Are social supports in late midlife a cause or a result of successful physical ageing?

G. E. VAILLANT,[1] S. E. MEYER, K. MUKAMAL AND S. SOLDZ

From the Division of Psychiatry, Department of Medicine, Brigham and Women's Hospital and the Study of Adult Development, Harvard University Health Services, Boston, MA, USA

ABSTRACT

Background. Many studies have noted a strong association between poor social support and premature mortality. A limitation of such studies has been their failure to control adequately for confounders that damage both social supports and physical health.

Methods. A 50-year prospective multivariate study of 223 men was used to examine the possible causal relationships between social supports and health. Alcohol abuse, prior physical health and mental illness prior to age 50 were controlled. Relative social supports were quantified over the period from age 50 to 70.

Results. Adequacy of social supports from age 50 to 70 was powerfully correlated with physical health at age 70 ($P < 0.001$). However, such social supports were also powerfully predicted by alcohol abuse ($P < 0.001$), smoking ($P < 0.001$) and indicators of major depressive disorder ($P < 0.01$) assessed at age 50. When prior smoking, depression and alcohol abuse were controlled, then the association of physical health with social supports was very much attenuated. Some facets of social support like religion and confidantes were unassociated with health even at a univariate level. Surprisingly, in this sample friends seemed more important for sustained physical health than closeness to spouse and to children.

Conclusions. While social supports undoubtedly play a significant role in maintaining physical well-being in late life, much of the association between poor social supports and mortality may be mediated by alcoholism, smoking and pre-morbid psychopathology.

INTRODUCTION

Prospective studies have noted that poor social supports (e.g. Berkman & Syme, 1979; House *et al.* 1982) accelerate the onset of premature or 'secondary' (Busse, 1969) ageing. Other more narrowly focused studies have noted the profound association of social supports on specific facets of health – for example, duration of sick leave (Stansfeld *et al.* 1997) and time of recovery from the common cold (Cohen *et al.* 1997). Nevertheless, investigators remain uncertain as to what specific factors account for the relationship between social support and physical health. One possible explanation could be that

prior studies have inadequately controlled confounders – confounders that undermine both physical health and social supports. Three such confounding variables, inadequately controlled in prior studies, are pre-morbid mental illness, poor pre-morbid physical health and alcohol dependence. Each of these three variables can exert deleterious effects on both social relationships and subsequent physical health.

In their influential review House *et al.* (1988) noted that a two-fold difference in mortality over time existed between individuals who were the least and the most socially integrated. Their review focused on the prospectively designed Alameda study of 4725 adults followed for 9 years (Berkman & Syme, 1978) and the Tecumseh study of 2754 adults followed for 10

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[1] Address for correspondence: Dr George E. Vaillant, Brigham and Women's Hospital, 75 Francis Street, Boston, MA 02115, USA.

to 12 years (House *et al.* 1982). These studies controlled for blood pressure, smoking, cholesterol, exercise and obesity. However, the Alameda study did not control for objectively determined pre-morbid physical health and neither study controlled for mental illness and alcohol abuse. For example, the Alameda study grouped alcohol consumption into three categories: $\geqslant 46$ drinks a month, 17–45 drinks a month and 0–16 drinks a month – a categorization that correlated neither with mortality nor with social relationships. If adequately measured (Ewing, 1984; Poikolainen, 1985; Moore *et al.* 1989; Searles *et al.* 1995), however, alcohol abuse, unlike reported alcohol consumption, profoundly affects both mortality (Peterson *et al.* 1984) and social relationships (Vaillant, 1995). House *et al.* (1988) acknowledged that almost no attention was paid to social relationships as dependent variables, and that a relationship might exist between prior physical health, depression, unhealthy habits and subsequent social supports.

The purpose of this report is to take advantage of a 50-year prospective study that has focused on physical health (Vaillant, 1979), social supports (Vaillant, 1978) and alcohol abuse (Vaillant, 1995). Our study will examine, when alcohol abuse, major depressive disorder and their correlate heavy smoking (Glassman, 1993) are controlled, whether social supports continue to be positively associated with physical health. We will also examine whether subsequent social supports are a consequence of prior health risk factors.

METHOD

Subjects

Our study sample consisted of 268 Harvard College sophomores (born between 1915 and 1924) drawn from the classes of 1939–1944. Fifty per cent were on scholarship and/or had to work during college. Selection criteria included the absence of known physical and mental illness and a satisfactory freshman academic record (Heath, 1945; Vaillant, 1977).

At intake, the men were studied by internists, psychiatrists, psychologists and anthropologists. The students' parents were interviewed, and extensive family, social and medical histories were obtained. The men have been reinterviewed

at approximately ages 25, 30 and 50. Two-thirds of the men obtained graduate degrees and most have worked as physicians, lawyers, university professors or business executives. Since the age of 45 they have been followed by questionnaires every 2 years and by physical examinations every 5 years until their 70th year. At age 70, 223 men had complete data sets. The original cohort of 268 was reduced to 237 due to voluntary withdrawal from the study ($N = 19$) or death before age 45 ($N = 12$). The sample was further reduced to 223 due to the fact that an additional 14 men died between ages 46 and 64 (mean age 54) before social supports after age 50 could be adequately estimated. In June 1996 the mean age of the 183 survivors was $76 \cdot 0 \pm 1 \cdot 6$ years.

To reduce halo effects eight different blinded independent raters and/or the men themselves were responsible over the years for the different ratings below.

Risk factors (measures age 50)

Objective physical health at age 50

Every 5 years since the age of 45 each man's health status (using data from physical examination, blood chemistries, electrocardiogram and chest X-ray) has been rated by an internist blinded to other data: 1 = physical health excellent; 2 = minor irreversible problems (e.g. glaucoma, gout, well-controlled hypertension); 3 = life shortening irreversible illness (e.g. diabetes, myocardial infarction); 4 = chronic illness with significant disability (e.g. multiple sclerosis); 5 = deceased. Since the 223 men in the sample were all still alive at age 50, the scale was only 1 to 4.

Family history of depression and alcoholism

When the subjects were sophomores (1940 to 1942), a social investigator visited the men's homes and took an extensive social history from their parents. This history included age and cause of death of any deceased close relative and whether any close relative suffered from mental illness, alcohol abuse, or had committed suicide. Over the next 50 years alcohol abuse and depression among siblings were recorded. In middle life the men were again specifically questioned about both depressed and alcoholic relatives. Separate raters blind to clinical outcome coded men separately for alcoholic and for depressed relatives: 1 = no afflicted relatives; 2

= 1 afflicted relative; 3 = 2 afflicted or 1 severely afflicted relative; 4 = multiple severely afflicted relatives.

Alcohol abuse (*age 50*)

At age 45–55 the men were interviewed by experienced clinicians regarding problem drinking. Since age 47 each biennial questionnaire has asked whether each man, his friends, his family, or his physician has worried about his drinking. Medical and psychiatric records were reviewed. DSM-III criteria (American Psychiatric Association, 1980) were used: 1 = no abuse or developed alcohol abuse after age 50; 2 = alcohol abuse (social complications of alcohol use and difficulty controlling or pathological pattern of alcohol use); 3 = alcohol dependence prior to age 50 (criteria for abuse plus tolerance or withdrawal symptoms) (Vaillant, 1995).

Indicators of depression scale (*age 20–50*)

This scale was designed to assess evidence of major depressive disorder in a community sample of men studied prior to the development of modern assessment instruments. An independent psychiatrist, who was blind to summary ratings, reviewed the men's complete records (from college until 1970) for nine correlates of depression. The items were: (1) being seriously depressed for 2 weeks or more by self-report; (2) diagnosed clinically depressed by a non-study clinician; (3) receiving antidepressant medication; (4) manic episodes; (5) sustained anergia or decreased concentration; (6) neurovegetative signs of depression; (7) attempted or completed suicide; (8) sustained anhedonia; and (9) psychiatric hospitalization (not for alcohol abuse). For the purpose of this paper all men with three or more indicators of depression (the mean number of indicators was $5 \cdot 4 \pm 1 \cdot 9$) and diagnosis of probable major depressive disorder by the independent clinician were classified as major depressive disorder ($N = 17$). The mean number of indicators of depression for the remaining 206 men was $0 \cdot 10 \pm 0 \cdot 38$.

Other risk factors

Obesity at age 50 was assessed by body-mass index (kg/m^2). In addition, cholesterol was assessed ages 45–55 in mg/dl and cigarette smoking (age 15–50) was measured in pack-years (Vaillant *et al.* 1991).

Exercise (age 20–45) (Schnurr *et al.* 1990) was measured on a 1 to 3 scale defined as: $1 > 2000$ kcal/week; $2 = 500$–2000 kcal/week; $3 \leqslant 500$ kcal/week. Since data were missing for 44 men, in multivariate analyses the men with missing data were scored as 2.

Social supports (age 20–49)

Prior to 1970 social supports had not been an independent variable of interest. Therefore, this variable had to be estimated by retrospectively creating a scale from existing scaled data assessed prior to age 50. The six subscales were as follows.

1 *Marital relations* (*age 20–47*): 2 = good first marriage; 1 = ambiguous data; 0 = divorced, single or clearly poor marriage.

2 *Sibling relations*: 1 = close to one or more siblings; 0 = only child or distant from sibs.

3 *Job satisfaction* (*age 30–47*): 2 = enjoyable job; 1 = ambiguous data; 0 = unhappy with job.

4 *Games with friends* (*age 20–47*): 1 = regular recreation with friends; 0 = absent.

5 *Relations with parents* (*age 10–20*): 1 = home life and relations with parents until 20 adequate; 0 = home life definitely non-supportive.

6 *Makes friends easily* (*age 21*): 1 = yes; 0 = no.

Total social supports (*age 20–49*): a sum of the subscales ranged from 0 to 8. Correlation with total social supports (50–70) rho = 0·55.

Social supports (age 50–70)

An independent rater assessed social supports on a 0–16 scale that reflected the men's lives from age 50 to age 70. (As already noted men who died between 50 and 60 were excluded from the main data set but their social supports prior to death were estimated.) The scale was based on the 11 biennial questionnaires returned by each individual over that period. Most men received at least one 2 h face-to-face interview. The seven subscales were as follows.

1 *Marital relations*, assessed by a methodology described elsewhere that included three wives' questionnaires and five men's questionnaires (Vaillant & Vaillant 1993): 4 = marriage – not necessarily a first marriage – consistently rated as happy by both partners from age 50 to 70; 2 = intact marriage with some strengths and

weaknesses; 0 = unmarried, divorced or divorce repeatedly considered during the period. Marriage was double weighted because we hypothesized greater importance in relation to the other measures.

2 *Sibling relations*: 2 = warm confiding relationship with at least one sibling; 1 = ambiguous relationship; 0 = only child, all siblings deceased or little contact with surviving siblings. (Based on three questionnaires.)

3 *Child relationships*: 2 = highly satisfying, loving and mutual relations with at least one child; 1 = unclear; 0 = unsatisfying or no children. (Based on data from five questionnaires.)

4 *Religious involvement*: 2 = sustained, gratifying relationship to some religious organization and regular religious observance; 1 = occasional or episodic involvement; 0 = little or no involvement. (Based on data from seven questionnaires examining different facets of religious involvement.)

5 *Use of confidantes*, on six questionnaires men were asked with whom they talked over personal problems or to whom they turned at times of crisis for sustenance and comfort: 2 = at least 1 non-family confidante; 1 = limited use or only wife; 0 = no confidantes.

6 *Games with friends*, different raters at the age of 47–50 and at age 62–65 life summaries (Vaillant & Schnurr, 1988) noted whether the subject participated in regular recreation (bridge, tennis, etc.) with non-family members: 2 = present at both times; 1 = noted at one of those times; 0 = absent at both times.

7 *Number of friends*, on six questionnaires men were asked about their social activities or number of friends with whom they were 'intimate' and with whom they 'shared companionship': 2 = part of a rich social network; 1 = unclear; 0 = socially isolated.

Total social supports (*age 50–70*): a sum of the seven subscales; scores ranged from 2·0 to 13·5 out of a possible 16. Reliability for these ratings (assessed by intraclass correlations computed for three raters each rating the same 30 cases) was 0·92.

Outcome measures

Activity at age 70

Every 2 years since age 65 the men have completed a 10 question multiple choice as-

sessment of graded physical limitation very similar to question 3 on the SF-36 (Ware & Sherbourne, 1992). Scores ranged from 10–25.
Definition 1: decline in activities (*a score of* > *11*) This meant men experienced one or more of the following: ceasing to play strenuous sports (e.g. downhill skiing, tennis singles); unable to climb two flights of stairs without resting; unable to move heavy furniture without limitation; or experienced 'significant' cutbacks with age.

Objective physical health at age 70

This was scored as physical health at age 50.
Definition 2: irreversible serious illness, disabled or dead by age 70 This included the 121 men who had a health score > 2 at age 70 (i.e. chronic irreversible illness, disability or death). For details see Vaillant (1979).

Mortality

Except for two men who died overseas, death was established by death certificate.
Definition 3: death by age 73 In order to increase the number of observed deaths from 30 to 38, age 73 was used for death rather than age 70. All but three men in the study have either reached their 74th birthday or died by age 73.

Statistical methods

Because much of our data was not normally distributed Spearman's rho was used as a test of association. Because many of our significant findings supported each other in consistent directions, a full Bonferroni correction for multiple comparisons seemed too conservative. Instead, the paper comments on results significant at a two-sided alpha < 0·01. Predictors of the three definitions of physical health – activity, chronic illness, mortality – were identified by using logistic regression.

RESULTS

Fig. 1 illustrates the clear association between the quality of social support during the two decades from age 50 to age 70 (top quarter, middle half, bottom quarter) and decline in physical health during the same period. Men with good social supports from age 50 to 70 were twice as likely to be without chronic illness

by age 70 as those men with poor social supports (rho = 0·27, $P < 0·001$). When only the 199 men who were without chronic illness at age 50 were studied, the relationship between good social supports and good physical health at 70 remained equally strong (rho = 0·26, $P < 0·001$). In other words, poor pre-morbid physical health did not appear to explain the strong association of social supports with good health at age 70.

By inspection Fig. 1 reveals that the most socially isolated quarter accounted for most of the association of social supports with physical morbidity. In contrast to the remaining 165 men, however, the 59 most isolated men were far more likely to be alcohol dependent (15 % *v.* 2 %, $P = 0·001$), twice as likely to engage in little exercise (49 % *v.* 27 %, $P = 0·001$), twice as likely to be heavy smokers (34 % *v.* 13 %, $P < 0·001$), and twice as likely to have been chronically ill at age 50 (20 % *v.* 10 %, $P = 0·03$) Pearson's χ^2, with 1 df was the statistical test used.

The source of social support between age 50 and age 70 was important in predicting future physical health (Table 1). Two definitions of health outcome were examined: decline in physical activities at age 70 (10–25), and objective physical health at age 70 (1–5). Good relations with siblings, a close non-family confidante, and strong religious affiliation were not

Table 1.   *The univariate association of individual social supports before and after age 50 with two definitions of physical ageing*

	Decline in activities by age 70	Poor physical health age 70
I Social supports (age 50)	(10–25)	(1–5)
	$N = 223$	$N = 223$
Marital relations 0–2	−0·15*	−0·12
Sibling relations 0–1	0·01	0·01
Job satisfaction 0–2	−0·01	0·01
Games with friends 0–1	−0·14*	−0·15*
Relations with parents 0–1	−0·03	−0·05
Makes friends easily 0–1	−0·00	0·04
Total social supports 0–8	−0·11	−0·12
II Social supports (age 50–70)		
Marital relations 0–4	−0·16*	−0·14*
Sibling relations 0–2	−0·03	−0·06
Child relations 0–2	−0·15*	−0·13
Religious involvement 0–2	0·09	0·01
Confidante 0–2	−0·05	−0·03
Games with friends 0–2	−0·31***	−0·29***
Number of friends 0–2	−0·18**	−0·17**
Total social supports 0–16	−0·26***	−0·27***

* $P < 0·05$; ** $P < 0·01$; *** $P < 0·001$ (Spearman correlation).

associated with health outcome. The modest univariate association between health at 70, with number of friends, good marriage, games with friends and good relationships with children was maintained if health at age 50 was controlled.
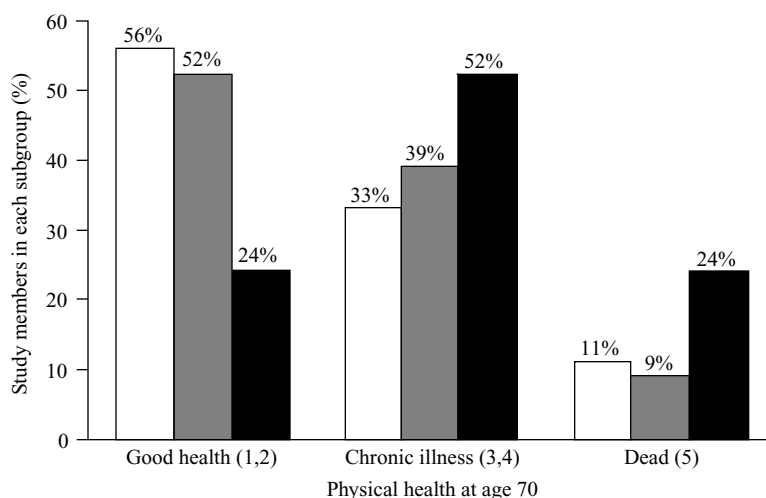

Fig. 1.   Relation between total supports assessed between ages 50–70 and physical health assessed at age 70. Men with excellent 1970 physical health (1) (□ excellent, $N = 55$) and minor illness (2) are grouped together, as are men with chronic illness (3) (▨ intermediate, $N = 109$) and significant irreversible physical disability (4) (■ poor, $N = 59$). For the full association of 1970 health (1–5) and social supports (2–13·5) the Spearman rho was 0·27, $P < 0·001$.

Table 2. *Univariate odds ratios (with 95% confidence limits) for the association of social supports and risk factors upon three definitions of physical ageing*

	Definition 1 Decline in activities by age 70 (Activity score = 12–15)	Definition 2 Irreversible illness, disabled or dead by age 70 (Health status = 3, 4, 5)	Definition 3 Dead by age 73 (Health status = 5)
Number of the 223 men affected	$N = 127$	$N = 121$	$N = 38$
I Social supports in the bottom quarter age < 50	$P = 0.84$	$P = 0.38$	$P = 0.61$
II Social supports in the bottom quarter (age 50–70)	OR = 2·86 (1·48, 5·55) $P = 0.001$	OR = 3·71 (1·90, 7·30) $P < 0.001$	OR = 3·16 (1·53, 6·53) $P < 0.002$
III Risk factors at age 50			
⩾ 30 Pack-years of smoking (no/yes)	OR = 2·89 (1·34, 6·24) $P = 0.007$	OR = 3·3 (1·54, 7·13) $P = 0.002$	OR = 5·18 (2·4, 11·1) $P = 0.001$
Alcohol abuse (1–3)	OR = 6·11 (16·4, 2·27) $P < 0.001$	OR = 4·48 (1·98, 10·1) $P < 0.001$	OR = 3·26 (1·89, 5·60) $P < 0.001$
Body-mass index > 28·0 (no/yes)	OR = 3·8 (1·24, 11·6) $P = 0.02$	OR = 2·43 (0·92, 6·48) $P = 0.07$	$P = 0.18$
Major depressive disorder by age 50 (no/yes)	OR = 2·62 (0·82, 8·31) $P = 0.10$	OR = 4·31 (1·2, 15·4) $P = 0.02$	$P = 0.95$
Little exercise (age 20–45) (1–3)	OR = 2·13 (1·34, 3·35) $P = 0.001$	$P = 0.40$	$P = 0.12$

However, social supports prior to age 50 (albeit crudely estimated) bore only a very weak relationship with health 20 years later.

Table 2 affirms these findings. Social support prior to age 50 did not predict health at age 70, but social support assessed from age 50 to age 70 was powerfully associated with health. Table 2 also illustrates that each of five common risk factors – low exercise, obesity, depression, smoking and alcohol abuse – assessed prior to age 50 predicted at least some facet of health decline at age 70. With the exception of obesity these same pre-morbid risk factors were also predictive of poor subsequent social supports (Table 3). So was poor physical health at age 50. The weak positive association between depression and strength of religious affiliation was a noteworthy exception to the negative association between risk factors and social support. Other potential confounders associated with late life physical health (long-lived relatives, independent negative life events and thoroughness of physical exam) were not associated with social supports between ages 50 and 70. The high correlation in Table 2 of games with friends and exercise suggests that these two variables may be confounded. (Cholesterol levels at age 50 were not predictive of health at age 70.)

The relationship between alcohol abuse, depression and smoking with social supports becomes clearer on close examination. For example, 63% of the 19 alcohol dependent men, but only 18% of the 187 social drinkers were divorced ($\chi^2 = 28.4$, df = 4, $P < 0.001$). Only 18% of the 166 men with no evidence of alcohol abuse and no evidence of major depression had social supports (age 50–70) in the lowest quarter. In contrast, 56% of the 34 men with alcohol dependence and/or major depression fell in the bottom quarter ($\chi^2 = 24.0$, df = 3, $P < 0.0001$). Only five (9%) of the 53 men with the best social supports smoked until age 60. In contrast, 27 (42%) of the 65 men with the worst social supports smoked until age 60.

Fourteen men had been excluded from the study sample of 223 because they had died between 46 and 64 – before their late midlife social supports could be fairly assessed. Of these 14 men, 8 had estimated social supports that would have put them in the lowest tenth of the sample. Six of these 8 men, however, also manifested two or all three of the three risk factors: 30+ pack-years of smoking, alcohol dependence or major depressive disorder by age 50.

Physical health and social supports appeared to have a modest effect on each other. Cross-lag analysis revealed that social supports from 20–50 predicted health at age 70 rho = 0·12, $P = 0.09$ and health at age 50 predicted social supports at age 70 rho = 0·17, $P = 0.01$. Alcohol abuse and social supports also appeared to affect each other (cross-lag analysis revealed that low social supports from 20–50 predicted the development

Table 3. *Association of risk factors assessed at age 50 with social supports and physical health*

	Poor physical health age 50 N = 223	Alcohol abuse N = 223	Pack-yr smoking N = 223	Indicators of depression N = 223	Little exercise age 20–45 N = 223
I Social supports (age 50–70)					
Marital relations 0–4	−0·11	−0·19**	−0·15	−0·22***	−0·07
Sibling relations 0–2	0·00	−0·08	−0·10	−0·14	−0·11
Child relations 0–2	−0·08	−0·18**	−0·14	−0·11	−0·20**
Religious involvement 0–2	0·03	0·00	−0·03	0·11 (sic)†	0·11
Confidante 0–2	−0·07	−0·09	−0·05	0·03	−0·06
Games with friends 0–2	−0·18**	−0·06	−0·08	−0·19**	−0·48***
Number of friends 0–2	−0·12	−0·12	−0·11	−0·10	−0·23***
Total social supports 0–16	−0·17**	−0·22***	−0·20***	−0·21**	−0·32***
II Social supports (< age 50) 0–8	−0·09	−0·25***	−0·23***	−0·30***	−0·24**
III Health (age 70)					
Physical health (1–5)	−0·31***	−0·34***	−0·25***	−0·22***	−0·07‡
Decline in activities (10–25)	−0·34***	−0·35***	−0·27***	−0·19**	−0·25***

** $P < 0.01$; *** $P < 0.001$ (Spearman correlation).
† This surprising positive correlation of depressive symptoms and religious affiliation was significant at $P < 0.05$.
‡ In contrast to exercise, obesity was uncorrelated with any of the seven sources of social supports, but was correlated rho 0·23, $P < 0.001$ with poor physical health.

Table 4. *Odds ratios (and 95% confidence intervals) of the independent contribution of major risk factors to three definitions of physical ageing*

	Definition 1 Decline in activities by age 70 (Activity score = 12–25)	Definition 2 Irreversible illness, disabled or dead by age 70 (Health status = 3, 4, 5)	Definition 3 Dead by age 73 (Health status = 5)
Number of the 223 men affected	127	121	38
Physical health age 50 (1–4)	OR = 2·14 (1·33, 3·27)	OR = 2·03 (1·30, 3·17)	OR = 1·85 (1·12, 3·05)
	$P < 0.001$	$P = 0.001$	$P = 0.015$
Alcohol abuse or dependence by age 50 (1–3)	OR = 6·03 (2·18, 16·6)	OR = 3·71 (1·60, 8·40)	OR = 2·59 (1·43, 4·69)
	$P < 0.001$	$P = 0.003$	$P < 0.002$
Social supports in bottom quarter age 50–70		OR = 2·64 (1·27, 5·47)	
	$P = 0.15$	$P = 0.01$	$P = 0.19$
Body-mass index > 28·0 at age 50 (no/yes)	OR = 3·21 (1·00, 11·4)	OR = 2·46 (0·86, 7·00)	
	$P = 0.05$	$P = 0.09$	$P = 0.12$
≥ 30 pack-years of smoking by age 50 (no/yes)		OR = 2·07 (0·87, 4·90)	OR = 3·38 (1·45, 7·84)
	$P = 0.19$†	$P = 0.10$†	$P = 0.005$
Little exercise age 20–45 (1–3)	OR = 1·87 (1·14, 3·07)		
	$P = 0.013$	$P = 0.32$	$P = 0.28$
Major depressive disorder by age 50 (no/yes)	$P = 0.85$	$P = 0.27$	$P = 0.30$

† Lack of statistical significance due to collinearity of smoking with alcohol abuse.

of alcohol abuse after 50 rho = 0·16, $P = 0.02$, and alcohol abuse before age 50 predicted poor social supports 50–70 rho = 0·17, $P = 0.01$).

Table 4 illustrates that when all major confounders (health age 50, alcohol dependence, pack-years of smoking, exercise and symptoms of depression) were controlled, good social supports continued only to make a significant contribution to objective good health (absence of chronic illness). However, social supports no longer made an independent contribution to preservation of physical activities or to mortality. When the 14 men who had died between 46 to 64 (and their estimated scores for social supports) were added to the sample expanding the number of dead to 52, alcohol abuse, prior health and smoking continued to remain the only variables making a significant contribution

to mortality. If social supports prior to age 50 replaced social supports after age 50 the association of health with social supports became entirely insignificant. If the men with absent exercise data were omitted, or if marriage was not double weighted, the findings were unchanged.

DISCUSSION

With its better control of potential confounders, especially of alcohol abuse, our study suggests that social support makes only a modest contribution to the reduction of 'secondary' ageing. The fact that social supports did not exert an independent effect on mortality in this small, highly selected sample of white men, however, should not be deemed evidence for the unimportance of social supports and health. First, there continues to be clear evidence that social supports not only affect mental well being but also the brain (Post, 1997). Secondly, good social support undoubtedly enhances self-care, smoking cessation, weight control and exercise (Berkman & Breslow, 1983). Thirdly, social support buffers the negative impact of life events on health (Paykel, 1994). However, social supports may be most important to health when the other protective social buffers – readily available to our privileged sample – are absent.

Many studies by others have established that 'secondary' ageing is also significantly affected by education, social class, gender and birth cohort. Since we focus on a homogeneous sample of white, highly educated American men born circa 1920, these variables were essentially controlled. The drawback of such control, of course, means that the findings of our study can be generalized to other populations only with great caution.

Another limitation was that the study used data averaged over time – e.g. 'social supports from age 50 to 70'. Since such averaging can conflate cause and effect, a naturalistic study such as ours can not provide final answers. It can only highlight confounders and suggest cause and effect. For example, the interaction over time between depression and alcohol abuse, on the one hand, and social supports, on the other, needs close scrutiny. Our inference that poor social supports were a consequence rather than a cause of alcohol abuse and depression

was based on the following, albeit indirect, reasoning. First, a variety of recent studies have provided evidence that the aetiology of alcoholism is more closely tied to heredity than to stressful environments (Kendler *et al.* 1977a; Vaillant, 1995). In this study familial history of alcohol abuse and depression respectively not only predicted alcohol abuse (rho $= 0.30$, $P < 0.001$) and indicators of depression (rho $= 0.21$, $P = 0.001$), but such a family history also predicted unstable marital relationships. Thus, 13% of the 127 men with stable marriages but 30% – twice as many – of the 100 men who were divorced or experienced bad marriages had several depressed and/or alcoholic relatives ($\chi^2 = 9.8$, df $= 1$, $P = 0.002$). Depression and/or alcohol abuse in the unhappily married men appeared to be the mediating link. Secondly, in a large community study the increased mortality observed in the divorced appeared mediated through illness exacerbated by alcohol abuse. For example, divorced men and women were only 1·2 times as likely to die from leukaemia but 4 times as likely to die from accident and 6 times as likely to die from cirrhosis of the liver (Erhardt & Berlin, 1974). Thirdly, in our sample, in 28 cases unhappy marriage followed the onset of alcoholism; in only seven cases did alcoholism first become manifest in the wake of a failing marriage. Lastly, in part, the deleterious effects of both depression and alcohol abuse upon health is that both disorders interfere with smoking cessation (DiFranza & Guerrera, 1990; Vaillant *et al.* 1996). Of the 21 heaviest smokers in the study all but five were divorced, unhappily married or life-long bachelors without a close relationship to a male partner. Thus, heavy smoking was associated with, but almost certainly did not cause or was primarily caused by, poor social supports (Table 2). The above evidence by no means excludes good social support as an important source of good self-care; the evidence merely focuses attention on the fact that alcohol abuse and poor self-care secondary to affective disorder must be controlled before poor social supports can be assigned a direct causal role in health decline.

It may be argued that the association between friendship networks and health was an artefact because organized activities with friends often include sports, which require prior good health, and result in healthy exercise as well as com-

panionship (Table 2). However, logistic regression (not shown) revealed that adding the variables of exercise, and games with friends to the logistic model did not significantly reduce the contribution of the variable 'total social supports minus games with friends' to health outcome.

An interesting finding in Table 3 was the positive association of depression with religious affiliation in this highly educated cohort. A history of past depression, whether measured as a yes/no variable, assessed by number of indicators of depression before age 50, number of depressed relatives, or lifetime use of psychotropic drugs was positively associated with strength of religious affiliation (rho 0·11 to 0·14, $P = 0·10$ to 0·04). However, the same four variables reflecting past depression were negatively associated with overall social supports (rho $= -0·15$ to $-0·17$, $P = 0·03$ to 0·009). In addition, all indices of depression and psychological distress correlated positively with psychiatric visits; however, strong religious affiliation – although positively correlated with depression – was uncorrelated with psychiatric visits (rho $= 0·00$) and/or with currently self-reported symptoms of depression (rho $= 0·02$). In other words, in this sample religious affiliation may have been used in lieu of psychiatrists to relieve rather than prevent major depressive disorder. General population studies by Williams (1991) and Kendler *et al.* (1997*b*) have also noted that religious affiliation was correlated with the low self-report of current depressive symptoms.

In conclusion, poor self-care of all kinds (e.g. little exercise, alcohol abuse, poor compliance with medical regimens, failure to stop smoking) may explain most of the association between poor social supports and physical health. In the past, the powerful association of social supports with physical health has often led observers, without direct evidence, to invoke explanations involving psychoimmunology (Ader *et al.* 1991) and the pituitary–hypothalamic axis, especially in the light of the infant-animal experimental literature (Cassel, 1976; Cobb, 1976; Post, 1997). For example, House *et al.* (1988) entertained a theory that 'social relationships and contacts, mediated through the amygdala, activate the anterior hypothalamic zone (stimulating the release of growth hormone), and inhibit the posterior hypothalamic zone (and hence secretion of ACTH, cortisol, [and] catacolamines…)' (p. 542) and that this might explain the observed increased mortality of individuals with poor social supports. Our study suggests that in order to confirm such hypotheses, alcohol abuse, major depressive disorder, and heavy smoking may need to be controlled.

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