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Geographical affiliation with top 10 NIH-funded academic medical centers and differences between mortality from cardiovascular disease and cancer

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Abstract

Background—Community engagement and rapid translation of findings for the benefit of patients has been noted as a major criterion for NIH decisions regarding allocation of funds for research priorities. We aimed to examine whether the presence of top NIH-funded institutions resulted in a benefit on the cardiovascular and cancer mortality of their local population.

Methods and results—Based on the annual NIH funding of every academic medical from 1995 through 2014, the top 10 funded institutes were identified and the counties where they were located constituted the index group. The comparison group was created by matching each index county to another county which lacks an NIH-funded institute based on sociodemographic characteristics. We compared temporal trends of age-standardized cardiovascular mortality between the index counties and matched counties and states. This analysis was repeated for cancer

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mortality as a sensitivity analysis. From 1980 through 2014, the annual cardiovascular mortality rates declined in all counties. In the index group, the average decline in cardiovascular mortality rate was 51.5 per 100,000 population (95% CI, 46.8–56.2), compared to 49.7 per 100,000 population (95% CI, 45.9–53.5) in the matched group ($P = .27$). Trends in cardiovascular mortality of the index counties were similar to the cardiovascular mortality trends of their respective states. Cancer mortality rates declined at higher rates in counties with top NIH-funded medical centers ($P < .001$).

Conclusions—Cardiovascular mortality rates have decreased with no apparent incremental benefit for communities with top NIH-funded institutions, underscoring the need for an increased focus on implementation science in cardiovascular diseases.

The National Institutes of Health (NIH) are the principle funder of biomedical research in the United States (US) with more than $39 billion distributed annually. Research advances spurned by investigations funded by the NIH have led to dramatic improvements in the understanding of cardiovascular diseases and development of therapies, translating into significant declines in cardiovascular diseases mortality over the last four decades in the US.[1] Despite its role as the key supporter of biomedical research in the country, NIH funding tends to be concentrated within a smaller number of academic medical centers. Furthermore, institutions receiving higher proportions of NIH's funding have remained relatively unchanged over the last 2 decades.[2,3]

NIH-funded projects frequently involve recruiting patients locally in trials, and community-based initiatives for disease prevention and awareness. Since community engagement and rapid translation of findings for the benefit of patients is a major criteria for NIH's decisions regarding allocation of funds for research priorities,[4] the population in the surrounding area of these medical centers may have better cardiovascular health outcomes than comparable populations without access to such resources. Conversely, much of this research is upstream from widespread care delivery and there are numerous hurdles preventing the timely translation of research findings to the bedside.[5,6]

Accordingly, we sought to examine whether the trends in cardiovascular mortality of the counties of top 10 NIH-funded academic medical centers are distinct from sociodemographically matched counties that lack such institutions.

Methods

Data on research center specific funding was obtained from NIH's online repository. Annual funding of every biomedical research center from 1995 through 2014 was aggregated and the counties of the top 10 funded institutes were identified to form the index group of counties. We created a comparison cohort by matching each index county to another county which lacks an NIH-funded academic institute based on median age, sex distribution, race distribution, urban-rural distribution and median household income from the 2014 U.S. Census Bureau data. We also included the cardiovascular mortality rate from 1980 as a matching covariate to create a matching cohort with similar cardiovascular mortality at the start of the study period. For matching, we used genetic matching algorithm that minimized the differences in the distribution of covariates by creating a potential distance metric on covariates of interest between the index counties and the remaining counties.[7] This is achieved through an automated iterative process of checking an improving overall covariate balance with different distance metrics, guaranteeing asymptotic convergence to the optimal matched sample. The balance of variables was assessed using cumulative probability distribution function with Kolmogorov-Smirnov test. County and state level, annual age-standardized cardiovascular mortality estimates from 1980 to 2014 were obtained from death registration data of the National Vital Statistics System, the details of which have been previously published.[8] We employed repeated measures ANOVA approach to compare the temporal trends of cardiovascular mortality between the index counties and matched counties. Furthermore, we compared the cardiovascular mortality of the two county groups at the end of the study period to assess whether the presence of top NIH-funded institutions result in additional benefit in cardiovascular mortality in the local population. Finally, we compared the cardiovascular mortality trends of the index counties with their respective states. This analysis was repeated for cancer mortality as a sensitivity analysis. The analysis was conducted using R programming language version 3.3.1. Two-tailed P values <.05 were considered statistically significant.

Results

The characteristics of the index and matched counties are shown in Table I. The sociodemographic characteristics and the cardiovascular mortality in 1980 were similar in the 2 county groups.

Figure 1 shows funding amounts at the top 10 NIH-funded academic medical centers. From 1980 through 2014, the annual cardiovascular mortality rates declined in all counties.

The average decline in cardiovascular mortality rate among the index counties was 51.5 per 100,000 population (95% CI, 46.8–56.2) over the study period. The matched counties experienced similar decline in cardiovascular mortality over the study period; 49.7 per 100,000 population (95% CI, 45.9–53.5). The mortality trends were similar in the two county groups with no significant difference ($P = 0.27$) (Figure 2A). At the end of the study period, the mortality rates of index counties were similar to the matched counties with no added mortality benefit in the counties of top NIH-funded institutions ($P = 0.88$). Furthermore, the trends in cardiovascular mortality of the index counties were similar to the cardiovascular mortality trends of their respective states. In order to examine whether NIH funding impacted outcomes outside of cardiovascular disease, we performed a sensitivity analysis using trends in outcomes from oncological diseases (Figure 2B). We noted that rates of death from oncological disease decreased in the counties and states of these research institutes, with most counties showing better mortality rates than their respective states. Unlike mortality from cardiovascular causes, oncological mortality rates declined at higher rates in the counties of research institutes than their states ($P < .001$).

Discussion

Death from cardiovascular disease consistently and remarkably declined from 1980 to 2014 in the counties with top 10 NIH-funded medical centers. This decline was similar when compared to the sociodemographically matched counties and states with similar cardiovascular mortality at the start of the study period. Whereas oncological mortality also declined greatly during this period, the rate of decline was more pronounced in the counties that included top NIH-funded academic medical centers.

Cardiovascular diseases are the leading causes of death in the US and thus have been the focus of new health policies.[9] While the cardiovascular mortality declined over time,[1] we found that the rate of decline in mortality from cardiovascular disease in the counties of top NIH-funded academic medical centers was not greater than the sociodemographically matched counties as well as their states. There are two potentially contradictory explanations for these findings. One is that research findings at top academic medical center hospitals might not be rapidly translating to improving health outcomes in the population living near these institutions. Alternatively, translation of findings across the country might be occurring rapidly and without significant delay, thus blunting differences between counties associated with and separate from academic medical centers. Although we can only hypothesize about these observations, a large body of literature showing poor implementation of cardiovascular research at the bedside at top academic medical centers suggests that the former explanation might be more likely; indeed, this realization has led to the creation of a separate branch with the NHLBI (The Implementation Science Branch) whose purpose is to assist with implementation of evidence-based interventions and guidelines within clinical and community settings.[10–12] Whereas community engagement and rapid translation of findings for the benefit of patients has always been noted as a major criteria for NIH decisions regarding allocation of funds for research priorities,[4] several studies have noted that this has not been occurring at a sufficient rate in the case of cardiovascular disease, adding credence to the validity of our findings. Altogether, our study also serves as a call to consider documentation of institutional efforts to improve outcomes among diverse socioeconomic populations–particularly among those subgroups most vulnerable and underrepresented–when allocating NIH funding.

We should consider the following limitations. First, we used sociodemographic data to create the matching cohort, whereas county health may be affected by a range of cultural, political, and environmental factors. The outcome was mortality, and we did not include other data which may be pertinent to cardiovascular health (e.g. hospitalization, health status, and quality of life data). Second, we were not able to account for the barriers to accessing healthcare at these academic centers like cost and insurance coverage. However, we did account for household income in our analysis which may account for the financial burden of healthcare in a population.

In conclusion, over the past 3 decades, cardiovascular mortality rates have decreased in the counties harboring top NIH-funded academic medical centers. However, the declining mortality trends were similar to the cardiovascular mortality trends of sociodemographically matched counties and their respective states. Whereas oncological mortality also declined during this period, the rate of decline was more pronounced in the counties that included top NIH-funded academic medical centers. These results demonstrate a differential beneficial association between the presence of top academic research institutes and the local population and may point to the need for an increased focus on implementation science in cardiovascular diseases.

Disclosures

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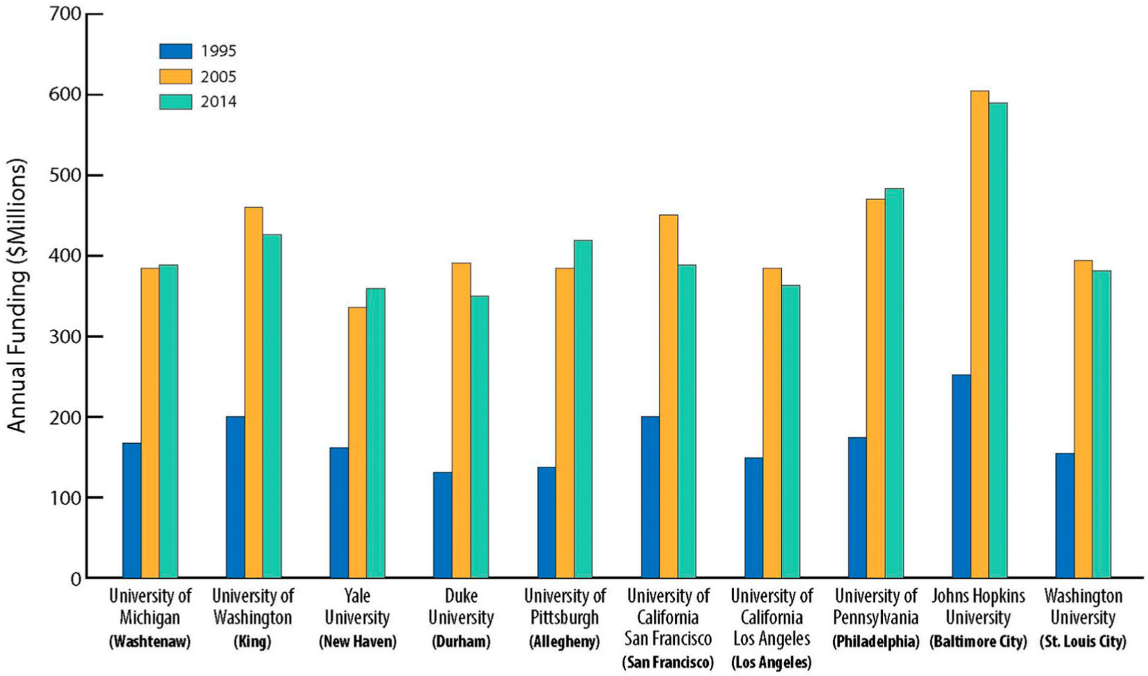

Figure 1.

Top NIH-funded academic medical centers and annual funding awarded for the years 1995, 2005 and 2014. The corresponding counties of the institutions are given in the parenthesis.

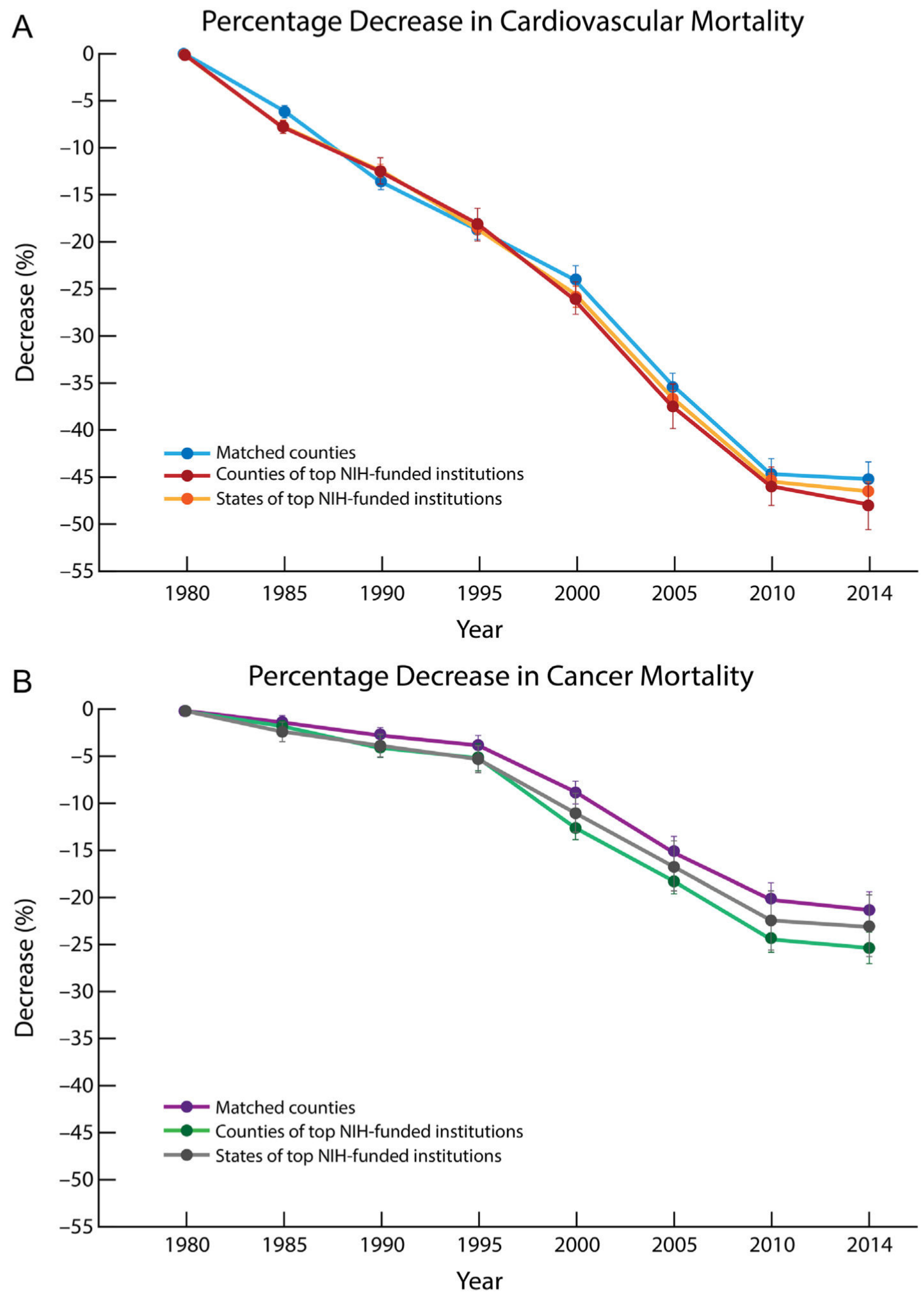

Figure 2.

Percentage decline in the age-standardized (a) cardiovascular and (b) oncological mortality rates in the counties and states of top NIH-funded institutions and their matched counties.

Table I.

Baseline characteristics of the index (top 10 NIH-funded medical centers) and matched (no academic medical center) counties

County	State	Median Age (y)	Female (%)	Black (%)	White (%)	Rural (%)	Median Household Income ($)	CV Mortality in 1980*	CV Mortality in 2014*
Washtenaw	Michigan	33.3	50.7	12.6	74.6	16.4	56618	464 (442, 485)	225 (215, 235)
Rutherford†	Tennessee	32.8	50.6	12.6	76.7	17	53566	486 (459, 513)	281 (268, 293)
King	Washington	37.2	50.1	6.1	67.7	3.2	68944	406 (390, 422)	198 (191, 204)
Snohomish†	Washington	37.5	49.9	2.5	77	10.8	67068	425 (406, 445)	220 (212, 229)
New Haven	Connecticut	39.6	51.8	12	68.2	3.6	59217	492 (477, 508)	221 (214, 229)
Seminole†	Florida	38.9	51.6	10.6	67.2	3.2	54901	475 (455, 495)	221 (212, 230)
Durham	North Carolina	34.1	52.3	37.7	43	5.6	50889	500 (475, 527)	211 (202, 220)
Macomb†	Michigan	40.6	51.4	9.2	85	2.8	52275	571 (553, 587)	305 (296, 314)
Allegheny	Pennsylvania	41	52	13.2	82	2.5	50831	584 (569, 599)	278 (270, 286)
Mecklenburg†	North Carolina	34.3	51.7	30.5	51.3	1.1	55392	492 (471, 513)	210 (203, 219)
San Francisco	California	38.6	49.2	5.7	43.6	0	72093	472 (457, 488)	180 (174, 186)
Clark†	Nevada	36.1	49.7	10.1	49.2	1.3	49583	518 (500, 536)	245 (238, 251)
Los Angeles	California	35.3	50.7	8.3	27.4	0.6	52929	533 (522, 543)	219 (214, 224)
Alameda†	California	36.9	50.9	12.1	35.9	0.4	70209	490 (473, 506)	197 (191, 203)
Philadelphia	Pennsylvania	33.6	52.8	42.1	37.6	0	35518	586 (574, 598)	321 (313, 328)
Richmond City†	Virginia	32.6	52.3	49.9	40.6	0	37933	553 (531, 575)	309 (296, 322)
Baltimore City	Maryland	34.5	52.9	63.2	29.5	0	39077	590 (574, 607)	387 (376, 399)
Orleans†	Louisiana	35.1	51.8	59.8	31.6	0.6	33948	587 (570, 605)	279 (267, 290)
St Louis City	Missouri	34.4	51.6	48.7	44.4	0	32084	658 (640, 676)	352 (340, 364)
Wayne†	Michigan	37.7	51.9	40	51.4	0.7	39461	611 (598, 623)	365 (356, 373)

CV, Cardiovascular.

*Mortality in deaths per 100,000 population with 95% Confidence Intervals

†Matched Counties