# Treatment Type and Demographic Characteristics as Predictors for Cancer Adjustment: Prospective Trajectories of Depressive Symptoms in a Population Sample

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***Objective:*** Prospectively identifying individuals at heightened risk for depression can alleviate the disease burden of distal physical and mental health consequences after cancer onset. Our objective was to identify heterogeneous trajectories of adjustment in cancer patients, using treatment-type as a predictor. ***Methods:*** Participants were followed for 6 years within the Health and Retirement Study (HRS), a prospective population-based cohort study. The sample consisted of 1,294 middle-aged participants who were assessed once before and 3 time points after their report of an initial cancer diagnosis. In addition to self-reported depressive symptoms, subjects indicated receipt of surgical, radiological, or chemical interventions as part of their usual oncological care. ***Results:*** Four symptom trajectories were identified with Latent Growth Mixture Modeling: an increasing depression (10.5%), chronic depression (8.0%), depressed-improved (7.8%), and stable-low depression (73.7%). A conditional model using participants with available predictor data ($n = 545$) showed individuals in the emerging depression class were significantly more likely to have received chemo/medication therapy when compared with the remitting depression, stable-low, and chronic depression classes. Participants in the chronic and depressed-improved classes generally had worse baseline health, and the depressed-improved were also younger in age. ***Conclusion:*** Patients who exhibited increasing depressive symptoms had a greater probability of receiving chemo/medication therapy than any other adjustment trajectory group, although the majority of chemotherapy patients did not exhibit depressive symptom changes. These data underscore the diversity of ways that patients adjust to cancer, and suggest cancer treatment, baseline health, and age may influence long-term patterns of psychological adjustment.

*Keywords:* cancer, adjustment, heterogeneity, chemotherapy

Cancer has long been known to confer risk for changes in psychological functioning, particularly in comparison with other major health-related diagnoses (Polsky et al., 2005). In addition to having impact on quality of life, the accurate understanding of the course and detection of psychopathology in oncological populations is made even more essential because its presence may impact the progression of the cancer itself (Spiegel & Giese-Davis, 2003). Premorbid psychological distress can reduce adherence to oncological screening (Lerman, Kash, & Stefanek, 1994) as well as adversely impact medical compliance (Somerset, Stout, Miller, & Musselman, 2004). These considerations underscore the impor-

tance of investigating psychological distress across the course of cancer treatment and follow-up, particularly in light that treatment itself may also contribute to symptomatology in the long term (Zebrack et al., 2002).

Prevalence rates for psychiatric conditions such as major depression vary considerably in cancer patients, with reported prevalences as low as 8% and as high as 24% (Krebber et al., 2014; Mitchell et al., 2011; Mitchell, Ferguson, Gill, Paul, & Symonds, 2013). This variability in estimates may have many sources. A meta-analysis of 58 studies revealed greater prevalence of depression in cancer patients than in the general population, with age, sex, and location of tumor all being linked to depressive symptoms (van't Spijker, Trijsburg, & Duivenvoorden, 1997). Variability has also been partially attributed to study methodological limitations of the extant literature, including inconsistent measurement techniques used across studies as well as the failure to account for subjects' premorbid psychological health (Massie, 2004). Prospective studies of depression in response to discrete life events have shown that estimates of psychopathology after such events often conflate rates of individuals that develop depression with rates of persons who were depressed before the event (Bonanno et al., 2002; Galatzer-Levy & Bonanno, 2012). As such, accurate esti-

mates of depression after cancer require both population-based data and a prospective model to accurately delineate heterogeneous patterns of adjustment.

Research on aversive life events has increasingly begun to apply novel statistical techniques to identify heterogeneous patterns of longitudinal outcomes (Bonanno, 2004). Trajectories modeled through Latent Growth Mixture Modeling (LGMM) permit empirically exploring the heterogeneity of data that has traditionally been treated as error (Muthén, 2004). The accumulation in this body of research suggests that multiple trajectories of outcome characterize reactions to major medical episodes (Bonanno, Kennedy, Galatzer-Levy, Lude, & Elfström, 2012; Le Brocque, Hendrikz, & Kenardy, 2010; Quale & Schanke, 2010) including longitudinal adjustment to the onset of cancer (Deshields, Tibbs, Fan, & Taylor, 2006; Dunn et al., 2012; Helgeson, Snyder, & Seltman, 2004; Henselmans et al., 2010; Hou, Law, Yin, & Fu, 2010; Lam et al., 2010). Four such studies have identified four unique trajectories of adjustment to cancer by measuring general distress, where each team of authors observed a group that was consistently low in distress, another group experiencing chronic distress, a third that recovered from initially elevated levels of distress, and a fourth that evidence delayed increase in distress (Helgeson et al., 2004; Henselmans et al., 2010; Hou et al., 2010; Lam et al., 2010). A separate study reported four similar trajectories of anxiety in patients after genetic testing for hereditary gastrointestinal cancer in Chinese patients (Ho, Ho, Bonanno, Chu, & Chan, 2010). In their trajectory analysis of depressive symptoms, only three classes were reported, and no recovery class was observed. The most recent study of this kind identified three trajectories of distress in a sample of radiation therapy patients and their families, who were followed up to six months after initiating treatment. Two classes were consistently low or high in their reported anxiety, and the third demonstrated moderate anxiety that improved over time (Dunn et al., 2012).

These findings have provided important groundwork for understanding acute response styles to cancer. However, it remains unclear in the cancer literature how these trajectories appear across a population with diverse cancer types, and what impact the course of the cancer treatment itself might have on these patterns. Longer time frames and use of preoncological diagnosis would allow distinguishing individuals with preexisting depressive symptoms from those who were comparatively asymptomatic before the to the receipt of oncological procedures, such that clinical characteristics might be used to predict these adjustment patterns. Such a distinction could hold important treatment implications (Watson, Brymer, & Bonanno, 2011). Prediagnosis data would also distinguish individuals who had minimal or absent depressive symptoms both before and after cancer onset.

The current investigation sought to address these questions by charting trajectories of depressive symptoms using a population sample, where data were obtained before and several years after an initial cancer diagnosis. We obtained data from a large population-based study of older Americans (ages 49–73) that allowed us to select participants that had already been followed for a number of years, minimizing sampling bias, and aimed to identify trajectories spanning the years immediately before and after the diagnosis. Additionally, because these data were population-based, we were able to examine a diverse sample of cancer patients, ranging in cancer type, treatment choice, and a number of important demographic factors that have previously been associated with depression in cancer. Using these data, we expected to identify at least three distinct groups of adjustment, with one group demonstrating chronically elevated depressive symptoms, another whose depressive symptoms improved over time, and a third group with consistently low to absent depressive symptoms. We then examined whether patients' cancer treatment types as well as demographic and health characteristics predicted these patterns of adjustment.

## Method

### Data

Prospective data were drawn from the Health and Retirement Study (HRS), a nationally representative study sponsored by the National Institute on Aging housed at the University of Michigan. Using face-to-face interviews, the HRS was designed to explore numerous aspects of aging in American adults, including mental and physical health. The study began in 1992 and employs a survey sampling design administered to noninstitutionalized adults and their spouses once every two years, oversampling for Black, Hispanic, and female participants, as well as Florida residents (Juster & Suzman, 1995). Data for the current investigation were drawn from a total of 8 waves (1994 to 2008). We elected to use only the most proximate pre-cancer data point for each participant because there was no reason to hypothesize sample-level patterns in adjustment before this point; receiving a diagnosis of cancer is an unexpected event. Limiting our analyses to only one pre cancer data point also increased our available sample size.

### Participants

Participants were asked at each time point if they had developed one or more of several health conditions. The sample was restricted to individuals who were members of the original HRS or War Baby cohorts (years of birth ranging from 1931 to 1947) that did not report a previous cancer history at the beginning of their participation, but did report a cancer onset at a later study time point. To ensure that a participant could have these data at every point in the analysis, we limited our inclusion of participants to those who initially reported their cancer at least 3 time points before their final measurement (i.e., sometime between 1996 and 2004). The final sample of the unconditional model consisted of 1,294 participants (58% female) with a mean age of 60.73 years at time of reported diagnosis ($SD = 3.97$). Participant data were organized using a "floating baseline" methodology such that measures were centered on the wave during which the cancer diagnosis was first reported. Cancer diagnosis and treatment took place sometime between T1 and T2. Slightly less than half of this sample had treatment data available, and thus the conditional model incorporating predictors of trajectory membership used a smaller subsample from the unconditional model ($n = 545$, Table 2).

### Measures

Participants were asked numerous questions regarding basic demographic information and their health status at each time point. Depressive symptoms were measured using an 8-item version of the Center for Epidemiologic Studies-Depression (CES-D) scale

(Radloff, 1977). This abbreviated version of the CES-D asked participants to endorse whether they did ($= 1$) or did not ($= 0$) experience any of the provided symptoms during the past week, and has demonstrated high external and construct validity (Kohout, Berkman, Evans, & Cornoni-Huntley, 1993). Our selected subsample evidenced adequate reliability ($\alpha = .81$) and on average reported between 1 and 2 depressive symptoms at any of the 4 time points that were included in the analysis ($M = 1.59$, $SD = 2.06$). Consistent with past depression research in a normal population, number of endorsed depressive symptoms were skewed for the first ($M = 0.18$, $SD = 0.25$, skewness $= 1.57$, kurtosis $= 1.63$), second ($M = 0.21$, $SD = 0.26$, skewness $= 1.32$, kurtosis $= 0.93$), third ($M = 0.21$, $SD = 0.26$, skewness $= 1.39$, kurtosis $= 1.02$), and fourth time points ($M = 0.19$, $SD = 0.26$, skewness $= 1.43$, kurtosis $= 1.14$).

Participant's treatment regimen, occurring sometime within the same 2-year window as the initial diagnosis, was transformed into 3 separate variables. Each variable was dummy coded ($1 = yes$, $0 = no$) for whether the patient received treatment in the form of chemotherapy or some other nonpalliative medication-based intervention, surgery, or radiation therapy. A participant could report receiving none to all three forms of therapy. Data on the type/origin of the participant's cancer were collected at the same time as treatment type. Participants' baseline health status was obtained at the time point before their cancer diagnosis (T1) from a single-item measure where participants listed rated their overall health on a five-point scale ($1 = Excellent$, $5 = Poor$).

## Results

### Analysis

We performed Latent Growth Mixture Modeling (LGMM) with Mplus 5.1 to identify the best fitting trajectory models of depressive symptoms covering a period before (T1) and at three time points after (T2, T3, and T4) initial cancer diagnosis and treatment. Preliminary tests suggested that nonlinear models evidenced improved fit, although variances for slope and quadratic parameters were fixed at zero to allow model convergence. We compared unconditional models (no covariates) for one to five classes by examining the Aikaike (AIC), Bayesian (BIC), and sample-size adjusted Bayesian (SSBIC) information criterion indices, entropy values, and the Lo-Mendell-Rubin (LRT) and bootstrap (BLRT) likelihood ratio tests (see Table 1). Our selection of the final model

was based on overall model fit, interpretability, and theoretical coherence (Bonanno, 2004; B. Muthén, 2003). The information indices showed improved fit in the 1 to 5 class solutions. However, both entropy and the LRT indicated less optimal fit in the 5-class solution. Additionally, the 5-class model proved unstable with the introduction of covariates and was less consistent with previous findings. Consequently, we chose the 4-class model as the optimal solution (see Figure 1). To ensure that mortality rates were not impacting class assignment for this solution, we performed a post hoc comparison of percentage of participants who died sometime between T1 and T4. The proportion of mortality rates did not differ across the 4 classes, $\chi^2(3, n = 1,294) = 2.17$, $p = .538$.

This solution described 4 unique trajectories that each contained a high probability of distinct membership with values ranging from .850 to .955. The majority of the sample (73.7%) was assigned to a class with low initial levels of depression and relatively low depression throughout the 8-year study. We labeled this trajectory *stable-low depression.* A second class (10.5%) was also characterized by initial low depressive symptoms, but demonstrated a steep positive slope across time. We labeled this trajectory as *emerging depression.* Another class displayed consistently high levels of depression across the study (8.0%). We labeled this trajectory as *chronic depression.* A fourth class (7.8%) also reported elevated symptoms at baseline, but demonstrated a dramatic negative slope along with a significant positive quadratic parameter such that symptom improvement plateaued at the 4th year. We labeled this class as *depressed-improved.*

### Predictors

We next created a conditional model that included demographic and treatment variables as predictors of the depression trajectories (see Table 2). Specifically, gender, age at diagnosis, race, income, educational status, baseline quality of health, and receipt of chemotherapy, radiation therapy, and surgery were all included as covariates in the model. Because of low frequencies between classes, we recoded data into dichotomous variables for race (white vs. nonwhite) and education (completion of high school and below vs. some college and above). To detect for gross class differences on these measures, omnibus tests were conducted outside of the Latent Growth Mixture Model and were significant for education, $\chi^2(3, n = 545) = 11.68$, $p = .009$, self-reported health, $F(3, 541) = 27.83$, $p < .001$, and receipt of chemotherapy, $\chi^2(3, n = 545) = 10.64$, $p = .014$ (see Table 2). Because LGMM

Table 1
*Fit Indices for 1 to 5 Class Unconditional Growth Mixture Models of Depression*

| Fit index | Growth mixture model | | | | |
| --- | --- | --- | --- | --- | --- |
| | 1 class | 2 classes | 3 classes | 4 classes | 5 classes |
| AIC | $-1021.63$ | $-1392.65$ | $-1677.01$ | $-1914.69$ | $-2024.66$ |
| BIC | $-980.31$ | $-1330.66$ | $-1594.37$ | $-1811.38$ | $-1900.69$ |
| SSBIC | $-1005.72$ | $-1368.78$ | $-1645.19$ | $-1874.91$ | $-1976.92$ |
| Entropy | — | .922 | .873 | .878 | .868 |
| LRT $p$ value | — | $<0.001$ | 0.108 | 0.003 | 0.094 |
| BLRT $p$ value | — | $<0.001$ | $<0.001$ | $<0.001$ | $<0.001$ |

*Note.* AIC = Akaike information criterion; BIC = Bayesian information criterion; SSBIC = Sample size-adjusted Bayesian information criterion; LRT = Lo-Mendell-Rubin test; BLRT = Bootstrap likelihood ratio test.
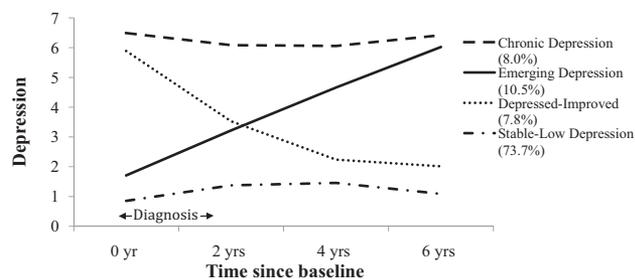
*Figure 1.* Estimated levels of mean depression score for each trajectory group at each time point within the unconditional model (without covariates), *n* = 1,294.

analysis is unable to accommodate participants with missing predictor data, adding these variables reduced the available sample size (*n* = 545). However, the addition of covariates did not significantly alter the shape and only slightly altered the proportion of the trajectory patterns. Furthermore, the proportion of missing data did not significantly differ according to class nor among the above referenced demographic measures, with the exception of gender where women were more likely to have missing data than men, $\chi^2(1, n = 1,294) = 7.42, p = .006$.

Results from the multinomial logistic regression where demographic and treatment variables were modeled to predict class indicated that of the demographic variables, participant gender, race, income, and educational status were the least predictive and did not significantly differ between any of the classes (see Table 3). Age at reported diagnosis was significantly lower for those in the depressed-improved class than the chronic (Est = −0.151, *SE* = 0.064, *p* = .018) and the stable-low (Est = −0.141, *SE* = 0.050, *p* = .005) classes. For the treatment variables, neither radiation therapy or surgery predicted membership to any of the four classes. Individuals in the emerging depression class were more likely to have received chemo/medication therapy than those in the depressed-improved (OR, 6.62; 95% CI, 1.28–34.34; *p* = .024), stable-low (OR, 3.53; 95% CI, 1.35–9.21; *p* = .010), and chronic classes (OR, 3.74; 95% CI, 1.20–11.67; *p* = .023).[1] Participants' self-reported health at T1 was significantly worse for members of the chronic class when compared to the stable-low (Est = 1.09, *SE* = 0.21, *p* < .001) and emerging depression classes (Est = 0.72, *SE* = 0.27, *p* = .008). Members of the depressed-improved class also had worse baseline self-reported health when compared to the stable-low class (Est = 1.03, *SE* = 0.37, *p* = .005).

We explored the possibility that trajectory membership might also be influenced by cancer type. Unfortunately, there was marked heterogeneity in this variable and it was not possible to include cancer type in the conditional model because of the low cell frequencies. Low cell frequencies also prohibited us from testing differences between the classes in cancer type outside of the model. It was possible, however, to combine the three smaller classes and compare them against the stable-low depression class on the three most common cancer types which were breast (14.1%), prostate (11.9%), and bowel cancers (6.8%).[2] This analysis was nonsignificant, $\chi^2(2, N = 179) = 0.490, p = .783$, indicating a similar profile of the most common cancer types among those who did and did not have stable low depression.

Inspection of cell frequencies of the individual classes likewise suggested equivalent distribution of cancer type, although we were unable to verify this statistically and could not present raw frequencies due to the infrequently occurring and thus potentially identifiable nature of these data.

## Discussion

Availability of data on psychological distress both before and after receipt of oncological services is critical in formulating patterns of adjustment in cancer patients. In the current study, we identified the presence and form of prospective patterns of depression across a representative sample of cancer patients, whose diverse clinical features more readily generalize to the broader American oncological population. We also incorporated treatment and demographic variables for a smaller subsample of these participants who had these data available to predict membership in depressive symptom trajectories. To our knowledge, this is the first prospective trajectory analysis in cancer patients, though these findings are largely consistent with others who have followed breast cancer patients upon initial diagnosis (Helgeson et al., 2004; Lam et al., 2010). One distinction from previously established trajectories is that the identified class with increasing depressive symptoms did not evidence any psychological improvement as time elapsed from the initial diagnosis and treatment, possibly because of the relatively large time scale employed in the current study's design. Most longitudinal studies of cancer adjustment limit measures from 6 months to one year after study onset. Although these studies permit assessing more acute fluctuations in mood, extending sampling intervals in the current investigation allowed us to identify broader trends in functioning.

A comparison of several potential models indicated that 4 classes of individuals showing distinct patterns of adjustment best accounted for fluctuations in depression before and after a diagnosis of cancer. The majority of the sample evidenced relatively little or no depressive symptoms across time. A second class reported chronically elevated symptom levels of depression, whereas a third demonstrated improvement and a fourth demonstrated persistently increasing depression after the cancer diagnosis. One interesting difference that emerged between these classes in the subsample included in the conditional model subsample was that persons who had consistently high depressive symptoms perceived themselves as having poorer health than those who evidenced continuously low or elevating depressive symptoms. Similarly, those in the improving class also reported worse health when compared with the stable-low class. These differences in premorbid health may explain why persons in this group were previously distressed before receiving oncological services, and is

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[1] We considered that the overlap of somatic symptoms of depression and side-effects of chemotherapy and/or hormone therapy may be responsible for this effect. A post-hoc comparison of chemo/medication therapy vs. non-chemo/medication therapy recipients in a calculated proportion of somatic symptomatology (number of endorsed CES-D somatic symptoms ÷ number of total endorsed CES-D symptoms) indicated that these two groups did not significantly differ in their ratio of somatic symptoms at the first, *U* = 33327.50, *p* = .69, second, *U* = 29135.50, *p* = .40, *U* = 19729.00, *p* = .65, or fourth time point, *U* = 15312.50, *p* = .21.

[2] Percentages represent the proportion of the conditional model subsample (*n* = 545) who reported diagnosis of these cancer types.

Table 2

*Demographic and Medical Characteristics of the 4 Latent Classes (Conditional Model, n = 545)*

| Demographics | Stable low depression (n = 415) Mean (SD) or % | Emerging depression (n = 43) Mean (SD) or % | Depressed-improved (n = 42) Mean (SD) or % | Chronic depression (n = 45) Mean (SD) or % | Group comparisons $F(df)$ or $\chi^2(df)$ | p |
|---|---|---|---|---|---|---|
| Age | 62.6 (4.8) | 62.0 (4.1) | 61.1 (4.6) | 62.8 (3.9) | 1.56 (3, 541) | .199 |
| Gender (% female) | 62.8% | 51.8% | 53.3% | 61.9% | 3.16 (3) | .367 |
| Income | $73,653 ($118,144) | $54,069 ($73,180) | $46,008 ($59,082) | $37,328 ($44,276) | 2.42 (3, 541) | .065 |
| Race/ethnicity | | | | | | |
| White | 80.7% | 79.1% | 78.6% | 64.4% | 6.51 (3) | .089 |
| Non-white | 19.3% | 20.9% | 21.4% | 35.6% | | |
| Education | | | | | | |
| High school or below | 55.7% | 74.4% | 69.0% | 73.3% | 11.68 (6) | .009 |
| College and above | 44.3% | 25.6% | 31.0% | 26.7% | | |
| Medical characteristics | | | | | | |
| Self-reported health[a] (T1) | 2.55 (1.04) | 3.05 (1.19) | 3.52 (1.31) | 3.82 (1.11) | 27.83 (3, 541) | <.001 |
| Oncological treatment | | | | | | |
| Surgery | 61.9% | 58.1% | 57.1% | 44.4% | 5.37 (3) | .147 |
| Radiation | 28.2% | 30.2% | 33.3% | 40.0% | 3.01 (3) | .390 |
| Chemo/medication | 33.3% | 41.9% | 33.3% | 35.6% | 10.64 (3) | .014 |
| Total treatments | | | | | | |
| 0 | 12.0% | 7.0% | 9.5% | 17.7% | 12.69 (9) | .177 |
| 1 | 59.0% | 46.5% | 64.3% | 46.7% | | |
| 2 | 22.5% | 39.5% | 19.1% | 33.3% | | |
| 3 | 6.5% | 7.0% | 7.1% | 2.2% | | |

[a] Lower scores indicate better health (1 = *excellent*, 5 = *poor*).

consistent with research linking long-term mental health consequences of major medical diagnoses (Polsky et al., 2005).

Another interesting and clinically relevant finding was the unique trajectory of persons whose depressive symptoms escalated after diagnosis, and that these individuals were most likely to have received chemotherapy or another nonpalliative medication-based treatment. This distinction was particularly sharp given the lack of differences between members of other trajectories and their use of this treatment type. Compatible results have been reported in a pediatric population (Zebrack et al., 2002). One possible explanation is that individuals with worsening depression presented with more advanced or severe forms of cancer that required chemotherapy, but we were unable to directly test this hypothesis with the available data. However, other studies have failed to establish a link between psychological outcomes and medical parameters such

as disease stage or response to treatment (Akechi, Okuyama, Imoto, Yamawaki, & Uchitomi, 2001; Hipkins, Whitworth, Tarrier, & Jayson, 2004). The post hoc comparison of mortality rates across this study's four trajectories, and their apparent equivalence, likewise lends some evidence that a shortened life span did not influence the trajectory membership. It is important to note that the present results do not suggest that most patients who receive chemotherapy go on to develop depression; the majority of chemo/medication therapy recipients in our sample evidenced no change in their depressive symptoms across the study's 6-year span.

Several potentially relevant findings have been reported that may link receipt of chemotherapy and nonpalliative cancer medications to potential for depression onset. Costanzo and colleagues (2007) observed that breast cancer patients receiving chemotherapy displayed higher levels of anxiety (but not depression) than

Table 3

*Multinomial Logistic Regression of Predictors on Depression Symptom Trajectories*

| Reference class | Emerging depression | | | Stable low | | Depressed-improved |
|---|---|---|---|---|---|---|
| Compared classes | Stable low Coefficient (SE) | Depressed-improved Coefficient (SE) | Chronic Coefficient (SE) | Depressed-improved Coefficient (SE) | Chronic Coefficient (SE) | Chronic Coefficient (SE) |
| Sex[a] | −0.22 (0.42) | −0.16 (0.68) | −0.01 (0.50) | 0.06 (0.60) | 0.21 (0.37) | 0.15 (0.71) |
| Age | 0.02 (0.05) | −0.13 (0.07) | 0.03 (0.06) | −0.14 (0.05)** | 0.01 (0.04) | 0.15 (0.06)* |
| Race | −0.28 (0.57) | −0.06 (0.97) | −0.31 (0.65) | 0.22 (0.84) | −0.03 (0.47) | −0.25 (1.06) |
| Education | 0.83 (0.48) | 0.94 (0.74) | 0.44 (0.62) | 0.11 (0.61) | −0.39 (0.42) | −0.50 (0.73) |
| Income | 2.13 (4.36) | 0.86 (5.83) | −2.10 (8.36) | −1.27 (4.66) | −4.23 (6.63) | −2.96 (10.45) |
| Surgery | 0.19 (0.46) | 0.13 (0.67) | −0.31 (0.54) | −0.06 (0.61) | −0.50 (0.39) | −0.44 (0.74) |
| Radiation | −0.13 (0.46) | −0.59 (0.92) | 0.46 (0.56) | −0.46 (0.91) | 0.60 (0.39) | 1.06 (1.03) |
| Chemo/medication therapy | −1.26 (0.49)* | −1.89 (0.84)* | −1.32 (0.58)* | −0.63 (0.74) | −0.06 (0.45) | 0.57 (0.93) |
| Self-reported health (T1) | −0.38 (0.24) | 0.65 (0.40) | 0.72 (0.27)** | 1.03 (0.37)** | 1.09 (0.21)*** | 0.06 (0.40) |

[a] Coded as 0 = *male*, 1 = *female*.
* $p < 0.05$.    ** $p < 0.01$.    *** $p < 0.001$.

those receiving radiation therapy alone at the conclusion of treatment, and suggest that the longer duration and severe side effects of the treatment may be responsible. Another study in breast cancer patients suggested this treatment type appears to have the greatest impact on coping behaviors (Hervatin, Sperlich, Koch-Giesselmann, & Geyer, 2012). Cognitive and neural consequences of chemotherapy are increasingly documented, and may also be mechanisms linking this treatment to development of depressive symptoms (Falleti, Sanfilippo, Maruff, Weih, & Phillips, 2005; Ferguson, McDonald, Saykin, & Ahles, 2007; Inagaki et al., 2007). Finally, it is possible that inflammation caused by chemical-based therapies may increase levels of circulating proinflammatory cytokines, a biological response associated with increased depressive symptoms and the phenomenologically similar "sickness behavior" syndrome (Dantzer, 2001). Other medication-based interventions such as endocrine therapy have also been linked to deficits in cognition and elevating fatigue (Jenkins, Shilling, Fallowfield, Howell, & Hutton, 2004; Stone, Hardy, Huddart, A'Hern, & Richards, 2000). It is interesting to note that the somatic and nonsomatic symptoms appear to occur in equal proportion for patients who did and did not receive chemo/medication therapy, suggesting that changes in somatic symptoms alone are not a long-term consequence of chemotherapy and medication therapy in our sample. However, it is possible that increases in somatic symptoms cause eventual elevation in mood symptoms, but a test of this hypothesis would require a significantly shorter sampling window than the one employed by the HRS.

Regardless of cause, the comparatively larger ratio of chemotherapy and other drug types in recipients who fall into the increasing depression class could serve as an important marker for physicians working with such cases. Identifying those most at risk of long-term development of symptoms can permit timelier implementation of interventions aimed at preventing and reducing the psychological distress of an intensive treatment regimen. Simple interventions such as telecare, psychoeducation, and group supportive counseling can have both psychological and physiological benefits (Goodwin et al., 2001; Kroenke et al., 2010; Lepore, Helgeson, Eton, & Schulz, 2003). Likewise, frequently monitoring individuals at the greatest risk to developing depression after the onset of cancer permits more efficient and cost-effective allocation of resources, and could alleviate the public health burden of both depression and cancer. The gradual slope of the increasing depression class also suggests that elevations in depression may not occur immediately after cancer treatment. Implementing regular depression screening and appropriate psychosocial referrals as part of follow-up oncological services would also benefit those whose elevations in depressive symptoms occur in the years, rather than months, after receiving oncological services (Stanton, 2012).

Consideration should also be given to the depressed-improved class that is, at first glance, something of a peculiar finding. The observed improvement appears to take place at the same time point that the cancer is reported. This runs counter to the conceptualization that people recover from the stressor itself and not preexisting high levels of distress, although a number of other studies have also identified such a pattern (Bonanno, Mancini, et al., 2012; Bonanno et al., 2002; Dickstein, Suvak, Litz, & Adler, 2010; Galatzer-Levy, Bonanno, & Mancini, 2010; Mancini, Bonanno, & Clark, 2011). This body of findings may provide an alternative and less contentious explanation for the "posttraumatic growth" phenomenon, in that it suggests that only persons who were distressed before a trauma are likely to receive any benefit from it. For instance, in a study of breast cancer patients, negative affect at baseline was associated with patient's tendency to seek out the positive consequences of negative events (Tomich & Helgeson, 2004). It is also possible that increased contact with oncologists and other medical care providers after diagnosis increases the likelihood of detecting and treating preexisting depression during the course of services. Participants in this class were also comparatively younger than those in the chronic and stable-low classes. As previous research indicates that prevalence of depression is lower in U.S. adults age 65 and older than those between the ages of 51–64, it is possible that the members of this group were experiencing maturation effects unrelated to their cancer (Kessler & Bromet, 2013). Similarly, other studies examining cancer adjustment have reported that older adults with certain cancers are more likely to have higher quality of life than their younger counterparts (Arden-Close, Gidron, & Moss-Morris, 2008; Bloom, Petersen, & Kang, 2007; Howard-Anderson, Ganz, Bower, & Stanton, 2012). As participants' average age was approximately 61 years at the time of their cancer diagnosis, the comparatively higher age of our sample may have also contributed to the large percentage of the sample that fell into the stable-low class as compared to other trajectory studies using younger samples. Future research in this line of inquiry would greatly benefit from using an LGMM analytical approach to help differentiate the effects of age, baseline depression, and potential secondary gains of cancer treatment.

A number of limitations of our study should be considered. The broad sampling pattern of the HRS allows for a first glimpse into functioning before and after a cancer diagnosis, but the 2-year period of time between each wave does not allow for detection of acute fluctuations of depression, especially in the time period immediately after treatment onset. Although the percentages of class membership in the current investigation closely resemble others who studied psychological adjustment more frequently and closer to diagnosis, we cannot draw conclusions regarding how the predictors such as treatment type impact acute distress. We did not measure psychosocial characteristics of cancer patients or lifetime occurrence of depression before study enrollment, two features that future trajectory studies should endeavor to include. As previously mentioned, it is possible that those in the depressed-improved trajectory received an increased amount of social support from medical staff or close others. Likewise, those in the emerging depression trajectory may have had initially positive adjustment during the reentry phase posttreatment, but became progressively worse because of a lack of interpersonal resources. Somewhat surprising was the lack of socioeconomic differences between the classes within the multinomial logistic regression, as these factors have often been closely linked with access to care and depression (Lorant et al., 2003). This may be attributable to the statistical power of the comparatively smaller class sizes in the conditional model. Similarly, the absence of gender differences between classes may be attributable to the disproportionate number of women whose data were missing in this analysis. Finally, although a number of steps were taken in our analytical approach to minimize the risk of overestimating the number of latent classes (Muthén, 2003; Nylund, Asparouhov, & Muthén, 2007), it is important to note that LGMM analyses of non-normal data, such as

the depression measures used in the current study, are biased to support models consisting of more classes than actually exist (Bauer & Curran, 2003).

The Health and Retirement Study's amalgamation of several cancer types provides a unique opportunity to examine adjustment in a representative sample of multiple cancer types, but unfortunately the sample size was inadequate to properly examine if specific cancer types predicted trajectories of depression. Future longitudinal studies should endeavor to sample specific cancer populations with distinct clinical features, as this would provide further useful information to practitioners regarding the risk-markers of depression onset. Future studies would also benefit greatly from incorporating more frequent assessment intervals to detect possible interactions between intervention type and cancer type during and after treatment initiation. The use of self-reported depressive symptoms further limits interpretations of our results to long-term patterns in psychological distress rather than actual diagnoses of major depression made by trained clinicians. Finally, our sample was limited to an age range of approximately 24 years. As age was a significant predictor of class membership even within this window, further studies are required to investigate depression patterns in pediatric and young adult oncology patients.

Although the limitations of the study prevented us from testing a number of important hypotheses, this study provides important data on prospective trajectories of adaptation in a large, representative sample of cancer patients. Our results suggest that individuals with initial low levels of depressive symptoms that progressively increased appeared more likely to have received chemo/medication therapy as part of the treatment regimen than any other trajectory. Persons whose reported elevated levels of distress before the cancer diagnosis and treatment also appeared to have worse baseline health, although some of these persons report decreasing depressive symptoms after oncological services. Combined, these findings warrant further investigation to clarify the effects of cancer treatments on trajectories of distress.

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