Social Support, Depression, and Activities of Daily Living in Older Heart Surgery Patients

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A theoretical model that specifies relationships among depression, ADL impairment, and social support components was tested using 147 patients age 55 and older undergoing open heart surgery for angina pectoris or aortic stenosis. Patients completed interviews and self-reports before surgery and one and 6 months after surgery. The longitudinal data were analyzed using covariance structure modeling techniques. Consistent with an initially theorized structural model, the number of close network members seen regularly before surgery was associated with perceived adequacy of support one month after surgery. In turn, perceived adequacy of support one month after surgery predicted less depression and less ADL impairment at 6 months. The number of close network members seen regularly was also directly associated with less ADL impairment at one month and less depression at 6 months after surgery.

Many researchers have identified an association between social support and depression in older persons (Bowling & Browne, 1991; George, Blazer, Hughes, & Fowler, 1989; Henderson, Byrne, & Duncan-Jones, 1981; Krause, Liang, & Yatomi, 1989; Matt & Dean, 1993; Oxman, Berkman, Kasl, Freeman, & Barrett, 1992). In addition, social support is frequently associated with less impairment in activities of daily living (ADLs) in the elderly (Cummings et al., 1988; King, Reis, Porter, & Norsen, 1993; Wilcox, Kasl, & Berkman, 1994). Indeed, the interrelation of social support and depression appears to be particularly relevant in older persons suffering impairment in ADLs (Oxman et al., 1992; Oxman, Barrett, Freeman, & Manheimer, 1994a; Schulz & Decker, 1985; Siegal, Calsyn, & Cuddihee, 1987; Turner & Noh, 1988).

Despite these lines of research, there are at least three problems that make it difficult to assess the clinical implications of the associations among social support, ADLs, and depression. First, analyses of social support and depression usually do not take into account the association these variables share with impairment in ADLs. This is important because ADL impairment is consistently a more powerful predictor of depression in the elderly than is social support (Bowling & Farquhar, 1991; Oxman et al., 1992). In addition, ADL impairment as a consequence of illness is often associated with changes in social support (Bloom & Kessler, 1994; Stoller & Pugliesi, 1991; Wilcox et al., 1994). Unless depression, social support, and ADLs are analyzed simultaneously, it is difficult to determine the extent to which their interrelations are independent.

A second problem with the majority of studies in this field is that they are cross-sectional. Interpreting the direction of associations between the domains of ADL impairment, social support, and depression is not possible in such studies. Several longitudinal studies have used structural equation analyses to address the relations between two of these three domains (e.g., Aneshensel, Frerichs, & Huba, 1984; Kaniasty & Norris, 1993; Krause et al., 1989; Matt & Dean, 1993). None of these studies have simultaneously looked at all three domains in the elderly, the group with the highest prevalence of ADL impairment. A third problem with research in this area is that social support is often measured as a unidimensional construct (Barrera, 1986; Berkman, 1983; Heller, Swindle, & Dusenbury, 1986). Contrary to such an approach, studies investigating effects of different components of social support on different outcomes have identified distinct effects of social support components (Berkman, 1983; Kaniasty & Norris, 1993; Kessler, Kendler, Heath, & Eaves, 1994; Oxman et al., 1992; Oxman, Freeman, Manheimer, & Stukel, 1994b; Oxman, Freeman, & Manheimer, 1995). Much of the available evidence emphasizes the need to consider multiple, specific components of social support rather than a global assessment.

The first two problems with research in this area can be addressed by including measures of social support, depression, and ADLs in a single longitudinal design. In order to address the third problem, issues related to social support and its components need to be considered in more detail.

Components of Social Support

To understand better how social support relates to improved outcomes, several investigators have described multidimensional models of social support (Barrera, 1986; Heller et al., 1986; Oxman & Berkman, 1990; Schaefer, Coyne, & Lazarus, 1981; Seeman & Berkman, 1988; Tardy, 1988). Three major components of social support are (1) the network of support providers, (2) the type and amount of support provided through that network, and (3) the adequacy of that support (George, 1989; Oxman & Berkman, 1990).

Social network. — The social network refers to structural characteristics such as the proximity of others, frequency of social contact, and the type of relationship (e.g., spouse, confidant, relative, friend, group). Although network variables such as the presence of a spouse or total network size are easy to assess and have shown some relationship to mortality.
outcomes (Case, Moss, Case, McDermot, & Eberly, 1992; House, Landis, & Umberson, 1988; Oxman et al., 1995; Williams et al., 1992), there is less evidence that these characteristics demonstrate any clear benefits to depression or ADLs in medically ill patients (Bowling & Farquhar, 1991; Oxman et al., 1994b; Stoller & Pugliesi, 1991). In fact, some social network characteristics, such as marital status, may have competing positive and negative influences (Bramwell, 1990; Kessler et al., 1994; Kulik & Mahler, 1993). Similarly, total network size has not shown a robust relationship to mental and physical outcomes in the elderly (Bowling & Farquhar, 1991), probably because of factors such as network attrition (Lewis & Meredith, 1988), geographic distance (Stoller & Pugliesi, 1991), and inequalities in reciprocity of support (Krause, 1995).

Among studies that find effects of network structural variables, the exact reason for such effects often remains unclear. Some research suggests that the number of emotionally close network members seen on a regular basis is important (Bowling & Farquhar, 1991; Kulik & Mahler, 1989, 1993; Oxman et al., 1992; Seeman & Berkman, 1988). Other research suggests that some subtypes of relationships (e.g., friendships) are more important than others (e.g., family) (Kaniasty & Norris, 1993; Oxman et al., 1992, 1994b). For example, because negative interactions are more likely to arise with family members than with friends (O’Reilly & Thomas, 1989; Rook, 1990) and because friendship is voluntary without normative obligations, friends may be more appreciated than family (Albrecht & Adelman, 1987; Crohan & Antonucci, 1989; Matt & Dean, 1993).

Finally, it must be recognized that although total network size is not likely to change in response to illness, the number of emotionally close network members making contact with an ill patient has been shown to change significantly in several studies (Bowling & Farquhar, 1991; Oxman et al., 1992; Seeman & Berkman, 1988; Stoller & Pugliesi, 1991). Accordingly, for the outcomes of depression or basic ADL impairment, the literature suggests that it is reasonable to focus on the number of emotionally close network members seen regularly.

Type and amount of social support. — A second component of social support is the type and amount of supportive behaviors provided by the network. Three types of support characterize the majority of such behaviors: emotional support, guidance support, and tangible support. Emotional support is the form most commonly assessed by researchers and includes behaviors such as comforting by physical affection or expressing concern for a person’s well-being. Guidance support includes behaviors such as giving knowledge of how to do something or suggesting some action to be taken such as instructions regarding diet or activities. Tangible support includes behaviors such as providing housing, money, or transportation. Receiving tangible assistance may be more necessary in functionally impaired elders, but is more problematic because of the unbalanced exchange or the feelings of dependency tangible support can engender (Krause, 1995; Oxman et al., 1994b; Wortman & Conway, 1985).

These different types of support can have different influences on function at different points in the course of illness (Fontana, Kerns, Rosenberg, & Colonese, 1989; Glass & Maddox, 1992; Hegelson, 1993; King et al., 1993). Studies that fail to differentiate among types of support and their timing may miss significant variations in their effects (Glass & Maddox, 1992; Hegelson, 1993).

Adequacy of social support. — A third component of social support is its adequacy. The adequacy of support refers to the availability and utility of social support for dealing with particular problems. Adequacy of support can be considered from two perspectives: the objective benefit from supportive behaviors (and cost of unsupportive behaviors) and the perceived adequacy of support (the recipient’s subjective assessment that the supportive behaviors of others enhance or hinder well-being). There is considerable evidence that the perception of adequate support is associated with decreased depressive symptomatology (Bowling & Farquhar, 1991; George, 1989; George et al., 1989; Kessler et al., 1994; Oxman et al., 1992) and better physical health (Antonucci, 1985). The most thoroughly investigated explanation for this effect is that people who perceive adequate support are accurate and more likely to actually receive the appropriate type and amount when needed. However, as reviewed by Kessler and colleagues (1994), naturalistic studies have generally failed to support this explanation. Another explanation for the importance of perceived adequacy is that adequate intimacy from relationships buffers the effects of stressful situations. Presumably, such buffering involves intrapsychic, cognitive mediation of the appraisal of the stressfulness of a situation (Cohen, Mermelstein, Kamarck, & Hoberman, 1985). A third account argues that the perception of adequacy provides a more generalized belief that a person is cared for and valued. This belief develops from ordinary socializing and companionship rather than from any single relationship or stress-related transaction. The appraisals derive from several network members’ views of the individual (Heller et al., 1986). For the outcomes of depression or basic ADL impairment, the literature thus suggests that it is important to focus on the perceived adequacy of support, which should be influenced in part by the number of emotionally close network members seen regularly.

Theoretical Framework

No single conceptual model relating social support components to outcomes applies adequately to all situations. For example, studies focusing on older persons find different relationships than studies among younger persons (Aneshensel et al., 1984; Matt & Dean, 1993). Similarly, studies focusing on stable, degenerating, or acute health conditions plausibly require different models of support processes. Given the number of studies examining the relationships between social support and emotional or physical impairment, primarily in the elderly, we summarize a theoretical framework that emerges from this literature and propose that it applies to acute changes in health. Our framework is organized around three sets of relationships.
Components of social support. — In the context of physical and psychological well-being, there is logical and empirical evidence that the components of social support are interrelated. Specifically, the type and amount of support (Krause, 1995) and, especially, the effects of network contacts (Connell & D’Augelli, 1990) and types of network contacts (Kessler et al., 1994; Oxman et al., 1992) are strongly associated with the perceived adequacy of support. Even for impairment in ADLs, the value of the type of support is probably as much from the perception of its adequacy as from the support itself (Antonucci, 1985; Wilcox et al., 1994). A critical issue is whether or not a hierarchy or ordering exists among the components of social support. As suggested by Kessler and colleagues (1994) and Krause (1995), the nature of these relationships is important for the design of interventions. On the one hand, if network contacts and the amount of support influence outcomes primarily through the perceived adequacy of support, then greater attention in interventions might be given to the cognitive processes mediating these influences. For example, if network contacts generate negative interactions, feelings of dependency, and the resulting perception of less adequate support, then interventions might focus more on cognitively minimizing negative interactions and perceptions. On the other hand, if network contacts and the type of support have direct outcome effects, independent of perceived adequacy, then interventions could focus more on social manipulations such as increasing the frequency or type of contact with emotionally close network members. Our previous work (Hann, Oxman, Ahles, Furstenburg, & Stukel, 1995; Oxman et al., 1992, 1994b) suggests that both types of relationships occur and should be included in a conceptual model. That is, network contacts have a direct or main effect as well as an indirect effect through perceived adequacy.

Social support and depression. — Two important aspects of the theoretical framework which have received the most attention are the buffering versus direct effects models of social support and the causal direction between social support and depression. The buffering model of social support postulates that social support moderates the power of psychosocial or biological stress to precipitate or exacerbate depression (Alloway & Bebbington, 1987; Broadhead et al., 1983; Gore, 1985). The direct effects model postulates that social support has a main effect on depression regardless of the presence or absence of stress. Most research suggests that buffering effects are inconsistent or weak while significant direct effects consistently occur regardless of the presence or absence of stress (Alloway & Bebbington, 1987; Andrews, Tennant, Hewson, & Vaillant, 1978; Aneshensel & Stone, 1982; Gore, 1985).

The causal direction between social support and depression is dependent in part on the severity and duration of the depression (Kessler et al., 1994; Krause et al., 1989). For example, older persons with major depressive disorder are likely to experience a decline in social support (Blazer, 1983). One of the consequences of such severe mood disorders can be social withdrawal and a more negative perception of social support. In contrast, subjects with acute, less severe levels of depression are more likely to have diminished social support precede the onset of depressive symptoms (Alloway & Bebbington, 1987; Brown, Bifulco, & Harris, 1987; Brugha et al., 1982). Because the majority of depressive symptomatology in the medically ill elderly does not reach the severity of major depression (Barrett, Barrett, Oxman, & Gerber, 1988; Blazer, Hughes, & George, 1987; Oxman et al., 1994a, 1994b), our framework includes the hypothesis of a unidirectional relationship from social support to depression.

Social support and ADL impairment. — Several different temporal relationships between social support and ADL impairment have been hypothesized (Stoller & Pugliesi, 1991; Wilcox et al., 1994). Longer-term social support is associated with weaker and conflicting effects on the incidence (Seeman et al., 1995) and course (Glass & Maddox, 1992; Wilcox et al., 1994) of ADL impairment. Theories hypothesized to explain this include unbalanced exchange theory (Dowd, 1975) and network attrition (Lewis & Meredith, 1988). Thus for longer periods (e.g., more than 6 to 12 months), the associations of social support with ADL impairment appear to diminish or change direction unless new events occur (Fontana et al., 1989; Glass & Maddox, 1992; Marottoli, Berkman, & Cooney, 1992). Shorter-term social support usually increases in response to greater frailty (Litwak, 1985). There is more consistent evidence that social support is associated with improved function after acute health events such as hip fracture (Cummins et al., 1988), stroke (Glass & Maddox, 1992), or cardiac surgery (King et al., 1993). The alternative pathway of the influence of ADL impairment on social support is not often investigated longitudinally. Nevertheless, this alternative path appears dependent on the time frame. Acutely, increased physical dependency increases the need for social support (Mor, Masterson-Allen, Houts, & Siegel, 1992; Wortman & Conway, 1985) and is likely to result in mobilization of that support. If ADL impairment is prolonged and irreversible, social support may dissipate (O’Brien, 1980; Tempelaar et al., 1989) or begin to have negative effects because of persistent dependence on others (Stoller & Pugliesi, 1991).

Hypotheses

In order to provide empirical evidence testing this theoretical framework in older persons facing an acute change in function, we investigated the relationship of social support components to physical and emotional outcomes in heart surgery patients. Based on the theoretical framework, the following groups of hypotheses were incorporated into a single structural equation model that was tested using data obtained from older heart surgery patients:

1. Social support. — The component of perceived adequacy is influenced by other social support components. Thus, we hypothesize that the perceived adequacy of social support at short-term (one-month) follow-up after a medical event is a positive function of (a) the number of network members seen regularly before the event and (b) the type and amount of support
provided before the event. A similar relationship exists between the short-term follow-up and a somewhat longer-term (6-month) follow-up.

2. Depression. — The theoretical framework we are testing includes a unidirectional path from social support to depression. Because previous research has so consistently found impaired physical function to be a strong predictor of depression, we also include the influence of impairment in ADLs on depression. In view of the evidence against a direct effect of the amount of support received, we do not include a direct effect of this component. Thus, we hypothesize that depressive symptoms at short-term follow-up are a negative function of (a) the perceived adequacy of support pre-event and (b) the number of network members seen regularly pre-event, and a positive function of (c) the amount of impairment in pre-event ADLs. Similar relationships exist between predictors assessed at the short-term follow-up and depression at the longer-term follow-up.

3. ADL impairment. — In the theoretical framework of an acute change in function, the path from social support to impairment in ADLs is also unidirectional. Impairment in ADLs at short-term follow-up is a negative function of (a) the perceived adequacy of support and (b) the number of network members seen regularly pre-event. Similar relationships exist between the short-term follow-up and the longer-term follow-up.

Patient Population

Angina pectoris, from coronary artery disease or aortic stenosis, is a major contributor to disability in the 20% of community-dwelling elderly who require some form of home assistance to avoid institutionalization. Angina pectoris and aortic stenosis are both common in the elderly and also conditions with a definite known pathology. In a sizable proportion of patients, symptoms become refractory to medical management and surgery is indicated. Surgery changes the pathology in these conditions, with a documented improvement in physiologic status. Variability in the amount of impairment after surgery can be attributed largely to causes other than cardiac pathology. Social support has been shown to be a significant predictor of the variability of impairment in ADLs and of emotional status in patients with cardiac disease (Bramwell, 1990; King et al., 1993; Kulik & Mahler, 1993; Riegel, 1989; Oxman et al., 1994b; Wilcox et al., 1994). Thus, testing the theoretical framework with older heart surgery patients has several methodological advantages over previous panel studies or tests of the stress buffering model (Kessler et al., 1994). In contrast to sudden, unpredictable events that change function (e.g., disasters, stroke, or hip fracture), examination of elective cardiac surgery patients provides an adequate evaluation period that is both temporally close and antecedent to the event. The elective surgery evaluation also provides a sufficiently calm milieu in order to obtain a comprehensive psychosocial assessment before the event of function-changing surgery. As a consequence, the role of social support in the subsequent variability of improvement in function can be examined.

METHODS

Subjects

Subjects were patients 55 years of age or older from the practices of the cardiothoracic surgeons of the Dartmouth-Hitchcock Medical Center. We selected subjects undergoing elective cardiac surgery for coronary artery bypass grafting (CABG), aortic valve replacement (AVR), or both. Although these diseases have different pathophysiologies, the surgical interventions are similar and associated with an immediate but variable increase in function. Evidence has suggested that the particular conditions leading to cardiac surgery are less important than the reversibility of functional impairment from the same type of cardiac surgical intervention (Jenkins, Stanton, & Jono, 1994; Oxman et al., 1994a, 1994b, 1995).

Patients who were scheduled and underwent elective surgery during the period November 1990 through November 1994 were eligible for this study (n = 243) if they were referred for surgery because of failure of medical management or intolerable side effects to medical management of cardiovascular symptoms. Based on a clinical interview by a psychiatrist (TEO) and a Mini-Mental State Examination (Folstein, Folstein, & McHugh, 1975) score less than 24, we excluded three patients with cognitive impairment. Of the remaining patients, 200 (82%) were entered. Reasons for nonentry included refusal (n = 10) and scheduling conflicts for the patient and interviewer to meet before surgery (n = 30). Nine patients withdrew after surgery, 24 died during or after surgery, and 20 did not adequately complete the self-report forms. Medical history, operative data, and psychosocial data were thus complete for 147 (74%) of the individuals who entered this study. A total of 98 (67%) patients underwent CABG only, 31 (21%) AVR only, and 18 (12%) both.

Procedures

After complete description of the study to the subjects, written informed consent was obtained. Patients were interviewed by a board-certified geriatric psychiatrist (TEO) who administered three interviewer-assisted measures to assess functional impairment, depression, and social networks. Based on information from a semi-structured diagnostic interview (Barrett et al., 1988), the psychiatrist completed observer-rated measures to quantify depressive symptoms. Patients were asked to complete self-report measures assessing type and amount of support and the perceived adequacy of support. After hospitalization, a research intern reviewed each participating subject's medical chart to record medical and surgical variables. All patients were routinely scheduled for a one-month follow-up appointment with their cardiac surgeon. At that appointment, the patient completed the self-report forms and the psychiatrist again administered the semi-structured interview, interviewer assisted measures, and completed observer ratings. Six months after surgery, all subjects were asked to complete the self-report forms and participate in a final follow-up interview at which the psychiatrist again administered the semi-structured interview, interviewer assisted measures and completed observer ratings. For the purpose of reporting the results, the three measurement periods were designated time 0 (presurgery),
Measures

To assess depression we used the interview-based 17-item Hamilton Rating Scale for Depression (HAM-D; Hamilton, 1963), ranging from 0 to 53 for the single rater version used in this study. The HAM-D has shown reliability and validity in measuring depression in both heart surgery patients (Eriksson, 1988; Gundle, Reeves, Tate, Rait, & McLaurin, 1980; Oxman et al., 1994b) and elderly nonpsychiatric patient groups (McDowell & Newell, 1987).

ADLs were measured using the interview-administered Sickness Impact Profile (SIP; Bergner, 1978). The SIP measures functional impairments from illness and consists of 136 statements in 12 categories. All items concentrate on changes in performance. The subject is instructed to respond "yes" to a statement only if sure it describes him/her at the time of questioning and is related to health status. Category scores are calculated by adding predetermined relative scale values for each item responded "yes" within the category, dividing by the maximum possible score for that category, and then multiplying by 100. The potential range for each category is 0 to 100. Three categories — ambulation, mobility, body care, and movement — are summed to form the "physical dimension," a basic ADL measure. In this study we used only the physical dimension score because the full SIP score contains items that overlap with social support and depression. Although the majority of the work on reliability and validity has been done using the total score, in other studies (e.g., Ott et al., 1983; Oxman et al., 1994b) reliability of the physical dimension score of the SIP has been sufficiently high.

To assess social networks we used the interview-based Social Network Questionnaire (SNQ) from the New Haven site of the Established Populations for the Epidemiologic Study of the Elderly (EPESE; Seeman & Berkman, 1988). As a summary measure we used the total number of emotionally close network members (children, relatives, friends) who were seen regularly, i.e., at least once per month. To assess type and amount of support provided by the network we used the Inventory of Socially Supportive Behaviors (ISSB; Barrera & Ainsley, 1983), a 40-item self-report of support received. The respondent rates each item's frequency during the preceding month using a 5-point scale. A summary score was obtained by adding the scores for each of the 40 items (range 40 to 200). A score for each subtype of support was derived by adding appropriate item scores from the three factors identified by Caldwell and Reinhart (1988): emotional (range 13–65); guidance (range 12–60); tangible (range 6–30). The ISSB has demonstrated good internal and test-retest reliabilities (Barrera & Ainsley, 1983; Oxman et al., 1994b). To assess perceived adequacy of support we used the Multidimensional Scale of Perceived Social Support (MSPSS; Zimet, Dahlem, Zimet, & Farley, 1988). The MSPSS is a 12-item self-report measure using a 7-point scale from "very strongly disagree" to "very strongly agree." Item scores are averaged for a total ranging from 1 to 7. It provides a summary score as well as three subtype scores for perceived adequacy of support from a significant other, family, and friends. The availability of assessing the network source of perceived adequacy is an important advantage of this measure (Kessler et al., 1994; Oxman et al., 1992, 1994b). Internal and test-retest reliability are high, and validity has been demonstrated in patients undergoing coronary angiography (Blumenthal et al., 1987), open heart surgery (Oxman et al., 1994b), or suffering metastatic cancer (Hann et al., 1995).

Relevant control variables that could influence depression, basic ADLs, or social support included the sociodemographic variables of age, sex, and income for the past year, and the biomedical variables of ejection fraction (a presurgery physiological measure of heart function), number of minutes the subject was on the heart/lung bypass machine during surgery, and surgical complications. Surgical complications such as severe anemia, persistent arrhythmia, delirium, or wound infection were monitored and coded as a binary variable of "none" versus "one or more." Because 97% of the subjects were Caucasian, race was not considered in the analyses.

RESULTS

The sample used in the analyses consisted of 30% females and 70% males. The average age was 69 years (SD 7) with a range of 55 to 91. Seventy-nine percent were married. The distribution of total household income was 11% less than $10,000, 31% between $10,000 and $20,000, and 58% greater than $20,000. The distribution of education was 29% less than a high school education, 29% with a high school education, and 42% with one or more years of college education.

Table 1 shows the means, standard deviations, and reliability coefficients for each of the measures used in the analyses along with the correlations between the measures. The mean HAM-D depression scores presurgery and one month postsurgery were 4.44 (SD 4.44) and 5.14 (SD 5.08), respectively. The mean HAM-D depression score at 6 months was 4.12 (SD 5.20) with a range of 0 to 18. Twenty-four patients (16%) had a score of 10 or greater at 6 months, a score associated with clinically significant depression in a previous study (Oxman et al., 1994a). Thirty-eight patients (26%) had a score of 6 or greater at 6 months, a cut score used as a sign of lack of resolution of major depression in the NIMH Collaborative Study on the efficacy of various therapies in depressed patients (Elkin et al., 1989).

Mean SIP physical dimension presurgery was 4.51 (SD 3.34), range 0 to 20.5. In 60% of subjects, the limitations in basic ADLs were due only to cardiovascular disease. These limitations were expressed primarily on the ambulation items of the SIP. Thirty percent of subjects had another medical condition that may have contributed to limitations, and another 10% had two or three other potentially limiting medical conditions. The most common other medical conditions were endocrinological (14%), pulmonary (13%), neurological (9%), renal (8%), and musculoskeletal (8%). Mean SIP physical dimension score one month after surgery was 2.49 (SD 3.14) and 6 months after surgery was 1.29 (SD 3.28), range 0 to 23.6. Although the mean level dropped significantly from presurgery (t = 12.2, p = .0001), there was still a wide range of ADL impairment 6 months after sur-
Table 1. Correlations, Means, Standard Deviations, and Reliability Coefficients of Social Support, Depression, and ADL Variables*

<table>
<thead>
<tr>
<th>Variables</th>
<th>Time 0</th>
<th>Time 1</th>
<th>Time 2</th>
</tr>
</thead>
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<tr>
<td></td>
<td>1 2 3 4 5</td>
<td>6 7 8 9 10</td>
<td>11 12 13 14 15</td>
</tr>
<tr>
<td>Time 0 = Presurgery</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>1 Perceived Adequacy of Support</td>
<td>1.00</td>
<td>0.42****</td>
<td>-0.31***</td>
</tr>
<tr>
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<td>0.01</td>
<td>-0.09</td>
</tr>
<tr>
<td>3 Number of Close Network Members Seen ≠ 1/mo.</td>
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<td>-0.14</td>
<td>0.01</td>
</tr>
<tr>
<td>4 HAMD Depression</td>
<td>1.00</td>
<td>0.22**</td>
<td>-0.14</td>
</tr>
<tr>
<td>5 SIP Physical Dimension</td>
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<td>-0.07</td>
</tr>
<tr>
<td>Time 1 = 1-month Postsurgery</td>
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<td></td>
<td></td>
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<tr>
<td>6 Perceived Adequacy of Support</td>
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<td>0.47****</td>
<td>0.17*</td>
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<tr>
<td>7 Type and Amount of Support Received</td>
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<td>0.01</td>
<td>-0.06</td>
</tr>
<tr>
<td>8 Number of Close Network Members Seen ≠ 1/mo.</td>
<td>1.00</td>
<td>-0.14</td>
<td>-0.09</td>
</tr>
<tr>
<td>9 HAMD Depression</td>
<td>1.00</td>
<td>0.19*</td>
<td>-0.09</td>
</tr>
<tr>
<td>10 SIP Physical Dimension</td>
<td>1.00</td>
<td>-0.10</td>
<td>0.01</td>
</tr>
<tr>
<td>Time 2 = 6-months Postsurgery</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11 Perceived Adequacy of Support</td>
<td>1.00</td>
<td>0.28***</td>
<td>0.15</td>
</tr>
<tr>
<td>12 Type and Amount of Support Received</td>
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<td>0.11</td>
<td>0.01</td>
</tr>
<tr>
<td>13 Number of Close Network Members Seen ≠ 1/mo.</td>
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<td>-0.20**</td>
<td>-0.18*</td>
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<tr>
<td>14 HAMD Depression</td>
<td>1.00</td>
<td>0.28***</td>
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</tr>
<tr>
<td>15 SIP Physical Dimension</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
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<td>Coefficient Alpha</td>
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<td>— 0.75</td>
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Analyses reported in the text are based on five decimal place accuracy. Readers interested in exact replication of the models should contact the authors for the complete matrix.

*p ≤ .05; **p ≤ .01; ***p ≤ .001; ****p ≤ .0001.
surgery, with some patients showing increased rather than expected decreased functional impairment.

Measurement reliability is an important issue which could affect the validity of our results. Accordingly, we evaluated internal consistency reliability using coefficient alpha. Table 1 shows our reliability scores. For research at this stage of hypothesis testing, reliabilities of .70 to .80 are usually considered adequate (Nunnally, 1978). All of the reliabilities were in or above this range.

Covariance Structure Models

All covariance structure models were conducted using the statistical program EQS (Bentler, 1989) applied to the covariance matrix of the observed variables. In order to test the adequacy of our theorized model, we used a procedure widely recommended by structural equation modelers (see Anderson & Gerbing, 1988). This procedure involves specifying a series of nested models: (a) a rudimentary base model, (b) a theorized structural model that includes all of the paths in the base model plus a set of additional paths that were theorized a priori, and (c) post-hoc models that differ from the theorized model in that they allow paths that were not theorized a priori but which modification statistics suggest might improve the fit of the model had they been included. In order to demonstrate the utility of one’s theorized model: (a) it should fit significantly better than the base model, (b) the theorized paths that distinguish it from the base model should themselves be statistically significant on an individual basis, and (c) very few post-hoc modifications should exist that would improve the fit of the theorized model.

Base model. — Typically, a base model includes all of one’s measurement assumptions along with rudimentary structural assumptions that are not the focus of the investigation but that are necessary to provide an adequate test of one’s hypotheses. The base model (see Figure 1) included (a) intercorrelations among all of the variables at time 0 (i.e., among the “exogenous” variables) and (b) paths representative of the assumption that each variable is in part a function of itself at a previous point in time (i.e., first and second order autoregressive paths). The base model provided a reasonable fit to the data, \( \chi^2(80) = 125.96, p < .001 \), CFI = .94, and is depicted in Figure 1. In support of the base model assumptions, all variables were significantly associated with themselves through time (all \( p < .025 \)).

Theorized structural model. — The theorized structural model contains all of the paths included in the base model, plus those specific paths that are theorized a priori on the basis of the researchers’ hypotheses about causes and effects. In our case, the theorized model differed from the base model in that it contained 14 additional paths associated with two sets of seven hypotheses each (see Figure 2). The first set of these hypotheses can be stated as follows:

1. Perceived social support at time 1 is a positive function of the type and amount of social support at time 0;
2. Perceived social support at time 1 is a positive func-

![Figure 1. Base structural model for relationship among ADL impairment, depression, and social support components. Values associated with single-headed arrows represent first and second order autoregressive path coefficients (all coefficients significant at \( p < .05 \)). Double-headed arrows represent correlations among exogenous variables (values appear in Table 2). Values within circles represent residual variances.](image)

<table>
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<th>Table 2. Baseline Structural Model Correlation of Exogenous Variables</th>
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*\( p \leq .05; \) **\( p \leq .001.\)
The second set of seven hypotheses were identical to the above seven hypotheses except that they referred to relationships between predictors at time 1 and outcomes at time 2 (as opposed to predictors at time 0 and outcomes at time 1).

An overall test of the theoretical model yielded a reasonable fit of the data, $\chi^2(46) = 94.04, p = .01$, CFI = .96, and a fit that was significantly better than the base model, difference $\chi^2(14) = 31.92, p < .005$. The 14 additional parameters included in this model are depicted in Figure 2 along with their respective paths. Paths associated with statistically significant parameters appear as solid lines; paths associated with parameters that did not achieve significance appear as dashed lines. $+p < .10, *p < .05$.

Theoretical structural model for relationship among ADL impairment, depression, and social support components. All parameters associated with the base model estimated but not depicted. Paths shown are the 14 additional parameters from hypothesized relationships. Paths associated with statistically significant parameters appear as solid lines; paths associated with parameters that did not achieve significance appear as dashed lines. $+p < .10, *p < .05$.

Figure 2. Theoretical structural model for relationship among ADL impairment, depression, and social support components. All parameters associated with the base model estimated but not depicted. Paths shown are the 14 additional parameters from hypothesized relationships. Paths associated with statistically significant parameters appear as solid lines; paths associated with parameters that did not achieve significance appear as dashed lines. $+p < .10, *p < .05$.

Post-hoc models. — Although our theorized model provided a reasonable fit to the data and support for multiple theorized paths, the logic of structural equation modeling requires us to consider a variety of alternative models that (a) might provide a better fit of the data, (b) might alter our conclusions regarding the significance of specific parameters within the model, or (c) might fit the data as well as our model but use fewer parameters (i.e., provide a more “parsimonious” model). Post-hoc Models 1, 2, and 3 all start with our theorized model and add paths that we did not theorize. Post-hoc Model 1 includes specific paths that we did not theorize (but that others have) linking depression to subsequent ADL impairment. Post-hoc Model 2 adds a variety of control variables that might plausibly reduce the statistical significance of our theorized paths. Post-hoc Model 3 considers all reasonable lagged effects not included in the theorized model. Although a set of logical restrictions were applied (e.g., no effects that flow backwards in time), parameters were added simply on the basis of their ability to improve the fit of the model. Post-hoc Model 4 dropped all of the paths in our theorized model that were associated with nonsignificant parameters to arrive at a more parsimonious “trimmed” model. Finally, because of sample size limitations, our theorized model was initially tested using observed variables rather than latent variables with subcomponents. In contrast, Post-hoc Model 5 treated perceived social support and type/amount of social support as latent variables with multiple subcomponents. Although the resulting model does not meet conventional recommendations regarding subject-to-parameter ratios, as an exploratory approach it allows for the examination of modification statistics indicative of potential subcomponent effects (see Hull, Lehn, & Tedlie, 1991).
Post-hoc Model 1: Depression and subsequent ADL impairment. — One clear advantage of longitudinal as opposed to cross-sectional research designs is that the former but not the latter allow for tests of bi-directional hypotheses. For example, we theorized and found support for the association of ADL impairment (at time 1) with subsequent depression (at time 2). We did not specifically test for the reverse association of depression with subsequent ADL impairment. Nevertheless, tests for such associations could provide important insights into the relation among these two variables. The initially theorized model was therefore modified to include two additional paths linking (a) presurgery depression with one-month postsurgery ADL impairment, and (b) one-month postsurgery depression with 6-month postsurgery ADL impairment. This model did not fit better than the initially theorized model, difference $\chi^2(2) = 2.65, p > .25$. In addition, neither the path linking time 0 depression with time 1 ADL impairment nor the path linking time 1 depression with time 2 ADL impairment achieved conventional statistical significance (standardized $\gamma = -.02, z = -.18$, n.s. and standardized $\beta = -.11, z = -1.66, p < .10$, respectively), although the latter effect approached conventional levels of significance.

Post-hoc Model 2: Control variables. — A second post-hoc model began with the initially theorized model and added a set of control variables. Four variables (sex, age, income level, and ejection fraction) were assessed presurgery and two variables (bypass minutes, surgical complications) were assessed after surgery in order to account for extraneous sociodemographic and medical factors in our analyses. Although we were not interested in such variables from a theoretical perspective, these variables have been predictors of depression or ADL impairment in other research. Our initially theorized model was therefore modified to include all six control variables as intercorrelated exogenous variables that served as predictors of one-month postsurgery depression and ADL impairment and 6-month postsurgery depression and ADL impairment. None of the control variables proved to be significant predictors of one-month postsurgery depression, one-month ADLs, or 6-month ADLs. Six-month postsurgery depression was significantly related to age (standardized $\gamma = -.16, z = -2.31, p < .05$). Being older was associated with less depression, consistent with epidemiologic findings (Blazer, Hughes, & George, 1987). Inclusion of this predictor did not diminish the significance of any of the theorized predictors of 6-month postsurgery depression (perceived social support, network size, and ADL impairment) reported earlier.

Post-hoc Model 3: Exploratory effects. — A third set of analyses considered all lagged effects not included in the model with the following exclusions: (a) reverse temporal effects and (b) cross-sectional effects. None of the considered effects significantly improved the fit of the model. The primary reason for conducting these analyses was to provide a different way of assessing the adequacy of the initially theorized model. In an important sense, the lack of significant LM tests provides additional confirmation of the adequacy of the initially theorized model. Thus, models are composed of paths theorized to be necessary and paths theorized to be unnecessary to account for relations among variables. Although one cannot confirm the null hypothesis, one’s confidence in the original model is increased to the extent that modification statistics suggest that nontheorized paths would not improve the fit of the model if they were added.

Post-hoc Model 4: Trimmed model. — Post-hoc Model 4 began with the theorized model and then dropped the 8 non-significant paths to yield a more parsimonious model. This trimmed model is depicted in Figure 3, provided a reasonable fit to the data, $\chi^2(74) = 99.07, p < .03, CFI = .97$, fit significantly better than the base model, difference $\chi^2(6) = 26.89, p < .001$, and did not differ in fit from the initially theorized model, difference $\chi^2(8) = 5.03, p > .50$. According to this model, (a) increased network members seen regularly is associated with subsequent increases in perceived social support; (b) increased network members seen regularly and perceived adequacy of social support are associated with decreases in depression, whereas ADL impairment following surgery is associated with subsequent increases in depression; (c) increased network members seen regularly and perceived adequacy of social support are associated with decreases in depression; and (d) most of these effects are qualified by measurement period such that they appear between the presurgery and one-month postsurgery, or one-month postsurgery and 6-month postsurgery, but not in both time intervals.
Post-hoc Model 5: Subcomponent effects. — As a final exploratory model, both perceived adequacy of support and social support type and amount were modeled as latent variables with multiple subcomponent indicators. The latent variable of perceived adequacy of support was composed of three observed indicators (perceived adequacy of support from friends, family, and significant other). The latent variable of type and amount of social support was composed of three observed indicators (emotional, guidance, and tangible support). Substituting these latent variables for their observed counterparts in the original theorized model yielded a model with reasonable fit, $\chi^2(276) = 382.97, p < .001, \text{CFI} = .95$.

Creating such a model allows one to investigate (a) the viability of a latent variable structure for social support measures, and (b) potential specific effects of social support subcomponents (Hull et al., 1991; Hull, Tedlie, & Lehn, 1995). In support of the former, both latent variables were significantly associated with all of their respective indicators at all three points in time (all $p < .001$). Furthermore, the associated factor loadings were relatively sizeable (> .60 for perceived social support indicators; > .47 for type and amount indicators) and stable over time.

In order to identify potential effects of the subcomponents of these two latent variables, we examined Lagrange Multiplier (LM) test statistics (Bentler, 1989) for each of the six hypothesized longitudinal effects of latent variables. In all cases, the longitudinal effect of the latent variable itself was included in the model such that in order for a subcomponent effect to improve the fit of the model it had to account for variance in the outcome variable over and above the effect of its associated latent variable. Only one effect passed this test: a specific effect associating perceived adequacy of support from friends at time 1 on ADL impairment at time 2, $\chi^2(1) = 4.45, p < .04$, such that perceived adequacy of support from friends one month following surgery had a unique effect of improving ADL impairment 6 months following surgery.

DISCUSSION

The results of this study describe a dynamic and complex relationship among social support components, impairment in ADLs, and depressive symptoms. Our tests of the base structural model reveal high autocorrelations suggestive of relative stability in the components of social support over a 7-month time despite the potential crisis of open heart surgery. The social support autocorrelations are greater than those of depression or ADL impairment. Nevertheless, the relationships between social support and depression or ADL impairment change over time. This is consistent with other longitudinal studies with assessments at more than two points in time (Aneshensel et al., 1984; Kaniasty & Norris, 1993).

The results of this study also support the theorized structural model of (a) the importance of perceived adequacy of support, and (b) both mediating and direct effects for the social network component. These results replicate previous research findings of significant associations between perceived support and depression/ADLs and the lack of significant associations between the type and amount of social support and depression/ADLs. In addition, the social network component (total number of emotionally close network members seen regularly) related to depression and ADL impairment indirectly through the perceived adequacy of support. Specifically, before surgery, regularly seeing a larger number of close network members was associated with the perception of more adequate social support one month after surgery. In turn, the perceived adequacy of support one month after surgery was associated with less depression and less impairment in ADLs at 6 months. In addition to its indirect effects via the perceived adequacy of support, the number of close network members seen at least monthly was also directly associated with less depression and less impairment in ADLs. This is important because it suggests that perceived adequacy of support is dependent on one of the other two fundamental components of social support. Finally, impairment in basic ADLs was directly associated with subsequent depression. This association was unidirectional in that depression in these heart surgery patients was not subsequently associated with more impairment in ADLs. All of these direct and indirect effects are consistent with initial predictions. At the same time, it must be acknowledged that some predicted effects did not achieve significance or proved significant within one but not both time intervals.

Social Support and Depression

Direction of association. — Several longitudinal studies have suggested that there is an association between social support and depression (Alloway & Bebbington, 1987; George et al., 1989; Henderson, Duncan-Jones, Byrne, & Scott, 1980; Kessler et al., 1994; Oxman et al., 1992). However, in these studies, depression may have influenced social support as much or more than social support influenced depression (Blazer, 1983). Longitudinal studies such as the present one can examine the potential bidirectionality of the association between depression and social support. Whereas support was found for the association of low social support and subsequent depression, modification statistics did not suggest that depression was associated with subsequent changes in social support. The finding that the direction from social support to depression is stronger and more frequent than the reverse is consistent with other studies using covariance structure modeling in longitudinal designs (Kaniasty & Norris, 1993; Krause et al., 1989; Matt & Dean, 1993).

Social support components and stress buffering. — The events covered at the presurgery assessment (including activity limited by health and the threat of death or disability from the impending open heart surgery [Allen, 1990]) could be viewed as sufficiently stressful for a stress-buffering model to apply (Alloway & Bebbington, 1987; Gore, 1985). Similarly, the events covered at the one-month postsurgery assessment (including surgical and hospitalization experiences and the substantial chest and leg wound healing) could be viewed as sufficiently stressful for the model to apply (Bramwell, 1990; Kulik & Mahler, 1993). Despite the apparently appropriate context for stress-buffering effects, none of the presurgery measures of social support compo-
ments had a significant relationship to depression one-month postsurgery.

In contrast, some social support components one month following surgery were related to depression at the apparently less stressful 6-month postsurgery measurement period. This latter period included adaptation to improved cardiovascular status and a return to previously limited activities with less pain and less threat of death (Mayou, 1986). Despite this less stressful period, both the perceived adequacy of support and the number of emotionally close network members seen in the month after surgery had direct relationships to depression 5 months later. This finding of a stronger association of social support with depression at a subsequently less stressful time period appears to be somewhat inconsistent with a stress buffering model. However, at least for immediate postsurgery stress this may be the manifestation of a delayed result of the effects of social support or of the longer time interval between assessments. It appears best, then, to view the present research as consistent with at least some aspects of a stress-buffering model. Similar conclusions were recently reported by Gerin, Milner, Chawla, and Pickering (1995).

ADL impairment and depression. — The finding that one-month postsurgery impairment in ADLs is significantly associated with depression 6 months after surgery is consistent with a variety of studies in older persons in which limitations in physical function are associated with depression (Berkman et al., 1986; Bowling & Farquhar, 1991; Oxman et al., 1992; Turner & Noh, 1988). Perhaps more important in this study is the finding that depression is not associated with subsequently greater impairment in ADLs over the short-term. (Indeed, post-hoc Model 1 revealed a near significant effect in the opposite direction.) In contrast, Aneshensel (1984) found that depression had a significant lagged effect on increasing levels of less severe but more prevalent morbidity such as colds, flu, and chronic pain. It is possible that in our sample some effects of depression on unmeasured minor illnesses may have occurred or that over longer time periods a cumulative effect of these illnesses on ADLs might begin to appear. Similarly, in a more heterogeneous sample of health conditions over a longer period of time, Rodin and McAvay (1992) found a relationship between depression and perceived health. Nevertheless, the absence of a short-term effect of depression on a functional health measure such as ADL impairment means that the effects of social support on ADLs are not mediated by depression in our study.

Social Support and Impairment in ADLs

For ADLs there seems to be clear support for the direct effects of social support. For 6-month postsurgery ADLs, perception of adequate support one month following surgery had a direct association with less impairment. This association of perceived adequacy of support with less limitation in ADLs is consistent with results from survey studies (Antonacci, 1985).

For one-month postsurgery ADLs, the number of emotionally close network members seen at least monthly also had a near significant direct association with less impairment. This is consistent with evidence for other outcomes suggesting that having in-person contacts with emotionally close network members is an important operative dynamic of network size (Bowling & Farquhar, 1991; Kulik & Mahler, 1989, 1993; Oxman et al., 1992; Seeman & Berkman, 1988). In this regard, Magaziner, Simonsick, Kashner, Hebel, and Kenzora (1990) found that post-hospital network contact, not network size per se, predicted ADLs at one year. Kulik and Mahler (1989) found that married heart surgery patients had an in-hospital recovery advantage if and only if they were actually visited by their spouses. One possible mechanism for the importance of these types of network contacts is that face-to-face contact affects both emotional and physical outcomes via universal, autonomic reactions to facial expression (Levenson, Carstensen, Friesen, & Ekman, 1991). For example, the work of Gerin et al. (1995) suggests that the mere presence of a supportive person in the room has stress-buffering effects on cardiovascular reactivity as well as effects on the perception of stress.

Potential Importance of Subcomponents

Although the subcomponent analysis must be considered preliminary in view of the small sample size, there is sufficient empirical evidence that subcomponents should be considered across the natural history of an illness (Kessler et al., 1994), particularly in the elderly (Fontana et al., 1989, 1993; Oxman et al., 1992). Of the hypothesized tests for the subcomponents of perceived adequacy of support and type of support (post-hoc Model 5), one effect proved to be significant beyond the effect of its respective latent variable: Perceived adequacy of support from friends one month after surgery was associated with less impairment in ADLs at 6 months. Because friendship is voluntary and without the normative obligation of family members, the contact with friends may have a different, more potent meaning (Albrecht & Adelman, 1987; Crohan & Antonucci, 1989; Kaniasty & Norris, 1993; Matt & Dean, 1993). This somewhat special effect of friendship appears to be phase-specific (Hegelson, 1993; Kaniasty & Norris, 1993). During the stressful presurgical illness period, friendship did not appear to have the same significant effect it had during the physically demanding, but less life-threatening postsurgical period.

Limitations

There are at least four limitations to the current findings. First, the size of the sample (N = 147) set constraints on the complexity of the models we considered. Most notably, we restricted the principal tests of our hypotheses to a model that incorporated observed as opposed to latent variable representations of the perceived adequacy of social support and the type and amount of social support. Although the sample size is small even for this observed variable model, it should be kept in mind that data of the type represented in the current study (complete longitudinal data on surgical patients from three points in time) are difficult and expensive to collect and as a consequence are relatively rare in the literature. Despite the limitation imposed by size, it offers distinct advantages insofar as it represents reactions to a discrete, identifiable stressor that is both common and severe (i.e.,
surgery), with a clearly delineated time-course, in a population that is both especially vulnerable to stress and responsive to beneficial social support. Thus, we feel that the present sample, small though it may be, offers a uniquely valuable opportunity to test our multi-component model of social support.

In addition to the relatively small size of the sample, it excludes those whose data were incomplete, who died, withdrew, or were otherwise lost to follow-up. We tested for differences between those with complete data and those who had baseline data but other incomplete data. Of the variables used in the models, three demonstrated significant differences. Those with incomplete data had more impairment in basic ADLs (5.5 vs 4.2), lower perceived adequacy of support from a significant other presurgery (6.1 vs 6.4), and were more likely to be male (82% vs 69%). There was also a trend ($p < .10$) toward lower education in those with incomplete data. Those not included in the analyses, however, did not differ significantly in any of the other social support variables, depression, disabling medical conditions, or income.

Third, the results may only apply to older cardiac surgery patients. Although the importance of emotional support does not appear to differ among studies of different types of surgery (Bloom & Kessler, 1994), tangible support may be more important in other surgical conditions, such as hip fracture, for reducing impairment in ADLs (Kiel, Eichorn, Intrator, Silliman, & Mor, 1994; Magaziner et al., 1990). Also, our results may apply only to elderly patients in northern New England. There may be some important differences in our particular rural New England population, for example its low rate of minorities compared to urban settings (Oxman et al., 1992) and the associated differences in education and income.

Fourth, it is possible that unmeasured factors such as self-efficacy, social competence (extraversion), or neuroticism, rather than social support, could account for these results (Redeker, 1992). Seeman et al. (1995) found that social support variables but not psychological characteristics, such as self-efficacy, predicted physical performance over a 2-year period. In other work looking at mortality and at depression at only two time points (Oxman et al., 1994b, 1995), we did include some basic measures of neuroticism and extraversion. In the former study, the personality traits were not related to mortality. In the latter study, the significant relationship of the personality traits was mediated by social support (rather than serving to mediate the effects of social support). Nevertheless, larger replications with measures of self-efficacy, social competence, and neuroticism may be useful.

**Implications**

The results of this study clearly replicate previous research establishing the importance of the perceived adequacy of social support for health outcomes. More specifically, this and other studies now also provide substantial empirical support for the design of social support interventions for older patients undergoing cardiac surgery. As recently pointed out by Krause (1995), there are at least two alternative perspectives that need to be considered in the design of interventions. The first, more traditional perspective is that the benefits of social support come primarily from positive aspects such as the helpful behaviors from network members or the self-esteem boosting, mood-elevating effects of being with close social network members. The second perspective emphasizes decreasing negative interactions or burdensome feelings of the need to reciprocate support, rather than simply increasing helpful behaviors or network member contacts. Although the present study was not designed to distinguish positive from negative contacts with emotionally close network members, it does appear that positive contacts predominate. Regularly seeing a greater number of emotionally close network members was associated with a subsequent increase in perceived adequacy of support and decreases in depression and ADL impairment. Such results suggest that interventions that could increase the number of emotionally close network members seen on a regular basis might have positive effects through multiple mechanisms. At this point, randomized controlled intervention trials seem justified and are likely to add the greatest clarification regarding the benefits and practicality of directly versus indirectly influencing the perceived adequacy of support.

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