A 15-Year Follow-Up Study of Sense of Humor and Causes of Mortality: The Nord-Trøndelag Health Study

Solfrid Romundstad, MD, PhD, Sven Svebak, PhD, Are Holen, MD, PhD, and Jostein Holmen, MD, PhD

ABSTRACT

Background: Associations between the sense of humor and survival in relation to specific diseases has so far never been studied.

Methods: We conducted a 15-year follow-up study of 53,556 participants in the population-based Nord-Trøndelag Health Study, Norway. Cognitive, social, and affective components of the sense of humor were obtained, and associations with all-cause mortality, mortality due to cardiovascular diseases (CVD), infections, cancer, and chronic obstructive pulmonary diseases were estimated by hazard ratios (HRs).

Results: After multivariate adjustments, high scores on the cognitive component of the sense of humor were significantly associated with lower all-cause mortality in women (HR = 0.52, 95% confidence interval [CI] = 0.33–0.81), but not in men (HR = 0.88, 95% CI = 0.59–1.32). Mortality due to CVD was significantly lower in women with high scores on the cognitive component (HR = 0.27, 95% CI = 0.15–0.47), and so was mortality due to infections both in men (HR = 0.26, 95% CI = 0.09–0.74) and women (HR = 0.17, 95% CI = 0.04–0.76). The social and affective components of the sense of humor were not associated with mortality. In the total population, the positive association between the cognitive component of sense of humor and survival was present until the age of 85 years.

Conclusions: The cognitive component of the sense of humor is positively associated with survival from mortality related to CVD and infections in women and with infection-related mortality in men. The findings indicate that sense of humor is a health-protecting cognitive coping resource.

Key words: sense of humor, cognitive, affective, social, follow-up, mortality.

INTRODUCTION

Sense of humor is a complex concept with cognitive, social, and affective components. To date, there seems to be only five reports published with a prospective design that has tested the old assumption that the sense of humor facilitates longevity and is good for the health. Three of these studies (1–3) were based on data from a highly selected cohort of 11-year-old gifted children in the 1920s, initiated by Lewis Terman, known as the Terman Life Cycle Study of Children With High Ability. Childhood conscientiousness, sociability, self-esteem-high motivation, prevailing moods, and an index of optimism-cheerfulness were at focus in the first report. It stated childhood conscientiousness to be a predictor of survival. In contrast, they reported a negative association of optimism-cheerfulness with longevity, and this trend was confirmed in a follow-up analysis (2) where confounding effects of alcohol consumption, obesity, and smoking were eliminated. In this way, their findings failed to support the prevailing assumption of positive effects from the “sense of humor” (cheerfulness) upon longevity. The negative trend for childhood cheerfulness was confirmed in the 2002 report where effects of optimism were excluded (3).

Opposite findings for the sense of humor were reported in a study of survival among patients with end-stage renal
failure (4). The sense of humor was the single best predictor of survival for 2 years and remained significant also after controlling for sex, age, education, duration of disease, comorbidity, number of dialyses needed per week, body mass index (BMI) and the quality of life. A number of differences between the studies may explain the discrepant findings, including sample characteristics, duration of the follow-up period, and the ways of assessing the sense of humor. Teachers and parents provided information for the estimation of sense of humor in the Terman sample that counted 1215 children. Thus, the social image of the sense of humor of a child was the basis for the humor index in the Terman sample. In contrast, the sense of humor in the patients with renal failure was assessed by self-rated scores and, therefore, reflected their self-image regarding their sense of humor. Apart from cohort differences, the difference between social image and self-image in the assessment of the sense of humor may have been the most important difference between the two studies.

The external validity of findings from the two previous cohort studies of potential health effects of the sense of humor may not be extended to the general population. Therefore, a short measure of the sense of humor was included in a large-scale county population health study in Norway, where the adult population older than 19 years was invited to participate. Results from a 7-year prospective analysis of the effects of the sense of humor upon survival (5) supported significantly higher survival among those scoring above the median when addressing effects upon all-cause mortality. The extensive health survey included three items on the self-image of the sense of humor. Despite the seemingly hazardous use of this limited measure, justification has been given in two Swedish studies. One of the studies (n = 1238) assessed depression by the use of a single item (6), whereas the other (n = 514) assessed three components of the sense of coherence by single items, respectively (7).

Several validated approaches have been suggested to assess individual differences in the sense of humor, including the pioneering Sense of Humor Questionnaire (SHQ) (8), the Coping Humor Scale (9), the Situational Humor Response Questionnaire (9), the State-Trait-Cheerfulness-Inventory (10), and the Humor Styles Questionnaire (11). The SHQ, used in this study, clearly reflects the assumption that the sense of humor is composed of a cognitive, social, and affective component. This scale has been revised several times over more than 40 years, and the items aim at neutrality in terms of culture, sex, academic background, and the purpose and style of the sense of humor. One item from each of the three components of the SHQ was used to assess the sense of humor in the present study.

Why should there be a reason to expect effects upon longevity from the sense of humor? Most attempts to address this complex question seem to have focused on the affective component. However, a review of studies testing the effects of laughter upon health concluded that more hazardous than beneficial effects were to be expected from laughter (12). A study of causes of laughter in everyday life indicated that around 85% of laughs in social interaction are not related to humor at all (13). The most promising candidate for health effects seem to be the cognitive component, taken that habitual cognitive orientations to situations in everyday life are reflected in the effects upon the mood as well as the risk of triggering a stress response. Recently, the essence of the cognitive process in humor was proposed to be that of “diminishment” (14), as opposed to exaggeration that is often a cognitive component of crises escalation. The cognitive diminishment thus may alleviate the impact of hassles and stressors in everyday life, often in a complex interplay of the cognitive, social, and affective components. From this perspective, the sense of humor may act as a protective resource where consequences might be beneficial to health and longevity.

The present study addressed the effects of the sense of humor in relation to mortality 15 years later in an adult county population that was previously tested for all-cause mortality after 7 years (The Nord-Trøndelag Health Study [HUNT] 2, Norway). For the first time, the associations between different causes of mortality and the scores on the three components of the self-image of the sense of humor were assessed.

**METHODS**

**Population**

The second survey of the HUNT study was conducted in 1995 to 1997 in the county of Nord-Trøndelag, Norway (127,000 inhabitants) (15). The county is representative of Norway as a whole, except that it has no large city, and the average educational and income levels were slightly below the national average. The population is ethnically homogenous. All inhabitants older than 19 years who were residing in the county at the time of screening were invited (N = 93,898). By mail, each inhabitant received a questionnaire and an invitation to a clinical examination; 70% participated. On the examination site, the participants received a second questionnaire to be completed and returned by mail.

A nonparticipation study was performed in a random 2.5% sample of nonattendants. The main reasons for not attending in the age group 20 to 69 years were time constraints, relocation, work obligations, having forgotten the invitation, or no particular reason. Several of those 70 years and older stated that they were well taken care of by their local physician or hospital; they felt no need to attend (15).

Attendance was voluntary, and each participant signed a written informed consent. The HUNT study and linkage of date were approved by the Norwegian Data Inspectorate and the Regional Committee for Medical and Health Research Ethics which also approved the present study.

**Survey Measures**

An extensive set of variables addressed the various health issues. Brevity was essential to ensure a high level of participation. Therefore, only a brief measure of the sense of humor was possible. The sense of humor was assessed by one item from each of the three components of the SHQ (8), as follows: “Do you easily recognize a mark of humorous intent?” (cognitive; n = 53,556); “Persons who are out to be funny are really irresponsible...
types not to be relied upon” (social; \( n = 52,208 \)); and “Do you consider yourself to be a mirthful person?” (affective; \( n = 53,143 \)). The items were selected from the seven-items subscales based on statistical criteria with highest factor loading and standardized item α (cognitive: \( \alpha = .91 \), item correlating 0.87 with subscale sum; social: \( \alpha = .91 \), item correlating 0.88 with subscale sum; affective: \( \alpha = .74 \), item correlating 0.78 with subscale sum) (5,8,16). The participants responded to four-step scales (labeled for the three items respectively: very sluggishly—very easily, yes indeed—not at all, not at all—yes indeed). The full seven-item versions of the scales have demonstrated acceptable reliability and validity, and they have been used for decades in research on humor and well-being (8).

Other self-reported variables in the present report included the level of education, exercise habits, smoking habits, social network, cardiovascular diseases (CVDs), diabetes mellitus, cancer, and subjective health (“How is your current health?” labeled bad, not well [poor subjective health], well and very well [good subjective health]). Anxiety and depression were assessed by the Hospital Anxiety and Depression Scale (HADS) (17). The clinical examination included standardized measurement of height, weight and blood pressure, and blood sampling.

**Follow-Up**

The unique 11-digit identification number of every Norwegian citizen enabled individual linkage between the collected information and the national Cause of Death Registry, Statistics Norway (Central Bureau of Statistics Kongsvinger, Oslo. Updated www.ssb.no 2012). The cause of death was defined according to the International Statistical Classification of Diseases (9th and 10th revisions, respectively) as follows: CVD (401-405, 410-414, 420-438, 440-447, and 110-115, I20-I25, I44-I49, I60-I77), infection (A00-B99, C00-C05, C10-C14, J00-J06, K00-K05, K10-K14), chronic obstructive pulmonary disease (COPD; J40-J47), psychiatric (F00-F99, X60-X84, Y87.0), and violent (accident, homicide; V01-X59, X60-X84, Y87.2). Each participant contributed survival time from the date of entry into the study (date of clinical examination) until the date of death or the end of the follow-up of December 31, 2012. The median and mean of the follow-up time was 16 and 15 years, respectively. After excluding those with missing data at follow-up, 53,556 (81.5%) participants were included in the final analysis.

**Statistical Analyses**

BMI was calculated in kilograms per meter squared. Systolic blood pressure was calculated as the mean of the second and third of three successive measurements. The subjective health variable was dichotomized into “good” and “poor” health, and HADS scores for anxiety and depression were the two sums of seven items for each scale. The between-participants effects of age and sex, as well as their interaction (age by sex), according to mean scores of the three components of the sense of humor were tested by the univariate general linear model.

The Cox proportional hazards model was used to calculate hazard ratios (HR), with 95% confidence interval (CI) for mortality according to the scores (high/level 4, medium high/level 3, medium low/level 2, and low/level 1 [reference]) on sense of humor for each of the three components of the sense of humor. Potential deviation from the proportional hazard assumption was evaluated by log-log plot. Assumptions were met for all models.

The individual number of person-years was included as the dependent time variable. A priori selected potential confounding factors were used in both bivariate and multivariate adjusted analyses including age, BMI, systolic blood pressure, creatinine, education (primary and lower secondary school [<10 years], upper secondary school [10-12 years], and college or university [≥12 years]), exercise (hours/week) in the leisure time (none, <1 hour, 1–2 hours, ≥3 hours), daily smoking (yes/no), quality of friendship, history of CVD (yes/no), diabetes mellitus (yes/no), and cancer (yes/no). The interaction terms (age by sex) and (cognitive humor by sex) were tested. Because of several significant interactions, we also performed analyses stratified by sex.

**FIGURE 1.** Mean scores for the cognitive (A), social (B), and affective components (C) of the sense of humor in men and women across eight age cohorts.

The effects of the sense of humor on HR were thus tested in the total sample, for men and women, young and old, and for subgroups with poor versus good subjective health. All statistical analyses were made with the Statistical Package for the Social Sciences, version 21.0 (SPSS Inc, Chicago, IL), and significant α criterion was set to .05 or above.

**RESULTS**

The mean scores on the three components of the sense of humor are given in Figure 1 for eight age cohorts, stratified by men and women. The mean values were slightly above the metric mean (2.5). Analyses of variance documented...
substantial effects of age upon scores for all three com-
ponents (F scores from 131 to 464(7/15), p < .001). Sex
made no difference, except for the affective component
where women, on average, scored somewhat higher than
men (F(1/15) = 12.37, p < .001). The interaction (sex by
age) was significant in all three components and most
evident in the cognitive (F(7/15) = 16.02) and affective
(F(7/15) = 7.34) components due to high means in the
oldest women (Fig. 1).

Table 1 shows significantly reduced all-cause mortal-
ity for the cognitive component in the total population.
When stratified by sex, this significant pattern was present
only in women and was consistent for cognitive scores
throughout the analyses (Table 1). There was no effect on
HR for the social and affective components after multiple
adjustments.

Effects upon mortality in the total population due to
CVD, infections and cancer are given in Table 2. For
CVD, the cognitive component was significantly associated
with reduced mortality in the total population; this effect was
stronger in women than in men. High cognitive scores were
also associated with reduced mortality due to infections; this
relationship was equally strong in men and women up until
age around 85 years. High scores on the affective component
were associated with higher mortality after multiple adjust-
ments, and sex made no difference (Table 2).

Table 1. Hazard Ratio of All-Cause Mortality in the Total Population, Stratified by the Three Components of Sense
of Humor, and by Sex in the Cognitive Component

<table>
<thead>
<tr>
<th>Component of the Sense of Humor</th>
<th>No. Participants/Deaths</th>
<th>HR (^a) (95% CI), (p) Value</th>
<th>HR (^b) (95% CI), (p) Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognitive (^c) ((n = 53,556))</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of humor</td>
<td>274/127</td>
<td>1.00 (Reference)</td>
<td>(Reference)</td>
</tr>
<tr>
<td>Level 2 (medium low score)</td>
<td>3025/800</td>
<td>0.48 (0.40–0.58), &lt;.001</td>
<td>0.74 (0.54–1.01), .060</td>
</tr>
<tr>
<td>Level 3 (medium high score)</td>
<td>37,914/7915</td>
<td>0.36 (0.30–0.43), &lt;.001</td>
<td>0.72 (0.54–0.97), 029</td>
</tr>
<tr>
<td>Level 4 (high score)</td>
<td>12,343/1974</td>
<td>0.27 (0.23–0.32), &lt;.001</td>
<td>0.72 (0.54–0.98), .033</td>
</tr>
<tr>
<td>Social (^c) ((n = 52,208))</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of humor</td>
<td>1495/642</td>
<td>1.00 (Reference)</td>
<td>1.00 (Reference)</td>
</tr>
<tr>
<td>Level 2</td>
<td>5190/1734</td>
<td>0.72 (0.66–0.79), &lt;.001</td>
<td>0.97 (0.83–1.13), .73</td>
</tr>
<tr>
<td>Level 3</td>
<td>21,088/4186</td>
<td>0.39 (0.36–0.43), &lt;.001</td>
<td>0.93 (0.81–1.08), .35</td>
</tr>
<tr>
<td>Level 4</td>
<td>24,435/3520</td>
<td>0.20 (0.25–0.30), &lt;.001</td>
<td>1.02 (0.89–1.18), .78</td>
</tr>
<tr>
<td>Affective (^c) ((n = 53,143))</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of humor</td>
<td>1424/515</td>
<td>1.00 (Reference)</td>
<td>1.00 (Reference)</td>
</tr>
<tr>
<td>Level 2</td>
<td>14,460/3757</td>
<td>0.66 (0.60–0.73), &lt;.001</td>
<td>1.03 (0.88–1.21), .71</td>
</tr>
<tr>
<td>Level 3</td>
<td>28,785/5283</td>
<td>0.45 (0.41–0.49), &lt;.001</td>
<td>1.03 (0.88–1.20), .77</td>
</tr>
<tr>
<td>Level 4</td>
<td>8474/1215</td>
<td>0.34 (0.31–0.38), &lt;.001</td>
<td>1.14 (0.96–1.36), .14</td>
</tr>
<tr>
<td>Cognitive (^c) men ((n = 24,413))</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of humor</td>
<td>121/57</td>
<td>1.00 (Reference)</td>
<td>1.00 (Reference)</td>
</tr>
<tr>
<td>Level 2</td>
<td>1216/405</td>
<td>0.61 (0.46–0.81), .001</td>
<td>0.95 (0.62–1.44), .79</td>
</tr>
<tr>
<td>Level 3</td>
<td>16,816/4176</td>
<td>0.42 (0.33–0.55), &lt;.001</td>
<td>0.92 (0.62–1.35), .66</td>
</tr>
<tr>
<td>Level 4</td>
<td>6260/1011</td>
<td>0.26 (0.20–0.34), &lt;.001</td>
<td>0.88 (0.59–1.32), .54</td>
</tr>
<tr>
<td>Cognitive (^c) women ((n = 29,143))</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of humor</td>
<td>153/70</td>
<td>1.00 (Reference)</td>
<td>1.00 (Reference)</td>
</tr>
<tr>
<td>Level 2</td>
<td>1809/395</td>
<td>0.39 (0.31–0.51), &lt;.001</td>
<td>0.50 (0.31–0.80), .004</td>
</tr>
<tr>
<td>Level 3</td>
<td>21,098/3739</td>
<td>0.31 (0.25–0.39), &lt;.001</td>
<td>0.49 (0.31–0.76), .002</td>
</tr>
<tr>
<td>Level 4</td>
<td>6083/963</td>
<td>0.27 (0.22–0.35), &lt;.001</td>
<td>0.52 (0.33–0.81), .004</td>
</tr>
</tbody>
</table>

No. = number; CI = confidence interval; HR = hazard ratio.
\(^a\) HR, unadjusted.
\(^b\) HR, adjusted for age, sex (not if stratified by sex), body mass index, systolic blood pressure, creatinine, education, exercise, smoking, quality of friendship, cardiovascular diseases, diabetes mellitus, cancer, subjective health, and the interaction (sex by age; not if stratified by sex).
\(^c\) Score levels: lack of humor/Level 1 (reference) is the lowest score and Level 4 is the highest score of the humor component.

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TABLE 2. Adjusted Hazard Ratio of Mortality Due to CVD, Infections, and Cancer in the Total Population, Stratified by the Three Components of the Sense of Humor

<table>
<thead>
<tr>
<th>Component of the Sense of Humor</th>
<th>CVD HR$^a$ (95% CI, $p$ Value)</th>
<th>Infections HR$^a$ (95% CI, $p$ Value)</th>
<th>Cancer HR$^a$ (95% CI, $p$ Value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognitive$^b$ ($n = 53,556$)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of humor</td>
<td>(No. of deaths = 3979)</td>
<td>(No. of deaths = 519)</td>
<td>(No. of deaths = 3023)</td>
</tr>
<tr>
<td>Level 2 (medium low score)</td>
<td>1.00 (Reference)</td>
<td>1.00 (Reference)</td>
<td>1.00 (Reference)</td>
</tr>
<tr>
<td>Level 3 (medium high score)</td>
<td>0.51 (0.34–0.76), .001</td>
<td>0.16 (0.06–0.45), &lt;.001</td>
<td>1.12 (0.48–2.58), .92</td>
</tr>
<tr>
<td>Level 4 (high score)</td>
<td>0.47 (0.32–0.68), .001</td>
<td>0.25 (0.11–0.55), .001</td>
<td>1.45 (0.65–3.24), .45</td>
</tr>
<tr>
<td>Social$^b$ ($n = 52,208$)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of humor</td>
<td>(No. of deaths = 3668)</td>
<td>(No. of deaths = 472)</td>
<td>(No. of deaths = 2877)</td>
</tr>
<tr>
<td>Level 2</td>
<td>1.00 (Reference)</td>
<td>1.00 (Reference)</td>
<td>1.00 (Reference)</td>
</tr>
<tr>
<td>Level 3</td>
<td>0.91 (0.72–1.17), .55</td>
<td>1.01 (0.45–2.26), .99</td>
<td>0.90 (0.67–1.20), .46</td>
</tr>
<tr>
<td>Level 4</td>
<td>0.93 (0.74–1.16), .54</td>
<td>1.26 (0.60–2.63), .54</td>
<td>0.88 (0.67–1.15), .39</td>
</tr>
<tr>
<td>Affective$^b$ ($n = 53,143$)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of humor</td>
<td>(No. of deaths = 3973)</td>
<td>(No. of deaths = 513)</td>
<td>(No. of deaths = 3012)</td>
</tr>
<tr>
<td>Level 2</td>
<td>1.00 (Reference)</td>
<td>1.00 (Reference)</td>
<td>1.00 (Reference)</td>
</tr>
<tr>
<td>Level 3</td>
<td>0.88 (0.69–1.11), .28</td>
<td>3.92 (0.96–16.04), .057</td>
<td>1.08 (0.80–1.45), .64</td>
</tr>
<tr>
<td>Level 4</td>
<td>0.87 (0.69–1.10), .23</td>
<td>4.63 (1.14–18.85), .032</td>
<td>1.02 (0.76–1.37), .93</td>
</tr>
<tr>
<td>Cognitive$^b$ men ($n = 24,413$)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of humor</td>
<td>(No. of deaths = 2101)</td>
<td>(No. of deaths = 267)</td>
<td>(No. of deaths = 1659)</td>
</tr>
<tr>
<td>Level 2</td>
<td>1.00 (Reference)</td>
<td>1.00 (Reference)</td>
<td>1.00 (Reference)</td>
</tr>
<tr>
<td>Level 3</td>
<td>0.77 (0.44–1.33), .35</td>
<td>0.15 (0.04–0.57), .006</td>
<td>1.73 (0.54–5.62), .36</td>
</tr>
<tr>
<td>Level 4</td>
<td>0.65 (0.39–1.07), .090</td>
<td>0.24 (0.09–0.61), .003</td>
<td>2.04 (0.65–6.36), .22</td>
</tr>
<tr>
<td>Cognitive$^b$ women ($n = 29,143$)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of humor</td>
<td>(No. of deaths = 1878)</td>
<td>(No. of deaths = 252)</td>
<td>(No. of deaths = 1364)</td>
</tr>
<tr>
<td>Level 2</td>
<td>1.00 (Reference)</td>
<td>1.00 (Reference)</td>
<td>1.00 (Reference)</td>
</tr>
<tr>
<td>Level 3</td>
<td>0.26 (0.14–0.49), .001</td>
<td>0.11 (0.02–0.57), .009</td>
<td>0.61 (0.18–2.02), .42</td>
</tr>
<tr>
<td>Level 4</td>
<td>0.27 (0.15–0.47), .001</td>
<td>0.16 (0.04–0.69), .014</td>
<td>0.90 (0.29–2.83), .86</td>
</tr>
<tr>
<td>Interaction (cognitive humor by sex) unadjusted and adjusted model</td>
<td>$p &lt; .001$ and .98</td>
<td>$p = .14$ and .56</td>
<td>$p &lt; .001$ and .60</td>
</tr>
</tbody>
</table>

CVD = cardiovascular disease; HR = hazard ratio; CI = confidence interval; No. = number.

$^a$ HR, adjusted for age, sex (not if stratified by sex), body mass index, systolic blood pressure, creatinine, education, exercise, smoking, quality of friendship, cardiovascular diseases, diabetes mellitus, cancer, subjective health, and the interaction (sex by age; not if stratified by sex).

$^b$ Score levels: lack of humor/Level 1 (reference) is the lowest score and Level 4 is the highest score of the humor component.

No significant association was found for the scores on any of the three components of the sense of humor in relation to mortality due to COPD, suicide, and violent death, also after multiple corrections including scores on anxiety, depression, and subjective health.

The cumulative effects of the cognitive component of the sense of humor upon survival over the observed 15 years are illustrated in Figures 2 and 3 as related to all-cause mortality, CVD, and cancer, respectively. Because of several significant interaction terms between the cognitive component of humor and sex, plots for men and women are given separately. Low scores on the sense of humor (reference level) emerged with the highest mortality risk in men and women, except for the cancer plots where an inverse relationship was found in the male group, although none of the risk scores were significant (Table 2). In Figure 3, CVD plots for women in Levels 2, 3, and 4 are overlapping, with equally reduced mortality when compared with those in the reference group (see HRs in Table 2).

Several sensitivity analyses were performed: with a) HADS included, b) women 90 years or older excluded, and c) the most obvious direct measures of mortality outcome (history of CVD, history of cancer) excluded. Most of the analyses did not change their results. However, when including HADS as a confounder, the association between the cognitive component and survival of infections was no longer significant in men, although the estimates were still low: Level 2: HR = 0.20 (95% CI = 0.03–1.27,
On the contrary, the association between the cognitive component and the survival of CVD in men reached significance for Level 3 (HR = 0.47 [95% CI = 0.26–0.86, \( p = .015 \)) and Level 4 (HR = 0.47 [95% CI = 0.25–0.88, \( p = .018 \]) when HADS was included as a confounder. In addition, the association between cognitive humor and survival of infections was no longer significant in women when sensitivity analyses c) were performed, although the estimates were equal, thus indicating that the power decreased.

**DISCUSSION**

This 15-year follow-up study demonstrated a significant negative association between scores on the cognitive component of the sense of humor and all-cause mortality, as well as for mortality due to CVD and infections. In analyses stratified by sex, these associations were confirmed in women. However, in men, only mortality due to infections was significantly and negatively associated with the cognitive component of the sense of humor. Mortality due to cancer, COPD, suicide, and accidents/homicide seemed unrelated to scores on the separate components of the sense of humor. The significant positive association between the sense of humor and survival disappeared after the age of 85 years, except in women; their risk of dying from CVD was reduced also after age 85 years.

The most obvious strength of the study is the population size; the high proportion of the adult population that participated in the survey added to the reliability of the findings. For the first time in this field of research, it was possible to distinguish between various causes of death in relation to scores on the three components of the sense of humor.

One limitation of the study relates to the three self-reported components as only one item per component could enter the survey due to space constraints. Despite the fact that item selections were based on statistical criteria of best power in findings from previous research, the assessment may still have been vulnerable (8,16). One might question the validity of each of the three selected items on face validity. For example, the cognitive orientation in “Do you easily recognize a mark of humorous intent?” seems to transcend the strictly cognitive domain and may also involve interpersonal sensitivity. This may still not preclude the validity of this item as a focus on the mental ability to process elements of humorous meta-communication recently precisely defined as identity diminishment (see below). It is likely that most of these components may emerge in social interaction. Regarding the social component, previous revisions of the SHQ consistently have presented good homogeneity among responses to items in this component when they were negatively twisted to humorous others and situations (8,16,18). The denial of negativity seems to reflect a welcoming attitude to social interactions with opportunities for fun. The affective component seems on face validity to be tapping into the core of humorous amusement. However, the ambiguity of the word “mirthful” implies that mirth may not be displayed to others in smiling and laughing, and that subjective mirth and its expression seem to reflect a range of different origins beyond the sense of humor, including ticklishness and asymmetrical power positions in social interaction (18,19). Still, it must be acknowledged that this item is more specific than just asking about the prevalence of positive mood and it explicitly is oriented to the emotion of mirth that also is a response to humor processing. The question of validity in the present measurement of the sense of humor should acknowledge the strength of being neutral to themes and techniques, including age, sex, cultural setting, and
intentions such as to cope with any particular stressor. Another source of validity problem is the cause of death that may sometimes be subject to complex evaluations and reduce robustness in the mortality statistics. Moreover, missing values of confounding variables, especially physical activity (30% missing), should be acknowledged. Sensitivity analyses without this variable did, however, not considerably change the point estimate in any of the analyses. Other unmeasured confounders we did not adjust for could of course have influenced the results.

Correlations between scores on the three components were given in the 7-year follow-up study (5) and supported a relative uniqueness of each of the three components due to between 1% and 16% of shared variance. We suggest that a future population study of the sense of humor and mortality should add at least one more question in each component. This extension can further validate the relative independence of the components and compensate for the limitation of only one item per component in the novel nature of the present work. We suggest the following three items to be added due to findings in the development of the SHQ (8):

Would it be easy for you to find something humorous in most situations if you really tried? (cognitive);

Humorists irritate me because they so blatantly revel in getting others to laugh (social);

Do you easily smile and laugh? (affective).

Suggested scoring formats are as follows: very easy—very difficult (4-1), strongly disagree—strongly agree (4-1), and yes indeed—not at all (4-1), respectively. This extension would leave a measure of six items to assess the sense of humor and would permit a stronger test of the uniqueness of the components as well as their predictive values in relation to all cause as well as specific causes of mortality.

FIGURE 3. Survival plots for cardiovascular (A) and cancer mortality (B) in men (left panel) and women (right panel) for 15 years, stratified by high (Level 4), medium high (Level 3), medium low (Level 2), and low (reference) scores on the cognitive component of the sense of humor.
The present scores for assessing the sense of humor seem to reflect a friendly humor style and to be uncorrelated with a hostile humor style (11). It is important to acknowledge the complexity of the concept of sense of humor when health effects are investigated. The unexpected finding that high scores on the affective component of the sense of humor were associated with increased risk of dying due to infections offers a perspective upon the Terman survival studies of the Californian cohort (1–3). Their social image of the assessment was oriented to cheerfulness that may correlate with the self-image of mirthfulness, as assessed in the present study. In this way, the present findings of increased mortality in the total population, due to infections, for high scores on the affective component, can be taken as supportive to the findings in the Terman survival studies, despite that the effects of sense of humor upon different causes of death were not investigated in those studies.

Over several decades, it has been argued that the sources of overt mirthful expression go beyond the sense of humor and include suggestibility, temperament, brain stem damage, and other causes (20). Recently, a review of 785 articles published on laughter over more than 65 years reported benefits (85 reports) as well as harms from laughter (114 reports). They included psychological benefits, such as reduced anger, anxiety, depression, and stress, but also cardiovascular (improvement of endothelial function), respiratory (improved lung function), metabolic (increase of energy expenditure), and obstetric effects (entertainment by a clown after embryo transfer increased successful fertilization with 16% (21)). Harmful effects of laughter included cardiovascular (syncope, arrhythmias, cardiac rupture) and respiratory effects (asthmatic attack, pneumothorax, interlobular emphysema), as well as effects upon the central nervous (cataplexy, cerebral infarct), gastrointestinal (hernia), musculoskeletal (dislocation of jaw), and urinary (stress incontinence) systems (12).

The selective effect of the cognitive component upon reduced mortality due to CVD and infections calls upon an explanatory model. Conscious processes are known to activate lipid mobilization via cascading effects involving stress hormones, cortisol in particular, known for decades as the “fight or flight” response. Recently, the cognitive process involved in the sense of humor was precisely defined as being of two types; labeled “disclosure humor” and “distortion humor,” both ending in some form of “identity diminishment” (i.e., any kind of down scaling of perceived importance, threat, stress, etc) (14). Several psychological and social characteristics enhance the “funniness” of a situation, including a playful mental state, cognitive synergy (identity diminishment), subjective engagement, social cues, and acute increase of arousal (14). Cognitively, any friendly humorous diminishment acts to defuse tension, with or without overt display of affect, but with the subjective experience of mirth. It has been demonstrated that a high sense of humor helps in coping with a stressor, resulting in the maintenance of salivary IgA, as opposed to a drop in salivary IgA in those scoring low on the sense of humor, when all were exposed to a stressor (22). Apparently, this defense against antigens in the mucosa may be protected by the cognitive component of a friendly sense of humor and, over the lifespan, present as reduced mortality due to infections.

Mortality due to COPD and to the wide range of cancer diseases may more strongly relate to substance exposures and genetic composition and be relatively less influenced by conscious processes in coping with life stress. This would not undermine the importance of psychological resources in coping with established and threatening diagnoses over the course of the disease (23–25).

We suggest that high scores on the cognitive component of the sense of humor may act to minimize the impact of stressors in everyday life through identity diminishment (see above). Unexpected sex differences may reflect differences in ways of coping with bodily diminishment and complaint. Although somewhat equivocal, women on average seem to seek medical advice earlier than men, and this difference has been most clearly demonstrated in responses to early cancer symptoms (26–32). However, these tendencies for different coping styles seemed not to affect the mortality risk for cancer, suggesting that the cognitive diminishment may not be a coping style with symptoms of cancer. Moreover, further research is needed to validate and explain the increased mortality from infectious diseases among those who scored high on the affective component.

Women 90 years and older scored particularly high on average cognitive humor, compared with those in the younger retirement cohorts. This may reflect a selection effect related to a relative lack of memory decline. Partly, men on average have a shorter life span than do women, and subjectively they have reported more memory problems than women in all adult age cohorts (33). Women 90 years or older may have better maintained a social network than men in this age cohort. Dementia seems to be one of the early markers of decline in the sense of humor although such clinical observations tell nothing about causal effects. Women may still convey the importance of maintaining the highly complex cognitive processes of humor where the social network continues to offer opportunities for fun.

In conclusion, mortality due to CVD and infections was lower during the 15 years when the scores were high on the cognitive component of the sense of humor. This association was particularly strong in the women. The sense of humor may interact with sex-specific coping styles when confronted with stressors of everyday life and be a health-protecting cognitive coping resource, more in women than in men. The effects seem to accumulate over the life span and explain differences in the reduced mortality risk for
specific disease as well as the sex differences in disease and health outcomes.

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