IMPACT OF GENDER AND HAVING CHILDREN IN THE HOUSEHOLD ON AMBULATORY BLOOD PRESSURE IN WORK AND NONWORK SETTINGS: A PARTIAL REPLICATION AND NEW FINDINGS[1,2,3]

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ABSTRACT

Ambulatory blood pressure (ABP) has been shown to differ for men and women across work and nonwork settings. For men, ABP is higher at work than at home on workdays or on nonworkdays. For women, ABP levels in different settings depend on whether they have children in the household. Women without children at home exhibit the "male" pattern of higher ABP at work than at home. Women with children at home show either similar ABP levels in the two locations or higher ABP at home. These different patterns have been assumed to represent different stress levels in the two locations, but this assumption has rarely been tested. Also, few studies have examined ABP levels on a nonworkday in women or the effect of having children in the household for men. The present study monitored ABP in men and women during two workdays and one nonworkday. Comparisons were made between ABP levels in three settings (workday at work, workday at home, nonworkday) using mixed random effects regression models. Psychosocial variables (e.g. mood, stress) that might mediate the different ABP patterns were also assessed. ABP differences were analyzed by gender and whether children were living in the household using mixed random effects regression models. Results indicated that diastolic blood pressure was higher at work versus home for men with children and higher at work and on nonwork-days than at home for women without children. ABP did not differ across settings for women with children or men without children. These results were not mediated by mood or stress levels in the three settings.

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INTRODUCTION

Prior research has found an association between stressful work conditions and the development of hypertension (1) and other cardiovascular outcomes (2). Consequently, there has been considerable interest in examining blood pressure at work and in nonwork situations. Several studies that examined this issue found that ambulatory blood pressure (ABP) in men was higher at work compared to their ABP at home after work (3–5) or their ABP on a nonworkday (6,7). Work–home ABP differences in women have been less consistent and have depended on whether the women had children living in the household (8–11). In general, the results of these studies indicate that women without children living at home and those who reported higher work stress than home stress exhibited the "male" pattern of higher ABP at work than at home (8–11). Women with children living at home and those who considered themselves to be more home-stressed than work-stressed had either higher ABP at home or similar ABP levels in the two locations (8–11).

Despite these findings, several gaps remain in our knowledge of ABP patterns in work and nonwork situations. First, women's ABP on a nonworkday has not been examined. Given the finding that work–home differences in women's ABP levels depend on whether the women have children living in the home, we might expect this factor to also influence women's ABP on a nonworkday. Second, the effect of children living at home on men's ABP has not been examined. Third, the different work–home ABP patterns for men and women have been thought to reflect different stress levels in the two locations. For men, the higher ABP at work is hypothesized to reflect, in part, greater stress levels at work and the decline in ABP at home in the evening is hypothesized to reflect a physiological "unwinding" from the day's stressors. For women, particularly those with children at home, household responsibilities are hypothesized to result in continued activity and higher stress levels at home and, consequently, blood pressures that are equal to, or higher than, those seen at work. These hypotheses, however, have not been directly tested. For example, James et al. (10) examined work–home differences in groups of women classified as "work stressed" versus "home stressed," but not on groups based on children living at home. Consequently, there is a confounding of the effects of chronic stress and daily stress on ABP. In other words, these results indicate that ABP is higher at home on days when home is more stressful (likewise, for work),

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but the results do not examine the overall effect of having children at home on stress and ABP levels. Both factors—daily stress and children being at home—need to be examined simultaneously.

The present study examined ABP, stress, and mood in men and women at work and in two nonwork situations (at home on a workday; on a nonworkday). The data were collected over the course of 2 workdays and 1 nonworkday. Comparisons were made between ABP levels in three conditions: at work, at home on a workday, and on a nonworkday. The data were analyzed according to whether children were present in the household as this has been shown to differentially predict ABP in women, though its effect in men is unknown.

Based on prior research, we predicted that (a) women with children living in the household would exhibit similar or lower ABP levels at work versus home; (b) women without children in the household would exhibit higher ABP at work than at home; and (c) men would exhibit higher ABP at work than either at home or on a nonworkday. Regarding the comparison of women's ABP at work and on a nonworkday, we predicted that having children in the household would result in similar ABP levels across all three situations and that women without children in the household would exhibit lower ABP levels on the nonworkday versus when at work. Regarding the effect of parental status on ABP in men, we predicted that men with children living at home would exhibit a pattern similar to women with children (i.e. no work–home ABP difference). Alternatively, if women indeed shoulder the burden of home responsibilities, we would expect men to be less active and less stressed at home and their ABP to be lower at home regardless of parental status. To the extent that there is a sharp division of labor, men with children at home may experience greater work stress than men without children at home, perhaps due to increased breadwinner responsibilities. Finally, we hypothesized that ABP differences in work and nonwork situations would be accounted for by situational differences in stress and mood.

METHOD

Participants

Participants were recruited through newspaper advertisements for a study of coping with work stress. Exclusionary criteria included working less than full-time, working multiple part-time jobs rather than a single full-time job, working weekend or nonday shifts, being severely overweight (body mass index [BMI] > 31 kg/m^2), having hypertension or taking medication that affects blood pressure, having an endocrine disorder or taking medication that affects cortisol (important for another focus of the study not relevant to this paper), or having been hospitalized for any psychiatric reason. Hypertensives were excluded because we did not want to study ABP under medicated conditions or to risk removing patients from their medications.

Of the 760 people screened, 353 were eligible, 114 who were eligible declined to participate, and 185 (52.4% of those eligible) participated. We had planned to collect data from approximately 200 participants; thus, 54 people who were eligible were unable to participate before the data collection ended for various reasons (e.g. they qualified for a group that was already filled; they canceled a training session and failed to reschedule).

Twenty-four people were eliminated from the analyses because they did not comply with the study protocol ($n = 6$), they failed to indicate the presence of children in the household ($n = 6$), or they had no relevant diary or ABP data ($n = 12$). The final sample consisted of 85 women (38 with children living at home; 47 without) and 76 men (35 with children living at home; 41 without). The sample was primarily White (88%), middle-aged (39 ± 9 years of age), married or living with a partner (60% for an average of 14 ± 10 years), and highly educated (32% had 1–3 years of college, 50% had a college or graduate degree). Participants with children under 18 years of age in the household averaged 1.9 ± 0.9 children at home. Their jobs included the full spectrum of job classifications from the 9-category Hollingshead rating system (12); however, there were few low-status jobs (e.g. custodian), as 96% of participants had jobs in the middle (e.g., secretary) to high (e.g. attorney) categories. There were no group differences in age, race, education level, marital status, job classification, or socioeconomic status (SES) as measured by the Hollingshead (12).

Equipment

Momentary diary reports were collected via a programmable palm-top computer (Psion Model LZ) with a 4-line (20 characters each) LCD screen and an audible alarm (13,14). Ambulatory blood pressure was recorded with the SpaceLabs Model #90207 (15). The electronic diary reminded participants to take the ABP reading during each entry. The diary entries and ABP readings were stored electronically and later uploaded to a data file.

Materials

A questionnaire was used to collect information on number of children under the age of 18 living in the household and other demographic factors (e.g. ethnicity, education level, marital status, etc.). Presence of children in the home was operationalized dichotomously (none versus one or more). The 9-category job classification and personal socioeconomic status based on a combination of job classification and education were assessed with the Hollingshead rating system (12).

The electronic diary implemented on the palm-top computer asked about location (work, home, other's home, bar/restaurant, store, vehicle, outside, other), posture (supine, sitting, standing), current mood, the occurrence of stressful events, and two indicators of perceived stress. The mood assessment included nine adjectives that represented two bipolar mood dimensions—positive/negative mood valence and arousal (16–18). For each mood item, participants responded whether they were experiencing that mood (*NO!!, no??, yes??, YES!!,* coded 0–3). Items were summed for each subscale. The mood items, their response options, and scoring were developed specifically for use with the electronic diary (19,20). The diary also assessed stress with three indicators. The first stress indicator involved whether any stressful event(s) had occurred or had been on the participant's mind since the last report (*No/Yes*). Up to three events could be reported at each entry. The second stress indicator was an 11-point rating for each of these stressful events, with higher scores indicating greater stress. These ratings were summed across the events at each diary report to obtain a single momentary stress score for that report. Because the event stressfulness rating was asked only when a stressor was reported, a score of "0" was assigned to reports having no stressful events. The third stress indicator was the 4-item Perceived Stress Scale (PSS) (21) which was assessed at each report.

Procedure

Participants learned to use the diary and ABP equipment in a group training session on Saturday mornings. Prior to training, participants provided informed consent, answered a background information questionnaire, and were screened for undiagnosed hypertension (systolic blood pressure [SBP] > 160 or diastolic blood pressure [DBP] > 105). Participants began monitoring im-

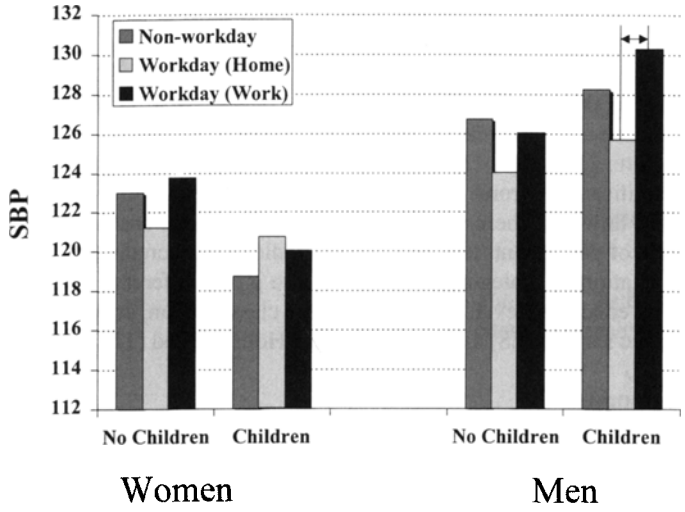

FIGURE 1: Mean Levels of SBP in Work and Nonwork Settings; by Gender and Presence of Children in the Household and Adjusted for Age, BMI, and Position.

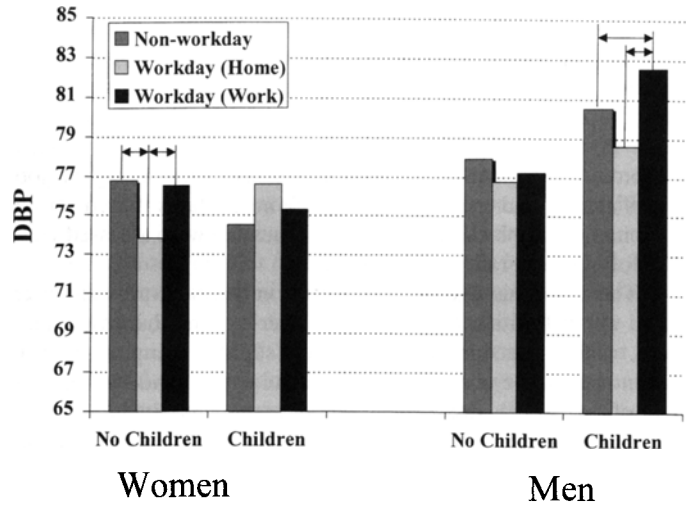

FIGURE 2: Mean Levels of DBP in Work and Nonwork Settings; by Gender and Presence of Children in the Household and Adjusted for Age, BMI, and Position.

mediately after the training session and continued for the next 5 days. The electronic diary randomly prompted participants to answer a diary report every 2.5 to 3.5 hours (mean = 3.0 hours) during daytime hours. In addition to the random prompting, participants were instructed to initiate a diary entry following any stressful work incidents (relevant for a major goal of the study which is not a focus of the present paper).[4]

The electronic diary had a feature that allowed participants to suspend the program when they went to sleep each night; consequently, the actual hours of monitoring depended on each participant's schedule. There were no differences between the groups in the number of hours spent monitoring each day, although all participants monitored 2 fewer hours on Sunday (14 ± 0.1 [s.e.]) than on Monday or Tuesday (mean for both days = 16 ± 0.1 [s.e.]), $F(2, 308) = 105.36, p = .0001$.

Participants were phoned Sunday morning (on average at 10:00 a.m. ± 1 hour 49 minutes) to follow-up on their understanding of and compliance with the monitoring procedure. Finally, participants returned to the lab on Thursday evening or on Friday to return the equipment and to complete a debriefing interview. Participants were paid $175 for the week of monitoring.

To reduce participant burden, ABP was monitored on Sunday, Monday, and Tuesday only; therefore, only reports from these days are included in the present analyses. There were 1,321 reports from 161 participants available for analysis. There were no differences among the groups in the number of reports available on the nonworkday (mean = 2.8 ± 1.0), at home on the workday (mean = 2.0 ± 1.2), or at work (mean = 3.9 ± 1.2). One reason for the missed entries on Sunday was because many participants admitted missing reports or temporarily suspending the diary program while they were attending religious services. Another reason is because there were, on average, 2 fewer hours of monitoring on Sunday, which could potentially eliminate one prompt that day for some participants.

Analytic Strategy

Given the multilevel nature of the data (reports randomly sampled from participants), multilevel random effects regression models were used to address the hypotheses. These models handle autocorrelated residuals, individual differences in mean blood pressure (BP) levels, and time-varying covariates assessed at each report (i.e. posture) (22). Analyses were conducted using PROC MIXED in SAS (23).

To examine the effect of having children in the household on men's and women's ABP, we tested the three-way (gender* children*location) interaction within the mixed regression model. Covariates included age (because age is positively associated with BP), BMI (because women generally have lower BMI than men and BMI is positively associated with BP), and posture (because posture is likely to differ in the two locations and posture is associated with BP levels (3,4).

To examine whether ABP differences in the different conditions were due to stress, we conducted two sets of analyses. The first set used the same three-way mixed regression model (gender* children*location while covarying age, BMI, and posture) to predict negative mood, arousal, presence of a stressful event, and perceived stress. These analyses allowed us to determine whether mood and stress levels followed patterns similar to the ABP levels. The second set repeated the ABP analyses while also covarying the mood/stress measures to determine whether they would account for the ABP differences in the different locations (24).

RESULTS

Effect of Gender, Children, and Location on BP

SBP and DBP exhibited similar patterns (see Figures 1 and 2); however, the three-way interaction (gender*children*location) was significant for DBP only, $F(2, 1150) = 11.13, p = .004$. To follow-up on this interaction, PROC MIXED provided pairwise comparisons of the means for each condition adjusted for the three covariates (age, BMI, posture). Given the significant overall F-test for DBP, we report within-person pairwise comparisons that were significant at the .05 level. As seen in Figure 1, DBP differed only for women without children and for men with children. For women

[4] A third type of report was also collected. Whenever participants reported a stressor rating of "5" or higher, the electronic diary entered an "intensive" data collection mode. While in this mode, three prompts were scheduled 40 minutes apart to follow-up on the stressful event. The timing of these reports are nonrandom because they follow a stressor of moderate to high magnitude; consequently, they were not included in the analyses.

without children, DBP at home on a workday was lower than both DBP on a nonworkday, $t(1150) = 2.58, p = .01$, and DBP at work, $t(1150) = 2.52, p = .01$. For men with children, DBP at work was higher than at home on a workday, $t(1150) = 3.45, p = .001$, or on a nonworkday, $t(1150) = 2.01, p = .04$.

Do Mood and Stress Mediate the DBP Differences?

The next set of analyses examined whether mood or stress levels in the different conditions mediated the ABP differences. First, we examined whether the mood and stress variables followed the same pattern as the BP results by testing within-person differences in mood and stressfulness for each location. Of the five variables tested (negative mood, arousal, perceived stress, presence of a stressor, stressor ratings), three were predicted by the three-way interaction: negative mood, $F(2, 1150) = 3.26, p = .04$; perceived stress, $F(2, 1150) = 3.94, p = .02$; and the stressor rating, $F(2, 1150) = 5.74, p = .003$. These patterns differed from the pattern of DBP levels across settings, however. As seen in Figure 3, ratings for negative mood were generally lowest on the nonworkday, followed by being at home on the workday, and highest while at work. The source of the significant interaction was the finding that negative mood did not differ on a nonworkday or at home on a workday for women without children or for men with children. Though not depicted in Figure 2, the patterns and associations for perceived stress and stressor rating were very similar and are not presented separately.

Second, to determine whether the DBP pattern was mediated by subjective experiences, the mixed regression model predicting DBP was rerun while covarying the mood and stress variables in addition to the demographic covariates. Covarying the mood and stress variables separately and simultaneously did not eliminate the three-way interaction for DBP. Consequently, we conclude that stress and mood do not mediate the effects of gender or the presence of children on work- and nonwork-related DBP levels.

DISCUSSION

The present study examined the moderating effects of gender and presence of children in the household on ABP levels in work and nonwork settings. The study also examined whether these differences were mediated by subjective experiences in these settings. We had predicted that ABP would be: (a) higher at work than at home or on a nonworkday for women and men without children living at home, (b) similar across conditions for women with children living at home, and (c) either similar across conditions or higher at work than at home or on a nonworkday for men with children living at home. We also expected that levels of mood and/or stress in the different settings would account for these ABP differences.

Several of our findings support these hypotheses and replicate results from previous studies. First, ABP was higher at work than at home or on a nonworkday for men. Second, ABP was higher at work than at home for women without children. Third, ABP was similar across all settings for women with children. The present study produced new findings as well. ABP did not differ across settings for men without children, and ABP on the nonworkday was similar to ABP at work for women without children.

Contrary to expectation, there was a dissociation between psychological and physiological indicators of stress. However, this finding is consistent with other field studies that find only a small to moderate association between mood/stress and cardiovascular activity (25,26). It is important to note that posture was controlled in the analyses; consequently, ABP differences that may be due to

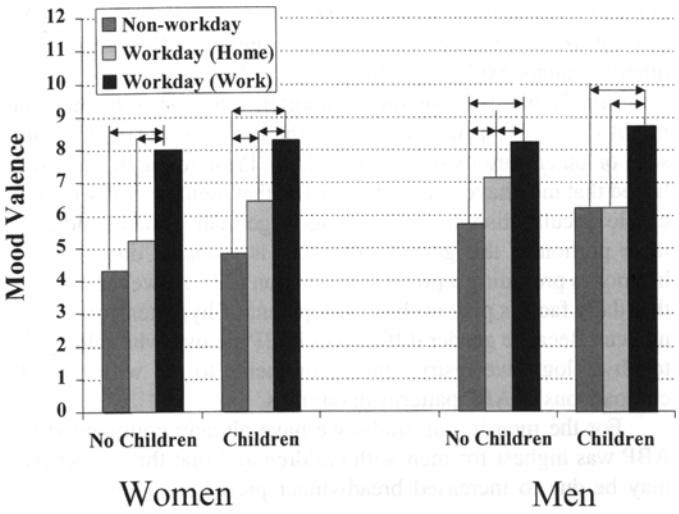

FIGURE 3: Mean Levels of Mood Valence; by Gender and Presence of Children in the Household and Adjusted for Age, BMI, and Position.

different activity levels in the three settings are generally accounted for. Perhaps other within-person factors that were not assessed in this study mediate these ABP patterns. Consider, for example, the finding that ABP on a nonworkday for women without children was higher than their ABP at home after work. Perhaps their types of weekend activities are more heterogeneous than their activities at home on a workday. For example, these women may relax at home after a workday resulting in a decrease in ABP, but on the weekend, they may pursue a wider variety of activities such as doing chores, socializing, or other leisure activities. Unfortunately, we did not collect an extensive assessment of the types of activities that participants were engaged in and cannot explore this possibility. Another possibility is that the threatening nature of the stressor may have a greater impact on ABP levels than mood or stress ratings. For example, although some events may be rated as equally stressful, some events may be positive (e.g. a promotion) and may therefore be less threatening than others (e.g. job insecurity). The present study did not distinguish between positive and negative stressors, however, and future studies may wish to consider this as another factor in determining ABP levels.

One other interesting finding is that the highest mean ABP level was observed in men with children living at home. Although the purpose of this paper was to examine within-person variations in ABP levels and the within-person factors that might mediate these variations, we speculate on the meaning of the between-person findings and possible directions for future research. For men with children, we suspect that their pattern reflects a persistent division of labor in which men have the primary responsibility for generating income. Thus, their extremely high ABP at work may reflect an added stressor of needing their job in order to support their family. Women with children, especially those with younger children, may purposely select jobs with greater decision latitude to allow them the flexibility necessary to care for their children. One limitation of the present study is that lower SES occupations were underrepresented; thus, our results may be restricted to people with jobs in the middle to upper range of SES levels.

Another factor that may influence ABP levels between people is the ages of their children. Younger children (e.g. preschool or elementary school) require more constant attention than older

children (e.g. teenagers) which may impact home ABP levels. We did not assess the ages of our participants' children and, consequently, cannot explore this idea.

Finally, we speculate on an important question: What meaning might these ABP patterns have for the development of hypertension or other cardiovascular disorders? Prior research has established that men have overall higher BP, that men generally develop cardiovascular disorders at a younger age than women, and that a large portion of this gender difference is probably due to female hormones providing a protective function (27). However, the roles that daily factors play in the development of hypertension are still unclear. Because gender differences in BP are overwhelmingly due to physiology, we restrict these comments to the within-gender comparisons of ABP patterns in our data.

For the men in our study, we have already commented that ABP was highest for men with children and that this higher ABP may be due to increased breadwinner pressures. Thus, for men, having children in the household may confer a greater risk of developing hypertension than not having children in the household. For the women in our study, not having children in the household was associated with ABP being approximately 2 mmHg higher in two of the three settings. For women with children in the household, ABP was approximately 2 mmHg lower in two of the three settings. Thus, we extrapolate that women without children may sustain higher ABP across the entire week than women with children. This may place them at greater risk for developing hypertension later in life. While this speculation is contrary to the notion that women with children have busier and more stressful days than those without, research has also shown that the balance and mastery of multiple roles is beneficial to women's mental health (28,29). If women with multiple roles feel better about themselves overall, their ABP levels may reflect this better mental health and general life satisfaction.

We cannot conclude our discussion without considering a limitation of the present study. First, the ABP estimates on a nonworkday and at home on a workday were based on a small number of reports (approximately two per person), which may be unreliable. The estimates for ABP at work were based on a larger sample of readings (approximately five per person); however, replication of these results with a larger sampling from participants is warranted. As noted in the Method section, we did have additional readings available that were excluded due to the nonrandom nature of their sampling. It is noteworthy to mention that we repeated these analyses while including these nonrandom readings and the patterns of results were very similar.

In sum, this study reveals the complicated nature of the association among gender, parental roles, stress, and physiology. ABP levels across different settings differed for men and women and by the presence of children in the household. Additionally, two factors that may explain these ABP patterns (stress, mood) did not follow the same patterns in the different settings and did not mediate the ABP findings.

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