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Pleasant Events, Activity Restriction, and Blood Pressure in Dementia Caregivers

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Abstract

Objective—A combination of high engagement in pleasurable activities and low perceived activity restriction is potentially protective for a number of health and quality of life outcomes. This study tests the newly proposed Pleasant Events and Activity Restriction (PEAR) model to explain level of blood pressure (BP) in a sample of elderly dementia caregivers.

Methods—This cross-sectional study included 66 caregivers, ≥ 55 years of age, providing in-home care to a relative with dementia. Planned comparisons were made to assess group differences in BP between caregivers reporting high engagement in pleasant events plus low perceived activity restriction (HPLR; N = 22) to those with low pleasure plus high restriction

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(LPHR; N = 23) or those with either high pleasure plus high restriction or low pleasure plus low restriction (HPHR/LPLR; N = 21).

Results—After adjustments for age, sex, body mass index, use of anti-hypertensive medication, physical activity, and number of health problems, HPLR participants (86.78 mm Hg) had significantly lower mean arterial pressure compared to LPHR participants (94.70 mm Hg) (p = .01, Cohen's d=0.89) and HPHR/LPLR participants (94.84 mm Hg) (p = .023, d=0.91). Similar results were found in post-hoc comparisons of both systolic and diastolic BP.

Conclusions—This study extends support for the PEAR model to physical health outcomes. Differences in BP between the HPLR group and other groups were of large magnitude and thus clinically meaningful. The findings may inform intervention studies aimed at investigating whether increasing pleasant events and lowering perceived activity restriction may lower BP.

Keywords

Alzheimer's disease; dementia caregiving; behavioral activation; coping; elderly

Caring for a loved one with dementia is a stressful experience that has been associated with negative mental and physical health consequences for the caregiver (Etters, Goodall, & Harrison, 2008; Mahoney, Regan, Katona, & Livingston, 2005; Ory, Hoffman, Yee, Tennstedt, & Schulz, 1999; Schulz, O'Brien, Bookwala, & Fleissner, 1995). For example, compared to non-caregivers, dementia caregivers experience increased rates of anxiety and depression (Mahoney et al., 2005; Ory et al., 1999), impaired cardiovascular health (Lee, Colditz, Berkman, & Kawachi, 2003; Mausbach, Patterson, Rabinowitz, Grant, & Schulz, 2007; Schulz et al., 1995; Shaw et al., 1999; von Känel et al., 2008) and premature death (Schulz & Beach, 1999). Among the negative cardiovascular outcome experienced by caregivers is high blood pressure (BP) (Cora, Partinico, Munafo, & Palomba, 2012; Grant et al., 2002; Roepke et al., 2011; Shaw et al., 1999). Shaw and colleagues (1999) found that dementia caregivers had a 67% increase in risk of developing hypertension over a three year period as compared to non-caregiving controls. Elevated BP is a risk factor for cardiovascular disease (CVD) (Chobanian et al., 2003) and is also one indicator of allostatic load, which refers to the cumulative effect of chronic caregiving stress on physiologic systems (Roepke et al., 2011), thereby possibly contributing to CVD (McEwen & Stellar, 1993).

Not all caregivers experience negative health consequences (Brown et al., 2009; Fredman, Cauley, Hochberg, Ensrud, & Doros, 2010). Therefore, it is important to identify factors that may protect caregivers from negative health outcomes such as elevated BP. For instance, reduced engagement in positively reinforcing activities contributes to the development and maintenance of depressive symptoms (Lewinsohn, 1974, 1975; Lewinsohn & Amenson, 1978). In turn, interventions aimed at increasing the frequency of engagement in pleasant activities (i.e., behavioral activation treatments) have been effective in reducing depressive symptoms in adults (Jacobson et al., 1996; Jacobson, Martell, & Dimidjian, 2001; Mazzucchelli, Kane, & Rees, 2009), including caregivers (Coon, Thompson, Steffen, Sorocco, & Gallagher-Thompson, 2003; Gallagher-Thompson & Coon, 2007), and increasing behavioral activation has been found to be a mechanism of action through which psychological interventions impact caregiver depressive symptomatology (Losada, Márquez-González, & Romero-Moreno, 2011). Pressman and colleagues (2009) found that greater engagement in enjoyable leisure activities was also associated with increased physical well-being, including lowered BP. Additionally, the presence of positive emotions, which are associated with engagement in pleasant activities in dementia caregivers (Mausbach, Coon, Patterson, & Grant, 2008), has been shown to reduce the impact of negative emotions on cardiovascular outcomes, including BP (Ong & Allaire, 2005). These

findings suggest that engagement in pleasant activities may be associated with reduced BP in dementia caregivers.

Another factor that may protect caregivers from negative health consequences such as high BP is a decreased sense of restriction from participating in everyday activities. The Activity Restriction Model of Depressed Affect (Williamson & Schulz, 1992) proposes that the presence of environmental stressors, such as caring for a disabled spouse, increases a person's perception that he or she is unable to sufficiently engage in social and recreational activities, thereby eliciting depressive symptoms (Williamson & Schulz, 1992, 1995; Williamson & Shaffer, 2000). In support of the activity restriction model, dementia caregivers displayed both increased depressive symptoms and increased levels of activity restriction compared to non-caregiving controls, whereby activity restriction mediated the relationship between caregiving status and depressive symptoms (Mausbach, Patterson, & Grant, 2008).

Conceptually, engagement in pleasant events refers to observable behaviors, whereas activity restriction refers to one's cognitive appraisal of not being able to engage in a desired amount of activities. Mausbach and colleagues (2011) have recently proposed a new theoretical model, The Pleasant Events (PE) and Activity Restriction (AR) model ("PEAR" model). The PEAR model posits that a combination of reduced behavioral engagement in pleasant events with increased cognitive appraisal of activity restriction is more predictive of caregiver outcomes than either of these two components alone; in dementia caregivers, this has been demonstrated in terms of mood disturbance, use of negative coping strategies, subjective health (Mausbach et al., 2011) and sleep (Moore et al., 2011). To our knowledge, there are no studies analyzing simultaneously the effect of pleasant events and activity restriction on caregivers' physical health, such as blood pleasure.

The present study applied the PEAR model to predict BP in dementia caregivers. Specifically, caregivers with high engagement in pleasant events plus low activity restriction (i.e., high pleasure, low restriction; HPLR) were hypothesized to have lower BP than caregivers with low pleasant events plus high activity restriction (LPHR) and also than caregivers with any other combination of pleasant events and activity restriction (HPHR or LPLR).

Methods

Participants

Sixty-six caregivers participated in the study. All participants were enrolled in the Pleasant Events Project (PEP) at the University of California, San Diego (UCSD), which was designed to assess the role of engagement in pleasant events on various caregiver outcomes. Participants were recruited via referral from the UCSD Alzheimer's Caregiver Study (a large-scale study on the physiologic and health consequences of caregiving), the UCSD Alzheimer's Disease Research Center (ADRC), presentations at local health fairs and caregiver support groups, and via recommendation by other participants. All participants were at least 55 years of age and providing in-home care to a spouse or parent with Alzheimer's disease (AD) or other forms of dementia (e.g., Lewy Body dementia). Participants reported no serious medical condition (e.g., cancer) and were not eligible for participation if they had severe hypertension (i.e., blood pressure exceeding 200/120 mm Hg). Use of antihypertensives and other medications was noted. All participants provided written informed consent before enrolling in the study, as approved by the UCSD Institutional Review Board.

Measures

All assessments were administered to caregivers in their homes. Participants completed a structured psychosocial interview with a trained research assistant, which included demographic information, as well as information regarding caregivers' engagement in pleasant events and perceived activity restriction. Following the psychosocial interview, a research nurse completed a physical check-up that included three BP measurements. To avoid diurnal effects, assessments were completed between 8:30 am and 10:30 am. The three BP readings were obtained using a non-invasive Microlife BP monitor while the participant was in the supine position, with the participant resting for 10 minutes in between each measurement. The mean of these three measurements was used as a measure of resting systolic and diastolic BP and the mean arterial pressure (MAP) was also calculated.

Pleasant Events—Caregivers' engagement in pleasant events was assessed using a modified version of the Pleasant Events Schedule-Alzheimer's Disease (PES-AD) (Logsdon & Teri, 1997). The PES-AD is a self-report questionnaire that lists 20 pleasant activities (e.g., "watching TV," "going on outings," "shopping or buying things," "having coffee, tea, etc. with friends."). Caregivers were asked to rate how much they engaged in each of these activities over the past month. Response choices were 0 = "not at all," 1 = "a few times (1–6 times)," and 2 = "often (7 or more times)." A summary score was created adding up the scores on all 20 items; higher scores indicate greater engagement in pleasant activities (range = 0–40; Cronbach's alpha for the present study = .75).

Activity Restriction—Caregivers' perceived level of restriction from daily activities was assessed using the Activity Restriction Scale (Williamson & Schulz, 1992). This questionnaire required participants to rate how much they have felt restricted from engaging in nine activities in the past month: a) "caring for yourself," b) "caring for others," c) "doing household chores," d) "going shopping," e) "visiting friends," f) "working on hobbies," g) "sports and recreation," h) "going to work," and i) "maintaining friendships." Response choices were 0 = "never or seldom did this," 1 = "not restricted at all," 2 = "slightly restricted," 3 = "moderately restricted," and 4 = "greatly restricted." A summary score was created adding up the scores on all nine items; higher scores indicate greater activity restriction (range = 0–36; Cronbach's alpha = .79).

Body Mass Index (BMI)—BMI was computed as the ratio between participant-reported weight in kilograms and height in square meters.

Caregiver Level of Physical Activity—The Rapid Assessment of Physical Activity (RAPA) questionnaire, designed for use with older adults (≥ 50 years of age), was used to assess caregivers' level of physical activity (Topolski et al., 2006). Participants responded to nine 'yes' or 'no' items assessing the frequency and duration of their engagement in light, moderate, and vigorous exercise in a typical week (the RAPA provided descriptions and examples of each of these three levels of physical activity). Based on their responses, participants were assigned a score of 0–6, with higher scores indicating greater level of physical activity.

Health Problems—Participants were provided a list of 17 health problems (e.g., arthritis, heart attack, diabetes, stroke/transient ischemic attack, problems with your kidneys) and responded 'yes' or 'no' indicating whether a doctor had told them that they currently have or have ever had each problem. The number of health problems to which participants responded 'yes' was totalled (range 0–17).

Dementia Severity of the AD Patient—The Clinical Dementia Rating (CDR) scale provides a global assessment of dementia severity (Morris, 1993). The scale required caregivers to report on their family member's level of functioning in six behavioural and cognitive domains: memory, orientation, judgment and problem solving, community affairs, home and hobbies, and personal care. Scores on these six domains were used to create an overall score of dementia severity ranging from 0–3, with higher scores indicating greater dementia severity. Scoring was determined using the online calculator from the Washington University Alzheimer's Disease Research Center (http://www.biostat.wustl.edu/~adrc/cdrpgm/index.html).

Caregiver Burden—Caregiver burden was assessed using the Role Overload scale (Pearlin, Mullan, Semple, & Skaff, 1990). This scale consisted of four statements (e.g., "You are exhausted when you go to bed at night."). Participants rated the extent to which each statement describes them using a 4-point scale from 0 = "not at all" to 3 = "completely." The four items were summed to create an overall score with higher scores indicating greater burden (range = 0–12; Cronbach's alpha = .79).

Caregiver Depressive Symptoms—The short-form of the Center for Epidemiological Studies-Depression scale (CESD-10) was used to assess depressive symptoms (Cronbach's alpha = .67) (Andresen, Malmgren, Carter, & Patrick, 1994).

Problem Behaviors of the Dementia Patient—The Revised Memory and Behavior Problem Checklist was used to assess the number of behavioral problems exhibited by the care recipient as well as the caregiver's negative reaction to these behaviors (Teri et al., 1992). Caregivers indicated how often their care recipient displayed each of 24 behavior problems over the past week using a 4-point scale from 0 = "never" to 3 = "daily or more often." The total problem behavior score was computed as the sum of the scores for these 24 items (range = 0–72; Cronbach's alpha = .77). If the care recipient exhibited a given behavior at least once over the past week, caregivers rated how bothered or upset they were by the patient's behavior on a 5-point scale from 0 = "not at all" to 4 = "extremely." If a behavior was not endorsed, it was assigned a score of 0 for the "bothered or upset" item. A total negative reaction score was computed as the sum of all 24 "bothered or upset" scores (range = 0–96).

Statistical Analysis

Using the same method previously described in developing the PEAR model (Mausbach et al., 2011), participants were categorized into three groups based on their levels of engagement in pleasant events and activity restriction. Median splits were used to code participants as either high or low on both pleasant events (high > 30) and activity restriction (high > 17). Using these codes, participants were then categorized into one of three groups: HPLR = high in pleasant events plus low in activity restriction (N = 22); HPHR/LPLR = either high in both pleasant events and activity restriction OR low in both pleasant events and activity restriction (N = 21); LPHR = low in pleasant events plus high in activity restriction (N = 23). Differences between groups with respect to demographic characteristics were determined using ANOVA for linear variables (e.g., age) and Chi-square tests for categorical variables (e.g., antihypertensive medication use).

Using this three-group PEAR categorization as our primary independent variable, we conducted a univariate between-subjects analysis of variance (ANOVA) to test whether these groups differed significantly with respect to MAP. To further examine the hypothesis that a combination of both high pleasant events with low activity restriction is associated with lowered BP in caregivers, we conducted post hoc comparisons of the HPLR group

(hypothesized to have the lowest BP) with the other two groups. Cohen's d effect sizes were calculated for BP differences between the HPLR and the other two groups. An alpha level of .05 was set for these planned comparisons. All omnibus tests and planned comparisons were first run using an unadjusted model examining the effect of PEAR group on MAP. Next, analysis of covariance (ANCOVA) was run to test the impact of PEAR group on MAP, adjusting for several covariates expected to influence BP. Age, BMI, level of physical activity (i.e., RAPA score), and number of health problems were entered as linear covariates, and use of antihypertensive medication (yes/no) and gender were categorical covariates. Finally, all analyses were repeated with systolic BP and diastolic BP separately.

Exploratory Analyses

Although the primary analyses controlled for several relevant covariates theorized to impact blood pressure, we were unable to include all potentially relevant factors that may impact caregivers' blood pressure, engagement in pleasant events, or perceived activity restriction, given that too few subjects per predictor can results in an overfitted model and inflate estimates or reduce power (Babyak, 2004). Therefore, we conducted exploratory analyses to test the impact of the following additional covariates on MAP: CDR score of the care recipient, hours per day spent caregiving, number of years participant has been caregiving, relationship of caregiver to care recipient (spouse vs. child), caregiver CES-D score, caregiver role overload score, caregiver monthly income, presence of diabetes, number of problem behaviors of the care recipient, and caregivers' negative reaction to problem behaviors. Each covariate was added one at a time to the original adjusted model, running each analysis separately rather than including all additional covariates in the same model, with the goal of not overfitting the model.

Additionally, in order to more fully explore the hypothesis that the combination of engagement in pleasant events and perceived activity restriction is more predictive of blood pressure than either outcome individually, we also conducted a series of tests with our original model using a regression approach to examine the effects of pleasant events and activity restriction as linear variables, as well as the interaction between pleasant events and activity restriction, on MAP. Engagement in pleasant events, activity restriction, and the covariates age, gender, BMI, antihypertensive use, physical activity, and number of health problems were entered in step one of the regression. The interaction between pleasant events and activity restriction was entered in step two of the regression. Post hoc analyses were conducted using Holmbeck's approach (Holmbeck, 1997, 2002) of running separate regression analyses for high (−1 standard deviation) and low (+1 standard deviation) levels of the moderator variable, activity restriction, and plotting simple slopes of the regression lines. In this regression, the collinearity statistic variance inflation factor (VIF) was also examined to detect multicollinearity among variables. VIF is computed as 1 / tolerance, where tolerance is an indicator of the percent of variance in a predictor that cannot be accounted for by the other predictors in the model. A variable with a VIF value greater than 10 may indicate a level of multicollinearity that merits further investigation (Chen, Ender, Mitchell, & Wells, 2003).

Results

Participant Characteristics

Detailed characteristics of the study sample are shown in Table 1. The total sample was predominantly female, Caucasian, and had a high level of formal education, with a mean age of 71.19 ± 8.71 years. Table 1 also displays participant characteristics compared across PEAR groups. The three PEAR groups differed significantly with respect to BMI. As expected, due to the categorization of participants into groups based on their levels of

pleasant events and activity restriction, the groups also differed in frequency of engagement in pleasant events and activity restriction scores. Engagement in pleasant events and perceived activity restriction were moderately and negatively correlated ($r = -.43$, $p < .001$). Collinearity statistics obtained in the regression analysis revealed that for all variables included in the model VIF values were below 2.

Mean Arterial Pressure (MAP)

Primary Analyses—There was a significant effect of PEAR group on MAP, $F(2, 63) = 6.46$, $p = .003$, partial $\eta^2 = .170$. Means and standard deviations of MAP for each group are presented in Table 1. When the model was adjusted for age, gender, BMI, antihypertensive medication use, physical activity, and number of health problems, the significant effect of PEAR group on MAP was maintained, $F(2, 57) = 4.10$, $p = .022$, partial $\eta^2 = .126$. Neither age, $F(1, 57) = .14$, $p = .714$, partial $\eta^2 = .002$, gender, $F(1, 57) = .02$, $p = .891$, partial $\eta^2 = .000$, BMI, $F(1, 57) = .30$, $p = .586$, partial $\eta^2 = .005$, antihypertensive medication use, $F(1, 57) = .14$, $p = .714$, partial $\eta^2 = .002$, physical activity, $F(1, 57) = 1.25$, $p = .269$, partial $\eta^2 = .021$, nor number of health problems, $F(1, 57) = 1.12$, $p = .294$, partial $\eta^2 = .019$, significantly impacted MAP. The overall model accounted for 21.8% of the variance in MAP.

Post Hoc Comparisons—Results of post hoc comparisons revealed that the HPLR group had significantly lower MAP ($p = .003$) than the LPHR group. Additionally, the HPLR group had significantly lower MAP than the HPHR/LPLR group ($p = .003$). Cohen's d effect sizes for group differences were large, using Cohen's suggested guidelines for effect size interpretation (Cohen, 1992), and are presented in Table 1. Post hoc comparisons remained significant when the model was adjusted for age, gender, BMI, antihypertensive medication use, physical activity, and number of health problems. The HPLR group had significantly lower MAP ($p = .008$) than the LPHR group and the HPHR/LPLR group ($p = .032$).

Secondary Analyses with Systolic BP

There was a significant effect of the 3-group PEAR categorization on systolic BP, $F(2, 63) = 4.68$, $p = .013$, partial $\eta^2 = .129$. Means and standard deviations of each group are presented in Table 1. This result maintained significance with adjustments for age, gender, BMI, antihypertensive use, physical activity, and number of health problems, $F(2, 57) = 3.49$, $p = .037$, partial $\eta^2 = .109$. Neither age, $F(1, 57) = 1.94$, $p = .169$, partial $\eta^2 = .033$, gender, $F(1, 57) = .64$, $p = .426$, partial $\eta^2 = .011$, BMI, $F(1, 57) = .91$, $p = .343$, partial $\eta^2 = .016$, antihypertensive medication use, $F(1, 57) = .24$, $p = .629$, partial $\eta^2 = .004$, physical activity, $F(1, 57) = 2.45$, $p = .123$, partial $\eta^2 = .041$, nor number of health problems, $F(1, 57) = 2.55$, $p = .116$, partial $\eta^2 = .043$, were significantly associated with systolic BP. The overall model accounted for 24.3% of the variance in systolic BP.

Post Hoc Comparisons with Systolic BP—Post hoc comparisons for the unadjusted model examining the effect of PEAR group on systolic BP revealed that the HPLR group had significantly lower systolic BP than the LPHR group ($p = .010$) and the HPHR/LPLR group ($p = .010$). As can be seen in Table 1, Cohen's d effect sizes for these differences were medium. When adjustments were made for age, gender, BMI, antihypertensive use, physical activity, and number of health problems, planned comparisons revealed that the HPLR group had significantly lower systolic BP ($p = .012$) than the LPHR group. However, the lower systolic BP in the HPLR group compared to the HPHR/LPLR group did only approach statistical significance ($p = .072$).

Secondary Analyses with Diastolic BP

There was a significant effect of the 3-group PEAR categorization on diastolic BP, $F(2, 63) = 5.80$, $p = .005$, partial $\eta^2 = .155$. Means and standard deviations of each group are presented in Table 1. When adjusting for age, gender, BMI, antihypertensive use, physical activity, and number of health problems, the effect of PEAR group on diastolic BP remained significant, $F(2, 57) = 3.62$, $p = .033$, partial $\eta^2 = .113$. Neither age, $F(1, 57) = 2.70$, $p = .106$, partial $\eta^2 = .045$, gender, $F(1, 57) = .14$, $p = .707$, partial $\eta^2 = .002$, BMI, $F(1, 57) = .03$, $p = .863$, partial $\eta^2 = .001$, antihypertensive medication use, $F(1, 57) = .06$, $p = .816$, partial $\eta^2 = .001$, physical activity, $F(1, 57) = .41$, $p = .525$, partial $\eta^2 = .007$, nor number of health problems, $F(1, 57) = .27$, $p = .604$, partial $\eta^2 = .005$, were significantly associated with diastolic BP. The overall model accounted for 22.4% of the variance in diastolic BP.

Post Hoc Comparisons with Diastolic BP—Post hoc comparisons for the unadjusted model examining the effect of PEAR group on diastolic BP revealed that the HPLR group had significantly lower diastolic BP than the LPHR group ($p = .004$) and the HPHR/LPLR group ($p = .005$). Cohen's d effect sizes were large (Table 1). The HPLR group maintained significantly lower diastolic BP than the LPHR group ($p = .015$) and the HPHR/LPLR group ($p = .033$) when adjustments were made for age, gender, BMI, antihypertensive use, physical activity, and number of health problems.

Exploratory Analyses

When the CDR score of the care recipient, $p = .123$, partial $\eta^2 = .042$, hours of daily care provided, $p = .639$, partial $\eta^2 = .004$, and years of caregiving, $p = .771$, partial $\eta^2 = .002$, were added into the original adjusted model as additional covariates, their relationship to MAP was not significant, while the significant relationship between PEAR group and MAP was preserved in all cases. Relationship of the caregiver to the care recipient was also not a significant predictor of MAP, $p = .710$, partial $\eta^2 = .002$, while PEAR remained a significant predictor. Neither caregivers' CES-D score, $p = .254$, partial $\eta^2 = .023$, nor role overload score, $p = .469$, partial $\eta^2 = .009$, were significantly associated with MAP when added to the original model, and PEAR group remained a significant predictor of MAP. Caregivers' monthly income was a significant predictor of MAP, $p = .010$, partial $\eta^2 = .150$, such that higher income was associated with lower MAP. However, PEAR group remained a significant predictor in the model, $p = .030$, partial $\eta^2 = .157$. Fifteen caregivers elected not to report their monthly income, so the sample size for this analysis was 51 participants. Whether the caregiver had diabetes, $p = .062$, partial $\eta^2 = .061$, the number of problem behaviors displayed by the care recipient, $p = .781$, partial $\eta^2 = .001$, and caregivers' negative reaction to problem behaviors, $p = .609$, partial $\eta^2 = .005$, were all not significantly related to MAP when added to the original adjusted model, while PEAR group remained a significant predictor of MAP.

Results of the regression analysis revealed a significant interaction between engagement in pleasant events and perceived activity restriction on MAP, $\beta = .29$; $t(56) = 2.24$, $p = .029$. The main effects of engagement in pleasant events, $\beta = -.20$; $t(56) = -1.37$, $p = .176$, and perceived activity restriction were not significant, $\beta = .25$; $t(56) = 1.73$, $p = .090$, nor were the covariates age, $\beta = .01$; $t(56) = .05$, $p = .958$, gender, $\beta = -.02$; $t(56) = -.15$, $p = .884$, BMI, $\beta = .06$; $t(56) = .41$, $p = .687$, antihypertensive use, $\beta = .12$; $t(56) = .84$, $p = .405$, physical activity, $\beta = -.13$; $t(56) = -1.02$, $p = .311$, or number of health problems, $\beta = -.13$; $t(56) = -.96$, $p = .339$. Post hoc analyses were conducted to probe the significant interaction effect according to the approach described by Holmbeck (2002). The regression for high activity restriction revealed that engagement in pleasant events was not significantly associated with MAP, $\beta = .04$; $t(56) = .24$, $p = .813$. The regression for low activity

restriction revealed that engagement in pleasant events was significantly associated with MAP, $\beta = -.43$; $t(56) = -2.20$, $p = .032$.

Discussion

The main results of this study indicate that a combination of high engagement in pleasant activities with low perceived activity restriction is associated with lower BP in dementia caregivers, as compared to a combination of low engagement in pleasant activities with high activity restriction. These findings provide further support for the utility of the PEAR model and its association with negative caregiver outcomes. Previous research has demonstrated associations between the PEAR model and psychosocial outcomes in caregivers (e.g., depressive symptoms, positive and negative affect, personal mastery) (Mausbach et al., 2011) as well as subjective sleep outcomes (Moore et al., 2011). The present study extends support of the PEAR model to include associations with physiological outcomes, in this case BP. Interestingly, according to WHO criteria (Kjeldsen, Erdine, Farsang, Sleight, & Mancia, 2002), caregivers in the HPLR group had mean systolic BP values in the normal range, whereas those caregivers in the HPHR/LPLR and LPHR groups had mean systolic BP levels in the high-normal range (i.e., greater than 130 mmHg). Elevated systolic BP is particularly associated with increased cardiovascular morbidity and mortality in elderly individuals (Kannel, 2000). Moreover, post hoc comparisons of the HPLR and HPHR/LPLR groups suggested that consideration of levels of engagement in pleasant events and activity restriction together is more predictive of lower BP than considering either engagement in pleasant events or activity restriction alone. Importantly, the effect sizes for the differences observed between the HPLR group and caregivers with other combinations of pleasant events and activity restriction were medium to large for all BP outcomes. Additionally, exploratory regression analyses examining pleasant events and perceived activity restriction as linear variables provide further support for the PEAR model hypothesis that the combination of these two factors is more predictive of blood pressure than either component alone. Post-hoc probing of the significant interaction between pleasant events and activity restriction revealed that engagement in pleasant events was predictive of MAP when perceived activity restriction was low, but pleasant events were not significantly associated with MAP at high levels of activity restriction. These findings suggest that information about both engagement in pleasant events and perceived activity restriction is important for predicting MAP in caregivers. Caregivers' monthly income was also a significant predictor of MAP, as indicated in the exploratory analyses, suggesting that caregivers with higher income have lower MAP. It is possible that caregiver income could also be related to engagement in pleasant events, given that caregivers with higher income may be better able to afford to participate in activities and to pay for alternate care for their care recipient.

These findings have significant implications for dementia caregivers' cardiovascular health. Caregivers have a greater risk than non-caregivers of developing hypertension (Shaw et al., 1999), which plays a major role in the development of CVD (Whitworth & World Health Organization, 2003). However, not all caregivers experience negative health consequences (Brown et al., 2009; Fredman et al., 2010), and the present results suggest that it is specifically caregivers with a combination of high engagement in pleasurable activities and low perceived activity restriction who may be protected from negative health outcomes such as elevated BP. For those caregivers who display elevated BP, the present findings provide support for the use of behavioral activation (BA) as an effective treatment for elevated BP in caregivers. Although research on the effects of psychotherapy on BP is sparse, significant effects of psychosocial interventions on BP have been found in non-caregivers (e.g., Linden, Stossel, & Maurice, 1996). Additionally, Williams and colleagues (2010) found that Alzheimer's caregivers who participated in a video-based coping skills intervention complemented by telephone coaching showed significantly greater improvements in systolic

and diastolic BP, compared to a control intervention, and these improvements were maintained over a 6 month follow up period. Currently, treatment for high BP commonly includes medication and suggested lifestyle modifications (e.g., change in diet and activity level) in both non-caregiving (Whitworth & World Health Organization, 2003) and caregiving populations (King, Atienza, Castro, & Collins, 2002). Although the data of this study are cross-sectional, the medium to large effect sizes for the differences between PEAR groups suggest that additional behavioral factors (i.e., engagement in pleasant activities) and cognitive appraisal (i.e., sense of activity restriction) may also influence BP and therefore might also be addressed as an element of treatment.

BA interventions aimed at increasing engagement in pleasant activities are already used to treat depression in caregivers (Coon et al., 2003; Gallagher-Thompson & Coon, 2007), and the present results provide support for the idea that pleasant-events-focused behavioral interventions may have secondary benefits for improving BP in caregivers. As such, these BA interventions could be used as an effective alternative treatment to lower BP in certain groups of caregivers, namely those with LPHR but also in those with HPHR/LPLR. Implementing behavioral interventions, either as a complement to BP-lowering medications, or as the primary treatment in those with mild hypertension, could provide a cost-effective treatment for BP in caregivers. Future research should investigate whether the PEAR model is predictive of other cardiovascular outcomes in caregivers (e.g., sympathetic nervous system arousal), which could reveal the possibility of additional health benefits of BA interventions. In addition, the inclusion of physiological measures may enhance the analysis of the effects and clinical significance of symptomatology outcomes for psychotherapeutic interventions for dementia caregivers (Schulz et al., 2002).

There are some limitations to the present study that should be mentioned. First, the data were cross sectional, which prevents drawing causal inferences. It is possible that caregivers who engaged in more pleasant activities and who had lower perceived activity restriction were caregivers who already had reduced stress and/or lower BP to begin with. Further research using experimental or longitudinal designs is needed to determine whether the PEAR model might predict BP outcomes in dementia caregivers over time and whether PEAR model tailored interventions also affect such BP trajectories. Although the present analyses controlled for caregiver BMI, physical activity, and health problems, obtaining these measures by self-report from the caregiver may have decreased the accuracy of the measurements obtained (e.g., BMI is often underestimated in self-report (Davis, 2007)). Measurement error may be one possible explanation for the unexpected finding that BMI was not a significant predictor of MAP in the analyses, despite previous research suggesting a positive association between BMI and blood pressure (e.g., Gregg et al., 2005). The lack of associations observed between BMI and other health-related variables and MAP in these analyses cannot be attributed to multicollinearity among predictors given that collinearity statistics (i.e., VIF) indicate that there is not a concerning level of multicollinearity among variables in the analyses.

Another limitation of the present study is that the study sample did not include caregivers with severe hypertension; therefore, the results may not generalize to caregivers with very high BP. Additionally, ethnic differences have been reported in caregivers' BP (Kim, Knight, & Longmire, 2007). Given that the majority of caregivers in the study were Caucasian and female, further research is needed with a more diverse sample to determine if the present results are generalizeable across gender and ethnicity. Results of the present study may also be specific to dementia caregivers. Additional research is needed to determine whether pleasant events and activity restriction are associated with blood pressure, using the PEAR model, in other populations experiencing different levels and/or sources of stress exposure. Finally, the relatively small sample size of the study limited the

total number of covariates that could be included in the original adjusted model, in order to preserve statistical power. Although many of the covariates added in the exploratory analyses were not significant predictors of MAP, it is possible that with a larger or more diverse sample some of these variables may have been significantly associated with MAP.

In summary, the present study provides further support for the PEAR model as a framework for understanding negative outcomes in dementia caregivers, suggesting that caregivers with a combination of high engagement in pleasant events plus low activity restriction show lower BP compared to caregivers with low pleasant events plus high activity restriction. Moreover, consideration of both pleasant events and activity restriction appears to add additional information in predicting caregiver BP above and beyond consideration of either pleasant events or activity restriction alone, as BP was also lower in the HPLR group compared to the HPHR/LPLR group. These results require replication and should also be examined longitudinally; nonetheless, although preliminary, the findings suggest that pleasant-events-based behavioral interventions that are already used to treat depressive symptoms in caregivers might also help to lower BP.

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Table 1

Participant characteristics by PEAR group

	Entire Sample (N = 66)	HPLR (N = 22)	HPHR/LPLR (N = 21)	LPHR (N = 23)	F, χ^2	p-value
Age, M (SD), years	71.19 (8.71)	73.24 (6.73)	69.83 (9.33)	70.46 (9.76)	.95	.394
Female, n (%)	50 (75.8)	19 (86.36)	13 (61.90)	18 (78.26)	3.62	.164
Caucasian, n (%)	56 (84.85)	20 (90.91)	19 (90.48)	17 (73.91)		.289†
Education, n (%)						
Less than high school	1 (1.52)	1 (4.55)	0 (0.00)	0 (0.00)		
High school	8 (12.12)	2 (9.09)	4 (19.05)	2 (8.70)		
Some college	23 (34.85)	6 (27.27)	7 (33.33)	10 (43.47)		
College graduate	34 (51.51)	13 (59.09)	10 (47.62)	11 (47.83)		.704†
Antihypertensive drug use, n (%)	33 (50.00)	7 (31.82)	13 (61.90)	13 (56.52)	4.49	.106
Relationship to care recipient, n (%)						
Spouse	58 (87.88)	21 (95.45)	19 (90.48)	18 (78.26)		
Partner	2 (3.03)	0 (0.00)	0 (0.00)	2 (8.70)		
Child	6 (9.09)	1 (4.55)	2 (9.52)	3 (13.04)		.422†
Monthly income in dollars, M (SD)	6549.39 (7551.13) N = 51	8478.71 (8528.66) N = 17	5807.25 (4340.94) N = 16	5386.94 (8771.95) N = 18	.84	.438
Years caregiving, M (SD)	5.22 (4.41)	4.18 (4.01)	5.84 (5.37)	5.65 (3.79)	.93	.400
Hours providing care per day, M (SD)	8.15 (5.17)	7.09 (6.10)	9.24 (5.50)	8.17 (3.69)	.93	.402
CDR Total Score, M (SD)	1.71 (0.62)	1.55 (0.58)	1.86 (0.79)	1.74 (0.45)	1.19	.320
BMI, M (SD)	26.68 (5.13)	24.54 (3.29)	29.15 (6.26)	26.46 (4.61)	4.91	.010
RAPA score, M (SD)	3.52 (1.58)	4.00 (1.51)	3.00 (1.58)	3.52 (1.56)	2.23	.116
Number of health problems, M (SD)	3.44 (1.78)	2.82 (1.62)	3.62 (1.86)	3.87 (1.77)	2.19	.120
Pleasant Events, M (SD)	29.89 (5.10)	34.18 (2.56)	30.00 (4.20)	25.70 (4.23)	29.89	<.001
Activity Restriction, M (SD)	18.15 (5.88)	13.41 (2.58)	17.52 (5.88)	23.26 (3.78)	30.36	<.001

Cohen's d Effect Size	
HPLR vs. LPHR	HPLR vs. HPHR/ LPLR

	Entire Sample (N = 66)	HPLR (N = 22)	HPHR/LPLR (N = 21)	LPHR (N = 23)	F, χ^2	p-value
MAP*, M (SD) mmHg	92.10 (9.20)	86.78 (9.98)	94.84 (7.55)	94.70 (7.78)	0.89*	0.91*
Systolic BP*, M (SD) mmHg	128.27 (12.96)	121.73 (14.79)	131.65 (11.31)	131.43 (10.34)	0.76*	0.75*
Diastolic BP*, M (SD) mmHg	74.02 (8.53)	69.30 (7.8)	76.43 (7.29)	76.33 (8.58)	0.86*	0.94*

Note. HPLR = High Pleasant Events + Low Activity Restriction; HPHR/LPLR = Either High Pleasant Events + High Activity Restriction or Low Pleasant Events + Low Activity Restriction; LPHR = Low Pleasant Events + High Activity Restriction; CDR = Clinical Dementia Rating scale; BMI = Body Mass Index; RAPA = Rapid Assessment of Physical Activity. Cells with different superscripts denote significant differences.

† = Fisher's exact test used due to small cell size (n< 5).

* = significance at $p < .05$. Positive Cohen's d effect size values indicate that the HPLR group has better BP outcomes (i.e., lower BP) compared to LPHR and HPHR/LPLR groups.