Ideal Cardiovascular Health in Adolescence and Young Adulthood: An International Comparison

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Background

Over the past decade, the United States (US) health disadvantage relative to OECD peer countries has gained widespread attention from a series of studies (Banks et al. 2006; Avendano et al. 2009; Martinson et al. 2011; Avendano and Kawachi 2014) and a well-cited Institute of Medicine (IOM) report (Woolf et al. 2013). Further evidence of the magnitude of this health disadvantage has arrived in the form of two consecutive years of life expectancy decline in the United States (Kochanek et al. 2017), leading to an increase in the existing disparity between the United States and OECD peer countries (World Bank 2017). Public commentary on this issue has often focused on the role of "diseases of despair" in mortality increases (e.g. drug and alcohol poisoning, suicide, and chronic liver disease/cirrhosis), particularly in middle and later adulthood (e.g. Case and Deaton 2015). Yet, the overall picture of the United States' slide in life expectancy is also due to the stagnation of improvements in cardiovascular and metabolic disease (Preston, Vierboom, and Stokes 2018; Frieden 2018) with recent research suggesting obesity (Preston, Vierboom, and Stokes 2018) and underestimates of diabetes deaths (Stokes and Preston 2017) playing key roles. In fact, these studies suggest that if cardiovascular disease was improving at the same rate in the United States as the OECD average, we wouldn't observe overall measurable declines in life expectancy. Evidence has suggested stagnation in cardiovascular mortality improvement is most notable for white adults age 25-54, particularly for women (Masters, Tilstra, and Simon 2017; Case and Deaton 2017).

In studies focused on morbidity, the United States remains an outlier among its peers in most indicators of chronic disease, and because the US disadvantage is still quite large despite healthcare spending at almost twice the OECD average (Banks et al. 2006; Martinson et al. 2011; Woolf et al. 2013). Research has shown that by middle and later adulthood, the United States has

fallen behind countries such as England on numerous health measures, including cardiovascular-related outcomes (Banks et al. 2006; Martinson et al. 2011). These patterns hold when accounting for race/ethnicity, socioeconomic status, and health insurance coverage (Martinson et al. 2011; Martinson 2012). The prevalence of cardiovascular diseases (CVD) in the United States is expected to rise 10% during the next decade and this change in the trajectory of cardiovascular burden is highly influenced by the dramatic rise over the past 25 years in obesity and the hypertension, diabetes mellitus, and physical inactivity that accompany weight gain (Havranek et al., 2015). Despite declines in CVD mortality over the past several decades, it remains the leading cause of death in the United States, and many disadvantaged groups are disproportionately burdened with poor cardiovascular health. These studies, and the report by Woolf and colleagues (2013), suggest that the health gap between the United States and peer countries emerges early in the life course. Yet, a recent comparison of health at birth in the United States, United Kingdom, Canada, and Australia demonstrated relatively less variation in health at birth, though the United States was still an outlier in inequalities in infant health by socioeconomic status (Martinson and Reichman 2016). Together, the evidence suggests that childhood, adolescence, and early adulthood may be critical periods to understanding why health in the United States is so poor.

An urgent call for innovative international research using comparable health measures, particularly for young people, was key to the recommendations from the IOM report (Woolf et al. 2013). Until recently, this was quite challenging. It is difficult to achieve adequate sample size for studies on adolescent and young adult health using the typical blunt measures of health often included in international health surveys (e.g. self-rated health, disability, and self-reported chronic conditions), which are more appropriate for older adults. Moreover, there is variability in

how these health outcomes are categorized and measured across countries. While there are comparable surveys for health in later adulthood, (e.g. the US Health and Retirement Study; English Longitudinal Study of Aging; and Survey of Health, Ageing and Retirement in Europe), nationally representative comparisons at younger ages have previously been hampered by data limitations.

This paper will generate a substantial contribution to understanding the US health disadvantage early in the life course by taking advantage of nationally representative health data that include comparable measures from questionnaires, body measures, and laboratory blood samples in the United States, England, and Canada to investigate differences in cardiovascular wellness in adolescence and early adulthood in these three countries. We explore and compare the ways in which the United States differs from England and Canada in terms of cardiovascular wellness early in the life course using Ideal Cardiovascular Health (ICH) (Lloyd-Jones et al. 2010). To address this question, first we investigate the ideal cardiovascular health status of the United States compared to England and Canada among adolescents and young adults. Then, we examine how socio-economic position and poverty influence patterns in cardiovascular wellness at early ages in the three countries.

Data and Methods

Data

We use nationally representative health data from the National Health and Nutrition Examination Survey (NHANES) and the Health Survey for England (HSE) in this abstract. For the manuscript to be completed for PAA in April 2019, we will also add the Canadian Health Measures Survey (CHMS), which was conducted from 2007-2015 (sample size for all ages ~24,000 for the years between 2004 and 2015). All three datasets take advantage of detailed

questionnaires, body measurement, and blood sample measures. We use the 2004-2015 waves of the NHANES with a total sample size of about 78,582. Likewise, we use the 2004-2015 years (total sample size 113,442) of the Health Survey for England.

Sample

Our analyses rely on the sample of adolescents and young adults (12-19 and 20-34 ages respectively) without missing information on key covariates. After controlling for missing information, our analytic sample ended was 18,553 for NHANES (9,832 adolescents and 8,721 young adults) and 36,172 for HSE (16,726 adolescents and 19,446 young adults).

Measures

Ideal Cardiovascular Health (ICH) is our outcome variable, which is a summary measure of health outcomes as defined in a special report by the Goals and Metrics Committee of the Strategic Planning Task Force of the American Heart Association (Lloyd-Jones et al. 2010). ICH was originally constructed using measures included in the continuous NHANES (NCHS 2013). The American Heart Association's (AHA) ideal cardiovascular health score is based on 7 cardiovascular health metrics, namely healthy diet, exercise, smoking status, BMI, cholesterol, blood pressure and blood glucose. The ICH metric has been used in several studies in the US, for example, in relation to social risk factors (Caleyachetty, et al., 2015), to obesity (Vasunilashorn, Kim & Crimmins, 2013), to educational disparities (Lawrence, Hummer, Domingue and Harris, 2018) and to health insurance coverage (McClurkin, et al., 2015). Also, several European studies have utilized this metric with European adolescents (Ruiz, et al., 2014; Henriksson, et al., 2017). However, some original components of the ICH are not included in the HSE and CHMS. Therefore, we follow previous studies that have modified this ICH summary measure in

examining cardiovascular wellness using datasets, such as the HELENA study in Europe (Henriksson et al. 2017) and Add Health in the United States (Lawrence, Hummer, and Harris 2017). We have defined each of indicators in line with the AHA, making accommodations given available data (as noted).

In this study, we define ICH as a categorical outcome based on each individual's ICH scores, namely ideal, intermediate and poor CH categories. ICH scores were calculated as the combination of six ICH factors; BMI, smoking, exercise, cholesterol, blood pressure and glucose. We define ideal and poor categories for each indicator using the thresholds of AHA. We use a scoring system (ideal=0 point and poor=1 point) on these indicators to create a continuous measure with a range of 0 to 6. And then, we set thresholds for this ICH score, where (1) ICH for scores of 0 to 1, (2) Intermediate CH scores of 2 to 3, and (3) Poor CH for scores of 4 or higher. The six components of ICH are detailed below.

Ideal Body Mass Index (BMI). We define BMI as a categorical variable into (1) Ideal BMI, (2) Intermediate BMI, and (3) Poor BMI. We use BMI ≥ 25 kg/m2 (intermediate) and BMI ≥ 30 kg/m2 (poor) for adults and International Obesity Task Force cut points for those under 18 age (Cole, Bellizzi & Flegal, 2000).

Ideal Exercise is classified into two categories according to their levels of exercise: (1) Ideal Exercise Status for meeting the criteria, and (2) Poor Exercise status for not meeting the criteria, criteria is defined as 60 minutes exercise daily for adolescents and 75 minute vigorous or 150 minute moderate weekly exercise for young adults.

Tobacco Use Status. We categorize tobacco use as a binary variable; (1) Ideal Smoking: not smoking or quit smoking, (2) Poor Smoking: current smoker.

Ideal Total Cholesterol is described different for age groups; (1) Ideal Cholesterol is lower than 200 mg/dL for young adults and 170 mg/dL for adolescents, (2) Intermediate Cholesterol is between 200 to 240 mg/dL for young adults and between 170 to 200 mg/dL for adolescents, (3) Poor Cholesterol is greater than 240 mg/dL for young adults and 200 mg/dL for adolescents.

Ideal Blood Pressure is measured according to mean values of Systolic Blood Pressure (SBP) and Diastolic Blood Pressure (DBP) readings: (1) Ideal Blood Pressure when lower than 120 SBP or 80 DBP, (2) Intermediate Blood Pressure when SBP is in between 120 to 139 and DBP is in between 80 to 89, (3) Poor Blood Pressure when SBP is greater than 149 and DBP is greater than 90.

Ideal Blood Glucose is measured by level of glycated hemoglobin, where (1) Ideal Glucose is when HbA1c less than 5.7, (2) Poor Glucose is when HbA1c is greater than 5.7 (Lawrence, Hummer, & Harris, 2017)

We also include a number of sociodemographic control measures that have been used in previous comparative studies using the NHANES and HSE: sex, age, income, education, race/ethnicity, nativity, and health insurance coverage (Martinson, Teitler, & Reichman 2011; Martinson 2012).

Preliminary Results

Table 1 assesses the prevalence of ICH and its components in the United States and England for adolescents and young adults. In line with previous research, we find that American adolescents and young adults are less likely to have ideal BMI (normal weight) than their English peers. On the other hand, smoking is markedly higher among young people in England

than in the United States. The third cardiovascular-related behavior, exercise, is better in the United States than England for adolescents, but by young adulthood this relationship is reversed.

For the biomarker measures that make up ICH, English young people are more likely to have total cholesterol levels in the ideal range. Interestingly, the rates very poor total cholesterol is twice as high in the United States as they are in England. English adolescents are more likely than American adolescents to have blood pressure measurements in the ideal range, but it appears this advantage erodes by young adulthood when the rates of ideal blood pressure are identical. The prevalence of ideal blood sugar (measured as glycated hemoglobin) are similar in the two countries. When, we combine these health behaviors and biological factors to examine the rates of ICH, the United States appears to enjoy better overall cardiovascular wellness on this summary measure than England for both adolescents and young adults. This result appears to be driven by the significant rates of smoking in England. We will further explore this in the full manuscript.

Future steps

Between now and April, we will extend the analysis in this abstract to Canada. We will be able to further disentangle patterns in cardiovascular wellness in the United States, England, and Canada by sex and socioeconomic status by calculating adjusted proportions and testing for statistical significance in the results in the three countries. We are confident we will be able to complete these analyses by April 2019.

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Table 1. Cardiovascular Behaviors and Risk Factors in England and the United States

	England		United States	
	Adolescents	Young Adults	Adolescents	Young Adults
	16,726	19,446	9,832	8,721
Ideal Health Behaviors				
Body Mass Index				
Ideal	77	58	58	38
Intermediate	17	27	21	28
Poor	6	15	21	34
Total	100	100	100	100
Current Smoking				
Smoking	15	30	3	8
Not Smoking	85	70	97	92
Total	100	100	100	100
Exercise				
Ideal	62	74	70	60
Poor	38	26	30	40
Total	100	100	100	100
Ideal Health Factors				
Total Cholesterol				
Ideal	73	66	66	63
Intermediate	20	25	16	19
Poor	7	9	18	18
Total	100	100	100	100
Blood Pressure				
Ideal	89	72	84	72
Poor	11	28	16	28
Total	100	100	100	100
Blood Sugar				
Ideal	91	89	93	90
Poor	9	11	7	10
Total	100	100	100	100
Ideal Cardiovascular Health				
Ideal	41	35	47	44
Intermediate	53	54	49	49
Poor	6	11	4	8
Total	100	100	100	100

Source: 2004-2015 HSE and NHANES