



The Interdependence of Advanced Cancer Patients' and Their Family Caregivers' Mental Health, Physical Health, and Self-Efficacy over Time

Trace Kershaw, PhD¹ · Katrina R. Ellis, PhD, MPH, MSW² ·
Hyojin Yoon, PhD, RN³ · Ann Schafenacker, MSN, RN⁴ ·
Maria Katapodi, PhD, RN, FAAN⁵ · Laurel Northouse, PhD, RN, FAAN⁶

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Abstract

Background The challenges of advanced cancer have health implications for patients and their family caregivers from diagnosis through end of life. The nature of the patient/caregiver experience suggests that their mental and physical health may be interdependent, but limited empirical evidence exists.

Purpose This study used social cognitive theory as a framework to investigate individual and interpersonal influences on patients' and their family caregivers' mental health, physical health, and self-efficacy as individuals to manage the challenges of advanced disease over time.

Methods Patients and caregivers (484 patient-caregiver dyads) completed surveys at baseline, 3 and 6 months. Longitudinal dyadic analysis techniques were used to examine (i) the influence that patients and caregivers had on their own mental health, physical health, and self-efficacy (actor effects) and (ii) the influence that they had on each other's health outcomes (partner effects). We also examined the influence of self-efficacy on mental and physical health over time.

Results Consistent with our hypotheses, each person's mental health, physical health, and self-efficacy had significant effects on their own outcomes over time (actor effects). Patients and caregivers influenced one another's mental and physical health (partner effects), but not their self-efficacy. In addition, patients and caregivers with higher self-efficacy had better mental health, and their partners had better physical health.

Conclusions Patients' and caregivers' mental and physical health were interdependent. Each person's cancer-related self-efficacy influenced their own mental and physical health. However, a person's self-efficacy did not influence the other person's self-efficacy.

Keywords Cancer · Dyads · Interdependence · Self-efficacy · Health · Caregivers · APIM analyses · Social cognitive theory

Advanced cancer is now treated in outpatient settings, and as a result, the burden of care has shifted from health professionals to patients and their family caregivers [1]. Patients with advanced cancer and their family caregivers have more symptom distress [2], greater disruptions in their daily lives [3], and poorer mental [4] and physical health [5] than patients and caregivers managing early-stage disease [5]. Yet, knowledge about the experiences of patients with the most common types of advanced cancer (i.e., lung, colorectal, breast, and prostate cancer) and their family caregivers is limited, as most research has focused primarily on patients with early-stage breast and prostate cancer [6, 7]. Although there may be some variation in patient care needs, advanced cancer often leads to a steady deterioration in functioning, requiring adaptation by both the patient and caregiver that is distinct from what is needed during early-stage cancer [5]. As a result, longitudinal studies that assess the mental and physical health of advanced cancer patients and their family caregivers over time are needed.

✉ Trace Kershaw
trace.kershaw@yale.edu

¹ Yale School of Public Health, 60 College, Rm 415, New Haven, CT 06520, USA

² Gillings School of Global Public Health, University of North Carolina, Chapel Hill, NC, USA

³ Marcella Niehoff School of Nursing, Loyola University, Chicago, IL, USA

⁴ University of Michigan Hospitals and Health Center, Ann Arbor, MI, USA

⁵ Institute of Nursing Science Faculty of Medicine, University of Basel, Basel, Switzerland

⁶ School of Nursing, University of Michigan, Ann Arbor, MI, USA

Studies suggest that the responses of patients and their family caregivers to the stress and demands associated with advanced cancer are interrelated [8]; however, prior research has often focused either on the patient or the caregiver as isolated individuals [6]. Few studies have assessed the patient-caregiver dyad (i.e., pair) as the unit of care. In a meta-analysis, Hagedoorn and colleagues [8] found a moderate correlation between patients' and their partners' distress suggesting that they react as an emotional system to cancer rather than as individuals. For example, patients' mental health has been associated with their family caregivers' mental health [9–14], while caregivers' mental health has also been associated with poorer mental health in patients [15]. As the physical functioning of patients with advanced cancer declines, the physical health of their family caregivers can also decline [16, 17], and physical deterioration among family caregivers can negatively affect patients' well-being [18].

The meta-analysis also identified a need for more research on patients' and caregivers' experiences in advanced cancer. Only three studies included in the meta-analysis had samples consisting of advanced cancer patients [8]. Although there are examples of more recent studies with advanced cancer patients and their caregivers [19–22], notable gaps still remain in our understanding of the interrelatedness of advanced cancer patients' and their caregivers' physical and mental health. This research can inform the development of dyadic interventions that will improve outcomes for both patients and caregivers within the context of advancing and life-threatening disease.

Social cognitive theory provides a useful framework for examining individual and interpersonal influences on cancer-related outcomes [23]. The foundation of this theory is the consideration of bidirectional influences between individual-level factors (e.g., cognition, affect, and self-efficacy), environment (e.g., family), and behavior. Based on social cognitive theory, patients and caregivers can be viewed as part of a shared physical and/or social environment that influences their individual cognitions (and vice versa). Within this environment, patients and caregivers can observe one another's experiences with managing cancer/caregiving and can learn from and be affected by one another. Consequently, proponents of this theory could argue that it is important to consider the effect patients and caregivers have on their own outcomes (i.e., actor effects) and how each member of the dyad influences the outcomes of the other member (i.e., partner effects) [24, 25]. Social cognitive theory has been used to examine the patient's experience of cancer [26], and it has been extended to assess the caregiver's influence on the patient's outcomes [27]. For example, when caregivers model positive care behaviors, this can have a direct interpersonal influence on the ways patients cope with their cancer [27].

Self-efficacy, a key component of social cognitive theory, may play an important role in managing the mental and physical consequences of cancer. A domain-specific construct,

self-efficacy in this context can be conceptualized as the degree of confidence patients and caregivers have in their individual ability to manage illness-related demands associated with advanced cancer, and as a resource that can help attenuate negative outcomes [28]. According to Bandura [29], individual perceptions of self-efficacy are expected to influence emotional reactions and associated biological systems that regulate well-being. A number of studies with patients and caregivers have confirmed this relationship. Higher self-efficacy has been associated with less emotional distress [30], less pain [31, 32], reduced fatigue [33] and anxiety [30], fewer depressive symptoms in cancer patients [32] and their caregivers [10, 34], and better quality of life [33]. Thus, self-efficacy is important for cancer patients to manage their illness and for family caregivers to provide optimal care. Yet, our understanding of the possible interrelatedness of patients' and caregivers' self-efficacy is limited.

Aims and Hypotheses

Since most studies have examined outcomes at only one point [35–37], further research that examines the relationship between patients' and caregivers' mental health, physical health, and self-efficacy as they manage advanced cancer over time is needed. Because we are studying patient-caregiver dyads (pairs), we used terminology that is common in dyadic analyses to formulate our aims (i.e., actor and partner effects) [38, 39]. The term "actor effect" refers to the influence that patients or caregivers have on their own outcomes over time. The term "partner effect" refers to the influence that an individual has on the outcomes of their partner over time.

The first aim simultaneously examined actor and partner effects of advanced cancer patients' and their family caregivers' mental health, physical health, and self-efficacy over time. For example, how does patients' mental health at baseline influence their own (actor effects) and their caregivers' mental health (partner effects) at a subsequent time point? Our specific hypotheses are as follows:

Hypothesis 1.1. Patients' and caregivers' mental health, physical health, and self-efficacy will be significantly related to their own individual-level measures of those variables over time (actor effects).

Hypothesis 1.2. Patients' and caregivers' mental health, physical health, and self-efficacy will be significantly related to their dyadic partner's individual-level measures of those variables over time (partner effects).

Secondly, given the known associations between individual self-efficacy and subsequent mental and physical health [29] and the shared environments of patients and caregivers, it is important to consider how one person's self-efficacy

influences the outcomes of the other within the patient-caregiver dyad. Thus, the second aim simultaneously examined the effects of patients' and caregivers' self-efficacy on their own and the other dyad members' mental health and physical health over time. For example, how does caregiver self-efficacy to manage the demands of cancer at baseline influence their own physical health (actor effects) and the physical health of the patient (partner effects) at a later time point? The associated hypotheses are as follows:

Hypothesis 2.1. Patients' and caregivers' level of self-efficacy to manage the illness at baseline will be significantly related to each person's mental health and physical health at 3- and 6-month assessments (actor effects).

Hypothesis 2.2. Patients' and caregivers' level of self-efficacy to manage the illness at baseline will be significantly related to the other member of the dyad's mental health and physical health at 3- and 6-month assessments (partner effects).

Our study fills several gaps in the literature. Little research has utilized social cognitive theory to explore actors' and partners' influences of self-efficacy over time for advanced cancer patients. In addition, we examined actor and partner effects on important variables not assessed longitudinally in other studies (e.g., physical health and self-efficacy). Capturing these effects will increase our understanding of how patients and caregivers mutually influence each other over time.

Method

This study was a secondary analysis of data obtained from a large multisite randomized clinical trial (RCT) that tested the effects of a dyadic intervention on patient and caregiver outcomes [40]. The psycho-educational intervention (i.e., The FOCUS Program) was delivered to cancer patients and their family caregivers jointly (as a pair) in their homes by masters-prepared nurses. Both patients and their family caregivers were actively involved in the intervention as suggested by Badr and Krebs [6], which means that the intervention addressed both patients' and caregivers' concerns (physical and emotional), facilitated their communication with one another, and promoted adaptive coping by both individuals.

The RCT compared the effects of a brief (three-session) program, a more extensive (six-session) program, and a control condition (usual clinic care) on psychological outcomes at baseline (pre-intervention) and at 3 and 6 months from baseline (post-intervention). The intervention was delivered between time 1 (baseline) and time 2 (3 months). Positive outcomes associated with the intervention were hypothesized to be less negative appraisal of illness, lower use of avoidant coping, more healthy lifestyle behaviors, more dyadic

communication, higher self-efficacy, and higher quality of life in patients or caregivers, or in the dyad as a unit. More information about the study procedures and sample can be found elsewhere [40]. The parent RCT study examined outcomes for dyads who all participated in the RCT. This secondary analysis is based on $N=484$ dyads and was conducted to analyze more closely the extent to which patients and caregivers influenced one another's mental and physical outcomes over time (aim 1) and to determine the influence of self-efficacy on their own or their partners' mental and physical health (aim 2).

Participants

Participants were patients with advanced cancer and their primary family caregivers. Eligible patients had either a new diagnosis of advanced lung, colorectal, breast, or prostate cancer (i.e., stage III or IV) during the previous 6 months or progression of their advanced disease during this time frame. Patients also had to have a life expectancy ≥ 6 months (as indicated by their oncologist), be 21 years of age or older, live within 75 miles of one of the four participating cancer centers, and have a family caregiver willing to participate in the study. Family caregivers had to be 18 years or older and identified by patients as their primary provider of emotional and/or physical care. Caregivers diagnosed with a cancer within the past year or who were receiving active treatment for cancer were excluded.

Procedures

Eligible patients and their family caregivers (i.e., dyads) were informed about the RCT by clinic staff at four cancer centers in the Midwest. Dyads willing to participate were contacted by research staff and scheduled for an initial home visit. Prior to completing baseline instruments, participants signed a consent form approved by Institutional Review Boards at the patient's cancer center and the University of Michigan (coordinating institution). Patients along with their caregivers were randomized to a psycho-educational intervention or control condition [40]. Assessments were obtained at baseline (time 1), 3 months (time 2), and 6 months (time 3). Data were collected in the home by research staff blinded to study group assignments. A research staff member was present in the home while patients and caregivers completed their questionnaires. Patients and caregivers completed their questionnaires separately, without consulting the other dyad member.

Measures

Both patients and caregivers completed the measures described below. Internal consistency reliability coefficients were assessed separately for patients and caregivers.

Mental and Physical Health Patient mental and physical health were assessed with the six-item emotional well-being and seven-item physical well-being scales of the Functional Assessment of Cancer Therapy Scale (FACT-G, Version 4) [41]. Caregivers reported on their own mental and physical health using the emotional and physical well-being subscales of a slightly modified version of the FACT-G [28] (adapted with permission of FACIT.org) that was used in our previous studies [4, 40]. Internal consistency reliabilities for the mental health measure at baseline, 3-month, and 6-month assessments were .85, .84, and .86 for patients and .81, .85, and .84 for caregivers. Reliabilities for the physical health measure were .86, .84, and .85 for patients and .81, .81, and .80 for caregivers.

Self-Efficacy Participants' self-efficacy was measured with the 17-item Lewis Cancer Self-Efficacy Scale that assesses patients' and caregivers' confidence about managing the illness [42]. The internal consistency reliabilities for the baseline, 3-month, and 6-month assessments were .97, .97, and .98 for patients and .97, .98, and .98 for caregivers.

Covariates A number of demographic and medical factors, which may influence relationships between patients' and their family caregivers' responses to advanced cancer, were included as covariates. Although age has been positively associated with patients' and caregivers' mental health, it has been negatively associated with their physical health [43]. Female patients [8, 44] and female caregivers [8, 44, 45] have reported lower mental health than their male counterparts. Other factors such as relationship of the caregiver to the patient (i.e., spousal vs. non-spousal) and caregivers' own health status (i.e., number of comorbidities) [46] have been associated with poorer mental and physical health.

Demographic characteristics (e.g., age, gender, and relationship of caregiver) and medical characteristics (e.g., type of cancer and comorbidities) were obtained from the demographic and health history sections of the Risk for Distress Scale—adapted from the original Omega Clinical Screening Interview [4, 40, 47] and with audits of patients' medical records. Since the current study was part of this larger RCT, intervention condition was added as a covariate in all analyses. We assessed for possible interactions between intervention and key study components, and no significant interactions were found.

Statistical Analyses

Frequencies and means were used to describe the sample. Dyadic analyses were conducted using the actor-partner interdependence model of patients' and caregivers' mental health, physical health, and self-efficacy over time using path analysis as outlined in Cook and Kenny [38]. For the path analysis, the

dyad is treated as the unit of analysis (i.e., the sample size is the number of pairs of patients and caregivers). Both patient and caregiver scores are modeled to determine the actor effect of each person's own variable (e.g., the effect of patient's mental health at time 1 on patient's mental health at time 2) [39]. We also examined partner effects of patients' and caregivers' outcomes (e.g., the effect of caregiver's mental health at time 1 on patient's mental health at time 2). Initial correlation at time 1 was modeled as well as the correlation of the error terms of the final time points in the model (e.g., error terms for time 3 mental health between patient and caregiver) [38, 48]. Further, because mental and physical health were correlated ($r=.41$ for patients and $r=.31$ for caregivers at baseline), we ran a combined analysis including both outcomes at the same time. This allowed us to correlate the patients' and caregivers' mental and physical health, avoiding issues of multiple testing and inflated type I error.

Because standardized solutions using path analysis software are not valid with dyadic data, we manually standardized the data in order to present standardized coefficients as recommended by Kenny, Kashy, and Cook [39]. All analyses use full information maximum likelihood (FIML) estimation, which creates model estimates using all available data [49]. This allows us to include all participants, regardless of their own missing time 2 and time 3 assessments, and regardless of missing assessments from the other dyad member. We tested the assumption of missing data to make sure data were missing at random (MAR) so that FIML techniques were valid. This was done by comparing those who were missing and not missing on study outcomes (e.g., mental and physical health), predictors (self-efficacy), and demographic covariates. The analyses controlled for age, gender, relationship of caregiver, type of cancer, comorbidities of patients and caregiver, and intervention group status for time 2 and time 3 outcomes.

Results

Sample Characteristics

Over 4 years, 906 patients were referred to the original RCT [40]; 706 patient-caregiver dyads were eligible for the study and 484 dyads completed time 1 (baseline) measures (enrollment rate=68.6 %); 345 couples (71 %), 2 patients only, and 2 caregivers only completed time 2 assessments; and 303 couples (64 %), 4 patients only, and 1 caregiver only completed time 3 assessments (see parent RCT for consort diagram) [40]. About 29 % of the sample died ($n=100$ patients, 3 caregivers) or were too ill ($n=39$) to complete the study; the remaining dropped out because they were too busy ($n=16$) or for various other reasons ($n=27$). Analysis of the missing and valid data which showed participants with missing values at time 2 or time 3 did not differ on the study outcomes (e.g., mental and

physical health), primary predictor (e.g., self-efficacy), or any of the demographic variables. This suggests that the data met the condition of MAR, and, therefore, FIML procedures for handling missing data were valid and recommended [50].

The average age of patients was 60.5 (SD=10.9, range=26–87) and for caregivers, it was 56.7 (SD=12.6, range=26–95). Sixty-two percent of patients and 57 % of caregivers were female. Participants reported their race/ethnicity as Caucasian (83 %), African-American (14 %), Hispanic (1 %), American Indian (1 %), Asian (1 %), or other (1 %). The dyadic relationship was spouse/partners (74 %), relatives (19 %), or other (7 %). The majority of patients had advanced breast cancer (37 %), followed by lung (24 %), colorectal (23 %), or prostate (16 %) cancer. Over two-thirds (69 %) were receiving chemotherapy, while other treatments included hormones (17 %), surgery (3 %), radiation (8 %), or watchful waiting (8 %) (multiple responses were possible).

Tables 1 and 2 provide descriptive statistics and correlations between main study variables (i.e., mental health, physical health, and self-efficacy) and background/demographic factors (i.e., age, gender, relationship, cancer type, comorbidities, and intervention group).

Actor and Partner Effects of Patient and Caregiver Outcomes

For aim 1, we modeled the actor and partner effects of patients' and caregivers' mental health, physical health, and self-efficacy.

Mental Health Patients' and caregivers' mental health were significantly correlated at time 1 ($r=.311, p<.01$). Results showed significant actor effects in both patients' and caregivers' mental health over time (see Fig. 1). The association of a person's mental health at time 1 and their own mental health at time 2 was different for caregivers and patients ($\beta=.635$ vs. $\beta=.520$, chi-square difference (1)=8.30, $p<.05$). However, caregivers and patients had similar actor effects for mental health between time 2 and time 3 ($\beta=.686$ vs. $\beta=.693$, chi-square difference=1.00, $p>.05$). There were three partner effects. Caregivers' mental health at time 1 was significantly associated with higher patients' mental health at time 2 ($\beta=.115, p<.05$). Caregivers' mental health at time 2 was significantly associated with higher patients' mental health at time 3 ($\beta=.079, p<.05$). Patients' mental health at

Table 1 Descriptives and correlations of patient outcomes and demographics/covariates

Descriptives	Mental health			Physical health			Self-efficacy		
	T1 N=484	T2 N=347	T3 N=307	T1 N=484	T2 N=347	T3 N=307	T1 N=484	T2 N=347	T3 N=307
Means	16.61	17.55	17.00	19.36	19.97	19.97	138.89	133.04	133.37
SD	5.36	5.00	5.38	6.20	5.75	6.06	29.38	28.94	29.88
Correlations									
Age	$r=.30^*$	$r=.23^*$	$r=.18^*$	$r=.27^*$	$r=.21^*$	$r=.12^*$	$r=.12^*$	$r=.15^*$	$r=.09$
Gender	$t=3.67^*$	$t=2.37^*$	$t=2.15^*$	$t=3.97^*$	$t=1.70$	$t=1.10$	$t=1.07$	$t=0.37$	$t=-0.15$
Male	17.74 (5.0)	18.36 (5.0)	17.93 (5.2)	20.77 (5.1)	20.63 (5.5)	20.45 (5.6)	134.72 (26.3)	133.77 (26.4)	133.06 (28.7)
Female	15.92 (5.4)	17.04 (5.0)	16.58 (5.5)	18.50 (6.6)	19.55 (5.9)	19.67 (6.3)	131.76 (31.1)	132.57 (30.5)	133.57 (30.7)
Relationship of caregiver	$t=0.89$	$t=0.60$	$t=-0.06$	$t=-2.16^*$	$t=0.36$	$t=-0.90$	$t=-0.90$	$t=0.76$	$t=-0.15$
Spouse	16.94 (5.4)	17.81 (4.9)	17.08 (5.9)	18.43 (6.6)	20.14 (5.7)	19.45 (6.6)	131.06 (32.6)	134.94 (28.3)	132.95 (32.1)
Non-spouse	16.47 (5.4)	17.45 (5.1)	17.12 (5.2)	19.76 (6.0)	19.89 (5.8)	20.16 (5.9)	133.07 (27.9)	132.30 (29.2)	133.52 (29.1)
Type of cancer	$F=2.41$	$F=3.01^*$	$F=2.57$	$F=9.67^*$	$F=3.79^*$	$F=0.82$	$F=0.14$	$F=0.68$	$F=0.51$
Prostate	18.02 (4.9)	19.20 (4.7)	18.47 (4.7)	23.03 (4.0)	22.46 (4.7)	21.14 (4.9)	134.98 (23.5)	137.63 (19.0)	135.00 (24.8)
Lung	16.48 (5.0)	17.61 (4.0)	16.69 (5.5)	19.19 (6.2)	19.54 (5.8)	19.66 (6.0)	132.99 (27.4)	130.38 (26.9)	136.41 (29.5)
Breast	15.95 (5.7)	16.72 (5.3)	16.28 (5.4)	18.23 (6.6)	19.45 (5.8)	19.59 (5.9)	132.14 (31.1)	132.86 (32.0)	131.76 (31.6)
Colon	16.89 (5.5)	17.70 (5.4)	17.89 (5.5)	19.13 (5.9)	19.67 (5.9)	20.09 (5.9)	132.64 (32.3)	133.35 (31.4)	131.49 (31.0)
Patient comorbidity	$t=-1.74$	$t=-0.04$	$t=-0.20$	$t=-0.86$	$t=0.94$	$t=-0.36$	$t=0.88$	$t=1.10$	$t=0.64$
No	15.92 (5.7)	17.53 (5.2)	17.00 (5.9)	18.96 (6.2)	20.46 (5.7)	19.78 (6.6)	134.82 (29.8)	135.90 (28.7)	135.16 (30.3)
Yes	16.87 (5.2)	17.56 (4.9)	17.14 (5.2)	19.51 (6.2)	19.79 (5.8)	20.05 (5.9)	132.17 (29.2)	132.00 (29.0)	132.70 (29.8)
Caregiver comorbidity	$t=0.30$	$t=0.65$	$t=0.51$	$t=-1.48$	$t=0.44$	$t=0.36$	$t=-0.26$	$t=0.10$	$t=0.53$
No	16.70 (5.5)	17.77 (5.0)	17.30 (5.9)	18.85 (6.8)	20.13 (6.0)	20.13 (6.2)	132.45 (30.2)	133.22 (27.1)	134.48 (28.1)
Yes	16.55 (5.3)	17.41 (5.0)	16.97 (5.2)	19.70 (5.8)	19.85 (5.6)	19.87 (6.0)	133.10 (28.9)	132.91 (30.2)	132.62 (31.1)

Cells contain means and standard deviations in parentheses unless otherwise noted

* $p<.05$

time 2 was significantly related to caregivers' mental health at time 3 ($\beta=.085, p<.05$).

Physical Health Results reported in Fig. 2 show similar trends for physical health. There was a significant correlation of physical health among dyad members at time 1 ($r=.094, p<.05$). There were significant actor effects in patients' and caregivers' physical health and these effects increased over time. The association of a person's physical health at time 1 and their own physical health at Time t was not different for caregivers than for patients ($\beta=.560$ vs. $\beta=.541$, chi-square difference (1)=0.40, $p>.05$). Similarly, the association of a person's physical health at time 2 and their own physical health at time 3 was not different for caregivers than for patients ($\beta=.646$ vs. $\beta=.606$, chi-square difference=0.60, $p>.05$). There was one significant partner effect. Patients' physical health at time 1 was associated with increased caregivers' physical health at time 2 ($\beta=.103, p<.05$).

Self-Efficacy We modeled actor and partner effects of patients' and caregivers' self-efficacy over time (see Figs. 1 and 2). Patients' and caregivers' self-efficacy were not significantly correlated at time 1 ($r=.086, p>.05$). Results showed strong actor effects of self-efficacy over time for both patients and caregivers. Caregivers had a stronger association of self-efficacy between time 1 and time 2 than patients ($\beta=.701$ vs. $\beta=.604$, chi-square difference=9.00, $p<.05$). However, there was no difference in association of a person's self-efficacy at time 2 and their own self-efficacy at time 3 between caregivers and patients ($\beta=.725$ vs. $\beta=.728$, chi-square difference=0.01, $p>.05$). There were no significant partner effects, showing that patients' self-efficacy at early time points did not influence caregivers' self-efficacy at subsequent time points, and that caregivers' self-efficacy at early time points did not influence patients' self-efficacy at subsequent time points.

Longitudinal Effects of Self-Efficacy on Patients' and Caregivers' Outcomes

We explored longitudinal actor and partner effects of self-efficacy (aim 2) by adding paths to the above models from self-efficacy to mental health and to physical health outcomes (see Figs. 1 and 2).

Actor Effects from Self-Efficacy to Outcomes Patients with more self-efficacy at time 1 had higher mental health at time 2 ($\beta=.217, p<.05$). Similarly, patients with higher self-efficacy at time 2 had higher mental health at time 3 ($\beta=.135, p<.05$). Caregivers with higher self-efficacy at time 1 had higher mental health at time 2 ($\beta=.174, p<.05$). Caregivers with higher self-efficacy at time 2 had higher mental health ($\beta=.190,$

$p<.05$) at time 3. Higher caregiver self-efficacy at time 1 was related to higher caregiver physical health ($\beta=.141, p<.05$) at time 2.

Partner Effects from Self-Efficacy to Outcomes We found one significant partner effect. Higher patients' self-efficacy at time 2 was related to higher caregivers' physical health ($\beta=.092, p<.05$) at time 3 (see Fig. 2).

Discussion

This longitudinal study examined actor-partner effects of cancer patients' and their family caregivers' mental health, physical health, and self-efficacy during advanced stages of the disease. Our hypotheses for aim 1 were partially confirmed. Specifically, patients' and caregivers' mental and physical health had a significant influence on their own health at subsequent time points (actor effects). However, there were only a few partner effects (four out of a possible eight), indicating that partner effects occurred, but were limited. Partner effects were more common for mental health outcomes (three out of four) compared to physical health outcomes (one out of four). Our hypotheses for aim 2 were also partially confirmed. Patients' and caregivers' self-efficacy influenced their own and one another's mental and physical health over time, but results were not consistent across patients and caregivers. These results partially support social cognitive theory, which suggests that self-efficacy influences an individual's mental and physical well-being.

Influence of Patients and Caregivers on Own Outcomes (Actor Effects)

Relationships over Time Findings indicated significant actor effects in each person's own level of mental health, physical health, and self-efficacy over time. In most cases, these actor effects strengthen over time indicating that patients' and caregivers' initial levels were more predictive of subsequent values. The actor effects for patients' and caregivers' health outcomes suggests that those with more mental and physical health problems initially are at risk of having sustained problems over time [51, 52], and warrant early intervention.

Mental Health Outcomes There were differences in actor effects on some outcomes for patients and caregivers. Actor effects for caregivers' mental health were larger than for patients' mental health, suggesting there was less change in caregiver mental health over time. The larger actor effects for caregivers may be due to the lack of mental health services that caregivers use when suffering from

Table 2 Descriptives and correlations of caregiver outcomes and demographics/covariates

Descriptives	Mental health			Physical health			Self-efficacy		
	T1 N=484	T2 N=347	T3 N=304	T1 N=484	T2 N=347	T3 N=304	T1 N=484	T2 N=347	T3 N=304
Means	16.61	17.55	17.10	24.02	24.07	24.56	133.07	132.32	131.87
SD	5.36	5.00	5.3844	4.15	4.12	3.76	27.56	30.32	28.89
Correlations									
Age	.12*	.08	.04	.04	.05	-.01	.08	.14*	.03
Gender	<i>t</i> =-1.53	<i>t</i> =-1.31	<i>t</i> =-1.01	<i>t</i> =-1.17	<i>t</i> =-0.88	<i>t</i> =-2.15*	<i>t</i> =-2.43*	<i>t</i> =0.11	<i>t</i> =-0.18
Male	13.53 (5.0)	14.30 (5.5)	14.36 (5.3)	23.74 (4.3)	23.83 (4.3)	23.98 (4.2)	129.21 (31.0)	132.55 (19.0)	131.48 (28.5)
Female	14.27 (4.9)	15.10 (5.5)	15.00 (5.4)	24.19 (4.0)	24.23 (4.0)	24.93 (3.4)	135.44 (25.0)	132.17 (31.2)	132.10 (29.2)
Relationship of caregiver	<i>t</i> =0.81	<i>t</i> =0.16	<i>t</i> =0.28	<i>t</i> =0.01	<i>t</i> =-1.02	<i>t</i> =-1.12	<i>t</i> =0.38	<i>t</i> =-1.20	<i>t</i> =-1.18
Spouse	14.28 (5.3)	14.87 (6.3)	14.90 (5.6)	24.02 (3.8)	23.70 (4.7)	24.16 (3.9)	133.79 (27.1)	129.14 (36.5)	128.59 (31.5)
Non-spouse	13.87 (5.1)	14.77 (5.2)	14.70 (5.3)	24.02 (4.3)	24.21 (3.9)	24.70 (3.7)	132.76 (27.8)	133.52 (27.6)	133.03 (27.9)
Type of cancer	<i>F</i> =0.83	<i>F</i> =1.03	<i>F</i> =0.99	<i>F</i> =3.61*	<i>F</i> =1.56	<i>F</i> =2.41	<i>F</i> =0.15	<i>F</i> =0.32	<i>F</i> =0.29
Prostate	14.13 (6.0)	14.39 (5.5)	14.93 (5.3)	24.84 (3.2)	24.70 (4.1)	25.20 (3.7)	131.08 (34.3)	132.37 (30.5)	134.71 (30.1)
Lung	13.47 (5.1)	14.06 (5.5)	13.90 (5.9)	23.30 (4.7)	23.38 (4.7)	24.09 (4.0)	132.95 (28.8)	129.71 (31.6)	129.94 (27.5)
Breast	14.40 (4.7)	15.26 (5.3)	15.27 (4.9)	24.61 (3.4)	24.42 (3.7)	25.06 (3.2)	133.83 (24.3)	133.69 (30.6)	131.41 (29.6)
Colon	14.00 (5.3)	15.16 (5.8)	14.73 (5.5)	23.68 (4.6)	23.94 (4.0)	23.83 (4.2)	133.27 (26.5)	133.10 (28.8)	132.73 (28.8)
Patient comorbidity	<i>t</i> =0.05	<i>t</i> =-0.54	<i>t</i> =0.28	<i>t</i> =0.21	<i>t</i> =-0.16	<i>t</i> =0.05	<i>t</i> =1.86	<i>t</i> =-0.24	<i>t</i> =0.64
No	14.01 (5.2)	14.53 (5.6)	14.89 (5.7)	24.09 (4.6)	24.01 (4.2)	24.58 (4.5)	136.90 (27.5)	131.67 (32.8)	133.56 (28.6)
Yes	13.98 (5.2)	14.89 (5.5)	14.70 (5.3)	24.00 (4.0)	24.09 (4.1)	24.56 (3.4)	131.66 (27.5)	132.54 (29.4)	131.21 (29.0)
Caregiver comorbidity	<i>t</i> =-1.65	<i>t</i> =-0.92	<i>t</i> =0.56	<i>t</i> =-2.71*	<i>t</i> =2.03*	<i>t</i> =2.31*	<i>t</i> =-0.92	<i>t</i> =-1.09	<i>t</i> =0.11
No	13.51 (5.2)	14.46 (5.8)	14.96 (5.0)	24.65 (3.4)	24.62 (3.9)	25.16 (3.4)	131.66 (28.1)	130.17 (32.1)	132.08 (27.3)
Yes	14.30 (5.2)	15.02 (5.4)	14.61 (5.6)	23.61 (4.5)	23.70 (4.3)	24.15 (4.0)	134.00 (27.2)	133.78 (29.1)	131.71 (30.0)

Cells contain means and standard deviations in parentheses unless otherwise noted

**p*<.05

emotional distress [53]. Caregivers are also less likely to be referred to mental health services because they seldom discuss concerns about their own mental health with the patient’s oncologist or oncology social worker

(1). Furthermore, caregivers often report less social support than patients, which may result in lack of help dealing with their own emotional needs while caring for their loved one [52].

Fig. 1 Actor-partner effects of patient and caregiver mental health over time. The analyses displayed in all figures control for age, gender, relationship of caregiver, type of cancer, patient and caregiver comorbidities, and intervention group status. Non-significant paths are not shown. ***p*<.01, **p*<.05, *N*=484 dyads

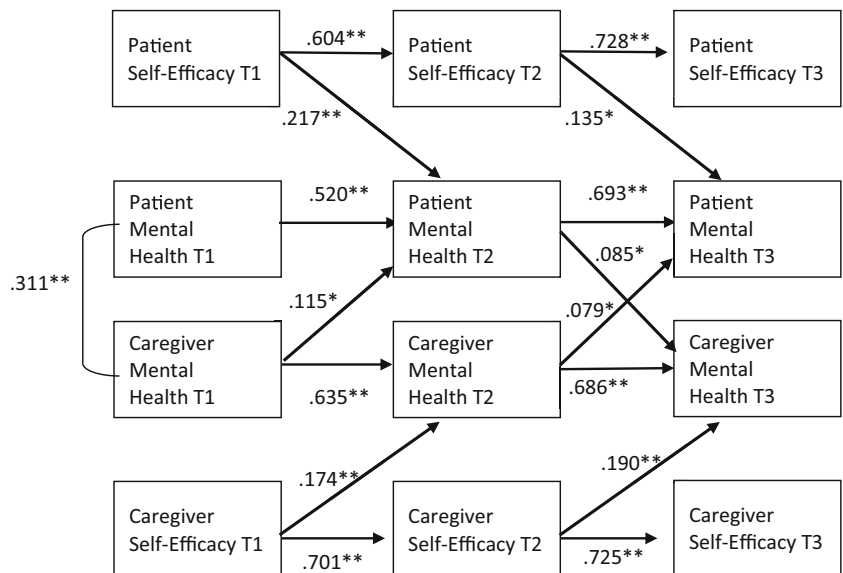
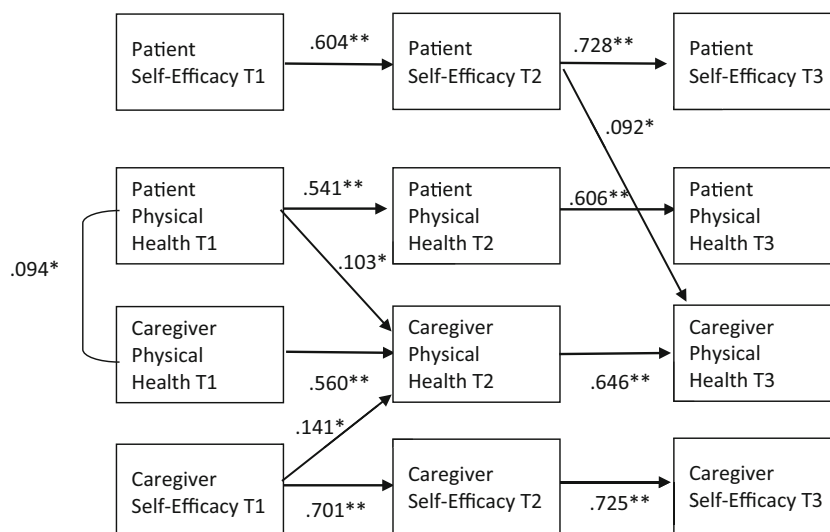


Fig. 2 Actor-partner effects of patient and caregiver physical health over time. The analyses displayed in all figures control for age, gender, relationship of caregiver, type of cancer, patient and caregiver comorbidities, and intervention group status. Non-significant paths are not shown. ** $p < .01$, * $p < .05$, $N = 484$ dyads



Influence of Patients and Caregivers on Their Partners' Outcomes (Partner Effects)

Mental Health Outcomes Consistent with other reports [48], there was a pattern of influence on one another's mental health outcomes, which originated from the caregiver. The mental health of caregivers at time 1 subsequently influenced patients' mental health at time 2, and patients' mental health at time 2 influenced caregivers' mental health at time 3. This indicates that each person's responses affected the other. Similar findings were reported in a large population-based study that examined the association between cancer patients' and their partners' quality of life [54]. Our findings are consistent with social cognitive theory, which posits that the social environment (e.g., important people in individuals' lives) can influence how individuals cope with the stress of cancer [27]. These findings indicate that interventions should target the mental health of both patients and caregivers to directly benefit each individual, as well as have some influence on their partners' mental health.

Physical Health Outcomes Similarly, social environmental influences were found on physical health outcomes, and these pathways originated from the patient. The patient's physical well-being at time 1 had partner effects on the caregiver's physical well-being at time 2. A growing number of studies have documented that stress associated with cancer can have a negative effect on caregivers' physical well-being by agitating normal physiological processes [55] and decreasing caregivers' immune function [17] and self-care behaviors [16].

Self-Efficacy Outcomes There was no relationship between patients' and caregivers' levels of self-efficacy at any of the assessment times. Self-efficacy is behavior specific [56], meaning that a person may feel efficacious performing one

behavior, but not another. Since the tasks required of the caregiver are often different from the tasks required of the patient, it is not surprising that patients' and caregivers' self-efficacy scores were not related. The lack of a relationship may indicate that when patients feel confident managing their illness, it does not mean that their caregivers are confident providing care or that caregivers receive a boost in confidence emanating from patients' confidence. Since a component of self-efficacy is vicarious experience [56], we may be more likely to see interdependence in the self-efficacy between a patient's primary and secondary caregiver (because of their similar tasks caring for the patient), rather than between a patient and caregiver.

This finding may also be a reflection of the individual-level orientation of our self-efficacy measures. According to Bandura [57], collective efficacy is a group-level construct, representing shared beliefs about a group's ability to achieve a goal through collective action. In patient-caregiver dyads, the knowledge, skills, and resources patients and caregivers use to reach a shared goal (e.g., well-being) could be viewed as an exercise of collective efficacy [58]. While their individual actions and their self-efficacy to reach that goal may differ, social cognitive theory suggests that there is an association between these individual-level factors (i.e., actions and self-efficacy) and a measure of dyadic efficacy [23, 57, 59]. Future research should examine the relationship between patient and caregiver self-efficacy, dyadic efficacy (i.e., collective efficacy), and actions taken to reach shared goals within the context of advanced cancer. Furthermore, because perceived interdependence and group dynamics influence collective efficacy [23, 57], health professionals should supplement information tailored to both patients' and caregivers' specific needs with support for key interpersonal factors (e.g., dyad relational quality and communication) [60].

Effects of Self-efficacy on Patients' and Caregivers' Outcomes

Self-Efficacy and Patient Outcomes Although there was not an association between patients' and caregivers' self-efficacy, self-efficacy was a strong predictor of outcomes over time, which aligns with social cognitive theory. This was particularly the case for the mental health outcomes. Patients with more self-efficacy reported higher mental health at each subsequent assessment time, and their caregivers' reported higher physical health (time 3). Patients with higher self-efficacy may feel more confident carrying out tasks by themselves, which may help decrease strain and improve physical well-being of their caregivers. Others have also reported that higher patient self-efficacy for engaging in physical activities was associated with higher patient mood [34]. Conversely, patients who are not confident carrying out physical activities may be less active and more dependent on their partners [34].

Self-Efficacy and Caregiver Outcomes Caregiver self-efficacy was also related to positive outcomes. Caregivers with more self-efficacy also had higher mental health at each subsequent assessment time possibly because self-efficacy served as a buffer to help caregivers manage the distress associated with caregiving [31] or because caregivers with more confidence felt more mentally equipped to provide care.

Limitations

There are some limitations to this study that may have influenced our findings. Our sample contained a group of patient-caregiver dyads who agreed to be part of a randomized clinical trial of a dyadic psycho-educational intervention to improve mental and physical health of families affected by cancer and who may have higher relationship functioning. In addition, our patients and caregivers had relatively high SES (i.e., high education and income) which may influence the resources available for care, affecting coping and self-efficacy. These associations should be tested and may be heightened for lower SES patients and caregivers. Further, although we had adequate representations of White and African-American families, we were underrepresented for Hispanic and Asian families. Families from collectivistic cultures may differ in terms of the interactions and expectations of patients and caregivers. Therefore, actor and partner effects should be compared across different cultural groups and settings. In addition, although we used dyadic analyses that assessed actor and partner effects, some of our measures failed to capture conceptually dyadic processes. For example, we used measures that assessed individual-level self-efficacy instead of measuring collective self-efficacy which would have better matched Social Cognitive Theory and our overall dyadic approach.

Finally, future studies should integrate biological indicators of mental and physical health to improve validity.

Conclusions

Since advanced cancer patients and their family caregivers are influenced by their own and their partner's mental and physical health, it is essential to view the patient-caregiver dyad as the unit of care. Clinicians need to ask both patients and caregivers how the illness is affecting them emotionally and physically and refer them to support resources and to reliable websites for information (e.g., National Cancer Institute or the American Cancer Society). In some instances, it may be helpful to refer caregivers to their primary care providers for a more in depth mental and physical health assessment. Caregiver assessment, training, and support need to be quality indicators that are integrated into routine inpatient and outpatient care [61].

Our findings also indicate that self-efficacy is a key variable to address in interventions offered to patients and their caregivers [34]. Increasing patients' and caregivers' self-efficacy will likely help improve outcomes for both members of the dyad [33]. However, we need to tailor self-efficacy interventions to the needs of the patient and caregiver within the dyad and recognize that their self-efficacy is influenced by dyad-level factors. The presence of high levels of individual self-efficacy does not automatically lead to patient and caregiver success in reaching shared goals [57]. Rather, dyads would benefit from interventions that enhance interpersonal mechanisms and improve their ability to cope with cancer together [59, 62].

Acknowledgments Funded by a Grant from the National Cancer Institute (RO1CA107383, L. Northouse)

Authors' Statement of Conflict of Interest and Adherence to Ethical Standards Authors Kershaw, Ellis, Yoon, Schafenacker, Katapodi, and Northouse declare that they have no conflict of interest. The study followed strict ethical considerations and was approved by the University of Michigan IRB and Yale IRB/HIC.

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