

Positive and negative mood in men with advanced prostate cancer undergoing androgen deprivation therapy: considering the role of social support and stress

Catherine Benedict^{1*}, Jason R. Dahn², Michael H. Antoni^{3,4}, Lara Traeger⁵, Bruce Kava⁶, Natalie Bustillo³, Eric S. Zhou⁷ and Frank J. Penedo⁸

¹Department of Psychiatry & Behavioral Sciences, Memorial Sloan Kettering Cancer Center, New York, NY, USA

²Miami Veteran Affairs Healthcare System, Miami, FL, USA

³Department of Psychology, University of Miami, Coral Gables, FL, USA

⁴Sylvester Comprehensive Cancer Center, University of Miami Miller School of Medicine, Miami, FL, USA

⁵Department of Psychiatry, Massachusetts General Hospital, Boston, MA, USA

⁶Department of Urology, University of Miami Miller School of Medicine, Miami, FL, USA

⁷Dana-Farber Cancer Institute, Boston, MA, USA

⁸Robert H. Lurie Comprehensive Cancer Center, Feinberg School of Medicine Northwestern University, Chicago, IL, USA

*Correspondence to:

Memorial Sloan Kettering
Cancer Center, 641 Lexington
Street, 7th Floor, New York, NY
10022, USA. E-mail: benedicc@
mskcc.org

Abstract

Advanced prostate cancer patients often undergo androgen deprivation therapy (ADT). Advanced disease and adverse ADT side effects are often debilitating and negatively impact mood. Social support has been shown to mitigate detrimental effects of stress on mood.

Objective: This study sought to characterize positive and negative mood in this select patient population and determine whether social support moderated relations between stress and mood.

Methods: Participants ($N=80$) completed the Interpersonal Support Evaluation List, Perceived Stress Scale, and Derogatis Affect Balance Scale at a single time point. Hierarchical regression models evaluated relations among social support, stress, and mood controlling for relevant covariates. Standard moderation analyses were performed.

Results: Participants reported higher levels of negative and positive mood compared with published means of localized prostate cancer patients. Overall, mood was more positive than negative. Stress levels were comparable to cancer populations with recurrent disease. Moderated regression analyses showed that social support partially buffered the effects of stress on positive mood; men with high stress and low support reported the lowest levels of positive mood. The model with negative mood as the dependent measure did not support moderation; that is, the relationship between stress and negative mood did not differ by level of social support.

Conclusion: Among individuals living with advanced prostate cancer, social support may be an important factor that sustains positive mood in the presence of stress. Future work should examine the extent to which social support prospectively impacts health-related quality of life by promoting positive mood. Limitations include cross-sectional design, which precludes causal inferences.

Copyright © 2014 John Wiley & Sons, Ltd.

Received: 31 January 2014

Revised: 18 July 2014

Accepted: 20 August 2014

Androgen deprivation therapy (ADT) is often the first line of treatment for advanced prostate cancer (APC; metastatic disease), and its use has grown markedly in the USA [1]. ADT is associated with a number of side effects that adversely impact physical well-being. These include hot flashes, fatigue, anemia, osteopenia and osteoporosis, and potential detrimental cardiovascular effects [1,2]. Importantly, studies show that ADT can negatively affect psychological well-being as well, often contributing towards depression, mood swings, and worsening cognitive function [1,2]. These treatment-related effects may occur simultaneously with general stressors associated with advanced stage cancer (e.g., end-of-life considerations, financial, spiritual, and social stressors) [3]. Adjustment to these sequelae

may be difficult and may undermine the ability of APC patients to maintain optimal mood and quality of life (QOL).

Studies highlighting the association of advanced stage prostate cancer and ADT with significant mood changes have primarily shown increased depression and anxiety [4,5]. DiBlasio *et al.* retrospectively reviewed medical charts of men with APC receiving ADT and reported that up to 28% of patients were newly diagnosed with a psychiatric illness in the years following treatment, with depression being the most common diagnosis (56%) [6]. At this point, however, no studies to our knowledge have characterized positive mood or considered simultaneous changes in both positive and negative mood in men with APC who are receiving ADT.

Positive and negative mood are conceptualized as distinct constructs with varying effects on health [7,8]. Although there has been extensive debate whether positive and negative mood are bipolar ends of the same construct or independent constructs, most of this has centered around the co-occurrence of both mood states in momentary experiences [9] with the strongest negative correlation during acute emotional responses [10]. Over longer periods of time, however, positive and negative mood appear to be more independent [10]. Folkman and Moskowitz [9] discussed the co-occurrence of positive and negative mood from the perspective of individuals coping with chronic stress and argued that not only do they co-occur, but they both can have independent effects on health and well-being. It is argued that the ability to experience both mood states independently and simultaneously has adaptive significance [9,11].

A vast amount of research has associated negative mood (e.g., depression, anxiety, hostility, and anger) with disease morbidity and mortality [12]. On the other hand, positive mood (e.g., happiness, joy, excitement, enthusiasm, and contentment) provides independent benefits to health controlling for the effects of negative mood [13]. Low levels of positive mood may also be predictive of disease onset and severity [10]. Notably, a lack of positive mood may be a more significant predictor of psychological distress and health outcomes than the presence of negative mood in some patient populations [14,15]. Anxiety is believed to result from high levels of negative mood, whereas depression is characterized by high levels of negative mood and low levels of positive mood [8,11]. The balance between positive and negative mood may be a distinguishing factor between healthy functioning versus psychopathology [11,16]. Research in cancer populations has largely failed to treat positive and negative mood as separate constructs, however, and there are few attempts to account for their simultaneous effects on well-being [10].

In addition to potentially significant mood changes, advanced cancer is associated with a number of stressors because of the various psychosocial and physical changes that may take place. These can include having to cope with, and adjusting to physical symptoms, changes in roles and responsibilities, uncertainty for the future, and end-of-life considerations [2,3]. Among patients with APC, greater intensity of treatment side effects is associated with more cancer-related stress [17]. High levels of stress may, in turn, affect psychological well-being. Localized PC patients who make active attempts to reduce stress report higher levels of QOL [18]. Men with APC undergoing ADT are vulnerable to experiencing heightened levels of stress, which may intensify the disease burden and further exacerbate mood difficulties.

Within this context, social support may help to mitigate or preclude detrimental effects of stress on mood by either reducing the propensity for negative mood or promoting

positive mood experiences. Support resources may buffer against negative effects of stress by protecting an individual from maladaptive cognitive and emotional responses to stressful events, or by minimizing physiological and behavioral responses [19]. Various indicators of support have been shown to moderate the effects of stress on health across several chronic diseases including cancer [20]. Importantly, the perception of support and satisfaction with the amount and type of support received are more critical factors than the mere availability of support resources [19].

In general, only limited research has been conducted specifically with APC patients. Despite the wealth of literature focusing on localized PC, there is a strong need to differentiate patients with advanced disease. Segrin *et al.* [21] reported that the effect of social support on depression was moderated by disease stage such that higher levels of support were associated with reductions in depression among men with APC, but the effect was reversed among men with localized PC. Low levels of support are also associated with increased psychological distress, depression, and anxiety among men with PC [22,23] and in mixed cancer samples [24]. Findings from a significant body of research suggest that perceived support may be a critical factor in determining patients' mood, particularly among those coping with advanced disease and with heightened levels of stress.

The present study sought to characterize positive and negative mood among men with APC undergoing ADT. Importantly, research clearly demonstrates the necessity of considering both positive and negative mood as separate constructs when determining effects on health and well-being [10]. Despite this, most studies continue to use uni-dimensional measures of mood or fail to control for potential simultaneous effects of both mood states. This is the first study to our knowledge to characterize both positive and negative mood in this select patient population. We also aimed to evaluate whether perceived stress contributes to positive and/or negative mood and how social support modulates those relations. It was hypothesized that greater perceived stress and lower social support would be related to worse mood (i.e., higher levels of negative mood and lower levels of positive mood); patients with high stress and low support would have worse mood than those with low stress and high support.

Methods

Participants were part of a larger 10-week, group-based cognitive behavioral stress management intervention study for men with APC undergoing ADT [25]. Data from the baseline assessment visit (T1; pre-intervention) were used for these analyses. Recruitment included referrals from urology clinics, community

presentations, and the Florida Cancer Data System (a cancer registry maintained by the Florida Department of Health).

Eligible participants were 50 years or older, were fluent in English, had completed a ninth grade-level education, were diagnosed with stage III or IV PC and currently undergoing ADT, and experienced ADT side effects in the past 12 months. A modified version of the Structured Clinical Diagnostic Interview for DSM-IV excluded participants with a history of or current psychosis, current substance use/dependence disorders, organic mental disorder, and current suicidal ideation or panic disorders [26]. A cut-off score of 26 on the Mini Mental State Examination ruled out cognitive impairment [27]. Study procedures and all documents were approved by the University of Miami IRB. All ethical guidelines stipulated by the NIH in the conduct of human subjects research were followed. All participants signed an IRB approved informed consent document. Monetary compensation (\$50) was provided.

Measures

Standard questionnaires were used to collect sociodemographic and health-related information. The Charlson Comorbidities Index, a weighted index of 19 medical conditions, was used to assess comorbid medical conditions [28].

Mood

Mood was measured using the Derogatis Affect Balance Scale positive and negative affect composites [29]. Each consists of a 20-item adjective checklist that describes positive (joy, contentment, vigor, and affection) and negative mood (anxiety, depression, guilt, and hostility) experienced in the past week. Responses were on a five-point scale ranging from 'Never' to 'Always'. Higher scores indicate higher levels of positive and negative mood. In the current study, both composites demonstrated internal consistency (Cronbach's alphas = 0.91 and 0.93, respectively). Additionally, an Affect Balance Index (ABI) assessed overall affective valence. A positive ABI score indicates a relatively higher proportion of positive mood than negative mood, whereas a negative score indicates a higher proportion of negative mood; a score of zero indicates equal amounts of positive and negative mood. The ABI has shown good psychometric properties with cancer patients [30]. The positive and negative mood composites were analyzed as primary outcomes, whereas the ABI was used to help characterize the sample.

Perceived stress

The Perceived Stress Scale, a 14-item self-report measure, assessed the degree to which participants considered situations to be unpredictable or overwhelming over the past

month [31]. Items were answered on a five-point scale ranging from 'Never' to 'Very Often'. Higher scores indicate greater perceived stress. Internal consistency was established in the current study (Cronbach's alpha = 0.87).

Social support

Social support was measured using the Interpersonal Support Evaluation List, a 40-item scale that assesses perceived availability of social resources [32]. Statements are rated on a four-point scale ranging from 'Definitely true' to 'Definitely false'. The scale is designed to give an overall measure of support using the total score as well as measures of separate support functions represented by four subscales (each 10 items): Appraisal Support (i.e., someone with whom to talk about problems), Belonging Support (i.e., people with whom one can do things), Tangible Support (i.e., material aid), and Self-esteem Support (i.e., comparison of one's self with others). Scores were coded such that higher scores indicated more social support. The Total and all subscales demonstrated adequate internal consistency (Cronbach's alphas ranged from 0.70 to 0.88).

Analytic strategy

Psychometric properties of all variables were evaluated. A categorical income variable was defined by creating three groups representing an annual household income less than or equal to \$35,000, between \$35,000 and \$100,000, and greater than or equal to \$100,000. Pearson correlations and one-way analysis of variance were used to evaluate preliminary relations among study variables. Covariates related ($p < .10$) to outcomes were retained in subsequent analyses.

Hierarchical multiple regression analyses evaluated relations among perceived stress, social support, and mood outcomes. Analyses were conducted separately for positive and negative mood and included participants who had complete data on all variables in the model. Following standard guidelines, perceived stress and social support were centered to avoid multicollinearity, and interaction terms were computed [33]. Main effects and the interaction effect on mood, controlling for covariates and the other mood scale, were evaluated. Post hoc tests assessed relations between perceived stress and mood for participants who reported high versus low levels of social support. Conditional group variables for social support were created by adding one standard deviation (SD; high social support group) and subtracting one SD (low social support group). Two regressions generated the slopes for high and low social support groups, which were then used to plot regression lines by substituting high and low values (i.e., one SD above and below the mean, respectively) of perceived stress in each equation [33]. All primary model parameters were tested at $p < .05$.

Results

Participants ($N=80$) were an average of 70 years old ($SD=9.8$), most were married/partnered (67%), and the sample was ethnically diverse (Non-Hispanic White, 65%; Hispanic, 13%; Black, 21%; Other, 1%). Men were about 3 years post-diagnosis ($SD=2.7$) and had undergone 1.6 ($SD=1.4$) years of ADT at the time of assessment. See Table 1 for descriptive information.

Mean levels of both negative ($M=14.3$, $SD=10.6$) and positive mood ($M=52.3$, $SD=12.8$) were lower than reported in a previous study of localized PC patients and a comparison cohort of healthy men [34]. The average ABI score was 1.89 ($SD=1.05$), indicating that participants acknowledged an overall emotional experience that was more positive than negative. Positive and negative mood were negatively correlated ($r=-.59$, $p<.001$).

Table 1. Sample characteristics ($N=80$)

	Mean	SD
Sociodemographic and health-related variables		
Age (years)	69.7	9.8
Education (years)	15.1	3.0
Time since diagnosis (months)	37.6	34.3
Time since any cancer-related treatment (months)	10.2	19.9
Months of ADT	18.7	17.3
Medical comorbidities	2.3	2.7
Perceived stress (PSS) ^a	17.83	8.09
Social support (ISEL; Total score) ^b		
Tangible Support subscale	22.61	5.49
Appraisal Support subscale	20.94	6.53
Self-esteem Support subscale	21.14	4.07
Belonging Support subscale	21.49	5.57
Positive mood (ABS Positive Mood Composite) ^c	52.25	12.78
Negative mood (ABS Negative Mood Composite) ^c	14.32	10.65
% of sample		
Ethnicity		
Non-Hispanic White	65	
Hispanic	13	
Black/African-American	21	
Other	1	
Income (annual; household)		
<\$35,000	24	
\$35,000–\$100,000	43	
>\$100,000	28	
Unknown ('I don't know'; 'No response')	5	
Current relationship status		
Married or equivalent relationship	67	
Single/never married	9	
Divorced or separated	13	
Widowed	11	

ADT, androgen deprivation therapy; PSS, Perceived Stress Scale; ISEL, Interpersonal Support Evaluation List; ABS, Affect Balance Scale.

^aThe PSS possible score range is from 0 to 10 with higher scores indicating higher levels of perceived stress.

^bThe ISEL Total score can range from 0 to 120 (each subscale score ranges from 0 to 40) with higher scores indicating more support.

^cThe ABS Positive and Negative Mood Composite scores can range from 0 to 80 (each subscale score range is 0–20) with higher scores indicating higher levels of the specified mood state.

Levels of perceived stress were higher than reported of healthy older adults [35] and post-treatment patients with localized PC [36].

Less education ($r=-.29$, $p<.05$) and a greater number of medical comorbidities ($r=.19$, $p<.10$) were related to higher levels of negative mood. Participants in the lowest income group ($\leq\$35,000$) reported higher levels of negative mood than those in the highest income group ($\geq\$100,000$; $F[2, 73]=3.03$, $p<.10$; Tukey pairwise comparisons, $p<.05$). Longer duration of ADT was related to higher levels of positive mood ($r=.20$, $p<.10$). No other relations were significant at the $p<.10$ level (age, ethnicity, time since diagnosis, and time since treatment). Covariates that were related ($p<.10$) to outcome variables were retained in primary analyses.

Associations among perceived stress, social support, and mood

Separate regression models were specified for positive and negative mood. First, main effect models were specified to evaluate the relationships between perceived stress and mood outcomes. Covariates in the positive mood model included months of ADT and negative mood; and the negative mood model included education, income (two dummy coded variables), medical comorbidities, and positive mood. Both main effect models were significant (positive mood, $F[3, 71]=20.42$, $p<.001$; negative mood, $F[6, 66]=20.31$, $p<.001$) and accounted for 46% and 65% of the variance in positive and negative mood, respectively. Perceived stress was associated with lower levels of positive ($\beta=-.52$, $p<.001$) and higher levels of negative mood ($\beta=.68$, $p<.001$).

Next, to determine whether social support moderated these relations, positive and negative mood models were specified in which covariates and the other mood scale were entered in the first step, perceived stress and social support were entered as main effects in the second step, and their interaction was entered in the third step. The positive mood model was significant ($F[5, 67]=17.96$, $p<.001$), accounting for 57% of the variance in positive mood scores (Table 2). The perceived stress and social support interaction factor was significant ($\beta=-.19$, $p<.05$; $R^2\Delta=.03$, $F\Delta[1, 67]=5.12$, $p<.05$); however, the main effects of perceived stress ($\beta=-.37$, $p<.01$) and social support ($\beta=-.30$, $p<.01$) continued to be significant with the inclusion of the interaction term, suggesting a partial moderation effect. The overall negative mood model was significant ($F[8, 62]=15.35$, $p<.001$) and accounted for 66% of negative mood variance. The interaction factor was not associated with negative mood; education ($\beta=-.19$, $p<.05$) and perceived stress ($\beta=.70$, $p<.001$) were the only significant correlates (Table 2). Both positive and negative mood models indicated acceptable collinearity diagnostics (variance inflation factor [VIF]

Table 2. Hierarchical regression models for positive and negative mood

Step	Factor	R ²	R ² Δ	FΔ	p	β	t	p
Positive mood								
1	Months of androgen deprivation therapy	.35	.35	18.90	<.001	.04	0.50	.62
	Negative mood					-.22	-1.81	.07
2	Perceived stress	.54	.19	14.01	<.001	-.37	-2.83	.01
	Social support					.30	3.44	.001
3	Perceived stress × social support	.57	.03	5.12	.03	.19	2.26	.03
Negative mood								
1	Education	.44	.44	10.14	<.001	-.19	-2.23	.03
	Medical comorbidities					.03	0.34	.74
	Income (dummy 1)					-.15	-1.58	.12
	Income (dummy 2)					-.04	-0.36	.72
	Positive mood					-.16	-1.49	.14
2	Perceived stress	.66	.24	21.04	<.001	.70	6.37	<.001
	Social support					.13	1.41	.16
3	Perceived stress × social support	.66	.001	.24	.62	-.04	-0.49	.62

range = 1.17–2.69; tolerance range = .37–.92), indicating multicollinearity was not a problem [37,38].

Post hoc analyses were conducted for positive mood to determine the nature of the moderation. Overall, men with higher levels of perceived stress reported lower levels of positive mood; those who also indicated less social support reported the lowest positive mood scores, whereas more social support was associated with higher positive mood scores (Figure 1). Men with low levels of perceived

stress reported higher levels of positive mood regardless of social support levels.

Discussion

Managing advanced cancer and adverse effects related to treatment can be taxing both physically and emotionally. Factors related to optimal adjustment among men with APC undergoing ADT are not well understood. We sought to characterize the mood of this select patient population and to identify modifiable factors (i.e., perceived stress and social support) that may increase risk for poor mood outcomes. Men reported levels of positive and negative mood that were lower than published findings of localized PC patients and a comparison cohort of healthy men [34] but an overall emotional experience that was more positive than negative. Our hypothesis was partially supported such that higher levels of perceived stress related to lower levels of positive mood, particularly if men reported less social support. Perceived stress was also positively correlated with negative mood. Contrary to expectations, this relation did not vary based on perceptions of social support. One of the strengths of this study is that positive and negative mood were analyzed separately and controlled for in all analyses. Over longer periods of time, positive and negative mood are believed to be relatively independent [7,8], suggesting that positive mood may provide benefit even in the midst of negative emotional experiences. Research has demonstrated that it is imperative to account for simultaneous effects of positive and negative mood when trying to understand related influences on health and well-being [10], particularly among advanced cancer patients [14]. Despite this, much of the literature has failed to measure and/or account for the potential effects of both mood states [10]. Evaluating factors that relate to positive mood experiences, even in the midst of

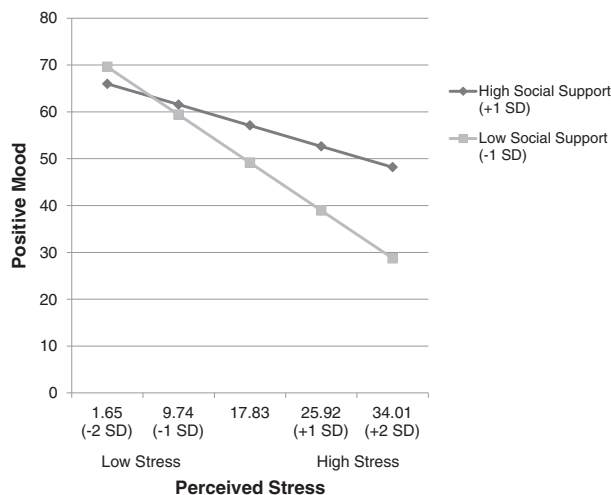


Figure 1. Social support is a partial moderator of the association of perceived stress with positive mood. Moderated regression analyses showed that social support partially buffered the effects of stress on positive mood. Men with high stress reported lower levels of positive mood; those who also indicated less social support reported the lowest positive mood scores, whereas more social support was associated with higher positive mood scores. Men with low levels of perceived stress reported higher levels of positive mood regardless of social support levels. Positive mood was measured using the Derogatis Affect Balance scale [26]; perceived stress was measured using the Perceived Stress Scale [28]; and social support was measured using the Interpersonal Support Evaluation List [29]

negative mood, may inform interventions to promote optimal adjustment and well-being.

Men reported more positive emotional experiences than negative ones, although their overall mood was less positive than reported of a healthy age-matched sample [39]. Positive mood is believed to serve important functions in the context of stressful situations such as providing respite and opportunity to restore coping resources, increase awareness and use of personal and interpersonal resources, promote creativity and flexibility in coping and problem-solving, and function as a buffer against deleterious physiological and psychological effects of stress and negative emotional experiences [9,40]. Benefits of positive mood are wide ranging and may increase engagement in social network activities and successful coping strategies [10,41]. Research suggests that positive mood may be more predictive of general health perceptions, expectations, and functional status than negative mood [42,43]. Sharpley and colleagues [43] reported that depression among PC patients was primarily a result of decreased interest and pleasure, not increased sadness or depressed mood. They hypothesized that anhedonic mood may prevent men from engaging in activities that facilitate coping and stress management. Similarly, men with low positive mood may be less likely to engage in social activities or access social support resources [10].

In situations of heightened stress, such as advanced cancer, having adequate social support is well accepted as a critical factor in helping individuals feel capable of managing stressors and maintaining a sense of control and well-being. We found that men in this study appeared better able to maintain positive mood under stress when they perceived higher levels of support. For those with lower levels of support, stress appeared to undermine their ability to experience positive affect states. The perception that support is available if needed contributes to an overall sense of having sufficient resources to cope effectively and regulate emotional reactions [19]. A wealth of literature has supported the buffering effects of social support and, consistent with our findings, has shown that although support may provide benefit under stressful conditions, effects may be limited during times of low stress [19].

Social support did not provide additional benefit to men who reported low levels of stress or modulate the effects of stress on negative mood. It is unclear why relations differed between positive versus negative mood outcomes. It may be that the number of side effects resulting from androgen deprivation (e.g., fatigue, hot flashes, bodily feminization, and erectile dysfunction) may overpower support benefits. Stress was more strongly associated with negative mood than it was with positive mood, possibly indicating that this relation is less easily modified by support resources. Costanzo *et al.* [44] reported that although cancer survivors had similar numbers and types of daily stressors as a sociodemographic-matched comparison

group, they experienced greater negative mood reactions in response to stressors, while differences in positive mood were not significant. The differential impact of stress on negative versus positive mood may be particularly true among older individuals living with cancer. Older age is related to greater ability to regulate emotional responses to stress, unless there are health problems or functional impairments [45,46]. In the context of poor health, stress may be more likely to manifest as negative emotional responses among older adults and thus may require more resources as compared with positive mood changes. Men in this study reported relatively low levels of support compared with mixed cancer populations [24] and may have needed more support or different kinds of support to buffer the effects of stress on negative mood.

An important caveat of the stress-buffering hypothesis is that social support will only mitigate the effects of stress if the support needs elicited by the stressor match the support resources perceived to be available [19]. It may be that men in this study were in need of *different kinds* of support than what they perceived themselves as having. As we did not measure perceptions of unmet support needs and satisfaction, it is difficult to determine what, if any, other support resources would have helped to modulate the effects of stress on negative mood. All men were part of a larger, group-based, psychosocial intervention study, suggesting they may have been looking for additional or different kinds of support resources. Furthermore, only 16% of participants reported that it was 'easy' to ask for help or support, and only 19% felt they could clearly express their needs to important people in their lives (as evidenced by responses of 'I can do this extremely well'), suggesting that men may have had difficulty accessing support in their personal lives even if it was available.

The only other significant correlate of negative mood, aside from perceived stress, was educational attainment; men with lower education levels reported more negative mood. Thirty-seven percent of participants reported having a high school education or less. It is well accepted that education ranks as a key determinant of health (among other indicators of socioeconomic status such as employment or income) [47]. Education is separate from but strongly associated with health literacy, which is an important mechanism that drives socioeconomic disparities observed across health outcomes including mental health [48,49]. This is particularly true among older adults and those with complex health conditions [49]. Of note, social support has been identified as a critical resource individuals use to compensate for health literacy problems [48]. Although not measured directly, participants with lower education may have had more difficulty understanding and/or managing their illness and thus may have been more likely to experience negative mood, particularly if support resources were perceived to be inadequate.

This study has a number of limitations that should be considered. The cross-sectional design precludes causal inferences regarding directionality, and prospective evaluation of these relations is necessary. As these were secondary analyses, we were not powered to control for all conceptually relevant covariates and therefore adopted a data-driven approach to specify which covariates to include in our models with the potential to lead to model over-fit. Participants' mood states may have been more transient than the assessment of mood (self-report of past 7 days) implied, and a single time point did not allow tracking of mood changes over time. We also did not have data on whether participants were experiencing clinically elevated depression and anxiety. Overall, levels of negative mood were relatively low, which may have affected our ability to detect a moderating role of social support. Future studies should explore the role of social support among men living with APC who report clinically significant levels of negative mood. Furthermore, although we argue the importance of maintaining positive mood levels, we also acknowledge that heightened positive mood may reflect maladaptive processes in some cases (e.g., denial or emotional suppression). A balance of negative and positive emotions is likely the most appropriate coping style and an indication that one is facing the reality of the situation and taking the disease and its treatment seriously [10]. Further research is needed to clarify these relations.

One final limitation of the study is its inability to distinguish whether the alterations and differential impact of social support on positive and negative mood result directly from advanced prostate cancer itself or from ADT. It is widely recognized that androgen replacement in hypogonadal men has restorative effects on mood, energy levels, vitality, and libido [50]. Distinguishing the differential impact of hypogonadism and APC itself on mood could have implications for management of these patients.

In addition to social support, brief cessation of ADT such as occurs in patients on intermittent hormonal therapy may offer both physical and psychological benefits. Further studies in this area are warranted.

Conclusions

This study broadens our understanding of the experience of APC patients undergoing ADT by examining associations of psychosocial factors with positive and negative mood. Although reducing negative mood is an important therapeutic goal, targeting positive mood may be a key factor in helping patients maintain their QOL. Social support was found to play a key role in helping participants maintain positive mood when under higher levels of stress. These findings are particularly relevant as absence of positive mood may be a more critical indicator of worse adjustment than presence of negative mood among cancer patients [35,36]. Interventions that aim to improve psychosocial adjustment among APC patients should consider the effects of stress and social support on positive mood.

Acknowledgements

Support for this research was provided by a grant from the National Cancer Institute (1R21CA102761-01A2: F. J. Penedo, PI).

Ethical approval

This study is in full compliance with institutional review board guidelines for protection of human subjects.

Conflict of interest

The authors have declared no conflicts of interest.

References

- Grossmann M, Zajac JD. Androgen deprivation therapy in men with prostate cancer: how should the side effects be monitored and treated? *Clin. Endocrinol. (Oxf)* 2011;**74**: 289–293.
- Eton DT, Lepore SJ. Prostate cancer and health-related quality of life: a review of the literature. *Psycho-Oncology* 2002;**11**:307–326.
- De Faye BJ, Wilson KG, Chater S, Viola RA, Hall P. Stress and coping with advanced cancer. *Palliat. Support. Care* 2006;**4**:239–249.
- Couper JW, Love AW, Duchesne GM et al. Predictors of psychosocial distress 12 months after diagnosis with early and advanced prostate cancer. *Med. J. Aust.* 2010;**193**:S58–S61.
- Chipperfield K, Fletcher J, Millar J et al. Predictors of depression, anxiety and quality of life in patients with prostate cancer receiving androgen deprivation therapy. *Psycho-Oncology* 2013;**22**:2169–2176.
- DiBlasio CJ, Hammett J, Malcolm JB et al. Prevalence and predictive factors for the development of de novo psychiatric illness in patients receiving androgen deprivation therapy for prostate cancer. *Can. J. Urol.* 2008;**15**:4249–4256; discussion 4256.
- Diener E, Emmons RA. The independence of positive and negative affect. *J. Pers. Soc. Psychol.* 1984;**47**:1105–1117.
- Watson D, Tellegen A. Toward a consensual structure of mood. *Psychol. Bull.* 1985;**98**: 219–235.
- Folkman S, Moskowitz JT. Positive affect and the other side of coping. *Am. Psychol.* 2000;**55**:647–654.
- Pressman SD, Cohen S. Does positive affect influence health? *Psychol. Bull.* 2005;**131**: 925–971.
- Hofmann SG, Sawyer AT, Fang A, Asnaani A. Emotional dysregulation model of mood and anxiety disorders. *Depress. Anxiety* 2012;**29**:409–416.
- Katon WJ. Clinical and health services relationships between major depression, depressive symptoms, and general medical illness. *Biol. Psychiatry* 2003;**54**:216–226.
- Ostir GV, Markides KS, Black SA, Goodwin JS. Emotional well-being predicts subsequent functional independence and survival. *J. Am. Geriatr. Soc.* 2000;**48**:473–478.
- Voogt E, van der Heide A, van Leeuwen AF et al. Positive and negative affect after diagnosis of advanced cancer. *Psycho-Oncology* 2005;**14**:262–273.
- Hou WK, Law CC, Fu YT. Does change in positive affect mediate and/or moderate the impact of symptom distress on psychological adjustment after cancer diagnosis? A prospective

- analysis. *Psychol. Health* 2010;**25**: 417–431.
16. Garamoni GL, Reynolds CF, Thase ME, Frank E, Fasiczka AL. Shifts in affective balance during cognitive therapy of major depression. *J. Consult. Clin. Psychol.* 1992;**60**: 260–266.
 17. Clark JA, Wray N, Brody B, Ashton C, Giesler B, Watkins H. Dimensions of quality of life expressed by men treated for metastatic prostate cancer. *Soc. Sci. Med.* 1997;**45**: 1299–1309.
 18. Roesch SC, Adams L, Hines A *et al.* Coping with prostate cancer: a meta-analytic review. *J. Behav. Med.* 2005;**28**:281–293.
 19. Cohen, S, Wills, TA. Stress, social support, and the buffering hypothesis. *Psychol. Bull.* 1985;**98**:310–357.
 20. Koopman C, Hermanson K, Diamond S, Angell K, Spiegel D. Social support, life stress, pain and emotional adjustment to advanced breast cancer. *Psycho-Oncology* 1998;**7**:101–111.
 21. Segrin C, Badger TA, Figueredo AJ. Stage of disease progression moderates the association between social support and depression in prostate cancer survivors. *J. Psychosoc. Oncol.* 2011;**29**:552–560.
 22. Baider L, Ever-Hadani P, Goldzweig G, Wygoda MR, Peretz T. Is perceived family support a relevant variable in psychological distress?. A sample of prostate and breast cancer couples. *J. Psychosom. Res.* 2003;**55**: 453–460.
 23. Mehnert A, Lehmann C, Graefen M, Huland H, Koch U. Depression, anxiety, post-traumatic stress disorder and health-related quality of life and its association with social support in ambulatory prostate cancer patients. *Eur J Cancer Care (Engl)* 2010;**19**: 736–745.
 24. Parker PA, Baile WF, de Moor C, Cohen L. Psychosocial and demographic predictors of quality of life in a large sample of cancer patients. *Psycho-Oncology* 2003;**12**:183–193.
 25. Penedo FJ, Benedict C, Zhou ES *et al.* Association of stress management skills and perceived stress with physical and emotional well-being among advanced prostate cancer survivors following androgen deprivation treatment. *J. Clin. Psychol. Med. Settings* 2013;**20**:25–32.
 26. First M, Spitzer R, Gibbon M, Williams J. Structured Clinical Interview for DSM-IV-TR Axis I Disorders, Research Version, Non-patient Edition (SCID-I/NP). New York: Biometrics Research, New York State Psychiatric Institute; 2002.
 27. Folstein MF, Folstein SE, McHugh PR. “Mini-mental state”. A practical method for grading the cognitive state of patients for the clinician. *J. Psychiatr. Res.* 1975;**12**: 189–198.
 28. Charlson M, Szatrowski TP, Peterson J, Gold J. Validation of a combined comorbidity index. *J. Clin. Epidemiol.* 1994;**47**:1245–1251.
 29. Derogatis LR. The Affect Balance Scale. Baltimore, MD: Clinical Psychometric Research; 1975.
 30. Derogatis LR, Abeloff MD, Melisaratos N. Psychological coping mechanisms and survival time in metastatic breast cancer. *JAMA* 1979;**242**:1504–1508.
 31. Cohen S, Kamarck T, Mermelstein R. A global measure of perceived stress. *J. Health Soc. Behav.* 1983;**24**:385–396.
 32. Cohen S, Mermelstein R, Kamarck T, Hoberman HM. Measuring the functional components of social support. In Sarason IG, Sarason BR, eds. *Social Support: Theory, Research and Applications*. Dordrecht, The Netherlands: Martinus Nijhoff; 1985;73–94.
 33. Holmbeck GN. Post-hoc probing of significant moderational and mediational effects in studies of pediatric populations. *J. Pediatr. Psychol.* 2002;**27**:87–96.
 34. Newton F, Burney S, Frydenberg M, Millar J, Ng K. Assessing mood and general health-related quality of life among men treated in Australia for localized prostate cancer. *Int. J. Urol.* 2007;**14**:311–316.
 35. Koschwaner HE. Expressive writing and wound healing in older adults: a randomized controlled trial. *Psychosom. Med.* 2013;**75**: 581–590.
 36. Lev EL, Eller LS, Gejerman G *et al.* Quality of life of men treated with brachytherapies for prostate cancer. *Health Qual. Life Outcomes* 2004;**2**:28–39.
 37. Field A. *Discovering Statistics Using IBM SPSS Statistics* (4th edition). SAGE Publications: London, 2013.
 38. Keith TZ. *Multiple Regression and Beyond*. Pearson, 2006.
 39. Benedict RH, Dobraski M, Goldstein MZ. A preliminary study of the association between changes in mood and cognition in a mixed geriatric psychiatry sample. *J Gerontol B Psychol Sci Soc Sci* 1999;**54**: P94–P99.
 40. Fredrickson BL. The role of positive emotions in positive psychology. The broaden-and-build theory of positive emotions. *Am Psychol* 2001;**56**:218–226.
 41. Tugade MM, Fredrickson BL, Barrett LF. Psychological resilience and positive emotional granularity: examining the benefits of positive emotions on coping and health. *J Pers* 2004;**72**:1161–1190.
 42. Benyamini Y, Idler EL, Leventhal H, Leventhal EA. Positive affect and function as influences on self-assessments of health: expanding our view beyond illness and disability. *J Gerontol B Psychol Sci Soc Sci* 2000;**55**:P107–P116.
 43. Sharpley CF, Bitsika V, Christie DH. Do prostate cancer patients suffer more from depressed mood or anhedonia? *Psycho-Oncology* 2013;**22**:1718–1723.
 44. Costanzo ES, Stawski RS, Ryff CD, Coe CL, Almeida DM. Cancer survivors’ responses to daily stressors: implications for quality of life. *Health Psychol* 2012;**31**:360–370.
 45. Charles ST, Carstensen LL. *Emotion regulation and aging*. Handbook of Emotion Regulation. New York, NY, US: Guilford Press, 2007:307–327.
 46. Isaacowitz DM, Smith J. Positive and negative affect in very old age. *J Gerontol B Psychol Sci Soc Sci* 2003;**58**:143–152.
 47. Nelson A. Unequal treatment: confronting racial and ethnic disparities in health care. *J Natl Med Assoc* 2002;**94**:666–668.
 48. Lee SY, Arozullah AM, Cho YI. Health literacy, social support, and health: a research agenda. *Soc Sci Med* 2004;**58**:1309–1321.
 49. Berkman ND, Sheridan SL, Donahue KE, Halpern DJ, Crotty K. Low health literacy and health outcomes: an updated systematic review. *Ann Intern Med* 2011;**155**:97–107.
 50. Wang C, Swerdloff RS, Iranmanesh A *et al.* Transdermal testosterone gel improves sexual function, mood, muscle strength, and body composition parameters in hypogonadal men. *J Clin Endocrinol Metab* 2000;**85**: 2839–2853.