Contents lists available at ScienceDirect

SSM - Population Health

journal homepage: www.elsevier.com/locate/ssmph

Article

Wide educational disparities in young adult cardiovascular health

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A B S T R A C T

Widening educational differences in overall health and recent stagnation in cardiovascular disease mortality rates highlight the critical need to describe and understand educational disparities in cardiovascular health (CVH) among U.S. young adults. We use two data sets representative of the U.S. population to examine educational disparities in CVH among young adults (24–34) coming of age in the 21st century: the National Health and Nutrition Examination Survey (2005–2010; N = 689) and the National Longitudinal Study of Adolescent to Adult Health (2007–2008; N = 11,200). We employ descriptive statistics and regression analysis. The results show that fewer than one in four young adults had good CVH (at least 5 out of 7 ideal cardiovascular indicators). Young adults who had not attained a college degree demonstrate particularly disadvantaged CVH compared with their college-educated peers. Such educational disparities persist after accounting for a range of confounders, including individuals' genetic propensity to develop coronary artery disease. The results indicate that the CVH of today's young adults is troubling and especially compromised for individuals with lower levels of educational attainment. These results generate substantial concern about the future CVH of the US population, particularly for young adults with a low level of education.

Introduction

Cardiovascular disease (CVD) is the leading cause of death in the United States, accounting for one in three deaths (Benjamin et al., 2017). Further, CVD has the highest medical costs of any chronic disease in the US, with expenses projected to rise in the future (AHA & ASA, 2017). While CVD mortality in the United States exhibited impressive declines between the 1960s and 2000s, improvements in CVD mortality have stagnated, with some evidence of an increasing rate among young women (Mensah et al., 2017; Wilmot, O'Flaherty, Capewell, Ford & Vaccarino, 2015). The worrisome trends appear to be driven by younger cohorts who have worse cardiovascular health than older generations had when they were young (Masters et al., 2018; Preston et al. 2018). Moreover, US young adults are in worse cardiovascular health (CVH) than those in peer nations (Murray et al., 2013; NRC & IOM, 2013). Thus, there have been many calls for increased attention to the troubling trends in CVH (Havranek et al., 2015; Huffman et al., 2012; Lloyd-Jones, 2012), and in particular to the CVH of young adults as harbingers of future trends (Ford & Capewell, 2007; George et al., 2017). Researchers have projected that the long-term

cardiovascular risk among U.S. young adults is sizable, and that few young adults had optimal CVH (Clark et al., 2014; Gooding et al., 2016). Young adults are also characterized by differences in cardiovascular risk by race/ethnicity and gender, with males and Black or American Indian young adults exhibiting the highest risks (Clark et al., 2014).

While much is known about the persistent educational gradients in CVD, we know little about educational disparities in CVH among U.S. young adults. Generally, there is a dose-response relationship such that additional years of education are associated with less CVD and more favorable CVH (Kubota, Heiss, MacLehose, Roetker & Folsom, 2017). However, educational disparities in CVH may differ among the contemporary cohort of U.S. young adults. Indeed, educational disparities in US health and all-cause mortality have been widening in the 21st century (Bor et al., 2017; Hayward et al., 2015; Murray et al., 2013; Sasson, 2016; Singh, Siahpush, Azuine & Williams, 2015) and recent gains in health and mortality, including CVH, have been concentrated among the highly educated (Benjamin et al., 2017). Further, there is some evidence of declines in health and increases in mortality among those with a high school degree or less (Bound, Geronimus, Rodriguez &

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Waidmann, 2015; Case & Deaton, 2017; Montez & Zajacova, 2014). Thus, we expect that CVH will be substantially better among young adults with more education, with degrees serving as important thresholds. Documenting and understanding educational differences in CVH among young adults will be crucial in future efforts to reduce disparities and improve population health.

Additionally, understanding educational disparities in young adult CVH can provide insight into when, how, and why differences emerge. Observed educational disparities in adult health are likely the result of both differences in health behaviors by educational attainment over time as well as physiological "imprinting" of prior health profiles across the life course (Montez & Hayward, 2011). We therefore employ a life course perspective that conceptualizes educational disparities in adult health as the culmination of prior experiences and circumstances (Zajacova & Lawrence, 2018). We consider factors from multiple domains and life course stages. First, we control for socioeconomic background, an influential factor for adult CVH (Galobardes et al., 2006). Prior research has shown that health behaviors in adolescence are related to adult cardiovascular functioning (Ames et al., 2018; Gooding et al., 2016; Lawrence, Mollborn, & Hummer, 2017), and we thus examine the extent to which these factors explain some of the young adult educational disparities in CVH. We also examine young adult socioeconomic and social factors related to educational attainment and cardiovascular health, including household income, employment, health insurance status, family structure, population density at residential location, and religiosity (Harper et al., 2011; Lawrence, Hummer, & Harris, 2017). Finally, genetic predisposition has been shown to be important in the development of cardiovascular conditions (Polderman et al., 2015), and thus may play a role in setting in motion pre-disease pathways over the early adult life course (Nikpay et al., 2015). We thus examine the extent to which genetic predisposition can account for the young adult education-CVH relationship.

We first document basic educational disparities in CVH among US young adults using two nationally representative datasets: the National Health and Nutrition Examination Survey (NHANES) and the National Longitudinal Study of Adolescent to Adult Health (Add Health). We use data from both studies to strengthen our conclusions and mitigate the sensitivity of our results to study-specific issues of data collection and measurement error. Second, we examine disparities in young adult CVH using the more detailed educational attainment data in Add Health. Third, we assess the extent to which the detailed educational disparities are shaped by individuals' genetic propensity for coronary heart disease, background SES, and young adult socioeconomic and social factors that have been shown to be associated with cardiovascular risk or disease and that may shape educational disparities. Because most young adults have yet to experience serious cardiovascular events, we assess CVH using a prospective measure of Ideal Cardiovascular Health suggested by the American Heart Association (AHA). The AHA introduced this metric to better monitor progress toward improvements in overall cardiovascular well-being; it has been shown to be a strong predictor of future morbidity and mortality (Benjamin et al., 2017; Ommerborn et al., 2016; Yang et al., 2012).

Methods

Data

We used two nationally representative data sources: NHANES and Add Health. These two datasets both offered health behavior reports, biomarkers of cardiovascular function, and medication information that could be used to identify CVH patterning among U.S. young adults. For some measures, NHANES provided more detailed information, but its cross-sectional design precluded insight into life course mechanisms. Further, NHANES sampled Americans of all ages, and thus the number of young adults was relatively small. Add Health, in contrast, included a much larger sample of young adults and longitudinal data, thus facilitating the understanding of life course mechanisms. We therefore employed both datasets.

NHANES collects detailed information on the health of Americans using questionnaires and physical examinations on a periodic cross-sectional basis (CDC and NCHS, 2017). To ensure comparability between NHANES and Add Health, we used NHANES data from the same time period as the young adult data collection in Add Health. We combined NHANES data from 2005–2010 to assess the CVH of young adults coming of age at the turn of the century. Our NHANES sample included young adults ages 24–34 who were U.S.-born, participated in the Mobile Examination Component and fasting subsamples of the NHANES survey, were not missing data on any CVH component, and were not pregnant (N = 689). See Appendix Fig. 1 for information on the construction of this analytic sample.

Add Health is a longitudinal study that first collected information on adolescents (ages 12–19) in 1994–1995 (Wave I), and were then followed up one year later (Wave II), seven years later in 2001–2002 (Wave III), and thirteen years later in 2008–2009 (Wave IV; Harris, 2010). Our outcome variable was from this last wave of data when respondents were young adults aged 24–34. Because Add Health is longitudinal, we incorporated data from earlier waves to conduct more detailed analyses of life course predictors of CVH. We analyzed a sample that included those Wave IV respondents who had a valid sampling weight, were US-born, were not pregnant or "probably pregnant," and were not missing information on the CVH indicators (N = 11,200). Appendix Fig. 1 provides information on how this analytic sample was constructed. Supplemental analyses used Add Health respondents who had genetic information collected at Wave IV and who were of European ancestry (N = 4201) (Harris et al., 2013).

Measures

Outcome

As defined by the AHA, CVH comprises seven factors: BMI, smoking, physical activity, diet, blood pressure, glucose, and cholesterol (Lloyd-Jones et al., 2010). We defined ideal, intermediate, and poor categories for each of these indicators in line with the AHA, making accommodations given available data. See supplemental materials (Appendix Table 1) for details on the thresholds and definitions for each of the indicators for both datasets. Add Health and NHANES measured height, weight, and blood pressure from the respondents, obtained blood samples for cholesterol and glucose, and asked respondents to report on their smoking, diet, and physical activity. See http://www.cpc.unc.edu/projects/addhealth/documentation/guides and https://www.cdc.gov/nchs/nhanes/nhanes_questionnaires.htm for additional information on the collection of these data.

We combined these seven metrics in one composite that characterized each individual as having good, fair, or risky CVH overall. We defined individuals as having *good CVH* if they met 5 of 7 ideal health metrics. Few individuals (1.1%) met all 7 metrics. Prior research indicates a general dose-response relationship such that more ideal metrics translates into lower cardiovascular risk (Wilmot et al., 2015). Similarly, individuals had overall *fair CVH* if they met 5 of 7 intermediate health metrics (but not 5 of 7 ideal factors). Individuals therefore had *risky CVH* if they did not meet at least 5 of 7 intermediate metrics (which is equivalent to having 3 or more poor metrics). Results using 6 instead of 5 metrics as the threshold, or using a scoring system (ideal = 2 points; intermediate = 1 point; poor = 0 points) to create a continuous measure with a range of 0 to 14, produced the same substantive conclusions to those presented here.

Education measures

For NHANES, educational attainment consisted of four categories: less than high school, high school diploma or GED, some college or associate's degree, and college degree or more. We used an identically-coded measure in Add Health, but also utilized a more detailed measure