

URBANICITY AFFECTS BLOOD PRESSURE AND HEART RATE REACTIVITY TO A SPEECH STRESSOR IN CAMEROON

Objective: To examine the interactive influence of urbanicity on cardiovascular reactivity to speech stressors among 103 urban and 93 rural Cameroonians.

Method: Heart rate, systolic, and diastolic blood pressure (HR, SBP, and DBP) changes from baseline were assessed during a speech preparation period, speech stressor task, and post-speech recovery period.

Results: After adjusting for income, age, BMI, and sex, urban subjects showed greater diastolic reactivity to the pre-speech and speech conditions than to recovery. Urban subjects also showed greater reactivity to the speech stressor than to other conditions. Urban subjects showed greater HR reactivity to the speech stressor. Rural subjects showed greater diastolic reactivity to the pre-speech and speech stressor and less recovery.

Conclusion: Urbanicity affects blood pressure and heart rate differently for urban and rural Cameroonians. It also affects recovery from stressors. More exploration into the influence of urbanization on hypertension risk factors in developing countries is warranted. (*Ethn Dis.* 2010;20:251–256)

Key Words: Heart Rate, Blood Pressure, Urban, Cameroon

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BACKGROUND

The incidence of essential hypertension in West Africa has risen dramatically over the last several decades.¹ Although the incidence of hypertension is at record levels, we do not fully understand the mechanism underlying this increase.^{2–5} Previous studies in West Africa focused on biomedical factors involved in blood pressure regulation.^{6–18}

In developing West African countries, like Cameroon, urbanization may exacerbate stress exposure and may be an ecologic contributor to hypertension development.¹⁹ Typically, urban areas are marked by challenges that require multiple kinds of acculturative coping. Westernization, increased exposure to unfamiliar indigenous Cameroonian sub-cultures, financial stress, redefinition of cultural identity, and movement away from traditional coping mechanisms and resources may produce stress among urban residents.^{20,21} Malan et al suggest that a conflict occurs between traditional rural African value systems and conflicting Westernized urban demands.^{20,21} For urban residents, this gap between the Western culture and the traditional rural African value systems may add chronic acculturative stress to already increased levels of urban life stress.

There is a burgeoning body of literature concerned with cardiovascular reactivity as a hypertensive risk factor within the continent of Africa.^{19,22–25} We propose that the African urban-rural cultural differences may expose urban residents to increased levels of chronic

stress, thus putting individuals at higher risk for dysregulated sympathetic nervous system activation.^{26–29} Thus, acute cardiovascular reactions to stress may be enhanced by being an urban resident. For example, Malan found that urbanized South Africans showed greater resting blood pressure levels, vascular responsiveness, and hypertension prevalence than their rural counterparts.²⁰ Hyper-reactivity to stressors and decreased recovery may be important outcomes of urban life and acculturative stress.

This study explores differences in cardiovascular responses to laboratory-based stressors among urban and rural West Africans.

This study explores differences in cardiovascular responses to laboratory-based stressors among urban and rural West Africans. It is based on the “reactivity hypothesis,” which assumes that acute changes in cardiovascular activity to laboratory procedures are analogous to cardiovascular challenges encountered in daily life.^{30–32} Prospective studies suggest that hyper-reactivity to laboratory stressors may be an independent risk marker for cardiovascular dysregulation and hypertensive development later in life.^{30,33–37} There is a prospective link between hyperten-

sion-related preclinical states, successive clinical events, and increased recovery.³⁸ We hypothesized that:

- Urban participants would be more reactive to laboratory stressors than rural subjects.
- We would find an interaction between patterns of reactivity and urbanicity, such that urban participants would be more reactive than rural participants to the pre-speech task, the speech stressor, and exhibit slower post-speech recovery.

METHOD

Study population

A convenience sample of 194 healthy Cameroonian men and women between the ages of 15 and 62 years was recruited by word-of-mouth for the study. Ninety-one urban participants were from Yaoundé, the capital of Cameroon. One-hundred and three rural participants were from Bafia, a rural area in the Center Region. Subjects were compensated a monetary sum equivalent to five US dollars for their time and effort.

Procedures

Health and Psychosocial Measures

The consent protocols, speech stressors, and questionnaires (demographic, medical history, and lifestyle) were “forward” and “back” translated according to a well-established methodology developed by the World Health Organization for use with French speaking Cameroonians.³⁹

Cardiovascular Reactivity Measurement

Speech stressors reliably induce cardiovascular reactivity.^{9,40-45} The speech stressor was adapted from the Social Competence Interview (SCI).⁴⁶⁻⁵¹ The speech stressor was divided into two components: the speech preparation (anticipatory stressor) and the speech

periods (verbal stressor). Cardiovascular changes in systolic (SBP), diastolic (DBP), and heart rate (HR) were measured from the upper right arm using a Dinamap Vital Signs Monitor Model 845 XT during minutes 0, 1, 2, 3, 4, and 5.

Speech Preparation Condition

Participants selected one card representing the area that generated the most life stress. The cards represented ten categories: 1) money, 2) marriage/companion, 3) illness/health, 4) someone's bad intentions toward them 5) job/career, 6) politics, 7) accomplishment of goals, 8) friends, 9) family and children, and 10) other. Life stressor card categories were piloted-tested and found to have validity among both urban and rural Cameroonians. To increase anticipatory stress, participants were given two minutes to ruminate on how they would describe the stressor. SBP, DBP, and HR were monitored at 0, 1, and 2 minutes.

Speech Condition

After the two-minute speech preparatory period, subjects were instructed to discuss their most stressful life challenge for four minutes in the form of a speech delivered verbally to the experimenter. To increase the saliency of the stressor, subjects were informed that their responses would be rated on delivery, poise and content. SBP, DBP, and HR were assessed at 0, 1, 2, 3, and 4 minutes.

Post-Speech Recovery

The final condition was measuring return of blood pressure levels to baseline after termination of the speech stressor condition (post-speech recovery). Subjects were asked to follow the same instructions as the pre-task baseline period. SBP, DBP, and HR were monitored at 0, 1, 2, 3, 4, and 5 minutes.

Physiological data reduction and analysis design

Cardiovascular reactivity was measured in the form of change scores from

the pre-speech baseline and the pre-speech, speech, and post-speech recovery conditions. Repeated measures MANCOVAs were performed controlling for age, sex, BMI, and income for the three experimental conditions (pre-speech, speech stressors, and recovery) and urbanicity (rural and urban). To take into account repeated measures sphericity, we used the Greenhouse-Geisser statistic (G-G). When interactions were significant, post-hoc analyses were performed (ANCOVAs with Bonferroni-adjusted comparisons and *t*-tests, as appropriate).

RESULTS

Demographic Findings

The mean age of the sample was (27.5, SD=9.9) years and BMI was (23.8, SD=4.2). Analyses of variance revealed significant differences between rural and urban groups for sex ($F[1,192]=3.770, P=.054$), age ($F[1,192]=22.676, P=.001$), BMI ($F[1,192]=6.968, P=.010$), baseline SBP ($F[1,192]=3.803, P=.053$), and HR ($F[1,192]=19.871, P=.001$). Baseline SBP and HR were higher for the rural sample than for the urban sample. Types of worries recounted did not vary according to urbanicity ($\chi^2=.281 [2] P=.87$).

Effects of Urbanicity on Cardiovascular Responses to the Experimental Conditions

SBP Responses

Figure 1 shows reactivity across conditions. As expected, there was a significant interaction between conditions and urbanicity ($F[1.813, 340]=44.9, P<.001, [G-G \text{ epsilon}=.906]$) for SBP was confirmed. Post-hoc analyses revealed that the pattern of responses across conditions was different across groups.

Between-Subjects SBP Reactivity

Our first hypothesis was confirmed by a between-subjects main effect for

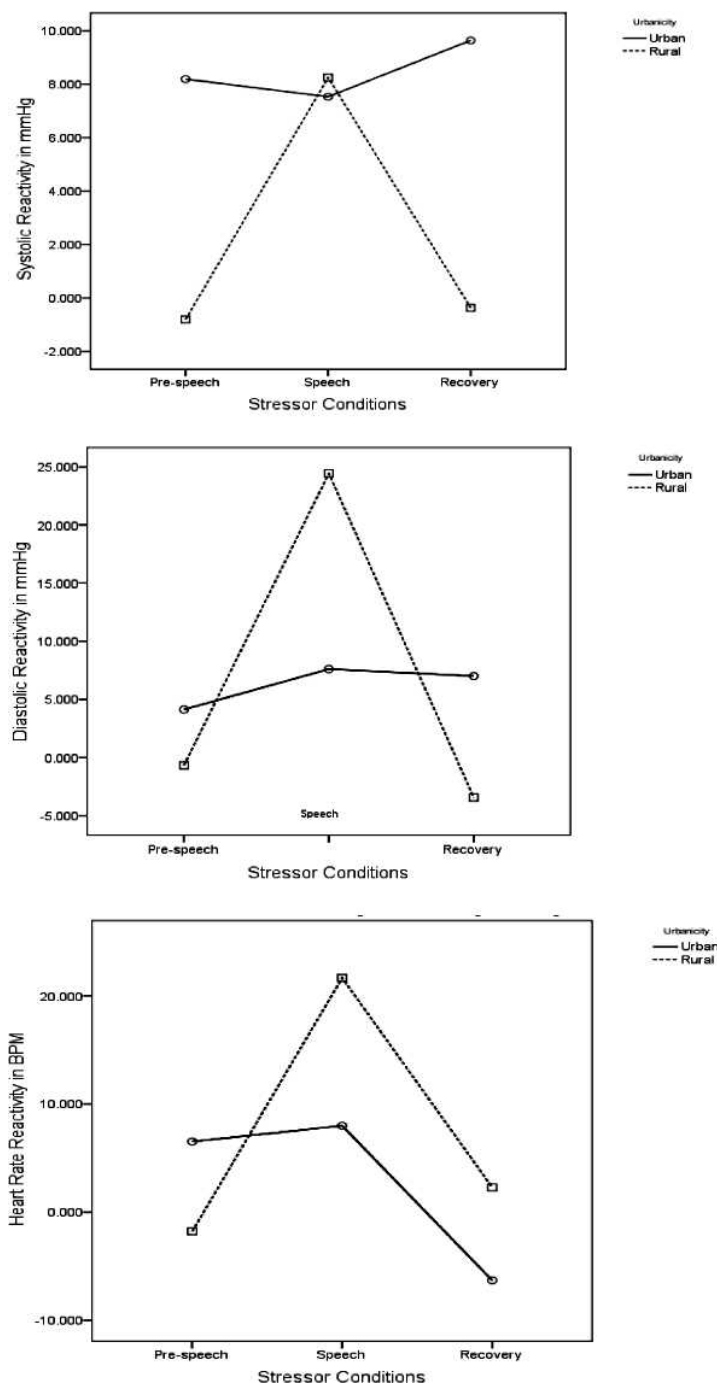


Fig 1. Systolic, diastolic, and heart rate reactivity by urbanicity

urbanicity and the dependent variable, averaged SBP reactivity ($F[1, 188] = 23.341, P < .0001$). Bonferroni-adjusted comparisons indicated that overall task reactivity was greater for urban participants than for rural counterparts (Mean difference = $6.093[1.261], P < .0001, 95\% CI = 3.605, 8.581$). This supports

our main hypothesis that urban participants would be more reactive to the laboratory stressors.

Urban SBP within-Subjects Reactivity

An un-hypothesized effect was that the urban group showed a small, but

significant decrease in reactivity for the pre-speech condition compared to the speech task ($M = -1.77[.863], t[90] = -2.046, P < .05$). Urban participants' blood pressure recovery was marked by greater reactivity than the during the pre-speech stressor condition ($M = 1.692 [.772], t[90] = 2.19, P = .03$). It was expected that SBP during post-speech recovery would show less reactivity than the speech condition. Another notable finding is that SBP reactivity increased during recovery and was significantly greater than reactivity levels observed during speech stressor ($M = 3.458 [.953], t[90] = 3.63, P < .0001$). There appears to be a state of minimal systolic arousal to the speech stressor that carried over into the recovery period.

Rural SBP within-Subjects Reactivity

Rural participants showed a large significant increase for pre-speech SBP compared to blood pressure during the speech condition ($M = 10.028 [.678], t[90] = 14.79, P < .0001$). An un-hypothesized effect was that for rural participants, SBP responses during the pre-speech condition were not different than reactivity during the recovery conditions ($M = -.218(.435), t(90) = -.50, p = .62$). This is readily understandable given the lack of reactivity to the pre-speech stressor displayed by rural participants. As expected, SBP levels for the rural group decreased during the post-speech recovery period compared to speech condition ($M = -9.722[.702], t[90] = -13.98, P < .0001$). Thus, rural participants' systolic activation appears to decline upon removal of the stressor.

DBP Responses

After entering covariates, the repeated measures ANCOVA for urbanicity by DBP reactivity showed that there was a significant interaction between experimental conditions and urbanicity ($F[1.771, 333.026] = 222.80, P < .001$,

[G-G epsilon=.886]). This finding is the converse of our SBP urbanicity effect. Post hoc tests revealed that although DBP was significantly greater for urban compared to rural participants across the three tasks, different patterns of reactivity emerged.

Between-Subjects DBP Reactivity

Our main hypothesis was that urban participants would be more reactive to the laboratory stressors in general, but our findings did not support this assumption. Averaged DBP reactivity was not significantly different between urban and rural participants ($F[1,188] = .211, P = .647$). The diastolic pressor response was similar in both groups when averaged across conditions.

Urban DBP within Subjects Reactivity

As hypothesized, the urban group showed a significant increase in reactivity for the pre-speech condition compared to the speech task ($M = 3.357[.645], t[90] = 5.20, P < .0001$). As expected, urban participants showed greater DBP reactivity during the post-speech recovery period than during the pre-speech condition ($M = 3.485 [.837], t[90] = 4.17, P = .0001$). DBP reactivity during recovery was similar to reactivity levels observed during speech stressor ($M = .128 [.719], t[90] = 18, P = .86$). This finding suggests that diastolic activity is increased for urban participants even after the stressor condition is terminated.

Rural DBP Within-Subjects Reactivity

As hypothesized, rural participants showed a large significant increase for pre-speech DBP compared to blood pressure during the speech condition ($M = 25.217 [1.0015], t[102] = 24.93, P < .0001$). Another hypothesized effect that was observed in rural participants was that DBP responses during the pre-speech condition were greater than during the recovery condition ($M =$

$3.295[.431], t[102] = 7.64, P = .0001$). As expected, DBP levels for the rural group decreased markedly during post-speech recovery compared to the speech condition ($M = -28.519[.944], t[102] = -26.64, P < .0001$). Thus, rural participants' diastolic responses decline markedly after removal of the stressor.

HR Responses

After controlling for age, sex, body mass index ($BMI = \text{weight [kg]} / \text{height [m}^2\text{]}$), and income, repeated-measures ANCOVAs showed that there was a significant interaction between experimental conditions and urbanicity ($F[1.804, 339.189] = 119.294, P < .0001, [G-G \text{ epsilon} = .902]$) for HR. Post-hoc analyses revealed that the pattern of responses across the three conditions was different for urban and rural participants.

Between-Subjects HR Reactivity

In support of hypothesis one, there was a between-subjects main effect for urbanicity and the dependent variable, averaged HR reactivity ($F[1, 188] = 15.740, P < .0001$). Bonferroni-adjusted pair-wise comparisons indicated that overall task reactivity was greater for urban participants than for rural participants (Mean difference = $4.653[3], P < .0001, 95\% \text{ CI} = 2.339, 6.966$). This effect is in keeping with our main hypothesis that urban participants would be more reactive to the laboratory-induced stressors in general.

Urban HR within-Subjects Reactivity

An un-hypothesized effect was that the urban group showed a small, but significant increase in reactivity for the pre-speech condition compared to the speech task ($M = -1.658[.777], t[90] = 2.13, P < .04$). Additionally, it was expected that HR during recovery would be lower than recovery after the speech condition. Urban participant's blood pressure recovery was marked by

greater reactivity than during the pre-speech stressor condition ($M = 11.763 [1.270], t[90] = 9.26, P = .0001$). It was expected that HR during post-speech recovery would show less reactivity than the speech condition. HR reactivity decreased during recovery and was lower than reactivity levels observed during speech stressor ($M = -13.145 [10.683], t[90] = -9.74, P < .0001$).

Rural HR within-Subjects Reactivity

As hypothesized, rural participants showed a large significant increase for pre-speech HR compared to blood pressure during the speech condition ($M = 23.262 [.797], t[102] = 29.171, P < .0001$). As hypothesized, HR responses during the pre-speech condition were greater than during the recovery conditions ($M = -2.128[4.630], t[102] = -6.857, P = .0001$). As expected, HR levels for the rural group decreased during the post-speech recovery period compared to speech condition ($M = -20.134[.875], t[102] = -23.019, P < .0001$). Thus, rural participants' HR declined upon removal of the stressor.

DISCUSSION

The purpose of this study was to examine the effects of urbanicity on cardiovascular reactivity to psychosocial stressors among Cameroonians. We hypothesized that urban participants would be more generally reactive across the three laboratory conditions than rural subjects in examining the effects of urbanicity on cardiovascular reactivity to psychosocial stressors among Cameroonians. The results for systolic, but not diastolic responses, to the three conditions were consistent with our hypothesis that urban Cameroonians, when compared to their rural Cameroonian counterparts, would exhibit more reactivity on average. Unexpectedly, rural participants showed greater average heart rate reactivity across the three tasks than urban participants.

Unexpectedly, rural participants showed greater average heart rate reactivity across the three tasks than rural participants.

Many studies of ethnic and racial differences in reactivity suggest that there is a hemodynamic link to peripheral resistance underlying exaggerated diastolic blood pressure responses among African Americans. Our task elicited greater SBP and HR responses, respectively among urban and rural Cameroonians, but roughly equivalent DBP responses. Anderson and et al⁵² suggested that American racial differences in reactivity are qualitative (myocardial and vascular patterns) and represent differences in hemodynamic mechanisms related to differential exposure to stressors. Perhaps, urbanicity differences in our study were reflected by differential exposure to urbanicity-related stressors that accelerate two types of cardiac mechanisms (SBP and HR), rather than vascular flow. Data from Black South Africans support the notion of increased vascular responsiveness among urban dwellers as a risk factor for cardiovascular disease.¹⁹

We hypothesized that there would be an interaction between patterns of reactivity to the three stressors and urbanicity, such that urban participants would be more reactive than rural participants to the pre-speech task, the speech stressor, and exhibit slower post-speech recovery. For SBP, our findings followed the expected reactivity pattern, with two exceptions involving post-speech recovery. Among urban subjects, the recovery period was marked by greater reactivity than the speech condition, but not for rural subjects. Rural participants showed comparable SBP reactivity during recovery and the pre-speech period, but urban subject's

recovery reactivity was lower than during the pre-speech period, as expected. Taken together, these findings indicate that SBP recovery was slower or incomplete for urban and rural participants in different ways. In a similar study from Zimbabwe, urban residents exhibited greater SBP and HR during the speech task than did rural residents.⁹ However, rural residents displayed more exaggerated HR reactivity during the speech preparatory phase.

Notable diastolic effects, which were similar to SBP responses, occurred during post-speech recovery. Urban participants remained reactive even after the speech stress ended, with post-speech recovery failing to decline as expected. Furthermore, post-speech recovery was increased compared to the pre-speech period. Urban-rural differences in reactivity appear to be most prominent in the pre-speech to speech comparison, although average reactivity across conditions is not statistically different. This might be interpreted to indicate that diastolic-vascular processes drive urban and rural responses to the pre-speech and speech conditions, but recovery is increased among urban participants only. As expected, urban participants showed greater HR reactivity to the speech stressor compared to pre-speech. Both urban and rural participants showed lower HR reactivity during the recovery period compared to the speech condition, as expected.

Urbanicity appears to play an overarching role in affecting patterns of responses to our various experimental conditions. This study will be extended to urban and rural African Americans, across ethnic groups in Cameroon, and many other parts of the developing world that are undergoing rapid urbanization.

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