Cardiovascular Risk

Lifetime Risks for Cardiovascular Disease Mortality by Cardiorespiratory Fitness Levels Measured at Ages 45, 55, and 65 Years in Men

The Cooper Center Longitudinal Study

Jarett D. Berry, MD, MS,* Benjamin Willis, MD, MPH,† Sachin Gupta, MD,*
Carolyn E. Barlow, MS,† Susan G. Lakoski, MD, MS,* Amit Khera, MD, MS,* Anand Rohatgi, MD,*
James A. de Lemos, MD,* William Haskell, PhD,‡ Donald M. Lloyd-Jones, MD, ScM§

Dallas, Texas; Palo Alto, California; and Chicago, Illinois

Objectives	The purpose of this study was to determine the association between fitness and lifetime risk for cardiovascular disease (CVD).
Background	Higher levels of traditional risk factors are associated with marked differences in lifetime risks for CVD. However, data are sparse regarding the association between fitness and the lifetime risk for CVD.
Methods	We followed up 11,049 men who underwent clinical examination at the Cooper Institute in Dallas, Texas, before 1990 until the occurrence of CVD death, non-CVD death, or attainment of age 90 years (281,469 person-years of follow-up, median follow-up 25.3 years, 1,106 CVD deaths). Fitness was measured by the Balke protocol and categorized according to treadmill time into low, moderate, and high fitness, with further stratification by CVD risk factor burden. Lifetime risk for CVD death determined by the National Death Index was estimated for fitness levels measured at ages 45, 55, and 65 years, with non-CVD death as the competing event.
Results	Differences in fitness levels (low fitness vs. high fitness) were associated with marked differences in the lifetime risks for CVD death at each index age: age 45 years, 13.7% versus 3.4%; age 55 years, 34.2% versus 15.3%; and age 65 years, 35.6% versus 17.1%. These associations were strongest among persons with CVD risk factors.
Conclusions	A single measurement of low fitness in mid-life was associated with higher lifetime risk for CVD death, particularly among persons with a high burden of CVD risk factors. (J Am Coll Cardiol 2011;57:1604–10) © 2011 by the American College of Cardiology Foundation

Despite a substantial decline in cardiovascular disease (CVD) death rates over the past 3 decades (1), CVD remains the leading cause of mortality in the United States. Moreover, recent data suggest that unfavorable lifestyle trends promoting weight gain are leading to an increase in

some CVD risk factors such as diabetes mellitus, obesity, and metabolic syndrome, which may halt or even reverse the favorable trends in CVD death (1). For example, only 1 in 2 adults achieve recommended moderate or vigorous activity levels in a given week (2). Therefore, more effective public health and clinical strategies are needed to communicate the importance of lifestyle factors such as physical activity in preventing CVD.

Prior research has demonstrated an independent, dose-dependent, inverse association between cardiorespiratory fitness and CVD outcomes among persons with and without CVD at baseline (3–7). While the consistency of these data provide support for the protective role of fitness, the reporting of these associations as absolute or relative risk estimates has well-recognized limitations for risk communication strategies (8–11). Therefore, national guidelines suggest clinicians consider current risk factor burden within the context of long-term or lifetime risk for CVD (12–14).

We and others have reported the association between traditional risk factors (i.e., smoking, diabetes, cholesterol, and blood pressure) and lifetime risks for CVD (15–17). However, it is unknown whether a single measurement of fitness in mid-life is associated with lifetime risks for CVD many years later. In addition, the combined effect of fitness and traditional risk factors on lifetime risks for CVD mortality is also unknown.

Therefore, the purpose of the present study was to determine the association between fitness measured at ages 45, 55, and 65 years and the lifetime risks for CVD death using a well-characterized cohort from the CCLS (Cooper Center Longitudinal Study) with objectively measured fitness data. Because of the large sample size and long-term follow-up needed to create lifetime risk estimates, to our knowledge, this cohort represents 1 of the only available datasets to conduct such analyses.

Methods

We included 11,049 men who underwent clinical examination at the Cooper Institute in Dallas, Texas, before 1990. Because of the long-term follow-up and large number of events required for lifetime risk analyses, we included men <60 years of age with an initial examination before 1985 and men 60 to 69 years of age with an initial examination before 1990. These persons were either self-referred or were referred by their employer or personal physician. Details of the clinical examination and the study cohort have been published previously (3,4). Participants completed a comprehensive clinical examination that included a self-reported personal and family history, standardized medical examination by a physician, fasting blood levels of total cholesterol, triglycerides, and glucose, and a maximal treadmill exercise test. Body mass index was calculated from measured height and weight. Participants signed an informed consent for the clinical examinations and follow-up, and the study was reviewed and approved annually by the institutional review board of the Cooper Institute as well as by the University of Texas Southwestern Medical Center.

Because the purpose of the present analysis is to determine the association between fitness levels and lifetime risks for CVD death, all participants were included in the study sample regardless of medical history. In addition, no one was excluded on the basis of performance on the exercise treadmill portion of the examination. Women were not included in the present analysis because of the small numbers and low event rates, which precluded the possibility of creating reliable estimates of lifetime risk.

As reported previously (3,4), fitness was measured in the CCLS cohort by a maximal treadmill exercise test using a Balke protocol. In this protocol, treadmill speed is set initially at 88 m/min. In the first minute, the grade is set at 0%, followed by 2% in the second minute, and an increase of 1% for every minute thereafter. After 25 min, the grade remains unchanged but the speed is increased by 5.4 m/min for

each additional minute until the test is terminated. Participants were encouraged not to hold onto the railing and were given encouragement to exert maximal effort. The test was terminated by volitional exhaustion reported by the participant or by the physician for medical reasons. As described previously, the test time using this protocol correlates highly with directly measured maximal oxygen uptake (r = 0.92) (18). Using well-characterized regression equations, treadmill times from the Balke protocol allow for estimation of fitness level in metabolic equivalents (METs) (18).

Mortality surveillance. Study participants were followed up for mortality from the date of the initial, complete clinical examination through 2006. Before 1979, follow-up was completed by direct mail, telephone, contact with employer, and matching of records with Social Security Administration files. After the development of the National Death Index in 1979, all-cause mortality and deaths due to CVD (as indicated by International Classification of Diseases [ICD]-9 codes 390.0 to 458.9, or equivalent codes from ICD-8 or -10) were included in the primary analysis. Additional details regarding follow-up of the CCLS cohort have been described previously in detail (3,4).

Statistical analyses. We grouped participants according to fitness levels and risk factor levels as measured within ±5 years from 1 of 3 index ages: 45 years, 55 years, and 65 years. For example, fitness levels and traditional risk factors measured between ages 40 and 49 years were included in the age 45 analyses. To estimate the lifetime risks of CVD mortality in different risk groups, participants were categorized according to 1) levels of fitness; 2) levels of traditional risk factors; and 3) combinations of fitness/traditional risk factor burden.

In accordance with standard approaches to the analysis of fitness data (3,4), treadmill times were compared with age- and sex-specific normative data on treadmill performance within the CCLS cohort, allowing each person's treadmill time to be classified into an age- and sex-specific quintile of fitness. These quintiles of fitness measures were then combined into 3 mutually exclusive fitness groupings: low fitness, quintile 1; moderate fitness, quintiles 2 and 3; and high fitness, quintiles 4 and 5. Where sample size allowed, additional analyses were performed among men with "very low fitness," defined as ≤6 METs.

Participants were stratified by baseline traditional risk factor burden using our previously published algorithm (16,19). Using this method, we stratified participants a priori into 5 mutually exclusive risk factor categories exclusive of medication data: all optimal risk factor levels, ≥1 not optimal risk factors, ≥1 elevated risk factors, 1 major risk factor only, or ≥2 major risk factors (see table footnotes for details).

Participants were also stratified according to combinations of fitness and traditional risk factor burden as follows. First, fitness was categorized dichotomously as low fit (quintile 1) versus high fit (quintiles 2 to 5). Next, traditional risk factor burden was also analyzed categorically using our recently published algorithm and classified for the purpose of these analyses as "high risk burden" ($\geq$1 elevated risk factors, 1 major risk factor, or $\geq$2 major risk factors) and "low risk burden" (all optimal risk factor levels, $\geq$1 not optimal risk factors) [19]. By combining traditional risk factor burden with the 2 levels of fitness, we were able to create 4 mutually exclusive risk groups at each index age: low risk burden/low fit; high risk burden/low fit; low risk burden/high fit; and high risk burden/high fit.

We calculated lifetime risk for CVD death for each risk group (as defined in the preceding text) using a modified technique of survival analysis, as described previously [20,21]. In this type of analysis, participants contributed information on the incidence of CVD and death free of CVD for each age they attained during follow up. Because the Kaplan-Meier cumulative incidence does not reflect the competing risk for death from other causes before development of CVD, adjustment was made for this competing risk to yield a true remaining lifetime risk for CVD. Therefore, significant differences between the lifetime risk estimate and the Kaplan-Meier estimate for CVD death suggest the importance of competing risks. Because of the unstable estimates that result when age-specific follow-up becomes limited, the follow-up period was truncated when weighted person-years were $\leq$90 for a given age of follow-up.

In an effort to compare lifetime risks in the CCLS cohort with prior lifetime risk estimates obtained from more representative cohorts, we compared lifetime risks for CVD death by traditional risk factor categories in the CCLS cohorts with lifetime risks for CVD death in the cardiovascular Lifetime Risk Pooling Project (LRPP) [22]. The LRPP represents a pooled analysis of 16 cohorts representing 64,907 participants from some of the most prominent observational cohorts in the United States in the past 50 years. All statistical analyses were performed using SAS for Windows (version 9.2, SAS Institute, Cary, North Carolina).

Results

We included 11,049 men who were 40 to 69 years of age who had both traditional risk factor measurement and exercise treadmill tests performed before 1990. During 281,469 person-years of follow-up through 2006, there were 1,054 CVD deaths and 1,736 non-CVD deaths. The baseline characteristics of the study cohort stratified by levels of age and fitness are shown in Table 1. As expected, older age was associated with a higher prevalence of diabetes, a lower prevalence of current smoking, higher blood pressure, and generally lower total cholesterol levels. Within each age strata, higher levels of fitness were associated with

Table 1 Baseline Characteristics (Men) Stratified by Age and Fitness Level in the Cooper Center Longitudinal Study

	Age 45 Years			Age 55 Years			Age 65 Years		
	Low Fit (n = 1,713)	Moderate Fit (n = 2,822)	High Fit (n = 1,912)	Low Fit (n = 802)	Moderate Fit (n = 1,492)	High Fit (n = 1,130)	Low Fit (n = 172)	Moderate Fit (n = 471)	High Fit (n = 535)
Age, yrs	45.1 ± 2.6	44.9 ± 2.6	44.4 ± 2.5	54.8 ± 2.5	54.2 ± 2.5	54.1 ± 2.4	64.2 ± 2.4	63.7 ± 2.4	63.4 ± 2.2
Systolic blood pressure, mm Hg	124.1 ± 14.5	120.2 ± 13.0	118.5 ± 12.4	129.2 ± 16.9	124.3 ± 14.6	123.6 ± 15.0	133.9 ± 16.4	130.4 ± 17.7	128.8 ± 17.6
Total cholesterol, mmol/l	5.77 ± 1.0	5.60 ± 0.98	5.32 ± 0.90	5.93 ± 1.1	5.80 ± 0.97	5.59 ± 0.95	5.87 ± 1.27	5.71 ± 0.96	5.61 ± 1.02
Body mass index, kg/m²	28.2 ± 4.2	26.1 ± 2.8	24.5 ± 2.2	28.1 ± 4.0	26.4 ± 2.9	26.4 ± 2.9	27.6 ± 4.3	26.7 ± 4.5	24.9 ± 2.6
Smokers, %	37.0	21.4	10.7	29.6	21.9	9.8	20.4	12.5	7.9
Diabetes mellitus, %	5.8	2.8	1.2	7.9	5.8	3.2	12.2	4.5	2.8
METs	8.4 ± 1.0	10.8 ± 0.7	13.9 ± 1.5	7.4 ± 0.9	9.6 ± 0.7	12.6 ± 1.5	5.9 ± 0.8	8.3 ± 0.7	11.2 ± 1.6
CVD deaths	163 (9.5)	115 (4.1)	35 (1.8)	212 (26.4)	191 (12.8)	85 (7.5)	61 (35.5)	110 (23.4)	82 (15.3)

Data are presented as mean ± SD, %, or n (%). Metabolic equivalents (METs) expressed as 3.5 ml $O_2 \cdot kg^{-1} \cdot min^{-1}$.

CVD = cardiovascular disease.

| Table 2 | Comparison of Lifetime Risks* for Cardiovascular Disease Death by Traditional Risk Factor Burden Measured at Ages 45, 55, and 65 Years (Men) in the CCLS and the Cardiovascular LRPP |

	Risk Factor Status				
	All Optimal RFs	**Not Optimal RFs**	**≥1 Elevated RF**	**1 Major RF**	**≥2 Major RFs**
Age 45 yrs					
Lifetime risks, CCLS, %	0.46 (0–1.4)	4.8 (1.8–7.5)	7.5 (4.8–9.8)	8.5 (6.9–10.0)	12.5 (8.7–15.7)
Lifetime risks, LRPP, %	9.1 (0–18.6)	13.1 (9.9–16.3)	15.3 (13.3–17.4)	20.7 (19.4–22.2)	32.5 (30.5–34.5)
Age 55 yrs					
Lifetime risks, CCLS, %	16.6 (0–33.1)	17.0 (6.3–24.5)	17.0 (11.3–21.3)	23.3 (11.3–21.3)	35.6 (27.6–41.7)
Lifetime risks, LRPP, %	17.0 (6.8–27.3)	20.7 (16.9–24.5)	29.5 (27.2–31.8)	32.3 (30.9–33.7)	41.4 (39.6–43.2)
Age 65 yrs					
Lifetime risks, CCLS, %	23.2 (0–46.5)	22.5 (13.3–30.2)	20.6 (15.0–25.2)	29.6 (23.3–34.9)	37.1 (26.1–46.3)
Lifetime risks, LRPP, %	—	18.4 (14.5–22.0)	27.7 (25.3–30.2)	33.6 (31.9–35.3)	42.2 (40.0–44.4)

Data are presented as % (95% confidence interval). Empty cells in the table represent strata for which no reliable estimates of lifetime risks could be made secondary to small sample sizes. "All Optimal RFs" was defined as total cholesterol <180 mg/dl, blood pressure <120/<80 mm Hg, nonsmoker, and nondiabetic. "Not Optimal RFs" was defined as nonsmoker and nondiabetic with total cholesterol 180 to 200 mg/dl, systolic blood pressure 120 to 140 mm Hg, or diastolic blood pressure 80 to 90 mm Hg. "Elevated RF" was defined as nonsmoker and nondiabetic with total cholesterol 200 to 240 mg/dl, systolic blood pressure 140 to 160 mm Hg or diastolic blood pressure 90 to 100 mm Hg. "Major RF" was defined as current smoker or total cholesterol ≥240 mg/dl, systolic blood pressure ≥160 mm Hg, or diastolic blood pressure ≥100 mm Hg. *Lifetime risks to age 80 years (for age 45 years) and to 90 years (for ages 55 years and 65 years).

CCLS = Cooper Center Longitudinal Study; LRPP = Lifetime Risk Pooling Project; RF = risk factor.

lower levels of traditional risk factors. In addition, because we used age-specific cutpoints for fitness levels, the mean METs within a given fitness level were higher at younger ages (i.e., age 45 years [moderate fit], 10.8 METs vs. age 65 years [moderate fit], 8.3 METs).

Lifetime risks for CVD death by traditional risk factor levels. To compare the lifetime risks in the CCLS cohort with other cohorts, we determined the lifetime risks for CVD death stratified by traditional risk factor burden using our previously published algorithm (16,19). As expected, higher levels of traditional risk factors was associated with a higher lifetime risk for CVD death in the CCLS cohort. Although the estimates were lower for men at age 45 years, the lifetime risk estimates for CVD death for men at age 55 years and at 65 years were overall quite similar to those estimates obtained from the LRPP, a pooled lifetime risk analysis of 16 unique study cohorts representing 64,907 persons (22) (Table 2).

Lifetime risks and survival for CVD death by fitness levels. Lifetime risks for CVD death to ages 80 and 90 years stratified by fitness levels measured at each index age are shown in Table 3. For each age group, lower levels of fitness were associated with higher lifetime risks for CVD death. Although in the first 10 years, the risk for CVD death was similar for all fitness levels (Fig. 1), there were

marked differences in the lifetime risk for CVD death across the remaining lifespan.

Lifetime risks for CVD death by both traditional risk factor burden and fitness. When participants were stratified by aggregate risk factor burden and fitness level, the lifetime risk for CVD death was lowest in the high fit/low risk burden group for risk factors measured at each index age (Fig. 2). The lifetime risks were highest for persons with both low fitness level and high levels of traditional risk factors at each index age. In contrast, the lifetime risks were intermediate for groups with either low fitness or high traditional risk factors risk, but not both.

Competing risks across the lifespan. Compared with Kaplan-Meier cumulative incidence data for CVD death, adjustment for competing causes of death resulted in a decrease in the lifetime risks for CVD death across all age, fitness, and risk factor groups studied (data not shown). The evidence for competing risks was most prominent at older ages and at lower levels of fitness, at which the rates of non-CVD death are highest. For example, among men with high fitness levels measured at age 55 years, the lifetime risks for CVD death were similar to the unadjusted, Kaplan Meier estimate (Kaplan-Meier cumulative incidence 13.1% vs. lifetime risk 11.5%). In contrast, among men age 55 years with very low fitness levels (≤6 METs), the unad-

| Table 3 | Lifetime Risk for Cardiovascular Disease Death Stratified by Fitness Level Measured at Ages 45, 55, and 65 Years in the Cooper Center Longitudinal Study |

	Lifetime Risk to Age 80 Years				Lifetime Risk to Age 90 Years*		
Age	**High Fitness (n = 2,687)**	**Moderate Fitness (n = 4,785)**	**Low Fitness (n = 3,577)**	**Very Low Fitness† (n = 174)**	**High Fitness (n = 2,687)**	**Moderate Fitness (n = 4,785)**	**Low Fitness (n = 3,577)**
45 yrs	3.4 (1.7–4.9)	6.2 (4.6–7.6)	12.2 (9.7–14.2)	—	3.4 (1.7–4.9)	7.5 (5.1–9.6)	13.7 (9.8–16.6)
55 yrs	4.9 (3.4–6.3)	9.8 (8.1–11.3)	19.6 (16.5–22.4)	28.7 (17.2–39.1)	15.3 (10.1–19.2)	19.7 (15.0–23.1)	34.2 (27.1–39.0)
65 yrs	5.6 (3.5–7.6)	8.8 (6.0–11.4)	12.2 (6.7–17.4)	15.2 (6.1–23.3)	17.1 (12.0–21.2)	25.1 (19.5–29.7)	35.6 (26.5–43.7)

Data are presented as % (95% confidence interval). Empty cells in the table represent strata for which no reliable estimates of lifetime risks could be made secondary to small sample sizes. *To age 85 years for age 45 years group. †Metabolic equivalents ≤6.
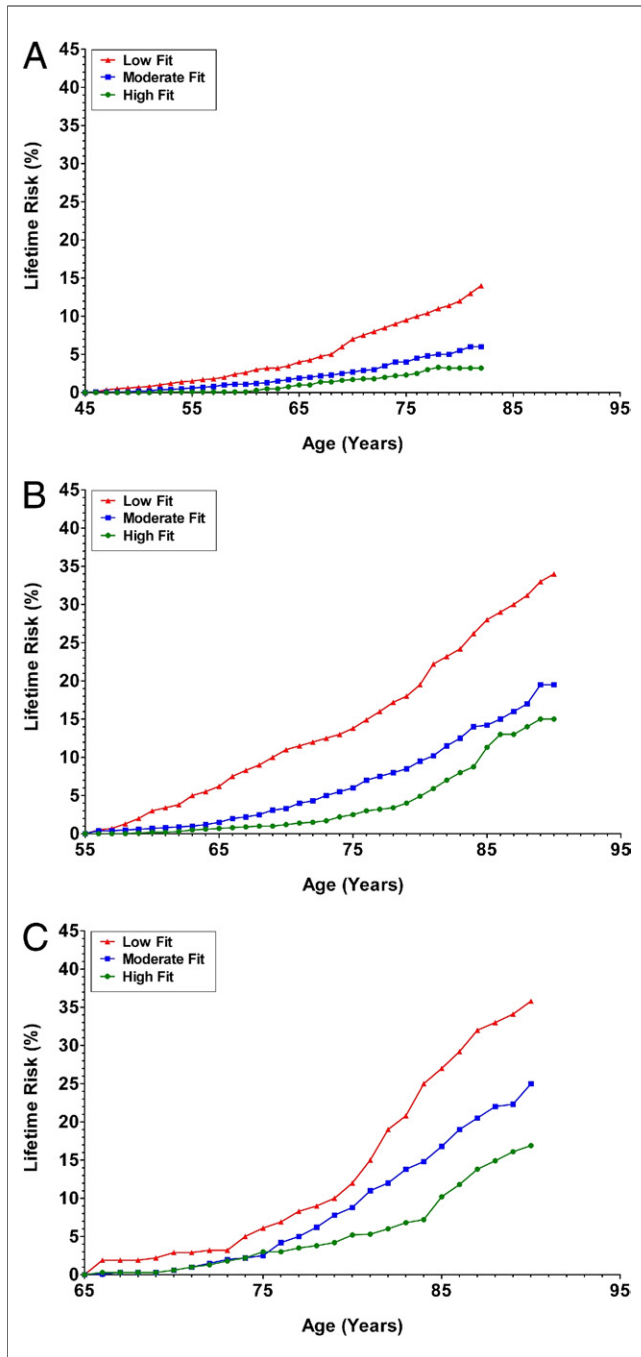
Figure 1   Lifetime Risks for CVD Death by Cardiorespiratory Fitness

Lifetime risks for cardiovascular disease (CVD) death in men stratified by cardiorespiratory fitness measured at age **(A)** 45 years, **(B)** 55 years, and **(C)** 65 years. Treadmill times were compared with normative data on treadmill performance, allowing treadmill time to be classified into an age-specific quintile of fitness. Quintile 1 was defined as "low fit" **(red triangles)**, quintiles 2 and 3 as "moderate fit" **(blue squares)**, and quintiles 4 and 5 as "high fit" **(green circles)**. See the Methods section for details.
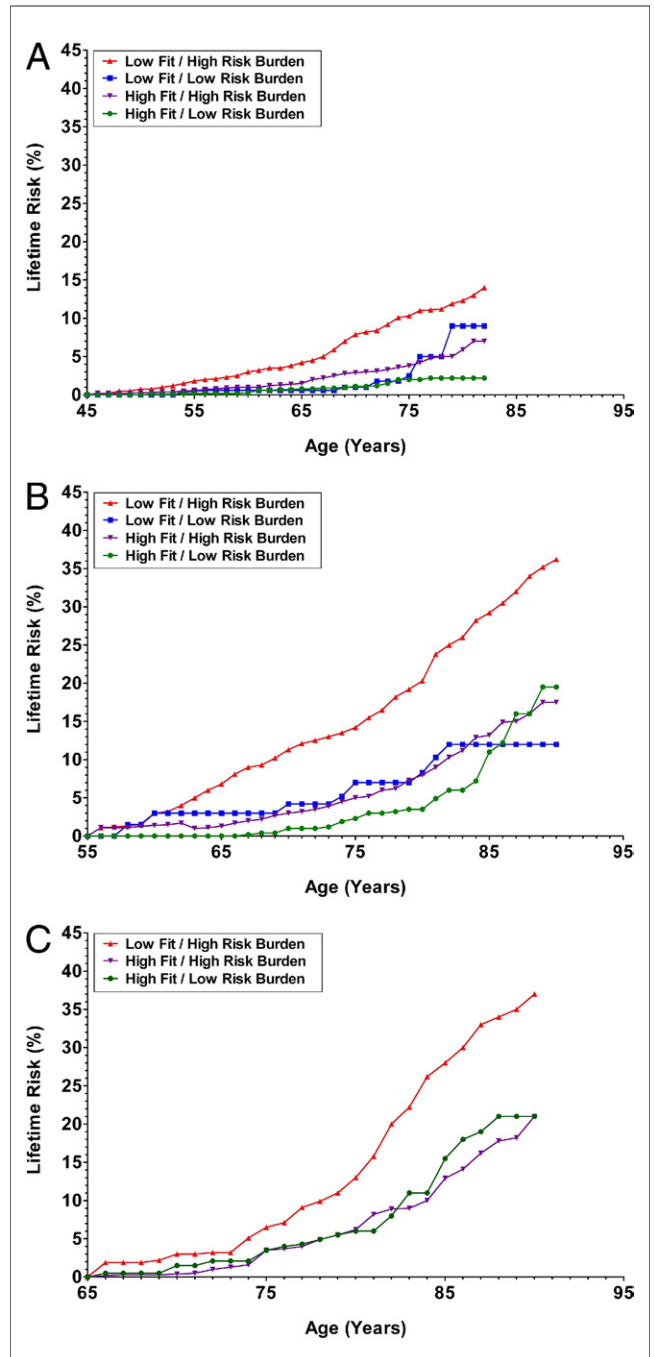
Figure 2   Lifetime Risks for CVD Death by Cardiorespiratory Fitness and Risk Burden

Lifetime risks for cardiovascular disease (CVD) death stratified by cardiorespiratory fitness and risk factor burden measured at age **(A)** 45 years, **(B)** 55 years, and **(C)** 65 years. Quintile 1 was defined as "low fit," and quintiles 2 through 5 were defined as "high fit." "Low risk burden" was defined as the combined presence of nonsmoking status and nondiabetic status with total cholesterol <200 mg/dl, systolic blood pressure <140 mm Hg, and diastolic blood pressure <90 mm Hg. "High risk burden" was defined as the presence of 1 or more of the following: current smoker, diabetes mellitus, total cholesterol ≥200 mg/dl, systolic blood pressure ≥140 mm Hg, and/or diastolic blood pressure ≥90 mm Hg. See the Methods section for details. At age 65 years, the sample size was insufficient to create reliable lifetime risk estimates for the low fit/low risk factor burden group. **Red triangles** indicate low fit, high risk burden; **blue squares** indicate low fit, low risk burden; **down-pointing purple triangles** indicate high fit, high risk burden; **green circles** indicate high fit, low risk burden.

justed Kaplan-Meier estimate was higher than the lifetime risk estimate adjusted for competing risk (Kaplan-Meier = 44.0%, lifetime risk = 35.7%).

Discussion

We observed several important findings in this study. First, the lifetime risks for CVD death according to traditional risk factors in the CCLS were similar to those obtained in a larger, more representative cohort. Thus, although the risk factor burden is lower in the CCLS cohort compared with the general population, the association of these risk factors with lifetime risks for CVD mortality was quite similar, particularly for men at ages 55 and 65 years. Second, low fitness obtained from a single fitness measurement was associated with marked differences in the lifetime risks for CVD death >30 years later. Finally, the combination of high fitness with a high traditional risk factor burden was associated with a lifetime risk for CVD death that was comparable to that of a person with low risk burden.

Multiple prior studies have shown that a single measurement of cholesterol or blood pressure in mid-life was associated with marked differences in CVD risk across 30 or more years of follow-up (16,23,24). The findings in the present study extend these observations to physical fitness. Despite the effects of interval changes in fitness over time, the presence of a single measurement of low physical fitness in mid-life translated into a 15% to 20% absolute difference in the lifetime risk for CVD death.

Furthermore, among persons with elevated cholesterol, hypertension, diabetes, or current smoking status, the presence of a higher fitness level in mid-life attenuated substantially the risk from traditional risk factors. These data have potential implications for public health and clinical practice, providing novel insight into the importance of fitness for long-term CVD risk, particularly among persons with elevated traditional risk factor burden.

Current study in context. Several prior studies have described the association between levels of fitness and the risk for CVD mortality, including the Lipid Research Clinics Study (5), the Veteran Affairs Study (7), and previous reports from the CCLS (3,4). These prior studies, as well as a recent meta-analysis (6), have demonstrated a consistent, inverse association between fitness and mortality in persons with and without prevalent CVD at baseline and after adjustment for traditional risk factors.

In general, these studies have applied conventional statistical techniques to provide both absolute and relative risk estimates. Because these techniques censor data at the time of a competing (non-CVD) death, they cannot be extrapolated to estimate cumulative risk across the lifespan when competing risks can be substantial. In addition, relative and absolute risk estimates have well-recognized limitations for risk communication strategies (8–11,25–27). In particular, relative risks require comparison to a base rate that is rarely known in practice by patients or by physicians. Although

absolute risks overcome this limitation, short-term absolute risks do not reflect risks across the remaining lifespan (28).

The current study provides a clinically relevant and intuitive estimate of the association between fitness, traditional risk factors, and long-term risk. With the knowledge of a man's age, fitness, and risk factor status, clinicians can provide an estimate of the lifetime risk for CVD death. For example, consider a 55-year-old man able to walk 1 mile in 15 min, consistent with very low fitness (METs <6). With these data, we would predict that his lifetime risk for CVD death was nearly 30%. In contrast, a man able to run a 10-min mile (i.e., moderate fitness, or 10 METs) would have an estimated lifetime risk of CVD mortality of just 10%.

Study limitations. First, participants in the CCLS cohort represent a unique sample of well-educated persons with a relatively high socioeconomic status compared with the general population. Therefore, these results may not generalize to persons with a lower educational status or socioeconomic level. However, the association between traditional risk factor burden and lifetime risk observed in the CCLS at ages 55 and 65 years were strikingly similar to those obtained from a large, pooled cohort of 16 unique studies (22). For men at these ages, we believe these findings are generalizable to the broader population, extending prior work on lifetime risks for CVD to include fitness—an additional, modifiable lifestyle factor. However, the present findings may not generalize to men at age 45 years, given the overall lower lifetime risks for CVD in this subgroup.

Second, the ability to adequately control for competing risks is reliable but somewhat limited using mortality from death certificates because of the presence of misclassifications of non-CVD death as CVD death at older ages (29). Thus, we expect that adjudicated CVD deaths would have yielded lower estimates across all risk groups, particularly among the highest fit groups. Therefore, we expect that the actual lifetime risks for CVD death among the highest fit groups are actually lower than those reported in the present paper.

Finally, we assessed the association between a single measurement of fitness and the risk for CVD >30 years later. Although we acknowledge that fitness levels most certainly changed over the follow-up period, we feel that this actually represents a significant strength of our findings. In spite of these changes over time, a single measurement of fitness in mid-life represents a strong determinant of long-term CVD risk. These data provide additional support for the importance of fitness in mid-life and could be useful in efforts to promote risk communication.

Conclusions

In summary, using a large, well-characterized cohort with long-term follow-up, we report the association between fitness levels and lifetime risks for CVD. In this study, a single measurement of fitness in mid-life was associated

with marked differences in the lifetime risk for CVD mortality >30 years later—particularly among persons with at least 1 risk factor in mid-life. These data emphasize the importance of fitness on long-term cardiovascular health and could be useful for practicing clinicians to facilitate more effective risk communication regarding the health benefits of exercise.

Reprint requests and correspondence: Dr. Jarett D. Berry, Division of Cardiology, Dedman Family Scholar in Clinical Care, University of Texas Southwestern Medical Center, 5323 Harry Hines Boulevard, Dallas, Texas 75390-9047. E-mail: jarett. berry@utsouthwestern.edu.

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