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Are Health-Related Quality-of-Life and Self-Rated Health Associated with Mortality? Insights from Translating Research Into Action for Diabetes (TRIAD)

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Abstract

Aims—To determine if health-related quality-of-life and self-rated health are associated with mortality in persons with diabetes.

Methods—Survey and medical record data were obtained from 7,892 patients with diabetes in Translating Research Into Action for Diabetes (TRIAD), a multicenter prospective observational study of diabetes care in managed care. Vital status at follow-up was determined from the National Death Index. Multivariable proportional hazards models were used to determine if a generic measure of health-related quality-of-life (EQ-5D) and self-rated health measured at baseline were associated with 4-year all-cause, cardiovascular, and noncardiovascular mortality.

Results—At baseline, the mean EQ-5D score for decedents was 0.73 (SD=0.20) and for survivors was 0.81 (SD=0.18) ($p<0.0001$). Fifty-five percent of decedents and 36% of survivors ($p<0.0001$) rated their health as fair or poor. Lower EQ-5D scores and fair or poor self-rated health were associated with higher rates of mortality after adjusting for the demographic, socioeconomic, and clinical risk factors for mortality.

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Conclusions—Health-related quality-of-life and self-rated health predict mortality in persons with diabetes. Health-related quality-of-life and self-rated health may provide additional information on patient risk independent of demographic, socioeconomic, and clinical risk factors for mortality.

Keywords

diabetes; mortality; QoL

Introduction

Persons with diabetes and those with diabetic complications have an increased risk of mortality [1]. Measures of health-related quality-of-life (HRQoL) and self-rated health provide a subjective weighting of health problems that may not be captured with objective physical health assessments and may predict mortality in persons with diabetes [2]. Such measures can capture physical limitations which may impact mental functioning, which in turn can impact health by altering health behaviors, adherence with treatment plans, or the function of the immune, endocrine, and cardiovascular systems [2]. Self-rated health may also predict mortality because it provides a dynamic evaluation that reflects not only the current level of health but the trajectory of health, or the presence or absence of resources that can attenuate a decline in health [3]. Davis and colleagues suggested that the psychosocial impact of having diabetes might predict mortality, but their study, conducted 20 years ago, was limited by small sample size and their inability to adjust for demographic and socioeconomic risk factors for death such as race, education, or income [4]. Another study by Dasbach and colleagues showed that self-rated health predicted mortality in persons with diabetes after adjustment for physical health [5]. However, the authors did not examine cause-specific mortality and the study population was composed primarily of non-Hispanic white persons [5].

The purpose of this study was to reexamine the associations between HRQoL, self-rated health, and mortality, and to expand upon the previous research by assessing different measures of quality-of-life (the EQ-5D and self-rated health), by studying a racially and ethnically diverse population, and by examining both cardiovascular and noncardiovascular mortality. Our primary aim was to determine if HRQoL and self-rated health are associated with mortality in patients with diabetes after controlling for demographic, socioeconomic, and clinical risk factors for mortality and whether their assessment might identify persons at increased risk for death.

Methods

Study setting and population

Translating Research Into Action for Diabetes (TRIAD) has been described in detail elsewhere [6]. In brief, six centers collaborate with 10 managed care health plans and 68 provider groups that serve approximately 180,000 Americans with diabetes. Patients 18 years of age with diabetes were sampled. Institutional Review Boards at each participating

site and the Centers for Disease Control and Prevention approved the study. All participants provided informed consent.

A baseline survey was administered to all TRIAD participants either by computer-assisted telephone interview or in writing by mail. Medical records for each participant were also reviewed. Vital status was determined from electronic searches of the National Death Index (NDI) Plus [7]. Deaths were verified by matching the first and last name, sex, and month, day, and year of birth of the decedent with data supplied by the NDI. If available, Social Security number (available for 52% of participants), race, and state of residence were also submitted to NDI and used for verification. “True matches” were determined by using the NDI probability score and additional information from relatives, health plans, Social Security Index searches, and obituary searches. In previous studies, the sensitivity of the NDI has been reported to be between 87 and 98 percent [8]. In previous studies, combinations of identifiers excluding Social Security numbers correctly identify 83 to 92 percent of dead persons (i.e., they classify as deceased persons who are known to have died) and 92 to 99 percent of living persons [9].

Vital status was determined for all TRIAD participants (N=11,927) through December 31, 2004. We excluded TRIAD participants who had incomplete survey or medical record data for the independent and confounder variables after single imputation of selected variables with less than 15% missing data (age, sex, race, educational level, income, duration of diabetes, body mass index (BMI), and smoking). Imputation was carried out using the transcan function in S-PLUS (S-PLUS edition 6.1, Insightful Corporation, Seattle, WA, 2002). Of the original sample, 34% were excluded, 77% of whom did not consent to a review of their medical records. We were left with a study population of 7,892 persons, 749 (9%) of whom were identified as having died before January 1, 2005. The demographic characteristics and HRQoL of those included were similar to those of the entire cohort (age 61 vs 60 years, sex 54% female vs 53% female, 43% white vs 44% white, EQ-5D 0.80 vs 0.80).

Outcome measures and covariates

International Classification of Diseases 10th revision (ICD-10) codes for the underlying and contributing causes of death were derived from the NDI file. We investigated all-cause mortality, cardiovascular mortality (underlying cause of death ICD-10 codes I00-I99), and noncardiovascular mortality (all other underlying cause of death ICD-10 codes).

The two primary independent variables were the United States scored EQ-5D and self-rated health (9-10). Both were assessed by survey at baseline. The EQ-5D defines health by five dimensions: mobility, self-care, usual activities, pain or discomfort, and anxiety or depression. Responses to the EQ-5D can be presented separately for each dimension or converted into a single weighted index score using population preferences [10]. We used the single weighted index because we wanted to determine how overall HRQoL would impact mortality. Self-rated health was ascertained by response to the question “In general, would you say your health is: excellent, very good, good, fair, or poor?” Given the low frequency of the “excellent” and “poor” responses we combined “excellent” with “very good” and “fair” with “poor.”

In a prior publication, we determined which demographic, socioeconomic, and clinical risk factors were associated with mortality and these were included as covariates in the current models [11]. We defined macrovascular disease as any medical record history of transient ischemic attack, cerebrovascular accident, angina, myocardial infarction, congestive heart failure, other coronary heart disease or coronary artery disease, or peripheral vascular disease. We used the Charlson index to quantify the comorbidity burden [12, 13].

Previously, we found that older age, male sex, non-Hispanic white race (vs. Hispanic), lower income, longer duration of diabetes, treatment with oral antidiabetic medications (with or without insulin), lower BMI, smoking, macrovascular disease, dyslipidemia, nephropathy, and a higher Charlson index were associated with all-cause mortality [11]. Cardiovascular mortality was associated with older age, male sex, lower income, longer duration of diabetes, lower BMI, smoking, macrovascular disease, dyslipidemia, and nephropathy were predictors of risk [11]. Noncardiovascular mortality was associated with older age, male sex, non-Hispanic white race (vs. black race or other), treatment with oral antidiabetic medications (with or without insulin), lower income, lower BMI, smoking, dyslipidemia, nephropathy, and a higher Charlson index [11].

Statistical analyses

Univariate proportional hazards models were constructed to determine the unadjusted hazard rate ratios (HR) for all-cause mortality, cardiovascular mortality, and noncardiovascular mortality. Multivariate proportional hazard models were constructed to determine HRs for mortality adjusted for the covariates cited above as well as health plan and provider group. We tested the assumption of proportional hazard graphically and determined the correlations between the ranked failure time variable and the Schoenfeld residuals of the independent variables. All of the analyses were performed using SAS version 9.1.3 sp 4 (SAS Institute Inc., Cary, NC, 2003).

Results

Of the 7,892 persons included in our analyses, 749 (9%) died before January 1, 2005. The average length of follow-up was 3.7 years. The median age at death was 71 years and 54% of decedents were men. Fourteen percent of decedents were Hispanic, 18% black, 51% white, 9% Asian/Pacific Islander, and 8% of other races/ethnicities (Table 1). Of the 749 patients who died, 320 (43%) had a cardiovascular cause and 429 (57%) had a noncardiovascular cause listed as the underlying cause of death.

Compared to survivors, decedents were more likely to report extreme or some problems for each of the five dimensions of the EQ-5D and to have lower EQ-5D scores (Table 1). At baseline, the mean EQ-5D score for decedents was 0.73 (SD=0.20) and for survivors was 0.81 (SD=0.18) ($p<0.0001$). Lower EQ-5D scores were also associated with female versus male gender ($p<0.0001$), black race/ethnicity (versus white) ($p<0.0001$), white race/ethnicity (versus Hispanic ($p<0.0001$) or Asian/Pacific Islander ($p<0.0001$)), lower income ($p<0.0001$), longer duration of diabetes ($p<0.0001$), treatment with insulin ($p<0.0001$), higher BMI ($p<0.0001$), smoking ($p<0.0001$), dyslipidemia ($p<0.0001$), macrovascular

disease ($p<0.0001$), nephropathy ($p=0.001$), and a higher Charlson index ($p<0.0001$). EQ-5D scores were not correlated with time to death (Pearson correlation coefficient=0.20).

Decedents were also more likely to report fair or poor self-rated health compared to survivors (Table 1). Fifty-five percent of decedents and 36% of survivors ($p<0.0001$) rated their health as fair or poor. Lower self-rated health was also associated with younger age ($p<0.0001$), female versus male gender ($p<0.0001$), Hispanic ($p=0.020$), black ($p<0.0001$), or other race/ethnicity ($p=0.005$) (versus white), lower income ($p<0.0001$), longer duration of diabetes ($p<0.0001$), treatment with insulin ($p<0.0001$), higher BMI ($p<0.0001$), smoking ($p<0.0001$), macrovascular disease ($p<0.0001$), nephropathy ($p<0.0001$), and a higher Charlson index ($p<0.0001$).

In the multivariable models that incorporated the EQ-5D score and self-rated health and all covariates, a lower EQ-5D score and fair or poor self-rated health were associated with higher rates of all-cause and noncardiovascular mortality (Table 2). A lower EQ-5D score but not poorer self-rated health was associated with a higher rate of cardiovascular mortality (Table 2). Adjustment for demographic, socioeconomic, and clinical risk factors for mortality attenuated the associations but did not change the significance or direction of the associations. After adjusting for demographic, socioeconomic, and clinical risk factors for mortality, we found that every 0.10 unit increase in the EQ-5D score was associated with an 8% decrease in mortality (adjusted HR 0.92 (95% confidence interval 0.87-0.96)).

Discussion

Research has highlighted the importance of HRQoL and self-rated health in predicting health outcomes [3, 14-20]. We have shown a consistent relationship between the EQ-5D score and mortality after adjusting for demographic, socioeconomic, and clinical risk factors for death. While the mechanism for this relationship is unknown, we hypothesize that the long-term complications of diabetes may contribute to lower HRQoL that in turn affect self-care and survival. In our study, fair or poor self-rated health was also associated with all-cause and noncardiovascular mortality, even after adjustment for important demographic, socioeconomic, and clinical risk factors. While this association was not significant for cardiovascular mortality, an association between lower self-rated health and higher mortality was apparent. We hypothesize that self-rated health may provide insight into health problems that are not captured by objective physical health assessments but are associated with mortality.

Recently, Hayes and colleagues reported that better HRQoL as assessed by the EQ-5D Visual Analog Scale was associated with a lower risk of diabetic complications and vascular events [19]. Kleefstra and colleagues also reported that the physical component summary of the RAND-36 was inversely associated with mortality in persons with type 2 diabetes [20]. Using other validated measures of HRQoL, we extended these findings and showed that both HRQoL and self-rated health were associated with mortality. In an older analysis of a non-Hispanic white population with diabetes, Dasbach and colleagues found that self-rated health predicted mortality [5]. We found that this relationship existed in our prospective

cohort with a larger sample size, greater racial/ethnic diversity, and with respect to both cardiovascular and noncardiovascular mortality.

There are some limitations to our study. Since we studied patients who were diagnosed with diabetes at least 18 months before the survey, our sample is biased toward persons with longer durations of diabetes. Our study sites may not be representative of all managed care populations, and the results may not be generalizable to non-managed care settings. Since we studied only people who consented to chart review and had complete data on all covariates after imputation of some variables, we excluded 34% of the TRIAD sample, 429 of whom had died. These exclusions resulted in some selection bias. However, the distributions of characteristics of the entire TRIAD cohort were very similar to the distribution of characteristics of the population of persons who were included in multivariate analyses. Finally, short-term mortality is likely to be different from long-term mortality. Poor self-rated health may simply reflect a greater severity of disease or a better respondent knowledge of conditions leading to mortality [16]. If people with poor self-rated health only survive for a short time, the effects of self-assessed health may be explained by inadequate adjustment for physical health status. Idler and Benyamini [3] reviewed twenty-seven studies which showed that self-rated health predicted both short-term mortality (2 to 7 years) and long-term mortality (9 to 13 years). In addition, we found no correlation between EQ-5D scores and time to death.

In conclusion, both the EQ-5D score and self-rated health predicted 4-year mortality in this diabetic cohort after adjustment for demographic, socioeconomic, and clinical risk factors associated with death. Future studies of mortality in persons with diabetes should investigate whether HRQoL and self-rated health are associated with non-adherence to medication and treatment regimens.

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Abbreviations

BMI	body mass index
CI	confidence interval
HR	hazard rate ratio
HRQoL	health-related quality of life
ICD-10	<i>International Classification of Diseases – 10th revision</i>
NDI	National Death Index
TRIAD	Translating Research into Action for Diabetes

Table 1

Characteristics of decedents and survivors as defined by underlying cause of death, Translating Research Into Action for Diabetes (N=7892), 2000-2004. Data are percent or mean (standard deviation (SD)) as specified.

	All Decedents N= 749	Cardiovascular decedents N= 320	Noncardiovascular decedents N= 429	Survivors N= 7143
Demographics				
Age (years) (mean(SD))	68.9 (10.6)	70.0 (10.4)	68.1 (10.7)	60.0 (12.7)
Sex (female)	46	46	46	55
Socioeconomic				
Race				
Hispanic	14	14	14	17
Black	18	19	18	16
White	51	47	52	42
Asian/Pacific Islander	9	8	9	16
Other	8	10	7	9
Annual Income				
<\$15,000	47	48	47	30
\$15,000-40,000	32	33	31	30
\$40,000-75,000	14	13	14	24
>\$75,000	7	6	7	16
Clinical				
Diabetes duration (years) (mean(SD))	16.0 (13.7)	16.5 (13.3)	15.6 (14.0)	11.8 (10.3)
Diabetes treatment				
Diet/exercise only	8	6	9	7
Oral medication	51	50	52	62
Oral medication + insulin	14	17	12	13
Insulin	27	28	27	18
Body mass index (kg/m ²) (mean(SD))	29.9 (7.3)	29.5 (7.0)	30.0 (7.5)	31.4 (7.2)
Current some or every day smoker	21	18	23	18
Dyslipidemia	48	52	46	53
Macrovascular disease	64	73	56	31
Nephropathy	30	31	30	17
Charlson index (mean(SD))	3.6 (2.2)	3.6 (2.1)	3.6 (2.2)	2.1 (1.5)
EQ-5D				
EQ-5D (mean (SD))	0.73 (0.20)	0.73 (0.20)	0.74 (0.21)	0.81 (0.18)
Problems with mobility	67	71	65	42
Problems with self-care	19	18	20	9
Problems with usual activities	60	62	59	36
Pain or discomfort	65	66	65	58
Anxiety or depression	38	41	36	30
Self-rated health				
General state of health				

	All Decedents N= 749	Cardiovascular decedents N= 320	Noncardiovascular decedents N= 429	Survivors N= 7143
Excellent	3	3	3	5
Very good	14	15	13	18
Good	29	30	28	40
Fair	39	36	41	29
Poor	16	17	16	7

Table 2

Factors associated with mortality defined by underlying cause of death, hazard rate ratios (HR) and their associated 95 percent confidence intervals (CI), Translating Research Into Action for Diabetes (N=7892), 2000-2004.

	Adjusted [†] HR (95% CI) for all-cause mortality		Adjusted [‡] HR (95% CI) for cardiovascular mortality		Adjusted [§] HR (95% CI) for noncardiovascular Mortality	
	HR	95% CI	HR	95% CI	HR	95% CI
EQ-5D	0.44*	0.30, 0.65	0.34*	0.19, 0.61	0.46*	0.27, 0.77
Self-rated health (referent=excellent or very good)						
Good	0.97	0.78, 1.22	0.95	0.68, 1.33	1.00	0.74, 1.36
Fair or poor	1.41*	1.13, 1.76	1.28	0.91, 1.78	1.65*	1.22, 2.23

* p-value < 0.05

[†] includes EQ-5D and self-rated health, and adjusted for age, sex, race, income, duration and treatment of diabetes, body mass index (BMI), smoking, dyslipidemia macrovascular disease, nephropathy, the Charlson index, and provider group/health plan cluster.

[‡] includes EQ-5D and self-rated health, and adjusted for age, sex, income, duration of diabetes, BMI, smoking, dyslipidemia, macrovascular disease, nephropathy, and providergroup/health plan cluster.

[§] includes EQ-5D and self-rated health, and adjusted for age, sex, race, income, treatment of diabetes, BMI, smoking, dyslipidemia, nephropathy, the Charlson index, and provider group/health plan cluster.