National Health Statistics Reports

Number 119 ■ October 30, 2018

Prevalence, Change Over Time, and Comparison With U.S. Estimates of Selected Infectious Diseases in Los Angeles County: Findings From the National Health and Nutrition Examination Survey, 1999–2006 and 2007–2014

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Abstract

Objective—This report compares prevalence of and change over time for five infectious disease outcomes for the Los Angeles County (LAC) and the U.S. populations. The infectious disease outcomes examined are: herpes simplex virus type 1 (HSV-1) and type 2 (HSV-2), any hepatitis B virus (HBV) infection, HBV immunization, and hepatitis A virus (HAV) from infection or immunization, available for 1999–2006 and 2007–2014, as well as any human papillomavirus (HPV) and high-risk HPV infection, available for the 2007–2014 period only.

Methods—LAC was sampled in every 2-year cycle of the current National Health and Nutrition Examination Survey, enabling creation of two 8-year samples (1999–2006 and 2007–2014). Demographic differences associated with disease prevalence were examined between LAC and the United States. Changes over time and differences in prevalence, unadjusted, age adjusted, and "fully" adjusted by direct standardization for these demographic variables, were evaluated between the United States and LAC for 2007–2014.

Results—Compared with the United States, persons in LAC were more likely to be Mexican American, born outside of the United States, and live below the poverty level. Prevalence varied significantly by demographic subgroup for each outcome in the United States and for some outcomes in LAC. Differences between LAC and the United States existed for some outcomes but varied with adjustment. Over time, prevalence of HSV-1, HSV-2, and HBV infection decreased, and HBV immunization and HAV infection or immunization increased for the U.S. population. The direction of changes over time were mostly similar for LAC, but significance varied.

Conclusions—The LAC and U.S. populations differ demographically. The effect of controlling for demographic differences in the disparities in prevalence between these two populations and changes over time varied by outcome. Estimates of infectious disease outcomes for smaller geographical areas like LAC can assist local public health practitioners in developing appropriate programs for their regions.

Keywords: herpes simplex virus • hepatitis B virus • hepatitis A virus • human papillomavirus

Introduction

Los Angeles County (LAC), California has the largest population of any U.S. county and has been included in every 2-year cycle of the National Health and Nutrition Examination Survey (NHANES). The prevalence of antibody to or infection from many viruses can now be estimated for LAC for two periods, 1999–2006 and 2007–2014, and compared with prevalence estimates for the U.S. population. Data for the most recent 8-year period were available from NHANES for seven infectious disease measures. They included antibody to herpes simplex virus type 1 (HSV-1), herpes simplex virus type 2 (HSV-2), markers of infection with any type and high-risk type of human papillomavirus (HPV), antibody from infection or immunization for hepatitis A virus (HAV), antibody to hepatitis B virus (HBV) core antigen (anti-HBc) (a marker of infection), and antibody to HBV surface antigen (anti-HBs) (a marker of immunization to HBV).

Both HSV-1 and HSV-2 are common lifelong infections, which often do not have symptoms (1). Those with symptoms typically may have painful blisters or sores around their mouths or lips if infected with HSV-1, or

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genitals or anus if infected with either HSV-2 or, increasingly, HSV-1 as well. Transmission is caused by contact with the virus in lesions, mucosal surfaces, genital secretions, or oral secretions, as well as from a partner who is asymptomatic and does not know they are infected (2,3).

HPV is the most common sexually transmitted infection in the United States (4). Some HPV types can cause warts and are considered low risk. Other types are considered high risk and are the cause of cervical cancer; they have also been associated with cancer of the vagina in women, penis in men, and anus, mouth, and throat in both men and women (5).

HAV and HBV are common types of viral hepatitis. Chronic HBV infection can lead to serious health consequences, such as progressive liver disease and liver cancer. HAV is highly infectious, is transmitted via the fecal-oral route through contaminated food and water, and can cause severe disease, especially among the susceptible older population (6). HAV infections are common in countries lacking modern sanitation; in the United States, HAV infections are associated with travel to these countries, as well as foodborne outbreaks and person-to-person transmission from crowding and poor hygiene conditions, especially among persons who use drugs or are homeless (7). HAV immunization was introduced in areas with high rates of infection, including LAC starting in 1996, with universal childhood immunization initiated in 2006 for HAV, and 1991 for HBV (8,9).

This report provides both national estimates and subnational estimates for LAC on the prevalence of antibody to HSV-1 and HSV-2; any infection and high-risk infection from HPV; antibody to HAV virus from either infection or immunization; antibody to HBV core antigen, a measure of infection; and antibody to HBV surface antigen in core antibody negative persons, a measure of HBV antibodies from immunization. These estimates are provided by core demographic subgroups, including age, race and Hispanic ethnicity, sex, index for living below the poverty level, and U.S. birth status, using data from 2007 through 2014. Differences between the United States and LAC were also examined for this time period, and changes in prevalence between 1999–2006 and 2007–2014 (where data are available for both time periods) were examined and compared between the U.S. and LAC populations. Differences between the populations and over time were examined by comparing estimates that were unadjusted, age adjusted, or "fully" adjusted using direct standardization.

Methods

NHANES survey design

NHANES is a cross-sectional survey conducted by the National Center for Health Statistics (NCHS) that is based on a stratified, multistage probability cluster design to draw a representative sample of the civilian noninstitutionalized U.S. population. NHANES collects information on a wide variety of health measures and conditions through in-home interviews, standardized physical examinations, and collection of blood and other laboratory samples in mobile examination centers. Since 1999, data have been collected annually and released in 2-year cycles. From 1999 to 2014, a variety of demographic subgroups, including low-income white persons, non-Hispanic black persons, non-Hispanic Asian persons, and all Hispanic persons, as well as Mexican-American persons, were sampled at higher proportions to obtain more reliable and precise estimates for these subgroups. More detailed information about the NHANES survey design and sampling methods have been published elsewhere (10).

Because of the size and population density of LAC and the large Mexican-American and Hispanic population, LAC is a primary sampling unit that was selected with certainty in each 2-year NHANES cycle, and weights were calculated to match the population totals for LAC (11,12). Data were aggregated over four 2-year survey cycles grouped into two time periods (1999–2006 and 2007–2014) to provide adequate sample size for LAC.

Protocols for the overall NHANES were reviewed and approved by the NCHS Research Ethics Review Board. Written informed consent for the original NHANES study was collected from adults, and parental permission (for those aged 0–17 years), which included assent for children aged 7–17 years, was collected from children and adolescents.

Outcome variables

This study considered all infectious disease outcome variables available from NHANES and measured on the same age subsample for each outcome for all 8 years from 2007 through 2014. Prevalence for four outcomes—hepatitis C virus (HCV) RNA positivity, HIV antibody seropositivity, urinary positivity to chlamydia, and positivity to HBV surface antigen HBsAg (an indicator of chronic or acute HBV infection)—was low, and the numbers of positives in the LAC sample were too small for detailed analyses, so they were not included in the study. Details on laboratory testing procedures for each outcome for each survey cycle are available from the NCHS website at: https://wwwn.cdc.gov/nchs/nhanes/. Included outcomes are as follows:

HSV-1—Serum positive to antibody to HSV-1, indicative of infection. Blood specimens were tested from those aged 14–49 for 1999 through 2014.

HSV-2—Serum positive to antibody to HSV-2, indicative of infection. Blood specimens were tested from those aged 14–49 for 1999 through 2014.

Any HPV infection—Vaginal swab sample that tested positive for 1 or more of the 37 HPV types tested for, indicative of infection. HPV types include: 6, 11, 16, 18, 26, 31, 33, 35, 39, 40, 42, 45, 51, 52, 53, 54, 55, 56, 58, 59, 61, 62, 64, 66, 67, 68, 69, 70, 71, 72, 73, 81, 82, 83, 84, 89, or IS39. Vaginal swabs were tested from females aged 14–59 for 2007 through 2014 only.

High-risk HPV infection—Vaginal swab sample that tested positive for 1 or more of the 14 high-risk HPV types, indicative of high-risk infection. High-risk HPV types include: 16, 18, 31, 33, 35, 39, 45, 51, 52, 56, 58, 59, 66, or 68. Vaginal swabs were tested from females aged 14–59 for 2007 through 2014 only.

HAV—Serum positive to antibody to HAV, indicative of antibody from

immunization or natural infection. Blood specimens were tested from those aged 6 years and over for 1999 through 2014.

HBV infection—Serum antibody positive to HBV core antigen (anti-HBc), indicative of hepatitis B infection sometime in the past or present. Blood specimens were tested from those aged 6 years and over for 1999 through 2014.

HBV immunization—Serum antibody positive to HBV surface antigen (anti-HBs), without HBV core antibody (anti-HBc), indicative of antibody from HBV immunization. Blood specimens were tested from those aged 6 years and over for 1999 through 2014.

Covariates

Interview data used for this study included age in years, race and Hispanic ethnicity, poverty-index to family-income ratio, and U.S. birth status. Age was grouped according to the subpopulation tested for the different outcome variables as follows: 14–29, 30–39, and 40–49 for HSV-1 and HSV-2; 14–19, 20–29, 30–39, 40–49, and 50–59, for both HPV outcome variables; and 6–19, 20–39, 40–59, and 60 and over for all HAV and HBV outcome variables. Race and Hispanic-ethnicity subgroups were based on the respondents' self-assessment and categorized as non-Hispanic white, non-Hispanic black, Mexican American, and other including other Hispanic persons. Participants who did not self-select into these groups were classified as "other," which included individuals reporting multiple races. U.S. birth status was defined as U.S. born (born in the 50 U.S. states or the District of Columbia) or non-U.S. born (not born in the 50 states or the District of Columbia). Poverty was calculated by dividing family income by a poverty threshold specific for family size, using the U.S. Department of Health and Human Services' poverty guidelines and categorized as either living below poverty level or at or above poverty level (13). Those with data missing for U.S. birth status and poverty status were treated as missing in analyses involving each variable. More detailed information on each variable collected can be found in the NHANES documentation file (10).

Weighting

All estimates of seroprevalence were weighted using the NHANES examination weights to represent the total civilian noninstitutionalized U.S. population and to account for oversampling and nonresponse to the household interview and physical examination (14). Taylor series linearization was used for variance estimation in SUDAAN (15), using the appropriate sample weights and variance units created for the LAC files to produce subnational estimates, and the sample weights and variance units from the national file to produce national estimates (11).

Statistical analysis

Seroprevalence was calculated for the total population and by age group. Age-adjusted seroprevalence was used when comparing prevalence by demographic subgroup. Estimates were age adjusted using direct standardization with the projected U.S. Census 2000 population as the reference population, using the age groups based on the outcome mentioned above (16). Confidence intervals (CIs) were constructed using the method described in Korn and Graubard for use with small expected positive counts (17). Estimates based on fewer than five seropositive or seronegative persons were suppressed because they did not meet confidentiality criteria. Estimates with an absolute CI width greater than 30 or a relative CI width greater than 130% were considered unstable, and when presented, are designated as such and should be interpreted with caution (18). Pairwise differences in seroprevalence between subgroups were evaluated using a *t* statistic, and tests for trends across age groups were conducted using a linear orthogonal procedure, both in SUDAAN (15).

Differences between LAC and the total U.S. population in the percentage seropositive for each outcome were also evaluated for the most recent time period, 2007–2014. Estimates were again calculated for both the U.S. and LAC populations, unadjusted for any variables, age adjusted to the projected U.S. Census 2000 population, as well as fully adjusted to the 2007–2014 weighted NHANES U.S. population distribution for the five demographic variables. The five demographic variables used were those that differed between the two populations and were associated with at least one outcome in the U.S. population (age, race and Hispanic ethnicity, sex, U.S. birth status, and living below the poverty index). Each variable was grouped as described above, and included an additional subgroup for those with missing data for the poverty index variable. All adjustments used direct standardization (16). Estimates and their standard errors were output, and differences between the U.S. and LAC populations were evaluated using a univariate two-sided *t* test with a combined standard error that took into account the overlapping geographic areas and the population overlap between nested samples used in prior NCHS health reports (11,19). Age-adjusted analyses were also conducted using the 2007–2014 NHANES population as the reference population, instead of the projected 2000 census population, and results compared. There were no notable differences, so only the estimates adjusted to the 2000 census are reported.

Differences in prevalence over time were evaluated using a contrast statement comparing estimates for 1999–2006 with those for 2007–2014. This analysis was conducted for both the U.S. and LAC populations, unadjusted for any variable, and age adjusted and fully adjusted using direct standardization to the 2007–2014 NHANES U.S. population distribution for the five demographic variables previously listed. All hypothesis tests with *p* values less than 0.05 were considered statistically significant. No adjustments were made for multiple comparisons.

Results

Response to testing

There were 50,939 persons sampled in the United States for NHANES 1999–2006. A total of 41,474 (81.4% of those sampled) were interviewed and 39,352 (94.9% of those interviewed)

were examined. Similarly, of the 53,978 persons sampled in NHANES 2007–2014, a total of 40,617 (75.2% of those sampled) were interviewed and 39,166 (96.4% of those interviewed) were examined.

In LAC, 3,051 persons were sampled during 1999–2006, 2,280 (74.7% of those sampled) were interviewed, and 2,155 (94.5% of those interviewed) were examined. For 2007–2014, 2,779 persons were sampled in LAC, 1,899 (68.3% of those sampled) were interviewed, and 1,810 (95.3% of those interviewed) were examined.

For both the U.S. and LAC samples in 1999–2006 and 2007–2014, response to testing among those examined was 91% to 92% for almost all outcomes except HAV testing (LAC sample 89%), and HPV testing among women (88% for the LAC sample and 89% for the U.S. sample) in NHANES 2007–2014. Response to testing among those examined did not drop below 80% for either time period for both the U.S. and LAC samples for any subgroup (i.e., age group, race and Hispanic ethnicity, sex, poverty index, and U.S. birth status).

Population demographic characteristics

This report compared sociodemographic characteristics (age group, sex, and race and Hispanic ethnicity) of both the weighted U.S. NHANES sample population and the weighted LAC NHANES sample population from 2007–2014 to characteristics of the LAC and U.S. Census 2010 population (https://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml). Differences in the sociodemographic characteristics for all ages varied by 0.3 percentage points or less for each demographic subgroup for the U.S. population and 1.5 percentage points or less for the LAC population (data not shown).

Percentages of the weighted sample population for those aged 6 years and over (the analysis sample) were compared by sociodemographic group for each time period between the United States and LAC (Tables 1 and 2). The percentage of the population that was male compared with female did not vary between the United States and LAC for both time periods. Similarly, the distribution by age group of both the LAC and U.S. populations did not vary in either time period, except for those aged 70 and over during 1999–2006, where the U.S. percentage was greater. There was a significantly greater percentage of persons in the LAC population who were born outside of the United States in both 1999–2006 and 2007–2014 (42.3% and 42.4%, respectively) compared with the U.S. population (13.7% and 15.5%, respectively). Similarly, there was a significantly greater percentage of the LAC population (23.2% in 1999–2006 and 23.5% in 2007–2014) living below poverty compared with the U.S. population (14.2% in 1999–2006 and 16.3% in 2007–2014).

Population composition by race and Hispanic ethnicity also varied between the U.S. and LAC populations in both time periods. For 1999–2006, a smaller percentage of the population in LAC identified as non-Hispanic white (32.8%), and a greater percentage identified as Mexican American (32.9%) or Other (26.2%), compared with the United States (non-Hispanic white: 69.0%, Mexican American: 8.4%, and Other: 10.7%). Similarly, for 2007–2014, a smaller percentage of the LAC population identified as non-Hispanic white (28.0%) or non-Hispanic black (8.6%), and a greater percentage identified as Mexican American (34.3%) or Other (29.1%) compared with the U.S. population (non-Hispanic white: 65.0%, non-Hispanic black: 12.1%, Mexican American: 9.7%, and Other: 13.2%).

Univariate age-adjusted estimates

Detailed univariate age-adjusted analyses were conducted on the more recent data (2007–2014) only. Prevalence of each outcome for both the United States and LAC overall and by each demographic cofactor—age, sex, race and Hispanic ethnicity, living below the poverty threshold, and U.S. birth status—is given in Table 3. Patterns among each demographic cofactor were compared separately within the U.S. and LAC populations.

Overall age-adjusted prevalence of HSV-1 among those aged 14–49 was 53.7% in the United States and 67.9% in LAC for 2007–2014. In both the LAC and the U.S. populations, prevalence was greater with increasing age, greater among Mexican-American persons (77.1% United States, 80.3% LAC) compared with non-Hispanic black (60.8% United States, 56.8% LAC) and non-Hispanic white (45.6% United States, 50.7% LAC) persons, greater among those living below the poverty index (67.1% United States, 76.5% LAC) compared with those living at or above poverty (50.0% United States, 62.0% LAC), and greater among those born outside of the United States (75.4% United States, 81.1% LAC) compared with those who were U.S.-born (48.8% United States, 56.3% LAC). Higher prevalence among non-Hispanic black persons compared with non-Hispanic white persons, and among females (56.3% United States, 68.9% LAC) compared with males (51.2% United States, 67.0% LAC), reached statistical significance in the U.S. analysis only where the magnitude of the difference between males and females was 5.1 percentage points compared with 1.9 in LAC. Estimates for non-Hispanic white and non-Hispanic black persons for LAC had wide absolute CIs, which may have limited the ability to find differences.

Overall age-adjusted prevalence of HSV-2 among those aged 14–49 was 15.1% in the United States and 13.4% in LAC for 2007–2014. Prevalence in both the LAC and the U.S. populations was greater with age, and was greater among non-Hispanic black persons (38.8% United States, 40.2% LAC) than among both non-Hispanic white (11.2% United States, 12.7% LAC) and Mexican-American (12.1% United States, 11.6% LAC) persons. Prevalence was also greater among those who were U.S.-born (15.6% United States, 19.2%, LAC) than among those born outside the United States (13.0% United States, 11.7% LAC) in both the U.S. and LAC populations, but it reached statistical significance only in the much larger U.S. sample, even though the magnitude of the difference was greater in LAC (7.5 percentage

points compared with 2.6 for the U.S. population). Prevalence was also greater among those living below poverty (23.0% United States, 13.4% LAC) compared with those living at or above the poverty index (13.4% United States, 13.3% LAC) for the U.S. population (9.6 percentage points); but there was no difference in prevalence for LAC (0.1 percentage point). The difference in prevalence between males (10.1% United States, 11.9% LAC) and females (19.9% United States, 15.0% LAC) in the United States (9.8 percentage points) was smaller for LAC (3.1 percentage points) and no longer reached statistical significance. Again, LAC estimates for both non-Hispanic white and non-Hispanic black persons had wide CIs and may be unstable.

Overall age-adjusted prevalence of all HPV types among females aged 14–59 was 38.8% in the United States and 42.2% in LAC for 2007–2014. Prevalence in both LAC and the United States varied by age and was highest among those aged 20–29 (53.0% United States, 51.6% LAC). Prevalence was also higher among non-Hispanic black (57.0% United States, 65.2% LAC) than Mexican-American (37.4% United States, 38.0% LAC) persons in both the LAC and U.S. populations. Differences between non-Hispanic white (48.3%) and non-Hispanic black (65.2%) persons in LAC (16.9 percentage points) were somewhat smaller than differences in the United States (35.9% non-Hispanic white, 57.0% non-Hispanic black, 21.1 percentage points). Estimates for the LAC groups were much less stable with wider CIs, which limited the ability to find differences in the LAC data. Prevalence was also greater among those born in the United States (39.8% United States, 51.2% LAC) compared with those born outside the United States (34.8% United States, 36.1% LAC) in both populations. Those living below poverty (50.5% United States, 47.0% LAC) were more likely to be HPV-positive than those living at or above poverty (36.2% United States, 41.7% LAC) in both the United States and LAC, but the difference was greater and reached statistical significance only among the U.S. population (14.3 percentage points for the United States and 5.3 for LAC).

Overall age-adjusted prevalence of HPV high-risk infection among females aged 14–59 was 21.1% in the United States and 18.0% in LAC. Again, prevalence of infection varied by age and was greatest among those aged 20–29 (35.0% United States, 37.0% LAC). Most estimates by age group for LAC were very unstable with wide CIs and should be interpreted cautiously. Prevalence was greater among non-Hispanic black persons (30.9% United States, 41.9%, LAC) than among both non-Hispanic white (19.6% United States, 22.6% LAC) and Mexican-American (20.6% United States, 18.7% LAC) persons in the United States, but only the difference between non-Hispanic black and Mexican-American persons reached statistical significance for LAC. The differences between race and Hispanic-ethnicity subgroups were greater in LAC, but smaller sample size, wider CIs, and unstable estimates for both the non-Hispanic white and non-Hispanic black subgroups limited the ability to find a difference in the LAC analysis. Prevalence was greater among those born in the United States (21.8% United States, 22.9% LAC) compared with those born outside the United States (18.4% United States, 10.9% LAC) for both the LAC and U.S. populations. Those living below poverty were again more likely to be positive (29.4% United States, 25.8% LAC) than those living at or above poverty (19.2% United States, 17.1% LAC) in both LAC and the United States; and although the two differences were similar (10.2 percentage points in the United States and 8.7 for LAC), they reached statistical significance only among those in the larger U.S. population.

Overall age-adjusted prevalence of antibody to HAV from infection or immunization among those aged 6 years and over was 38.5% in the United States and 69.8% in LAC for 2007–2014. Prevalence varied with age and was highest among those aged 6–19 years (52.9% United States, 90.3% LAC). In LAC, prevalence among females (38.5% United States, 73.1% LAC) was greater than among males (38.5% United States, 66.6% LAC), but prevalence did not vary by sex in the U.S. population. Prevalence of antibody to HAV was greatest among Mexican-American persons (80.2% United States, 86.0% LAC) compared with both non-Hispanic black (41.9% United States, 52.9% LAC) and non-Hispanic white (26.7% United States, 47.8% LAC) persons in both LAC and the United States. In the U.S. population, prevalence was also higher among non-Hispanic black persons than non-Hispanic white persons. Prevalence was also higher among those born outside the United States (76.4% United States, 83.9% LAC) compared with those who were U.S.-born (30.7% United States, 49.5% LAC), and higher among those living below the poverty threshold (50.1% United States, 83.0% LAC) compared with those living at or above the poverty threshold (35.8% United States, 63.7% LAC) for both the LAC and U.S. populations.

Overall age-adjusted prevalence of ever infected with HBV (positive for HBV core antibody) among those aged 6 years and over was 3.7% in the United States and 9.1% in LAC for 2007–2014. Differences by U.S. birth status (greater among those born outside the United States [10.2% United States, 12.4% LAC] than those who were U.S.-born [2.5% United States, 5.6% LAC]) were the same for both the U.S. and LAC populations. However, there was no significant variability in the LAC population by sex (8.9% for males and 9.3% for females), poverty (6.9% below poverty and 9.7% at or above), or race and Hispanic ethnicity (5.1% among non-Hispanic white, 6.3% among non-Hispanic black, and 3.7% among Mexican-American persons). Prevalence in the United States increased with age, was higher among males (4.2%) than females (3.3%), was greater among non-Hispanic black (8.8%) than both non-Hispanic white (1.9%) and Mexican-American (2.2% United States) persons, and was greater among those living below the poverty threshold (6.3%) compared with those living at or above the poverty threshold (3.3%). As noted previously, estimates for LAC for both non-Hispanic black and non-Hispanic white persons were unstable and should be interpreted cautiously. LAC estimates for the youngest age groups (6–19 and 20–39) were not reported because the estimates did not meet NCHS standards

for confidentiality or reportability (20).

Overall age-adjusted prevalence of antibody from HBV immunization among those aged 6 years and over was 25.9% in the United States and 28.0% in LAC for 2007–2014. In both LAC and the United States, prevalence declined with age, and was lower among Mexican-American persons (20.4% United States, 23.8% LAC) than among both non-Hispanic black (26.5% United States, 33.6% LAC) and non-Hispanic white (26.0% United States, 35.9% LAC) persons. In the LAC population, prevalence was greater among those who were U.S.-born (32.5%) compared with those born outside the United States (25.3%). In contrast, in the U.S. population, prevalence was greater among those born outside of the United States (28.1%) compared with those who were U.S.-born (26.2%). Differences by sex (28.5% among females and 23.2% among males) and poverty (26.4% for those at or above poverty compared with 23.7% for those below poverty) were statistically significant in the U.S. population but not in LAC (29.8% among females and 26.1% among males; 29.3% for those at or above poverty compared with 26.8% for those below poverty).

Differences between LAC and the United States for 2007–2014

Estimates for 2007–2014, unadjusted, age adjusted, and fully adjusted for all demographic factors, were compared to examine the differences in prevalence between the United States and LAC for each outcome. Most results from the unadjusted and age-adjusted analyses were similar, but several results from the fully adjusted analyses differed (Table 4). The prevalence of HSV-1 was significantly higher in LAC (unadjusted 65.9%, age adjusted 67.9%) compared with the United States (unadjusted 53.3%, age adjusted 53.7%) in both the unadjusted and age-adjusted analyses. However, after adjustment for the other demographic factors in the fully adjusted analysis, prevalence was lower in LAC (51.1%) compared with the United States (53.1%), although this difference did not reach statistical significance.

In contrast with HSV-1, prevalence of HSV-2 was lower in LAC compared with the United States in the unadjusted and age-adjusted analyses (unadjusted: 12.5% for LAC and 14.8% for the United States; age adjusted: 13.4% for LAC and 15.1% for the United States), but it was higher in LAC (15.2%) compared with the United States (14.8%) once adjustment was made for the five demographic variables. None of these differences in HSV-2 prevalence reached statistical significance.

Prevalence of any HPV was consistently higher in LAC than the United States (unadjusted estimate: 43.1% and 38.8%, respectively; age-adjusted estimate: 42.2% and 38.8%, respectively); however, the difference between the two estimates reached statistical significance only when fully adjusted (52.3% and 38.8%, respectively). In contrast, the prevalence of high-risk HPV in LAC compared with the United States was lower in the unadjusted (19.3% for LAC and 21.0% for the United States) and age-adjusted (18.0% for LAC and 21.1% for the United States) analyses, but higher in the fully adjusted (22.0% for LAC and 21.1% for the United States) analyses; however, differences were small and did not reach statistical significance.

Prevalence of HAV antibody from infection or immunization was significantly greater in LAC compared with the United States in all analyses (unadjusted estimate: 69.2% for LAC and 38.1% for the United States; age-adjusted estimate: 69.8% for LAC and 38.5% for the United States), even after adjustment for population demographic differences (51.8% for LAC and 38.5% for the United States).

Similarly, prevalence of HBV core antibody, an indicator of ever being infected with HBV, was significantly higher in LAC than the United States in both the unadjusted and age-adjusted analyses (unadjusted estimate: 9.2% and 4.0%; age-adjusted estimate: 9.1% and 3.7%, respectively). However, after adjustment for the five demographic factors, the difference was smaller and no longer reached statistical significance (5.2% and 3.9%, respectively, $p = 0.060$).

Unadjusted prevalence of surface antibody to HBV alone, an indicator of HBV immunization, was significantly greater in LAC than the United States (unadjusted estimate: 27.7% and 24.5%, respectively). The differences between these two populations were even greater after adjustment for the five demographic factors in the fully adjusted analysis (31.5% and 24.9%, respectively). Age-adjusted differences were smaller and did not reach statistical significance (28.0% and 25.9%, respectively).

Change over time (1999–2006 compared with 2007–2014)

To compare the change over time in the United States and LAC in the prevalence of each outcome, this report examined unadjusted, age-adjusted, and fully adjusted estimates, controlling for all five demographic cofactors (age, race and Hispanic ethnicity, sex, birth outside the United States, and living below the poverty index) for each time period (1999–2006 and 2007–2014), for five out of seven outcomes (Table 5). Data were not available for prevalence of any HPV or high-risk HPV for 1999–2006, so this report was unable to examine changes over time for those two outcomes.

Prevalence of HSV-1 decreased significantly from 1999–2006 to 2007–2014 in the United States in the unadjusted, age-adjusted, and fully adjusted analyses (decrease of 3.5, 3.1, and 4.7 percentage points, respectively). In contrast, prevalence of HSV-1 increased (1.3, 3.4, and 3.0 percentage points, respectively) over the same time period in LAC in all three analyses. The change over time in LAC did not reach statistical significance, possibly due to the smaller sample size and greater variability in the LAC estimates. However, it appears that the direction of change over time in LAC may differ from the United States.

Prevalence of HSV-2 decreased significantly over time from 1999–2006 to 2007–2014 in the unadjusted, age-adjusted, and fully adjusted analyses for the U.S. population (2.2, 1.8, and 2.0 percentage points, respectively). Similarly, prevalence decreased (7.8, 7.3, and 1.4 percentage points, respectively) over time in LAC. The magnitude of change was larger in LAC than the

United States for both the unadjusted and age-adjusted analyses but reached statistical significance only in the age-adjusted analysis.

Prevalence of antibody to HAV due to immunization or infection increased significantly in the United States in the unadjusted and age-adjusted analyses (3.2 and 3.8 percentage points, respectively). After adjustment for the demographic factors strongly associated with HAV antibody prevalence (age, race and Hispanic ethnicity, living below poverty, and birth outside the United States), this change over time was no longer statistically significant (increase of 1.0 percentage points). Prevalence also increased over time in LAC in the unadjusted (3.7 points) and age-adjusted (3.3 points) analyses. This change did not reach statistical significance in the analysis of the smaller LAC sample. Of note, the fully adjusted analyses for LAC showed a decrease in prevalence of HAV from infection or immunization over time that was similar in magnitude (4.2 percentage points); however, the difference did not reach statistical significance.

Prevalence of HBV core antibody (a marker for ever being infected) decreased significantly (0.8, 1.0, and 1.5 percentage points, respectively) over time in the United States in all three analyses. Prevalence over time decreased in LAC only after adjustment for age (0.1 percentage points) or for all demographic cofactors in the fully adjusted model (0.5 percentage points), but the magnitude of change was smaller and did not reach statistical significance for any of the analyses.

Prevalence of HBV surface antibody alone, without core antibody, a marker of HBV immunization, increased significantly over time in the United States in all three analyses (2.3, 2.9, and 3.0 percentage points, respectively). Similarly, prevalence increased over time for LAC. Although the magnitude of the difference was greater in LAC in all three comparisons, it only reached statistical significance in the age-adjusted (5.1 percentage points) and fully adjusted (9.9 percentage points) analyses.

Discussion and Conclusions

This report examined the prevalence and changes over time of seven selected infectious disease outcomes in LAC, with comparisons to the U.S. population based on data from the 1999–2006 and 2007–2014 NHANES. Such studies are helpful to the LAC Department of Public Health and others who monitor the public's health in LAC, and provide useful comparisons with national data that would otherwise not be easily obtained were it not for NHANES. The inclusion of LAC in every NHANES survey cycle provides a unique opportunity for this type of study even though, for some of the attempted analyses, the smaller sample size in LAC, especially within demographic subgroups, precluded some analyses from reaching display standards for disclosure, statistical stability, or significance.

One example of the public health utility of the NHANES data is the LAC-specific information for the age-adjusted prevalence of antibody to HAV from infection or immunization for those aged 6 years and over. The higher age-adjusted prevalence of HAV antibody in LAC (69.8%) compared with the United States (38.5%) may be a result of increased immunization in LAC. This higher adjusted prevalence, together with targeted vaccination of homeless persons and men who have sex with men, may have been a factor for the recent outbreaks of HAV in LAC not reaching higher numbers of persons (7,21).

Some of the statistically significant differences noted in the results of prevalence in the selected infectious disease outcomes were due to the significant demographic differences between the LAC and U.S. populations, including that persons in LAC were more likely to be Mexican American, born outside of the United States, and live below poverty. Significant differences between LAC and the United States in the unadjusted analyses for indicators of HSV-1 and HBV infection were no longer significant when examining the fully adjusted estimates controlling for these demographic cofactors. Prevalence was higher among Mexican-American persons, those living below poverty, and those born outside the United States in this analysis and in previous studies for HSV-1 (22), and was higher among those born outside the United States for HBV infection (23). Direct standardization of LAC estimates to the U.S. 2007–2014 population distribution decreased the prevalence for LAC, resulting in smaller differences in prevalence that were no longer statistically significant.

No real difference was seen in prevalence of high-risk HPV between LAC and the United States, however, prevalence of any HPV infection was greater in LAC after adjustment for the demographic difference between the two populations. Prevalence of any HPV was higher among those who were U.S.-born compared with those born outside the United States, and higher among non-Hispanic black persons compared with Mexican-American persons. These differences by race and Hispanic ethnicity were similar to those seen by McQuillan et al. (24). The population distribution of both subgroups (non-Hispanic black and U.S.-born) was lower in LAC compared with the United States, therefore, adjustment to the U.S. 2007–2014 population using direct standardization increased prevalence for LAC compared with the unadjusted estimate. Other differences between LAC and the United States, such as antibody for HAV from infection or immunization and HBV surface antibody, an indicator of immunization, remained even after adjustment for the demographic differences between the two populations.

Another example of the public health utility of the LAC-specific NHANES data is the information on the statistically significant increases over time in both the LAC and U.S. populations in the prevalence of HBV surface antibody, an indicator of HBV immunization, and the simultaneous decrease in the prevalence of HBV core antibody, an indicator of ever being infected (although statistically significant only for the U.S. population). Similar changes over time were found by Roberts et al. when comparing unadjusted prevalence for the United States from NHANES for 1999–2006 to 2007–2012 (23). These data, along with immunization records, provide public health officials with an indication

that vaccination is continuing to have an impact on reducing the number of persons susceptible to HBV infection.

A significant decrease in the age-adjusted prevalence of antibody to both HSV-1 and HSV-2 over the two time periods in the U.S. population, seen in this analysis, is similar to previously published NHANES data that showed a linear decreasing trend in the United States using 2-year cycles from 1999–2000 to 2015–2016 for both outcomes (25). Decreases over time similar or larger in magnitude for HSV-2 were also found for LAC, however, these changes reached statistical significance only for the age-adjusted analysis.

There are several limitations to this analysis. First, NHANES samples only the noninstitutionalized population of the United States and does not include homeless or incarcerated persons who may be at higher risk for many of the outcomes analyzed. Second, oversampling of the non-Hispanic Asian population did not begin until 2011–2012, therefore, it was not possible to create estimates for or examine the effects of the population distribution for that subgroup within LAC. Third, even though it is possible to create estimates for LAC, many of the estimates when stratified by subgroup were unstable and differences difficult to examine because of the much smaller sample size and corresponding limited statistical power to find significant differences in the LAC population. As noted in Table 3, several differences by demographic subgroup for LAC should be interpreted with caution. Outcomes with lower prevalence (HIV and HCV, among others) had such low prevalence that many estimates were not reliable and were not presented here. Fourth, analyses for differences over time were limited to comparing two time periods: 1999–2006 and 2007–2014. No additional analyses within these time periods could be conducted for LAC.

In conclusion, the NHANES survey data, especially now that a sufficient number of survey cycles has been completed so trends over time can be analyzed, are a valuable source of information for the LAC Department of Public Health for "keeping its fingers on the pulse" of the public's health in the county, and for comparing selected health indicators in LAC with those of the country.

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Table 1. Sociodemographic characteristics of weighted examined sample aged 6 years and over: United States and Los Angeles County, 1999–2006

Variable	United States			Los Angeles County		
	Sample size	Percent distribution	Standard error	Sample size	Percent distribution	Standard error
Total	34,338	100	…	1,844	100	…
Age group (years)						
6–11	4,534	9.4	0.2	288	11.1	1.1
12–19	9,493	12.6	0.3	594	13.8	2.0
20–29	3,866	14.7	0.4	178	16.2	2.2
30–39	3,419	15.8	0.4	168	18.6	2.2
40–49	3,319	16.9	0.4	174	16.1	2.3
50–59	2,530	13.0	0.4	112	11.3	1.0
60–69	3,019	8.3	0.3	175	7.0	1.2
70 and over	4,158	9.4	0.4	155	†5.9	1.2
Sex						
Male	16,612	48.6	0.3	853	49.6	1.7
Female	17,726	51.4	0.3	991	50.4	1.7
Race and Hispanic ethnicity						
Non-Hispanic white	13,898	69.0	1.5	172	†32.8	4.2
Non-Hispanic black	8,512	11.0	1.0	189	8.1	1.6
Mexican American	9,118	8.4	0.7	1,279	†32.9	3.1
All Hispanic	…	…	…	…	…	…
All other, including Hispanic	2,810	10.7	1.0	204	†26.2	3.5
All other non-Hispanic	…	…	…	…	…	…
U.S. birth status						
Non-U.S. born	6,332	13.7	0.9	696	†42.3	3.3
U.S. born	27,978	86.3	0.9	1,148	†57.7	3.3
Poverty status						
Below poverty	7,539	14.2	0.6	531	†23.2	2.7
At or above poverty	23,936	79.3	0.6	1,112	†67.9	2.9
Missing	2,863	6.4	0.4	201	9.0	1.5

… Category not applicable.
† p is less than 0.05 from a two-sided t statistic examining the difference in percent between the United States and Los Angeles County populations using the combined standard error accounting for the population overlap.

NOTE: Percentages may not add to 100.0 because of rounding.

SOURCE: NCHS, National Health and Nutrition Examination Survey.

Table 2. Sociodemographic characteristics of weighted examined sample aged 6 years and over: United States and Los Angeles County, 2007–2014

Variable	United States			Los Angeles County		
	Sample size	Percent distribution	Standard error	Sample size	Percent distribution	Standard error
Total	33,982	100	…	1,610	100	…
Age group (years)						
6–11	5,218	8.7	0.2	250	8.5	0.8
12–19	5,282	12.0	0.2	282	12.8	0.9
20–29	3,889	15.0	0.5	191	18.4	2.0
30–39	4,015	14.2	0.3	161	14.3	1.7
40–49	3,991	15.4	0.3	176	15.5	1.6
50–59	3,728	14.7	0.3	184	13.9	1.3
60–69	3,808	10.4	0.3	197	9.3	1.3
70 and over	4,051	9.6	0.3	169	7.4	1.0
Sex						
Male	16,787	48.7	0.3	757	49.1	1.4
Female	17,195	51.3	0.3	853	50.9	1.4
Race and Hispanic ethnicity						
Non-Hispanic white	13,184	65.0	1.8	207	†28.0	2.7
Non-Hispanic black	7,677	12.1	0.9	180	†8.6	1.2
Mexican American	5,943	9.7	1.0	674	†34.3	2.7
All Hispanic	9,538	15.5	1.3	918	†46.5	3.0
All other, including Hispanic	7,178	13.2	0.8	549	†29.1	2.9
All other non-Hispanic	3,583	7.4	0.5	305	†16.9	3.0
U.S. birth status						
Non-U.S. born	7,612	15.5	0.9	692	†42.4	2.3
U.S. born	26,349	84.5	0.9	915	†57.5	2.3
Poverty status						
Below poverty	8,162	16.3	0.7	445	†23.5	2.5
At or above poverty	22,832	76.7	0.9	915	†62.8	2.5
Missing	2,988	7.0	0.4	250	†13.8	1.9

… Category not applicable.
† p is less than 0.05 from a two-sided t statistic examining the difference in percent between the United States and Los Angeles County populations using the combined standard error accounting for the population overlap.

NOTE: Percentages may not add to 100.0 because of rounding.

SOURCE: NCHS, National Health and Nutrition Examination Survey.

Table 3. Age-standardized percent prevalence of designated infectious outcomes overall and by level of select demographic cofactors: United States and Los Angeles County population, 2007–2014

Variable	United States					Los Angeles County				
	Sample size	Percent	Lower 95% CI	Upper 95% CI	*p* value	Sample size	Percent	Lower 95% CI	Upper 95% CI	*p* value
HSV-1 antibody										
Total	14,176	53.7	51.7	55.8	…	658	67.9	62.4	73.1	…
Age group (years)										
14–29	6,910	40.3	38.3	42.4	(1)	355	51.3	43.1	59.5	(1)
30–39	3,615	59.9	57.1	62.7	…	141	76.8	67.2	84.8	…
40–49	3,651	66.6	63.7	69.4	…	162	82.6	72.4	90.3	…
Sex										
Male	6,949	51.2	48.9	53.5	(2)	307	67.0	58.6	74.6	(†)
Female (ref)	7,227	56.3	53.9	58.6	…	351	68.9	62.7	74.5	…
Race and Hispanic ethnicity										
Non-Hispanic white (ref)	5,374	45.6	43.2	48.0	…	79	§50.7	32.1	69.1	…
Non-Hispanic black	2,954	60.8	57.8	63.9	(2,3)	60	§56.8	40.6	72.0	(†,3)
Mexican American	2,664	77.1	74.4	79.6	(2)	294	80.3	73.8	85.7	(2)
All other	3,184	62.9	60.2	65.5	---	225	68.8	58.1	78.3	---
U.S. birth status										
Non-U.S. born	3,695	75.4	72.3	78.3	(2)	302	81.1	73.6	87.3	(2)
U.S. born (ref)	10,474	48.8	46.8	50.8	…	355	56.3	49.5	62.9	…
Poverty status										
Below poverty	3,612	67.1	64.5	69.6	(2)	194	76.5	67.0	84.4	(4)
At or above poverty (ref)	9,451	50.0	47.7	52.2	…	359	62.0	54.8	68.8	…
HSV-2 antibody										
Total	14,176	15.1	14.0	16.1	…	658	13.4	10.0	17.5	…
Age group (years)										
14–29	6,910	5.9	5.0	6.8	(1)	355	5.3	2.6	9.4	(1)
30–39	3,615	18.2	16.6	19.9	…	141	11.7	6.9	18.2	…
40–49	3,651	25.0	22.5	27.6	…	162	26.7	17.7	37.3	…
Sex										
Male	6,949	10.1	9.2	11.1	(2)	307	11.9	7.8	17.1	(†)
Female (ref)	7,227	19.9	18.5	21.3	…	351	15.0	10.7	20.3	…
Race and Hispanic ethnicity										
Non-Hispanic white (ref)	5,374	11.2	10.0	12.6	…	79	¶12.7	5.8	23.4	…
Non-Hispanic black	2,954	38.8	37.0	40.6	(2,3)	60	§40.2	23.5	58.7	(2,3)
Mexican American	2,664	12.1	10.6	13.7	(†)	294	11.6	7.1	17.6	(†)
All other	3,184	14.8	12.8	17.1	---	225	9.9	5.1	17.0	---
U.S. birth status										
Non-U.S. born	3,695	13.0	11.3	14.8	(5)	302	11.7	7.0	18.1	(†)
U.S. born (ref)	10,474	15.6	14.3	17.0	…	355	19.2	13.3	26.3	…
Poverty status										
Below poverty	3,612	23.0	20.7	25.5	(2)	194	13.4	8.0	20.5	(†)
At or above poverty (ref)	9,451	13.4	12.3	14.5	…	359	13.3	8.8	19.2	…
Any HPV										
Total	8,512	38.8	37.3	40.4	…	413	42.2	36.3	48.2	…
Age group (years)										
14–19 (ref)	1,537	26.0	23.1	29.1	(†)	91	20.8	11.3	33.5	(1)
20–29	1,696	53.0	49.8	56.2	…	84	51.6	38.4	64.7	…
30–39	1,778	39.3	36.3	42.3	…	71	38.0	24.3	53.3	…
40–49	1,865	38.5	35.8	41.2	…	83	47.6	34.6	60.9	…
50–59	1,636	32.0	28.2	36.1	…	84	§45.9	29.3	63.1	…
Race and Hispanic ethnicity										
Non-Hispanic white (ref)	3,232	35.9	34.0	37.8	…	48	§48.3	31.0	65.9	…
Non-Hispanic black	1,904	57.0	54.1	59.8	(2,3)	39	§65.2	44.8	82.2	(†,3)
Mexican American	1,504	37.4	34.9	40.0	(†)	173	38.0	30.3	46.1	(†)
All other	1,872	36.8	33.7	40.0	---	153	35.1	24.2	47.2	…

See footnotes at end of table.

Table 3. Age-standardized percent prevalence of designated infectious outcomes overall and by level of select demographic cofactors: United States and Los Angeles County population, 2007–2014—Con.

Variable	United States					Los Angeles County				
	Sample size	Percent	Lower 95% CI	Upper 95% CI	*p* value	Sample size	Percent	Lower 95% CI	Upper 95% CI	*p* value
U.S. birth status					Any HPV—Con.					
Non-U.S. born	2,194	34.8	32.0	37.6	(4)	211	36.1	28.3	44.5	(4)
U.S. born (ref)	6,315	39.8	38.1	41.7	…	202	51.2	44.1	58.3	…
Poverty status										
Below poverty	2,178	50.5	48.3	52.7	(2)	121	47.0	35.7	58.5	(†)
At or above poverty (ref)	5,689	36.2	34.4	38.0	…	221	41.7	33.3	50.5	…
					High-risk HPV					
Total	8,512	21.1	19.9	22.5	…	413	18.0	13.3	23.7	…
Age group (years)										
14–19 (ref)	1,537	17.3	14.4	20.4	(†)	91	¶14.5	6.2	27.3	(†)
20–29	1,696	35.0	31.9	38.3	…	84	37.0	25.2	50.0	…
30–39	1,778	21.0	19.0	23.0	…	71	¶¶11.2	3.7	24.3	…
40–49	1,865	17.5	15.1	20.0	…	83	¶¶14.7	5.2	30.4	…
50–59	1,636	13.1	10.7	15.9	…	84	¶¶12.4	4.2	26.4	…
Race and Hispanic ethnicity										
Non-Hispanic white (ref)	3,232	19.6	18.0	21.3	…	48	¶22.6	10.2	40.0	…
Non-Hispanic black	1,904	30.9	28.6	33.2	(2,3)	39	§§41.9	19.3	67.3	(†,3)
Mexican American	1,504	20.6	18.1	23.3	(†)	173	18.7	12.8	25.7	(†)
All other	1,872	19.2	17.0	21.5	---	153	9.5	5.0	15.9	---
U.S. birth status										
Non-U.S. born	2,194	18.4	16.3	20.7	(5)	211	10.9	6.7	16.5	(4)
U.S. born (ref)	6,315	21.8	20.2	23.4	…	202	22.9	16.1	30.9	…
Poverty status										
Below poverty	2,178	29.4	27.4	31.4	(2)	121	25.8	15.7	38.3	(†)
At or above poverty (ref)	5,689	19.2	17.6	20.8	…	221	17.1	11.0	24.9	…
					HAV antibody from immunization or infection					
Total	29,749	38.5	36.7	40.4	…	1,373	69.8	66.2	73.3	…
Age group (years)										
6–19 (ref)	8,641	52.9	49.3	56.4	(†)	437	90.3	84.3	94.5	(†)
20–39	7,124	32.0	29.7	34.3	…	305	59.5	50.8	67.8	…
40–59	7,005	30.5	28.3	32.9	…	323	70.1	61.9	77.5	…
60 and over	6,979	44.7	42.2	47.4	…	308	62.0	48.5	74.4	…
Sex										
Male	14,709	38.5	36.5	40.6	(†)	657	66.6	61.9	71.1	(5)
Female (ref)	15,040	38.5	36.5	40.4	…	716	73.1	68.3	77.6	…
Race and Hispanic ethnicity										
Non-Hispanic white (ref)	11,815	26.7	25.1	28.4	…	171	47.8	38.0	57.9	…
Non-Hispanic black	6,424	41.9	39.1	44.7	(2,3)	134	52.9	43.3	62.3	(†,3)
Mexican American	5,290	80.2	78.2	82.2	(2)	590	86.0	82.2	89.2	(2)
All other	6,220	66.3	64.0	68.5	---	478	79.9	73.2	85.6	---
U.S. birth status										
Non-U.S. born	6,806	76.4	74.0	78.6	(2)	620	83.9	77.7	89.0	(2)
U.S. born (ref)	22,926	30.7	29.2	32.3	…	752	49.5	45.0	54.0	…
Poverty status										
Below poverty	7,101	50.1	46.6	53.6	(2)	392	83.0	76.1	88.5	(2)
At or above poverty (ref)	20,237	35.8	34.1	37.6	…	780	63.7	59.4	67.9	…
					HBV core antibody, a marker of ever infected					
Total	30,017	3.7	3.3	4.1	…	1,411	9.1	6.4	12.3	…
Age group (years)										
6–19 (ref)	8,641	0.3	0.2	0.5	(†)	437	*	*	*	---
20–39	7,181	2.4	2.0	3.0	…	314	*	*	*	…
40–59	7,132	5.9	5.1	6.8	…	336	17.2	10.7	25.6	…
60 and over	7,063	6.6	5.8	7.5	…	324	16.9	12.0	22.9	…

See footnotes at end of table.

Table 3. Age-standardized percent prevalence of designated infectious outcomes overall and by level of select demographic cofactors: United States and Los Angeles County population, 2007–2014—Con.

Variable	United States					Los Angeles County				
	Sample size	Percent	Lower 95% CI	Upper 95% CI	*p* value	Sample size	Percent	Lower 95% CI	Upper 95% CI	*p* value
Sex				HBV core antibody, a marker of ever infected—Con.						
Male	14,864	4.2	3.7	4.7	[4]	675	8.9	5.4	13.6	[†]
Female (ref)	15,153	3.3	2.9	3.8	…	736	9.3	6.1	13.5	…
Race and Hispanic ethnicity										
Non-Hispanic white (ref)	11,920	1.9	1.6	2.3	…	180	¶5.1	2.2	10.0	…
Non-Hispanic black	6,489	8.8	8.0	9.7	[2,3]	143	¶6.3	3.0	11.7	[†,‡]
Mexican American	5,346	2.2	1.8	2.8	[†]	602	3.7	2.1	5.9	[†]
All other	6,262	11.5	10.0	13.1	…	486	19.8	13.5	27.4	---
U.S. birth status										
Non-U.S. born	6,867	10.2	9.0	11.6	[2]	639	12.4	8.2	17.9	[4]
U.S. born (ref)	23,133	2.5	2.2	2.8	…	771	5.6	3.8	8.0	…
Poverty status										
Below poverty	7,175	6.3	5.5	7.3	[2]	400	6.9	3.8	11.5	[†]
At or above poverty (ref)	20,406	3.3	2.9	3.7	…	806	9.7	6.6	13.6	…
				HBV surface antibody, a marker of HBV immunization						
Total	30,013	25.9	25.1	26.7	…	1,411	28.0	25.5	30.5	…
Age group (years)										
6–19 (ref)	8,638	41.1	39.2	43.1	[1]	437	47.3	42.5	52.1	[1]
20–39	7,181	37.5	35.9	39.2	…	314	44.8	37.7	52.0	…
40–59	7,132	13.8	12.5	15.2	…	336	8.3	5.2	12.3	…
60 and over	7,062	6.5	5.6	7.5	…	324	7.0	3.8	11.5	…
Sex										
Male	14,862	23.2	22.2	24.1	[2]	675	26.1	22.8	29.6	[†]
Female (ref)	15,151	28.5	27.4	29.6	…	736	29.8	26.1	33.8	…
Race and Hispanic ethnicity										
Non-Hispanic white (ref)	11,919	26.0	25.0	27.1	…	180	35.9	28.7	43.5	…
Non-Hispanic black	6,488	26.5	25.3	27.7	[†,3]	143	33.6	24.4	43.8	[†,3]
Mexican American	5,346	20.4	19.3	21.6	[2]	602	23.8	20.0	28.0	[4]
All other	6,260	28.9	27.1	30.7	…	486	24.7	19.7	30.4	---
U.S. birth status										
Non-U.S. born	6,867	28.1	26.5	29.8	[5]	639	25.3	21.5	29.5	[5]
U.S. born (ref)	23,129	26.2	25.4	27.0	…	771	32.5	29.2	36.0	…
Poverty status										
Below poverty	7,175	23.7	22.1	25.4	[2]	400	26.8	21.9	32.3	[†]
At or above poverty (ref)	20,403	26.4	25.6	27.2	…	806	29.3	25.7	33.1	…

… Category not applicable.
† Test of difference or trend not statistically significant; *p* value greater than 0.05.
§ Estimate considered unstable—absolute CI width greater than or equal to 30 and less than 40.
--- Data not available.
¶ Estimate considered unstable—relative CI width greater than or equal to 130 and less than 160.
¶¶ Estimate considered unstable—relative CI width greater than or equal to 160 and less than 190.
§§ Estimate considered unstable—absolute CI width greater than or equal to 40 and less than 50.
* Estimate not reported because it does not meet standards of confidentiality or reportability.
‡ Estimate of difference in prevalence between non-Hispanic black and Mexican-American persons is not statistically significant; *p* value greater than 0.05.
[1] *p* value less than 0.05 for test of linear trend in prevalence with age group.
[2] *p* value less than 0.001 for test of difference in prevalence between subgroup and reference group for each cofactor.
[3] *p* value less than 0.05 for difference in prevalence between non-Hispanic black and Mexican-American persons.
[4] *p* value less than 0.01 for test of difference in prevalence between subgroup and reference group for each cofactor.
[5] *p* value less than 0.05 for test of difference in prevalence between subgroup and reference group for each cofactor.

NOTES: Age-standardized estimates are adjusted using the direct method to the U.S. Census 2000 population using the age groups designated in the table. "All other" racial and ethnic category is not representative of any race and Hispanic group. CI is confidence interval. HSV is herpes simplex virus. ref is reference group. HPV is human papillomavirus. HAV is hepatitis A virus. HBV is hepatitis B virus.

SOURCE: NCHS, National Health and Nutrition Examination Survey.

Table 4. Unadjusted, age-adjusted, and fully adjusted difference in prevalence between the United States and Los Angeles County, 2007–2014

Outcome	Prevalence (percent) United States	Prevalence (percent) LAC	Difference in prevalence	Combined standard error	*p* value
HSV-1[1]					
Unadjusted	53.3	65.9	12.6	2.9	Less than 0.001
Age-adjusted 2000 Census[2]	53.7	67.9	14.2	2.6	Less than 0.001
Fully adjusted[3]	53.1	51.1	–2.0	3.5	0.563
HSV-2[1]					
Unadjusted	14.8	12.5	–2.3	1.7	0.175
Age-adjusted 2000 Census[2]	15.1	13.4	–1.7	1.8	0.358
Fully adjusted[3]	14.8	15.2	0.4	3.4	0.905
Any HPV[4]					
Unadjusted	38.8	43.1	4.3	3.0	0.158
Age-adjusted 2000 Census[2]	38.8	42.2	3.4	2.9	0.243
Fully adjusted[3]	38.8	52.3	13.5	5.0	0.007
High-risk HPV[4]					
Unadjusted	21.0	19.3	–1.7	2.6	0.516
Age-adjusted 2000 Census[2]	21.1	18.0	–3.1	2.4	0.203
Fully adjusted[3]	21.1	22.0	0.9	3.6	0.804
HAV antibody[5]					
Unadjusted	38.1	69.2	31.1	2.0	Less than 0.001
Age-adjusted 2000 Census[2]	38.5	69.8	31.3	2.0	Less than 0.001
Fully adjusted[3]	38.5	51.8	13.3	2.6	Less than 0.001
HBV ever infected[5]					
Unadjusted	4.0	9.2	5.2	1.5	0.001
Age-adjusted 2000 Census[2]	3.7	9.1	5.4	1.4	Less than 0.001
Fully adjusted[3]	3.9	5.2	1.3	0.7	0.060
HBV antibody from vaccination[5]					
Unadjusted	24.5	27.7	3.2	1.6	0.041
Age-adjusted 2000 Census[2]	25.9	28.0	2.1	1.2	0.073
Fully adjusted[3]	24.9	31.5	6.6	2.0	0.001

[1]Available for those aged 14–49 years.
[2]Age adjusted using direct standardization to the U.S. Census 2000 population.
[3]Fully adjusted using direct standardization to the U.S. population distribution stratified by age, race and Hispanic ethnicity, sex, living below poverty, and birth outside the United States, estimated from the weighted sample from the 2007–2014 National Health and Nutrition Examination Survey.
[4]Available for those aged 14–59 years.
[5]Available for those aged 6 years and over.

NOTES: LAC is Los Angeles County. HSV is herpes simplex virus. HPV is human papillomavirus. HAV is hepatitis A virus. HBV is hepatitis B virus.

SOURCE: NCHS, National Health and Nutrition Examination Survey.

Table 5. Unadjusted, age-adjusted, and fully adjusted prevalence of five infectious outcomes and change in prevalence over time: United States and Los Angeles County, 1999–2006 to 2007–2014

Outcome	Prevalence (percent) 1999–2006	Lower 95% CI	Upper 95% CI	Prevalence (percent) 2007–2014	Lower 95% CI	Upper 95% CI	Change over time	*p* value for change
HSV-1 antibody[1]								
United States:								
Unadjusted	56.8	55.2	58.4	53.3	51.1	55.4	–3.5	0.007
Age-adjusted 2000 Census[2]	56.8	55.2	58.4	53.7	51.7	55.8	–3.1	0.018
Fully adjusted[3]	57.8	56.4	59.2	53.1	51.5	54.8	–4.7	Less than 0.001
LAC:								
Unadjusted	64.6	56.6	72.0	65.9	59.9	71.6	1.3	0.770
Age-adjusted 2000 Census[2]	64.5	56.3	72.1	67.9	62.6	72.9	3.4	0.453
Fully adjusted[3]	48.1	42.0	54.2	51.1	43.8	58.4	3.0	0.521
HSV-2 antibody[1]								
United States:								
Unadjusted	17.0	15.8	18.3	14.8	13.8	15.8	–2.2	0.004
Age-adjusted 2000 Census[2]	16.9	15.8	18.1	15.1	14.0	16.2	–1.8	0.017
Fully adjusted[3]	16.8	15.9	17.8	14.8	14.1	15.6	–2.0	0.001
LAC:								
Unadjusted	20.3	12.8	29.7	12.5	9.3	16.4	–7.8	0.077
Age-adjusted 2000 Census[2]	20.7	15.0	27.5	13.4	9.9	17.7	–7.3	0.041
Fully adjusted[3]	16.6	10.5	24.4	15.2	8.8	23.8	–1.4	0.775
HAV antibody[4]								
United States:								
Unadjusted	34.9	33.2	36.6	38.1	36.3	40.0	3.2	0.009
Age-adjusted 2000 Census[2]	34.7	32.9	36.5	38.5	36.6	40.4	3.8	0.003
Fully adjusted[3]	37.5	36.2	38.7	38.5	37.3	39.7	1.0	0.235
LAC:								
Unadjusted	65.5	59.9	70.7	69.2	65.3	73.0	3.7	0.248
Age-adjusted 2000 Census[2]	66.5	61.0	71.7	69.8	66.0	73.5	3.3	0.298
Fully adjusted[3]	56.0	48.6	63.2	51.8	46.3	57.3	–4.2	0.347
HBV core antibody, a marker of ever infected[4]								
United States:								
Unadjusted	4.8	4.3	5.3	4.0	3.6	4.4	–0.8	0.014
Age-adjusted 2000 Census[2]	4.7	4.2	5.2	3.7	3.3	4.2	–1.0	0.005
Fully adjusted[3]	5.4	5.0	5.9	3.9	3.7	4.2	–1.5	Less than 0.001
LAC:								
Unadjusted	8.5	5.5	12.5	9.2	6.3	13.0	0.7	0.764
Age-adjusted 2000 Census[2]	9.2	5.9	13.6	9.1	6.4	12.3	–0.1	0.950
Fully adjusted[3]	5.7	3.0	9.8	5.2	3.8	6.8	–0.5	0.756
HBV surface antibody, a marker of vaccination[4]								
United States:								
Unadjusted	22.2	21.2	23.1	24.5	23.6	25.4	2.3	Less than 0.001
Age-adjusted 2000 Census[2]	23.0	21.9	24.1	25.9	25.1	26.7	2.9	Less than 0.001
Fully adjusted[3]	21.9	21.0	22.9	24.9	24.2	25.6	3.0	Less than 0.001
LAC:								
Unadjusted	24.1	19.7	29.0	27.7	24.6	31.1	3.6	0.189
Age-adjusted 2000 Census[2]	22.9	20.1	25.8	28.0	25.6	30.4	5.1	0.006
Fully adjusted[3]	21.6	18.1	25.4	31.5	27.4	35.8	9.9	Less than 0.001

[1]Available for those aged 14–49 years.
[2]Age adjusted using direct standardization to the U.S. Census 2000 population.
[3]Fully adjusted using direct standardization to the U.S. population distribution stratified by age, race and Hispanic ethnicity, sex, living below poverty, and birth outside the United States, estimated from the weighted sample from the 2007–2014 National Health and Nutrition Examination Survey.
[4]Available for those aged 6 years and over.

NOTES: CI is confidence interval. HSV is herpes simplex virus. LAC is Los Angeles County. HAV is hepatitis A virus. HBV is hepatitis B virus.

SOURCE: NCHS, National Health and Nutrition Examination Survey.

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National Health Statistics Reports ■ Number 119 ■ October 30, 2018

Suggested citation

Kruszon-Moran D, McQuillan G, Kim-Farley R. Prevalence, change over time, and comparison with U.S. estimates of selected infectious diseases in Los Angeles County: Findings from the National Health and Nutrition Examination Survey, 1999–2006 and 2007–2014. National Health Statistics Reports; no 119. Hyattsville, MD: National Center for Health Statistics. 2018.

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DHHS Publication No. 2019–1250 • CS296295