INTERNATIONAL JOURNAL OF BEHAVIORAL MEDICINE, *9*(3), 176–194

Physiological and Affective Responses to Family Caregiving in the Natural Setting in Wives Versus Daughters

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This study examined differences in hemodynamic responses to usual caregiving duties undertaken in the natural setting by caregiving wives versus daughters. Participants were 88 women (36 daughters, 52 wives), 50 years of age or older, caring for a relative with dementia. Participants underwent 2 standard laboratory challenges (1 physical and 1 emotional) and ambulatory monitoring in the natural setting. Although wives and daughters showed similar physiological responses to the laboratory challenges, daughters evidenced greater hemodynamic responses in the natural setting relative to wives when the care recipient was present ($p < .02$). The increases in hemodynamic responses were accompanied by increased negative interactions with the care recipient as well as other family members ($p < .0009$). The results add to the small body of research indicating that family caregiving may have negative acute effects on psychosocial and physiological responses in the natural setting, particularly in daughters.

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This research was funded by PHS Grant AG–12358 from the National Institute on Aging awarded to Dr. King and PHS–NHLBI Training Grant 5T32HL07034 awarded to Stephen P. Fortmann.We gratefully acknowledge the help and assistance provided by Kellie Baumann and Paula O'Sullivan in participant recruitment and data collection activities and by David Ahn in data analysis.

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Key words: family caregiving, hemodynamic responses, ambulatory monitoring

Providing informal care to an infirm or disabled older family member on a regular basis (i.e., family caregiving) has become an increasingly prevalent life role for middle- and older-aged women in the United States as well as other industrialized nations (Lee & Porteous, 1998; National Alliance for Caregiving and the American Association of Retired Persons, 1997; Stone, Cafferata, & Sangl, 1987). Iatrogenic physical, psychological, social, and financial effects of the caregiving role have been increasingly documented (Russo, Vitaliano, Brewer, Katon, & Becker, 1995; Schulz & Beach, 1999; Schulz, O'Brien, Bookwala, & Fleissner, 1995) and appear to be exacerbated when the care recipient is suffering from dementia (Goode, Haley, Roth, & Ford, 1998; Ory, Hofffman, Yee, Tennstedt, & Schulz, 1999; Schulz et al., 1995). Among the detrimental health effects of family caregiving among at least some groups of older caregivers are an increased vulnerability to physical illness (Stone et al., 1987), as well as disruptions in immune function (Kiecolt-Glaser, Marucha, Malarkey, & al., 1995; Wu et al., 1999) and metabolic regulation (Vitaliano, Scanlan, Siegler, McCormick, & Knopp, 1998). The potentially devastating impact of such physical perturbations on the health of family caregivers has been underscored recently by the Caregiver Health Study, in which family caregiving accompanied by emotional strain was an independent risk factor for mortality among older adults (Schulz & Beach, 1999).

Virtually all of these studies have focused on physical health outcomes in response to the chronic effects of the caregiving experience. Investigation of the more immediate, *acute* physiological effects of caregiving on stress-responsive pathways that may, over time, generate or exacerbate disease processes has received minimal attention (Mills, Yi, Ziegler, Patterson, & Grant, 1999; Vitaliano, Russo, Bailey, Young, & McCann, 1993). One such pathway potentially mediating the relation between stress and cardiovascular morbidity and mortality outcomes in caregivers is cardiovascular responsivity to stress (Kral et al., 1997). One study evaluated the acute effects of the caregiving experience on blood pressure (BP) and heart rate (HR) responses throughout the day, measured via ambulatory monitoring in the caregiver's natural setting (King, Oka, & Young, 1994). The results indicated that although caregivers and noncaregivers showed comparable hemodynamic responses in clinical and work settings, caregivers demonstrated a significant increase in BP levels, relative to noncaregivers, following work, particularly when they were in the presence of the care recipient (King et al., 1994).

The majority of family care for older adults with dementia is carried out by either wives or daughters (National Alliance for Caregiving and the American Association of Retired Persons, 1997; Stone et al., 1987). In light of the differing relationship as well as challenges occurring when the care recipient is one's spouse as opposed to one's parent (Skaff & Pearlin, 1992), much of the caregiving literature is comprised

of studies focusing on either spousal caregivers (Vitaliano, Dougherty, & Siegler, 1994; Vitaliano, Russo, Young, Teri, & Maiuro, 1991; Wu et al., 1999) or daughters (Christensen, Stephens, & Townsend, 1998; Stephens & Townsend, 1997). For example, the previously described study of hemodynamic responses to caregiving in the natural environment included only daughters (King et al., 1994). Yet, the inclusion of both wives and daughters provides an opportunity to gain a greater understanding of the differential effects of family caregiving for these two important caregiver subgroups (Alspaugh, Stephens, Townsend, Zarit, & Greene, 1999; Li, Seltzer, & Greenberg, 1997; Skaff & Pearlin, 1992; Strawbridge, Wallhagen, Shemea, & Kaplan, 1997; Young & Kahana, 1989).

The goal of this investigation was to evaluate hemodynamic responses to the usual caregiving duties undertaken in the natural setting in caregiving wives versus daughters. In light of the greater potential for role conflicts that could adversely affect physiological responses among child, relative to spousal, caregivers (Skaff & Pearlin, 1992; Strawbridge et al., 1997; Young & Kahana, 1989), we hypothesized that daughters would evidence more elevated hemodynamic responses to their caregiving situation relative to wives. In addition, we explored psychosocial and behavioral correlates of the hemodynamic responses observed in the natural setting.

METHOD

Participants

Participants were 88 women (36 daughters and 52 wives) who had enrolled in the Teaching Healthy Lifestyles for Caregivers study. Eligibility criteria for the major trial were: postmenopausal, 50 years of age or older (could be 46 to 49 years if participant was postmenopausal due to a complete hysterectomy), a woman caregiver (defined as caring for a relative with Alzheimer's disease or another form of dementia, as documented by the care recipient's physician, in the caregiver's home), providing as least 10 hr of unpaid care per week, free from any medical conditions or disorders that would limit participation in light to moderate intensity exercise (e.g., walking), not participating in a regular program of physical activity (i.e., less than 3 times per week of exercise lasting 20 min or more per session over the past 6 months), and stable on all medications for at least 3 months prior to study entry.

Procedure

Recruitment occurred via community-wide promotion, including use of an array of media sources as well as referrals from physicians and organizations serving older

adults and caregivers (Wilcox & King, 1999). Each participant attended two baseline assessment visits, generally occurring within a 2-week period, at the Stanford University Clinical Research Facility. Eligible participants were subsequently randomized into a 1-year health intervention program (nutrition or exercise). Data presented in this investigation are from the baseline testing that occurred prior to randomization.

Measures

Demographics. Participants completed a measure of demographic characteristics, including their age (in years), marital status, ethnicity, education (in years), and employment status (Wilcox & King, 1999).

Caregiving characteristics. Participants completed a survey focused on different aspects of their caregiving experience (King & Brassington, 1997). Items included their familial relationship to the care recipient, age of care recipient, diagnosis of care recipient (confirmed by the care recipient's physicians), length of time as a caregiver (years or months), and average hours per week spent caregiving. Caregiver burden was assessed with the 25-item Screen for Caregiver Burden (Vitaliano, Russo, Young, Becker, & Maiuro, 1991).

Measurement of hemodynamic responses in a standard setting. To evaluate whether there was a general predisposition toward higher levels of physiological responsiveness in either wives or daughters independent of setting, participants underwent a laboratory-based physical challenge (submaximal treadmill exercise test) and emotional challenge (interpersonal interview focused on their caregiving experience) prior to hemodynamic assessment in the natural setting. These two challenges are described later. Participants were instructed to refrain from caffeine intake and cigarette smoking for at least 2 hr prior to these assessments.

Treadmill exercise test (physical challenge). Participants performed an ECG-monitored, symptom-limited, graded treadmill exercise test using a Balke-type protocol with workloads increasing by approximately 1.0 to 2.0 metabolic equivalents every 2 min (American College of Sports Medicine, 1986). Prior to beginning the treadmill test, participants rested quietly in a supine position for 5 min, at the end of which pretest HR and BP levels were assessed. Submaximal HR and BP levels were determined at the end of the second 2-min stage (treadmill speed at 2 miles per hour; grade at 7.5% incline; 4.5 MET work level). The

submaximal portion of the test assesses an individual's physiological response to a standard, moderate-intensity physical challenge.

Laboratory-based emotional challenge. The laboratory-based psychological stressor, which occurred on the morning of the first assessment day, consisted of an interpersonal interview with a trained research technician that focused on negative aspects of the individual's caregiving situation. The protocol began with a 10-min rest period during which time the participant sat alone quietly in a room and listened to relaxing music via headphones (baseline). Following that period, a trained research assistant directed the participant to speak for about 6 min about the aspects of her caregiving experience that she found to be particularly frustrating or disturbing. The research assistant made minimal verbal responses during the task period. Following the 6-min task period, the research assistant left the room and the participant rested for an additional 10 min (the recovery period). HR and BP recordings were collected every 2 min from the beginning of the baseline period through the recovery period using a Colin ambulatory BP monitor (Model ABPM–630; Colin Medical Instruments, Plainfield, NJ) attached to the nondominant arm. The recordings were averaged within each portion of the emotional challenge (i.e., baseline, task, recovery) to obtain mean HR, systolic blood pressure (SBP), and diastolic blood pressure (DBP) levels. Reactivity levels were obtained by subtracting the mean baseline from mean task levels for each hemodynamic variable. Such speaking tasks involving emotionally relevant content have been shown to provide a reliable means of eliciting elevations in hemodynamic variables in a variety of populations of women (Carels, Szczepanski, Blumenthal, & Sherwood, 1998), including family caregivers (Vitaliano et al., 1993).

Ambulatory assessment of BP and HR in the natural setting. The procedures for collection of ambulatory monitoring data have been described previously (King et al., 1994) and are briefly described here. Following the emotional challenge, the Colin Medical Instruments Model ABPM–630 ambulatory BP monitor remained attached to the nondominant arm. In studies investigating the accuracy of the Colin ABPM monitor compared to simultaneous intra-arterial BP readings, the monitor has been reported to be accurate, showing less disparity and closer limits of agreement with intra-arterial BP recordings than clinician-derived BP measurements (White, Lund-Johansen, & McCabe, 1989; White, Lund-Johansen, & Omvik, 1990). The Colin monitor records BP through use of both oscillometric and auscultatory (Korotkoff sound) methods (White et al., 1989). The oscillometric method measures BP through perception of the oscillometric waves generated by the brachial artery during cuff deflation. Because the two methods provided reasonably close readings in the study sample and more complete data were obtained

through the less sound-sensitive oscillometric method, readings from this latter method are reported.

The ambulatory BP recorder was set to automatically record at hourly intervals up until the time that the participant retired for the night. The ambulatory recording portion of the protocol began in the early afternoon (i.e., around 1:00 p.m.) immediately following the participants' study assessment visit. The decision to use hourly BP recordings rather than more frequent recordings (e.g., 20- or 30-min intervals) was based on information obtained during a previous study with female caregivers (King et al., 1994). In that study, caregivers noted that recordings that occurred more frequently rather than on an hourly schedule posed undue burden. To minimize movement artifact that could interfere with BP recordings, participants were instructed to remain in the position that they were in at the initiation of cuff inflation and to minimize undue movement of the cuffed arm (White et al., 1989). The recorder was held in a waist belt, with leads to the cuff worn under clothing to minimize disruption or inconvenience.

Participants were instructed subsequently in the use of a Casio PB–1000 (Casio Corporation, Tokyo, Japan) pocket computer for the recording of psychosocial and health-related information throughout the day (King et al., 1994). The PB–1000 weighs 440 g, including batteries and RAM expansion pack, and is 2.5 cm × 19 cm × 18 cm when folded. It has a built-in clock and calendar, and a 32-column × 4-line LCD touch-sensitive screen. This pocket computer-based logging system has been used extensively by our group as well as other researchers at Stanford (Taylor, Fried, & Kenardy, 1990), and has been found to be an accurate and reliable method for obtaining information on behavioral variables in the natural environment (King et al., 1994; Taylor et al., 1990).

The participant's location (e.g., home, work, other location); position during each BP measurement (i.e., standing, sitting, lying prone); interpersonal contacts (i.e., occurrence of a negative or positive interaction along with the person with whom it occurred, e.g., care receiver, other family member, coworker, friend); physical activity levels (rated on a Likert scale); and intake of caffeine, alcohol, and medications (answered as yes/no) were recorded on an hourly basis throughout the day that coincided with the hourly inflation of the BP recorder (King et al., 1994; Taylor et al., 1990).

The pocket computer was programmed to automatically inform the participant each hour, via a series of auditory beeps, that it was time to complete the diary. Diary completion was accomplished by having the participant, through touching the computer screen, respond to the series of 22 questions that automatically flashed onto the screen at the designated time. The diary took approximately 3 min to complete. If the participant was unresponsive to the initial series of auditory signals, the microcomputer would continue the auditory signals for 10 min, after which time it would terminate the signal pattern until the next designated time for data entry arrived.

All participants were requested to wear the ambulatory monitor and complete the computerized diary from early afternoon to just before they retired for the night. The ambulatory BP recorder data were subsequently downloaded to a Nippon Colin AS–100 printer (Nippon Colin Co., Nagoya, Japan) for readout. The pocket computer diary data were downloaded to a Macintosh computer through use of a Casio MD–100A 3.5-inch floppy disk drive (Casio Corporation).

Data Analysis

Descriptive statistics, including independent-sample *t* tests, were conducted on the wife and daughter caregiver groups. Hypothesis-testing evaluating wife–daughter differences in hemodynamic responses in the natural setting were undertaken using a two-step approach as a means of reducing potential proliferation of Type I error. A multivariate analysis of variance (MANOVA) was used initially as an omnibus test incorporating the three hemodynamic variables. Subsequent analyses were planned for each hemodynamic variable contingent on the MANOVA reaching statistical significance. In light of the potential relation between age and BP levels that has been reported consistently in the literature, the planned analyses consisted initially of analysis of covariance procedures in which age was used as a covariate. Because results of the analyses of covariance were similar to those undertaken using independent-sample *t* tests, the more straightforward *t*-test results are presented.

Previous work evaluating ambulatory hemodynamic responses in female caregivers has indicated the importance of differentiating the time periods during the day when the caregiver was either with or not with the care recipient (King & Brassington, 1997; King et al., 1994). Given these findings, the ambulatory BP and HR data were analyzed separately for these two time periods, identified via the portable computerized diary (King & Brassington, 1997; King et al., 1994) using separate MANOVAs. Paired-comparison *t* tests were used to provide descriptive data on behavioral and social variables when the care recipient was either present or absent. Alpha was set at .05 (two-tailed tests).

RESULTS

Descriptive Analysis

Description of participants. Descriptive statistics for wife and daughter caregivers are shown in Table 1. The two groups were comparable with respect to years of education, ethnicity, care recipient diagnosis, length of time caring for the family member, objective and subjective caregiver burden levels, smoking status (only one participant—a daughter—was a current smoker), percentage who were

TABLE 1
Baseline Demographic Characteristics for Wife and Daughter Caregivers (Means ± Standard Deviations, Percentages)

Variable	*Wives*[a]	*Daughters*[b]
Age (years)[c]	67.9 ± 8.7	56.8 ± 5.4
Married (%)[d]	100.0	47.5
Education (years)	14.8 ± 2.8	15.3 ± 2.1
White (%)	92.2	85.0
Employed (%)[d]	17.7	50.0
Number of people in household[d]	2.3 ± 0.7	3.1 ± 1.3
Body mass index (kg/m^2)	27.1 ± 5.1	28.3 ± 4.6
Age of care recipient (years)[c]	75.9 ± 8.5	85.0 ± 6.6
Alzheimer diagnosis (%)	59.0	67.5
Length of caregiving (years)	4.4 ± 3.4	3.5 ± 2.7
Objective burden score	11.5 ± 4.1	12.6 ± 3.8
Subjective burden score	41.7 ± 10.8	41.3 ± 8.8

[a]$n = 52$. [b]$n = 36$. [c]Wives vs. daughters different at $p < .0001$.[d]Wives versus Daughters different at $p < .002$.

taking antihypertensive medications (approximately 29% across the sample as a whole), and body mass index ($p > .10$). The objective and subjective caregiver burden levels, as well as length of time caregiving, were similar to other family caregiving populations reported in the literature (King et al., 1994; Vitaliano et al., 1993). As expected, wife caregivers were significantly older and a greater percentage was married relative to daughters ($p < .001$). Seventy three percent of daughters were caring for their mother. A significantly greater percentage of daughters were currently employed outside of the home relative to wives ($p < .001$). Daughters reported a significantly greater number of people living in their household relative to wives ($p < .002$).

Hemodynamic responses in the laboratory setting: Submaximal exercise test. Mean HR and BP recordings taken during the submaximal treadmill exercise test are shown in Table 2. There were no significant HR or BP differences observed for wife versus daughter caregivers either at rest (i.e., pretest) or at submaximal exercise levels. Both caregiver groups showed a level of HR increase during the submaximal treadmill exercise test commensurate with that expected from a reasonably inactive sample of older women (King et al., 2000).

Hemodynamic responses in the laboratory setting: Emotional challenge. The mean HR and BP recordings taken during the laboratory-based emotional challenge are shown in Table 2. There were no significant mean HR or BP differ-

ences observed for wife versus daughter caregivers during the initial rest (pretest) period prior to the challenge. Nor were there significant mean BP or HR differences observed for wife versus daughter caregivers either during the emotional challenge itself or during the subsequent 10- min recovery period immediately following the challenge. Both caregiver groups had task-related SBP and DBP increases of approximately 15 mmHg and 9 mmHg, respectively—response levels similar to those reported in a number of other laboratory- based reactivity studies of adult women and men (Carels et al., 1998; King, Taylor, Albright, & Haskell, 1990; Matthews et al., 1986).

In summary, no statistically significant differences were detected among wife versus daughter caregivers in mean BP and HR responses taken both at rest as well as during standard laboratory-based physical and emotional challenges.

TABLE 2
Heart Rate (HR), Systolic Blood Pressure (SBP) and Diastolic Blood Pressure (DBP) for the Two Laboratory Challenges, by Wife Versus Daughter Caregiver Status[a]
(Means ± Standard Deviations)

Variable	*Wives*[d]	*Daughters*[e]
Physical challenge[b]		
Pre-task		
HR (beats/min)	73.3 ± 13.6	77.8 ± 10.7
SBP (mmHg)	132.7 ± 14.1	124.8 ± 16.9
DBP (mmHg)	79.9 ± 11.1	77.4 ± 8.6
Submax level		
HR (beats/min)	116.5 ± 17.9	112.6 ± 14.3
SBP (mmHg)	160.4 ± 22.9	151.1 ± 25.7
DBP (mmHg)	79.6 ± 11.2	80.4 ± 7.8
Emotional challenge[c]		
Rest		
HR (beats/min)	65.1 ± 9.1	67.6 ± 12.4
SBP (mmHg)	137.8 ± 17.3	132.0 ± 19.3
DBP (mmHg)	77.0 ± 9.0	76.1 ± 9.9
Task		
HR (beats/min)	72.1 ± 9.8	76.3 ± 10.6
SBP (mmHg)	153.7 ± 18.9	145.4 ± 18.4
DBP (mmHg)	85.2 ± 10.5	84.9 ± 10.9
Recovery		
HR (beats/min)	67.4 ± 10.0	67.9 ± 9.8
SBP (mmHg)	138.3 ± 16.8	130.5 ± 15.0
DBP (mmHg)	77.3 ± 9.1	76.7 ± 9.3

[a]All p values for analyses comparing wives and daughters > .05. [b]Treadmill exercise test. [c]Laboratory-based emotional challenge consisting of an interpersonal interview focused on the negative aspects of the individual's caregiving situation. [d]$n = 52$. [e]$n = 36$.

Hypothesis Testing Related to Hemodynamic Responses in the Natural Setting. Wife and daughter caregivers had a similar number of hourly ambulatory BP and HR recordings in the natural setting (*M* number of recordings = 8.3 + 2.2 for wives and 8.2 + 2.4 for daughters; difference *ns*). As noted earlier, to explore the elevations in HR and DBP in the natural setting, the portable computerized diary results were used to divide the day into two time periods based on whether the care recipient was present or not (*M* number of hourly recordings during the time period when the care recipient was present = 5.6 + 2.6 for wives and 3.4 + 2.6 for daughters, difference *ns*; *M* number of recordings during the time period when the care recipient was not present = 4.3 + 2.5 for wives and 5.8 + 2.9 for daughters; difference *ns*). The MANOVA evaluating wife–daughter differences in hemodynamic responses when in the presence of the care recipient was significant, $F(3, 71) = 2.88$, $p < .04$. Planned independent-sample *t* tests on each hemodynamic variable indicated that daughters, relative to wives, had significantly greater DBP (*M* between-group difference = 6.7, $p < .0007$, 95% confidence interval = 2.33–10.99) and HR levels (*M* between-group difference = 5.2, $p < .02$, 95% confidence interval = 1.60–9.84) during this time period (see Figure 1). Between-group differences were not found in SBP responses during this time period.

In contrast, the MANOVA evaluating wife–daughter differences in hemodynamic responses when the care recipient was not present did not reach statistical significance ($p > .80$; see Figure 1).

Within-group analyses, undertaken for descriptive purposes, indicated that daughters had significantly greater mean SBP and DBP levels when they were in the presence of the care recipient relative to when the care recipient was absent; *M* within-group difference for SBP = 5.7 ($t = 2.4$), $p < .02$; *M* within-group difference for DBP = 5.2 ($t = 3.0$), $p < .006$. There were no significant within-group differences for wives.

Exploring Potential Confounds Influencing Wife–Daughter Hemodynamic Differences

Because of the greater percentage of daughters working outside of the home relative to wives, the period of time when daughters were in the presence of the care recipient tended to be shifted somewhat toward evening as opposed to afternoon hours. To determine whether the wife–daughter differences in BP and HR levels occurring in the presence of the care recipient were due primarily to time of day effects (i.e., afternoon vs. evening), as opposed to care recipient effects, wife–daughter ambulatory responses were compared in the afternoon and evening hours. In contrast to the significant differences found for the time period when the care recipient was present, no significant between-group differences in any of the three hemodynamic variables were found when the day was divided into the afternoon and the evening periods.

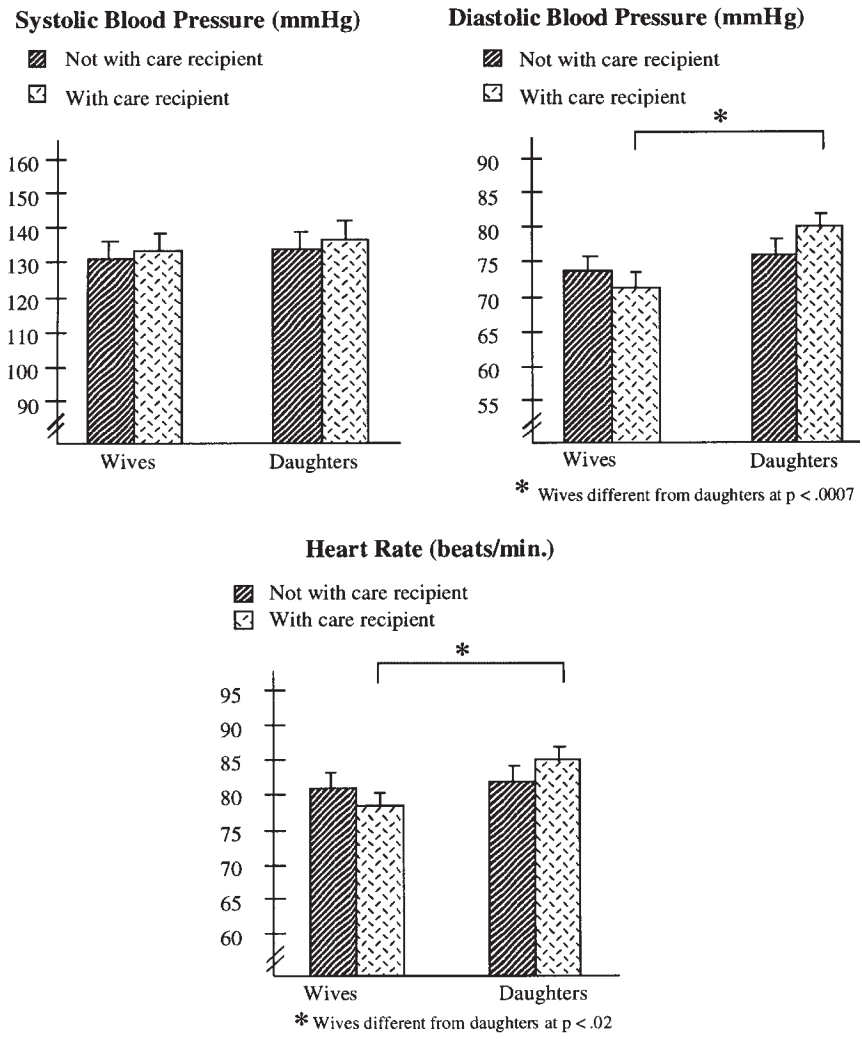

FIGURE 1 Systolic blood pressure, diastolic blood pressure, and heart rate responses (means and standard errors) in the natural setting for wives versus daughters, when the care recipient was present versus absent.

Similarly, to evaluate the potential effects of the variables, in addition to age, on which wives and daughters differed significantly (i.e., employment status, marital status, caregiver recipient gender and age, number of people in the household), we re-ran the analyses on hemodynamic variables in the natural setting described earlier, controlling for each of these variables in turn. As with age, no significant differences were found when each of these variables was included in the model. In addition, when several of these variables were compared within the daughter group itself (i.e., *t* tests comparing married vs. unmarried daughters; employed versus unemployed daughters), the means for the subgroups being compared were virtually indistinguishable from one another ($p > .10$).

To ascertain whether the differences noted in ambulatory hemodynamic responses between wives and daughters could be due to differences in other relevant behavioral factors occurring during the day, results from the portable computerized diary were used to compare wives and daughters on levels of physical activity; postural position at the time of the BP/HR rate recordings; and caffeine, alcohol, or medication use throughout the day. No significant wife–daughter differences were found for any of these variables, either across the day as a whole or when the day was broken into the two time periods described earlier (i.e., care recipient present vs. absent).

Relation of Psychosocial Factors to Hemodynamic Responses in the Natural Setting

In addition to the potential impact of the aforementioned behavioral factors on hemodynamic responses in the natural setting, a growing literature has documented the potential iatrogenic effects of negative social interactions with significant others on hemodynamic responses, both in laboratory and naturalistic settings (Carels et al., 1998; Ewart & Koldner, 1991). To evaluate this variable in this investigation, the portable computerized diary data were used to identify how often throughout the day caregivers recorded the occurrence of at least one distressing verbal interaction within the hour preceding each BP/HR measurement. The occurrence of such an event, coded as either 0 (*absent*) or 1 (*present*), was then averaged across the day for each caregiver. Across the day as a whole, the mean percentage of hourly recordings containing at least one recorded distressing interaction was significantly greater for daughters (*M* percentage of hourly recordings in which at least one distressing interaction occurred = 0.62 + 0.33) relative to wives ($M = 0.36 + 0.38$; $p < .003$). When evaluated by whether the care recipient was present or absent, the wife–daughter difference in frequency of a distressing interaction was found only during that period when the caregiver was in the presence of the care recipient (*M* for daughters = 0.63 + 0.36; *M* for wives = 0.32 + 0.38, $p < .0009$, 95% confidence interval = .13 – .49). When the care recipient was absent, *M* for daughters = 0.39 + 0.42; *M* for wives =

0.31 + 0.42; *ns*. Based on the portable computerized diary information, a substantial percentage of these distressing interactions (approximately 60% for daughters and 69% for wives) were with the care recipient. For daughter caregivers, another 26% of the distressing interactions during the care recipient–present time period occurred with other family members (compared with 11% for wife caregivers).

To further evaluate the relation between hemodynamic responses and the occurrence of distressing interactions with the care recipient for wives and daughters, within-group analyses were undertaken. Specifically, for wives and daughters separately, paired-comparison *t* tests were conducted comparing each of the three hemodynamic variables in turn during the time periods when a distressing interaction was reported versus when a distressing interaction was not reported. For daughters, DBP responses were significantly higher when a distressing interaction occurred relative to when a distressing interaction was not reported (*M* difference in DBP across these two time periods = 5.2 + 7.9 mmHg; $p < .02$), and a similar pattern was observed for SBP (*M* difference = 8.4 + 13.9 mmHg; $p < .07$). In contrast, no significant differences were observed in BP responses across these two time periods in wives ($p > .70$). (Neither group of women evidenced differences in HR responses.)

Because daughters, relative to wives, showed significant between-group as well as within-group differences in ambulatory hemodynamic responses when the care recipient was present as opposed to absent, additional within-group analyses (paired-comparison *t* tests) were employed to explore differences in other psychosocial variables during these two time periods within the daughter group. The results of these exploratory analyses are shown in Table 3.

TABLE 3
For Daughters, Mean Ratings (± Standard Deviation) on Affective and Cognitive Variables Assessed in the Natural Setting During the Period of the Day When the Care Recipient Was Either Present or Absent ($n = 36$)

Variable[a]	*Care Recipient Absent*	*Care Recipient Absent*
Mental workload[b]	1.6 ± 0.5	1.2 ± 0.3
Emotional upset[c]	2.6 ± 1.4	1.5 ± 0.7
Anger[b]	2.1 ± 1.0	1.3 ± 0.5
Tension or anxiety[b]	2.9 ± 1.2	1.8 ± 1.0
Sadness[d]	1.9 ± 1.7	1.4 ± 0.8
Sleepiness	2.2 ± 1.9	2.9 ± 1.9
Happiness	5.0 ± 2.4	4.9 ± 2.1
Level of demands[c]	4.0 ± 1.5	2.6 ± 1.5
Demands relative to usual[c]	1.9 ± 0.5	1.5 ± 0.4
Feelings of control over situation[e]	6.5 ± 2.3	7.4 ± 2.0

[a]Rated on a 10-point Likert scale ranging from 1 (*low*) to 10 (*high*). [b]Time periods different at $p < .002$. [c]Time periods different at $p < .0006$. [d]Time periods different at $p < .05$. [e]Time periods different at $p < .02$.

Of the 10 affective and cognitive variables assessed via the portable computerized diary, daughters reported significantly more negative levels on 8 of the variables when the care recipient was present as opposed to absent ($p < .04$). The only 2 variables for which such differences were not reported were sleepiness and happiness. In contrast, wives reported significantly more negative levels on only 2 of the 10 affective and cognitive variables when the care recipient was present as opposed to absent (level of demands and level of demands compared to usual; $p < .03$).

Although daughter caregivers rated their affective and cognitive states significantly more negatively when the care recipient was present, the overall mean ratings for these variables, similar to those for wives, were not high, suggesting that in general they were coping adequately with their situation.

DISCUSSION

This study represents the second systematic investigation of hemodynamic responses in the natural environment among older female caregivers. The results of this study corroborate the findings from the original investigation by suggesting that increased hemodynamic responses accompany that portion of the day when daughter caregivers are in the presence of their care recipient (King et al., 1994). The findings of this study also extend the original study results by indicating that increased hemodynamic responses may occur only in daughter, as opposed to wife, caregivers. As reflected in the diary data, these differences were not due to differences in posture, physical activity, or other behavioral factors (e.g., caffeine, tobacco, medication intake) occurring throughout the day. In contrast to the wife-daughter differences found in the natural setting, no between-group differences in hemodynamic response were found in the two standard laboratory-based challenges. This suggests that the greater physiological responsiveness on the part of daughters in the natural setting was not due simply to a general predisposition toward higher levels of physiological responsiveness in that group. The assumption that laboratory-based cardiovascular reactivity procedures capture important dispositional tendencies that carry over into more natural settings has been shown to be valid in some situations (Abel & Larkin, 1991; Matthews, Owens, Allen, & Stoney, 1992). However, this is the first study to evaluate the relation between laboratory-based hemodynamic responses and responses occurring in the natural setting in a caregiving sample—a sample for whom, by virtue of its chronic stress levels and increased morbidity and mortality risk, such questions take on particular importance. Our results suggest that laboratory measurement may not adequately capture differences in hemodynamic functioning observed in the natural environment for at least some caregiver samples.

In light of growing evidence indicating an increased probability of morbidity and mortality outcomes accompanying chronic caregiving duties, an increased focus on potential physiological, behavioral, and psychosocial pathways serving as potential mediators of those relations has been recommended (Schulz & Beach, 1999; Vitaliano et al., 1994). This investigation suggests acute hemodynamic variability in the presence of the care recipient as one possible pathway for some groups of caregivers (notably, daughters) that merits further study. Although the mean ambulatory BP levels across the day for daughters and wives generally remained in the normotensive range, frequent increases in BP throughout the day in response to psychosocial stress may, at least in some individuals, contribute to target organ damage, such as left ventricular hypertrophy, which has been found to be an independent predictor of cardiovascular morbidity (Casale et al., 1986; Pickering et al., 1991). In addition, the increases in BP and HR among daughters in the presence of the care recipient provide physiological evidence in support of the distressing social interactions reported by daughters when the care recipient was present as opposed to absent. The greater frequency of stressful interactions among daughters relative to wives underscores the potential role conflicts that may be more common in many child, relative to spousal, caregiving situations (Skaff & Pearlin, 1992; Strawbridge et al., 1997; Young & Kahana, 1989). It was notable that although the majority of these stressful interactions occurred with the care recipient, another important source of negative interactions for daughter caregivers was other family members. Studies by Russo and Vitaliano (1995), as well as others (Pearlin, Mullan, Semple, & Skaff, 1990; Schuster, Kessler, & Aseltine, 1990), have underscored the potentially iatrogenic effects of interpersonal conflicts with family members in addition to the care recipient on caregiver burden and distress. Other studies of caregivers have indicated that positive forms of social participation and emotional support may be especially important in mitigating depressive symptoms in daughters relative to wives (Li, Seltzer, & Greenberg, 1997). Our results suggest that such forms of positive social and emotional support might also be indicated to help buttress daughters against the greater frequency of negative interpersonal interactions that they may experience with a variety of family members in the presence of the care recipient. In addition, interventions that specifically teach methods of appropriate conflict resolution for caregivers and their families may provide a means for diminishing caregiver stress and physiological responsivity.

As part of this investigation, we conducted a series of analyses to evaluate the potential effects on hemodynamic response of the several demographic variables that differed between wives and daughters (e.g., age, employment status, marital status, care recipient gender, number of people living in the household). Although, given the study design, we cannot fully rule out the potential effects of such variables on the outcomes of interest, the lack of significant effects found for such variables makes it less likely that they were substantially responsible for the results. It should be noted that all of these demographic variables reflect natural differences implicit in being a

caregiving daughter versus wife (National Alliance for Caregiving and the American Association of Retired Persons, 1997). That is, across the caregiving population as a whole, daughters tend to be younger than wives, by extension more of them are employed relative to wives, and they tend to have a greater number of people living in their households (due to the presence, often, of their spouse and children; National Alliance for Caregiving and the American Association of Retired Persons, 1997). They therefore often face a potentially greater level of role conflict given the greater number of social roles that they typically face (Skaff & Pearlin, 1992; Strawbridge et al., 1997).

Given the relatively small number of participants being evaluated, caution must be applied with respect to the strength and generalizability of the conclusions that can be drawn. Additional research is required to evaluate the generalizability of our results to different populations of caregivers, including persons of different ethnicity, gender, age, familial relationship (e.g., daughters-in-law), and differing caregiving situations. For example, this sample of daughter and wife caregivers was living with their care recipient. Other studies of daughter caregivers have included only daughters *not* living with their care recipient (Stephens & Townsend, 1997), or a mix of daughters living with or independent of the impaired parent (Martire, Stephens, & Atienza, 1997). Similarly, caregivers in this study were caring for relatives with dementia, as opposed to those with physical health impairments only or a mixed sample of care recipients. In light of the fact that daughters had, on average, a greater number of people living in their households relative to wives, it would also be useful, as noted earlier, to better understand how these additional household relationships could influence caregiver stress. This is particularly true in light of the frequency with which daughter caregivers reported distressing interactions with other family members.

Our results support other investigations indicating the potentially detrimental impact, in both psychosocial and physical arenas, on women serving as family caregivers for an older relative. In addition, the results add to the small body of research indicating that the specific set of circumstances that often accompany home caregiving may have negative acute effects on both psychosocial and physiological responses, especially in daughters. In particular, developing interventions aimed at diminishing the effects of negative interactions on acute physiological as well as emotional responses to stress may benefit the caregiver as well as her family.

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