california health interview survey

Making California's Voices Heard on Health

California Health Interview Survey
UCLA Center for Health Policy Research
10960 Wilshire Blvd.
Suite 1550
Los Angeles, CA 90024

Tel (310) 794-0925
Toll Free (866) 275-2447
Fax (310) 794-2686
Email: chis@ucla.edu

www.chis.ucla.edu

Age-Adjusted Estimates Using California Health Interview Survey

Age-adjusted estimates are widely used in epidemiological studies to compare rates of health outcomes, morbidity and mortality. Age adjustments are commonly used to compare estimates across different geographic areas that have differential population age distributions. Age-adjustment makes such comparisons independent of age effects and is important because rates of most diseases or health outcomes differ by age groups. Heart disease, for example, is more prevalent among older people, while injuries are more likely among younger people. Differences in health related estimates may be confounded by different age distributions in the population and age adjustment is a method to eliminate this confounder. Note that once an age adjustment is applied, estimates no longer represent the population characteristics of the selected area, because the adjustment artificially alters the age distribution. Therefore, an age-adjusted estimate is a relative index of the risk rather than the actual index.

The following sections describe how age-adjusted estimates and their standard errors are calculated, including an example of using age adjustment.

1. Age Adjustment

Age adjustment is rather simple as it directly applies a standardized age distribution to an age-specific estimate. Let p_{ij} be the rate of some estimate. Let p_{ij} be the rate of some characteristics for area *i* and age group *j* (e.g., asthma rate for ages 17 or younger in Los Angeles County) and N_j be the standardized population size for age group *j* (e.g., the population size for ages 17 or younger in California), where $i = 1,...,I$ and $j = 1,...,J$. The age-adjusted estimate for area *i* can be expressed as follows:

$$p_{i,adj} = \frac{\sum_{j=1}^{J} p_{ij} N_j}{\sum_{j=1}^{J} N_j}.$$

Note that age adjustment requires the standardized population age distribution coming from an external source. For CHIS, one may consider using population projections or estimates published by U.S. Census Bureau, California Department of Finance, or some other source. There is no standard way of forming age categories, and, therefore, it is up to the discretion of the analyst.

2. Standard Errors for Age-Adjusted Estimates

As N_j's are fixed (meaning the same standardized population age distribution is applied to all areas), the variance can be estimated as follows:

$$\mathrm{var}\left(p_{i,adj}\right)=\frac{\sum_{j=1}^{J} N_j^2\,\mathrm{var}\left(p_{ij}\right)}{\left(\sum_{j=1}^{J} N_j\right)^2}.$$

As long as there are $\mathrm{var}\left(p_{ij}\right)$'s (which can be obtained from standard software, such as SAS), standard errors of the age-adjusted estimates can easily be estimated as $se\left(p_{i,adj}\right)=\sqrt{\mathrm{var}\left(p_{i,adj}\right)}$ and confidence intervals for age-adjusted estimates as $p_{i,adj}\pm z_{1-\alpha/2}\cdot se\left(p_{i,adj}\right)$. Note that since $\mathrm{var}\left(p_{ij}\right)$ accounts for complex sample design, the design complexity is already accounted for in $\mathrm{var}\left(p_{i,adj}\right)$.

3. Example

Suppose that we are interested in comparing asthma prevalence in San Francisco, Fresno and Los Angeles counties. From CHIS 2005, the respective estimates are 13.1%, 19.2%, and 11.9% with standard errors of 1.41%, 1.83%, and 0.41%. Table 1 indicates that there are differential age distributions in these three counties. While the age distribution in San Francisco appears to differ from the statewide distribution, Los Angeles resembles the statewide distribution closely (based on the California Department of Finance population estimates). As mentioned previously, CHIS does not recommend any specific age categories or sources for the standardized age distribution, and Table 1 is presented only for illustration purposes.

In order to mitigate the age differential in comparing the counties, we use the statewide age distribution for the standardized population size. Age-adjustment uses the age-specific estimates shown in Table 2 along with the standardized age distribution in Table 1 and produces the following age-adjusted estimates for each county:

$$p_{\text{San Francisco},adj}=\frac{0.194\times 9,759,000+0.127\times 22,515,000+0.089\times 3,873,000}{9,759,000+22,515,000+3,873,000}=0.141,$$

Table 1. Age Distribution by County

County	Age					
	0-17		18-94		65+	
	N	%	N	%	N	%
San Francisco	101,000	13.2	556,000	72.8	107,000	14.0
Fresno	246,000	28.9	525,000	61.7	80,000	9.4
Los Angeles	2,613,000	26.5	6,260,000	63.5	984,000	10.0
Statewide	*9,759,000*	*27.0*	*22,515,000*	*62.3*	*3,873,000*	*10.7*

Table 2. Age-Specific Asthma Prevalence by Age and County

County	Age					
	0-17		18-94		65+	
	%	SE (%)	%	SE (%)	%	SE (%)
San Francisco	19.40	4.66	12.70	1.65	8.90	2.65
Fresno	30.50	4.12	14.90	2.08	12.40	3.01
Los Angeles	14.20	0.93	11.10	0.49	10.80	0.97

Source: California Health Interview Survey, 2005

$$p_{\text{Fresno},adj} = \frac{0.305\times 9,759,000 + 0.149\times 22,515,000 + 0.124\times 3,873,000}{9,759,000 + 22,515,000 + 3,873,000} = 0.188,$$

$$p_{\text{Los Angeles},adj} = \frac{0.142\times 9,759,000 + 0.111\times 22,515,000 + 0.108\times 3,873,000}{9,759,000 + 22,515,000 + 3,873,000} = 0.119.$$

The respective standard errors are calculated as follows:

$$se\left(p_{\text{San Francisco},adj}\right) = \sqrt{\frac{0.0466^2\times 9,759,000^2 + 0.0165^2\times 22,515,000^2 + 0.0265^2\times 3,873,000^2}{\left(9,759,000 + 22,515,000 + 3,873,000\right)^2}} = 0.0165,$$

$$se\left(p_{\text{Fresno},adj}\right) = \sqrt{\frac{0.0412^2\times 9,759,000^2 + 0.0208^2\times 22,515,000^2 + 0.0301^2\times 3,873,000^2}{\left(9,759,000 + 22,515,000 + 3,873,000\right)^2}} = 0.0174,$$

$$se\left(p_{\text{Los Angeles},adj}\right) = \sqrt{\frac{0.0093^2\times 9,759,000^2 + 0.0049^2\times 22,515,000^2 + 0.0097^2\times 3,873,000^2}{\left(9,759,000 + 22,515,000 + 3,873,000\right)^2}} = 0.0041.$$

Table 3 compares the population-based and age-adjusted asthma prevalence rates in these three counties. As the age distribution of Los Angeles resembles that of the state, the age-adjusted estimate is not different from the unadjusted population-based estimate. For San Francisco and Fresno counties, the difference in asthma prevalence between these two counties decreased from 6.1% to 4.7% after adjusting for the age differential.

Table 3. Population-Based and Age-Adjusted Asthma Prevalence by County

County	Population-based		Age-adjusted	
	%	SE (%)	%	SE (%)
San Francisco	13.1	1.41	14.1	1.65
Fresno	19.2	1.83	18.8	1.74
Los Angeles	11.9	0.41	11.9	0.41

Source: California Health Interview Survey, 2005