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Ethnic Differences in Inter- and Intra-Situational Blood Pressure Variation: Comparisons among African-American, Hispanic-American, Asian-American, and European-American Women

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Abstract

Objectives—The purpose of this study was to compare the daily inter- and intra-situational ambulatory blood pressure (BP) variation by ethnicity in women.

Methods—The African-American (N=82; Age=39.7+8.9), Hispanic-American (N=25; age=37.5+9.4), Asian-American (N=22; Age=35.2+8.6), and European-American (N=122; Age=37.2+ 9.4) women in this study all worked in similar positions at two major medical centers in NYC. Each wore an ambulatory monitor during the course of one mid-week workday. Proportional BP changes from work or home to sleep, intra-situational BP variation (standard deviation (SD)) and mean situational BP levels were compared among the groups using ANOVA models.

Results—African-American and Asian-American women had significantly smaller proportional work-sleep systolic changes than either European- ($p<.05$) or Hispanic-American ($p<.05$) women, but the Asian-American women's changes tended to be smallest. The variability (SD) of diastolic BP at work was significantly greater among African- and Hispanic-American women compared to Asian- and European-American women (all $p<.05$). African-American women had greater sleep variability than European-American women ($p<.05$). Asian-American women had the highest level of sleep diastolic pressure (all comparisons $p<.05$).

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Conflict of Interest: None.

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Conclusions—African-American and Asian-American women have an attenuated proportional BP decline from waking environments to sleep compared to European-American and Hispanic-American women. Asian-American nocturnal BP may be elevated relative to all other groups.

Keywords

Ambulatory Blood Pressure Variability; Ethnicity; Women

Recent reviews have reported that greater circadian variability in ambulatory blood pressure (BP) measurements predict cardiac, vascular, and renal morbidity and mortality (Flores, 2013; Parati et al., 2015). Aggregate variability as indicated by the coefficient of variation (CV) or standard deviation (SD) of a sample distribution of BPs over 24-hours, the “average real variability” (ARV24) defined as the mean of the absolute differences of consecutive ambulatory measurements, the magnitude of BP changes between daily situations, and within situation BP variation (e.g. during sleep) have all been associated with adverse cardiovascular outcomes (e.g. Hansen et al., 2010; Ma et al., 2010; Flores, 2013; Parati et al., 2015). The harmful effects of BP variability are more pronounced in people with higher average BPs (Parati et al., 2015), although the roots of variability’s pathological impact likely begin when BP levels are low, accumulating over time as a consequence of allostatic load (e.g. McEwen, 2004). Hence, understanding the sources of circadian BP variability in younger, currently healthy people may provide insight into how it contributes to cardiovascular pathology risk when BP levels increase.

The variability in BP likely occurs to adapt people to changing environmental circumstances (e.g., work) as well as to instantaneous events that ensue within each daily setting (James, 2007; 2013). The patterns and extent of circadian BP variability may also be affected by the person’s genetic and cultural background (James, 2007). There are numerous studies showing that BP declines proportionately less from waking environments to sleep among African-Americans than European Americans (Agyemanga et al. 2005; van Berge-Landry et al, 2010); but, there are conflicting data regarding Asians and Asian-American comparisons with European-Americans, with some studies showing no difference with European groups (Agyemanga et al. 2005) while others suggest that Asian-Americans decline proportionately less (Brown et al., 2003; van Berge Landry et al., 2013). To date, nearly all studies examining ethnic effects on circadian BP variation compare another ethnicity to a European group. Lacking are studies making direct comparisons among multiple ethnic groups; thus for example, it is largely unknown whether Asian-Americans or Hispanic-Americans differ from African-Americans. The purpose of this study was to compare the daily inter- and intra-situational BP variation among African-American, Hispanic-American, Asian-American, and European-American women who were recruited from the same two work sites, and were exposed to similar patterns of circadian situational demands.

METHODS

Subjects and Design

To evaluate ethnic differences in situational BP variation, a natural experimental approach was used in which measures of the average and variance of ambulatory BPs taken under

three contrasting daily situations (at work, at home and during sleep) were compared across four groups of ethnically diverse women who worked in similar jobs at two major medical centers in New York City. The comparison groups were composed of 82 African-American, 25 Hispanic-Americans, 22 Asian-American, and 122 European-American healthy, premenopausal women who volunteered to participate in a study investigating the role of life stress in developing breast cancer. Ethnicity was determined from self-report. The protocol was IRB approved and all of the participants signed written informed consent. All worked during the day shift in clerical, technical, or professional positions. A more complete discussion of the subjects and protocols for the study can be found in Dettenborn et al. (2005).

The average ages in years of the groups compared in the current analysis was 39.7 ± 8.9 for African American, 37.5 ± 9.4 for Hispanic Americans, 35.2 ± 8.6 for Asian Americans, and 37.2 ± 9.4 for European Americans. The average BMIs of the groups were 28.1 ± 6.9 , 28.8 ± 5.5 , 23.6 ± 4.3 , and 23.7 ± 4.0 , respectively. The percent of women who were married in each group was: 41.0% for African-Americans, 41.7% for Hispanic-Americans, 23.8% for Asian-Americans and 43.2% for European-Americans, and the percentage of women who were smokers was 9.6%, 8%, 0%, and 15.6% respectively.

Procedures

As part of the protocol, each woman was fitted with the Spacelabs 90207 ambulatory BP monitor during the course of one mid-week work-day. The monitors were calibrated to a mercury column at the time of hook-up. They were set to take pressures automatically every 15 minutes from 8AM–10PM and every 30 minutes from 10PM–8AM the next morning and participants were instructed to minimize movements during measurements. BPs were averaged at work (11AM–3PM), at home (approximately 6 PM–10 PM) and during sleep (approximately 10 PM–6AM). On average, there were 15 measurements evaluated at work, 14 measurements at home, and 14 measurements during sleep. The determination of the daily situations (work, home, sleep) in which pressures were taken was based on diary entries recorded by the patient.

Analysis

To assess the inter-situational variation in BP, proportional changes between waking situations and sleep were first calculated as (work or home-sleep)/sleep. These proportional changes were compared across the ethnic groups using ANOVA. To examine the intra-situational variance, the standard deviations (SD) of the within situation BP distributions were calculated and then compared across situations and by ethnic group using ANOVA. Finally, the mean situational BPs were compared by ethnic group using the same modelling technique. Age was not included as a covariate in these analyses due to the limited age range of the sample. Analyses were conducted using SPSS 21 for Windows® and statistical significance was set at $p < 0.05$. Post-hoc comparisons were adjusted using the Bonferroni method.

RESULTS

Comparisons of the proportional situation BP changes are shown in Table 1. As indicated, the proportional decline from work to sleep in Asian-American women's systolic and diastolic BP was significantly less than that of European-American and Hispanic-American women ($p<0.05$). Their proportional home to sleep systolic and diastolic BP also declined less than that of the European-American women ($p<0.05$). The proportional decline in systolic BP from work to sleep of African-American women was significantly less than that of European-American and Hispanic-American women and their decline in work to sleep diastolic BP was also significantly less than that of Hispanic-American women ($p<0.05$). Lastly, the proportional decline in African-American women's home to sleep systolic BP was significantly less than that of European-American women ($p<0.05$).

The results of the intra-situational variance and situational mean comparison analyses are shown in Table 2. Asian-American and European-American women's diastolic SD at work was less than that of the African-American and Hispanic-American women ($p<0.05$). The African-American women's sleep systolic SD was also significantly greater than that of European-American women ($p<0.05$). In examining the situational means, Asian-American women had the highest average sleep diastolic BP which was significantly higher than those of all other ethnic groups ($p<0.05$). Finally, African-American women had significantly higher sleep systolic BP than the European-American and Hispanic-Americans women ($p<0.05$).

DISCUSSION

Previous studies have shown that the BPs of African-American and Asian-American women decline proportionately less from waking environments to sleep than those of European-American women (Brown et al. 2003, Van Berge-Landry et al. 2013, van Berge-Landry et al, 2010) and the results in the present study generally confirm these findings. However, the results of both the proportional change and mean comparisons suggest that these groups also differ from Hispanic-American women in a similar pattern to European-American women. The results also suggest that the BP of Asian-American women from waking environments to sleep may decline proportionately less than that of African-American women. It is not clear why these differences in variation exist, although both genetic and stress related factors may be involved (e.g., Brown et al. 2003, Hughes et al., 2007, Ituarte et al. 1999, Rodriguez et al. 2013). It is also possible that different mechanisms may be driving the variation in different ethnic groups (James, 2013).

In examining the intra-situational variation, the data showed that the African –American and Hispanic-American women had greater variability at work than the Asian-American and European-American women, while there were no statistically significant differences at home. The African-American women also had greater systolic BP variability during sleep than the European-American women. Previous research has shown that the women in this study were not physically active at work or home, so it is unlikely that the ethnic variability differences at work are related to activity difference (James et al., 2015). However, the dissimilarities could result from ethnic differences in work perception or coping strategies

that can influence BP reactivity to specific events as has been found in earlier studies (see James, 2007 for discussion). Likewise, the similarities in variation in the home environment may indicate both a lack of activity variation and a similarity in perceived stress at home (James, 2007). The fact that the sleep systolic SD among the African-American women was elevated and significantly higher than the European-Americans may reflect poorer sleep quality while wearing the BP monitor, as found in an earlier study (Hughes et al., 2007).

Caution should be used in extrapolating the results of this study to the general population; the sample was limited to healthy younger women employed in select occupations. In addition, ethnicity was determined by self-report, which could increase type II error in the group comparisons. Lastly, the frequency of measurements during each situation was relatively low, which could inflate the intra-group variance estimates. Nonetheless, these findings confirm earlier studies showing that African-American and Asian-American groups have an attenuated proportional BP decline from waking environments to sleep compared to European-Americans, and also show for the first time that they have similar differences with Hispanic-Americans. The results also suggest that the diurnal proportional BP changes among Asian-Americans are the smallest among the groups, which is likely due to their relatively elevated sleep BP.

Acknowledgments

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Table 1

Proportional Blood Pressure Change Comparisons Among the Four Ethnic Groups.

Characteristic [*]	AfA	HiA	AsA	EuA
W-S/S SP %	10.2±7.8	14.4±6.9 ^{a,b}	8.8±9.4	12.6±6.2 ^{a,b}
W-S/S DP %	17.6±8.5	21.7±9.6 ^{a,b}	14.3±13.4	19.7±7.2 ^a
H-S/S SP %	8.9±6.5	11.6±6.7	8.1±7.9	11.9±5.4 ^{a,b}
H-S/S DP %	15.1±8.7	16.9±11.1	12.3±11.2	17.4±7.5 ^a

AfA = African American, HiA = Hispanic-American, AsA = Asian American and EuA = European American

^{*} W-S/S SP%, W-S/S DP%, H-S/S SP%, and H-S/S DP% indicate (Work or Home- Sleep)/Sleep Proportional Change in Systolic or Diastolic Pressure.

^a significantly different than Asian-Americans, p<0.05.

^b significantly different than African-Americans, p<0.05.

Table 2
Situational Blood Pressure Level (mmHg) and Variance (SD) Comparisons among the Four Ethnic Groups.

	Mean Blood Pressure Level (mmHg)				Blood Pressure Variance (SD)			
	AfA	HiA	AsA	EuA	AfA	HiA	AsA	EuA
Systolic BP	123±11	121±13	119±13	121±10	7.3±2.3	7.8±3.0	7.2±2.0	7.6±2.3
Diastolic BP	82±10	80±9	85±9	82±11	7.5±2.1 ^{a,b}	7.9±3.1 ^{a,b}	6.4±2.5	6.7±2.1
Systolic BP	121±12	117±13	118±13	120±10	8.0±2.9	7.4±2.6	8.3±2.7	8.2±3.1
Diastolic BP	79±11	75±10 ^a	83±10	80±11	8.3±3.3	7.0±2.3	7.6±2.7	7.6±3.4
Systolic BP	111±12	103±10 ^c	108±17	105±10 ^c	9.0±3.0 ^b	9.0±4.2	8.3±3.9	7.9±2.7
Diastolic BP	67±10 ^a	62±11 ^a	72±10	66±11 ^a	8.1±2.9	7.8±3.4	8.1±4.3	7.3±2.8

AfA= African American, HiA= Hispanic-American, AsA= Asian American and EuA= European American

^a significantly different than Asian-American, $p<0.05$.

^b significantly different than European-Americans, $p<0.05$.

^c significantly different than African-Americans, $p<0.05$.