Physiological Stress Responses in Filipino-American Immigrant Nurses: The Effects of Residence Time, Life-Style, and Job Strain

DANIEL E. BROWN, PHD, AND GARY D. JAMES, PHD

Objective: The purpose of this study was to evaluate the relationship between measures of Americanization (the adoption of American life-style and culture) and physiological measures of stress in Filipino-American immigrants. **Methods:** Ambulatory blood pressure monitors and timed urine collections were used to evaluate blood pressure and urinary catecholamine excretion across the work, home, and sleep daily settings among 31 healthy, premenopausal, immigrant Filipino-American women employed as nurses or nurse's aides. Migration history and life-style were evaluated from questionnaire responses. Reported job strain, decision latitude, and psychological demand were obtained from the Job Content Questionnaire. **Results:** Immigrants who had lived longer in the United States had elevated norepinephrine levels in the work and home settings ($p < .05$), higher diastolic blood pressure during sleep ($p < .01$), and lower dips in blood pressure during sleep ($p < .05$). Job strain measures were not related to blood pressure, catecholamine excretion rates, or residence time in the United States. **Conclusions:** The results suggest that indicators of stress increase as a function of time since immigration, although this result is not explained by self-reports of identification with Filipino or American life-style or by measures of job strain. **Key words:** stress, catecholamines, ambulatory blood pressure, modernization, migration, employed women.

NE = norepinephrine; EPI = epinephrine; BP = blood pressure; BMI = body mass index.

INTRODUCTION

The adoption of modern Western life-styles, whether occurring acutely through migration (1–3) or in situ as a consequence of Western contact (4–6), has been associated with increases in the average casual blood pressure of many populations (7, 8). Various theories have been advanced for these increases, including changes in diet (9, 10), physical activity, and psychosocial stress (11, 12). However, the blood pressures evaluated in these studies were casual seated measurements taken under standardized conditions, which are not reliable indicators of pressure in real life circumstances (13, 14). Ambulatory blood pressures have not been studied in the context of culture change (14, 15), although it is likely that they are significantly affected by the stresses that modifying life-styles introduce.

Several studies have also associated the process of modernization with increased psychosocial stress (16–20), but few have examined variation in urinary catecholamine (epinephrine and norepinephrine) excretion rates as a measure of psychosocial stress resulting from the process (16–19, 21–23). Generally, the studies that have been conducted show that the process of adopting modern Western life-styles increases the level of urinary catecholamine output.

Filipino-Americans living in Hawaii have higher hypertension prevalence rates than the state average (24). Filipinos constitute the largest immigrant group to Hawaii, and a large number of adult Filipino-Americans residing in the state are immigrants from rural areas of the Philippines, chiefly from the Ilocos province in northern Luzon. In an earlier study, Filipinos who migrated to Honolulu from rural areas of the Philippines who had intermediate levels of accommodation into the urban American life-style were found to have elevated catecholamine levels compared with immigrant Filipinos who had either low or high levels of acculturation (16, 17).

In the present study we have measured 24-hr ambulatory blood pressure and urinary catecholamines in immigrant Filipino-American women employed as nurses or nurse's aides on the island of Hawaii. Our primary objective was to ascertain among these women whether increases in these physiological stress measures were related to factors associated with the adoption of or exposure to modern American life-styles. Because work represents a time when immigrants are particularly exposed to individuals from other ethnic groups, including the host culture (25), special attention was paid to sources of stress in the workplace by use of Karasek's job strain model (26).

METHODS

Design

A natural experimental design was used in which the daily environment was divided into three major settings: work, home, and sleep. The work environment was somewhat controlled because all subjects had similar occupations (nurses and nurse's aides) and worked exclusively in one of two healthcare settings. Subjects varied in the amount of time since migration from the Philippines, and

From the Department of Anthropology (D.E.B.), University of Hawaii at Hilo, Hilo, HI; and the Decker School of Nursing (G.D.J.), Binghamton University, Binghamton, NY.

Address reprint requests to: Daniel E. Brown, PhD, Department of Anthropology, University of Hawaii at Hilo, 200 W. Kawili Street, Hilo, HI 96720-4091. Email: dbrown@hawaii.edu

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in their degree of contact and identification with typical American life-styles. The effect of this variation in social variables on physiological measures of stress was assessed separately in the different daily settings. In the work setting, immigrants are frequently in direct contact with nonFilipinos, but in the home environment, there is more variability in the degree to which immigrants interact with nonFilipinos (for example, two subjects are married to whites).

Subjects

The study included female nurses and nursing aides employed at either Hilo Medical Center or Hilo Life Care Center in the city of Hilo, Hawaii. All full-time workers of Filipino ethnicity and born in the Philippines were requested to participate if they met initial criteria: no currently diagnosed cardiovascular or other major health problems, premenopausal, weight less than 200 pounds, not pregnant, and not presently on any form of drug therapy.

A total of 31 women of Filipino-American ethnicity who were born in the Philippines were participants in the study. Eleven women were employed as professional nurses, whereas the other 20 were nursing aides. They are a subsample from a larger study (27) that included all full-time nurses and nurse's aides from the two health care facilities who were either Filipino-Americans or whites. In the larger study, there was a 92.4% participation rate of those eligible for the study (27); it is not possible to ascertain whether the few who declined participation were immigrants to the United States.

Procedures

On the day before the start of blood pressure monitoring, all subjects underwent an anthropometric battery, filled out questionnaires, and had their ambulatory blood pressure monitors calibrated. The ambulatory blood pressure monitor used, the Spacelabs 90207 (Spacelabs, Redmond, WA), is an oscillometric device that has been previously validated (28). Calibration readings were taken in the seated position using a "T" connector between the monitor and a mercury column, as previously described (29). Calibration was considered successful when three consecutive readings agreed to within 5 mm Hg for both systolic and diastolic pressure. The purpose of this calibration was to familiarize the subject with the monitor.

On the day of study, subjects were fitted with monitors just before beginning work (at approximately 6:30 AM), and the calibration procedure was repeated. The monitors measured blood pressure and pulse every 15 minutes during waking hours and every 30 minutes during sleep for a 24-hour period. Timed urine samples were also collected on this day using a protocol similar to that of James et al. (30). However, in the present study, to avoid interference with work schedules, subjects emptied their bladders just before commencing work, then collected any voidings until the beginning of their lunch hour, approximately 4 hours later (approximately between 7 AM and 11 AM). Similarly, home samples were collected beginning with the subject's return home until bedtime, about 4 hours later (somewhat variable, but approximately 6 PM to 10 PM). An overnight sample was also collected of approximately 8 hours duration (again somewhat variable, but approximately between 10 PM and 6 AM).

The samples were analyzed for EPI and NE levels using HPLC with electrochemical detection (31). In brief, the urine samples were mixed with buffer, alumina, water, and an internal standard. After mixing, the alumina was washed using a water-jet vacuum pump for aspirating waste. The catecholamines were then eluted with H_3PO_4 and mixed with tripotassium citrate, sodium octyl sulfonate, and tetrasodium EDTA. The mixture was injected into the HPLC column, which used a mobile phase consisting of sodium octyl sulfonate, KH_2PO_4, and tetrasodium EDTA with 12% acetonitrile. Unknown specimens were run with standards to determine the catecholamine concentrations. The catecholamines were expressed as a rate of excretion (ng/min) over each time period for the purpose of analysis. These rates were calculated by multiplying the urine production rate (ml/min) by the concentration (ng/ml) as measured above.

All participants filled out questionnaires, including one that assessed the individual's migration history and identification with Filipino vs. typically American life-styles. The questionnaires included two questions that asked respondents to note their perception of how their current life-style fits with Filipino (Filipino life-style) and with typical American (American life-style) life-styles on a 10-point scale. Both professional nurses and nurse's aides had median scores of eight on the Filipino life-style scale. For the American life-style scale, professional nurses had a median score of five, and nurse's aides had a median score of four. Subjects were also questioned about the amount of time they had resided in the United States (residence time). Finally, subjects filled out the Karasek job-content survey (32), from which a measure of job strain was calculated using the decision latitude and psychological demand subscales (mean scores on the subscales are noted in Table 1). Subjects then underwent an anthropometric battery before beginning the monitoring period. The BMI (weight divided by the square of the height) was computed. Table 1 presents some characteristics of the women in the sample, divided by occupational status; there were no significant differences in these characteristics between professional nurses and nurse's aides.

The blood pressure readings for each woman were averaged over a 4-hour period in the work and home awake settings and an 8-hour period during sleep (a total of 16 readings). In some cases, fewer than 16 readings were available (work: mean, 15.8 readings, range, 11–16; home awake: mean, 14.3, range, 5–16; sleep: mean, 14.1, range, 8–16). In all cases, there were sufficient readings to compute averages for a setting, as well as to calculate nighttime dipping of BP (mean waking BP minus mean sleeping BP: minimum number of waking BP readings = 21). The time period of ambulatory blood pressure measurements corresponded to the time of urine collections.

TABLE 1. Selected Characteristics of the Subjects by Occupational Group[a]

Characteristic	Professional Nurses	Nurse's Aides
Age (year)	34.4 ± 5.2	35.0 ± 6.0
Stature (mm)	1503 ± 46	1523 ± 46
Weight (kg)	57.5 ± 7.9	56.5 ± 9.1
Body Mass Index (kg/m^2)	25.4 ± 2.6	24.3 ± 3.6
Married	81.8%	70.0%
With children	81.8%	75%
Smokers	0.0%	0.0%
Drink regularly		
Alcohol	0.0%	0.0%
Coffee	45.5%	40.0%
Time resident in U.S. (years)	15.1 ± 7.2	12.3 ± 6.2
Scores[b]		
Decision latitude	33.8 ± 3.6	33.4 ± 2.9
Psychological demand	36.0 ± 5.7	33.1 ± 7.0

[a] Mean ± SD or percent of total.
[b] Each is a portion of the Karasek job-content instrument.

Analysis

Comparisons of blood pressures and catecholamine excretion among the three settings were carried out by means of repeated measures analysis of variance, with two-tailed *t* tests used to assess differences between each pair of settings. The amount of dipping of blood pressure was computed as the absolute difference between mean waking (work + home settings) and mean sleeping blood pressures.

Univariate (Spearman) correlations were used initially to assess relationships between the biological and both social measures and subscales of the Karasek job-content instrument. Partial correlations were used to assess the relationship between BP and catecholamine measures with social measures controlling for age, BMI, and/or mean heart rate.

Similarly, univariate correlations were used to assess the relationships between the blood pressure averages in each setting and the corresponding catecholamine excretion rates. Partial correlations were calculated to determine whether the observed associations were affected by social measures (ie, residence time) with physical activity (ie, mean heart rate) and age controlled in analyses.

Quantitative scores for assessing decision latitude and psychological effort were obtained from subscales of the Karasek job-content instrument. Individuals who had scores both above the median for psychological effort and below the median for decision latitude were characterized as belonging to a high job strain group ($N = 7$), with all other subjects in a low-strain group ($N = 24$). Comparisons of physiological measures between the two groups were carried out by means of two-tailed *t* tests.

RESULTS

Setting Comparisons

Table 2 presents mean values and standard deviations of blood pressure and catecholamine excretion rates in the three settings for all subjects. For both EPI and NE, the excretion rates at work were significantly higher than in the home or sleep settings, with no significant difference between home awake and sleeping values (Table 3). The blood pressure values in the sleep setting were significantly lower than at other times, and mean diastolic blood pressure at work was significantly higher than at home (Table 3).

There were no significant differences between occupational groups (professional nurses or nurse's aides) in catecholamine excretion rates in any daily setting. Similarly, there were no significant differences between the occupational groups in mean systolic or diastolic blood pressure in any daily setting. Similarly, no significant differences between subjects in these physiological measures were found based on marital status (married vs. single), and there were no significant correlations between the physiological measures and the woman's number of children.

TABLE 2. Comparisons of Blood Pressure and Catecholamine Measures in Three Daily Settings

Measure	Mean	SD	Repeated Measures ANOVA (*F*)	*p*
Systolic BP (mm Hg)				
Work	123.1	11.2		
Home	120.9	12.1	132.4	<.001
Sleep	105.0	10.3		
Diastolic BP (mm Hg)				
Work	80.6	8.3		
Home	75.8	8.8	125.3	<.001
Sleep	62.2	8.6		
Heart rate (bpm)				
Work	90.4	10.0		
Home	78.8	16.3	46.8	<.001
Sleep	66.9	7.2		
Norepinephrine (ng/min)				
Work	29.8	13.0		
Home	22.8	9.2	8.3	<.001
Sleep	16.7	21.5		
Epinephrine (ng/min)				
Work	7.0	4.8		
Home	2.9	2.1	10.1	<.001
Sleep	2.7	6.2		

Age, BMI, Catecholamines, and Social Variables

Age was significantly correlated with the amount of time a woman had lived in the United States after migration (residence time) ($r = .41$, $p < .05$) but not with self-reported Filipino ($r = -.07$, NS) or American ($r = -.02$, NS) life-style. BMI was significantly correlated with self-reported Filipino ($r = -.48$, $p < .01$) and American ($r = .45$, $p = .01$) life-style but not with residence time ($r = .21$, NS).

Older subjects had significantly higher NE excretion rates in all settings (work: $r = .45$, $p = .01$; home: $r = .49$, $p < .01$; sleep: $r = .54$, $p < .01$), but age was not significantly correlated with EPI excretion rates in any setting (home: $r = .24$; home awake: $r = .08$; sleep: $r = .21$). BMI was not significantly correlated with catecholamine excretion rates in any setting.

TABLE 3. Paired Comparisons of Catecholamine Excretion Rates (EPI and NE) and Mean BP in Work, Home Awake, and Sleep Settings (Two-Tailed *t*-Tests)

Measure	Settings Compared	*t*	*p*
Mean systolic BP	Work–Home	1.7	<.09
	Work–Sleep	13.6	<.001
	Home–Sleep	15.3	<.001
Mean diastolic BP	Work–Home	4.7	<.001
	Work–Sleep	13.6	<.001
	Home–Sleep	11.3	<.001
NE excretion	Work–Home	3.2	<.01
	Work–Sleep	3.9	<.001
	Home–Sleep	1.6	NS
EPI excretion	Work–Home	4.8	<.001
	Work–Sleep	3.5	<.001
	Home–Sleep	0.2	NS

Residence time was significantly correlated with NE excretion rate at work and home and with EPI excretion rate at work (Table 4). Self reports of Filipino or American life-style were not significantly correlated with EPI or NE excretion rate in any setting. Partial correlations controlling for age between residence time and both NE at work ($r = .42$, $p < .05$) and EPI at work ($r = .39$, $p < .05$) remained significant, but the partial correlation between residence time and NE excretion at home was not statistically significant when age was controlled ($r = .30$, NS).

Because NE excretion is influenced by physical activity rates (33), partial correlations between catecholamine excretion rates and residence time that controlled for heart rate (a surrogate activity measure) and age were also carried out. In both the work and home settings, residence time was significantly correlated with NE excretion when analyses were controlled for age and mean pulse rate in that setting (work: $r = .38$, $p < .05$; home: $r = .34$, $p < .05$); residence time was not significantly correlated with EPI excretion in the work setting when age and mean pulse rate were controlled for in the analysis ($r = .21$, NS).

Age, BMI, Ambulatory Blood Pressure, and Social Variables

Older subjects had greater mean blood pressure at work (diastolic: $r = .34$, $p = .06$; systolic: $r = .40$, $p < .05$) but not in other daily settings (home, diastolic: $r = .27$; home, systolic: $r = .19$; sleep, diastolic: $r = .25$; sleep, systolic: $r = .17$). Correlations between age and the amount of dipping of blood pressure were small and not significant (diastolic: $r = .12$; systolic: $r = .19$). BMI was significantly correlated with systolic blood pressure during sleep ($r = .39$, $p < .05$) but not in other settings, and there was no significant correlation between BMI and diastolic blood pressure in any setting, nor between BMI and amount of dipping of blood pressure.

Residence time was significantly correlated with mean blood pressure during sleep but not in other settings (Table 4). When these correlations were controlled for age and BMI, mean diastolic blood pressure ($r = .44$, $p < .05$) but not systolic blood pressure ($r = .30$, NS) during sleep remained significantly related to residence time. Neither the self-reports of Filipino life-style nor that of American life-style were significantly correlated with mean blood pressure in any daily setting.

Women who resided in the United States longer had significantly smaller dips in their blood pressure during sleep (partial correlations controlling for age and BMI, diastolic: $r = -.45$, $p < .05$; systolic: $r = -.47$, $p = .01$). Correlations between the extent of the blood pressure dip and the self-reports of Filipino and American life-style were not significant.

TABLE 4. Correlation Coefficients (Spearman) Between Social and Physiological Variables

Variable	Residence Time	Lifestyle	
		Filipino	American
Work			
Systolic BP	0.19	−0.04	−0.12
Diastolic BP	0.21	0.15	−0.18
NE	0.52**	0.02	0.12
EPI	0.44*	−0.05	0.05
Home			
Systolic BP	0.18	−0.07	0.11
Diastolic BP	0.26	0.12	−0.13
NE	0.43*	−0.03	0.19
EPI	0.15	0.26	0.05
Sleep			
Systolic BP	0.39*	−0.25	0.30
Diastolic BP	0.53**	−0.07	0.01
NE	0.24	0.00	0.00
EPI	0.20	−0.02	0.11

* $p < .05$.
** $p < .01$.

Job Strain, Catecholamines, Ambulatory Blood Pressure, and Social Variables

There was no significant difference between occupational groups in scores of the two subscales of the job-control instrument (decision latitude, Mann-Whitney U = 94.0, NS; psychological demand, U = 70.5, NS). As shown in Table 5, a significant correlation (Spearman) was found between decision latitude and residence time, but otherwise correlations between the two subscales of the job-control instrument and residence time or either American or Filipino life-style reports were not significant. Correlations between the subscales and mean blood pressure or catecholamine excretion rates were not significant in any setting (Table 5).

Blood Pressure and Catecholamine Excretion

Table 6 presents the Pearson correlations between ambulatory blood pressure and catecholamine excretion rates in each setting. At work, EPI excretion rates were significantly correlated with both systolic and diastolic blood pressure. However, in the home setting, NE excretion rates were significantly correlated with blood pressure, but EPI excretion rates were not correlated with blood pressure. There were no associations between blood pressure and catecholamine ex-

TABLE 5. Correlation Coefficients (Spearman) Between Subscales of the Karasek Job-Content Instrument and Social and Physiological Variables

Variable	Decision Latitude	Psychological Demand
Residence time (y)	0.40*	−0.01
Filipino lifestyle	−0.01	0.14
American lifestyle	0.11	0.12
Work		
Systolic BP	0.00	−0.18
Diastolic BP	0.28	−0.25
Norepinephrine	−0.06	−0.18
Epinephrine	0.05	−0.12
Home		
Systolic BP	−0.10	−0.14
Diastolic BP	0.09	−0.34
Norepinephrine	0.01	−0.03
Epinephrine	0.12	0.10
Sleep		
Systolic BP	0.08	−0.25
Diastolic BP	0.24	−0.29
Norepinephrine	−0.06	−0.14
Epinephrine	−0.09	0.00

* $p < .05$.

cretion rates during sleep. Partial correlations adjusting for residence time in the United States were similar in magnitude to those obtained for the bivariate correlations. When the effects of activity were also partialled out, the correlations were also similar to the unadjusted associations.

DISCUSSION

In this cross-sectional study, longer-term United States residents among immigrants to the United States from rural areas of the Philippines showed greater catecholamine and blood pressure levels than their more newly arrived coworkers. This is particularly apparent in elevated NE levels at work. Interestingly, although the results suggest that work is the most stressful part of the day for the Filipino-American nurses and nurse's aides, it also represents a time when immigrants generally are most exposed to people from ethnic groups other than their own (25), although detailed social interaction data on this sample are not available. One might predict that long-term residents would have adapted to this exposure and would show an attenuated stress response compared with newer migrants, but the results suggest just the reverse. Although measures of job strain are not related to residence time, prolonged exposure to American life-style due to increased residence time leads to generally higher catecholamine and blood pressure levels as opposed to an improved adaptation to a new environment in these immigrants.

As previously noted, NE levels are affected by increased physical activity, so the higher NE levels at work might have been due to high levels of physical activity. Because heart rate is sensitive to physical activity, measures of pulse, obtained here every 15 minutes during waking hours, can be used as an operational measure of activity that allows a control in analyses. Also, long-term immigrants tend to be older than those more newly arrived in the United States. The relation between elevated NE and increased residence time in the Unites States remains a significant one when both age and pulse are controlled in analyses; in fact, residence time is a stronger predictor of NE excretion rate at work than either age or pulse.

Waking blood pressure is not significantly associated with residence time in the United States in these women. However, long-term migrants tend to have elevated diastolic blood pressure during sleep, even when age is controlled in analyses. This elevated sleep blood pressure and related decreased dip in blood pressure during sleep in long-term migrants may indicate either a greater amount of generalized stress or more accumulated stress during their residence time in the United States. Because decreased blood pressure dips are considered an important risk factor for cardiovascular disease (34–36), longer-term immigrants may be at increased risk for serious health problems independent of simple age effects.

Increased time of residence in the United States may not necessarily reflect an increase in the adoption of life-style factors that characterize American culture. An earlier study of Filipino-American immigrants in Hawaii (17) found that some immigrants effectively insulate themselves from American life-style by living in Filipino enclaves and rarely associating with non-Filipinos. Self reports of identification with Filipino and with 'typical American' culture are not associated with catecholamine excretion rates and blood pressure in this sample, but it is unclear whether these self reports are adequate measures of Americanization. It is therefore hard to specify just what factors are working during residence time in the United States to increase the biological stress response measures.

There are significant associations between epinephrine excretion rate and mean blood pressure while at work, and between norepinephrine excretion and mean blood pressure while at home, with these associations persisting after adjusting them for heart rate (physical activity). This suggests that environmental differences, perhaps including psychosocial stress, among the women has a similar impact on both blood pressure and catecholamine excretion.

This study is clearly preliminary given the small sample size, cross-sectional design, and focus on a

TABLE 6. Correlations Between Blood Pressure and Catecholamine Excretion Rates Partialing the Effects of Either Residence Time in the U.S. or Mean Heart Rate

	Systolic[a]			Diastolic[a]		
	Actual	Partial[b]	Partial[c]	Actual	Partial[b]	Partial[c]
Work						
Epinephrine	0.41*	0.53**	0.47**	0.56**	0.58***	0.58***
Norepinephrine	0.31	0.33	0.29	0.22	0.18	0.20
Home						
Epinephrine	0.15	0.12	0.05	0.15	0.13	0.10
Norepinephrine	0.45**	0.44*	0.38*	0.41*	0.41*	0.39*
Sleep						
Epinephrine	−0.03	−0.07	0.00	0.12	−0.01	0.14
Norepinephrine	0.02	0.06	−0.01	0.12	0.01	0.10

[a] Pressure corresponding to catecholamine time period.
[b] Partial correlation controlling for residence time.
[c] Partial correlation controlling for mean heart rate.
* $p < .05$.
** $p < .01$.
*** $p < .001$.

single ethnic group, but, to our knowledge, is the first to use both catecholamine excretion rates and ambulatory blood pressure measures to assess the stress of immigration. These findings point to the need for expanded research that furthers the understanding of real-life stress processes and of human adaptation to rapid culture change.

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