Biological Indicators in a Nationally Representative Sample of Young Adults: How Do Add Health Wave IV Biomarkers Measure Up?

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BACKGROUND AND SIGNIFICANCE

In the past decade, biological indicators have emerged as important components of large-scale, population-based social surveys. In combination with in-depth demographic, psychosocial, and behavioral data traditionally collected in social surveys, the integration of biomarker data opens up opportunities for examining interactions between social and biological factors as well as how health and developmental trajectories are formed. The National Longitudinal Study of Adolescent Health (Add Health) is one such survey that includes comprehensive longitudinal sociodemographic, economic, psychological, and behavioral data from a nationally representative sample of adolescents over the course of four waves; a set of biological indicators that represent cardiovascular, metabolic, immune, and inflammatory systems are available in the fourth wave, when respondents have entered young adulthood. While many other social surveys with biomarkers have focused on aging in older populations, Add Health collects biomarkers in a cohort of young adults, enabling research efforts to obtain a better understanding of how health problems and subclinical disease emerge at earlier ages.

As researchers from multiple disciplines utilize these data to study the complex transition from adolescence to adulthood, it is important to establish a basic understanding of available biological indicators, what they represent, and how to use them in appropriate contexts. This paper presents a descriptive profile of biological indicators in Wave IV of Add Health by: 1) comparing distributions of biomarker to those available in the National Health and Nutrition Examination Survey (NHANES); 2) comparing biomarker collection, measurement, and assay techniques in Add Health and NHANES; and 3) examining sociodemographic patterns of subclinical high risk levels of biomarkers in Add Health.

NHANES is used as a comparison because, similar to Add Health, it is based on a nationally representative sample that overlaps with the age group in Add Health and contains a comprehensive range of comparable biomarkers. Despite these similarities, there are a number of differences in the two studies, including study design (longitudinal vs cross-sectional); recruitment (in-home vs mobile examination centers); sample collection (dried blood spots vs. venipuncture); and biomarker assays. Potential reasons for variations across the two studies in terms of the values and distributions of biomarker variables will be discussed.

DATA AND METHODS

Data description. This study uses data from the National Longitudinal Study of Adolescent Health (Add Health), a longitudinal study of a nationally representative sample of adolescents in grades 7-12 in the U.S. during the 1994-95 school year. The cohort has been followed into young adulthood with a total of four in-home interviews, the most recently in 2007-2008, when the sample was aged 24-32 years. Add Health is a multi-respondent study, collecting data from respondents themselves, as well as their parents, friends, and school administrators (Bearman, Jones, & Udry, 1997). A school-based design was used to select a stratified sample of 80 high schools. The school student rosters constituted the student-level sampling frame. In Wave IV, in-home questionnaires were immediately followed by physical measurements and collection of biological specimens (salivary samples for DNA and blood spots from respondents). The analytical sample for this study includes all respondents 24-32 years who have valid data on biomarkers, are not pregnant, and completed Wave I and Wave IV in-home questionnaires.

Biomarker data from the National Health and Nutrition Examination Survey (NHANES) 2007-2008 (not yet publicly available), approximately the same time frame as collection of Wave IV of Add Health, are used for comparison. The NHANES survey is a cross-sectional study that uses a complex stratified, multistage probability sampling design to provide national estimates of health and nutritional status for the civilian, non-institutionalized US population. Beginning in 1999, NHANES IV has been collected on a continuous basis and released every two years. Eligible respondents are obtained with the use of household-based sampling procedures. Survey components include questionnaire interviews, clinical examination, and laboratory procedures (the clinical and laboratory components occur in Mobile Examination Centers (MEC)). The analytic sample for this study consists of respondents ages 24-32 years old who have valid data on biomarkers, are not pregnant, and completed the interview and MEC exam components.

Biomarker variables. The biomarkers available in Add Health and NHANES represent cardiovascular, metabolic, immune, and inflammatory systems. While individual biological indicators are generally categorized to represent certain systems, there is considerable overlap due to complex interaction of physiological systems. Cardiovascular measures include resting heart rate, and systolic and diastolic blood pressure. Metabolic functioning is represented by body mass index (BMI), waist circumference, total cholesterol, low density lipoprotein (LDL), high density lipoprotein (HDL), and glycosylated hemoglobin (HbA_{1c}). Immune/inflammatory markers include Epstein-Barr virus (EBV) and C-reactive protein (CRP) concentrations. All biomarkers in Add Health, with the exception of anthropometric measures, were collected via dried blood spots (McDade, Snodgrass, & Williams. 2007) In NHANES, biomarker measures were derived from blood samples taken via venipuncture. Dichotomous variables for subclinical high risk for each biological indicator in Add Health will be created using cutoffs based on the highest risk quartile value of the analytical sample distribution.

Independent variables. The key independent variables in Add Health used to describe high risk patterns of biomarkers include: gender (male/female); race/ethnicity (non-Hispanic (NH) white; NH black; Hispanic; NH Asian; NH Native American; NH Other), socioeconomic status (parents' and respondent's education; household income), and nativity status (US- and foreign-born). Parental and respondents' educational attainment are categorized as less than high school; high school graduate; some college; college graduate; and post-graduate. Respondent's household income at Wave IV is categorized as <$20,000; $20,000-29,999; $30,000-39,999; $40,000-49,999; $50,000-74,999; and ≥$75,000. Other sociodemographic variables examined include age and marital status.

Analysis. The distributional qualities of each of the individual biomarkers will be examined (range, mean, median, quartiles) and compared between Add Health and NHANES. Detailed qualitative descriptions of biomarker collection, measurement, and assay techniques will be described for biomarkers in both datasets and discussed as potential sources of differences. Bivariate cross-tabulations and multivariate logistic regression models will be employed to assess sociodemographic

correlates of having subclinical high risk values on biological indicators in Add Health. All analyses and estimates will be conducted using Stata 11 (StataCorp, 2009) and weighted using sampling weights, which adjust for complex sample design, selection, and non-response, appropriate to each dataset.

PRELIMINARY RESULTS

Table 1 presents the range, mean, median, and quartiles of select biomarkers in NHANES 1999-2004 (data from 2007-2008 is not publicly available yet). When Wave IV of Add Health becomes available in the fall of 2009, distributional qualities of biological indicators will be similarly examined and compared with those in NHANES. Table 2 presents unweighted bivariate cross-tabulations of sociodemographic variables and preliminary Wave IV dichotomous variables that incorporate biological indicators. Older age was significantly associated with higher prevalence of high blood sugar/diabetes, pre-hypertension/hypertension, and high blood cholesterol/triglycerides/lipids. Females had higher prevalence of high blood sugar/diabetes, whereas males had higher prevalence of pre-hypertension/hypertension. Non-Hispanic blacks and Native Americans had the highest percentages of obesity, high blood sugar/diabetes, and hypertensive disease. Lower socioeconomic status was generally associated with higher prevalence of health conditions. Respondents who had never been married had lower prevalence of obesity and high cholesterol, but higher prevalence of high blood sugar/diabetes and hypertensive conditions, compared to those who had been married once or more.

Table 1. Descriptive statistics of individual biomarkers among 24-32 year olds, NHANES 1999-2004 (N=1869).

Biomarker	Range	Mean	25%	50%	75%	Clinical high risk standard
Cardiovascular markers						
Blood pressure – systolic (mm Hg)	(0, 181)	114.83	106.00	114.00	122.00	≥140
Blood pressure – diastolic (mm Hg)	(0, 121)	69.65	63.00	70.00	76.00	≥90
Pulse rate (bt/min)	(44, 116)	72.90	64.00	72.00	80.00	≥90
Metabolic markers						
Body mass index (kg/m^2)	(14.83, 64.97)	27.64	23.14	26.32	30.76	≥25
Glycosylated hemoglobin (%)	(3.6, 12.9)	5.22	5.00	5.20	5.40	≥6.4
HDL (mg/dL)	(20, 160)	50.55	41.00	48.00	59.00	<40
Total cholesterol (mg/dL)	(72, 539)	188.81	162.00	185.00	212.00	≥240
Inflammatory markers						
CRP (mg/dL)	(0.01, 18.50)	0.39	0.06	0.16	0.41	≥0.3

Table 2. Percentage distributions (unweighted) of sociodemographic characteristics and preliminary Add Health Wave IV health variables (N=9271).

Characteristic	% Distribution	Obesity	High blood sugar/diabetes	Pre-hypertension/ Hypertension	High blood cholesterol or triglycerides or lipids
Total	`100.00	36.43	5.33	23.03	7.62
Age at W1 (years)			**	*	***
12	2.72	30.96	2.38	20.24	4.76
13	13.63	34.24	4.03	20.49	4.83
14	16.56	35.08	4.56	21.30	5.54
15	20.26	36.58	5.27	23.11	8.31
16	22.03	37.84	5.68	24.83	8.67
17	18.02	37.42	6.58	23.46	9.22
18	6.78	38.68	6.68	26.23	9.70
Gender			**	***	
Male	45.15	35.73	4.59	31.77	7.24
Female	54.85	37.05	5.94	15.83	8.07
Race/ethnicity			***	***	***
NH White	56.59	33.25	2.69	22.05	7.96
NH Black	20.40	43.43	12.18	26.06	5.19
Hispanic	15.25	43.22	5.81	21.60	9.42
NH Asian	6.20	25.05	4.70	23.17	7.67
NH Native American	0.79	51.47	13.70	38.36	10.96
NH Other	0.77	26.09	2.82	23.94	7.04
Parental education		***		**	
Less than high school	14.07	42.73	7.35	26.35	8.37
High school/GED	28.60	40.81	5.54	24.43	7.27
Some college	20.28	63.97	5.43	21.81	7.11
College graduate	23.97	31.63	4.82	21.48	7.25
Post graduate	13.08	27.21	3.11	21.28	8.58
Respondent's education W4		***	***	***	†
No college degree	65.76	41.36	6.51	25.19	7.23
College degree	34.24	26.83	3.06	18.87	8.35
Household income W4		***	***	**	*
<$20,000	11.04	40.20	8.58	27.30	5.44
$20,000-29,999	9.54	41.19	6.90	22.40	7.02

Table 2, continued.

Characteristic	% Distribution	Obesity	High blood sugar/diabetes	Pre-hypertension/ Hypertension	High blood cholesterol or triglycerides or lipids
$30,000-39,999	10.70	39.01	5.94	21.49	6.59
$40,000-49,999	12.14	41.20	5.33	24.36	7.71
$50,000-74,999	24.77	37.77	4.38	22.81	8.07
≥$75,000	31.80	29.90	3.92	21.32	8.79
Marital status W4		*	†	***	***
Never married	52.04	35.20	5.77	24.61	6.39
Married once or more	47.96	37.79	4.86	21.30	8.94

Note: Results based on Pearson's chi-square test.
†p≤.1; * p ≤ .05; ** p ≤ .01; *** p ≤ .001.

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