



Using NHANES Data to Characterize the Magnitude of Allostatic Load in Vulnerable Communities: Impact to Existing Risk Assessment Uncertainty/Variability Factors

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Abstract:

Characterization of the degree of susceptibility among vulnerable communities is an emerging need in health-based risk assessments with particular interest in the impact of non-chemical stressors. Further, publications have suggested that basal stress levels, or allostatic loads, are elevated among vulnerable populations compared to the general population which may impact the sensitivity to chemical stressors. Recent agency and academic investigations have focused on historically disadvantaged communities likely impacted by non-chemical stressors with the development of geographical tools like EJ screen to locate such communities for additional consideration. The objective of this work is to investigate the degree of susceptibility within such populations. This was accomplished by leveraging publicly available NHANES data (2017-2018 and 2015-2016 datasets) and nine biometric indicators of human health to estimate allostatic load for the general population and for defined subpopulations. Considering survey and demographic information, subpopulations within the NHANES cohort were subset by specific criteria highlighted in the EJ screen and other investigatory tools. These criteria broadly related to income, attained education, food availability, and healthcare access. A cumulative group which matched criteria from all of the aforementioned subsets was also included as the prototypical vulnerable community. The allostatic indicators (serum albumin, body mass index, serum C – reactive protein, serum creatinine, diastolic blood pressure, glycated hemoglobin, systolic blood pressure, total cholesterol, and serum triglycerides) were evaluated by percentile and summed to generate a score from 0-9, i.e. an allostatic load score. Medication use and declared health status were reviewed and adjustments to allostatic score were made for medications which while potentially successful in treating the symptoms may not address the true basal stress of the respondents due to non-chemical stressors. NHANES exam weights were used to calibrate the results from the NHANES cohorts to the US population. Results suggest that there is an increased allostatic load within the low food availability and education subpopulations as median allostatic load scores across the populations shifting from 2 to 3. These data groups had relatively large sample sizes (n = 892 and n = 3501, respectively) within the 2017-2018 NHANES cohort (n = 5520). Clear demographic differences were seen within several of the subpopulations with a shift towards minority populations. Notably, the 2017-2018 NHANES general population consisted of 62% white and 38% non-white whereas within the prototypical population 43% were white and 57% non-white with 28% being Hispanic and 18% black. Additionally, this prototypical population was also younger with a mean age of 38 yrs vs. 45 yrs for the general population. Lastly, the magnitude of the excess allostatic load observed in certain subpopulations was contextualized within current sensitivity uncertainty/adjustment factors commonly used in risk assessments. While there is no geographic data available in publicly released NHANES data to overlay onto EJ screen output, this analysis provides a potential methodology which could be applied to other datasets. Such quantitative investigations improve the understanding of susceptibility and may provide the foundation for additional adjustment factors to incorporate into cumulative risk assessments.