Social Factors and Mortality in the Old-Old in Israel: The CALAS Study

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Objectives. Using a theoretical framework that divided social factors measures into structure, function, and social engagement, this study determined those aspects of social networks most significantly associated with 8-year, all-cause mortality among the old-old in Israel.

Methods. Jews (n = 1,340) aged 75–94 living in Israel on January 1, 1989, were randomly selected from the National Population Register; stratified by age, sex, and place of birth; and interviewed in person. Mortality was determined according to the National Death Registry (December 1997).

Results. After controlling for sociodemographics and measures of health, cognitive status, depressive symptoms, and physical function, the measures of social engagement that explicitly involved others were associated with a lower risk of mortality. No measure of the function of the social network was associated with risk of mortality. Living in the community without a spouse and with a child and living in an institution were significantly associated with a higher risk of mortality.

Discussion. The finding that participating in activities with people outside of the immediate family is associated with a lower risk of death has practical implications for helping the aging population and their families in their decision-making process. Lack of support for the hypothesis that those with more social support would show reduced risk of mortality may indicate that the positive effect of perceiving support and the negative effect of needing support may cancel each other out and result in no perceived effect. In this population, the association between socioeconomic status (SES) and the risk of mortality seems to be expressed through the living arrangements, with the sick and frail, both in institutions (higher SES) and in the community with a child or other (lower SES), having a higher risk of mortality. These findings are consistent with the use of children as a substitute for institutionalization, and imply that at least some cohabitation was the caretaking solution for the noninstitutionalized old-old who were of low SES, frail, and close to death.

The full wording of the Fifth Commandment is “Honor thy father and mother so that your days may be long upon the land. . . . ”, an ancient recognition of the association between family ties and life expectancy. More recently, the role of social relationships in health outcomes has been understood since the time of Emile Durkheim (Berkman, Glass, Brissette, & Seeman, 2000; Durkheim, 1951), and social networks and family life have been studied since at least the 1950s (Bane, 1976; Bott, 1971; Granovetter, 1973; Wellman, 1981; Young & Willmott, 1957). Family relationships have been understood to be crucial factors in the lives of elderly persons and have long been a prominent focus in the sociology of aging (Bengtson, Kasschau, & Ragan, 1977; Litwak, 1965; Shanahan, 1968; Sussman, 1965; Wake & Sporakowski, 1972; Walter, 1985).

The specific role of the structure of social networks in health and longevity of elderly persons intensified after two widely cited articles appeared almost simultaneously in the mid-1970s (Cassel, 1976; Cobb, 1976), closely followed by several studies that found social network or social support characteristics to be significantly associated with risk of mortality in aging populations (Berkman & Syme, 1979; Blazer, 1982; House, Robbins, & Metzner, 1982).

However, these early studies tended to confuse the conceptually distinct measures of support with measures of networks (Berkman, 1985). Networks are defined as the web of social relationships surrounding individuals and the characteristics of these ties, whereas social support is defined as the emotional and instrumental help that is transmitted among network members. The degree to which networks may or may not be supportive is an empirical question, because there is not necessarily a direct positive relationship between the structure of social networks and their adequacy (i.e., supportiveness) (Berkman, 1985; Broadhead, Gehlbach, deGruy, & Kaplan, 1989; House & Kahn, 1985; Murrell, Norris, & Chipley, 1992; Norbeck, Lindsey, & Carrieri, 1981; Seeman & Berkman, 1988).

The current study is therefore based on a conceptual framework proposed by Berkman (1986), which separated social networks into two major dimensions consisting of the structure of networks, operationalized as size, durability, and location or geographic dispersion; and the function of networks, operationalized as intimacy, reciprocity, and frequency of contact.

In addition to confusing structure and function of social networks, many previous studies have used both indices composed of several variables (aggregated) and individual variables (disaggregated) to measure social networks and social support (Berkman & Syme, 1979; Fuhrer et al., 1999; Hirdes & Forbes, 1992). It is not, therefore, surprising that previous studies of social networks and mortality in elders have had mixed results, with some (Branch & Jette, 1984; Dalgard & Lund, 1998; Hanson, Isacsson, Janzon, & Lindell, 1989; Jylha & Aro, 1989; Kaplan et al., 1988; Lepore, 1998; Sporakowski, 1972; Walter, 1985).
1998; Orth-Gomer & Johnson, 1987; Penninx et al., 1997; Steinbach, 1992; Sugisawa, Liang, & Liu, 1994), but not all (Forster & Stoller, 1992; Kelman, Thomas, & Tanaka, 1994; Olsen, Olsen, Gunner-Svensson, & Waldstrom, 1991; Shah-tahmasbei, Davies, & Wenger, 1992), findings pointing to an inverse relationship between social factors and mortality. Several authors (Berkman et al., 2000; Broadhead, Kaplan, & James, 1983; Penninx et al., 1997) have found difficulty in determining exactly which aspects of the social networks have been responsible for observed associations between social factors and mortality.

In addition to confounding structure and function, and using both aggregated and disaggregated measures that themselves confounded structure and function, a careful examination of the composition of the social support measures used in previous studies reveals that many of the significant predictors of mortality that have been called social support may better have been called measures of social participation or social engagement (Blazer, 1982; Forster & Stoller, 1992; House et al., 1982; Jylha & Aro, 1989; Steinbach, 1992; Sugisawa et al., 1994; Yasuda et al., 1997). In fact, social engagement has been recently postulated by Berkman herself as one of the crucial links in the chain between social networks and health outcomes (Berkman et al., 2000), and the first major article that linked social networks with mortality in the population of elderly persons had measures of social integration (being a member of a church, and being involved in informal and formal group associations) as components of the index (Berkman & Syme, 1979).

Consequently, we have modified the original Berkman (1986) theoretical model to introduce (or rather reintroduce) the concepts of social engagement and participation in activities associated with the world outside the home. These concepts are associated with the debate in the field of gerontology near its inception, 40 or so years ago, as to whether successful aging was characterized by disengagement (Cumming & Henry, 1961) or continued engagement in the activities of life (Havighurst, Neugarten, & Tobin, 1968). It was asserted more than 30 years ago that “the older person who ages optimally is the person who stays active . . . .” (Havighurst et al., 1968). Without entering into that debate, it seems to us that the basic issues in gerontological research do recur with some regularity. The current study, therefore, includes a set of measures of “social engagement” to help assess to what extent these early observations are supported by recent data.

The goal of the study was to assess the relative importance of each domain of the social network as a predictor of mortality among the old-old Israeli population. The underlying hypothesis of this study is that disaggregated measures of the structure, function, and social engagement aspects of social networks would be associated with the risk of mortality in the old-old Israeli population after controlling for a large set of demographic, health, and functioning variables that have been demonstrated repeatedly to be associated with a higher risk of mortality. We expect that the individual variables will affect the risk of mortality, effects that might be masked if the variables were aggregated and analyzed as groups. In terms of the theoretical approach that divides social networks into structural, functional, and social engagement aspects, it was hypothesized that larger network structures would be associated with reduced risk of mortality; that those with more (functional) support would show reduced risk of mortality; and that those who had higher levels of social engagement would have reduced risk of mortality.

**METHODS**

**Subjects**

The population in Israel is extremely heterogeneous, coming from more than 70 countries and speaking more than 100 different native languages. A focus on the old-old was suggested by several pioneering works in the 1980s that pointed out that those aged 75 and older were the fastest-growing group of elders (Rosenwaike, 1985) and worthy of separate study by gerontologists (Szumza & Riley, 1985), including in Israel (Brodsky, Shnor, & Beer, 2000; Cnaan, Olsson, & Wette, 1990). The Jewish population is often divided into two origin groups: Ashkenazi or Western-origin Jews (born in or descended from those born in Europe or America) and Sephardi or Eastern-origin Jews (born in or descended from those born in the Middle East or North Africa). A third part of the population was born in what is now Israel, but among those aged 75 and over, this proportion is only about 4% of the total. The old-old born in the early years of the last century in Europe or America had different life experiences and family-formation patterns than did the Middle Eastern and North African-born (Eisenbach & Sabatello, 1991; Walter-Ginzburg, Blumstein, Chetrit, Gindin, & Modan, 1999; Weihl, 1970). Both of these groups differ from the Israeli-born old-old (most of whose ancestors were of European-American origin), a group which did not itself experience immigration.

The study consisted of in-person interviews with Jews aged 75 years and over living in Israel as of January 1, 1989, selected randomly from the National Population Register, a complete listing of the Israeli population maintained by the Ministry of the Interior, stratified by age (five 5-year age groups: 75–79, 80–84, 85–89, 90–94, and 95+), sex, and place of birth (Israel, Middle East or North Africa, or Europe-America). One hundred subjects were randomly selected in each of 30 cells. For those aged 95+ born in Israel, there were less than 100 individuals in some of the cells, so all persons in these cells were selected. The total sample included 2,891 individuals. Because only a very small proportion (33%) of those aged 95+ were located, leading us to believe that there was serious bias in sampling or finding members of this age group, it was removed from the analysis. The study was originally designed to include non-Jews (Israeli Arabs), but insurmountable data quality obstacles arose that made it impossible to include this very important sector of the population in the study at the time the baseline fieldwork was conducted (1989–1992).

Of the 2,400 potential interviewees aged 75–94, 1,820 (76%) were located and interviewed (15.7% of the sampled individuals were not located and an additional 8.5% refused to be interviewed). Interviewing extended from Spring 1989 through the end of 1992, with most interviews (96%) being completed by the end of 1991. Mortality was determined by cross-checking with the National Death Registry as of De-
on the location of each living child.

The specific measures used in the current study are listed in Table 1, along with their coding algorithms, frequency distributions, and crude 8-year mortality.

Social network characteristics.—The social network characteristics used in this study were divided into structural, functional, and social engagement aspects.

The structure of the social network was operationalized in terms of size, durability, and location or geographic dispersal, measured by: the number of living children, obtained by asking for lists of living children; marital status (currently married or not married); living arrangements (in the community alone; in the community with a spouse only; with a spouse and with any other person; with a spouse and a child; in the community without a spouse with another person; in the community without a spouse and with a child; or in any institution); and proportion of children living in the same city as the respondent, calculated from a question on the location of each living child.

The function (supportiveness) of the network was operationalized by the frequency of contact with children and with friends, and whether or not the subject perceived that there was instrumental or emotional support available to them and if they needed it. Frequency of contact was calculated from a series of questions on each living child and on friends, and can theoretically measure either structure or function, depending on the content of the contact. We have chosen to include it under function as did Berkman (1986).

It is plausible that in-person contact between aged persons and their children in and of itself enables the “transmission” of whatever social support will be provided, and that more frequent contact will enable more “support” to be generated, despite the possibility that there can be negative content (Rook, 1984). Existence of perceived instrumental support was obtained by asking “who from among your family and friends helps you with emotional support, such as talking over problems and making difficult or major decisions.” Respondents categorized as perceiving emotional support reported having at least one person to talk to.

Social engagement.—Engagement with the social environment was measured by asking respondents about solitary leisure activities (watching television; listening to radio or music; or reading newspapers, books, or religious books); group activities (talking with family or friends; sitting outside in good weather; sitting in a cafe or senior center; playing cards or other board games; attending movies, restaurants, concerts, or the theater; or writing letters); and reciprocal neighborly relationships (reporting borrowing, lending, or visiting with neighbors, in either direction, so that respondents can visit with neighbors or perform small neighborly gestures, or have neighbors visit with them or perform small neighborly gestures for them).

Sociodemographic variables.—The sociodemographic variables included in this study were: age group (75–79, 80–84, 85–89, and 90–94); gender; place of birth (Europe-America; North Africa; Middle East; Israel); number of years of education, including religious studies; and source of income (only Social Security, or Social Security plus any other pension).

Measures of health, cognitive status, depression, and function.—Comorbidity was measured by the number of self-reported conditions, asked as “do you suffer from or has a physician ever told you that you suffer from” (and then a list of 15 major conditions was read). We categorized the responses as not reporting any conditions, or reporting 1–3 or more comorbid conditions. The 15 conditions were: cancer, diabetes, high blood pressure, heart attack, other heart disease, cardiovascular accident, circulatory disease, respiratory diseases, gastrointestinal disease, osteoporosis, Parkinson’s disease, thyroid disease, rheumatic disease, joint diseases, and kidney disease.

Cognitive status was measured by a six-item version (Katzman et al., 1983) of the Blessed Information-Memory-Concentration Mental Status Test (Blessed, Tomlinson, & Roth, 1968), scored as normal (<9), mild impairment (9–19), and cognitively impaired (20+). This short test is easily administered by nonphysicians, and has been shown to produce positive correlations with plaque counts obtained from the cerebral cortex at autopsy and to discriminate among mild, moderate, and severe cognitive deficits.

Depressive symptoms were measured by the Center for Epidemiological Studies–Depression (CES-D) scale (Radloff, 1977), a short self-report scale that measures depressive symptomatology in the general population. The use of this scale in the old-old Israeli population has been previously reported (Ruskin, Blumstein, Walter-Ginzburg, Fuchs, & Modan, 1996).

Activity of daily living (ADL) function was measured by asking whether the respondent had difficulty in performing any of seven ADLs: walking across a small room, washing, grooming, dressing, eating, transfer, and toileting (Katz, 1983).
Table 1. Variables Used in the Analysis of 8-Year Mortality in the Cross-Sectional and Longitudinal Aging Study (CALAS) of Jewish Israelis Aged 75–94 in 1989 (n = 1,340)

<table>
<thead>
<tr>
<th>Measures of Social Network Structure</th>
<th>n</th>
<th>% Mortality</th>
<th>Measures of Health, Cognitive Status, and Function</th>
<th>n</th>
<th>% Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marital status</td>
<td></td>
<td></td>
<td>Place of birth</td>
<td></td>
<td></td>
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<tr>
<td>Married</td>
<td>578</td>
<td>43.1</td>
<td>Israel</td>
<td>425</td>
<td>31.7</td>
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<tr>
<td>Not married</td>
<td>762</td>
<td>56.9</td>
<td>Middle East</td>
<td>234</td>
<td>17.5</td>
</tr>
<tr>
<td>No. of children alive</td>
<td></td>
<td></td>
<td>Years of education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>150</td>
<td>11.2</td>
<td>Europe-America</td>
<td>503</td>
<td>37.5</td>
</tr>
<tr>
<td>2</td>
<td>189</td>
<td>14.1</td>
<td>North Africa</td>
<td>178</td>
<td>13.3</td>
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<tr>
<td>3</td>
<td>290</td>
<td>21.6</td>
<td>0–4</td>
<td>402</td>
<td>30.0</td>
</tr>
<tr>
<td>4</td>
<td>224</td>
<td>16.7</td>
<td>5–8</td>
<td>331</td>
<td>24.7</td>
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<tr>
<td>4+</td>
<td>487</td>
<td>36.3</td>
<td>9–12</td>
<td>356</td>
<td>26.6</td>
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<tr>
<td>Living arrangement</td>
<td></td>
<td></td>
<td>Income</td>
<td></td>
<td></td>
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<tr>
<td>Community alone</td>
<td>441</td>
<td>32.9</td>
<td>Only social security</td>
<td>532</td>
<td>39.7</td>
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<tr>
<td>Community with spouse alone</td>
<td>477</td>
<td>35.6</td>
<td>Social security plus any other pension</td>
<td>769</td>
<td>57.4</td>
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<tr>
<td>Community with spouse and child</td>
<td>52</td>
<td>10.7</td>
<td>Missing</td>
<td>39</td>
<td>2.9</td>
</tr>
<tr>
<td>Community without spouse, with other</td>
<td>50</td>
<td>10.3</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Institution</td>
<td>137</td>
<td>28.1</td>
<td>Measures of Health, Cognitive Status, and Function</td>
<td></td>
<td></td>
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<tr>
<td>Measures of Social Network Function</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Frequency of contact with children</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>194</td>
<td>14.5</td>
<td>No. of comorbid conditions</td>
<td>201</td>
<td>15.0</td>
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<tr>
<td>1–3.9 times per week</td>
<td>298</td>
<td>22.2</td>
<td></td>
<td>295</td>
<td>22.0</td>
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<tr>
<td>4 or more times per week</td>
<td>820</td>
<td>61.2</td>
<td></td>
<td>571</td>
<td>42.6</td>
</tr>
<tr>
<td>Missing</td>
<td>28</td>
<td>2.1</td>
<td></td>
<td>768</td>
<td>57.3</td>
</tr>
<tr>
<td>Frequency of contact with friends</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>None</td>
<td>403</td>
<td>30.1</td>
<td>Cognitive status (score)</td>
<td>397</td>
<td>29.6</td>
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<tr>
<td>1–3.9 times per week</td>
<td>153</td>
<td>11.4</td>
<td>Normal (≤9)</td>
<td>160</td>
<td>11.9</td>
</tr>
<tr>
<td>4 or more times per week</td>
<td>784</td>
<td>58.5</td>
<td>Impaired (20+)</td>
<td>15</td>
<td>1.1</td>
</tr>
<tr>
<td>Perceived instrumental support</td>
<td></td>
<td></td>
<td>Depression symptoms (CES-D)</td>
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<tr>
<td>No</td>
<td>206</td>
<td>15.4</td>
<td></td>
<td>760</td>
<td>56.7</td>
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<tr>
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<td>1099</td>
<td>82.0</td>
<td></td>
<td>385</td>
<td>64.9</td>
</tr>
<tr>
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<td>35</td>
<td>2.6</td>
<td></td>
<td>64</td>
<td>8.1</td>
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<tr>
<td>Perceived emotional support</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td>438</td>
<td>26.0</td>
<td></td>
<td>933</td>
<td>69.6</td>
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<td>70.3</td>
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<td>255</td>
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<td>50</td>
<td>3.7</td>
<td></td>
<td>152</td>
<td>11.3</td>
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<td>Measures of Social Engagement</td>
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<td>Measures of Health Behaviors</td>
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<td>Reciprocal neighborly relationships</td>
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<tr>
<td>No</td>
<td>719</td>
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<td>Body mass index</td>
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<td>31.8</td>
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<td>1</td>
<td>195</td>
<td>14.6</td>
<td></td>
<td>370</td>
<td>27.6</td>
</tr>
<tr>
<td>2</td>
<td>70</td>
<td>5.2</td>
<td></td>
<td>328</td>
<td>24.5</td>
</tr>
<tr>
<td>3</td>
<td>356</td>
<td>26.6</td>
<td></td>
<td>216</td>
<td>16.1</td>
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<td>Leisure activity (solitary)</td>
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<td></td>
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<td></td>
<td></td>
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<tr>
<td>Never/very rarely</td>
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<td>10.4</td>
<td>Smoking status</td>
<td>426</td>
<td>31.8</td>
</tr>
<tr>
<td>Frequently</td>
<td>395</td>
<td>29.5</td>
<td></td>
<td>370</td>
<td>27.6</td>
</tr>
<tr>
<td>Very frequently</td>
<td>805</td>
<td>60.1</td>
<td></td>
<td>328</td>
<td>24.5</td>
</tr>
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<td>Leisure activity (group)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never/very rarely</td>
<td>792</td>
<td>59.1</td>
<td></td>
<td>216</td>
<td>16.1</td>
</tr>
<tr>
<td>Frequently</td>
<td>290</td>
<td>21.6</td>
<td></td>
<td>216</td>
<td>16.1</td>
</tr>
<tr>
<td>Smoking status</td>
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<td></td>
<td>Smoking status</td>
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<td></td>
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<tr>
<td>Age (mean age = 83.3, SD = ±5.5)</td>
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<td></td>
<td></td>
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<tr>
<td>75–79</td>
<td>426</td>
<td>31.8</td>
<td>Past smoker</td>
<td>806</td>
<td>60.1</td>
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<tr>
<td>80–84</td>
<td>370</td>
<td>27.6</td>
<td>Current smoker</td>
<td>399</td>
<td>29.8</td>
</tr>
<tr>
<td>85–89</td>
<td>328</td>
<td>24.5</td>
<td>Physical activity per week</td>
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<td>10.1</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>726</td>
<td>54.2</td>
<td></td>
<td>848</td>
<td>63.3</td>
</tr>
<tr>
<td>Female</td>
<td>614</td>
<td>45.8</td>
<td></td>
<td>170</td>
<td>12.7</td>
</tr>
</tbody>
</table>

Note: CES-D = Center for Epidemiological Studies–Depression scale; ADL = activities of daily living; IADL = instrumental ADL.

*Please keep in mind that this distribution is the result of a random-stratified sample from a national population register, and therefore the proportions do not reflect the population distribution of these variables. These data have been weighted to reflect the true composition of the Israeli old-old population, and the results of this weighting are available upon request from the first author.
Downs, Cash, & Grotz, 1970). The level of difficulty with ADL activities in this population has been previously reported (Walter-Ginzburg et al., 2001).

Instrumental ADL (IADL) function, the ability to maintain an independent lifestyle, was measured by items asking whether the respondent had difficulty in completing any of nine IADLs: preparing meals, doing daily shopping for necessities, doing less frequent shopping for major items, doing light housekeeping, doing heavy housekeeping, handling personal finances, using the telephone, getting to the nearest bus stop, and doing laundry (Fillenbaum, 1985; Lawton & Brody, 1969).

Physical robustness was measured by items asking whether the respondent had difficulty in pulling or pushing an armchair; bending, stooping, or crouching; walking 1 km; climbing 10 stairs without resting; carrying 5 kilos; raising arm over head; or holding small implements, such as writing implements (Harris, Kovar, Suzman, Kleinman, & Feldman, 1989; Nagi, 1976; Rosow & Breslau, 1966).

Health behaviors.—Three health behaviors that are known to influence health and mortality were included in this study. Smoking history was obtained by asking whether the subject currently or ever smoked; body mass index was obtained by weighing the participants and measuring their heights, and then calculating the index as weight (in kilograms) divided by the square of the height (in meters); and participation in sport or physical activities was obtained by reading a list of sports or other activities requiring physical effort that included walking up to 2 km (about 1.3 miles), swimming, gardening, or other activities listed by the respondents when asked for “other” activities involving physical effort. These were coded as no activity, 1–2 times a week, or 3+ times a week.

Statistical Analysis

Proportional hazard models (Cox, 1972) were used to assess the effect of network, support, and engagement characteristics on mortality. Follow-up time was computed from date of baseline interview (between June 1989 and December 1992) to date of death or date of last follow-up (December 31, 1997) for censored cases. We first estimated the risk of mortality for the various social network variables, introduced the sociodemographic variables in a block, and then introduced the health and functioning variables in a block to determine whether or not the effect of the social network variables was attenuated or eliminated by the inclusion of sociodemographic or health factors in the model, an approach that has been used previously in the analysis of mortality risks (Wolinsky, Johnson, & Stump, 1995).

A correlation matrix was used to examine possible collinearity between variables in each block of social factors. The proportion of children living in the same city was found to be highly correlated with living arrangements and was excluded from the network structure block. Using the Cox regression model, the effect of each independent variable was assessed separately with age, sex, and origin as covariates (data not shown), and independent variables that showed an association with mortality at a $p$ value $>.10$ in our sample were excluded from the three multivariate models.

Separate categories were included in the multivariate models for individuals with missing data in some of the covariates and in some of the social factors (frequency of contact with children, and perceived instrumental and emotional support) to retain the maximum number of subjects in the analysis, a method that has been previously used with this data set (Fuchs et al., 1998).

Results

Social Network Variables

By the end of 1997, 60.6% of study subjects had died. With respect to the social network variables, the results are as follows (Table 1).

Structural factors.—Those who had no children, were unmarried, lived in institutions, lived in the community without a spouse but with a child, or lived with a spouse and another person (not a child), had high mortality.

Functional (supportiveness) factors.—The relationship between contact with children and mortality was nonlinear. Those who had no contact with children (some of whom had children) had the highest mortality, and those with lower levels of contact had lower mortality, whereas those who had the most contact with children again showed higher mortality. Two other measures of the supportiveness of the networks showed significant associations with mortality, but in an unexpected direction: those who perceived that they had instrumental and emotional support had higher mortality than did those who did not.

Social engagement.—These variables showed a pervasive inverse relationship with risk of mortality. Those who engaged in more reciprocal neighborly relationships had lower mortality, and those who frequently or very frequently engaged in solitary and group leisure activities all showed lower mortality than did those who never or rarely engaged in those activities.

The mortality trends in the nonsocial factors reflect what is known about the major predictors of mortality and show that the mortality pattern in this population is what would be expected (Bush, Miller, Criqui, & Barrett-Connor, 1990).

Multivariate Analysis

Model 1 (Table 2) presents the social factors that were significantly associated with time-adjusted risk of mortality (Cox, 1972) in univariate analysis. (The results that were significant at least at the .05 level are shown.)

The social factors that were significantly associated with lower risk of mortality were having more children ($p < .01$), engaging in solitary leisure activity frequently ($p < .01$) or very frequently ($p < .05$), engaging in group leisure activity frequently or very frequently ($p < .001$ each), and engaging in reciprocal relationships with neighbors ($p < .001$). Living in the community without a spouse and with a child, and living in a long-term care institution were both associated with higher risk of mortality ($p < .001$ each).

After entering the sociodemographic variables (age, gender, level of education, place of birth, and a rough measure
Table 2. Three Models of the Association Between Social Network and Risk of 8-Year Mortality, Controlling for Demographic, Health, and Functioning Variables, in Israelis Aged 75–94 (n = 1,340)

<table>
<thead>
<tr>
<th>Measure</th>
<th>Model 1: Only Social Network Variables</th>
<th>Model 2: Controlling for Demographic Variables</th>
<th>Model 3: Controlling for Demographic, Health, and Functioning Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Structure of Social Network</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. of children (continuous)</td>
<td>.89 (.83–.96)**</td>
<td>.93 (.86–1.01)**</td>
<td>.94 (.86–1.02)</td>
</tr>
<tr>
<td>Married (vs. not married)</td>
<td>1.11 (1.14–1.58)</td>
<td>1.08 (.76–1.52)</td>
<td>1.07 (.76–1.52)</td>
</tr>
<tr>
<td>Living arrangement (vs. living alone in community)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Community with spouse</td>
<td>.90 (.61–1.31)</td>
<td>.80 (.55–1.15)</td>
<td>.81 (.56–1.18)</td>
</tr>
<tr>
<td>Community with spouse plus other, not child</td>
<td>1.27 (.67–2.40)</td>
<td>1.27 (.67–2.41)</td>
<td>1.35 (.71–2.57)</td>
</tr>
<tr>
<td>Community with spouse and child</td>
<td>.90 (.53–1.51)</td>
<td>.89 (.53–1.50)</td>
<td>.97 (.58–1.63)</td>
</tr>
<tr>
<td>Community without spouse, with child</td>
<td>1.64 (1.28–2.09)***</td>
<td>1.57 (1.22–2.01)***</td>
<td>1.49 (1.15–1.91)**</td>
</tr>
<tr>
<td>Community without spouse, with other</td>
<td>1.18 (.81–1.71)</td>
<td>1.09 (.75–1.59)</td>
<td>.94 (.65–1.38)</td>
</tr>
<tr>
<td>Institution</td>
<td>1.83 (1.46–2.29)***</td>
<td>1.60 (1.27–2.01)***</td>
<td>1.28 (1.00–1.64)**</td>
</tr>
<tr>
<td><strong>Function of Social Networks</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency of contact with children</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1–3 times per week</td>
<td>.89 (.68–1.170)</td>
<td>.84 (.64–1.11)</td>
<td>.81 (.61–1.07)</td>
</tr>
<tr>
<td>4+ times per week</td>
<td>1.10 (.81–1.48)</td>
<td>.98 (.73–1.33)</td>
<td>.91 (.67–1.23)</td>
</tr>
<tr>
<td>Perceived instrumental support (vs. does not perceive)</td>
<td>1.09 (.87–1.35)</td>
<td>1.08 (.86–1.35)</td>
<td>1.02 (.82–1.28)</td>
</tr>
<tr>
<td>Perceived emotional support (vs. does not perceive)</td>
<td>1.17 (.99–1.40)</td>
<td>1.23 (1.03–1.47)*</td>
<td>1.12 (.94–1.34)</td>
</tr>
<tr>
<td><strong>Social Engagement</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solitary leisure activity (vs. rarely or never)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequently</td>
<td>.70 (.56–.89)**</td>
<td>.75 (.59–.95)*</td>
<td>.92 (1.72–1.18)</td>
</tr>
<tr>
<td>Very frequently</td>
<td>.75 (.60–.94)*</td>
<td>.81 (.64–1.03)</td>
<td>1.11 (.86–1.43)</td>
</tr>
<tr>
<td>Group leisure activity (vs. rarely or never)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequently</td>
<td>.67 (.56–.81)***</td>
<td>.69 (.57–.84)***</td>
<td>.79 (.65–.95)*</td>
</tr>
<tr>
<td>Very frequently</td>
<td>.63 (.52–.78)***</td>
<td>.65 (.53–.80)***</td>
<td>.78 (.63–.96)*</td>
</tr>
<tr>
<td>Reciprocity with neighbors</td>
<td>.89 (.84–.94)***</td>
<td>.90 (.85–.96)***</td>
<td>.94 (.89–1.00)</td>
</tr>
</tbody>
</table>

Note: All values are odds ratio (95% confidence interval).

*The demographic variables that were entered into Model 2 are those presented in Table 1: age, gender, level of education, place of birth, and a rough measure of income.

**The health and functioning variables that were entered into Model 3 are those presented in Table 1. Model 3 includes all of the demographic variables, plus measures of health (number of medical conditions, cognitive status, depressive symptoms) and measures of functional status.

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

of income) into Model 2, those who frequently engaged in solitary leisure activity still had reduced risk of mortality (p < .05). The reduced risk of mortality for those who frequently or very frequently engaged in group leisure activity and those who engaged in reciprocal relationships with neighbors remained significant at the p < .001 level, as did the increased risk of mortality for those living in the community without a spouse and with a child and those living in an institution (p < .001). Those who perceived that they had emotional support showed increased risk of mortality (p < .05).

When all of the health, cognitive, depression, and functioning variables (number of medical conditions, cognitive status, depressive symptoms, ADL, IADL, and robustness) were entered into Model 3, the results were relatively stable. Those living without a spouse and with a child or in an institution still had a higher risk of mortality (p < .01 and p < .05, respectively). Perceiving emotional support was no longer significantly associated with increased risk of mortality, nor was engaging in solitary leisure activity. However, engaging in group leisure activity frequently or very frequently remained significant at the p < .05 level after all the health and functional variables were taken into account.

In addition, we tested the final model for possible interactions between the significant health predictors of mortality and all social factors presented in Model 1. We found two interesting interactions (data not shown). First, whereas the main positive effect of institutional setting on risk of mortality remained significant, we found a lower risk of mortality for the elderly living in institutions with high level of ADL difficulties (p < .01). Second, we found that those who reported having perceived emotional support, together with a low level of depressive symptoms (CES-D < 17), had a significantly lower risk of mortality (p < .05). When all interactions are accounted for in the model, the direction and significance of the main effects of the social variables remain unchanged, except for a slight decrease in the significance of group leisure time activities.

A fourth model was developed that included the set of health behaviors (smoking, body mass index, and physical activity), but the results of Model 3 were not changed. Therefore, this model is not presented separately.

**DISCUSSION**

This study has attempted to broaden our understanding of the specific dimensions of the social network system that were significantly associated with an 8-year risk of mortality in a randomly selected stratified sample of the popula-
tion of Israel aged 75–94 in 1989, including those receiving long-term care in institutions or at home, after controlling for factors known to be related to mortality. Based on suggestions by several previous authors (Jylha & Aro, 1989; Penninx et al., 1997; Seeman & Berkman, 1988; Sugisawa et al., 1994), we used disaggregated single variables rather than indices derived by factor analysis or other methods to measure the various constructs, using a conceptual framework that separated structural, functional (Berkman, 1986), and social engagement aspects (Cumming & Henry, 1961; Havighurst et al., 1968).

Some (Tucker, Schwartz, Clark, & Friedman, 1999) but not all (Sabin, 1993; Samuelsson & Dehlin, 1993) previous studies have found that those with more children have a lower risk of mortality. We found that the number of living children was significantly associated with risk of mortality in the unadjusted model (Model 1), but this measure was no longer significant after the sociodemographic and health factors were included in the model.

The number of living children was highly associated with place of birth; both North African- and Middle Eastern-born had significantly more children than did the European- or Israeli-born (Walter-Ginzburg, Blumstein, Chetrit, Gindin, & Modan, 1999). Because place of birth, especially the Middle East, was found to be associated with reduced mortality risk, this association may itself explain the change in the effect of number of children when place of birth is taken into account, and the effect is therefore not a direct consequence of family size. Therefore, the hypothesis that those with larger network structures would show reduced risk of mortality was not supported.

In contrast to findings of other studies (Samuelsson & Dehlin, 1993; Sugisawa et al., 1994), marital status was not found to have any significant effect on the risk of mortality when introduced into Model 1 with living arrangements. The higher rate of institutionalization and cohabitation with children among the unmarried may account for the disappearance of the effect of marital status.

The major network structural characteristic associated with risk of mortality was living arrangements. Living in the community without a spouse and with a child, and living in an institution were significantly associated with a higher risk of mortality in all three models, although the odds ratio decreased after the introduction of health variables. Living in an institutional setting and having a higher level of ADL difficulty was found to be associated with a significantly lower risk of mortality, whereas the main effect of living in an institution remained significant in the opposite direction. This may indicate that the assistance with ADLs that institutional living provides has some effect on risk of mortality.

There are very few if any community studies of social supports and mortality that included the institutionalized population, but to the extent that the long-term care institution is the “last stop” in the continuum between independence and death (Jagger, Spiers, & Clarke, 1993; Merrill & Mor, 1993; Stones, Dorman, & Kozma, 1989; Wolinsky, Callahan, Fitzgerald, & Johnson, 1992), mortality rates would be expected to be higher there than in other living arrangements. The finding that those living without a spouse and with children had a higher risk of mortality after all sociodemographic and health factors have been controlled is consistent with the use of children as a substitute for institutionalization, and implies that at least some cohabitation was the caretaking solution for the noninstitutionalized old-old who were most frail and closest to death (Kovar, Hendershot, & Mathis, 1989). To examine this hypothesis, we conducted further analysis. We compared several of the socioeconomic and health characteristics of those who live in institutions to those who live with a child, and found that whereas there are some similarities in function and comorbidity, the populations are distinct. The group that lived with children was more likely to be female and of lower socioeconomic status in terms of origin, educational level, and income than were those who lived independently (alone or only with a spouse) in the community (data not shown).

In the Israeli old-old population, the association between socioeconomic status (SES) and risk of mortality seems to be expressed through the living arrangements; those living in an institution were of higher SES, and moved to the institution relatively recently for the long-term care offered, whereas those living with children were of lower SES, had “aged in place,” and were receiving whatever long-term care they had at home. This issue is addressed more thoroughly in another report based on these data (Walter-Ginzburg et al., 2001). A study of 4-year mortality conducted in Japan on people aged 65 years and over (Nakanishi et al., 1998) found higher mortality for those who lived with their spouse and children or only with their children. Despite the fact that there is very little cultural or religious similarity between Israel and Japan, the family structure in both countries is very strong and cohabitation with children is relatively high. In addition to the influence of SES on living arrangements, it is possible that there are some negative aspects involved when elders live in extremely close proximity to their children (Berkman et al., 2000; Chappell, 1991; Dunkel-Schetter & Bennett, 1990; Finch, Okun, Barrera, & Zautra, 1989; Krause, 1995; Lawton, 1983; Rook, 1984, 1997), which may be exacerbated if the parents and children live together, and may increase the risk of mortality.

In addition, because few families have extensive medical capabilities, the risk of mortality for the old-old may increase as a result of living with the child, especially in low SES groups, rather than in a location where professional assistance can be provided. This issue has implications for equal access to long-term care for the various SES groups in Israel and may warrant the attention of those responsible for the care of the old-old in Israel.

The second hypothesis examined in this study was that those respondents with more social support would show reduced risk of mortality. However, in this study, none of the measures of the functioning (supportiveness) of the social network (frequency of contact with children and perceived instrumental support) were found to be associated with risk of mortality. Although perceived emotional support was associated with a somewhat higher risk of mortality when sociodemographic variables were included in the model, this relationship became insignificant when the health and functioning variables were added to the model, indicating that the perception of emotional support was associated with health and depressive symptoms. In fact, an interaction be-
between having no depressive symptoms and having perceived emotional support was associated with a significantly lower risk of mortality. Previous studies found these concepts to have had a significant inverse relationship with predicted mortality (Blazer, 1982; Hanson et al., 1989), although significant positive relationships have been found between the use of instrumental support and mortality (Forster & Stoller, 1992; Kaplan et al., 1994), perhaps because those who were most needy received the most support (Dunkel-Schetter & Bennett, 1990). When social support is perceived to be available, it may be because the support networks were activated (Walter-Ginzburg et al., 1999), which would turn the perception of potential support into something closer to received support, although we cannot make that leap given these data. There may be some interaction between the positive effect of perceiving emotional or instrumental support, and the negative effect of requiring those forms of assistance (losing independence and needing to lean on others), which would attenuate the possible positive effects on risk of mortality. Finally, once again, the possible negative aspects of family relationships must be taken into account when considering their role in the risk of mortality (Finch et al., 1989; Krause, 1995; Lawton, 1983; Rook, 1984, 1997).

In short, the hypothesis that those with more support would show reduced risk of mortality is not supported in this population. It may be that the measures of the supportiveness of social networks used here do not capture the most relevant aspects of this concept in the old-old population in Israel.

The third hypothesis addressed the issue of social engagement and hypothesized that those with higher levels of social engagement would show reduced risk of mortality. We found that the one social engagement factor that involved contact with others outside the home (engaging in leisure activities with groups of people) remained a statistically significant predictor of reduced risk of mortality after all of the sociodemographic, health, cognitive, depression, and functional variables were included (Model 3), thus supporting the hypothesis.

This finding is consistent with the findings of other studies. The first major article that linked social networks with mortality in the population of elderly persons had measures of social integration (being a member of a church, and being involved in informal and formal group associations) as components of the index (Berkman & Syme, 1979); more recent studies have had similar measures (Dalgard & Lund, 1998; Fuhrer et al., 1999; Hanson et al., 1989). In summary, the results presented here support the conclusion that, when social networks are measured with indices conceptualized separately in terms of social network structure, function, and social engagement, it may be the latter types of measures that most influenced the observed predictive powers of those models.

A series of physiological pathways linking social networks and health outcomes has been described carefully by Berkman and associates (2000). The evaluation of neurobiological and other physiological evidence is beyond the scope of this study, but can help us to understand our findings that a wide range of social leisure activities outside the family can be associated with reduced risk of mortality even at very advanced ages. Although Grundy (1996) pointed out that, whereas socially active people differ from “nonjoiners” in willingness and ability to participate in social activities, meaning that our findings may point to pre-existing fundamental differences within our population that have not otherwise been captured, the physiological evidence points to the plausibility of a link between social participation and mortality because of the effects of participation on human biology as well as morale, and because such participation may involve activities such as physical exercise, which are known to be beneficial. Sabin (1993) hypothesized that relationships that are an end in themselves (as opposed to instrumental relationships) and voluntary (as opposed to family relationships) are most important in reducing the risk of mortality. Relationships with friends have been found to be more important for sustained physical health than were closeness to spouse and children (Vaillant, Meyer, Mukamel, & Soldz, 1998).

The finding that three measures of health behavior (smoking, body mass index, and physical activity) did not change the relationship between social network factors and mortality, once all of the sociodemographic, health, and functioning variables were considered, has several possible explanations. First, it may be that the measures of social engagement used may already be closely associated with health behaviors (Berkman et al., 2000; Vaillant et al., 1998). It may also be that those who engaged in risky health behaviors by smoking, being excessively over- or underweight, and not participating in any physical activity did not reach the minimum age of our study (75). We are indeed assessing a survivor population.

The findings here explore the effect of social factors on mortality in a population with prevailing high levels of social support, and can be understood as a study of optimization of social support in a socially robust group. The findings that, in a population with very high levels of familial contact and perceived instrumental and emotional support, those who are of lower SES and live with children have higher risk of mortality than those who live in the community, point to the flexibility of caretaking options. Those with high financial resources use long-term care institutions, whereas those with lower SES take their disabled, ill elders into their homes until they die—a finding that has implications for understanding caregiver burden and equity of access to institutional services in Israel. The finding that participating in social activities with people outside of the immediate family reduces the risk of mortality has practical implications for planning by the aging population and their families.

**Study Limitations**

As in similar community-wide investigations, this study has several limitations. Very old people may not be able to respond to an interviewer validly, leading to possible inaccurate self-reporting of functional status, although self-reports have been shown to provide useful estimates of the prevalence of medical conditions and functional disabilities in elderly populations (Dorevitch et al., 1992; Ford et al., 1988). An additional limitation is that the validity and reliability of the measures used have not been determined specifically for the Israeli old-old population.
This study has a potential bias resulting from the reduction of sample size from 1,820 to 1,340 because we used only nonproxy respondents to obtain information on the subjective perception of health and available support, and included only those who provided full information on social networks. Individuals represented by proxies are demographically different from the self-reporters, with higher proportions of proxy respondents among the Middle East- and North African-born, among women, among those with less than 5 years of education, and among those living in institutions and with children, which resulted in those categories being somewhat underrepresented in the analysis. These characteristics are associated both with the sociodemographic characteristics of the sample and with the structural characteristics of the network, and probably have the result of underestimating the role of the structural components on risk of mortality. There is no bias from loss to follow-up of mortality, because all cases were found through the National Death Registry.

Although our response rate of approximately 76% is higher than that found in other studies of elderly persons (Bowling, 1991; Fuhrer et al., 1999; Penninx et al., 1997; Sugisawa et al., 1994; Yasuda et al., 1997), there is a possibility of bias from selective nonresponse (Colsher & Wallace, 1989).

The measures of social support used in this study did not disentangle potentially supportive relationships from support that is actually received (Pearlin & Aneshensel, 1987). However, in a community population that is basically healthy, limiting analysis of support to support received would limit our analysis to a more disabled or needy segment of the population, which would reduce its utility (Rowe & Kahn, 1987).

Despite these potential limitations, this study is the only prospective study of social support and mortality conducted to date in Israel that is based on a random national stratified sample of the old-old, including those living in long-term care, with data on a large number of interviewees.

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