Long-Term Impact of Preventive Proactivity on Quality of Life of the Old-Old

EVA KAHANA, PhD, RENEE H. LAWRENCE, PhD, BOAZ KAHANA, PhD, KYLE KERCHER, PhD, AMY WISNIEWSKI, MA, ELEANOR STOLLER, PhD, JORDAN TOBIN, MD, AND KURT STANGE, MD, PhD

Objective: This research explored the long-term benefits of engaging in proactive health promotion efforts among old-old residents of Sunbelt retirement communities to empirically test components of the Preventive and Corrective Proactivity (PCP) Model of Successful Aging. Specifically, we examined the contributions of exercise, tobacco use, moderate alcohol use, and annual medical checkups to multidimensional quality of life indicators of physical health, psychological well-being, and mortality. Method: Data were obtained from a longitudinal study of adaptation to aging. Annual in-home interviews were conducted with 1000 older adults over a 9-year period. Whether health promotion behaviors at baseline predicted quality of life outcomes 8 years later was examined, controlling for the baseline outcome, sociodemographic variables, and, as an additional test, baseline health conditions. Results: Exercise was predictive of fewer IADL limitations and greater longevity, positive affect, and meaning in life 8 years later. Avoiding tobacco was predictive of longevity. Before controlling for health conditions, exercise predicted decreased risk of basic activities of daily living limitations and having more goals; moderate alcohol use predicted longevity; annual health checkup predicted more IADL limitations; and having once smoked predicted having more IADL limitations and negative affect. Conclusions: Among the old-old, exercise had long-term and multifaceted benefits over an 8-year period. Tobacco avoidance also contributed to long-term positive outcomes. These results lend support to the long-term preventive value of health-promoting proactivity spontaneously engaged in by old-old persons proposed in the framework of the PCP model. Key words: health promotion, quality of life, older adults, prevention, proactivity, exercise.

INTRODUCTION

Successful aging and maintenance of good quality of life among the old-old represent central concerns to gerontologists, particularly as the rapidly aging cohort of elders enters the 21st century (1, 2). In the framework of the stress paradigm, researchers have focused on the ways in which the normative stressors of aging, such as chronic illness and social losses, threaten continued high quality of life (3). Social scientists have also focused on demographic and environmental factors, which render older adults particularly vulnerable to diminished quality of life (4, 5). Only in recent years has emphasis shifted from focusing on vulnerability of aging to consideration of proactive adaptations that individuals can undertake well into late life to enhance their quality of life and ameliorate adverse stress effects (6, 7).

Research anchored in the stress paradigm has generally focused on the effects of stress exposure, vulnerability, and coping with stress on quality of late life (8, 9). A parallel line of inquiry by medical sociologists seeking to understand maintenance of high quality of life has focused on the value of health behaviors, including preventive health-promoting activities and health care use among the elderly (10, 11). The research described here integrates stress-based models of proactive adaptations to achieve successful aging and the medical sociological model of preventive health promotion. This study is based on a conceptual model of successful aging we developed termed preventive and corrective proactivity (PCP) (12, 13). This model recognizes that normative stressors (eg, chronic illnesses, social losses) pose threats to the quality of life of the old-old. Proactive initiatives by older adults are seen as important actions that can buffer the ill effects of these stressors. Furthermore, proactive adaptations are also expected to serve preventive functions, especially when they are undertaken before the time that stressors arise. The PCP model thus considers the usefulness of preventive health behaviors along with corrective adaptations, which come into play after stressors arise. This reflects an innovative approach to the stress paradigm because it goes beyond traditional consideration of only corrective adaptations in dealing with stressors that have already impinged on the older person. This model integrates behavioral adaptations, which can prevent or diminish stress exposure and can build social resources, with more traditional conceptions of coping with stress.

The PCP successful aging model proposes three key areas of preventive adaptations: health promotion,
planning ahead, and helping others. This article focuses on health-promoting behaviors and their preventive impact on long-term quality of life among old-old residents of retirement communities. Health promotion refers to diverse efforts undertaken to maintain good health ranging from exercising to avoiding harmful substances and seeking preventive health care (10). Our study proposes that health-promoting activities have preventive roles by slowing down processes of decline and contributing to maintenance of well-being and high-level functioning. Although our focus is on prevention, it is useful to note that some elderly persons who have already experienced an illness may also exercise or stop smoking to correct a problem that has already occurred. Our study provides insights into health-promoting efforts that occur without formal interventions based on proactive initiatives of older adults. By considering the long-term contribution of health-promoting activities in maintaining high quality of life in the context of the broader theoretical framework of the PCP model, we hope to contribute to a more comprehensive understanding of the roles of prevention and proactivity in the attainment of successful aging.

In this article, data are presented from an ongoing longitudinal study of old-old adults designed to assess how health-promoting behaviors relate to good quality of life and to longevity. The gerontological literature designates adults above age 75 as old-old, contrasted with the young-old, who are ages 60 to 75 (14). Respondents in our study had a mean age of 79 years at baseline. The relationships explored here are placed in the context of the PCP successful aging model, which considers quality of life to be a multidimensional construct that goes beyond maintenance of good physical health (15–17). The focus of this article is on the influences of preventive proactivity on multiple outcomes of successful aging. We examine how exercise, tobacco use, alcohol consumption, and regular check-ups with physicians influence mortality, morbidity, physical functioning, psychological well-being, and finding goals and meaning in life among a sample of old-old community dwelling adults. While there have been a number of studies that examined how these health-promoting behaviors relate to mortality, morbidity, and physical functioning, there has been limited research on how health-enhancing behaviors influence psychological well-being and other dimensions of quality of life beyond physical health (18–21). Although the relationship of exercise and depression has been studied (22–24), the role of health-promoting behaviors in maintenance of psychological well-being indicators, such as maintenance of goals and meaning in life, has largely remained unexplored.

Yet it is increasingly recognized that psychological well-being and high quality of life represent complex phenomena that go beyond absence of depression or negative affect (12, 13). Furthermore, the long-term value of health-promoting behaviors engaged in during late life has thus far received little attention and deserves additional study.

Based on prior literature, we can anticipate that exercise (25–32), avoidance of tobacco use (25, 28, 32–34), moderate alcohol consumption (25, 28, 30, 35–37), and annual checkups (38–40) can contribute to maintenance of health and high quality of life in old age. Nevertheless, it is notable that prior research exploring benefits of health promotion among older adults has generally focused on middle-aged and young-old populations (41–43) and has typically considered relatively short-term benefits for the elderly. The present study aims to address these gaps. Additionally, it also adds to our understanding of long-term benefits of spontaneous health promotion efforts pursued by old-old adults.

**Rationale and Hypotheses**

We hypothesized that engaging in health-promoting efforts contributes to long-term maintenance of diverse quality of life indicators. We anticipated that the spectrum of positive sequelae for health-promoting activities and lifestyles spans diverse components of the disability cascade (44), including maintenance of physical functioning in instrumental and basic activities of daily living, reduced hospitalization and morbidity, and ultimately lower mortality. Furthermore, consistent with our multidimensional view of quality of life indicators (12, 13), we also sought to explore the long-term impact of health-promoting activities on some key indicators of psychological well-being. Consistent with conceptualizations set forth in the PCP model of successful aging (12), we expanded psychological well-being outcomes beyond traditional mental health indicators of depression or negative affect to also encompass positive affect and having goals and meaning in life. We consider important contributions of this study to be based on consideration of the long-term impact of naturally occurring health-promoting efforts in old-old populations and the inclusion of diverse positive indicators of quality of life.

**METHODS**

Sample and Data Collection Procedures

This study used baseline (wave 1) and 8-year follow-up data (wave 9) from an ongoing National Institute on Aging-funded longitudinal study of late-life adaptation to aging and increasing frailty...
As part of the ongoing project, all baseline participants were interviewed annually in their homes. The initial data collection (T1) took place in 1989 to 1990. A sample of 1000 adults was randomly selected from three retirement communities in Clearwater, Florida. Eligibility criteria required that participants be at least 72 years old, live in Florida at least 9 months of the year, and be free of major mental and physical infirmities (eg, bedridden or confused). Because all respondents lived in independent housing with no services, we did not have to use the latter exclusion criterion. Approximately half of the residents were migrants from the Midwest, and another 30% migrated from the East Coast [see Borawski, Kinney, and Kahana (47) for a more detailed description of the sample]. The retirement communities consisted of Caucasian older adults with predominantly Protestant religious affiliation (68%). Residents were of working class or middle class backgrounds with a mean education level of 14 years. All respondents were interviewed in their homes by carefully trained professional interviewers. Principal investigators retrained interviewers each year and observed interview sessions on an annual basis.

Respondents who moved from their original residence after the initial interview were also followed up in subsequent years. Students from universities near respondents’ new residences were hired to conduct these interviews. Non-interviewable status (ie, death or institutionalization) was evaluated and verified each year through contact with relatives or contact persons provided by the respondent at previous waves. In addition, the National Death Index was used to verify non-interview status for individuals for whom contacts were not available. Mortality data used in this report were collected through the ninth year of the study.

During the ninth data collection period (1998), 357 of the original respondents were interviewed. We refer to this group as the follow-up sample. Of the 643 participants who were not interviewed in 1998, 374 had died, 74 could not be located or contacted for an interview, 88 were no longer interested in participating, 78 were too ill to participate, 13 were involved with caregiving duties, and the remaining 16 did not participate for unspecified reasons.

Measures


Exercise—To assess exercise, respondents were asked how often they participated in sports or other exercise activities. The response scale ranged from rarely or never (1) to several hours a day (5).

Annual health checkup—Respondents were asked whether they have a complete physical checkup at least once a year (including having their blood pressure and cholesterol checked).

Tobacco use—Current smoking practices were assessed by asking respondents whether they currently smoked, previously smoked but currently do not smoke, or never smoked. For analyses, the reference group consisted of those who had never smoked, and two dummy variables were created to compare the other two groups (once smoked and current smokers) with this group.

Alcohol use—Respondents were asked the question “On average, how much beer, wine, and mixed drinks do you drink per day?” Because very few respondents who drank exhibited heavy drinking patterns (the vast majority of alcohol users were moderate drinkers), the distribution was skewed. Thus, responses were used to create a dichotomous measure of current drinking practices: does not drink at all or drinks to some degree.

Sociodemographic variables. Potentially confounding sociodemographic variables suggested by the literature (25) include age (actual years), sex (0 = male, 1 = female), education (actual years), and whether or not the respondent lives alone (0 = no, 1 = yes).

Outcomes. The outcome variables were subdivided into three major categories: physical health and physical functioning outcomes, psychological well-being outcomes, and mortality.

Physical health and functioning. The following measures were used to assess respondents’ physical health and functioning: a) number of health conditions, b) disability, c) subjectively rated health, and d) hospitalizations.

Health conditions—The chronic conditions subscale of the Older Americans Resources Study (OARS) was used as an aggregate index of pathology (48). Items in this scale include arthritis; osteoporosis; orthopedic problems; heart problems; high blood pressure; circulation disorders; asthma; emphysema or chronic bronchitis; cancer or leukemia; stroke; diabetes; ulcers; stomach, liver, or kidney disorders; and urinary tract problems (including prostate problems).

Disability—Both basic ADL and IADL were assessed at each of the relevant waves using the OARS functional limitations subscale (48).

The individual items assessing difficulty performing basic and instrumental ADLs were assigned a value of zero for no difficulty and one for difficulty. Instrumental activities of daily living disability was measured by the total number of activities done with difficulty (0–6) reported for the following: getting from room to room, going out of doors, walking up and down stairs, doing own housework, preparing meals, and shopping for groceries. Basic activities of daily living disability was measured based on reported difficulty in performing the following set of items: washing and bathing, dressing and putting on shoes, toileting, getting in/out of bed, and eating.

Various options for scoring the disability items were evaluated because they exhibited problematic skewness and kurtosis. Recoding the scale for the instrumental activities disability to four levels (ie, zero, one or two areas of difficulty; three or four areas of difficulty; and five or more areas of difficulty) eliminated the kurtosis and skewness problems while retaining the greatest degree of information at wave 9. In addition, at baseline, a logarithmic transformation was required to make the distribution more symmetric. Because of the rather low frequency of problems with basic activities at baseline, the best option for basic activities was determined to be a dichotomous variable indicating the presence or absence of any difficulty (ie, zero indicates the person never had difficulty with any of the five items; one indicates that the person had some degree of difficulty with at least one of the items).

Subjectively rated health. This was assessed based on self-report of health in response to the question “In general, considering your health over the past year, would you say your health is very poor (1), poor (2), fair (3), good (4), or excellent (5)?”

Hospitalizations. Respondents were asked to recall the number of times they were hospitalized during the previous year. Dichotomous versions of this variable were used because of the extreme degree of skewness and kurtosis associated with this variable (zero represents no hospitalizations and one represents one or more times hospitalized).

Psychological well-being. Indicators of psychological well-being included positive and negative affect, having goals in life, and having meaning in life.

Positive and negative affect subscales. The positive and negative affect subscales (PANAS) were determined as follows: Respondents were asked to indicate, during the past year, to what extent they felt each of 10 emotions (49). Each item was rated on a five-point Likert scale (ranging from one, not at all, to five, very much). Positive affect was measured by five items (excited, enthusiastic, alert, inspired, and determined) (alpha = 0.816 at the 8-year follow-up). Negative
OLD-OLD ADULTS AND PREVENTIVE PROACTIVITY

affect was also measured by five items (distressed, upset, scared, nervous, and afraid) (alpha = 0.839 at the 8-year follow-up).

Goals and meaning in life. Goals in life was assessed by asking a respondent the extent to which she/he had goals or aims in her/his life. The response options ranged from no goals or aims to very clear goals or aims on a one to five point scale (only the endpoints were defined). Meaning in life was measured by the extent to which a respondent felt that her/his personal existence was meaningful (very meaningful to utterly meaningless). The response options were on a five-point scale, and only the endpoints were defined. These two variables were not assessed until wave 5, so this was considered baseline for this follow-up study.

Mortality. Mortality was evaluated by coding zero to indicate the respondent was still alive at the time of the interview and one to indicate the respondent was deceased.

Data Analytic Strategy

The analytic samples include all respondents with complete data or limited missing data (defined as missing information on less than two items) on the relevant variables at baseline and at the 8-year follow-up (N = 357) (referred to as the follow-up sample). Those individuals who were determined to have died (N = 374) were included in the mortality analysis.

Descriptive differences between the 8-year follow-up sample and the other respondents at baseline were evaluated by chi-square or t test as appropriate for evaluating differences in proportions or mean levels. Repeated measures procedures were used to evaluate descriptive change longitudinally in the outcome variables for the 8-year follow-up sample. Specifically, repeated-measures generalized linear models were used for continuous variables and McNe- mar’s test was used for dichotomous variables to evaluate whether there were significant changes across time in the mean levels (eg, higher mean level of number of health conditions from baseline to the 8-year follow-up) or in proportional distributions (eg, higher proportion of respondents with basic activities of daily living limitations) of the variables for those present at both baseline and 8 years later.

Multiple regression or multiple logistic regression were used to evaluate each of the health-promoting behavior’s longitudinal relationship to change in the continuous and dichotomous outcome variables, respectively. Individual models were tested for each of the outcome variables at the 8-year follow-up because the present focus is on understanding the contributions made by health-promoting behaviors rather than in modeling the interrelationships among the health-promoting behaviors and/or among the outcome variables. Specifically, the individual models were evaluated by adjusting for the demographic measures (age, gender, living arrangement, and education) and the baseline measure of the outcome variable of interest (all entered simultaneously in the equation predicting an outcome).

To evaluate the impact of health-promoting behaviors, additional models were evaluated only for significant findings associated with the health-promoting behaviors. In particular, significant findings related to predicting mortality, physical health (other than for chronic conditions), and psychological well-being were followed up by evaluating an additional model in which the baseline measure of chronic illness was included, along with the demographic measures and the baseline measure of the outcome variable. This was done to address the issue that physical well-being at baseline is an important factor that needs to be adjusted for and may help explain the observed relationship.

To clarify the model testing approach, we provide the example of the model evaluating whether exercise significantly predicts IADL at the 8-year follow-up. We included exercise level at baseline, age, gender, living arrangement, education, and the measure of IADL at baseline. If exercise was significant in this model, then an additional model was run with the aforementioned predictors and the baseline measure of number of health conditions. Accordingly, 10 models (ie, the number of outcome variables) were needed for each of the four health-promoting behaviors evaluated. Additional models were then run to further evaluate significant relationships associated with the health-promoting behavior (this turned out to be nine additional models). The longitudinal sample size for the 8-year follow-up period is ample (N = 357) for these models, which include at most seven or eight variables (the model for tobacco use behavior would include eight variables because of the two dummy coded variables).

As mentioned, goals in life and meaning in life were not assessed at baseline. Accordingly, the longitudinal model included the wave 5 measure (first wave when these variables were included) as a means of evaluating change in status when evaluating the contribution of the baseline measures of health-promoting behaviors. This approach overcontrols for the initial value of meaning in life and goals in life by using measures closer in time to the 8-year outcome than would be the case if parallel measures were available at baseline, ie, usually measures taken closer together are more strongly correlated. As such, the measures from the 4-year interval are likely to be more strongly correlated with the 8-year follow-up (only 4 years later) than those from the baseline (representing an 8-year interval). This would mean that there would potentially be more variation accounted for by the 4-year follow-up measures and therefore less unexplained variance for other factors to significantly predict in the 8-year measure. It is important to keep this in mind when interpreting the findings.

For the continuous outcome variables, the tables include the standardized regression coefficient associated with each of the health-promoting behaviors for the outcomes and the R² for the model (including the demographic characteristics and the baseline measure of the outcome). For the dichotomous outcome variables, the tables include the odds ratio (and the 95% confidence interval, ie, the range of values that has a 95% chance of including the population odds ratio) associated with each of the health-promoting behaviors (adjusted for sociodemographic characteristics and the baseline measure of the outcome) and the Nagelkerke R² for the model. The Nagelkerke R², like the R² in general, is a measure that attempts to provide a sense of the amount of variance explained by the set of variables. The level of significance was .05 for determining whether the health-promoting behavior made a significant contribution in the multivariate models.

RESULTS

The results are organized around three major sections. The first section is a descriptive overview of the total sample and the follow-up sample at baseline (Tables 1 and 2). The second section is a descriptive overview of change regarding the outcome variables for the 8-year follow-up sample (Table 3). The third section provides a summary of the individual models describing the effects of health-promoting behaviors on psychological well-being, physical health, and mortality at follow-up. This latter section is organized by each of the health-promoting behaviors (Tables 4 to 7).
Descriptive Overview: Baseline

The univariate statistics reported below are for respondents at baseline who were also present at the follow-up (8 years later) and are summarized in Tables 1 and 2. Baseline information relevant to the total sample (all 1000 original participants) is also included in these tables. Significant differences between the 8-year follow-up sample (N = 357) and those who were not in the follow-up sample (N = 643) are indicated in the tables. Note that the tables do not provide the data separately for those who were not in the follow-up sample but are presented below.

Predictors. Sociodemographic characteristics. Table 1 (part II) summarizes the information for the entire sample at baseline (N = 1000) and the 8-year follow-up (longitudinal) sample (N = 357) at baseline. At baseline, the mean age for the follow-up sample was about 78 years, and about two thirds of the total sample was female. At baseline, the mean years of education was about 14 years and about 50% lived alone.

The 8-year follow-up sample is similar to the total sample. The 8-year follow-up sample and the nonlongitudinal sample have similar percentages of females and those living alone (no statistically significant differences) and similar levels of education. The only significant difference is with regard to age: as expected, the mean age is less (about 2 years younger) among the respondents of the 8-year follow-up sample compared with the nonlongitudinal sample.

Health-promoting behaviors. The top half of Table 1 summarizes information. For the most part, the sample is rather active, with only about 16% of the follow-up sample at baseline indicating that they rarely or never participated in sports or exercise. Only 19% of the follow-up sample at baseline indicated they did not get an annual checkup; about 7% were current smokers and about half had never smoked. About 30% of the sample did not drink at all at baseline, and respondents who drank were predominantly moderate drinkers (less than 5% drank three or more drinks per day at baseline).

The follow-up sample differed significantly from the other respondents at baseline only with regard to level of exercise: on average, respondents in the follow-up sample exercised more at baseline than those who were not in the longitudinal (8-year follow-up) sample. The follow-up sample was not significantly different from respondents who are not in the longitudinal sample.

### TABLE 1. Health-Promoting Behaviors and Sociodemographic Characteristics: Descriptive Information for the Total and Longitudinal Sample at Baseline

<table>
<thead>
<tr>
<th>Baseline Measure</th>
<th>Total Sample at Baseline (N = 1000)</th>
<th>8-Year Follow-Up Sample at Baseline (N = 357)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
</tr>
<tr>
<td>I. Health-promoting behaviors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exercise</td>
<td>2.88 (1.31)***</td>
<td>3.10 (1.20)</td>
</tr>
<tr>
<td>Rarely or never</td>
<td>251 (25.1)</td>
<td>58 (16.2)</td>
</tr>
<tr>
<td>Several times/month</td>
<td>60 (6.0)</td>
<td>22 (6.2)</td>
</tr>
<tr>
<td>Several times/week</td>
<td>356 (35.6)</td>
<td>151 (42.3)</td>
</tr>
<tr>
<td>One hour or less/day</td>
<td>224 (22.4)</td>
<td>80 (22.4)</td>
</tr>
<tr>
<td>Several hours/day</td>
<td>109 (10.9)</td>
<td>46 (12.9)</td>
</tr>
<tr>
<td>Had annual checkup</td>
<td>823 (82.3)b</td>
<td>289 (81.3)</td>
</tr>
<tr>
<td>Tobacco use</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never smoked</td>
<td>473 (47.3)b</td>
<td>175 (49.0)</td>
</tr>
<tr>
<td>Once smoked</td>
<td>458 (45.8)</td>
<td>158 (44.3)</td>
</tr>
<tr>
<td>Smokes</td>
<td>69 (6.9)</td>
<td>24 (6.7)</td>
</tr>
<tr>
<td>Alcohol use</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never drinks</td>
<td>336 (33.6)b</td>
<td>104 (29.1)</td>
</tr>
<tr>
<td>Drinks</td>
<td>664 (66.4)</td>
<td>253 (70.9)</td>
</tr>
<tr>
<td>II. Sociodemographics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>79.35 (4.81)***</td>
<td>77.64 (3.89)</td>
</tr>
<tr>
<td>Range</td>
<td>72–98</td>
<td>72–98</td>
</tr>
<tr>
<td>Gender (female)</td>
<td>658 (65.8)b</td>
<td>241 (67.5)</td>
</tr>
<tr>
<td>Education (years)</td>
<td>13.58 (2.57)a</td>
<td>13.79 (2.50)</td>
</tr>
<tr>
<td>Range</td>
<td>5–23</td>
<td>6–23</td>
</tr>
<tr>
<td>Living arrangements (alone)</td>
<td>514 (51.4)b</td>
<td>177 (49.6)</td>
</tr>
</tbody>
</table>

* Difference evaluated by t test.

** Difference evaluated by chi-square.

*** p < .001.
dinal sample with regard to having an annual checkup, tobacco use, and alcohol use.

Outcomes. Physical health and functioning. The follow-up sample at baseline had an average of almost two health conditions (Table 2). About 16% of respondents at baseline reported having had difficulty with at least one IADL activity, and only about 3% had any difficulty with one or more of the ADL items. Most respondents who were part of the follow-up sample considered themselves to be in good health, and few reported being hospitalized (16% at baseline). In general, at baseline, the follow-up sample was healthier than the respondents who were not in the 8-year follow-up: on average, the 8-year follow-up sample had fewer health problems, higher (better) subjective health ratings, and lower levels of disability. The samples did not differ with regard to percentage of respondents hospitalized during the previous year.

Psychological well-being. At baseline, the average for the follow-up sample was 16.50 for positive affect and 8.30 for negative affect (possible range for the subscales is 5–25) (Table 2). Respondents in the follow-up sample generally reported having clear goals and aims in life (mean of 3.79) and reported their lives to be meaningful (mean of 4.32) at baseline. The 8-year follow-up sample had a significantly higher mean level of positive affect at baseline than the sample of respondents who were not in the 8-year follow-up. Negative affect did not differ across the two samples. Recall that, because measures of goals and meaning in life were first included in wave 5, we could not relate the 8-year follow-up sample to the nonlongitudinal sample at baseline.

Descriptive Overview of Outcomes for Longitudinal (8-Year Follow-Up) Sample

Physical health and functioning. At the 8-year follow-up, a statistically significant decline in various measures of physical health was observed, including an increase in the mean number of health conditions and in the number of limitations in ADL and IADL and a lower mean level for the subjective health rating. The findings for more respondents being hospitalized during the previous year at the 8-year follow-up compared with baseline approached statistical significance ($p = .06$). Table 3 summarizes the longitudinal information.

Psychological well-being. For the 8-year follow-up sample, the mean level of negative affect increased significantly, and positive affect decreased signifi-
For those who participated in the 8-year follow-up, the mean values for meaning in life and goals in life were significantly lower at the follow-up compared with wave 5 (when the measures were first used in the study).

Table 4 summarizes the findings for exercise. Exercising more often at baseline was associated with fewer instrumental ADL limitations, a decreased likelihood of having basic ADL limitations, and decreased risk of mortality. In addition, exercising was associated with higher levels of positive affect and with having more of a sense of goals and a sense of meaning in life. Except for basic ADL limitations and goals in life, these relationships remained significant after adjusting for health conditions at baseline. Specifically, the relationship between exercise and IADL was still significant (standardized coefficient = -0.134, \( p = .005 \)), as was the relationship between exercise and mortality (odds ratio = 0.856, confidence interval = 0.767–0.954, \( p = .005 \)), positive affect (standardized coefficient = 0.107, \( p = .025 \)), and meaning in life (standardized coefficient = 0.105, \( p = .034 \)). The relationships between exercise and basic ADL (odds ratio = 0.813, confidence intervals = 0.653–1.01, \( p = .063 \)) and between exercise and goals in life (standardized coefficient = 0.083, \( p = .100 \)) were no longer significant when including the measure of baseline health conditions.

Health-Promoting Behaviors and Prediction of Physical Health, Psychological Well-being, and Mortality 8 Years Later (Multivariate Models)

Table 5 summarizes the findings for tobacco use. Those who smoked at baseline were at increased risk for mortality compared with those who never smoked, ie, about 2 1/3 times more likely to be deceased than those who never smoked. Former smokers were also at increased risk for mortality compared with those who never smoked, though at an increased risk level that was less than for those who were smoking at baseline. Also, having once smoked was significantly related to having higher levels of negative affect and greater number of IADL limitations. However, adjusting for health conditions at baseline eliminated the latter two
findings. Specifically, the relationship between former smoking and negative affect was no longer significant (standardized coefficient = 0.092, \( p = .076 \)). Similarly, the relationship between former smoking and IADL limitations was no longer significant (standardized coefficient = 0.082, \( p = .093 \)). When controlling for baseline health conditions, the relationship between having once smoked and mortality remained significant (odds ratio = 1.397, confidence interval = 1.028–1.897, \( p = .033 \)), as did the relationship between smoking and mortality (odds ratio = 2.616, confidence interval = 1.514–4.521, \( p < .001 \)).

Table 6 summarizes the findings for alcohol use. Reported practices at baseline only significantly related to predicting mortality 8 years later: those who reported using alcohol were at a decreased risk of death than those who reported that they never drink. This relationship ceased to be significant when including the variable measuring the number of health conditions at baseline (odds ratio = 0.771, confidence interval = 0.577–1.032, \( p = .081 \)).

Table 7 summarizes the findings for annual checkup. Having an annual checkup was only significantly related to having more IADL limitations. However, once baseline health conditions were controlled for, this relationship ceased to be significant (standardized coefficient = 0.058, \( p = .212 \)).

**DISCUSSION**

Looking at the long-term benefits associated with health-promoting behaviors among old-old adults provided the opportunity to assess important linkages and fill the gaps in our current understandings of the value of spontaneously occurring health-promoting behaviors in late life. While three or four wave annual follow-ups are not uncommon in longitudinal studies of older adults, our study is one of the first empirical studies to provide documentation of long-term (8-year) and multidimensional benefits of exercise among the community-living old-old. Our study aimed to evaluate the benefits of health-promoting behaviors after adjusting for sociodemographic variables and baseline measure of the relevant outcome variables. In essence, a stringent test of the contributions of each health promotion variable was undertaken in order to evaluate the benefits over time.

Overall decreases in physical health and psychological well-being indicators in our sample confirm the notion that both physical and mental health problems among the aged increase over time (50). In the area of psychological well-being indicators, our study also adds important longitudinal data to the understanding of age changes, which have largely been based on cross-sectional comparisons in most epidemiological
studies (51). Health promotion activities at baseline thus primarily serve to slow the pace of decline. Our data thus suggest that notions of prevention in late life should be expanded to encompass adaptations that diminish rather than completely forestall adverse outcomes.

### TABLE 5. Tobacco use: The Relationship to Physical and Mental Health Outcome Measures (8-Years) After Adjusting for Sociodemographic Characteristics and the Baseline Measure of the Outcome (N = 357)

<table>
<thead>
<tr>
<th>Physical Health Outcome Measures</th>
<th>Health Conditions*</th>
<th>Subjectively Rated Health*</th>
<th>IADL Limitations*</th>
<th>Basic ADL Limitationsb</th>
<th>Hospitalized During Last Yearb</th>
<th>Mortalityb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standardized coefficientc</td>
<td>−0.042</td>
<td>0.035</td>
<td>0.019</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smoked at baseline</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Odds ratio (95% confidence interval)</td>
<td>0.041</td>
<td>−0.024</td>
<td>0.119**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smoked at baseline</td>
<td>0.333</td>
<td>(0.089–1.24)</td>
<td>0.560</td>
<td>2.349**</td>
<td>0.2616***</td>
<td></td>
</tr>
<tr>
<td>Once smoked</td>
<td>1.404</td>
<td>(0.816–2.42)</td>
<td>0.898</td>
<td>1.581*</td>
<td>1.404*</td>
<td></td>
</tr>
<tr>
<td>R² for full model (Nagelkerke for logistic regression)</td>
<td>0.297</td>
<td>0.123</td>
<td>0.229</td>
<td>0.183</td>
<td>0.053</td>
<td>0.136</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mental Health Outcome Measures</th>
<th>Positive Affect*</th>
<th>Negative Affect*</th>
<th>Goals in Life*</th>
<th>Meaning in Life*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standardized coefficientc</td>
<td>−0.035</td>
<td>0.028</td>
<td>−0.013</td>
<td>−0.065</td>
</tr>
<tr>
<td>Smoked at baseline</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Once smoked</td>
<td>−0.037</td>
<td>0.109**</td>
<td>−0.011</td>
<td>0.051</td>
</tr>
<tr>
<td>R² for full model</td>
<td>0.285</td>
<td>0.183</td>
<td>0.189</td>
<td>0.221</td>
</tr>
</tbody>
</table>

* Effects evaluated using multiple regression.

b Effects evaluated using multiple logistic regression.

c Adjusted for sociodemographic characteristics (age, gender, education, and living arrangements) and baseline measure of outcome.

d Adjusted for sociodemographic characteristics, baseline measure of outcome, and baseline measure of health conditions. Pattern remained significant after also adjusting for baseline measure of health conditions.

e Pattern was no longer significant after also adjusting for baseline measure of health conditions (see text for details).

* p < .05; ** p < .01; *** p < .001.

### TABLE 6. Alcohol Use: The Relationship to Physical and Mental Health Outcome Measures (8-Years) After Adjusting for Sociodemographic Characteristics and the Baseline Measure of the Outcome (N = 357)

<table>
<thead>
<tr>
<th>Physical Health Outcome Measures</th>
<th>Health Conditions*</th>
<th>Subjectively Rated Health*</th>
<th>IADL Limitations*</th>
<th>Basic ADL Limitationsb</th>
<th>Hospitalized During Last Yearb</th>
<th>Mortalityb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standardized coefficientc</td>
<td>−0.007</td>
<td>−0.029</td>
<td>0.042</td>
<td>0.643</td>
<td>1.168</td>
<td></td>
</tr>
<tr>
<td>Odds ratio (95% confidence interval)</td>
<td></td>
<td></td>
<td></td>
<td>(0.375–1.101)</td>
<td>(0.652–2.093)</td>
<td>0.752***d</td>
</tr>
<tr>
<td>R² for full model (Nagelkerke for logistic regression)</td>
<td>0.294</td>
<td>0.123</td>
<td>0.218</td>
<td>0.181</td>
<td>0.062</td>
<td>0.123</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mental Health Outcome Measures</th>
<th>Positive Affect*</th>
<th>Negative Affect*</th>
<th>Goals in Life*</th>
<th>Meaning in Life*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standardized coefficientc</td>
<td>−0.037</td>
<td>0.014</td>
<td>0.042</td>
<td>−0.014</td>
</tr>
<tr>
<td>R² for full model</td>
<td>0.284</td>
<td>0.175</td>
<td>0.191</td>
<td>0.216</td>
</tr>
</tbody>
</table>

* Effects evaluated using multiple regression.

b Effects evaluated using multiple logistic regression.

c Adjusted for sociodemographic characteristics (age, gender, education, and living arrangements) and baseline measure of outcome.

d This pattern was no longer significant after adjusting for baseline measure of health conditions (see text for details).

* p < .05.
Findings of this study provide consistent and compelling support for expectations about the long-term benefits of exercise for multiple domains of quality of life outcomes, including reducing risk of mortality and functional decline. Reduced risk of functional decline may occur because regular exercise helps improve older adults’ flexibility, balance, endurance, and muscle strength (27, 52). The present findings related to positive affect are also consistent with prior research suggesting that exercise is associated with improvements in mood ratings (53, 54). Our findings thus expand insights gained in short-term intervention studies to a longer time frame and to physical exercise spontaneously engaged in by older adults.

One gap in the literature on quality of life has been the relative absence of research considering quality of life outcomes of goals and meaning in later life. While exercise predicted having goals and meaning in life, these long-term benefits remained only for meaning in life after adjusting for health conditions. Our findings are consistent with observations documented in one study that intensity of physical exercise was associated with greater self-reported meaning in life (55). In distinguishing results relevant to meaning in life and goals in life, it may be useful to note that the former construct relates to the present while the latter one has a more future-oriented or teleological orientation. Thus, it is possible that health-promoting behaviors would predict long-term maintenance of current meaning in life, while setting goals for the future among the old-old may be more independent of prior health-promoting efforts.

Findings regarding long-term benefits of other health-promoting behaviors were less consistent. Increased risks of long-term mortality were associated with prior smoking even when chronic conditions were controlled for. This finding is consistent with observations of prior research about negative health consequences of smoking (32). Having once smoked was associated with increased long-term negative affect and increased IADL limitations over the 8-year period in this study. However, these associations only held before controlling for chronic health conditions. A possible explanation for this set of observations may relate to selective cessation of smoking by persons who experienced certain health conditions at baseline.

The lack of association between having annual preventive health checkups and favorable long-term outcomes must be interpreted with caution. The findings regarding annual health checkups underscore potential overlaps between preventive and corrective use of health care among the old-old. Older adults typically visit physicians for multiple reasons (56, 57). It may be difficult for older adults suffering from multiple chronic conditions to distinguish between medical checkups undertaken for prevention from those ad-

### TABLE 7. Annual Checkup: The Relationship to Physical and Mental Health Outcome Measures (8-Years) After Adjusting for Sociodemographic Characteristics and the Baseline Measure of the Outcome (N = 357)

<table>
<thead>
<tr>
<th>Physical Health Outcome Measures</th>
<th>Health Conditions</th>
<th>Subjective Rated Health</th>
<th>IADL Limitations</th>
<th>Basic ADL Limitations</th>
<th>Hospitalized During Last Year</th>
<th>Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standardized coefficient&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.037</td>
<td>−0.005</td>
<td>0.096&lt;sup&gt;de&lt;/sup&gt;</td>
<td>1.288</td>
<td>(0.656–2.527)</td>
<td>1.229</td>
</tr>
<tr>
<td>Odds ratio&lt;sup&gt;e&lt;/sup&gt; (95% confidence interval)</td>
<td></td>
<td></td>
<td></td>
<td>(0.832)</td>
<td>(0.430–1.611)</td>
<td>(0.859–1.757)</td>
</tr>
<tr>
<td>R² for model (Nagelkerke for logistic regression)</td>
<td>0.294</td>
<td>0.121</td>
<td>0.220</td>
<td>0.163</td>
<td>0.050</td>
<td>0.120</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mental Health Outcome Measures</th>
<th>Positive Affect&lt;sup&gt;e&lt;/sup&gt;</th>
<th>Negative Affect&lt;sup&gt;e&lt;/sup&gt;</th>
<th>Goals in Life&lt;sup&gt;e&lt;/sup&gt;</th>
<th>Meaning in Life&lt;sup&gt;e&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standardized coefficient&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.022</td>
<td>0.020</td>
<td>0.034</td>
<td>0.049</td>
</tr>
<tr>
<td>R² for full model</td>
<td>0.283</td>
<td>0.173</td>
<td>0.190</td>
<td>0.216</td>
</tr>
</tbody>
</table>

<sup>a</sup> Effects evaluated using multiple regression.
<sup>b</sup> Effects evaluated using multiple logistic regression (LR).
<sup>c</sup> Adjusted for sociodemographic characteristics (age, gender, education, and living arrangements) and baseline measure of outcome.
<sup>d</sup> This pattern was no longer significant after adjusting for baseline measure of health conditions (see text for details).
<sup>e</sup> <i>p</i> < .05.
dressing symptoms of chronic disease management (58). We do not believe the finding indicates ineffectiveness of preventive health care among the elderly.

Overall, our findings lend support to our broader PCP model of successful aging by documenting the preventive functions of proactive health promotion efforts, particularly exercise, toward slowing down the cascade of chronic illness, impairment, loss of function, and diminished quality of life. Our findings support the expectations that individuals continue to have the potential for different developmental trajectories and can improve and modify their chances for positive outcomes through adaptations (ie, proactive health promotion) they undertake (59). Accordingly, our study adds to the growing body of literature underscoring resilience of older adults in late life (60).

The model of successful aging we have proposed (12, 13) adds a preventive component to traditional conceptualizations of stress-buffering corrective behaviors. Our conceptualization suggests that older adults can engage in proactive behaviors that can forestall or delay the emergence of late-life stressors, such as chronic illness, and their attendant adverse outcomes. Our consideration of prevention is related to reduction of future adverse outcomes and is independent of the intentions of older adults to engage in a given behavior for purposes of prevention vs. correction. This article has served as an empirical test of this preventive component of our successful aging model. Future analyses will permit consideration of the role of stress buffering as well as the preventive impact of proactive behaviors. Furthermore, future research can provide comparisons of preventive vs. corrective functions served by diverse proactive strategies.

Although the focus of this empirical article has been on the preventive influences of health-promoting behaviors on quality of life outcomes, it is useful to consider these influences as representing only one component of the more complex reality wherein quality of life among old-old persons unfolds. Recognition of proactive adaptations (12), which come into play and serve useful functions as older adults confront normative stresses of aging, helps contextualize the empirical findings we present here and points the way to additional areas of inquiry for better understanding of well-being in late life. These empirical building blocks can thus help us weave meaningful theory.

When interpreting and generalizing these findings, it is important to keep in mind that the present study has focused on a unique population of active older adults who self-selected to live among active age peers in age-homogeneous retirement communities. These retirement communities reinforce norms of physical activity. In fact, we have previously noted (12, 61) that respondents in our study engaged in considerably higher levels of health promotion and specifically exercise than that reported for older adults in the United States population at large (62–64). It is important to recognize that high levels of exercise at baseline may in some sense serve as a marker of an active orientation to life, which subsequently results in enhanced health outcomes.

An important limitation of our study is the fact that our original sample, which was selected from Florida retirement communities, did not include ethnic minorities. Inclusion of ethnic minorities is important particularly because some studies have documented that minorities engage in less physical activity (65, 66). In recent study waves, we have added an ethnically heterogeneous sample from a midwestern city. Another limitation of our study, along with other gerontological research focusing on late-life adaptations and their prospective benefits, is our inability to look at life-course influences on proactive adaptations that older adults engage in during later life. Thus, if we had known about initiation and duration of health promotion activities that were engaged in throughout the life course, we could have answered questions about benefits of health promotion activities that are begun earlier in life (67).

In discussing the differential impact of health promotion activities when chronic conditions are adjusted for, it is important to recognize that our measure, based on the number of chronic conditions, provides just one commonly used index of physical illness. In the present sample, none of the health promotion activities engaged in by respondents had a significant impact on the number of health conditions. Yet we know from prior studies that health promotion efforts, such as exercise, generally do impact physical health (25–27). Accordingly, we are cognizant that focus on young-old populations and use of alternative health measures may yield stronger associations between health promotion behaviors and outcome measures.

In conclusion, this study serves as a useful building block toward further specification of models of successful aging by empirically testing elements of the proposed larger PCP model. It provides empirical support for the long-term preventive and corrective benefits of exercise. It also documents the value of abstinence from tobacco use as an important health-promoting effort, which may contribute to greater longevity. Of particular interest is the evidence from this research that proactive health-promoting efforts, even when engaged in late in life, continue to have important long-range benefits, including contributing to high quality of the remainder of one’s life.
OLD-OLD ADULTS AND PREVENTIVE PROACTIVITY

REFERENCES