Title

Increasing Hepatitis B Vaccine Prevalence Among Refugee Children Arriving in the United States, 2006-2012.

Journal

American Journal of Public Health, 106(8)

ISSN

0090-0036

Authors

Yun, Katherine
Urban, Kailey
Mamo, Blain
et al.

Publication Date

2016-08-01

DOI

10.2105/ajph.2016.303203

Increasing Hepatitis B Vaccine Prevalence Among Refugee Children Arriving in the United States, 2006–2012

Katherine Yun, MD, MHS, Kailey Urban, MPH, Blain Mamo, MPH, Jasmine Matheson, MPH, Colleen Payton, MPH, Kevin C. Scott, MD, Lihai Song, MS, William M. Stauffer, MD, MSPH, Barbara L. Stone, MSPH, Janine Young, MD, and Henry Lin, MD

Objectives. To determine whether the addition of hepatitis B virus (HBV) vaccine to national immunization programs improved vaccination rates among refugee children, a marginalized population with limited access to care.

Methods. The sample included 2291 refugees younger than 19 years who completed HBV screening after arrival in the United States. Children were categorized by having been born before or after the addition of the 3-dose HBV vaccine to their birth country's national immunization program. The outcome was serological evidence of immunization.

Results. The odds of serological evidence of HBV immunization were higher for children born after the addition of HBV vaccine to their birth country's national immunization program (adjusted odds ratio = 2.54; 95% confidence interval = 2.04, 3.15).

Conclusions. National HBV vaccination programs have contributed to the increase in HBV vaccination coverage observed among US-bound refugee children.

Public Health Implications. Ongoing public health surveillance is needed to ensure that vaccine rates are sustained among diverse, conflict-affected, displaced populations. (*Am J Public Health.* 2016;106:1460–1462. doi:10.2105/AJPH.2016.303203)

Approximately 240 million people are chronic carriers of hepatitis B virus (HBV).[1] Exposed children are more likely than adults to become chronically infected, placing them at risk for potentially fatal liver disease. Disruption of childhood transmission—both maternal-child and child-child—is a global health priority.[1] The primary tool is the HBV vaccine.

Following its introduction in 1981 to 1982, the HBV vaccine was slowly integrated into national vaccine plans. Many highly endemic nations in sub-Saharan Africa and Southeast Asia were unable to introduce universal childhood HBV vaccination until the 2000s. As a result, vaccination coverage in countries with endemic HBV varies widely.[1,2] Thailand incorporated the vaccine in its Expanded Program on Immunization (EPI) in 1992, and by 1995, more than 90% of the 1-year-old children in that country had received the 3-dose series.[2] As a result, the prevalence of HBV infection among these children declined from 4.3% (prevaccine era) to 0.7%.[3] By contrast, neighboring Burma (also known as Myanmar) did not introduce the vaccine until 2005, and in 2012, only 58% of the 1-year-old children in that country had completed the series.[2]

HBV vaccination among refugee children has not been well described, and it cannot be assumed that refugees have experienced improvements in coverage. Refugees are often geographically or socially marginalized, compromising access to mainstream health services.[4–6] Childhood vaccine programs may be disrupted by conflict (e.g., Syria) or restrictions on movement (e.g., the Rohingya in Myanmar).[7] After fleeing their homes, refugee children do not always have access to national health services. Frequently, health care both within and outside of camps is instead coordinated through nonprofit organizations. Furthermore, refugees have no vaccine requirement for entry into the United States. Nonetheless, recent studies indicate that HBV infection has become less common, suggesting that HBV vaccination has increased even among this marginalized population.[8]

We describe the prevalence of HBV vaccination among refugee children resettled in Minnesota; Philadelphia, Pennsylvania; and Washington State from 2006 to 2012. We hypothesized that the inclusion of HBV vaccine in EPIs was associated with higher rates of HBV vaccination among refugee children. We examined HBV serology results for children born before and after the inclusion of the vaccine in national EPIs to test this hypothesis.

ABOUT THE AUTHORS

At the time the work was conducted, Katherine Yun was with PolicyLab, Division of General Pediatrics, The Children's Hospital of Philadelphia, Philadelphia, PA, and Department of Pediatrics, Perelman School of Medicine, University of Pennsylvania, Philadelphia. Kailey Urban and Blain Mamo were with the Refugee Health Program, Minnesota Department of Health, Saint Paul. Jasmine Matheson was with the Refugee Health Program, Washington State Department of Health, Shoreline. Colleen Payton and Kevin C. Scott were with Family and Community Medicine, Thomas Jefferson University, Philadelphia, PA. Lihai Song was with the Healthcare Analytics Unit, Center for Pediatric Clinical Effectiveness, and PolicyLab, The Children's Hospital of Philadelphia. William M. Stauffer was with the Departments of Medicine and Pediatrics, University of Minnesota, Minneapolis. Barbara L. Stone was with the Refugee Health Program, Colorado Department of Public Health and Environment, Denver. Janine Young was with General Pediatrics, Denver Health and Hospitals, Denver, CO. Henry Lin was with the Division of Gastroenterology, The Children's Hospital of Philadelphia.

Correspondence should be sent to Katherine Yun, MD, MHS, PolicyLab, The Children's Hospital of Philadelphia, 3535 Market St, Room 1539, Philadelphia, PA 19104 (e-mail: yunk@email.chop.edu). Reprints can be ordered at http://www.ajph.org by clicking the "Reprints" link.

This brief was accepted March 20, 2016.

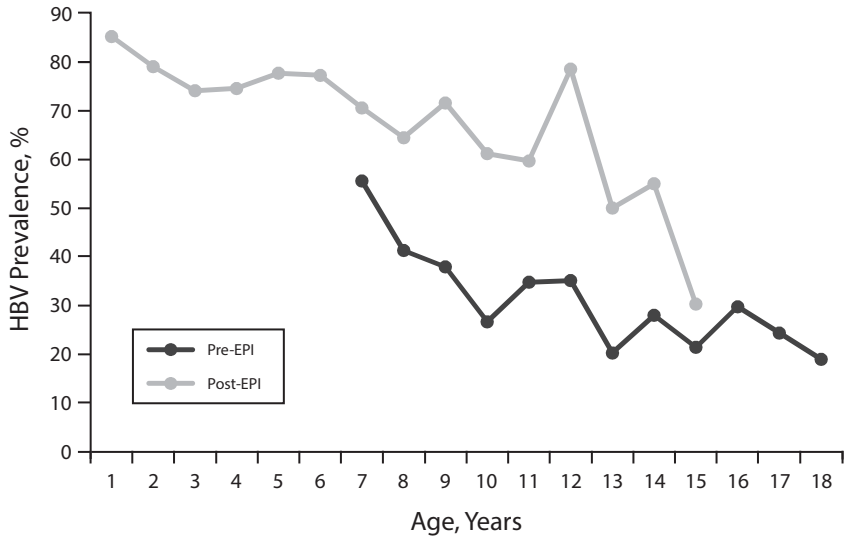
doi: 10.2105/AJPH.2016.303203

METHODS

In this retrospective study, we used public health surveillance data from 3 refugee health programs that have implemented the Centers for Disease Control and Prevention refugee domestic medical examination, which includes screening for HBV. The sample comprised children younger than 19 years from Bhutan, Myanmar, Ethiopia, Iraq, Laos, and Somalia with complete data for hepatitis B surface antigen (HBsAg), antibody to HBsAg (anti-HBs), antibody to hepatitis B core antigen (anti-HBc), and country of birth (n = 2291). Children with negative HBsAg, negative anti-HBc, and positive anti-HBs were categorized as vaccinated.

To verify that children with complete serology results did not constitute a biased sample at higher risk for HBV, we used the χ^2 test and logistic regression to compare children with complete and incomplete results (data available as a supplement to the online version of this article at http://www.ajph.org). Children with incomplete serology results were more likely to have arrived in the United States from 2006 to 2008, when most screening protocols did not include anti-HBs or anti-HBc. The prevalence of positive HBsAg was comparable (3.0% of children with incomplete serology results and 3.3% of those with complete results).

We used logistic regression to describe the relation between serology results and whether children had been born before or after the inclusion of HBV vaccine into their birth country's EPI. Children born before the incorporation of the vaccine into their birth country's EPI were categorized as "pre-EPI." Those born at the time of or after the incorporation of HBV vaccine into the EPI were categorized as "post-EPI." For each birth country, post-EPI was defined as the year the 3-dose vaccine was introduced in the entire country.[9] An exception was made for Iraq, for which we used 1996, when the United Nations' Oil-for-Food Programme liberalized access to materials needed for health and humanitarian programs.[10] The model was adjusted for age, because up to 20% of vaccinated adolescents may have waning or anamnestic antibody levels.[11]



Note. EPI = Expanded Program on Immunization; HBV = hepatitis B Virus. Data are not shown for cells where n < 30. Children born before the addition of HBV vaccine to their birth country's EPI were categorized as belonging to the "pre-EPI" birth cohort. Those born at the time of or after the incorporation of HBV vaccine into the EPI were categorized as "post-EPI." Age is in years at the time of arrival in the United States.

FIGURE 1—Serological Evidence of Hepatitis B Vaccination (Negative Hepatitis B Surface Antigen [HBsAg], Positive Antibody to HBsAg, Negative Antibody to Hepatitis B Core Antigen), by Birth Cohort and Age: Minnesota; Philadelphia, PA; and Washington State, 2006–2012

RESULTS

The sample comprised 937 children born pre-EPI and 1354 children born post-EPI. Children's families originated in Myanmar (n = 1258), Somalia (n = 489), Iraq (n = 214), Bhutan (n = 193), Ethiopia (n = 100), and Laos (n = 37). The mean ages in the post- and pre-EPI cohorts were 6.6 years (SD = 4.3) and 13.0 years (SD = 3.8), respectively. The time between arrival in the United States and testing was comparable between groups (35.3 and 38.3 days, respectively), as was gender (47.6% and 47.8% female, respectively). Most children in the post-EPI cohort had been born in Thailand (65.6%) and arrived in the United States from 2010 to 2012 (55.5%). Most children in the pre-EPI cohort had been born in Myanmar (34.5%), Somalia (19.9%), or Ethiopia (16.2%) and arrived in the United States from 2006 to 2009 (59.9%). Other than Somalia, each birth country had incorporated HBV vaccine into the EPI by 2012.[9]

HBV infection was less common post-EPI than pre-EPI (2.4% vs 4.6%; data available as a supplement to the online version of this article at http://www.ajph.org). Serological evidence of vaccination was more common post-EPI than pre-EPI both overall (69.7% vs 31.3%) and within each birth country (data available as a supplement to the online version of this article at http://www.ajph.org). The odds of having serological evidence of HBV vaccination were higher among children born post-EPI, even after adjusting for age (Figure 1; adjusted odds ratio = 2.54; 95% confidence interval = 2.04, 3.15).

DISCUSSION

EPI expansions have positive effects even for refugee populations. Countries that have made national preventive health programs accessible to refugee children should be commended. However, because vaccination post-EPI was below the US target for children (95%) and many children have relatives who are chronically infected with HBV,[12] we recommend that US-based refugee health programs continue both HBV screening and catch-up vaccination.

Given that 31.3% of the children born pre-EPI had serological evidence of HBV immunization, we believe that many refugee

children are being vaccinated later in life. Given the resource limitations in refugee camps and equivalent urban areas, children are unlikely to have been tested for HBV infection prior to vaccination. For this reason, we also recommend that US-based refugee health programs test children for HBV infection even if they have a well-documented history of vaccination.

Because most research on HBV has been conducted in a limited number of high- and middle-income countries, there is a paucity of data on the epidemiology of HBV in other countries. A comprehensive literature review on the global epidemiology of HBV noted that in many regions, data were limited to a single country with an unusually strong research infrastructure.[1] Although refugee health surveillance data are not a substitute for national studies, surveillance data nonetheless offer valuable insight into the epidemiology of HBV among highly vulnerable populations in low-income countries. Public health programs in high-income, refugee-receiving countries should continue to contribute to this field by publishing prevalence data for large refugee cohorts.

The primary limitations to this study were missing data (addressed in the Methods section) and the use of birth country to categorize children. Use of birth country may decrease the observed difference between pre- and post-EPI cohorts: (1) children born post-EPI may nonetheless have limited access to vaccination for the reasons described in the introductory section of this brief, and (2) children born pre-EPI may be vaccinated against HBV later in life but before coming to the United States through catch-up vaccination programs.

PUBLIC HEALTH IMPLICATIONS

HBV vaccine coverage has improved among US-bound refugee children, particularly children born in countries where the vaccine is included in the EPI. Ongoing public health surveillance is needed to ensure that vaccine rates are sustained among diverse, conflict-affected, displaced populations. US-based refugee health programs should continue to test children for HBV infection. AJPH

CONTRIBUTORS

K. Yun conceptualized the study, conceptualized and completed the analysis, and led the writing of the brief. K. Urban, J. Matheson, C. Payton, K. C. Scott, and B. L. Stone contributed data and contributed to the analysis and writing of the brief. B. Mamo conceptualized the study, contributed data, and contributed to the analysis and writing of the brief. L. Song prepared the unified study data set. W. M. Stauffer and H. Lin conceptualized the study and contributed to the analysis and writing of the brief. J. Young contributed to the analysis and writing of the brief.

ACKNOWLEDGMENTS

K. Yun received support from PolicyLab at The Children's Hospital of Philadelphia and the National Institute of Child Health and Human Development (1K23HD082312). K. C. Scott and C. Payton received support in part from a Cooperative Agreement with the Centers for Disease Control and Prevention (CDC; CDC-RFA-CK12-1205).

Data on the prevalence of hepatitis B virus infection by country of origin were previously published in the *American Journal of Public Health*.

Note. The contents of this brief are solely the responsibility of the authors and do not necessarily represent the official views of the CDC, US Department of Health and Human Services, or state health departments.

HUMAN PARTICIPANT PROTECTION

The study was approved by the institutional review board at Thomas Jefferson University. It was exempt from institutional review board review by the other participating sites.

REFERENCES

1. Ott JJ, Stevens GA, Groeger J, Wiersma ST. Global epidemiology of hepatitis B virus infection: new estimates of age-specific HBsAg seroprevalence and endemicity. *Vaccine*. 2012;30(12):2212–2219.

2. World Health Organization. Immunization, Vaccines and Biologicals: Data, statistics, and graphics. 4.3 WHO/UNICEF Estimates of National Immunization Coverage (WUENIC). Available at: http://www.who.int/immunization/monitoring_surveillance/data/en. Accessed January 5, 2016.

3. Chongsrisawat V, Yoocharoen P, Theamboonlers A, et al. Hepatitis B seroprevalence in Thailand: 12 years after hepatitis B vaccine integration into the national expanded programme on immunization. *Trop Med Int Health*. 2006;11(10):1496–1502.

4. Agadjanian V, Prata N. Civil war and child health: regional and ethnic dimensions of child immunization and malnutrition in Angola. *Soc Sci Med*. 2003;56(12):2515–2527.

5. Cetorelli V. The impact of the Iraq War on neonatal polio immunisation coverage: a quasi-experimental study. *J Epidemiol Community Health*. 2015:69(3):226–231.

6. Rossi C, Shrier I, Marshall L, et al. Seroprevalence of chronic hepatitis B virus infection and prior immunity in immigrants and refugees: a systematic review and meta-analysis. *PLoS One*. 2012;7(9):e44611.

7. Cousins S. Syria struggles to vaccinate residents. *Al Jazeera*. November 23, 2014. Available at: http://www.aljazeera.com/news/middleeast/2014/11/syria-struggles-vaccinate-residents-201411237180769415.html. Accessed February 2, 2016.

8. Yun K, Matheson J, Payton C, et al. Health profiles of newly arrived refugee children in the United States, 2006-2012. *Am J Public Health*. 2016;106(1):128–135.

9. World Health Organization. Immunization, Vaccines and Biologicals: Data, statistics, and graphics. 6.2 Year of introduction of selected vaccines database. Available at: http://www.who.int/immunization/monitoring_surveillance/data/en. Accessed January 5, 2016.

10. Ali HYM. Hepatitis B infection among Iraqi children: the impact of sanctions. *East Mediterr Health J*. 2004;10(1-2):6–11.

11. Poovorawan Y, Chongsrisawat V, Theamboonlers A, Bock HL, Leyssen M, Jacquet J-M. Persistence of antibodies and immune memory to hepatitis B vaccine 20 years after infant vaccination in Thailand. *Vaccine*. 2010;28(3):730–736.

12. Scott KC, Taylor EM, Mamo B, et al. Hepatitis B screening and prevalence among resettled refugees—United States, 2006–2011. *MMWR Morb Mortal Wkly Rep*. 2015;64(21):570–573.