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(RESEARCH ARTICLE)

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Cardiovascular disease risk reduction for all-cause mortality benefit in low-risk individuals

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Abstract

Background: Current recommendations for the primary prevention of cardiovascular disease (CVD) are based solely on 10-year CVD risk assessment. However, CVD mortality is not compared with all-cause mortality, which could provide insights into the potential benefits of CVD risk interventions on overall mortality.

Methods: CVD risk for average American white and black males and females is calculated using the 2013 American Heart Association equations. CVD death risk is determined by combining CVD risk with the death rate following a CVD diagnosis. This CVD death risk is then compared with all-cause mortality data from National Vital Statistics Reports. A larger ratio indicates that most deaths are attributed to CVD, suggesting that intervention may be more beneficial.

Results: The CVD mortality ratio is highest for white men and lowest for black men, indicating that white male likely to benefit most from CVD risk modification, while black males will benefit the least. Additionally, the ratio, and the potential benefit, decreases with age for all groups, especially after the age of 70.

Conclusion: For the average U.S. population without a CVD diagnosis, the potential mortality benefit from interventions targeting CVD risk factors varies significantly based on patient characteristics such as race, age, and gender. The potential benefit is greatest for white males and decreases with age for all groups.

Keywords: Cardiovascular Mortality; All-Cause Mortality; Risk Reduction; Average American

1. Introduction

With the aim of improving cardiovascular disease (CVD), the American Heart Association (AHA) recommends lifestyle modifications that meet 7 cardiovascular health metrics: smoking avoidance, maintaining a normal BMI, engaging in physical activity, following a healthy diet, controlling cholesterol levels, managing blood pressure, and monitoring plasma glucose [1]. Meeting a greater number of cardiovascular health metrics was associated with a lower risk of total and CVD mortality, as expected [2]. CVD risk factors significantly impact CVD mortality, but they have an even greater impact on non-CVD mortality [3]. Therefore, the AHA's lifestyle modifications are expected to result in greater overall mortality improvement. The initial step to improve CVD risk is to prescribe lifestyle modifications [4,5]. Pharmacologic interventions are to be used when lifestyle improvements are not adequate. Some authors suggest that clinicians should treat CVD risk and not just individual risk factors [6]. Therefore, pharmacological treatment with cardioprotective lipid-lowering drugs and antihypertensives needs to be considered in patients at high absolute cardiovascular risk, irrespective of their blood pressure or blood cholesterol levels. Other authors suggest that statins should be prescribed even to individuals at the lowest risk [7], despite a detrimental effect on overall mortality and minimal improvement in CVD mortality, even while the majority of mortality in the USA is non-cardiovascular [8].

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Current recommendations for the primary prevention of cardiovascular disease (CVD) are based solely on 10-year CVD risk. However, CVD mortality is not compared with all-cause mortality, which could provide insights into the potential benefit of CVD risk interventions on the overall mortality. Utilizing data from available literature, this study attempts to determine the proportion of cardiovascular mortality relative to overall mortality. A larger proportion will be considered indicative of higher relative CVD risk and consideration for pharmacological intervention, in addition to lifestyle improvements. The populations studied include average American white and black men and women without known CVD. The primary focus of this article is on cardiovascular and all-cause mortality; non-fatal event rates are not considered. For the younger population, the 10-year risk is small and may not be the ideal parameter to evaluate their lifetime risk. Hence, in this article, long-term risks are emphasized.

2. Methods

10-year CVD risk is calculated using the American Heart Association's CVD risk Pooled Cohort Equations (PCE) [9], as outlined in the current practice guidelines. To calculate long-term risk (risk at age 89), the subsequent 10-year risk is determined by adding 10 years to the subject's age and adjusting systolic blood pressure, total cholesterol, HDL cholesterol, prevalence of type 2 diabetes mellitus (DM II), and smoking prevalence for the 10-year increase in age. This process is repeated until the risk at the target age is reached. For any fraction of 10 years, the additional risk is calculated using a linear proportion.

The CVD risk was calculated using parameters from the following sources: lipids from Table 2 of Ref 10, systolic BP from Figure 3 of Ref 11, DM II prevalence obtained from Ref 12, and smoking prevalence from Ref 13. These same sources were also used to determine the changes in parameters with age. From the calculated CVD risk and yearly death rate for persons with CVD in Ref 14, the 10-year and long-term CVD death risk was derived. All-cause mortality of the average population (black & white men and women) was obtained from Table B, Ref 15.

3. Results

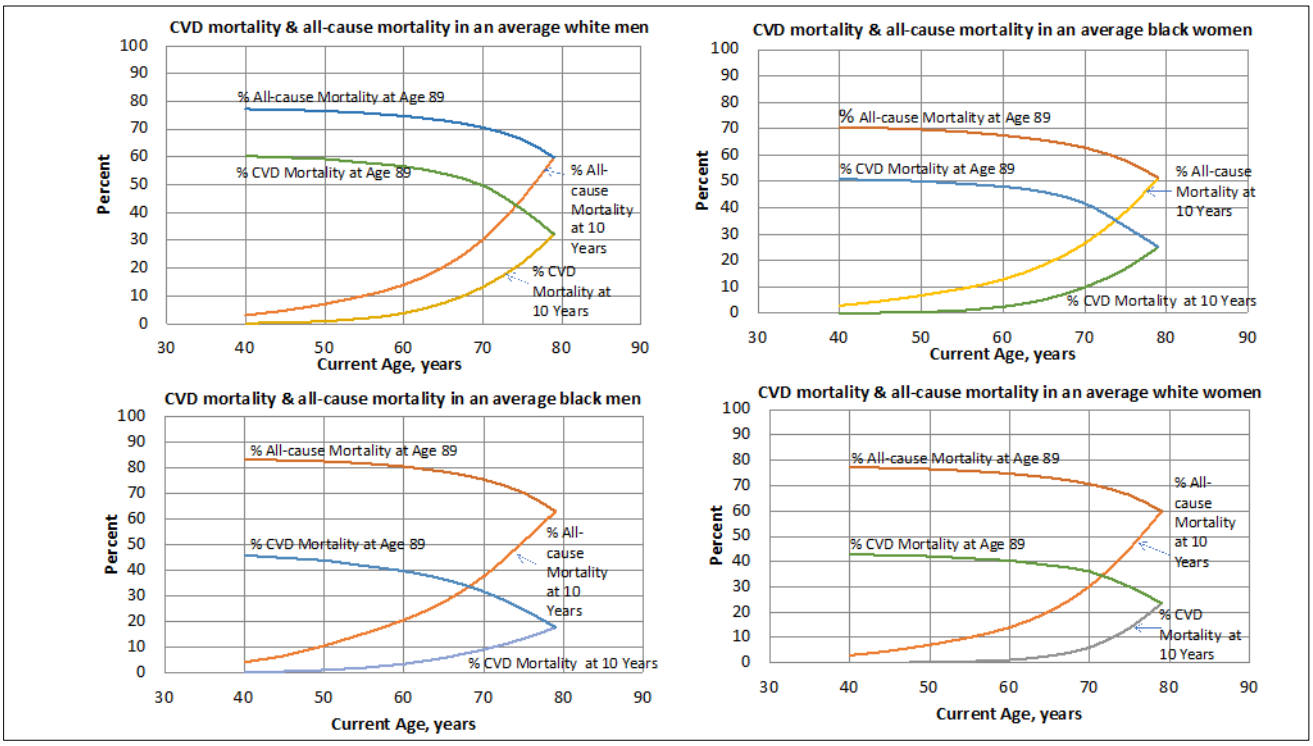

Figure 1 CVD and all-cause mortality of an average White and Black American Male and Female, ages 40 to 79, in 10 years and at age 89. The CVD risk is calculated using AHA CVD risk calculator [9] using parameters from the following sources: Lipids- from Table 2 of Ref 10; Systolic BP- from Figure 3 of Ref 11; DM II prevalence is obtained from the Ref 12; Smoking prevalence from Ref 13. The same sources were also used to find the change in the parameters with age. From the calculated CVD risk and yearly death rate for persons with CVD in Ref 14, the 10 year and long-term CVD death risk was derived. All-cause mortality was obtained from Table B, Ref 15

Figure 1 shows the calculated CVD mortality at 10 years and at age 89 for an 'average' American white and black male and female, which can be compared with all-cause mortality at 10 years and at age 89. The gap between CVD and all-cause mortality is small for white men, indicating that CVD is a major contributor to mortality in this group. This patient is an AHA candidate for a statin drug at the age of 54 when his 10-year CVD risk is 7.5%. However, after age 70, all-cause mortality becomes significantly higher compared to CVD mortality, and he may not be a good candidate to initiate pharmacologic intervention at that age. Similar results are seen for black women, except her AHA eligibility for a statin is at age 58.

Black men have a 10-year CVD risk of 7.5% at age 54, meeting AHA criteria for statin drug candidacy. The CVD mortality risk is significantly lower than the all-cause mortality risk, suggesting that CVD is not a major contributor to overall mortality, especially with advancing age. Therefore, the benefits of aggressive pharmacologic treatment of CVD risk factors after lifestyle modifications may not outweigh the risks. A similar trend is seen for White women. Her eligibility for AHA-recommended statins occurs 10 years later than for the Black man, at age 64, making her an even less optimal candidate for aggressive CVD risk treatment.

Figures 2 shows the ratio of CVD to all-cause mortality for the four groups over 10 years and at age 89, respectively. It confirms that there is a significant difference among the groups in the impact of CVD on all-cause mortality. White men experience the greatest impact of CVD, while black men experience the least. The differences among the groups become more prominent over the long term. Here, the CVD/all-cause mortality ratio starts to decrease more rapidly after age 70. The figures indicate that among individuals with average risk, white men have the greatest potential benefit for aggressive CVD risk treatment beyond lifestyle modification, while black men have the least.

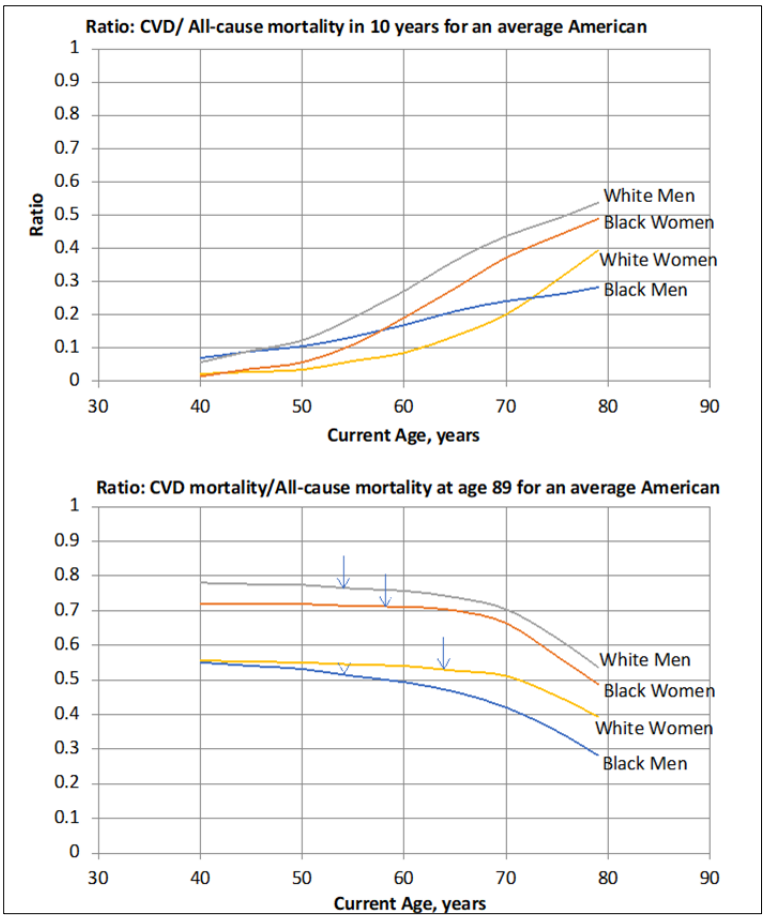

Figure 2 The ratio of CVD to All-cause mortality for the four groups. (From Figures 1-4). Arrows indicate ages for AHA statin eligibility

It is evident from figure 2 that while the mortality risk at 10 years is significantly lower for younger individuals compared to the elderly, their long-term mortality risk is much higher. Therefore, the 10-year risk data may be misleading for this group.

4. Discussion

Low-cost lifestyle interventions targeting psychological stress, unhealthy eating habits, tobacco smoking, and physical inactivity can significantly reduce morbidity and mortality from chronic diseases [16, 17, 18, 19]. Counseling patients about the adverse effects of poor lifestyle choices will be more impactful when the provider can clearly explain the risks and benefits of interventions.

Here, it is evident that compared to the overall mortality risk, the benefit of CVD risk modification is expected to be greatest among white males and roughly similar for black females. Relatively less benefit is anticipated among white females and even less among black males. Lloyd-Jones et al. [20] have demonstrated that CVD mortality is lower than non-CVD mortality, with the difference being smaller in men compared to women. Since their study primarily involved white subjects, it supports the notion that CVD contributes more to death in white men than in white women. It is seen that, the relative benefit of CVD risk modification decreases with age, especially noticeable in black males, and this decline accelerates after age 70 across all groups.

Cardiovascular risk factors need to be treated, with the extent of treatment depending on the absolute CVD risk [5]. Most of these risk factors have an even worse effect on non-CVD mortality. Lifestyle modifications offer the most benefits compared to their adverse effects. Pharmacologic treatment has inherent adverse effects, which are more pronounced in the geriatric population [21-24]. Since the relative benefit of CVD risk modification decreases with age, and the decrease is faster after age 70, initiating primary prevention with pharmacological intervention in the average geriatric population may not be wise in many situations. Mortality and morbidity benefits need to be weighed against the quality of life before such interventions are advised.

Since the long-term CVD mortality risk is much higher for younger subjects, and since most deleterious lifestyle habits start at a young age, lifestyle modifications should be promoted since childhood. Thus, individuals will be healthier with lower long-term CVD and all-cause mortality risks, and they will require less pharmacologic intervention by the time they reach middle age. By the time individuals reach geriatric age, the benefit of intervention is lower while the adverse effects are higher.

In addition to smoking avoidance, physical activity and eating a healthy diet are two simple yet powerful habits for improving health. For example, a review article on the health effects of a plant-based diet [25] demonstrates benefits in all-cause and cardiovascular disease mortality. This is supported by a meta-analysis of randomized studies [26], which shows significant improvements in lipid profiles from a plant-based diet (with a mean reduction in LDL-C of -0.30 mmol/L, corresponding to a 10% reduction from baseline, and an overall decrease in apo-B levels of -12.9 mg/dL). For most average Americans, this may be sufficient, and the earlier they adopt these habits, the better.

Recently, Anderson et al. [27] compared CVD risk estimates using the new AHA's 'Predicting Risk of Cardiovascular Disease Events' (PREVENT) equations and the older 'Pooled Cohort Equations' (PCEs). The results show that the currently established PCEs, as used in this study, overestimate the CVD risk for all groups, with the largest difference observed in blacks and the elderly. Consequently, the CVD-to-all-cause mortality ratio as shown here will decrease even further for black men and the elderly, making them even less suitable candidates for pharmacological intervention.

Abbreviations

AHA = American Heart Association
BMI = body mass index.
CVD = cardiovascular disease
DM II = type 2 diabetes mellitus
LDL-C = Low Density Lipoprotein Cholesterol
PCE = Pooled Cohort Equations
PREVENT = Predicting Risk of Cardiovascular Disease Events
USA = United States of America

5. Conclusion

This study compares the total mortality risk with the risk of cardiovascular disease (CVD) mortality for the average US population. It indicates that the potential mortality benefit from interventions targeting CVD risk factors varies significantly depending on patient characteristics such as race, age, and gender. For some individuals, lifestyle improvements may be sufficient, and the benefits of pharmacological treatment may not justify the risks. This situation

is particularly relevant for black men and the elderly. Health promotion should ideally begin at a young age. Initiating treatment beyond lifestyle improvement after the age of 70 may not justify the risks in most cases.

5.1. Drawbacks

This article focuses solely on all-cause and cardiovascular mortality among various groups. Cardiovascular non-fatal events have not been addressed. Data and formulas from multiple sources were used for calculations and comparisons, which inherently introduces errors. Nevertheless, this publication aims for a qualitative presentation

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

[1] Lloyd-Jones DM, Hong Y, Labarthe D, et al. Defining and setting national goals for cardiovascular health promotion and disease reduction. Circulation 2010;121(4):586-613.

[2] Yang Q, Cogwell ME, Flanders WD, et al. Trends in cardiovascular health metrics and associations with all-cause and CVD mortality among US adults. JAMA 2012; 307: 1273-83.

[3] Kim E Innes, Cheryl Bourguignon, Ann Gill Taylor, "Risk Indices Associated with the Insulin Resistance Syndrome, Cardiovascular Disease, and Possible Protection with Yoga: A Systemic Review"; J Am Board Fam Pract 2005; 18; 491-519.

[4] ATP III, National Institutes of Health Publication No. 02-5215, September 2002.

[5] Scott M. Grundy et al., "Implications of Recent Clinical Trials for the National Cholesterol Education Program Adult Treatment Panel III Guidelines", Circulation, 2004, Vol 110, p227-239.

[6] Rod Jackson, Carlene M M Lawes, Derrick A Bennett, Richard J Milne, Anthony Rodgers, "Treatment with drugs to lower blood pressure and blood cholesterol based on an individual's absolute cardiovascular risk"; Lancet 2005; 365: 434–41.

[7] Cholesterol Treatment Trialists' (CTT) Collaborators, Mihaylova B, Emberson J, Blackwell L, Keech A, Simes J, Barnes EH, Voysey M, Gray A, Collins R, Baigent C.," The effects of lowering LDL cholesterol with statin therapy in people at low risk of vascular disease: meta-analysis of individual data from 27 randomised trials"; Lancet 2012; 380: 581–90.

[8] Ali H. Mokdad, PhD; James S. Marks, MD, MPH; Donna F. Stroup, PhD, MSc; Julie L. Gerberding, MD, MPH, "Actual Causes of Death in the United States, 2000", JAMA. 2004; 291: 1238-1245.

[9] American Heart Association ASCVD Risk Calculator, www.cvriskcalculator.com

[10] Margaret D. Carroll et al., "Serum Lipids and Lipoproteins of Adults", JAMA, October 12, 2005- Vol 294, No. 14.

[11] Vicki L. Burt et al., "Prevalence of Hypertension in the US Adult Population", Hypertension. 1995; 25: 305-313.

[12] Lifetime Risk for Diabetes Mellitus in the United States, K. M. Venkat Narayan; James P. Boyle; Theodore J. Thompson; et al., JAMA 2003;290(14):1884-1890 (doi:10.1001/jama.290.14.1884).

[13] Health consequences of smoking--50 years of progress, Chapter 12, p 654, Table 12.2, year 2011. A Report of the Surgeon General 2014, US Department of Health and Human Services.

[14] Life With and Without Heart Disease Among Women and Men Over 50, Eileen M. Crimmins, Mark D. Hayward, Hiroshi Ueda, Yasuhiko Saito and Jung Ki Kim, J Women Aging. 2008; 20(1-2): 5–19.

[15] National Vital Statistics Reports, Vol 65, No. 8, November 28, 2016 (Table B for Survival Rate.).

[16] S M Straus et al. "The incidence of sudden cardiac death in the general population", Journal of Clinical Epidemiology 2004, 57: 98-102.

[17] Robert Beaglehole, Shah Ebrahim, Srinath Reddy, Janet VoÛte, Steve Leeder, "Prevention of chronic diseases: a call to action", Lancet 2007; 370: 2152–57.

[18] L. H. Opie, P. J. Commerford, B. J. Gersh, "Controversies in stable coronary artery disease"; Lancet 2006; 367: 69–78.

[19] Daniel J Brotman, Sherita H Golden, Ilan S Wittstein, "The Cardiovascular Toll of Stress"; The Lancet 2007, 370: 1089 – 1100.

[20] Donald M. Llyod-Jones, Alan R. Dyer, Renwei Wang, Martha L. Daviglus, Philip Greenland, "Risk Factor Burden in Middle Age and Lifetime Risks for Cardiovascular and Non-Cardiovascular Death (Chicago Heart Association Detection Project in Industry)", Am J Cardiol 2007; 99; 535-540.

[21] Beatrice A. Golomb, Marcella A. Evans, Joel E. Dimsdale, Halbert L. White, "Effects of Statins on Energy and Fatigue with Exercise: Results from a Randomized Controlled Trial"; Arch Intern Med 2012; 172(15), 1180-1182.

[22] Beatrice A. Golomb, Marcella A. Evans, "Statin Adverse Effects: A Review of the Literature and Evidence for a Mitochondrial Mechanism"; Am J Cardiovasc Drugs 2008; 8(6): 373–418.

[23] Harumi Okuyama, Peter H Langsjoen, Tomohito Hamazaki, Yoichi Ogushi, Rokuro Hama, Tetsuyuki Kobayashi, Hajime Uchino; "Statins stimulate atherosclerosis and heart failure: pharmacological mechanisms," Expert Review Clinical Pharmacology 2015, 8(2): 189-199

[24] Janice B. Schwartz, "Primary Prevention, Do the very elderly require a different approach?"; Trends Cardiovasc Med. 2015, 25, 228-239.

[25] Lap Tai Le, Joan Sabate, "Beyond Meatless, the Health Effects of Vegan Diet: Findings from the Adventist Cohorts"; Nutrients 2014, 6, 2131-2147

[26] Caroline A Koch, Emilie W Kjeldsen, Ruth Frikke-Schmidt, "Vegetarian or vegan diets and blood lipids: a meta-analysis of randomized trials"; EuropeanHeart Journal 2023, 44(28): 2609–2622.

[27] Timothy S. Anderson, Linnea M. Wilson, Jeremy B. Sussman, "Atherosclerotic Cardiovascular Disease Risk Estimates Using the Predicting Risk of Cardiovascular Disease Events Equations"; JAMA Intern Med. Published online June 10, 2024. doi:10.1001/jamainternmed.2024.1302