significant association between pregnancy intention and rotavirus vaccination uptake among children (crude OR = 0.9; 95% CI = 0.9–1.04).

There was a statistically significant interaction between pregnancy intention and rotavirus immunization by maternal literacy status ($P = 0.006$). Based on this observation, we stratified our study participants into two groups by maternal

TABLE 2. Logistic regression analysis of determinants of inadequate rotavirus immunization in Peruvian children, using data from the 2012 Demographic and Health Survey[a]

Factor	Adjusted odds ratio	95% confidence interval	*P* value
Illiterate			
Unintended pregnancy	2.6	1.21–4.40	0.011
Intended pregnancy	1	Reference	
Not illiterate			
Unintended pregnancy	0.9	0.7–1.1	0.297
Intended pregnancy	1	Reference	
Mother received breast-feeding education			
Yes	0.8	0.7–0.99	0.036
No	1	Reference	
Rotavirus included in immunization schedule			
Yes (2009 and after)	0.2	0.2–0.3	< 0.0001
No (before 2009)	1	Reference	
Polio immunization			
Incomplete	5.9	3.5–9.9	< 0.0001
Complete	1	Reference	
Measles immunization			
Incomplete	0.5	0.3–0.6	< 0.0001
Complete	1	Reference	
Influenza immunization			
Incomplete	2.3	1.8–2.8	< 0.0001
Complete	1	Reference	
Pneumococcal immunization			
Incomplete	6.3	5.0–7.9	< 0.0001
Complete	1	Reference	
Child had SIS[b]			
Yes	0.8	0.6–0.9	0.023
No	1	Reference	
Mother's education			
None	1.8	0.9–3.4	0.08
Primary	1.4	1.001–1.8	0.049
Secondary	1.2	0.9–1.5	0.15
Higher	1	Reference	
Television in the home			
Yes	1.4	1.1–1.7	0.007
No	1	Reference	

Source: Prepared by the authors, based on the study results.

[a] Each variable is adjusted for all other variables in the model.

[b] SIS = Seguro Integral de Salud, Peru's subsidized comprehensive health insurance.

literacy status (illiterate vs. not illiterate). Table 2 presents the association between pregnancy intention and rotavirus vaccination by maternal literacy, adjusting for potential covariables. Results from the stratified analysis show that among mothers who were illiterate, unintended pregnancy was associated with a 2.6-fold increased odds (95% CI = 1.2–4.4) of inadequate rotavirus vaccination as compared to vaccination among children from intended pregnancies. There was no association between unintended pregnancy and rotavirus immunization in children of literate women (Table 2).

DISCUSSION

Our study addressed two important public health problems in the developing world: rotavirus infection and unintended pregnancies. Much attention has been given in Peru to the prevention of rotavirus infection through immunization, and rotavirus immunization coverage improved in the last decade. However, many children remain nonimmunized, and little attention has been placed on determinants of inadequate or nonimmunization against rotavirus, including the role of unintended pregnancy. Identification of these factors is important in a time when vaccination rates have stagnated, in order to identify vulnerable groups and enhance immunization programs. This is the first study examining the association of unintended pregnancy and inadequate rotavirus immunization in Peru, using nationally representative data from the DHS while controlling for important confounders.

We found that more than 50% of the children of women in the 2012 DHS for Peru had inadequate rotavirus immunization. Although this figure appears to be inconsistent with the increasing rotavirus immunization coverage rates in Peru since 2009, the immunization coverage is defined by Peru's Ministry of Health as the total share of children up to 12 months old who received rotavirus immunization, regardless of the timing of vaccination. Our definition takes into account compliance with the immunization schedule. Timing of vaccination has important implications for vaccine immunogenicity and efficacy, and for prevention of poor outcomes. A study from Nepal demonstrated a significant delay in receipt of infant vaccines using prospective cohort data despite traditional coverage metrics being high (10). Adequacy of immunization, timing, and compliance may need to be incorporated by Peru's immunization program, in addition to the classic metrics, in order to better evaluate the impact of such programs in a time when coverage rates have stagnated.

Our findings suggest that in Peru that the mother's ability to read may play an important role in postpregnancy outcomes, such as childhood immunization. Some studies have examined the association between literacy status and unintended pregnancy in low-income countries and have reported conflicting results. Metwally et al. (11) found that low-level education and illiteracy of the wife was associated with unintended pregnancy in Egyptian couples. Another study, conducted in Nepal, found that illiterate women experienced more unintended pregnancies, but multivariate analysis failed to show an association (12). Among Ethiopian women, literacy status was not associated with unintended pregnancies (13).

However, the association between literacy and child outcomes appears to be more consistent. In Ethiopia, data from two studies demonstrated that compared

to illiterate women, literate women were up to three times more likely to fully vaccinate their children (14). In India, complete vaccination was more likely if the mother was literate (15). In Swaziland, literate women were 1.8 times more likely to utilize immunization services for their children (16). In Pakistan, low literacy and less education of the head of the household and the spouse was associated with low vaccination coverage (17). Finally, a conference presentation on research from Peru found that in 1984, 80.2% and 67.9% of children of mothers with secondary or higher education, respectively, were immunized, as compared to 32.8% and 23.7% of children of mothers with primary or no education, respectively (18). In our study, compared to children from women with higher education, the children of women with primary education were significantly more likely to have inadequate rotavirus vaccination. The same was not found for children of women with no education at all, but the small proportion of women with no education may have biased the results.

The role of literacy in less-developed countries is independently recognized in the pathway from schooling through health literacy and to child care outcomes in reproductive health (19). Thus, literate women who suffer unintended pregnancies may protect their pregnancies and their child's health better than illiterate women. Therefore, improving literacy skills of Peruvian women might help increase vaccination rates. After all, developing-country health status indicators (e.g., life expectancy and infant/maternal survival rates) are known to improve as the population's literacy level increases (20).

Only one study has examined the association between unintended pregnancy and childhood immunization in Peru. However, these data could be outdated for our current context. In the study, conducted in 1996, unwanted pregnancies were associated with increased likelihood that a child had not received full vaccination by age 12 months (9). Nevertheless, those authors found no such association with mistimed pregnancies, but they did not use the unintended pregnancy definition (which includes mistimed and unwanted pregnancies). Also, the outcome was a full set of vaccinations as opposed to individual immunizations. The aforementioned study was made before the implementation of the rotavirus vaccine in Peru, so compliance with this vaccine has not been well studied until now. However, based on that study and the results of our study, it is likely that, in Peru, the negative effect of unintended pregnancy on childhood immunization may continue to be a problem.

Other secondary findings of our study deserve attention. We found that breast-feeding education was associated with lower odds of incomplete rotavirus immunization. The benefits of breast-feeding on child health have been well established (21). However, maternal breast-feeding education may play a role as an important modifier of behavior that could result in better breast-feeding practices and also increase compliance with appropriate postnatal care, including obtaining recommended vaccinations. For example, the effect of breast-feeding education based on the health belief model resulted in significantly better scores in terms of self-efficacy, knowledge, and attitude in a study done in primiparous women (22). In our study, conversely, there was no difference in rotavirus immunization based on duration of breast-feeding. Therefore, the education program probably works through other pathways of behavioral science when it comes to compliance with immunizations.

Another notable result of our study is the significant association of inadequate rotavirus immunization with other inadequate immunizations, such as polio, influenza, and pneumococcal vaccines. These vaccines are scheduled in close proximity, and the compliance with one may have an impact on others. For example, in Australia, the introduction of rotavirus vaccination improved the timing of diphtheria-tetanus-pertussis vaccination (23, 24). Schweitzer et al. (25) found similar findings in two countries in Latin America, one of them being Peru, where the introduction of the rotavirus vaccine improved the coverage and timing of other similarly scheduled vaccinations. Since vaccination against measles does not happen until the child is between 12 and 15 months old, a positive relationship may not be seen. Our data showed that inadequate measles vaccination was actually associated with lower odds of inadequate rotavirus immunization.

The protective effect of the child having SIS and of vaccination against rotavirus on or after 2009 is not unexpected. These results may be explained by the availability of the rotavirus vaccine on a large scale after its introduction in the national immunization schedule, as well as the large proportion of children with SIS, the subsidized comprehensive health care insurance of Peru.

On the other hand, another interesting finding is the association of the presence of a television in the household and increased odds of incomplete immunization, especially when neither watching television, listening to the radio, or reading the newspaper by women were associated with rotavirus immunization. It is possible that the media had an effect on the perceptions that a woman's partner or other family members held on vaccination, resulting in reduced immunization of children against rotavirus. This may especially have been due to the heavily publicized criticism from antivaccine groups in recent years.

Another interesting finding was that birthweight was not associated with rotavirus immunization in this study of survey data. However, a previous cohort study in Peru found that vaccination of very-low-birthweight infants is significantly delayed, especially in those with a birthweight of less than 1 000 g (5).

Our study had some limitations. First, the DHS collects vaccination information from two sources: i) directly from the child's vaccination card (either date recorded or vaccine marked on the card) and ii) vaccination self-reported by the mother. This might have introduced recall bias. That is because while rotavirus immunization information by self-report was less than 0.2%, information by self-report for other vaccinations had higher frequencies. However, a previous study in low-income settings has found that maternal recall performs well when it comes to identifying vaccinated children aged 12-23 months, similar to information taken from vaccination cards (26). Also, we did not include antenatal care or postnatal care data in the analysis as this data was only available for the very last alive child. However, we conducted a similar analysis for the lastborn child only, and the results were similar (data not shown).

There are also several strengths to our study. One is that the use of DHS data—with high response rates, national coverage, superior interviewer training, and standardized data

collection procedures—provides an excellent source of information. Another strength is that we conducted an assessment of several other determinants of inadequate rotavirus immunization, as well as an evaluation of vaccination adequacy and compliance rather than vaccination coverage rates.

In conclusion, our study shows that unintended pregnancy was associated with inadequate rotavirus immunization in children of illiterate women. Literacy status modified the effect of unintended pregnancy on immunization against rotavirus, and there was no association between unintended pregnancy and inadequate rotavirus vaccination in children of literate women. This indicates that literacy is an important factor that could mitigate the known adverse consequences of unintended pregnancy, particularly for child health outcomes.

Our results also indicate that vaccination compliance may be highly interdependent when vaccinations are given in close proximity, and that breast-feeding education has an impact on childhood rotavirus immunization. As the first study that has investigated the relationship between pregnancy intendedness and adequacy of rotavirus immunization in Peru, this research could be of great value for policy and program development.

Funding. This research received no specific grant from any funding agency or commercial or not-for-profit sectors.

Conflicts of interest. None of the authors has a conflict of interest.

Disclaimer. Authors hold sole responsibility for the views expressed in the manuscript, which may not necessarily reflect the opinion or policy of the *RPSP/PAJPH* or PAHO.

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Manuscript received on 6 July 2017. Revised version accepted for publication on 11 March 2018.

RESUMEN

Embarazo involuntario y su repercusión sobre la vacunación contra rotavirus de la niñez en Perú

Objetivo. Examinar la asociación entre el embarazo involuntario y la vacunación inadecuada contra rotavirus en niños peruanos.

Métodos. A partir de datos de observación transversales de la Encuesta de Demografía y Salud del 2012, se empleó el análisis de regresión logística para calcular las razones de posibilidades ajustadas (aOR) y los intervalos de confianza de 95% (IC) de la asociación entre el embarazo involuntario y la inmunización inadecuada contra rotavirus en los niños.

Resultados. De 9 620 embarazos en los cinco años anteriores a la encuesta, 5 396 (56,1%) se reconocieron como involuntarios, de los cuales 2 981 fueron inoportunos (30,9%) y 2 415 (25,1%) fueron no deseados. Se registraron 5 187 niños (54,9%; IC de 95% = 53,8%–56,1%) con inmunización contra rotavirus inadecuada. El alfabetismo materno resultó ser un importante modificador de efecto de la asociación entre la intencionalidad del embarazo y la vacunación antirrotavírica (valor de P = 0,006). En los hijos de las mujeres analfabetas, el embarazo involuntario se asoció significativamente con mayores probabilidades de inmunización inadecuada contra rotavirus (aOR = 2,6; IC de 95% = 1,2–4,4), en comparación con los nacidos de los embarazos voluntarios. Las vacunaciones antipoliomielítica, antineumocócica y antigripal inadecuadas, tener un televisor en el hogar y una menor escolaridad materna fueron factores predictivos significativos de una inmunización antirrotavírica deficiente. Por el contrario, haber recibido instrucción respecto a la lactancia materna fue un factor protector contra la inmunización antirrotavírica inadecuada. En las madres alfabetizadas, no hubo asociación alguna entre la intencionalidad del embarazo y la inmunización contra rotavirus.

Conclusiones. Nuestro estudio aporta evidencia que muestra que mejorar el alfabetismo en las madres podría aumentar la captación de la vacunación antirrotavírica en los niños nacidos de embarazos involuntarios.

Palabras clave Rotavirus; inmunización; embarazo no planeado; Perú.

RESUMO

Gravidez indesejada e repercussão na vacinação contra rotavírus em crianças no Peru

Objetivo. Examinar a associação entre gravidez indesejada e falta de vacinação oportuna contra rotavírus em crianças peruanas.

Métodos. A partir de dados observacionais transversais obtidos na Pesquisa de Demografia e Saúde 2012, foi conduzida uma análise de regressão logística para estimar razões de chances ajustadas (OR aj) e intervalos de confiança de 95% (IC 95%) para a associação entre gravidez indesejada e falta de vacinação oportuna contra rotavírus em crianças.

Resultados. Dentre 9.620 gravidezes ocorridas nos cinco anos anteriores à pesquisa, 5.396 (56,1%) foram referidas como não intencionadas, das quais 2.981 foram não no momento certo (30,9%) e 2.415 (25,1%) indesejadas. Registrou-se falta de vacinação oportuna contra rotavírus em 5.187 crianças ao todo (54,9%; IC 95% = 53,8%–56.1%). Verificou-se que o nível de escolaridade materna é um importante modificador de efeito da associação entre intenção de engravidar e vacinação contra rotavírus (valor de P = 0,006). Nas crianças nascidas de mães sem escolaridade, observou-se uma associação significativa entre gravidez indesejada e maior chance de falta de vacinação oportuna contra rotavírus (OR aj = 2,6; IC 95% = 1,2–4,4) quando comparadas às crianças de gravidezes intencionadas. A falta de vacinação contra rotavírus prognosticou de modo significativo a falta de vacinação oportuna contra poliomielite, doença pneumocócica e gripe; possuir televisor no domicílio e menor nível de escolaridade materna. Em contraste, receber orientação sobre o aleitamento materno foi um fator protetor contra a falta de vacinação oportuna contra rotavírus. Entre as mães com escolaridade, não se verificou associação entre intenção de engravidar e vacinação contra rotavírus.

Conclusão. O estudo evidencia que melhorar o nível de escolaridade materna poderia contribuir para aumentar a vacinação contra rotavírus em crianças nascidas de gravidez indesejada.

Palavras-chave Rotavirus; imunização; gravidez não planejada; Peru.