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Social Ties and Cancer

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The possible role of the social environment in cancer risk and survival has received considerable attention over the last 15 years. Much of the impetus for this interest derives from increasing evidence that social ties are related to both endocrine and immune responses thought to play a role in the risk for cancer and the progression of disease (1,2). However, evidence for the role of social networks in the onset and progression of cancer has been unclear. Some of the confusion derives from inconsistency in the quality of published studies, from differences in conceptualization of social network variables, and from a failure to consider whether relations with the social network may differ across patient gender, stage of disease, and cancer site. The purpose of this chapter is to evaluate the role of social ties in the onset and progression of cancer. We begin by addressing the plausibility of social environmental influences on the pathogenesis of neoplastic disease. We propose psychologic, behavioral, and biological mechanisms that could link social ties to cancer. Next, we review over 30 studies that have examined the relation of the social environment to cancer. We distinguish between studies of cancer incidence and mortality among healthy people and of length of survival and time to recurrence among those already afflicted with the disease. Finally, we summarize the work we review, discuss its limitations, and propose guidelines for future work.

Social networks can have both positive and negative effects on health and well-being. It is generally believed that positive effects are attributed to strong network ties and to resources that the network can provide when persons are in need (3). Negative effects are primarily attributed to social conflict and social threats to self-esteem and self-concept (4,5). The research linking social networks to cancer has focused on the characteristics of the environment thought to result in beneficial effects on health. For this reason, the term "social support" is often used in describing this literature.

PATHWAYS LINKING THE SOCIAL ENVIRONMENT TO CANCER

How could social networks contribute to the onset and progression of cancer? Figure 10–1 presents a simplified model of the mechanisms by which social ties can influence disease risk and progression. Simply, positive characteristics of the social environment are associated with *cognitive benefits* such as increased access to information, and feelings of control, self-esteem, and optimism, and with *affective benefits* such as the experience of more positive and fewer negative emotions (6). In turn, these psychologic characteristics can influence *behavioral* and *biologic* responses that are thought to play a role in the onset and progression of cancer. For example, greater self-esteem might result in increased motivation to care for oneself. This can be manifest in behaviors associated with decreased risk of cancer incidence and mortality (e.g., quitting smoking, improving diet), early cancer detection (e.g., self-examinations, routine screenings), timely response to symptoms, and improved compliance with medical regimens. Similarly, by preventing negative emotional reactions, social ties can buffer against disturbances of the neuroendocrine and immune systems thought to contribute to disease pathogenesis (see 1,7).

At a more detailed level, the beneficial effects of the social environment are thought to occur as a function of two processes: *(1)* network membership and social interaction directly increase positive cognitions, emotions, and behaviors, and *(2)* social networks help ameliorate the deleterious effects of stressful life events by providing coping resources such as emotional, informational, and instrumental support (3,6). The former is termed the "main (or direct) effect" hypothesis and the latter the "stress-buffering" hypothesis. Either of these hypotheses may explain the relations between social ties and cancer that we report in this review, as studies are not designed to distinguish between the two.

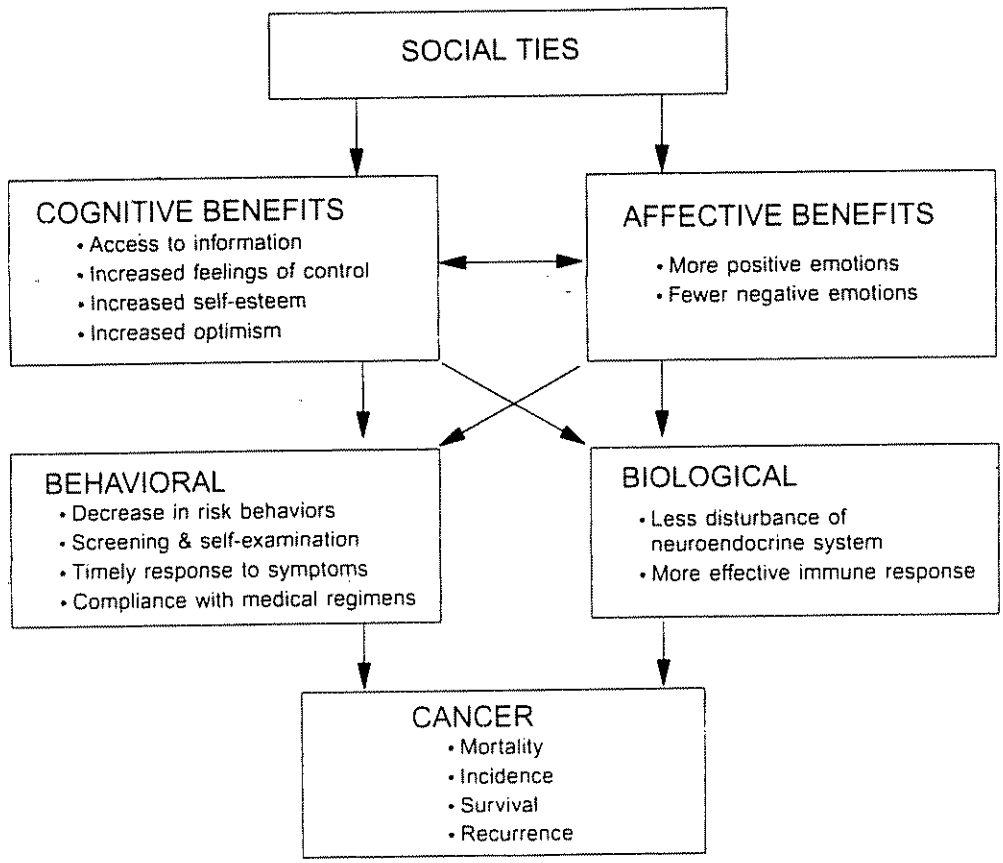

FIG 10–1. Pathways linking social ties to cancer. The paths identified in the model move in only one direction from social ties to cancer. The absence of alternative paths is not intended to imply that they do not exist.

REVIEW OF THE LITERATURE

We review studies that examine the impact of the social environment on cancer incidence and mortality for healthy persons (Table 10.1), and length of survival and time to recurrence for persons with a prior diagnosis of cancer (see Table 10.2). For the most part, the correlational work we review is limited to prospective studies. By assessing the social environment at study onset and then examining subsequent changes in

TABLE 10.1 *Study of the Relation of the Social Environment to Cancer Incidence and Mortality among Healthy Persons*

Author	Site	*n*	Sex	Race	Marital	Structure	Function	Outcome
Jenkins (13)	Variety	39 areas			–			Mortality
Krause & Lilienfeld (14)	Variety	not given			–			Mortality
Reynolds & Kaplan (15)	Variety	6,848			0	–Women 0 Men	–women 0 men	Mortality
Welin et al. (16)	Variety	9,89	100% men		0	– –		Mortality
Reynolds & Kaplan (15)	Variety	6,848			0	0		Incidence
Zonderman et al. (21)	Variety	9,000–			–			Incidence
Vogt et al. (38)	Healthy	2,603				0		Incidence
Thomas and Duszynski (42)	All sites	20	100% men	100% white			–	Incidence

TABLE 10.2. *Study of the Relation of the Social Environment to Survival and Recurrence among People with Cancer*

Author	Site	*n*	Sex	Race	Marital	Structure	Function	Intervention	Outcome
Neale et al. (22)	Breast: all stages	1,261	100% women	100% white	+				Survival
Wilkinson et al. (23)	Breast	1,784	100% women		0				Survival
LeMarchand et al. (24)	Breast: all stages	2,956	100% women	Caucasian Japanese Hawaiian Chinese Filipino	0				Survival
Goodwin et al. (25)	Epithelial	27,779		White Hispanic	+				Survival
Waxler-Morrison et al. (26)	Breast: all stages	118	100% women	100% white	–	+,0			Survival
Ell et al. (27)	Breast, lung, colorectal: all stages	294	78% women	83% white	+ Breast 0 Lung 0 Colorectal	+	+ Breast		Survival
Dean and Surtees (28)	Breast: local, regional	121	100% women		0				Survival
Funch and Marshall (29)	Breast: local, regional	208	100% women	100% white	0	+,0			Survival
Stavraky et al. (30)	Lung: regional advanced	224	75% men		0		+		Survival
Cassileth et al. (31)	All sites: advanced	204	63% men	76% white	0	0			Survival
Cassileth et al. (32)	All sites: advanced	204	63% men	76% white	–	+			Survival
Reynolds & Caplan (15)	Variety	339	55% women		0	+ men 0 women	0		Survival
Dean and Surtees (28)	Breast: local, regional	121	100% women		0				Recurrence
Cassileth et al. (31)	Breast stage 2 skin stages 1,2	149	79% women	78% white	0	0			Recurrence
Cassileth et al. (32)	Breast stage 2 skin stages 1,2	149	79% women	78% white	0	0			Recurrence
Horn et al. (33)	Breast: local, regional	338	100% women		+/–				2nd cancer
Vogt et al. (38)	Variety	not given				+,0			Survival
Hislop et al. (39)	Breast: all stages	127	100% women	100% white		+			Survival
Richardson et al. (40)	Hematologic	94	63% men	17% white 23% black 55% hispanic		0		+	Survival
Hislop et al. (39)	Breast: all stages	124	100% women	100% white		+			Recurrence
Levy et al. (43)	Breast: stage 1,2	90	100% women				0, +		Recurrence
Spiegel et al. (44)	Breast: metastatic	86	100% women					+	Survival
Fawzy et al. (45)	Melanoma	68	51% women					+	Survival
Fawzy et al. 93	Melanoma	68	51% women					+	Recurrence
Morgenstern et al. (40)	Breast: all stages	136	100% women	100% white				0	Survival
Gellert et al. (47)	Breast: all stages	136	100% women	100% white				0	Survival

health. prospective designs allow us to *exclude* interpretations of the data that suggest that the disease is responsible for changes in social networks and their functions. The better studies also provide control for spurious variables that might be responsible for changes in both social networks and disease status. For example, increased age may be associated with both network shrinkage (i.e., close friends and relatives die) as well as increased risk for cancer. Potential spurious variables that are commonly assessed and statistically controlled include age, socioeconomic status, and (in survival and recurrence studies) stage of disease at diagnosis. This review also includes several provocative, if not as methodologically sophisticated studies, that compare the social characteristics of persons who died of cancer to those of persons in the general population. Finally, we report intervention evaluations that use experimental and quasi-experimental designs and hence provide evidence that is less subject to alternate causal explanations.

The literature includes studies of both structural and functional characteristics of social networks, as well as evaluations of interventions intended to increase available social support. *Structural* measures of the social environment describe the existence of and interconnections between network members. Three types of structural measures have been used in the literature we review: marital status, network size, and social integration. Marital status variables range from a simple married unmarried dichotomy to more specific categories of married, never married, widowed, divorced, and separated. Network size is assessed by counts of friends and close family members. Number of network members with whom there is regular social contact is intended to provide a marker of social integration. More elaborate measures of social integration assess the range of social roles and social activities in which persons participate. A frequently used measure of social integration is the Social Network Index (SNI) (8)—a composite index that includes marital status, membership in organizations, and frequency and number of social contacts. *Functional* measures of support tap either the perception that resources are available or the receipt of resources from network members through supportive interactions. Typologies of functions typically differentiate emotional, informational, and instrumental support (e.g., 9,10). *Social support interventions* refer to professionally designed attempts to alter patients' social networks and provide one or more support functions. They are generally based on structured or semistructured protocols.

Structural Measures

Marital Status. Being married has been associated with better mental health (11) and with lower all-cause mortality (see Ref. 12 for a review). Typically, the marriage benefit is attributed to the emotional and material resources that can be provided by an intimate relationship. The studies reviewed here are intended as tests of the marriage benefit in relation to cancer.

MORTALITY. Comparisons of cancer mortality rates across geographic areas have provided some support for a health benefit of marriage. Jenkins (13) found more cancer deaths in catchment areas with fewer married couples and more divorced, separated, and widowed people. Kraus and Lilienfeld (14) compared cancer deaths in married and widowed persons to distributions of these two marital status groups in the population and found an increased risk of cancer mortality for widowed persons. It is not clear, however, whether this finding represents a protective effect of marriage or a harmful effect of losing a spouse.

Unfortunately, prospective studies of marital status and mortality do not support a marriage benefit. Reynolds and Kaplan (15) followed 6848 initially healthy adults for 17 years, and Welin and colleagues (16) followed 989 initially healthy men (50–60 years old) for 12 years. Neither of these studies found evidence that marital status as assessed at study onset was associated with subsequent cancer mortality.

INCIDENCE. Many reports have been published examining cancer incidence by comparing the marital status of cancer patients to population data derived from the census. These studies are based on very large samples and hence even very small differences are statistically significant. In general, this literature suggests that: (1) marriage has been associated with both lower and higher incidence of cancer, and (2) the role of marital status in incidence probably varies by race and gender and possibly by cancer site (see Refs. 17–19). The lack of clear results is further complicated by two methodological problems: misclassification of marital status groups and underenumeration of specific race and marital status groups (20).

Results from prospective population studies fail to support a protective effect of marriage on cancer incidence. In the previously mentioned study conducted by Reynolds and Kaplan (15), there was no relation of marital status to cancer incidence over 17 years for either men or women. Zonderman and colleagues (21) studied over 9000 healthy people and found that married people were *more likely* to be diagnosed with

cancer than unmarried people over a 10-year period The latter study made no mention of whether results applied to both men and women, and neither study explored whether results applied across racial or ethnic groups

Overall, this literature fails to provide any clear answers in regard to the role of marriage in cancer incidence It does, however, suggest that the role of marriage in incidence may vary across gender and ethnic groups It is important to point out that it is unclear whether a marriage benefit would be manifest in increased or decreased cancer incidence Diagnosis of cancer requires the seeking of care To the extent that the marriage benefit is derived from spousal help in detection and reduced delay in seeking care, marriage could be associated with a higher incidence of disease

SURVIVAL In four archival studies, medical records were abstracted for length of survival and for marital status at the time of cancer diagnosis Three of the four studies were of women with any stage of breast cancer A study comparing 10-year survival of married and widowed women found that married women survived longer even when stage of disease at diagnosis, age, socioeconomic status, and delay in seeking treatment were statistically controlled (22) However, studies of 2 to 7-year (23) and 5-year survival (24) comparing married to single and formerly married women found no relation after including appropriate statistical controls The remaining archival study examined survival from epithelial cancer in 27,779 white and Hispanic men and women (25) Even after including controls for age, gender, stage of disease at diagnosis, and treatment, married patients had a longer survival compared to unmarried patients for all stages of cancer (length of follow-up was variable), but the effect was strongest among patients with localized disease The overall relative risk of death for being unmarried was 1 23

In other studies, newly diagnosed patients were recruited and followed for length of survival These were based on smaller sample sizes than the archival studies reviewed above Four studies of women with breast cancer showed that marriage is either associated with *poorer* survival or not associated with survival A study of 118 white women with any stage of disease revealed a lower survival rate for married compared to unmarried people over 1–4 years of follow-up (26) Analyses of data collected from 168 women with breast cancer (length of follow-up not specified) similarly found marriage to be associated with shorter survival (27) The cause of death in that study was not limited to cancer, however In contrast, two studies of women with local and regional breast cancer found no relation of marital status to survival (n = 121, 6–8 years (28); n = 208, 20 years (29))

Research focusing on other cancer sites or not differentiating sites has generally found little evidence for any relation of marital status to survival Marital status was not related to 1-year survival among 224 regional and advanced lung cancer patients (30) nor to 5-year survival among 204 white and black men and women with all sites of metastatic cancer (31) Eight-year follow-up of the latter group of patients revealed married people were *more likely* to have died than unmarried people (32), but this finding should be interpreted with caution as only 6% of patients remained alive at 8-year follow-up In the study by Ell described earlier (27), there was no association between marital status and survival among people with either lung or colorectal cancer Finally, in a 17-year prospective study, Reynolds and Kaplan (15) identified 339 people who developed cancer (any site, any stage) during the intervening period, and determined their length of survival Marital status had no relation to survival from cancer

In sum there is no consistent association of marital status with survival from cancer This inconsistency seems to hold across persons with localized and advanced cancer and across men and women It is noteworthy that the studies showing protective effects of marriage on survival employed very large samples by extracting data from medical records It may be that there is a marriage benefit but that the effect size is so small that it is only detectable in studies of this type In fact, the only study to report an effect size (25) reported a relative risk of only 1.23 A conclusion that sample size provides the answer to the inconsistencies in the literature is insufficient, however, in light of the three smaller prospective studies that found marriage to be associated with *shorter* survival (26,27,32)

RECURRENCE Two studies examined the relation of marital status to recurrence of cancer and found no association This included a study of 121 women with local or regional breast cancer that followed patients for 6–8 years after diagnosis (28) and a study of 149 white and black patients with either stage 2 breast cancer or stages 1 and 2 melanoma at either 5-year (31) or 8-year follow-up (32)

One study examined the association of marital status to the development of a *second* primary breast cancer by comparing 338 patients who developed a second cancer with two different control groups of women with an initial diagnosis of breast cancer (33) One control group was randomly selected from the tumor

registry (n = 338) and the other matched on age and time since diagnosis from the tumor registry (n = 336). Marital status interacted with age such that never being married was associated with a decreased risk of second breast cancer among younger women but an increased risk among older women, regardless of which control group served as the comparison. The authors suggest that marital status may reflect reproductive history because their findings parallel reports that not having children reduces risk of breast cancer among women under age 40 and increases risk of breast cancer among women after age 40.

SUMMARY. The literature on marital status is inconsistent. It is possible that more information about the role of marriage in cancer for men and women and for members of different cultural groups may provide more clarity. Although a number of studies have focused exclusively on women by studying breast cancer, few of the studies examined men separately. Research on all-cause mortality shows that marriage is more health protective for men than for women (34,35). There also is reason to believe that marriage may not have the same effect across cultural groups, as different ethnic groups construe marriage differently in terms of support resources. Moreover, it is likely that differences in marital quality may be important, with better relationships providing a marriage benefit and worse relationships conveying the same (or greater) risk as not being married. Such a finding has been documented for other health outcomes (11,36). Finally, it is likely that studies (particularly incidence and mortality studies) that associate marital status to a cancer outcome occurring many years later may include many initially married persons who divorce, remarry, or are widowed by the time the outcome occurs. As a consequence, any beneficial effects of marriage may be diluted by the instability of the measure.

Network Size and Social Integration. A large all-cause mortality literature suggests that although network size does not predict mortality, social integration as indicated by membership in organizations and frequency of social contacts is reliably associated with lower mortality rates (reviews in Refs. 6,37). Here we review the role of these same structural network variables in predicting cancer mortality, incidence, survival, and recurrence.

MORTALITY. As shown in Table 10.1, two studies found some evidence for protective effects of structural measures of support on cancer mortality. A prospective study of 989 men found that more people living in the house and more frequent social activities predicted reduced mortality from cancer (16). These relations did not hold, however, when age, smoking status, and perceived health at the onset of the study were statistically controlled. Reynolds and Kaplan (15) found that greater social integration as assessed by the SNI was associated with reduced mortality, and social isolation (i.e., few close friends and little contact with friends) was associated with increased mortality among women but not among men (n = 6848). These relations held even with statistical controls for age, baseline physical health status, income, alcohol use, and smoking status.

INCIDENCE. Neither of the two studies that examined the effects of structural support on cancer incidence found a relation. In a prospective study of 6848 men and women, Reynolds and Kaplan (15) found that the SNI did not predict incidence of cancer for either gender. Similarly, in a study of 2603 men and women, Vogt and colleagues (38) report that none of the network measures assessed at the onset of the study (scope of network, frequency of contact, and size of network) predicted subsequent incidence of cancer over 15 years among either gender.

SURVIVAL. There are seven prospective studies that examine the influence of structural measures of support, aside from marital status, on survival from cancer (see Table 10.2). These studies include a variety of network measures that can be roughly categorized as either markers of social integration or as *counts* of network members. In general, network size does not predict survival, but involvement in a range of social activities is associated with longer survival.

Two studies that measured both network size and markers of social integration support this conclusion. In a 15-year follow-up of 2603 initially healthy men and women, Vogt (38) found that number of domains in which men and women had relationships and frequency of contact with network members were both associated with longer survival from all cancers, but network size was not. These relations held when age, gender, smoking status, socioeconomic status, and baseline health status were statistically controlled. The number of cancer cases was not specified, however. In a study of 208 white women with local and regional breast cancer, active membership in organizations was associated with longer survival over 20 years of follow-up, but number of family and friends was not (29). These findings held when stage of disease at diagnosis, past health status, and socioeconomic status were statistically controlled.

Other studies assessing either a marker of social integration or network size suggest a similar conclusion. Activities involving social interactions were associated with better 1 to 4-year survival rates among 127 women with all stages of breast cancer (39). This relation was upheld after controlling for age, stage of disease at diagnosis, nodal status, and estrogen receptor status. In this same sample of women (n = 118), Waxler-Morrison and colleagues (26) found evidence that social contacts with friends were more important than social contacts with relatives. Frequency of contact with friends predicted increased survival, but frequency of contact with relatives did not. Inconsistent with other studies, *number* of friends (but not relatives) also was associated with longer survival. These findings held even with controls for stage of disease at diagnosis and nodal status. In a study of 294 men and women with breast, colorectal, or lung cancer, greater access to distant social ties was associated with increased survival even when age, stage of disease at diagnosis, and socioeconomic status were statistically controlled (27). In the one study to evaluate network size variables only, neither living alone nor network size was associated with 2 to 5-year survival among 94 patients with hematologic malignancies participating in an intervention (described later (40)).

Three studies using the SNI or a variation of it suggest that greater social integration is associated with longer survival. Recall that the SNI assesses the range of social roles and social activities in which persons participate. The SNI was related to greater likelihood of survival over 1–4 years of follow-up among 118 women with any stage of breast cancer (26) and with longer survival for men but not women in Reynolds and Kaplan's (15) study of 339 initially healthy individuals who developed cancer during the 17 years of their study. Their findings held even when stage of disease and age at diagnosis were statistically controlled. A "social ties" index, composed of the SNI as well as frequency of phone contact and adequacy of number of friends, was administered to 204 patients with all sites of advanced cancer. The index did not predict survival at 5-year follow-up (31), but did predict survival at 8-year follow-up (32). The latter finding must be regarded with caution, however, as only 6% of patients remained alive at 8-year follow-up.

RECURRENCE. Two studies evaluated the associations between social network variables and recurrence. The social ties index developed by Cassileth and colleagues did not predict recurrence among patients with stage 2 breast cancer or stages 1 and 2 melanoma at 5 years (n = 149 (31)) or 8 years (32). Hislop's (39) measure of activities involving social interactions, however, was associated with less likelihood of breast cancer recurrence over 1–4 years of follow-up, controlling for age, stage of disease, nodal status, and estrogen receptor status.

SUMMARY. Overall, there is no evidence that structural measures of support predict incidence of new disease. Although there are only a few studies that evaluate whether these measures predict disease mortality or recurrence, the existing evidence is suggestive of a protective effect for persons involved with their social networks. By contrast, there is substantial evidence for relations between social integration and increased survival. Because the majority of studies focus on breast cancer, the generalization of these findings is limited by both gender and site. There is, however, some evidence (e.g., Ref. 15) that social participation may differentially influence men and women. Further gender comparisons may help clarify this issue. Unfortunately, only one study (27) examined whether social integration had a differential impact on localized versus advanced disease, and it found no differential effects.

Functional Measures

Among the different kinds of support, cancer patients report that their need for emotional support is often not met by their social networks, and prospective studies indicate that emotional support is associated with better psychological adjustment to disease (see review in Ref. 41). In this section, we evaluate whether certain resources provided by the social network are similarly associated with disease onset and progression.

MORTALITY. There are no studies that directly examine the influence of functional support on cancer mortality. However, one study of 6848 initially healthy people found that feeling isolated predicted increased mortality from cancer among women but not men (15). Feeling isolated was measured by perceptions of feeling left out and difficulty in getting close to others, which may reflect loneliness rather than perceived lack of support.

INCIDENCE. Cancer incidence was examined in a study of white male medical students who were followed for 9–24 years after graduation (42). The 20 who subsequently developed malignant tumors were compared with a group of healthy individuals matched on age, gender, race, and class in school. Those who developed cancer reported less closeness to their parents at the

onset of the study [measured by subjects' attitudes toward their parents (e.g., warm, understanding) and perception of parents' attitude toward subject] than people in the matched control group

SURVIVAL Two prospective studies indicate effects of emotional support on survival. In a study of lung, colorectal, and breast cancer patients, perceived adequacy of emotional support (which was not defined) predicted survival only among women with localized breast cancer (27). These relations held when age, socioeconomic status, and stage of disease at diagnosis were statistically controlled. In a study of 224 men and women with lung cancer, Stavraky and colleagues (30) evaluated needs for and supplies of different kinds of support (emotional support, network membership, esteem support) as well as the fit between needs and supplies. A high *need* for emotional support (i.e., sympathy, care, and devotion) predicted death at one year, when stage of disease at diagnosis was statistically controlled. The more seriously ill patients may have desired more emotional support, or it may be that the patients who had the least emotional support available expressed the greatest need. Feeling isolated did not predict survival in a follow-up of men and women who developed cancer over a 17-year period (15).

RECURRENCE Only one study examined the relation of support functions to cancer recurrence. Perceived family support (quality of relationships, availability of help, quality of communication) did not predict recurrence among 81 women with stage I or II breast cancer (43). However, among those whose cancer recurred (n = 29), family support predicted longer time to recurrence.

SUMMARY Given the small number of studies and the diversity of measures across studies, we cannot draw any firm conclusions about the association of functional measures of support and cancer. We note that the majority of the studies focused on the more emotional aspects of support. In addition, the two studies that examined women separately from men found that the protective effects of emotional support are limited to women (15,27).

Support Interventions

Support interventions are limited to those diagnosed with cancer. Four studies have been conducted in which the survival or recurrence rate of people assigned to a support intervention was compared to that of those assigned to a no-treatment control group. The interventions are aimed at two functions of support, emotional support and informational support, although the interventions also may inadvertently increase network size (see Ref. 41).

The three methodologically strong studies show clear benefits of the support intervention on survival. A study in which 86 women with metastatic breast cancer were randomly assigned to an emotional support group (lasting one year) or a no-treatment control group, showed an 18-month survival benefit for the intervention group 10 years later (44). The intervention consisted of weekly 90-minute meetings for one year that focused on discussing problems with having a terminal illness and ways to improve relationships. An educational intervention in which 94 men and women were sequentially assigned to experimental or control conditions showed a positive effect on survival three years later (40). The intervention was designed to increase compliance with therapy among patients with hematologic malignancies. A randomized psychosocial intervention that involved group provision of emotional and informational support increased survival and reduced recurrence 5–6 years later among 68 men and women with melanoma (45). Finally, a nonrandomized intervention that involved emotional support, imagery, and counseling for 136 women with breast cancer found effects on survival one year later (46), but the time lag between diagnosis and study participation was longer for intervention participants than nonparticipants, suggesting that the sickest patients may have been selected out of the intervention. The intervention effect was not statistically reliable when the time interval between diagnosis and study participation was controlled in the analysis. In addition, there was no effect of the intervention on survival 10 years later (47).

Summary. The current literature reveals provocative evidence for health benefits of support interventions for people with cancer. However, the studies are few and involve different intervention protocols and different kinds of support. This makes it difficult to draw strong conclusions about the nature of an intervention that would influence survival. We note that the interventions are aimed at two functions of support: emotional support and informational support. None of the studies evaluated whether men or women or people of different races were more likely to derive health benefits from the interventions.

CONCLUSIONS

Only a few studies have evaluated the influence of social networks on cancer mortality and cancer recur-

rence, but findings suggest health benefits. By contrast, there is substantial evidence that social ties influence cancer survival. Among the social environment variables, there is stronger evidence that social integration and functional support influence cancer than there is for marital status or network size. Support interventions also seem to have health benefits, which can be attributed to increased social network integration or receipt of specific support functions. Thus, it is not the mere existence of a social network but more extensive and meaningful involvement that provides disease-related benefits.

Why would involvement in a social network or receipt of support resources influence neoplastic disease? Earlier, we suggested two proximal pathways: behavioral and biologic. One behavior that may be influenced by social ties is timely response to symptoms—delay in seeking treatment. To the extent that network members reduce delay, an earlier stage and more treatable form of cancer may be diagnosed, which would have beneficial effects on survival and recurrence rates. Two studies found that longer delay periods were associated with diagnosis of a more advanced stage of cancer and reduced survival (22,23), but neither provided evidence for social network influences on delay (only marital status is evaluated (22). Some support for the delay hypothesis, however, is provided by evidence that married people were more likely to be diagnosed with an earlier stage of cancer and more likely to receive treatment for localized and regional disease (25). Another behavioral mechanism that may influence disease progression is compliance with treatment. One of the intervention studies reviewed was aimed at increasing treatment compliance (40). Not only did the intervention influence compliance, but compliance predicted survival. None of the studies we reviewed, however, evaluated whether richer measures of the social environment (i.e., social integration) were associated with behavioral factors, such as delay, treatment adherence, or general health practices, that could have accounted for survival benefits.

A biologic pathway by which the social environment might influence disease progression is immune function. There is increasing evidence that stronger social ties and perceptions of social support are associated with more competent immune responses (at least in vitro; see reviews in Refs. 1,2). This includes two studies in which perceptions of supportive relationships were associated with higher natural killer cell (NK) activity among women with stage I and II breast cancer (48,49). Only one study, however, has evaluated whether immune function mediates the relation between social ties and cancer survival. Fawzy and colleagues (50) found a positive effect of their support intervention on NK activity, but NK activity did not account for the intervention's effect on survival. Thus, it is not yet clear whether the immune system plays a role in linking social networks to cancer.

LIMITATIONS AND FUTURE DIRECTIONS

Much of the literature we have reviewed suffers from methodologic weaknesses and poor reporting. For example, not all studies provide adequate controls for spurious factors such as age, socioeconomic status, or health at study onset. Some studies do not distinguish cancer deaths from deaths due to other causes. Some of the survival studies do not specify the follow-up period, and many studies could provide greater methodologic detail, such as precise sampling techniques and detailed descriptions of the independent variables.

One limitation of the prospective studies reviewed in this chapter is that investigators do not take into consideration that the social environment may change from study onset to termination of data collection (51). For example, in our culture, marital status may vary considerably over the 10- to 15-year follow-ups that are often used in mortality studies. This might account, in part, for why measures of social integration, thought to be stable over long periods of time, are more reliable predictors in this literature (6).

The studies reviewed in this chapter are heavily biased toward women with breast cancer. Other studies typically include people with a variety of cancers with different prognoses. Few studies examine whether findings hold across men and women, across different sites of cancer, and across different stages of disease. Those that do often find differential effects. Some investigations statistically control for variables such as gender, race, age, and stage of disease, but rarely do they stratify the data or otherwise investigate whether they alter the association of social network variables to cancer outcomes.

Most importantly, few studies examine the mechanism by which the social environment could impact on cancer. The two types of mechanisms most proximal to the disease outcome are behavioral and biologic (see Figure 10–1). Future researchers should examine the extent to which the social environment influences behavioral risk factors for incidence or mortality; cancer-specific health behavior (e.g., delay in seeking treatment), which could affect incidence, mortality, survival, and recurrence; or compliance with treatment, which could affect survival and time to recurrence.

Finally, in order to design effective social support interventions, we need a more detailed understanding of how interventions influence the social environment and the various pathways that influence disease outcomes. Interventions may be providing patients with specific support functions (e.g., emotional support) or may be altering the structure of patients' social networks (i.e., increasing network size or social integration). Although the intervention studies reveal provocative effects of support manipulations, generally investigators have failed to examine mechanisms through which support interventions influence disease outcomes. Only by understanding these mechanisms can we develop effective interventions for different populations, cancer sites, and stages of disease.

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