Dispositional Optimism and All-Cause and Cardiovascular Mortality in a Prospective Cohort of Elderly Dutch Men and Women

Erik J. Giltay, MD, PhD; Johanna M. Geleijnse, PhD; Frans G. Zitman, MD, PhD; Tiny Hoekstra, PhD; Evert G. Schouten, MD, PhD

Background: Major depression is known to be related to higher cardiovascular mortality. However, epidemiological data regarding dispositional optimism in relation to mortality are scanty.

Objective: To test whether subjects who are optimistic live longer than those who are pessimistic.

Design: Our analysis formed part of a prospective population-based cohort study in the Netherlands (Arnhem Elderly Study).

Setting: General community.

Participants: Elderly subjects aged 65 to 85 years (999 men and women) completed the 30-item validated Dutch Scale of Subjective Well-being for Older Persons, with 5 subscales: health, self-respect, morale, optimism, and contacts. A total of 941 subjects (466 men and 475 women) had complete dispositional optimism data, and these subjects were divided into quartiles.

Main Outcome Measure: Number of deaths during the follow-up period.

Results: During the follow-up period of 9.1 years (1991-2001), there were 397 deaths. Compared with subjects with a high level of pessimism, those reporting a high level of optimism had an age- and sex-adjusted hazard ratio of 0.55 (95% confidence interval, 0.42-0.74; upper vs lower quartile) for all-cause mortality. For cardiovascular mortality, the hazard ratio was 0.23 (95% confidence interval, 0.10-0.55) when adjusted for age, sex, chronic disease, education, smoking, alcohol consumption, history of cardiovascular disease or hypertension, body mass index, and total cholesterol level. Protective trend relationships were observed between the level of optimism and all-cause and cardiovascular mortality (P<.001 and P=.001 for trend, respectively). Interaction with sex (P=.04) supported a stronger protective effect of optimism in men than women for all-cause mortality but not for cardiovascular mortality.

Conclusions: Our results provide support for a graded and independent protective relationship between dispositional optimism and all-cause mortality in old age. Prevention of cardiovascular mortality accounted for much of the effect.

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Many studies have consistently linked depression to an excess risk of cardiovascular and all-cause mortality, whereas relationships with positive aspects of personality have received less attention. The personality trait of optimism for a given individual is relatively stable across time and has been related to better health outcomes. However, optimism has been conceptualized in 2 rather different ways; that is, as an explanatory-style measure by Peterson et al (ie, the general belief that the causes of bad events are not one’s own fault, are temporary, and are confined to the present circumstances rather than attributable to internal, stable, and/or global factors) and as dispositional optimism by Scheier et al (ie, generalized outcome expectancies that good things rather than bad things will happen). On the one hand, evidence suggests that explanatory-style optimism has been associated with better health and lower morbidity and mortality. Explanatory-style optimism was associated with a lower incidence of coronary heart disease in cohort studies. On the other hand, dispositional optimism has been linked to medical staff ratings of better physical health after surgery for heart transplantation, a more rapid recovery from coronary artery bypass surgery, and a lower rate of rehospitalization after coronary artery bypass grafting. The related score for positive life orientation was linked to physicians’ and patients’ ratings of good recovery after hospitalization for myocardial infarction. Another study found that...
dispositional optimism, assessed by the Life Orientation Test,11 was associated with better cancer survival among patients younger than 59 years but not in older patients.21 Because explanatory-style and dispositional optimism do not strongly correlate with each other,12,22,23 these constructs may represent different aspects of well-being. Although hope is not equivalent to the expectation of a favorable outcome, as dispositional optimism is usually defined, hope may be a conceptually related construct. Hopelessness has been associated with an increased risk of fatal and nonfatal cardiovascular disease1,24,25 as well as cancer24 and the progression of atherosclerosis26 in large cohorts with long follow-up periods. However, the benefits of dispositional optimism in increasing longevity and reducing cardiovascular mortality have not been clearly identified in older people.

To test the hypothesis whether subjects who are optimistic live longer than those who are pessimistic, we performed a prospective analysis in elderly men and women who were participants in the Arnhem Elderly Study. Dispositional optimism was assessed as a bipolar construct with questions about whether a participant thinks in a positive way, sees the future as meaningful and fulfilling, has a desire to achieve new goals, and has a sense of happiness and joy.27 To determine whether the trait of optimism was independently associated with known predictors of mortality, we adjusted for cardiovascular risk factors and sociodemographic characteristics. Potential confounders included dietary factors, smoking habits, obesity, and physical activity, which are related to an individual’s emotional state.20-31 and alcohol dependence, which is associated with a lack of optimism.30 Additionally, low socioeconomic status (eg, poverty) or a recent loss in the social network may diminish optimistic feelings and increase the risk of premature death. We also explored whether this potential relationship was modified by sex because a lower level of explanatory-style optimism has been associated with premature death, especially in men.10 However, sex differences for the effects of dispositional optimism received little attention.

METHODS

STUDY POPULATION

The Arnhem Elderly Study is a population-based cohort study that started in 1991-1992. We evaluated a random sample (stratified for age and sex) of 1793 independently living men and women aged 65 to 85 years in the city of Arnhem, the Netherlands. Of these individuals, 49 were excluded because they were institutionalized, had moved elsewhere, or had died. In addition, 732 people (42% of the eligible subjects) refused participation for various reasons. A total of 1012 noninstitutionalized subjects (56%) agreed to be interviewed, and 685 agreed to undergo a physical examination and venipuncture.

The study design and population characteristics have been described elsewhere.14 Subjects participating in the study were more likely to be men (52% vs 44%; P = .01) and of younger age (73.6 years vs 76.1 years; P < .001) than nonparticipants and subjects who were only interviewed. Other characteristics, including lifestyle factors and self-perceived health, did not significantly differ between these groups. All subjects provided written informed consent. The study was approved by the Ethical Committee of Wageningen University (Wageningen, the Netherlands).

QUESTIONNAIRE ON WELL-BEING AND THE OPTIMISM SUBSCALE

Subjective well-being was assessed by the Dutch Scale of Subjective Well-being for Older Persons (SSWO) developed by Groningen University (Groningen, the Netherlands).27,35,36 The SSWO was constructed with 93 items from 5 existing scales. With factor analyses, this number was reduced to 30 items. The SSWO sum score is an indicator of how the elderly individual experiences subjective general well-being. Five subscales were identified through factor analysis: health (5 items; Cronbach α = .87), self-respect (7 items; α = .73), morale (6 items; α = .77), optimism (7 items; α = .76), and contacts (5 items; α = .65), accounting for 48.1% of variance.

The questionnaire included 3-point scales. Several scores for negative items had to be reversed so that all items were coded from 0 to 2, with higher scores indicating greater well-being. For each subscale and the sum score, a mean item score was calculated and multiplied by 10, resulting in ranges from 0 to 20. Validity was previously assessed by testing against objective measures of well-being (eg, physical activity, mobility, use of health care, and activities of daily living). The test-retest reliability coefficient was 0.85 for the total SSWO score and 0.76 for the optimism subscore.27 Validating the SSWO with the Hopkins Symptom Checklist11 in elderly subjects yielded correlation coefficients ranging from –0.50 to –0.70 (P < .01 for all).27

Participants were ranked according to their SSWO subscores and divided into quartiles. Quartiles categorized a person as being a pessimist (ie, quartile 1 = lowest score) or an optimist (ie, quartile 4 = highest score), defined relative to one another. The 7 questions of the optimism subscale consisted of the following: “I often feel that life is full of promises,” “I still have positive expectations concerning my future,” “There are many moments of happiness in my life,” “I do not make any more future plans,” “Happy laughter often occurs,” “I still have many goals to strive for,” and “Most of the time I am in good spirits.” Participants were asked to fill out the questionnaire at home and return it. Subscales that contained any blank items were excluded from the analyses.

DEMOGRAPHIC, BEHAVIORAL, AND BIOLOGICAL FACTORS

Standardized data collection was performed by trained interviewers at baseline. Physical activity was scored continuously according to a validated questionnaire on household activities, sports, and other leisure time activities.38 Dichotomous variables were created for sex (1 = men; 2 = women), marital status (1 = living together as a married or unmarried couple; 2 = otherwise), physical disability (based on the Activities of Daily Living Scale27,19 = having some or great problems with 1 or more of 22 activities; 2 = otherwise), alcohol (1 = ≤ 5 alcoholic consumption per day; 2 = otherwise), education (1 = high school; 2 = otherwise), and socioeconomic status (1 = housewives, unskilled and skilled workers, and lower employees; 2 = small-business owners, employees, and higher professions). For married or widowed women, socioeconomic status was classified according to that of the husband. Smoking status was coded as current, former, or never. Respondents were asked if they had chronic or acute health conditions that might affect longevity (eg, cardiovascular disease [ie, a history of heart disease or stroke], diabetes, or chronic obstructive pulmonary disease), which were represented by binary variables. In addi-
tion, the variable of chronic disease coded for the total number of chronic disorders and illnesses of respondents (0, 1, 2, 3, 4, or 5 or more from a list of 24; eg, chronic venous leg ulcers, chronic gastric disease, chronic low back pain, rheumatic disease, cancer, thyroid disease, and deafness). Subjects were considered to be receiving cardiovascular medication if they used angiotensin-converting enzyme inhibitors, anticoagulants, lipid-reducing agents, and/or salicylates during the 3 months prior to the interview. The semiquantitative food frequency questionnaire was based on the validated EuronutSENeca [Survey in Europe on Nutrition and the Elderly, A Concerted Action] dietary history questionnaire and the Dutch Food Consumption Survey. Fat intake was calculated with the Dutch nutrient database.

Body mass index was calculated by dividing weight in kilograms (to the nearest 0.5 kg with the subject dressed but not wearing shoes) by height in meters squared (to the nearest 0.5 cm). Systolic and diastolic blood pressures were measured twice in supine position with a random-zero sphygmomanometer (Hawksley Technology, Lancing, England), and the mean was used. Hypertension was defined as a blood pressure reading of 160/95 mm Hg or higher or the use of antihypertensive medication. A single nonfasting blood sample was obtained in 641 subjects. Venipuncture was performed between 8:00 AM and 5:30 PM using citrate collection tubes, and time of blood sampling was recorded. Samples were stored at –80°C. Plasminogen activator inhibitor type 1, the main inhibitor of fibrinolysis and a potential risk factor for cardiovascular disease, was evaluated using the Chromolize kit (Biopool, Umeå, Sweden) and adjusted for time of blood sampling. Total serum cholesterol level was determined enzymatically (cholesterol oxidase–phenol amionophenazon peroxidase reaction; Boehringer Mannheim, Mannheim, Germany), and high-density lipoprotein (IDL) and low-density lipoprotein (LDL) cholesterol levels were measured directly (Dimension HDL; Dade Behring Marburg, Marburg, Germany; and N–geneous LDL; Genzyme Diagnostics, Cambridge, Mass). We assessed C-reactive protein using a highly sensitive enzyme-linked immunosorbent assay procedure. Seven blood parameters could not be assessed for 31 subjects.

FOLLOW-UP

Municipal registries provided data on mortality and migration until February 2001. One person was lost to follow-up owing to emigration (and was censored); in the remaining 1011 subjects, follow-up for all-cause mortality was complete.

Data regarding cause-specific mortality were obtained for the 641 subjects from whom blood was sampled. These data were obtained from general physicians by means of a standard form. Some subjects (n = 39) gave no permission for the collection of follow-up data, and for other subjects the general physician could not be traced (n = 31), did not cooperate (n = 39), or did not provide proper data (n = 10). Follow-up for cause-specific mortality was complete for 518 subjects (81%; 268 men and 250 women) to code for cardiovascular death according to the International Classification of Diseases, 10th Revision (ICD–10) (codes 100–196). Characteristics of subjects who received follow-up were similar to those of subjects who did not, except for a lower total cholesterol level (232 mg/dL [6.0 mmol/L] vs 243 mg/dL [6.3 mmol/L]; P = .02).

STATISTICAL ANALYSIS

First, exploratory factor analysis was performed for the 30 questions of the SSWO questionnaire (with orthogonal varimax rotations and Kaiser-Meyer-Olkin and Bartlett tests25). Baseline characteristics were reported as number (percentage) or (geometric) means (± SD or with 95% confidence interval [CI]). The positively skewed distributions of plasma total, LDL, and HDL cholesterol, C-reactive protein, and plasminogen activator inhibitor type 1 were log transformed. Comparisons between men and women and between quartiles for the SSWO scores were analyzed using Mann-Whitney, χ², or independent t tests as appropriate. Linear trends from the lowest to the highest quartile were tested. The Kaplan-Meier method was used to examine crude all-cause and cardiovascular mortality (Figure 1).

Second, we analyzed optimism in relation to all-cause mortality in 941 subjects who completed all of the optimism questions. Cox proportional hazards analysis was used to adjust for potential confounders (eg, sex, age, and sociodemographic and cardiovascular covariates). We explored the associations of quartiles of the SSWO total score and its subscales with mortality, using the first quartile as the reference category. To examine whether the relationship differed between men and women, tests for interaction were performed by entering cross-product terms for sex and optimism into the Cox model (for the highest vs lowest quartile). The analyses were repeated stratified for sex. In post-hoc analyses, we tested each of the 7 questions of the optimism subscale for the highest discriminating power by dichotomizing the answer categories.

Third, we analyzed optimism in relation to cardiovascular mortality using Cox proportional hazards analysis, similar to the analyses of all-cause mortality. P < .05 was considered statistically significant using a 2-tailed test. The software used was SPSS version 10.0 (SPSS Inc, Chicago, Ill).

BASELINE CHARACTERISTICS

The SSWO was filled in by 999 (98.7%) of 1012 subjects. Of those subjects, 893 completed all 30 questions and 941 (93.0%) completed the 7 questions of the optimism subscale. The main reasons for not completing the SSWO questionnaire were difficulties with questions and forgetfulness. The 71 nonresponding subjects as compared with the 941 subjects who did complete the questions on optimism did not differ in sex, body mass index, marital status, socioeconomic status, physical activity, or physical disability; however, they were slightly older (mean age, 75.7 vs 74.5 years; P = .09) and reported slightly more chronic disease (P = .07). Factor analysis confirmed that the 30 SSWO questions yielded 5 reliable subscales (Kaiser-Meyer-Olkin measure, 0.89; Bartlett test, P < .001). Following varimax rotation, the 7 items of the optimism subscale were loaded into 1 cluster similar to the original SSWO questionnaire (item loading on this cluster ranged from 0.28 to 0.77), although 4 of the 7 items also loaded into the contacts subscale.

The 941 subjects (466 men [49.5%] and 475 women) who completed the 7 optimism questions had a mean ± SD age of 74.5 years. The median ± SD optimism subscore was 12.9 ± 4.8 (range, 0–20.0); this score was similar for men and women (P = .77) and was divided into quartiles (quartile 1, 0–8.6; quartile 2, 10.0–12.9; quartile 3, 14.3–15.7; and quartile 4, 17.1–20.0). The medical history included hypertension in 215 subjects (22.8%), cardiovascular disease in 41 subjects (4.4%), diabetes mellitus in 54 subjects (5.7%), and chronic obstructive pulmonary disease in 34 subjects (3.6%). The mean ± SD
Body mass index was 25.9±3.7, and the mean±SD diastolic and systolic blood pressures were 81.4±10.9 and 150.1±20.9 mm Hg, respectively. On average, men were younger (mean age, 73.9 years vs 75.0 years), less obese (mean body mass index, 25.4 vs 26.4), more physically active, less often living alone, of higher socioeconomic status, more often smokers or former smokers, more often consuming 2 or more alcoholic drinks per day, and less often experiencing diabetes mellitus, hypertension, or chronic disease in general than women (P<.005 for

Figure 1. Kaplan-Meier analysis of survival according to the quartiles of the optimism subscale in 466 men and 436 women aged 65 to 85 years. Quartiles range from high pessimism (1) to high optimism (4). Compared with subjects with a high level of pessimism, those reporting a high level of optimism showed a decreased mortality rate in men (A) and less evidently in women (B). Optimism in men (C and E), but not in women (D and F), was associated with a lower rate of cardiovascular death as well as noncardiovascular death. The P values were calculated using the log-rank test for trend.
all). Only 2 subjects reported a depressive disorder and 1 a nonspecified psychiatric disorder.

For both sexes, higher optimism subscores were associated with younger age, less chronic disease, a higher health subscale score, a higher total activity score, and less physical disability (P < .001 for all). In men, higher optimism subscores were also associated with living together vs alone (P = .005), a higher level of education (P = .004), more vitamin use (P = .02), less use of primary health care (P = .02), and less often currently smoking (P = .03). In women, higher optimism subscores were also associated with living together vs alone (P < .001), a higher level of education (P < .001), no medical history of diabetes (P = .02), less use of primary health care (P = .003), less often currently smoking (P = .03), and more often consuming either no alcohol (P = .01) or a moderate amount of alcohol (ie, 1-2 consumptions per day; P = .005). Optimism was unrelated to dietary variables, body mass index, blood pressure, or any serum or plasma parameter.

**OPTIMISM AND ALL-CAUSE MORTALITY**

During the mean ± SD follow-up period of 9.1 ± 0.1 years, 397 (42%) of 941 subjects died (48.8% of men vs 35.9% of women; P < .001). Using January 1996 through December 2000 as a reference period, sex-specific data, and the same age distribution as the cohort that survived until January 1, 1996, the mortality rates of our cohort and the Dutch population were comparable: all-cause mortality (48.8% of men vs 35.9% of women; P < .001). Using January 1996 through December 2000 as a reference period, sex-specific data, and the same age distribution as the cohort that survived until January 1, 1996, the mortality rates of our cohort and the Dutch population were comparable: all-cause mortality (48.8% of men vs 35.9% of women; P < .001). Using January 1996 through December 2000 as a reference period, sex-specific data, and the same age distribution as the cohort that survived until January 1, 1996, the mortality rates of our cohort and the Dutch population were comparable: all-cause mortality (48.8% of men vs 35.9% of women; P < .001).

The SSWO total score was associated with a decreased risk of all-cause mortality (P < .001 for trend) (Table 1). For the SSWO subscores, only the health and optimism subscores were associated with a decreased risk of all-cause mortality (P < .001 for trend) (Table 1). The crude death rates were 56.5%, 43.1%, 38.2%, and 30.4% for quartiles 1 to 4 of the optimism subscale (ranging from a high level of pessimism to a high level of optimism), respectively, in men and women combined (P < .001 for trend). Compared with subjects with a high level of optimism (quartile 1), those reporting a high level of optimism (quartile 4) had an age- and sex-adjusted hazard ratio of 0.55 (95% CI, 0.42-0.74). When adjusted for age, sex, smoking, alcohol consumption, education, total activity score, socioeconomic status, and marital status, this hazard ratio was 0.71 (95% CI, 0.52-0.97; P = .02 for trend).

As expected, women had lower all-cause mortality than men (hazard ratio, 0.51; 95% CI, 0.41-0.64). The Kaplan-Meier curves suggested modification of the relationship between optimism and mortality by sex; that is, the protective effect of optimism seemed stronger in men than in women (Figure 1). An interaction term between sex and optimism was added to the multivariate model with sex and age and did show a statistically significant interaction (P = .04), supporting a stronger protective effect of optimism in men as compared with women. This interaction was of borderline statistical significance (P = .07) after adjustment for age, sex, chronic disease, smoking, alcohol consumption, education, total activity score, socioeconomic status, and marital status.

Figure 1 illustrates survival rates among quartiles of the optimism subscale. In men, death rates were reduced by 1.0%, 14.0%, and 62.9% across the second to fourth quartiles (using the lower quartile as the reference) at 6 years of follow-up. In women, corresponding death rates were 8.6%, 22.7%, and 34.8% at 6 years, respectively. Figure 2 shows the hazard ratios according to age groups and optimism quartiles in men and women.

### Table 1. Hazard Ratios for Death According to the Dutch Scale of Subjective Well-being for Older Persons, With Adjustment for Sex and Age*

<table>
<thead>
<tr>
<th>Model</th>
<th>No. of Cases/No. of Subjects</th>
<th>Quartile</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>P Value for Trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>All-cause mortality†</td>
<td>374/891</td>
<td>1.00</td>
<td>0.74 (0.57-0.97)</td>
<td>0.68 (0.51-0.90)</td>
<td>0.57 (0.42-0.77)</td>
<td>&lt;.001</td>
<td></td>
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<tr>
<td>Health subscore‡</td>
<td>403/954</td>
<td>1.00</td>
<td>0.63 (0.49-0.82)</td>
<td>0.48 (0.39-0.61)</td>
<td>NA</td>
<td>&lt;.001</td>
<td></td>
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<tr>
<td>Self-respect subscore</td>
<td>397/943</td>
<td>1.00</td>
<td>0.96 (0.74-1.25)</td>
<td>0.93 (0.69-1.26)</td>
<td>1.06 (0.81-1.39)</td>
<td>.76</td>
<td></td>
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<tr>
<td>Morale subscore</td>
<td>403/946</td>
<td>1.00</td>
<td>1.03 (0.77-1.36)</td>
<td>0.93 (0.66-1.31)</td>
<td>0.97 (0.74-1.28)</td>
<td>.68</td>
<td></td>
</tr>
<tr>
<td>Optimism subscore</td>
<td>397/939</td>
<td>1.00</td>
<td>0.89 (0.69-1.15)</td>
<td>0.75 (0.56-1.00)</td>
<td>0.55 (0.42-0.74)</td>
<td>&lt;.001</td>
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<tr>
<td>Contacts subscore</td>
<td>405/961</td>
<td>1.00</td>
<td>0.86 (0.66-1.11)</td>
<td>0.79 (0.61-1.02)</td>
<td>0.93 (0.67-1.28)</td>
<td>.93</td>
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<td>Cardiovascular mortality§</td>
<td>59/468</td>
<td>1.00</td>
<td>0.61 (0.29-1.27)</td>
<td>0.57 (0.26-1.22)</td>
<td>0.59 (0.28-1.23)</td>
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<tr>
<td>Health subscore</td>
<td>62/492</td>
<td>1.00</td>
<td>0.95 (0.46-1.97)</td>
<td>0.60 (0.29-1.21)</td>
<td>NA</td>
<td>.15</td>
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<tr>
<td>Self-respect subscore</td>
<td>62/487</td>
<td>1.00</td>
<td>0.86 (0.43-1.69)</td>
<td>0.69 (0.30-1.59)</td>
<td>1.25 (0.63-2.51)</td>
<td>.69</td>
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<tr>
<td>Morale subscore</td>
<td>63/492</td>
<td>1.00</td>
<td>0.36 (0.16-0.85)</td>
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<td>0.86 (0.44-1.68)</td>
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<td>Optimism subscore</td>
<td>63/486</td>
<td>1.00</td>
<td>0.76 (0.41-1.42)</td>
<td>0.55 (0.27-1.12)</td>
<td>0.27 (0.12-0.57)</td>
<td>.001</td>
<td></td>
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<tr>
<td>Contacts subscore</td>
<td>62/495</td>
<td>1.00</td>
<td>0.52 (0.23-1.17)</td>
<td>1.00 (0.55-1.84)</td>
<td>0.67 (0.29-1.55)</td>
<td>.68</td>
<td></td>
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</table>

Abbreviations: NA, not applicable; SSWO, Dutch Scale of Subjective Well-being for Older Persons.

*Data are presented as hazard ratio (95% confidence interval) unless otherwise indicated. P values were determined by Cox proportional hazards analysis (linear term).
†Adjusted for sex and age.
‡The health subscore was categorized into tertiles because it could not be divided evenly into quartiles.
§Adjusted for age, sex, body mass index, smoking status (current, former, or never), and history of cardiovascular disease or hypertension.
separately and suggests that the level of optimism is inversely associated with mortality rate, independent of age. Table 2 and Table 3 show the unadjusted and adjusted hazard ratios for all-cause mortality in men and women, respectively. In both sexes, adjusting for the subjective health score attenuated the relationship more so than adjustment for chronic disease. After adjustment for prognostic (sociodemographic) factors associated with optimism, the hazard ratio in men (but not in women) was statistically significant (men: 0.58; 95% CI, 0.37-0.91 [Table 2]; women: 0.80; 95% CI, 0.51-1.25 [Table 3]).

In post-hoc analyses, the questions “I do not make any more future plans” and “I still have many goals to strive for” allowed for a highest significant discrimination in men (hazard ratio, 0.55 [95% CI, 0.42-0.73] and 0.53 [95% CI, 0.39-0.71], respectively). In women, the question “There are many moments of happiness in my life” showed the highest discriminating power (hazard ratio, 0.70 [95% CI, 0.50-0.99]).

OPTIMISM AND CARDIOVASCULAR MORTALITY

In the subgroup of 494 subjects (259 men and 235 women) who received follow-up for cause-specific mortality, 110 men and 69 women died (42% of men vs 29% of women; *P* = .002). A total of 41 deaths in men and 25 deaths in women were due to cardiovascular disease (37% and 36%, respectively; *P* > .99 for sex difference). There were 29 incident myocardial infarctions (15 fatal), 48 transient ischemic attacks, 57 strokes (38 fatal), 11 fatal events due to other cardiovascular causes (ICD-10 codes I00-I99), and 113 fatal events of noncardiovascular (33 malignancies) or unknown cause. One man committed suicide at age 79 years.

The SSWO total score was not significantly associated with a decreased risk of cardiovascular mortality (Table 1). For the SSWO subscores, only the optimism subscore was associated with a decreased risk of cardiovascular mortality (*P* = .001 for trend) (Table 1). Compared with subjects with a high level of pessimism, those reporting a high level of optimism had a multivariate-adjusted hazard ratio of 0.27 (95% CI, 0.12-0.57). When adjusted for age, sex, chronic disease, education, smoking, alcohol consumption, history of cardiovascular disease or hypertension, body mass index, and total cholesterol level, the hazard ratio was 0.23 (95% CI, 0.10-0.55).

Tables 2 and 3 show the unadjusted and adjusted hazard ratios for cardiovascular mortality in men and women, respectively. The protective effect of dispositional optimism was somewhat stronger in men than in women, and the age- and sex-adjusted interaction term with sex was of borderline statistical significance (*P* = .09) but not after multivariate adjustment (*P* = .26). After multivariate adjustment for cardiovascular risk factors or a combination of sociodemographic and cardiovascular risk factors, there was still a protective effect of dispositional optimism against cardiovascular mortality in both men and women.

COMMENT

We found that dispositional optimism was predictive of lower all-cause and cardiovascular mortality in elderly subjects. Prevention of cardiovascular mortality accounted for much of the effect on all-cause mortality. Trend relationships were found between the level of dispositional optimism and mortality, and optimism remained a significant predictor of mortality even after adjustment for many potential confounders. In addition, we found that the beneficial effect of dispositional optimism on mortality was significantly stronger in men than...
in women; this was also apparent in multivariate analyses. Therefore, our findings indicate that dispositional optimism is an independent determinant and that men predisposed to optimism experience a higher survival benefit than women predisposed to optimism.

Our findings are consistent with those from other prospective studies, yet cohort studies of a possible association between dispositional optimism and mortality are rare. Four cohort studies (1 from Appels and Mulder, 1 from Anda et al, and 2 from Everson et al) found an adverse effect of hopelessness on the progression of disease, morbidity, and mortality. Notably, questions about having future plans and the desire to achieve new goals provided the largest discriminatory power among men in our study. Other previous studies used an explanatory-style measure of optimism. These studies also showed that optimists report better physical and mental health and experience lower rates of fatal myocardial infarction and coronary death as well as better survival. The 2 constructs of optimism are not strongly correlated, so these may represent different aspects of the tendency to respond in a positively toned manner to a variety of stimuli. The advantage of our study is that it considerably strengthens the relationship between dispositional optimism and lower (cardiovascular) mortality.

The mechanism underlying the link between optimism and mortality remains unclear, and there are several possible explanations. First, optimism was related to a higher level of physical activity, moderate alcohol use in women, and less smoking. However, in our study the association persisted even after adjustment for these potential confounding health behaviors. We also found that subjects are more optimistic when they live with a spouse or have a higher educational level, yet in our study these factors did not substantially modify the relationship between optimism and mortality. Furthermore, optimistic subjects did not have healthier diets, as indicated by similar intakes of total and saturated fat. Finally, no associations were found between optimism and body mass index, blood pressure, or plasma and serum cardiovascular risk markers.

### Table 2. Hazard Ratios for Death According to the Optimism Subscale in Men, With Adjustment for Age and Other Risk Factors

<table>
<thead>
<tr>
<th>Model</th>
<th>No. of Cases/No. of Subjects</th>
<th>Quartile</th>
<th>P Value for Trend</th>
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</thead>
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<tr>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
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<td>All-cause mortality</td>
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<td></td>
</tr>
<tr>
<td>Unadjusted</td>
<td>227/465</td>
<td>1.00</td>
<td>0.84 (0.60-1.18)</td>
</tr>
<tr>
<td>Adjusted</td>
<td>224/460</td>
<td>1.00</td>
<td>0.93 (0.67-1.31)</td>
</tr>
<tr>
<td>Age and subjective health subscore</td>
<td>226/462</td>
<td>1.00</td>
<td>1.06 (0.75-1.50)</td>
</tr>
<tr>
<td>Age, smoking (current, former, or never), alcohol, education, total activity score, socioeconomic status, and marital status</td>
<td>191/397</td>
<td>1.00</td>
<td>1.02 (0.71-1.48)</td>
</tr>
<tr>
<td>Cardiovascular mortality</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unadjusted</td>
<td>41/255</td>
<td>1.00</td>
<td>0.63 (0.29-1.39)</td>
</tr>
<tr>
<td>Adjusted</td>
<td>32/189</td>
<td>1.00</td>
<td>0.66 (0.30-1.45)</td>
</tr>
<tr>
<td>Age, smoking (current, former, or never), total activity score, BMI, and LDL cholesterol levels, CRP, PAI-1, and history of CVD, hypertension, or diabetes mellitus</td>
<td>32/216</td>
<td>1.00</td>
<td>0.55 (0.20-1.49)</td>
</tr>
<tr>
<td>Age, chronic disease, education, smoking (current, former, or never), BMI, alcohol, history of CVD or hypertension, and total cholesterol level</td>
<td>32/216</td>
<td>1.00</td>
<td>0.62 (0.25-1.53)</td>
</tr>
</tbody>
</table>

Abbreviations: BMI, body mass index; CRP, C-reactive protein; CVD, cardiovascular disease; LDL, low-density lipoprotein; PAI-1, plasminogen activator inhibitor type 1.

*Data are presented as hazard ratio (95% confidence interval) unless otherwise indicated. P values were determined by Cox proportional hazards analysis (linear term).
Second, optimism is associated with better health in general. It seems plausible that clinical or subclinical disease increases pessimism, resulting in a spurious association between optimism and mortality due to reverse causality. In our study, subjects who perceived their health as bad or deteriorating (assessed by the health subscale of the SSWQ questionnaire) were more likely to have a high level of pessimism, because these measures are not independent. Optimistic subjects may be biased toward reporting better health and vice versa. When we included the health subscale in a separate multivariate analysis, the associations between optimism and mortality were attenuated but not eliminated. When we included the more objective measures of chronic disease or physical disability in the analyses, there was less attenuation. Thus, baseline health may explain only part of the relationship between optimism and mortality.

Third, optimists may cope differently and more effectively than pessimists do. Optimism correlated positively with problem-focused coping and seeking social support. Therefore, an optimistic person may be more likely to have habits that enhance health or a recovery process; for example, they may be more compliant with their medical treatment regimens.

Fourth, other biological mechanisms that have been suggested in the link between major depression and excess mortality include effects of genetic factors, the immune system, sympathoadrenal system, endorphins, steroid hormones in the hypothalamic-pituitary-adrenal axis, heart rate variability, and platelet function. The findings that dispositional optimism in our study and hopelessness in another study were related to both cardiovascular and all-cause mortality suggest that a combination of factors are involved. To provide further evidence for causality, randomized studies are needed to find out whether stimulating future optimism and hope increases life expectancy in elderly individuals, yet such psychosocial intervention studies are difficult to perform and interpret.

The potential limitations of our cohort study merit careful consideration. We used only a single questionnaire; thus, our results do not necessarily apply to other scales of optimism. The optimism subscale has not been

Table 3. Hazard Ratios for Death According to the Optimism Subscale in Women, With Adjustment for Age and Other Risk Factors

<table>
<thead>
<tr>
<th>Model</th>
<th>No. of Cases/No. of Subjects</th>
<th>Quartile 1</th>
<th>Quartile 2</th>
<th>Quartile 3</th>
<th>Quartile 4</th>
<th>P Value for Trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>All-cause mortality</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unadjusted</td>
<td>170/474</td>
<td>1.00</td>
<td>0.66 (0.45-0.97)</td>
<td>0.47 (0.30-0.76)</td>
<td>0.48 (0.32-0.72)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Adjusted</td>
<td>170/474</td>
<td>1.00</td>
<td>0.84 (0.57-1.23)</td>
<td>0.68 (0.42-1.09)</td>
<td>0.69 (0.46-1.03)</td>
<td>.05</td>
</tr>
<tr>
<td>Age and subjective health subscore</td>
<td>166/465</td>
<td>1.00</td>
<td>0.92 (0.62-1.36)</td>
<td>0.87 (0.53-1.43)</td>
<td>0.91 (0.59-1.42)</td>
<td>.66</td>
</tr>
<tr>
<td>Age and chronic disease</td>
<td>169/472</td>
<td>1.00</td>
<td>0.83 (0.57-1.23)</td>
<td>0.71 (0.44-1.15)</td>
<td>0.72 (0.48-1.09)</td>
<td>.10</td>
</tr>
<tr>
<td>Age, smoking (current, former, or never), alcohol, education, total activity score, socioeconomic status, and marital status</td>
<td>153/418</td>
<td>1.00</td>
<td>0.76 (0.49-1.16)</td>
<td>0.79 (0.47-1.31)</td>
<td>0.80 (0.51-1.25)</td>
<td>.39</td>
</tr>
<tr>
<td>Cardiovascular mortality</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unadjusted</td>
<td>25/235</td>
<td>1.00</td>
<td>0.69 (0.26-1.84)</td>
<td>0.21 (0.04-0.98)</td>
<td>0.48 (0.17-1.33)</td>
<td>.05</td>
</tr>
<tr>
<td>Adjusted</td>
<td>25/235</td>
<td>1.00</td>
<td>0.90 (0.33-2.44)</td>
<td>0.28 (0.06-1.35)</td>
<td>0.60 (0.22-1.66)</td>
<td>.12</td>
</tr>
<tr>
<td>Age, smoking (current, former, or never), total activity score, BMI, total and LDL cholesterol levels, CRP, PAI-1, and history of CVD, hypertension, or diabetes mellitus</td>
<td>16/174</td>
<td>1.00</td>
<td>0.47 (0.12-1.76)</td>
<td>0.14 (0.02-1.25)</td>
<td>0.22 (0.05-0.99)</td>
<td>.03</td>
</tr>
<tr>
<td>Age, chronic disease, education, smoking (current, former, or never), BMI, alcohol, history of CVD or hypertension, and total cholesterol level</td>
<td>21/209</td>
<td>1.00</td>
<td>0.81 (0.27-2.45)</td>
<td>0.17 (0.02-1.43)</td>
<td>0.40 (0.12-1.34)</td>
<td>.04</td>
</tr>
</tbody>
</table>

Abbreviations: BMI, body mass index; CRP, C-reactive protein; CVD, cardiovascular disease; LDL, low-density lipoprotein; PAI-1, plasminogen activator inhibitor type 1.

*Data are presented as hazard ratio (95% confidence interval) unless otherwise indicated. P values were determined by Cox proportional hazards analysis (linear term).
validated against the Life Orientation Test, which measures dispositional optimism. The lack of face-to-face interviews to complete questionnaires may have limited the precision. Potential confounders were assessed only in a subgroup of participants, leading to reduced statistical power in multivariate analyses. The association between optimism and sociodemographic characteristics and other risk factors may be subtle, and the overall association with mortality could be (partly) ascribed to residual confounding and reverse causation. Moreover, we cannot exclude the possibility that the apparent interaction of optimism with sex is a function of different levels of power between the sexes because mortality rates were higher in men than women. The strengths of this study are the longitudinal design with a follow-up period of 9 years and the hard clinical end point of death. Our mortality rate was generally similar to that reported in the Netherlands, suggesting a wide relevance. Further validation is suggested by the expected baseline associations of optimism with sociodemographic variables. We also included risk factors known to predict mortality, suggesting that the relationship between optimism and mortality was not due to confounding.

In conclusion, we found that the trait of optimism was an important long-term determinant of all-cause and cardiovascular mortality in elderly subjects independent of sociodemographic characteristics and cardiovascular risk factors. A predisposition toward optimism seemed to provide a survival benefit in elderly subjects with relatively short life expectancies otherwise. Our results, combined with the finding that hopelessness was associated with an increased incidence or progression of disease, suggest that dispositional optimism affects the progression of cardiovascular disease. Although optimism reduces the risk of cardiovascular death through mechanisms largely unaffected by baseline values of physical activity, obesity, smoking, hypertension, and lipid profile, pessimistic subjects may be more prone to changes across time in risk factors that affect the progression of cardiovascular disease (eg, the development of smoking habits, obesity, or hypertension) than optimistic subjects. Dispositional optimism may also be associated with better coping strategies that are adhered to throughout life.

Submitted for Publication: January 22, 2004; final revision received April 19, 2004; accepted April 21, 2004. Correspondence: Erik J. Giltay, MD, PhD, Psychiatric Center GGZ Delfland, PO Box 5016, 2600 GA Delft, the Netherlands (giltay@dds.nl).

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