The Power of Positive Emotions: It’s a Matter of Life or Death—Subjective Well-Being and Longevity Over 28 Years in a General Population

Jingping Xu and Robert E. Roberts
The University of Texas–Houston

Objective: This study longitudinally examined Subjective Well-Being (SWB) and its components, namely, Positive Feelings (PF, including global life satisfaction [GLS]), domain life satisfaction [DLS], and positive affect [PA]) as well as Negative Feelings (NF) as predictors of longevity in a general population. Design: Data from the Alameda County Study over 28 years (1965–1993, N = 6856) were analyzed with multivariate Cox Proportional Hazard Models. Main Outcome Measures: Longevity, evaluated by risks of all-cause, natural-cause, and unnatural-cause mortality. Results: After demographic and baseline health covariates were controlled, SWB, PF, GLS, and DLS significantly predicted lowered risks of all-cause and natural-cause mortality (Relative Risk per unit predictor increase [RR] ranged .904–.989, \( p \) values ranged .000–.05). SWB, PF, and GLS also significantly predicted lowered risk of unnatural-cause mortality (RR ranged .862–.961, \( p \) values ranged .014–.05). These associations seemed partially or completely mediated by social networks. The associations were also found separately in younger (<55 in age) and/or older (≥55) subsamples, and were especially salient in the healthy subsample. However, NF showed no associations with the mortality outcomes. Conclusion: SWB and its various positive components, but not NF, significantly predict longevity in the general population.

Keywords: subjective well-being, life satisfaction, affect, positive and negative feelings, mortality
SWB as a possible cause of health has gained more attention with plausible findings (see reviews, Chida & Steptoe, 2008; Pressman & Cohen, 2005; Veenhoven, 2008). Longevity, or mortality, is the ultimate result of health. However, thus far community-based longitudinal studies on SWB and mortality tend to focus on aging/aged groups (e.g., Levy, Slade, Kunkel, & Kasl, 2002; Li, 2005; Maier & Smith, 1999; Kawanoto & Doi, 2002). These studies yield inconsistent results, ranging from no effects (e.g., Li, 2005) to strong effects (e.g., Levy et al., 2002). As SWB was measured, and its effects assessed, at advanced ages when health might have declined, SWB as a predictor of mortality in these groups might be quite different from that in the general population. Chida and Steptoe (2008) have noted that the effects of positive emotions on mortality may be stronger among, or only apply to, older adults. This awaits confirmation. A few studies included young adults and/or middle-aged subjects, and found that SWB was associated with mortality, some strongly as in the Nun Study (Danner et al., 2001). However, these studies either used more targeted, thus narrower, SWB measures (e.g., attitudes on aging [Iwasa, Kawaa, Gondo, Inagaki, & Suzuki, 2006] and life satisfaction [Frijters, Haisel-DeNew, & Shields, 2005]), or used unique samples (men at risk of smoking/hypertension [Engström, Hedblad, & Janzon, 1999], nuns [Danner et al., 2001], or twins [Koivumaa-Honkanen, Honkanen, Koskenvuo, & Kaprio, 2003]).

The relationship of SWB with mortality seems to also involve social networks (SN). Berkman and Breslow (1983) reported a positive correlation of life satisfaction with SN and negative correlations of both life satisfaction and SN with mortality. More generally, positive emotions such as SWB, life satisfaction, positive affect have been repeatedly shown to predict SN (e.g., Casciaro, Carley, & Krackhardt, 1999; Johnson & Fredrickson, 2005; Waugh & Fredrickson, 2006); and SN has long been linked with health and longevity (Berkman & Breslow, 1983; Lee, 2007; Reynolds & Kaplan, 1990). However, an integrative model of these two sets of relationships does not seem to be articulated nor explored. One model that would logically link the two sets of associations could be that SN is a mediator between positive emotions and longevity. That is, the associations of positive emotions with SN propel the association of SN with longevity, resulting in indirect associations of positive emotions and longevity through SN. There are also other possibilities of SN’s role(s) in the relationship of SWB and longevity, such as moderating, or confounding. These possibilities should be explored for a better understanding of this relationship.

Another interesting and important question is whether positive emotions affect mortality through preventing healthy people from getting sick, and/or through preventing sick people from dying. Scattered evidence supports both. Positive emotions have been linked to resistance against the common cold (Cohen, 2003), breast cancer (Peled, Carmil, Siboni-Samocha, & Shoham-Vardi, 2008), and stroke (Ostir, Markides, Peek, & Goodwin, 2001); Optimistic cancer patients (Allison, Guichard, Fung, & Gailain, 2003) and happy hypertensive men (Engström, et al., 1999) have better survival. Chida and Steptoe’s (2008) meta-analysis found associations of SWB and mortality in both “healthy” and “diseased” populations. But their “healthy population” meant community samples, with baseline health status undifferentiated. How SWB may affect people with different baseline health status in the community is still unclear.

Existing studies also rarely compare and contrast the positive and negative components of SWB. Some studies do not measure negative feelings at all (e.g., Engström et al., 1999; Iwasa et al., 2006). These two types of components may function relatively independently (Diener & Emmons, 1984), which was the rationale for negative affect to be included in SWB (Diener, 2000) that should be examined as a separate factor. In terms of outcomes, some studies investigate only specific causes of mortality (e.g., Engström et al., 1999; Koivumaa-Honkanen et al., 2003). Those targeting all-cause mortality rarely distinguish natural- and unnatural-causes of death, which is important as some research (e.g., Lieberman & Coburn, 1986; Zilber, Schufman, & Lerner, 1989) suggests that the emotion-related elevated risk of deaths is largely attributable to increased risk of “unnatural” deaths (e.g., suicide), rather than that of natural causes (i.e., from failed physical health).

In sum, existing studies have made much progress in understanding SWB and longevity. But gaps remain. We felt that a comprehensive examination of a general population, contrasting components of SWB, as well as SWB as a whole, as predictors and contrasting natural- and unnatural-cause mortality, as well as all-cause mortality as the outcomes, while exploring the roles of SN, age, and baseline health in the relationship of SWB and longevity, was lacking and important for a fuller understanding of this relationship.

The Alameda County Study (ACS) provided excellent data for such an examination. ACS is a longitudinal (30+ years) investigation of behavioral, psychological, social, and economic influences on health and mortality based on a systematic, randomized sample (N = 6928) representing the general adult population in the Alameda County, California. The baseline (1965) survey of ACS addressed all four components of SWB. Also measured extensively in ACS were baseline physical health status and perceived health, other mental health indicators besides SWB (such as depression, perfectionism, anomie), social and economic well-being, and health practices. Biologic and demographic information was also collected. The ACS data set also is linked to State death registries with accurate mortality data and causes of death information. The richness of this data set allowed us to examine a large sample of the adult population of all ages for a long duration of time, to measure the broad concept of SWB (and all components), to differentiate among SWB components as predictors and among all-cause-, natural-cause and unnatural-cause mortality as outcomes, to explore possible influences of SN, age and baseline health, and to perform well-controlled and thorough analyses, all at the same time.

Data from ACS have been widely analyzed and reported, for example, Berkman and Breslow (1983); Roberts, Strawbridge, Deleger, and Kaplan (2002); Reynolds and Kaplan (1988, 1990). However, except the analyses at 9-year follow up of ACS by Kaplan and Camacho (1983, in part on happiness and mortality) and Berkman and Breslow (1983, in part on “life satisfaction” and mortality), how positive emotions may predict longevity has not been studied in this sample.

**Current Study Hypothesis**

SWB predicts longevity in the general population such that subjects with higher baseline (1965) scores of SWB will have
lower mortality risks over the course of the subsequent 28 years (1965–1993), compared to those with lower scores of SWB. This hypothesis is tested against all-cause mortality, natural-causes mortality, as well as unnatural-cause mortality (as classified by Singer, Garfinkel, Cohen, & Srole, 1976), with SWB and all of its components as separate predictors.

Method

Study Sample

The ACS subjects were selected by the Human Population Laboratory (HPL) to represent the adult population of Alameda County in 1965, based on a stratified, randomized, systematic sample of Alameda County housing units, as detailed by Berkman and Breslow (1983). Baseline N was 6,928 with an 86% response rate. The current study sample was drawn from ACS, including those who had data on no less than 2/3 of the predictor items and all adjustment variables at baseline. Study sample N was 6,856.

Measures

SWB included 14 items that measured its four components: GLS, DLS, PA, and NA (Diener, 2000). Appendix 1 listed the 14 items categorized into the components, as well as psychometric information associated with the measures. Longevity was indicated by risks of mortality (time to death during the 28 years). Mortality and cause-of-death data were collected through the California Death Registry and out-of-state death records with methods described by Berkman and Breslow (1983). There were 2,434 deaths from all causes during the 28 years (1965–1993), including 2,258 deaths from natural causes and 176 deaths from unnatural causes (suicide, homicide, accidents, mental disorders, drug dependency, alcohol-related liver diseases).

Other covariates. Age, sex, years of education, baseline health status (self reports of chronic medical conditions and functional disabilities), perceived health (excellent, good, fair, poor) and SN (ACS Social Network Index, including marital status, contact with relatives/close friends, church attendance, and other group affiliations, weighted based on the closeness of the relationships). These covariates have been shown to be associated with mortality as well as emotional factors such as depression and SWB (Berkman & Breslow, 1983; Engström et al., 1999; Levy et al., 2002; Roberts, et al., 2002).

Missing data treatment. Subjects who answered less than 2/3 of a SWB component (GLS, DLS, PA, or NA), or missed any of the covariate items, were excluded from the analyses of that component. For subjects who answered all covariate items and 2/3 or more, but not all, items in a component, the component score was calculated by imputing the missing value with the mean value of the answered items of the subject. The score of PF was the sum of the scores of all GLS, DLS, and PA items, imputed as above. The SWB score was the sum of the score of PF and the reversed score of NF.

Data Analysis

Sequential Cox Proportional Hazard models with fixed variables (Cox & Oakes, 1984) were adopted to evaluate the association between SWB and subsequent all-cause mortality risk with the covariates being adjusted in groups, using Proportional Hazard Regression Functions in SPSS, version 17, on four models. Model 1 included age, sex, and education. Model 2 added medical conditions and functional disabilities to Model 1. Model 3 added perceived overall health to Model 2. To evaluate possible role(s) of SN in the relationship, a fourth model was introduced by adding SN to Model 3. When controlling SN changed the significance level of the relationship, an “SN × SWB” interaction term was further introduced to test moderation of SN, and the Distribution of the Product (DOP) test was performed to examine SN’s mediation by evaluating asymmetric confidence limits (ACLs, Mackinnon, 2008). Interactions of age/baseline health with SWB were also explored by first introducing an “age/baseline health × SWB” term into the Cox regression models. Age and baseline health were then separately stratified and the Cox regression analyses repeated if the association’s significance level was changed by the interaction term. To control the interaction of SWB and socioeconomic status, before whole sample analyses, analyses with education levels stratified (≤12 years or >12 years of school) were always performed first for each model.

The relationships of SWB’s components (PF, GLS, DLS, PA, and NF/NA) with all-cause mortality were then each examined separately in the same manner as that for SWB above. Then, all-cause mortality was separated into “natural-cause” and “unnatural-cause” mortality to be evaluated as separate outcomes in the same manner as that for all-cause mortality, as described above.

Results

In all results, RR was relative risk per unit predictor increase. For all-cause mortality (see Table 1), after demographic (age, sex, education) and baseline health covariates (medical conditions, functional disabilities, and perceived health) were controlled in Model 3, significant associations were shown by SWB (RR = .988, p = .006), PF (RR = .974, p = .000), and GLS (RR = .906, p = .000). DSL showed a marginally significant association (RR = .954, p = .05), while PA and NA showed no associations (p > .05). After SN was also controlled, the association of SWB lost its significance (RR = .996, p = .348); those of PF and GLS reduced but were still significant (RR = .985, p = .035; RR = .930, p = .001, respectively); and the association for DSL was significant (RR = .945, p = .021). PA and NA remained insignificant (p > .05).

Introducing SN × predictor terms did not reveal any significant moderation of SN (tables not shown). Multivariate DOP tests with SN as possible mediator revealed significant mediated associations (95% ACLs were (−.011, −.006) for SWB, (−.014, −.007) for PF, (−.036, −.018) for GLS, and (−.015, −.004) for DLS). Sobel tests (Preacher & Leonardelli, 2006) were also explored, which confirmed these and other DOP tests below, all with significant test statistics, p < .01. These associations, and other mediated associations found below, were independent from all demographic and baseline health covariates.

The results on natural-cause mortality (see Table 2) largely repeated the patterns of that for all-cause mortality, that is, after all demographic and health covariates were controlled, SWB, PF, GLS, and DLS showed significant associations with natural-cause
12

Table 1
1965–1993 Relative Risk of All-Cause Mortality by 1965 SWB and Components Adjusted for Age, Gender, Education, Baseline Physical Measures, and Social Networks

<table>
<thead>
<tr>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>RR*</td>
<td>95% CI</td>
<td>RR*</td>
<td>95% CI</td>
</tr>
<tr>
<td>SWB</td>
<td>.972***</td>
<td>.964 .980</td>
<td>.981***</td>
</tr>
<tr>
<td>PF</td>
<td>.953***</td>
<td>.941 .964</td>
<td>.965***</td>
</tr>
<tr>
<td>GLS</td>
<td>.844***</td>
<td>.810 .879</td>
<td>.879***</td>
</tr>
<tr>
<td>DLS</td>
<td>.979</td>
<td>.933 1.027</td>
<td>.962</td>
</tr>
<tr>
<td>PA</td>
<td>.938***</td>
<td>.908 .968</td>
<td>.954*</td>
</tr>
<tr>
<td>NF/NA</td>
<td>1.026*</td>
<td>1.006 1.047</td>
<td>1.008</td>
</tr>
</tbody>
</table>

Note. Model 1: Age, Sex, Education; Model 2: Add Medical Conditions and Functional Disabilities to Model 1; Model 3: Add Perceived Health to Model 2; Model 4: Add Social Network to Model 3.

* All Relative Risks (RRs) are for per unit predictor increase. The scores of SWB ranged 14–40; of PF, 9–25; of GLS, 3–7; of DLS and PA, 3–9; and of NF/NA, 5–15.

** .01 < p < .05.  *** .001 < p < .01.  **** p < .001.  * p ~ .05 (marginally significant).

mortality (RR = .980, p = .018; RR = .975, p = .001; RR = .904, p = .000; RR = .946, p = .030, respectively); but PA and NA showed no such associations. Controlling SN brought very similar results as that for all-cause mortality; that is, the association of SWB and natural-cause mortality lost its significance, those of PF and GLS reduced but were still significant (RR = .985, p = .043; and RR = .925, p = .001, respectively), DLS remain significant (RR = .939, p = .014), and PA and NA were insignificant. Introducing SN × predictor terms did not reveal moderation by SN (data not shown).

For unnatural-cause mortality (see Table 3), after controlling for demographic and baseline health covariates (Model 3), significant associations were found for SWB (RR = .961, p = .014), PF (RR = .951, p = .037), and GLS (RR = .862, p = .05, marginally significant). DLS, PA, and NA did not show a significant association. Controlling SN (Model 4) reduced the associations for SWB, PF, and GLS to be insignificant (p > .05), while DLS, PA, and NA remained insignificant. Introducing SN × predictor terms did not reveal significant moderation (tables not shown), although it brought SWB and PF back to significance (RR = .948, p = .048; and RR = .922, p = .042, respectively). DOP tests with SN as possible mediator revealed significant mediated associations (95% ACLs were (.921, .903) for SWB, (.927, .904) for PF, and (.927, .901) for GLS. Again, Sobel tests confirmed these results with significant test statistics, p < .01.

Introducing age × predictor terms did not reveal significant interaction for any outcome (tables not shown). Analyses with age stratified (<55, or ≥55 years old, tables not shown) revealed that for all-cause mortality, in Model 3 the associations in the cases of SWB and PF were significant in the older group (RR = .986, and RR = .973, respectively, p < .05) but not in the younger group (p > .05). DLS, on the contrary, has an association in the younger group (RR = .926, p < .05) but not in the older group (p > .05). GLS showed strong associations for both groups even after SN

Table 2
1965–1993 Relative Risk of Natural-Cause Mortality by 1965 SWB and Components Adjusted for Age, Gender, Education, Baseline Physical Measures, and Social Networks

<table>
<thead>
<tr>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>RR*</td>
<td>95% CI</td>
<td>RR*</td>
<td>95% CI</td>
</tr>
<tr>
<td>SWB</td>
<td>.973***</td>
<td>.965 .982</td>
<td>.983***</td>
</tr>
<tr>
<td>PF</td>
<td>.954***</td>
<td>.942 .966</td>
<td>.967***</td>
</tr>
<tr>
<td>GLS</td>
<td>.843***</td>
<td>.808 .879</td>
<td>.880***</td>
</tr>
<tr>
<td>DLS</td>
<td>.971</td>
<td>.924 1.020</td>
<td>.954</td>
</tr>
<tr>
<td>PA</td>
<td>.940***</td>
<td>.910 .971</td>
<td>.958*</td>
</tr>
<tr>
<td>NF/NA</td>
<td>1.024*</td>
<td>1.005 1.045</td>
<td>1.004</td>
</tr>
</tbody>
</table>

Note. Model 1: Age, Sex, Education; Model 2: Add Medical Conditions and Functional Disabilities to Model 1; Model 3: Add Perceived Health to Model 2; Model 4: Add Social Networks to Model 3.

* All Relative Risks (RRs) are for per unit predictor increase. The scores of SWB ranged 14–40; of PF, 9–25; of GLS, 3–7; of DLS and PA, 3–9; and of NF/NA, 5–15.

** .01 < p < .05.  *** .001 < p < .01.  **** p < .001.  * p ~ .05 (marginally significant).
was also controlled in Model 4 (RR/H11021.922, and RR/H11005.917, p/H1135055.01). For unnatural-cause mortality, the results repeated the above pattern, that is, SWB and PF showed associations only in the older group, DLS showed an association only in the younger group, and GLS showed strong associations in both groups persisting through Model 4. For unnatural-cause mortality, SWB and PF showed associations only in the younger group (RR = .946, respectively, p < .05). For natural-cause mortality, the results repeated the above pattern (data not shown).

Discussion

Subsample analyses with the Cox Regression models at different education levels (>12 years vs. ≤12 years of school, tables not shown) revealed that the two subsamples had the same patterns of relationships between the predictors and the mortality outcomes, which indicates that combining the subsamples in the analyses, as described above, would not change the pattern of the relationships.

Categorization of SWB, PF and NF (in tertiles) was also explored (tables not shown). The results confirmed those above. SWB and PF, but not NF, showed associations with the mortality outcomes.

Results for all-cause mortality (see Table 1) showed that SWB, PF, GLS, and DSL predicted lowered risk of all-cause mortality in the population. The associations seemed partially (for PF, GLS, and DSL) or completely (for SWB) mediated by SN. Very similar mediated associations were also found for natural-cause mortality, and completely mediated associations through SN were found for SWB, PF, and GLS with unnatural-cause mortality. These results indicate that SN appears to be a possible mediator in the relationships of these positive emotions and mortality. To prove causal mediation, or rule out other possibilities such as confounding, would require more systematic, in-depth research that is beyond the scope of this study. But the consistent and statistically significant mediated associations found across the three outcomes demonstrate the plausibility that one pathway of SWB/positive components associating with mortality might be through SN. This is supported by evidence from some experimental studies (e.g., Dunn & Schweitzer, 2005; Fredrickson, Cohn, Coffey, Pek, & Finkel, 2008; Johnson & Fredrickson, 2005) showing that induced positive

<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RR*</td>
<td>Lower</td>
<td>Upper</td>
<td>RR*</td>
</tr>
<tr>
<td>SWB</td>
<td>.948***</td>
<td>.921</td>
<td>.975</td>
<td>.948***</td>
</tr>
<tr>
<td>PF</td>
<td>.928***</td>
<td>.888</td>
<td>.969</td>
<td>.930***</td>
</tr>
<tr>
<td>GLS</td>
<td>.796***</td>
<td>.694</td>
<td>.913</td>
<td>.802**</td>
</tr>
<tr>
<td>DLS</td>
<td>1.059</td>
<td>.919</td>
<td>1.219</td>
<td>1.048</td>
</tr>
<tr>
<td>PA</td>
<td>.934</td>
<td>.832</td>
<td>1.049</td>
<td>.972</td>
</tr>
<tr>
<td>NF/NA</td>
<td>1.086*</td>
<td>1.013</td>
<td>1.165</td>
<td>1.089*</td>
</tr>
</tbody>
</table>

Note. Model 1: Age, Sex, Education; Model 2: Add Medical Conditions and Functional Disabilities to Model 1; Model 3: Add Perceived Health to Model 2; Model 4: Add Social Networks to Model 3.

* All Relative Risks (RRs) are for per unit predictor increase. The scores of SWB ranged 14–40; of PF, 9–25; of GLS, 3–7; of DLS and PA, 3–9; and of NF/NA, 5–15.

.01 < p < .05. ** .001 < p < .01. *** p < .001. * p ~ .05 (marginally significant).
emotions promoted SN or SN-related factors (e.g., increased trust and decreased racial bias), and prospective studies linking SN and mortality (some cited above). It seems people with high scores of SWB/positive components might have an advantage in building or sustaining their SN, possibly through positive social interactions (Waugh & Fredrickson, 2006), open-mindedness (Johnson & Fredrickson, 2005), or accurate perception (Casciaro et al., 1999). The enhanced SN might then help improve health/longevity. The sense of connectedness by itself has health benefits (Berkman & Breslow, 1983). SN may also provide moral/practical support when needed (Berkman & Breslow, 1983; Fredrickson, 2003, 2009), thus help to reduce the negative physical impacts of stress, illnesses, and other hardship in life and protect physical well-being.

The results that showed completely mediated associations of SWB/PF/GLS and unnatural-cause mortality could imply that these positive emotions might affect unnatural-cause mortality mainly through enhancing SN; and in turn, at times of crisis when risk of unnatural deaths (e.g., suicide) increases, the enhanced SN might serve as a buffer, resources, and/or moral and practical support to help to reduce such risk. Also, enhanced SN might work to reduce the chance of such crisis from arising at the first place, as some researchers (Koivumaa-Honkanen et al., 2001) note that the risk of unnatural deaths such as suicide may accumulated over a long time and poor social support may contribute to such accumulation.

As affective states are associated with neuroendocrine regulations and cardiovascular functions (Chida & Steptoe, 2008), one may argue that for aggregated measures such as SWB, the health effects may be generally attributable to emotional (affective) components. However, we may also argue that the cognitive components (GLS and DLS) are relatively more stable and trait-like, and rely less on external stimuli, therefore over time may affect health more significantly. In this study, PA and NA did not show asso-

### Table 4

<table>
<thead>
<tr>
<th></th>
<th>SWB</th>
<th>PF</th>
<th>GLS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All-cause mortality</td>
<td>Natural-cause mortality</td>
<td>Unnatural-cause mortality</td>
</tr>
<tr>
<td></td>
<td>Model 3</td>
<td>Model 4</td>
<td>Model 3</td>
</tr>
<tr>
<td></td>
<td>p value</td>
<td>RR*</td>
<td>95% CI</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Upper</td>
<td>Lower</td>
</tr>
<tr>
<td>SWB</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not Healthy</td>
<td>0.332</td>
<td>0.994</td>
<td>0.981</td>
</tr>
<tr>
<td>Healthy</td>
<td>0.004</td>
<td>0.982**</td>
<td>0.97</td>
</tr>
<tr>
<td>PF</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not Healthy</td>
<td>0.091</td>
<td>0.983</td>
<td>0.964</td>
</tr>
<tr>
<td>Healthy</td>
<td>0.000</td>
<td>0.965***</td>
<td>0.974</td>
</tr>
<tr>
<td>GLS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not Healthy</td>
<td>0.073</td>
<td>0.942</td>
<td>0.883</td>
</tr>
<tr>
<td>Healthy</td>
<td>0.000</td>
<td>0.877***</td>
<td>0.827</td>
</tr>
</tbody>
</table>

Note. Model 1: Age, Sex, Education (Not shown); Model 2: (Omitted, baseline health controlled by stratification); Model 3: Add Perceived Health to Model 1; Model 4: Add Social Networks to Model 3.

* All Relative Risks (RRs) are for per unit predictor increase. The scores of SWB ranged 14–40; of PF, 9–25; of GLS, 3–7.

* .01 < p < .05. ** .001 < p < .01. *** p < .001.
ciations with the outcomes after demographic and baseline health covariates were controlled (Tables 1–3, Model 3), although PA came very close for both all-cause and natural-cause mortality. On the other hand, GLS and DLS showed significant associations with lowered risks of all-cause and natural-cause mortality in the same model (Model 3), as well as in Model 4 when SN was controlled (Tables 1 & 2). GLS also showed one with unnatural-cause mortality (Table 3, Model 3). These supported our argument. In fact, in almost all analyses in this study, saving that for unnatural deaths, GLS showed the strongest associations with lowered risks of mortality among all factors evaluated. It seems as if a global sense of satisfaction with life might be the most helpful for reducing risks of mortality, comparing to other components of SWB.

When contrasting the positive and negative components, PF as a whole has a significant association with all-cause mortality after demographic and baseline health covariates were controlled. The association was still significant after SN was also controlled, though partial mediation of SN was indicated. This is consistent with Berkman and Breslow’s (1983) findings of the same measure (termed by them “Life Satisfaction”) and all-cause mortality for the first nine years of ACS. They reported that a high level of baseline “Life Satisfaction” “reduced all-cause mortality by nearly half for men and nearly two thirds for women” during the 9-year period. The strong association of PF and subsequent mortality persisted for at least 28 years, as revealed in this study. This is also consistent with the Nun Study cited above, in which positive emotions recorded in the nuns’ youth strongly predicted their longevity over six decades. Contrary to expectations, however, NF showed no association with all-cause mortality (see Table 1). This will be discussed more below.

From the results on natural-cause mortality we may see that after removing the unnatural deaths from all-cause mortality, the relationships of the predictors and mortality remained largely the same (comparing Tables 1 and 2). This implies that the prospective associations of SWB/positive components with mortality are mainly realized through “natural” pathways, i.e., through physical health. That is, these positive emotions might have helped improve physical health and in turn helped improve “natural” longevity.

Therefore, the associations of emotions and mortality might not be limited, or largely attributable, to unnatural deaths as suggested by some previous studies cited above. However, it is still interesting to see how emotions affect unnatural deaths in the population. In the current study, significant associations were found for SWB, PF, and GLS on unnatural-cause mortality in the whole sample, as well as for SWB and PF in the <55 years old subsample, and for SWB, PF, and GLS in the Healthy subsample. It seems in this population sample, these positive emotions might have protected people from risk of unnatural deaths, in addition to promoting their physical health. This is consistent with other population studies that have found decreased risk of suicide being predicted by happiness (Koivumaa-Honkanen et al., 2003) and life satisfaction (Koivumaa-Honkanen et al., 2001). It is not necessarily inconsistent with a study that found no association between mean level of happiness and suicide or homicide rates across 15 industrialized nations (Lester, 2002), as it might be a high level, not a mean or medium level, of happiness that is associated with unnatural deaths, as revealed in our exploration that tertially categorized PF (data not shown). NF did not predict unnatural deaths in this study, which is the most surprising finding and will be discussed more below.

Across the three outcomes, age seemed to affect the relationships of SWB/positive components and mortality differently in different predictor-outcome pairs such that an association may only show in the older group (SWB and PF for all-cause and natural cause mortality) or only show in the younger group (SWB and PF for unnatural-cause mortality, DLS for all-cause and natural cause mortality), or show strongly in both (GLS for all-cause and natural-cause mortality). But the notion that positive emotions’ health effects may be stronger in, or only apply to, older adults (Chida & Steptoe, 2008) did not appear to hold entirely here. This notion might have been made based on the existing studies focused mainly on older age groups.

On the other hand, stratification of baseline health status differentiated the associations of the positive emotions and mortality in a very clear pattern across the three outcomes, with the associations consistently being stronger in the healthy group than in the unhealthy one. That the associations seemed insignificant or weaker in the Not Healthy group might or might not be due to the large variation of the subjects’ physical conditions in the group, which could be explored further in future studies. But clearly, healthy people who had high positive emotions at baseline also had lowered risks of subsequent mortality. Those who were healthy yet had lower positive emotions at baseline subsequently suffered higher risks of all three mortality outcomes. This may have important implications in public health and preventive medicine, as healthy people are the majority of the population (over 70% in the current study sample). A potentially effective way of keeping healthy people healthy and long-lived, then, could be to increase their positive emotions, which prospect is promising as supportive empirical evidence is mounting and effective intervention techniques are fast developing (Fredrickson & Cohn, 2008; Fredrickson, 2009; Ho, 2007; Rein et al., 1995; Seligman, 2002).

What, then, might be the mechanisms of the associations between positive emotions (e.g., SWB and positive components) and longevity? According to Fredrickson’s (2003) Broaden and Build Theory, positive emotions broaden our attention and action span, down-regulate (“undo”) what negative feelings do to us, and build enduring psychological, physical, and social resources that we can draw upon when needed, thus promote health and longevity. Evidence supporting this theory has been mounting (Fredrickson, 2003, 2009). Positive emotions were found to predict better social interactions (Waug & Fredrickson, 2006), improved creativity and action span (Isen, 1987), healthier behaviors (Berkman & Breslow, 1983), and faster recovery from the cardiovascular sequelae of negative emotions (Fredrickson & Levenson, 1998). Positive emotions were also found to predict physical and mental health (Fredrickson, 2000; Peterson, 2000), lowered disease susceptibility (Cohen, 2003; Peled et al., 2008; and Ostir et al.; 2001), increased resilience against adversity (Fredrickson, Tugade, Waug, & Larkin, 2003), as well as improved quality of life in cancer patients (de Moor et al. 2006). In a randomized, placebo-controlled field experiment, Fredrickson and colleagues (2008) induced positive emotions among working adults, which led to increased mindfulness, purpose in life, social support, and decreased illness symptoms. HeartMath researchers found that self-induction of positive emotions increased levels of salivary IgA that
provides us the first line of defense against pathogens (Rein et al., 1995).

It seems, then, the broaden, down-regulate, and build functions of positive emotions might help the population in achieving better longevity through promoting positive behaviors (e.g., health practices, positive social interactions, open-mindedness, religious attendance), enhancing immune and other physical functions, and/or building resilience to adversity and negative stimuli. It would be interesting to study whether the associations of SWB/positive components and mortality found in this study indeed have these pathways. In fact, in the ACS sample, religious attendance has been linked to lowered mortality risks (Strawbridge, Shema, Cohen, & Kaplan, 1997) through pathways of improving and maintaining healthy behaviors, mental health, and social relationships (Szwarcberg, Shema, Cohen, Kaplan, 2001). SWB and other positive emotions could also lead to improving of these behavorial/mental outcomes, and in turn, lead to longevity. More studies are needed to test these possibilities. Another intriguing question concerns how positive emotions may down-regulate negative emotions’ effects on health. Might one pathway be that positive emotions activate or enhance certain immune, hormonal, or neural function that may have been suppressed by negative emotions? Research to answer such questions may shed light on the biological mechanisms of positive emotions’ benefits on health, which is relevant to psycho-neuroimmunology.

Across the three outcomes emerged a surprising pattern that NF showed no associations with mortality (most surprisingly, unnatural-cause mortality), unlike many studies of depression and mortality. However, most studies that found an association were on patients or other vulnerable populations such as the elderly or the infirmed; and many were poorly controlled (see reviews, Cuijpers & Smit, 2002; Wulsin, Vaillant, & Wells, 1999). A few well-designed general population studies also found an association (e.g., Barefoot & Schroll, 1996; Bruce, Leaf, Rozal, Florio, & Hoff, 1994). One explanation may be the differences in measures between these studies and the current study. These studies measured clinical depression or severe negative emotions (e.g., with DIS, MMPI). The current study measured NA with the NA subscale of the Bradburn-Caplovitz (1965) index. As noted in Appendix 1, this subscale was extensively validated to measure NA, with good psychometrics. In this study, it did not predict population mortality. This, however, does not refute that severe negative emotions such as clinical depression, or negative emotions in patients or other vulnerable groups, could be associated with mortality (Wulsin et al., 1999).

The findings on NF were consistent with a number of other population studies (e.g., Reynolds & Kaplan, 1988; Roberts, Kaplan, & Camacho, 1990; Rorsman, Hagnell, & Lanke, 1982a & b; Thomas, Kelman, Kennedy, Ahn, & Yang, 1992; Vaillant, Orav, Meyer, Vaillant, & Roston, 1996; Zonderman Costa, & McCrae, 1989) that measured depression with psychiatric instruments, the CES-D, or the 18-item HPL Depressive Symptoms index, developed by Roberts and colleagues (1990) using physicians’ ratings. None of these studies found an association between depression and all-cause or specific-cause mortality. Also, interestingly, Berkman and Breslow (1983) reported that out of the seven psychological factors (from factor analyses of all 60 psychological items in the ACS baseline survey), namely, personal uncertainty, anonymity and normlessness, life satisfaction, social insecurity, perfectionism, negative feelings, and isolation-depression, the factor that most strongly predicted mortality was “life satisfaction.” Note that this was the only positive factor out of the seven, and its prospective association with population mortality reportedly outweighed any of the other six which were a wide range of measures of negative psychological factors, but showed only moderate to no associations with mortality. These seemed to imply that non-clinical negative emotions are not a major threat to longevity of the general population.

More notable in this study were positive emotions’ possible roles in lowering risks of mortality, which might point to a potentially effective route for improving population longevity, or population health in general. Fredrickson (2000), having had made a persuasive case that positive emotions may have robust functions and can be effectively cultivated, stated that cultivating positive emotions will ultimately advance skills to enhance health, resilience, and well-being. Chesney et al.’s (2005) calling for exploring positive emotions as “the other hemisphere in behavioral medicine,” as cited at the beginning of this article, is visionary.

Limitations

Although to our knowledge the current study could be considered unprecedented in terms of comprehensiveness and thoroughness in the investigation of SWB as a predictor of longevity, it has a number of limitations. Baseline health status was based on self-reports, which is widely used and is often the only available health status measure in a large population survey. But potentially, its accuracy is not as high as data from medical examinations. For example, self reports were found to underestimate some conditions such as hypertension while reasonably estimating some other conditions such as diabetes (Goldman, Lin, Weinstein, & Lin, 2003). Also, the nature of prospective observations has both advantages and limitations in terms of drawing causal inferences. The obvious advantages are the temporal precedence of the predictors and covariates to the outcomes, and the ability for observations of the outcomes over time while controlling baseline covariates. These are supportive but not sufficient for causal inferences, especially considering potential influences of any unmeasured third factor (Mackinnon, 2008). Thus, the associations found in this study demonstrate a possible, but not proven, role of SWB and positive components as causal factors of longevity.

Conclusion

The hypothesis of this study was generally supported by the results, with SWB and its various positive components predicting lowered risks of all-cause, natural-cause, and unnatural-cause mortality. These associations were found among younger and older adults, were especially clear among healthy adults, and were possibly mediated by SN. Contrary to expectations, however, NF/NA did not predict the mortality outcomes in this population sample. These results call for more focus on positive emotions as a potential promoting agent for population longevity and health.

References


SUBJECTIVE WELL-BEING PREDICTED LONGEVITY


Appendix 1

The Measure of Subjective Well-Being (SWB) and Psychometrics

SWB was the sum of the scores of Positive Feelings and the reverse scores of Negative Feelings described below, totally 14 items from the Alameda County Study baseline survey. The items’ order has been rearranged, and headings were added, to illustrate Diener’s (2000) four-factor definition of SWB that this study adopted.

Positive feelings (PF)

These nine PF items constituted the “Life Satisfaction” factor from factor analyses of all ACS baseline psychological items (Berkman & Breslow, 1983).

Global Life Satisfaction (GLS)

1. All in all, how happy are you these days?
2. On the whole life gives me a lot of pleasure.
3. I feel as good now as I ever have.

Satisfaction with Important Life Domains (DLS)

4. Consider everything, how satisfied are you with your present job?
5. Has your marriage turned out to be better or worse than you expected?
6. Have your children turned out to be better or worse than expected?

Positive affect (PA)**

All from the positive feeling subscale of the Bradburn-Caplovitz (1965) index.

Negative feelings (NF/NA)**

Includes all five negative feeling items in the Bradburn-Caplovitz (1965) index.

Excerpts from the original text:

11. How often do you feel very lonely or remote from other people?
12. How often do you feel vaguely uneasy about something without knowing why?
13. How often do you feel bored?
14. How often do you feel so restless you couldn’t sit long in a chair?

Item 1 was scored 1 = Not so happy, 2 = Pretty happy, 3 = Very happy. Items 2 & 3 were scored: 1 = False, 2 = True. Item 4 was scored: 1 = Not satisfied, 2 = Somewhat satisfied, and 3 = Very satisfied. Items 5 & 6 were scored 1 = Worse, 2 = About the same, 3 = Better. Items 7 through 14 were scored: 1 = Never, 2 = Sometimes, 3 = Often.

GLS and DLS were not validated as scales, except their apparent face validity. However, in a 2-week test–retest among 1000 Alameda county households (Berkman & Breslow, 1983), the overall happiness and marital satisfaction items, and a total of 60 ACS items pretested showed good reliability, with Indices of Reliability (Observed agreement % – Expected agreement %)/ (Maximum agreement % – Expected agreement %) being 64, 72, and 79, respectively.

** From the Bradburn-Caplovitz (1965) index which has been extensively validated. Test–retest (8 months) reliability was \( r = .36 \) \((p < .001)\) for PA, and \( r = .41 \) \((p < .001)\) for NA. For PA items, \( r \) ranged .26–.47; for NA times, \( r \) ranged .31–.54. PA correlated with happiness \((G = .38, p < .01)\), but was unrelated to NA, psychosomatic complaints, anxiety, and worrying; NA correlated with happiness \((G = -.49, p < .01)\), anxiety \((G = .41, p < .001)\), psychosomatic complaint \((G = .53, p < .01)\), and worrying \((G = .49, p < .01)\), but not PA. Since one positive feeling item from the index was omitted in ACS, the PA subscale used was not precisely validated. The NA subscale as used in its entirety was precisely validated as above and by other work done with the index. A modified version (Chesney, Neiulands, Chambers, Taylor, & Folkman, 2006) of the two subscales had internal consistency of \( a = .89 \) for PA and \( a = .72 \) for NA. It was also reported (Berkman, 1971) that the eight PA and NA items used in this study together measured the same psychological dimension as that identified by the psychiatric ratings done in the Midtown Manhattan Study.

E-Mail Notification of Your Latest Issue Online!

Would you like to know when the next issue of your favorite APA journal will be available online? This service is now available to you. Sign up at http://notify.apa.org/ and you will be notified by e-mail when issues of interest to you become available!