Annals of Epidemiology xxx (2017) 1–5

Contents lists available at ScienceDirect

Annals of Epidemiology

journal homepage: www.annalsofepidemiology.org

Brief communication

Widespread recent increases in county-level heart disease mortality across age groups

Adam S. Vaughan PhD, MPH [a,*], Matthew D. Ritchey PT, DPT, OCS, MPH [a], Judy Hannan RN, MPH [a], Michael R. Kramer PhD [b], Michele Casper PhD [a]

[a] Division for Heart Disease and Stroke Prevention, Centers for Disease Control and Prevention, Atlanta, GA
[b] Department of Epidemiology, Rollins School of Public Health, Emory University, Atlanta, GA

ARTICLE INFO

Article history:
Received 24 August 2017
Accepted 20 October 2017
Available online xxx

Keywords:
Heart diseases
Geography
Mortality decline
Mortality rates
Age groups

ABSTRACT

Purpose: Recent national trends show decelerating declines in heart disease mortality, especially among younger adults. National trends may mask variation by geography and age. We examined recent county-level trends in heart disease mortality by age group.
Methods: Using a Bayesian statistical model and National Vital Statistics Systems data, we estimated overall rates and percent change in heart disease mortality from 2010 through 2015 for four age groups (35–44, 45–54, 55–64, and 65–74 years) in 3098 US counties.
Results: Nationally, heart disease mortality declined in every age group except ages 55–64 years. County-level trends by age group showed geographically widespread increases, with 52.3%, 58.5%, 69.1%, and 42.0% of counties experiencing increases with median percent changes of 0.6%, 2.2%, 4.6%, and −1.5% for ages 35–44, 45–54, 55–64, and 65–74 years, respectively. Increases were more likely in counties with initially high heart disease mortality and outside large metropolitan areas.
Conclusions: Recent national trends have masked local increases in heart disease mortality. These increases, especially among adults younger than age 65 years, represent challenges to communities across the country. Reversing these trends may require intensification of primary and secondary prevention—focusing policies, strategies, and interventions on younger populations, especially those living in less urban counties.

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Introduction

Over the past 40 years, heart disease mortality in the United States has declined sharply across race, gender, and age groups [1,2], with similarly strong declines occurring at the county level [3,4]. Recent national trends, however, indicate a slowing and even slight increase in heart disease mortality [5–7]. These slowing declines appear to be the most prominent among young adults [2,6], a group that has also recently experienced increased all-cause and stroke mortality [8–10].

Prior studies of age-specific declines in heart disease mortality in the United States have focused on national trends, potentially masking changes in local age-specific patterns. Local trends, which have historically been strong but varied [3,4], can provide important insights into potential drivers of population shifts in heart disease mortality and inform the development of tailored interventions. Therefore, using a period of marked leveling of national declines (2010–2015) [5], we examined recent county-level heart disease mortality trends by age group.

Methods

We obtained annual counts of county-level heart disease deaths during 2010–2015 from the National Vital Statistics System. Deaths with underlying causes of “diseases of the heart” were identified with the International Classification of Diseases, 10th revision (ICD-10) (codes I00–I09, I11, I13, I20–I51), including: rheumatic heart disease, hypertensive heart disease, ischemic heart disease, and pulmonary heart disease. The study population included residents of the 3098 counties in the continuous US, ages 35–74 years, stratified by age group (35–44, 45–54, 55–64, and 65–74 years). We chose this age range to reflect premature, largely avoidable, deaths due to heart disease [11]. All counties were included. We used US Census intercensal estimates for annual county-level population counts [12].

* Corresponding author. Centers for Disease Control and Prevention, 4770 Buford Highway, Mailstop F73, Atlanta, GA 30341. Tel.: 770-488-8060.
E-mail address: xha4@cdc.gov (A.S. Vaughan).

https://doi.org/10.1016/j.annepidem.2017.10.012
1047-2797/Published by Elsevier Inc.

Table 1
National and county-level heart disease mortality rates and percent change over time, by age group, United States, 2010–2015

Summary statistic	Ages 35–44 years	Ages 45–54 years	Ages 55–64 years	Ages 65–74 years	Ages 35–74 years*
National					
2010 rate (per 100,000) (95% credible interval)	27.0 (26.6–27.5)	84.8 (84.0–85.7)	191.0 (189.6–192.3)	415.6 (413.2–417.9)	133.0 (132.3–133.6)
2015 rate (per 100,000) (95% credible interval)	27.1 (26.7–27.5)	82.7 (81.7–83.4)	194.6 (193.4–195.8)	400.7 (397.7–402.6)	130.9 (130.2–131.5)
Percent change‡ (95% credible interval)	−0.8 (−2.5 to 0.8)	−1.7 (−0.5 to 2.8)	2.0 (0.4–3.7)	−3.8 (−6.3 to −1.2)	−1.6 (−3.3 to 0.0)
County-level†					
2010 rate (per 100,000) (interquartile range)	28.9 (21.9–40.7)	90.5 (69.0–125.6)	201.0 (158.5–262.1)	438.2 (359.5–530.2)	140.4 (113.3–180.0)
2015 rate (per 100,000) (interquartile range)	29.3 (21.8–41.7)	92.2 (69.4–127.7)	208.9 (162.0–278.2)	431.5 (347.8–530.3)	142.8 (112.1–185.3)
Percent change‡ (interquartile range)	0.6 (−7.4 to 9.1)	2.2 (−3.9 to 8.2)	4.6 (−1.5 to 11.4)	−1.5 (−6.6 to 4.0)	1.0 (−4.1 to 6.3)

* Age standardized to the 2000 US population.
† Median county-level rates and percent change are determined from the age-group–specific distribution of county-level rates and percent change. They differ from the national rates and percent change because they are not population weighted.
‡ Percent change was calculated using Poisson regression across all years.

We estimated the rates of heart disease mortality using a Bayesian multivariate space-time conditional autoregressive model. Details of this model have been previously described [13]. Briefly, this model is based on the popular Besag-York-Mollié conditional autoregressive model for spatially referenced count data [14]. It incorporates correlation across space, time, and age group. By iteratively estimating parameters and borrowing strength from spatially, temporally, and age-adjacent groups, these models generate precise, reliable rates even in the presence of small case counts and small populations [3,13]. We fit this model with a Markov chain Monte Carlo (MCMC) algorithm using user-developed code in the R programming language.

We estimated national and county-level heart disease mortality rates for all ages (ages 35–74 years combined) and each age group as the medians of the posterior distributions defined by the MCMC iterations. National values for rates and percent change were calculated using the sums of county-specific deaths and populations, and are therefore skewed toward high population counties. To describe the distribution of rates and percent change across counties, we report median county-level values, which are unweighted by county populations. National and county-specific overall rates for ages 35–74 years combined were age-standardized to the 2000 US standard population.

We estimated relative percent change in national and county-level rates from 2010 through 2015 using Poisson regression, rather than using differences in rates between 2010 and 2015. Using rates generated by each MCMC iteration, separate regression models were run for each county using rates for all 6 years for the given county. Relative percent change was calculated as 100 ($e^{5\beta}-1$), where β is the county-specific (or national) median coefficient for the year variable from the MCMC iterations, and five represents number of between-year intervals in the study period.

To further explore geographic and spatial patterns, we mapped relative percent change in mortality rates and 2015 mortality rates by county. Moreover, we compared percent change across quintiles of county-level heart disease mortality in 2010 and across urban/rural status using the National Center for Health Statistics' 2013 urban-rural classification scheme [15].

Results

Nationally, from 2010 to 2015, age-standardized heart disease mortality for ages 35–74 years declined slightly with a percent change of −1.6% (133.0 to 130.9 per 100,000 in 2010 and 2015, respectively) (Table 1). Nationally, rates slightly declined among adults at ages 35–44, 45–54, and 65–74 years, and increased among adults at ages 55–64 years.

In contrast to the national trends, at the county-level, from 2010 through 2015, the majority of counties experienced increases in heart disease mortality rates: 52.3%, 58.5%, and 69.1% of all counties among ages 35–44, 45–54, and 55–64 years, respectively (Table 2). Even in the oldest age group (65–74 years), 42.0% of the counties experienced increases. The magnitudes of the increases varied by age group, with roughly 1 in 5 counties in the 3 youngest age groups experiencing an increase of at least 10% (23.0%, 19.4%, and 29.3% of all counties among ages 35–44, 45–54, and 55–64 years, respectively; Fig. 1).

With the exception of ages 45–54 years, increasing rates were most prevalent among counties with the highest rates in 2010 (62.4%, 80.0%, and 46.5% of counties in the top quintile of 2010 heart disease mortality for ages 35–44, 55–64, and 65–74 years, respectively, compared with 42.9%, 69.1%, and 42.0% of counties in the bottom quintile) (Table 2). For ages 35–74 years combined, 62.3% of counties in the top quintile of rates in 2010 experienced

Table 2
Percent of counties experiencing increasing heart disease mortality, by age group, United States, 2010–2015

County classification	Ages 35–44 years	Ages 45–54 years	Ages 55–64 years	Ages 65–74 years	Ages 35–74 years*
Overall	52.3%	58.5%	69.1%	42.0%	54.5
Quintile of 2010 rates					
Lowest rates (first quintile)	42.9	58.2	64.5	37.9	46.1
Second quintile	45.2	60.7	60.4	36.5	48.1
Third quintile	53.1	59.4	64.0	43.5	53.9
Fourth quintile	57.8	56.9	76.6	45.6	62.2
Highest rates (Fifth quintile)	62.4	57.3	80.0	46.5	62.3
2013 NCHS urban/rural classification					
Large central metro (most urban)	40.6	34.4	50.0	20.3	31.3
Large fringe metro	53.6	47.3	66.8	32.1	46.4
Medium metro	55.8	61.8	71.3	42.8	56.1
Small metro	53.6	60.7	72.2	47.5	59.0
Nonmetropolitan	52.0	62.4	68.5	43.7	56.2
Noncore (most rural)	48.2	52.4	69.3	38.9	51.3

* Age standardized to the 2000 US population.