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Mediation and Moderation of the Association Between Cynical Hostility and Systolic Blood Pressure in Low-Income Women

H. Shellae Versey[1] and George A. Kaplan[2]

Abstract

Hostility may be related to risk factors for cardiovascular disease (CVD), such as blood pressure. However, the process by which hostility affects blood pressure is not fully understood. The current study sought to evaluate abdominal obesity (waist-to-hip ratio [WHR]) as a potential mediator and modifier of the relationship between cynical hostility and systolic blood pressure (SBP) in a group of disadvantaged women. Path analysis and multiple regression models were used to identify mediating and moderating pathways in the relationship between cynical hostility and SBP. Results indicate a significant interaction between WHR and cynical hostility. WHR was a partial mediator and significant moderator of the association between hostility and blood pressure. These findings highlight the potential importance of examining abdominal obesity and psychosocial factors as conjunctive determinants of CVD and risk factors for related metabolic conditions.

Several studies have indicated that cynical hostility may operate through behavioral, sociodemographic, and physiologic mechanisms to advance the development of cardiovascular disease (CVD) risk factors and end-stage disease (Houston & Vavak, 1991; MacDougall, Dembroski, Dimsdale, & Hackett, 1985; Nelson, Palmer, & Pedersen, 2004; Niaura et al., 2002; Scherwitz, Perkins, Chesney, & Hughes, 1991). Although the positive relationship between cynical hostility and blood pressure, in particular, has been documented by several studies (Diamond, 1982; Irvine, Gardner, Craig, & Logan, 1991; Räikkönen, Matthews, & Salomon, 2003; Suls & Bunde, 2006; Suls & Wan, 1993), rarely have mediational or moderational analyses examined intervening ways in which either factor may be related to other components of the metabolic syndrome, given the close relationship between blood pressure and several risk factors. Goldbacher and Matthews (2007) suggest such analyses would be useful in critically evaluating evidence related to mechanisms and moderators of the relationship between psychological characteristics and risk for the metabolic syndrome.

The metabolic syndrome has been the subject of much research over the past two decades regarding CVD risk and has been implicated as an underlying disease process influencing the development of coronary heart disease (CHD) and diabetes (Bjorntorp, 1991, 1997; Kissebah & Krakower, 1994; Niaura et al., 2002; Timar, Sestier, & Levy, 2000). Although a fair amount of evidence exists that suggests a positive relationship between hostility and blood pressure, few studies have examined this association while considering other complex risk factors involved in the metabolic syndrome, specifically abdominal obesity.

Hostility is a multidimensional construct characterized by a negative orientation toward interpersonal relationships (Barefoot, 1992; Cook & Medley, 1954; Smith, 1994). Of its three components—behavioral, affective, and cognitive—the cognitive factor represented by cynicism has been shown to be one of the most toxic elements of hostility and is most consistently associated with CVD (Miller, Smith, Turner, Guijarro, & Hallet, 1996). In the current study, cynical hostility represents the cynicism component and the direct and indirect effects on systolic blood pressure (SBP) are examined.

Direct physiological effects of hostility may involve several autonomic and neuroendocrine mechanisms; however, its effect on blood pressure is hypothesized to function primarily through excessive sympathetic nervous system activation (Cohen & Rodriguez, 2002; McEwen & Stellar,

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1993; Pollitt et al., 2005; Pope & Smith, 1991; Suarez et al., 1997; Tsigos & Chrousos, 2002; Williams, Barefoot, & Shekelle, 1985). Although examining physiological indicators of the sympathetic nervous system is not the focus of this study, the general mechanism does suggest that a reactivity response pathway may be important for understanding links between hostility and CVD.

Some research regarding metabolic risk factors has focused on abdominal obesity as an independent predictor of cardiovascular-related outcomes, even in the presence of traditional risk factors (Calle, Thun, Petrelli, Rodriguez, & Heath, 1999; Hubert, Feinleib, McNamara, & Castelli, 1983; Manson et al., 1990). High waist-to-hip ratio (WHR), an indicator of abdominal obesity, is differentiated from obesity by a higher degree of upper-body fat distribution (Abate & Garg, 1995; Bjorntorp, 1996; Everson et al., 1997; Wajchenberg, 2000). Relative to body mass index (BMI) or other measures of body fat, abdominal obesity is a more sensitive and accurate measure of the weight-related risk associated with CHD, stroke, and mortality, and several cross-sectional studies indicate a positive relationship between cynical hostility and WHR in both adolescents and adults (Bjorntorp, 1991; Janssen, Katzmarzyk, & Ross, 2004; Kissebah & Krakower, 1994; Lewis et al., 2009; Midei & Matthews, 2009; Suls & Bunde, 2006). For example, in a sample of older men, Niaura et al. (2000, 2002) found that hostility was positively associated with patterns of abdominal obesity and that the relationship between hostility and a cluster of metabolic risk factors was mediated by both WHR and BMI. The current study extends this research by examining the mediational effects of WHR and BMI separately and also by examining the potential moderating role of WHR.

Because blood pressure, abdominal obesity, and hostility are linked to overlapping metabolic pathways, it is possible that aside from independent effects, they may act synergistically in the pathogenesis of metabolic diseases (Barefoot, Peterson, & Dahlstrom, 1991; Miller et al., 1996). The mediating and moderating role of WHR in the relationship between cynical hostility and blood pressure has not been thoroughly examined; nor have these relationships been specifically assessed in a sample of women (Everson-Rose et al., 2006; Manson et al., 1990). Furthermore, women of low socioeconomic position (SEP) are more likely than those of higher SEP to be hypertensive and vulnerable to both obesity and stress-related dispositions, such as anger and hostility, yet neither relationship has been evaluated with cardiovascular health outcomes in an intersectional context (i.e., a sample of low-income women; Haukkala & Uutela, 2000; McLeod & Kessler, 1990; Merjonen et al., 2008). This study examines these associations in a unique group under severe economic strain—low-income mothers transitioning from welfare to work. Economic and social strains may place welfare recipients and their children at higher risk for substance abuse, health, psychological, and safety problems (Jayakody, Danziger, & Kessler, 1998; Kessler, 1982; Klebanov, Brooks-Gunn, & Duncan, 1994; McLeod & Kessler, 1990).

Our primary aim was to understand the relationship between hostility and blood pressure among transitioning mothers on welfare. Of the host of indicators related to both stress-related mechanisms and the cluster of factors known as the metabolic syndrome, we examined blood pressure as a biomarker identifying hostile and chronically stressed individuals. We believe that one mechanism through which hostility might influence the propensity for CVD is cardiovascular reactivity (Suls & Wan, 1993). Cardiovascular hyperactivity measured in terms of either blood pressure or heart rate, may significantly increase atherosclerotic onset and development of CVD over the life course, particularly in hostile individuals. Although research relating personality disposition types to health outcomes has become somewhat stagnant in recent years (Smith, 2006), much work is still needed to clarify the potential relationships between mind and body, as well as mediating and moderating pathways. The current study aimed to test the mediational properties of WHR in comparison with other potential factors (BMI, smoking, alcohol use, income) to identify pathways to hypertension among hostile individuals. A secondary aim was to examine abdominal obesity, measured by WHR, as a potential moderator of the association between cynical hostility and SBP.

Method

Participants

The participants in this study were current and former welfare recipients in the Women's Employment Study (WES). The general purpose of the study was to identify key factors that enabled or hindered welfare recipients in maintaining employment. Participants were selected from a sample of all single mothers with children receiving cash benefits in an urban county in Michigan. Institutional Review Board approval was granted for all phases of this research and recruitment efforts and the study population have been described in detail elsewhere (Kaplan et al., 2005). Briefly, original data collection for the four-wave study began in 1997; women had to have been county residents, been on welfare rolls in February of 1997, be single mothers with children, U.S. citizens between the ages of 18 and 54 years, and racially identify as either White or African American. The response rate was 86.2% for the first wave. The number of respondents and response rates for subsequent waves were 693 (92% in Wave 2), 632 (92% in Wave 3), and 577 (91% in Wave 4). In-person interviews were conducted by trained personnel and included information regarding employment histories, income from various sources, child and family-related stressors, mental health, and measures of health behaviors.

Following completion of the third wave of data collection, a health supplement (WES-HS) was administered to survey respondents. Of the 632 eligible respondents, 299 completed the health supplement. The response rate was 52%, excluding those who could not be located or had moved

out of the country. Demographic information, health status, and physical limitations of the 299 respondents were similar to the overall sample of Wave 3 respondents, although they were slightly younger (30.0 vs. 31.4 years old, $p < .05$). No other significant differences were found on key demographic variables between Wave 1 and Wave 3 participants. For the current study, data for 285 participants were used; women who were pregnant ($n = 5$) or taking antihypertensive medication ($n = 9$) were excluded.

Measures

Blood pressure. Oscillographic devices (HEM-737, Omron Healthcare, Inc., Bannockburn, IL) were used to obtain blood pressure readings. According to standard procedures, after a 5-minute rest, three readings of blood pressure, 1 minute apart were recorded and averaged.

Cynical hostility. This analysis restricts its consideration of hostility to cynical distrust. Therefore, cynical hostility was assessed according to the eight-item Cynical Distrust subscale of the Cook–Medley Hostility Scale (Cook & Medley, 1954; Greenglass & Julkunen, 1989). Derived from factor analysis, the Cynical Distrust subscale measures the cognitive component of hostility that reflects central elements of hostility, cynicism, and distrust (Greenglass & Julkunen, 1989), and has been associated with increased risk of stroke, progression of carotid atherosclerosis, and other outcomes (Bjorntorp, 1996). In two separate samples of Canadian and Finnish students, Greenglass and Julkunen demonstrated that the shortened Cynical Distrust Scale is a valid, reliable, and more specific measure of cynicism and distrust when compared with the full Cook–Medley Scale (Greenglass & Julkunen, 1991; Julkunen, Salonen, Kaplan, Chesney, & Salonen, 1994). Cronbach's alpha for the Cynical Distrust Scale was 0.72. The scale comprised questions in which respondents were asked to evaluate statements, including the following: "It is safer to trust nobody" and "No one cares much about what happens to you." Responses ranged from *strongly agree—strongly disagree* on a 4-point Likert-type scale. Items were reverse scored, summed, and standardized for a total score. Possible score range was from 8 (lowest score) to 32 (highest score).

Waist-to-hip ratio (WHR). Standard procedures were used to measure waist and hip circumference (National Heart, Lung and Blood Institute, 1998). Measures of waist circumference were taken (in centimeters) with participants standing and in light clothing. A measuring tape was used to determine the waist circumference, with measurements taken halfway between the lower border of the ribs and the iliac crest in a horizontal plane (to 0.5 cm). A similar procedure was used to measure hip circumference, with measurements taken at the widest point of the hip region. WHR was calculated as waist (in cm) divided by hip (in cm) circumference and was modeled continuously.

Body mass index (BMI). Standard procedures were used to measure BMI according to weight (to 0.2 kg) and height (to 0.5 cm) of all participants. BMI was calculated as weight (in kg) divided by height in meters squared (m^2) and was modeled as a continuous variable, which follows standard recommendations (National Heart, Lung and Blood Institute, 1998).

Health behaviors. Behavioral factors were assessed by self-report and included smoking status and alcohol consumption during the previous year. A series of questions in yes–no format determined whether respondents had ever smoked or were former or current smokers. Former smokers were those who reported that they had smoked at least 100 cigarettes during their lifetime, but did not currently smoke. Alcohol intake was characterized by self-report frequency of consuming a certain number of drinks per week. Both measures were categorical responses from participants.

Sociodemographic variables. Age at time of WES-HS administration was measured in years. An income-to-needs ratio (INR) was calculated as annual income from all household members and all income sources divided by the poverty line for the size of the respondent's household. Level of education attained was reported as number of years and grouped categorically according to "less than high-school education" ($n = 70$, 23.4%), "high school diploma or GED recipient" ($n = 131$, 43.8%), or "more than high school" ($n = 98$, 32.8%).

Data Analysis

Models were constructed in two stages to assess the role of potential mediation in the relationship between cynical hostility and blood pressure. Prior analyses examined bivariate relationships between hostility, sociodemographic (INR), behavioral (smoking status, alcohol consumption) and physiological characteristics (BMI, WHR), and determined significant relationships for INR, BMI, and WHR. Although smoking and alcohol use have been previously associated with processes linking psychosocial variables to CVD (Bjorntorp, 1996; Everson-Rose & Lewis, 2005), no relationship was found with the dependent variable in initial models. Therefore, these variables were excluded from further analysis. Age, race, and education were controlled for in all analyses; none of the control variables met the criteria for being included in the mediation model.

In the first stage, the main effect between hostility and SBP was assessed by modeling of the continuous variables. Individual mediator models examining covariates (WHR, BMI, INR) were analyzed as suggested by Baron and Kenny (1986) to determine whether variables along alternate pathways contributed to the relationship between hostility and blood pressure. Mediation was defined as the extent to which an intermediate variable (potential mediator) "explained" the association between cynical hostility and SBP. Mediation was assessed by the following conditions: (a) when the

mediator is regressed on the exposure, the exposure must affect the mediator; (b) when the outcome is regressed on the exposure, the exposure must affect the outcome; and (c) when the outcome is regressed on both the mediator and the exposure, the mediator must independently affect the outcome (Baron & Kenny, 1986; Hoyle & Kenny, 1999).

Further examination of mediation involved the condition that the mediator explained a portion of the main effect association and satisfied a percentage change in coefficient (>15%) provision, where the percent change in beta coefficient is calculated when the potential mediator is removed from the model. Although mediation is not demonstrated by any specific percent change in coefficients, we use the conventional assessment that a 15% or greater change in beta coefficient is considered evidence of mediation, and a 30% change or greater suggests strong mediation (Baron & Kenny, 1986; Holmbeck, 1997; Hoyle & Kenny, 1999; Pollitt et al., 2005).

A second stage of mediation was assessed using the Preacher, Rucker, and Hayes (2007) method, including a bootstrapping procedure. Bootstrapping is well suited for examining relationships in smaller samples, as estimates are more robust to violations of normality. Although widely used, Baron and Kenny's (1986) test of mediation has been criticized for its inability to test whether indirect effects are different from zero and the capacity to examine multiple mediators simultaneously (Preacher et al., 2007). Each variable that demonstrated mediation in the previous stage was then included in the multiple mediator model (Preacher & Hayes, 2008) to assess whether the unique indirect effect of any one variable mediated the relationship between cynical hostility and blood pressure above the other estimated variables entered in the model. These analyses were performed using regression analysis and a path analytic approach in AMOS statistical software, Version 17.

Finally, moderated multiple regression models were constructed with centered terms to determine whether WHR moderated the relationship between cynical distrust and SBP. A final set of models included interaction terms between hostility and WHR with adjustment for potential confounders.

Results

Sample Characteristics

Means (±standard error) and prevalence (%) for covariates included in the models are shown in Table 1. Of the 285 women, 57% of respondents were classified as obese (BMI ≥ 30) and 70.2% had a high WHR (≥ 0.8). The average cynical hostility score on a scale was 20.3 (±3.41); indicating that respondents were moderately hostile.

Main Effect and Mediation Analysis

Cynical hostility, as measured by the Cynical Distrust Scale, was positively associated with SBP ($\beta = .65$, $p = .04$), controlling for age, race, and level of education. No significant

Table 1. Baseline Characteristics[a]

Variable	Mean ± *SE*/ Prevalence (%)
Cynical Distrust Scale score	20.3 ± 3.41
Age (years)	33.5 ± 7.8
Income-to-needs ratio[b]	1.03 ± 0.74
Systolic blood pressure[c]	117 ± 18.2
Body mass index ([BMI] kg/m^2)	29.7 ± 0.93
Obese (BMI ≥ 30)	57.0
Waist-to-hip ratio (WHR)	0.85 ± 0.11
High WHR (>0.8)	70.2
Education	
Less than high school	23.4
High school diploma/GED	43.8
More than high school	32.8
Race	
Black	53.2
White	46.8
Cigarette smoking	
Never smokers	39.8
Former smokers	11.7
Current smokers	48.5

a. Mean ± standard error (*SE*) or prevalence (%) of baseline covariates are reported.
b. Scores on the measures of income-to-needs ratio scale ranged from 0 to 6, with higher scores indicative of higher surplus income relative to need-based expenses.
c. Average resting systolic blood pressure based on three readings.

direct effect was found between cynical hostility and diastolic blood pressure. Following the inclusion of WHR as a continuous variable, the initial association was attenuated ($\beta = .54$, $p = .14$) and no longer reached statistical significance. Adjustment for WHR reduced the association by 17%, suggesting that WHR partially mediated the association between cynical hostility and SBP. Other covariates were examined in similar individual mediator models. BMI attenuated the relationship between cynical hostility and blood pressure by approximately 14% ($\beta = .56$, $p = .11$). Analysis of percentage change in beta coefficients indicated that WHR was the stronger mediator in the relationship between cynical hostility and SBP, followed by BMI. The percentage change in coefficients for both variables provided a basis for moderate mediation, whereas the remaining model examining INR showed marginal percent change. In Stage 2 mediation analyses, INR was omitted and only WHR and BMI were considered in a multiple mediation model (see Figure 1).

Multiple Mediation

Figure 1 presents the indirect and direct effects model of cynical hostility on systolic blood pressure. Both models fit the data reasonably well (comparative fit index = .97 and .95 for direct and indirect model, respectively; root mean square error of approximation = .03 and .04, respectively). Significant effects are indicated in Table 2.
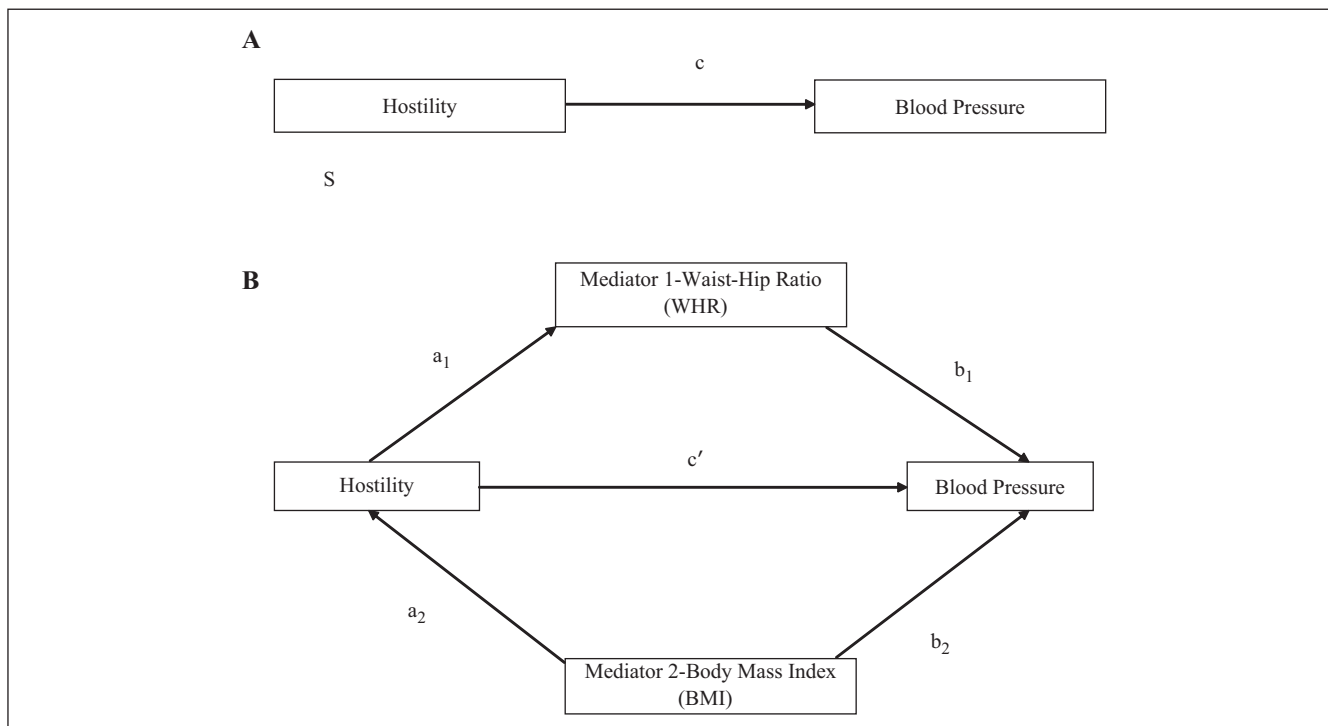
Figure 1. Path diagram of multiple mediator model

The specific indirect effect of each mediator was examined to determine whether either individual variable significantly mediated the effect of hostility on blood pressure beyond the effect of the other. The total effect of hostility on SBP was significant prior to entering mediators (see Table 2). Further analyses of specific indirect effects found a statistically significant effect of hostility on SBP through WHR ($\beta = .63$, $SE = .23$, $p < .05$); however, the indirect effect of hostility through BMI was not statistically significant ($\beta = .32$, $SE = .17$, $p > .05$).

Moderation by WHR

WHR was analyzed as a continuous variable in the moderation model. A significant interaction was found, indicating that the association between cynical hostility and SBP increases with increasing WHR ($\beta_{interaction} = 1.33$, 95% confidence interval [CI] = 0.07-2.59, $p < .05$). When control covariates were included, there was little change in the strength of the interaction ($\beta_{interaction} = 1.30$, 95% CI = 0.05-2.47, $p < .05$). To further examine the interaction between hostility and WHR, stratified means for "high" and "low" WHR were plotted. Participants with a waist–hip circumference ratio equal to or exceeding 0.8 were classified as having "high" WHR in accordance with national convention (National Heart, Lung and Blood Institute, 1998). The results of these analyses indicate that cynical hostility was significantly associated with increased SBP only among those with high WHR (>.8; Figure 2).

Table 2. Multiple Mediation of the Relationship Between Cynical Hostility and Systolic Blood Pressure

| | | | BC$_a$ 95% CI | |
	Point estimate	SE	Lower	Upper
Total	.95	.20*	0.65	1.52
WHR	.63	.23*	0.43	1.11
BMI	.32	.17	−0.16	0.47

Note: SE = standard error; CI = confidence interval; WHR = waist-to-hip ratio; BMI = body mass index; BC$_a$ = bias corrected and accelerated. Estimates based on 5,000 bootstrap samples.
*$p < .05$.

Discussion

This study examined the mediating and moderating roles of WHR on the relationship between cynical hostility and SBP among a sample of women. There was a main effect between cynical hostility and SBP. Although no significant effect was found between cynical hostility and diastolic blood pressure, it is somewhat expected that the predictive validity of hostility may vary across reactivity measures because of unequal hemodynamic response patterns. However, previous reports suggest a relatively consistent relationship between hostility and SBP and note that SBP is a better indicator of risk of CVD and stroke, particularly in women (Glynn, L'Italien, Sesso, Jackson, & Buring, 2002; Stamler, Stamler, & Neaton, 1993). We found evidence of moderate mediation
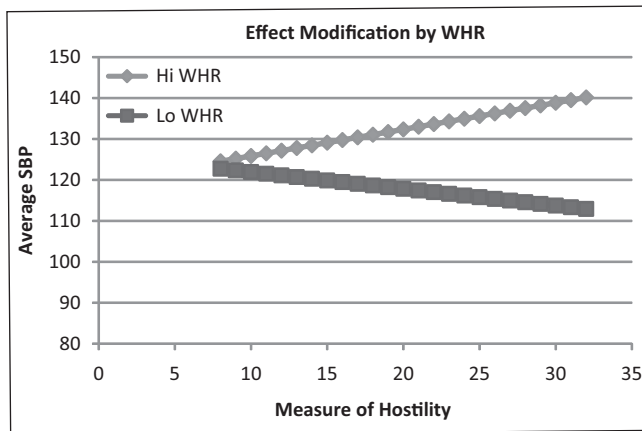
Figure 2. Moderation by waist-to-hip ratio
Note: WHR = waist-to-hip ratio; SBP = systolic blood pressure.

by WHR and subsequent analyses reveal these indirect effects were significant beyond those of BMI. Furthermore, WHR moderates the relationship between cynical hostility and SBP, as significant increases in average SBP are found only among high WHR women in this sample. Although examining whether a single variable can function as both a mediator and a moderator of the same relationship has not been adequately addressed in the literature, we believe that it is possible that WHR plays a mediating and moderating role in a larger web of metabolic effects (e.g., metabolic syndrome).

Our results support the hypothesis that the association between cynical hostility and blood pressure is partially mediated and moderated by heightened physiological responses that may be accelerated, in part by abdominal obesity. This research contributes to literature that supports the plausibility of regulatory mediating mechanisms (e.g., the hypothalamic–pituitary–adrenal axis) underlying findings of positive associations between psychosocial factors and ill health. Furthermore, the findings from this research may aid practitioners in considering measures other than obesity that might be different indicators of CVD risk and require clinical intervention.

This study presents preliminary evidence that WHR plays an important role in the relationship between cynical hostility and blood pressure. Compared with BMI, WHR was found to be a significant mediator of the main effect, whereas BMI was not. WHR was also found to be a moderator of the relationship between hostility and blood pressure, where cynically hostile individuals who have high WHR are particularly at risk for developing hypertension. Given the cross-sectional design of the current study, however, the possibility that cynical hostility may result from secondary effects of the metabolic syndrome or WHR specifically, perhaps due to lifestyle changes, cannot be completely eliminated. Clearly, additional longitudinal studies are needed to delineate the nature and direction of the relationship between

psychological characteristics and the metabolic syndrome over time. In addition, future research should explore the effects of sustained exposure to stressful situations, as may be the case for cynically hostile individuals.

According to the psychosocial vulnerability model, hostility likely exists on a broad continuum of negative affective dispositions where clusters of beliefs or attitudes may reflect ongoing exposure to broader, institutionalized factors (e.g., low SEP, neighborhood stress, discrimination/racism; Gallo & Matthews, 2003; Kivimäki et al., 2003; Miller et al., 1996; Smith, 1992). Gallo and Matthews (2003) suggest that low-SEP environments are stressful and decrease individuals' reserve capacity to successfully manage and cope with stress, thus increasing vulnerability to negative emotions and cognitions. Similar findings indicate that perceived discrimination due to race, gender, or SEP may contribute to cognitive schemas about the potentially threatening nature of the world and shape general dispositional tendencies to experience negative affect (Brondolo et al., 2008). These dispositions may increase the likelihood of perceiving experiences as distressing, and thus lead to higher levels of overall stress, negative dispositions (e.g., cynical hostility), and deleterious health behaviors. This general framework for understanding the roles of cognitive–emotional factors within disadvantaged populations presents several implications for interventions.

Since cynical hostility is hypothesized to be closely connected to aspects of the social environment, elements of the social environment that are amendable to change may present opportunities for community-level intervention. For example, considerable evidence indicates that hostility and low social support are correlated; hostile persons often report low levels of social support and high levels of social conflict (Gallo, Smith, & Cox, 2006; Scherwitz et al., 1991; Smith, 2006). Hostile individuals may also experience social isolation or other psychosocial handicaps that prompt negative coping behaviors (Blumenthal, Barefoot, Burg, & Williams, 1987; Moos, 1988). Therefore, creating opportunities at the community level where individuals could begin to foster and maintain healthy social relationships may be useful.

Several aspects of social support could be organized informally within one's community or neighborhood by initiating after-work support/motherhood groups, weekend activity groups centered around a common interest (e.g., quilting, exercise, book club), or general support networks in which family structures are considered (e.g., shared childcare/play groups). At the policy level, these and other programs can be supported materially through funding agencies concerned with providing aid and assistance to single mothers. The combined effort of individual- (emotional management and adaptive coping strategies), community-, and policy-level interventions may be key strategies for decreasing the negative effects of hostility in chronically stressed environments.

Another potential direction for future work may be to supplement observational studies with randomized clinical

trials or intervention-based studies where psychological intervention therapy is used to target behaviors associated with psychological characteristics (such as hostility and anger) and examine the effects on biological outcomes through follow-up examinations. Evaluating the efficacy of anger management or cognitive–behavioral-based therapy may be useful in providing information about whether the effects of certain negative personality affects can be modified to improve health outcomes.

In addition, lifestyle interventions targeted toward reducing waist circumference or WHR should be seriously considered in tandem with community networks and federal healthy food initiatives, as previous studies have shown that exercise and diet programs significantly improve metabolic syndrome profiles and reduce health risks (Ford, Hunt, Cooper, & Shield, 2010). From a contextual perspective, access to healthy and fresh foods should be a central priority of policy makers and city groups interested in reducing the prevalence of obesity-related diseases in poor communities. Minimal funding and effort would be required, for example, to promote food cooperatives, small inner-city farmer's markets, or neighborhood gardens thereby creating an availability of diverse food alternatives within the local economy. Community walking groups, also integrated within the local environment, would target exercise behavior as well as provide a sense of safety and social support. To compensate for work schedules and childcare issues that are often barriers to exercise programs, community centers that offer babysitting services would be a significant asset to the demographic sample represented in this study.

Given the complex and multifactorial nature of CVD and its antecedents, however, it is clear that individual recommendations for behavior alone are insufficient. Comprehensive and multilevel approaches that seek to address genetic, physiological, psychological, social, and economic reinforcing conditions at the national and federal level are also needed. As Candib (2007) argues, the underlying mechanisms contributing to vascular diseases and obesity, in particular, are socially and economically patterned. Appreciating the complexity of multiple sources of causation for cardiovascular outcomes will better enable practitioners and clinicians to understand and appropriately treat these issues in vulnerable groups.

Limitations

A limitation of this study is the constrained use of three blood pressure readings on a single occasion for the outcome variable. There is little consensus regarding the optimal number of readings necessary to adequately capture a stable estimate of true blood pressure (DesCombes, Porchet, Waeber, & Brunner, 1984; Llabre et al., 1998). We acknowledge the limited nature of any physiological measure taken on a single occasion; however, data from prospective epidemiological studies do indicate single measures are predictive of adverse outcome risk (Kaplan et al., 2005). The use of SBP is validated by reports that SBP is a more sensitive and accurate predictor of hypertension and blood pressure stage (Kannel, 2000; Silagy & McNeil, 1992).

A second potential limitation of this study is that information related to existing CVD or genetic profile was not available for this sample. It has been previously suggested that existing diseases may place individuals at higher risk for developing metabolic conditions and should thus be adjusted for (Timar et al., 2000). Because the original intent of the WES study was not to assess health outcomes, limited data regarding evidence of comorbidities were collected and studies examining these factors have been previously published (Kaplan et al., 2005; Ranjit, Young, & Kaplan, 2005). However, examining risk factors for disease, such as blood pressure, may provide a more useful evaluation of CVD risk, particularly in younger populations.

The limited generalizability of our results to other populations should be noted. The sample used in this study was drawn from an all female, low-income population. However, few studies have assessed the influence of hostility in women (Barefoot, Larsen, & von der Lieth, 1995; Lewis et al., 2009; Ljung et al., 2000), and fewer have examined the relationship of hostility and health outcomes in poor women. This potential limitation may also be interpreted as an opportunity to examine these effects within understudied socially vulnerable groups. Intersectionality maintains that the consequences associated with the combination of two or more hierarchies or axes of power (e.g., race, gender, class, etc.) may interact on multiple, and possibly simultaneous levels, to create systematic social inequalities (Crenshaw, 1991). Recent scholarship has introduced intersectionality as a means to examine fundamental causes of health disparities and the interaction between fixed variables such as gender and class (Kelly, 2009; Weber, 2006; Weber & Parra-Medina, 2003). It may be the case that experiences associated with being a poor woman or a poor woman of color is important to contextualize in order to understand the risk(s) associated with the progression of CVD. As noted previously, national and global patterns of obesity-related diseases often involve multiple sources of causation that extend beyond biological processes. Therefore, certain groups may be at increased risk for negative psychological characteristics or processes leading to obesity (e.g., thrifty genotype, maternal and fetal transition, and low-exercise/low-nutrition environments are often characteristics of low-SEP groups), and examining psychosocial relationships within these groups is important. Thus, improving disparities may not be entirely remedied by targeting separate groups, but rather addressing cross-sections within sociodemographic groups (e.g., poor women).

Conclusion

A longitudinal approach in the future is needed to confirm the consistency of these findings. Although the cross-sectional

nature of the present study does not allow causality to be inferred, the robust association between cynical hostility and SBP suggests that the cardiovascular consequences of psychosocial factors may be particularly detrimental in persons with high deposits of abdominal fat. Our analyses also indicate the importance of contextualizing such associations within a socioeconomic health disparity framework.

Declaration of Conflicting Interests

Funding

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