



## Perceived neighborhood problems are associated with shorter telomere length in African American women



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### ABSTRACT

**Objectives:** African Americans (AA) experience higher levels of stress related to living in racially segregated and poor neighborhoods. However, little is known about the associations between perceived neighborhood environments and cellular aging among adult AA. This study examined whether perceived neighborhood environments were associated with telomere length (TL) in AA after adjustment for individual-level risk factors.

**Methods:** The analysis included 158 women and 75 men AA aged 30–55 years from the Morehouse School of Medicine Study. Relative TL (T/S ratio) was measured from peripheral blood leukocytes using quantitative real-time polymerase chain reaction. Multivariable linear regression models were used to examine the associations of perceived neighborhood social cohesion, problems, and overall unfavorable perceptions with log-TL.

**Results:** Women had significantly longer TL than men (0.59 vs. 0.54,  $p=0.012$ ). After controlling for sociodemographic, and biomedical and psychosocial factors, a 1-SD increase in perceived neighborhood problems was associated with 7.3% shorter TL in women (Mean Difference [MD] =  $-0.073$  (Standard Error = 0.03),  $p=0.012$ ). Overall unfavorable perception of neighborhood was also associated with 5.9% shorter TL among women (MD =  $-0.059$  (0.03),  $p=0.023$ ). Better perceived social cohesion were associated with 2.4% longer TL, but did not reach statistical significance (MD = 0.024 (0.02),  $p=0.218$ ). No association was observed between perceived neighborhood environments and TL in men.

**Conclusions:** Our findings suggest that perceived neighborhood environments may be predictive of cellular aging in AA women even after accounting for individual-level risk factors. Additional research with a larger sample is needed to determine whether perceived neighborhood environments are causally related to TL.

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### 1. Introduction

A large body of evidence suggest that neighborhood contexts are associated with a wide-range of health outcomes above and beyond individual-level risk factors and socioeconomic status (SES) (Diez Roux and Mair, 2010). However, the molecular or cellular mechanisms through which neighborhood contexts contribute to health outcomes are not well understood. Several recent studies

have indicated that shorter telomere length (TL) is associated with increased risk of diabetes, hypertension, atherosclerosis, cardiovascular diseases (CVD), cancer and mortality (Cawthon et al., 2003; Blasco, 2005; Demissie et al., 2006; Salpea and Humphries, 2010; Sanders and Newman, 2013; Zee et al., 2010; Geronimus et al., 2010), although some studies have not replicated these associations (Bischoff et al., 2006; Carty et al., 2015). Therefore, TL may provide the biological link between neighborhood contexts and health outcomes.

Telomeres are nucleoprotein structures located at the ends of chromosomes, which play a vital role in providing genomic stability and maintaining chromosomal structural integrity (Blackburn, 2000). TL generally shortens progressively with every cell division and over the lifespan. A critically shortened TL triggers cellular

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senescence making TL a valuable biomarker for chronic stress and biological aging (Blackburn, 2000; Monaghan, 2010). Although genetic factors partially determine early life TL, evidence suggests that environmental factors may also affect TL in adulthood (Slagboom et al., 1994; Epel et al., 2004). Indeed, several studies have reported that telomere shortening is associated with various forms of chronic psychosocial stressors, such as life stress, low socioeconomic status, racial discrimination and depression (Epel et al., 2004; Simon et al., 2006; Geronimus et al., 2010; Price et al., 2013; Chae et al., 2014; Geronimus et al., 2015; Needham et al., 2015). Moreover, genetic factors and psychosocial stressors may further act synergistically to affect TL. For example, recent research found adverse social environment led to shorter TL in African American children with high risk of genetic variants in the serotonin and dopamine systems (Mitchell et al., 2014). Although the underlying mechanisms by which psychosocial stressors affect TL are not fully understood, it has been suggested that they may contribute to shorter TL by promoting oxidative stress and inflammation—two biological mechanisms that are known to cause accelerated TL shortening (Monaghan, 2010).

Aspects of neighborhood environments have also been suggested as sources of psychological and physiological stress (Ross and Mirowsky, 2001; Steptoe and Feldman, 2001; Burdette and Hill, 2008), and thus potential risk factors for cellular aging. Researchers hypothesize that residents who live in disordered neighborhood environments (e.g. problems with crime, vandalism, abandoned buildings, litter, poor quality of facilities, mistrust of neighbors) perceive their neighbors and neighborhoods less favorably and experience heightened psychological and physiological stress responses compared to residents who perceive their neighborhoods more favorably (Hill et al., 2005; Burdette and Hill, 2008). The constant exposure to a disordered neighborhood environment can lead to over-activation of multiple physiological systems, including the hypothalamic pituitary adrenal (HPA)-axis and sympathetic nervous system (SNS) (Mcewen, 1998; Bird et al., 2010). Perpetual over-activation of these systems have been shown to increase allostatic load, inflammation and oxidative stress, which in turn are major cause of cellular degradation and TL shortening (Tomiyama et al., 2012; Monaghan, 2010). Additionally, residents who live in disordered neighborhood environments are more likely to engage in negative health behaviors (e.g., smoking, sedentary behaviors, alcohol drinking, and poor diet quality), which could have deleterious effects on cellular aging (Hill et al., 2005; Burdette and Hill, 2008). On the other hand, neighborhood social cohesion is hypothesized to influence psychosocial processes by generating mutual trust, meaningful social bonds among neighbors and strong social support mechanisms (Kawachi and Berkman 2000). These psychosocial resources can serve as a buffer against adverse effects of chronic stress, which may in turn decelerate cellular aging. In addition, social cohesion may also play a protective role against cellular aging by promoting rapid diffusion of health-related knowledge, increasing access to services and amenities and reinforcing social norms for positive health-related behaviors (e.g. waking or exercise, banning smoking and drinking in public) (Kawachi and Berkman 2000; Echeverría et al., 2008).

To date, there are only three empirical studies that have examined associations between perceived neighborhood environments and cellular aging. One study reported that parental perceived neighborhood disorder was associated with salivary TL in African American children (Theall et al., 2013). A study in economically advantaged older populations from New York and Los Angeles reported neighborhood perceived lower aesthetic quality, safety and social cohesion were associated with shorter leucocyte TL (Needham et al., 2014). Recent study in Dutch populations from the Netherlands also showed an association between perceived neighborhood quality and cellular aging (Park et al., 2015). To

our knowledge, no study has examined the associations between perceived neighborhood environments and TL in adult African Americans from the southern United States.

More research in African Americans is especially needed given recent studies indicate that a steeper decline in TL with age in African Americans than in white (Diez Roux et al., 2009; Rewak et al., 2014). It has been suggested that cumulative exposure to multiple sources of psychosocial stressors over the lifecourse as possible contributors to faster TL shortening with age in African Americans (Diez Roux et al., 2009). While previous studies indicated that racial discrimination, perceived stress, and poverty are associated with TL among African Americans (Geronimus et al., 2010; Chae et al., 2014; Geronimus et al., 2015), the associations between neighborhood environments and TL in adult African Americans are not currently known. Researchers generally have shown that African Americans are more likely than whites or other racial groups to reside in neighborhoods with high levels of social and physical disorders often characterized by high rates of poverty, crime, noise, litter, trash, and environmental hazards (Williams and Jackson, 2005; Osypuk et al., 2009). Additionally, African Americans neighborhoods often lack the material and psychosocial resources (e.g. economic opportunities, quality health care, social network) necessary to cope with chronic stressors (Williams and Jackson, 2005). These stressful neighborhood environments can lead to physiological and psychological “wear and tear”, which in turn may result in biological weathering of TL in African Americans. Therefore, understanding the relationships between perceived neighborhood environments and TL has the potential to elucidate the cellular mechanisms by which neighborhood stressors contribute to life-shortening diseases in African Americans.

In this study, we examined the associations between perceived neighborhood environments and TL in adult African Americans recruited from the South after adjusting for individual-level risk factors. We hypothesized that perceived neighborhood social cohesion would be associated with longer TL whereas perceived neighborhood problems and overall unfavorable perception of neighborhood would be associated with shorter TL. We also hypothesized that the associations between perceived neighborhood environments and TL would be attenuated after adjusting for individual-level sociodemographic variables, and CVD and psychosocial risk factors.

## 2. Materials and methods

### 2.1. Population study

Data for this study were obtained from the Minority Health Genomics and Translational Research Bio-Repository Database (MH-GRID) study, a multi-cohort case-control study of severe-controlled and resistant hypertension among African Americans aged 30–55 years from the Southern United States. Details of the MH-GRID study design are described in detail elsewhere (Horbal et al., 2016). In this study, analysis was focused on a subset of MH-GRID participants who were recruited from Morehouse School of Medicine (Atlanta, GA), Grady Health System (Atlanta, GA), Kaiser Permanent-Georgia (Atlanta, GA), and the Jackson-Hinds Clinic (Jackson, MS) between April 2012 and September 2013. These participants were chosen because they had data on TL and completed an extensive examination on socio-demographic, health behaviors, biomedical, psychosocial and neighborhood measures. In total, 373 participants had information on TL. After excluding missing data on socio-demographic, neighborhood measures, and biomedical risk factors as well as mismatch of self-reported sex with genotypic sex, analysis included 233 (158 women and 75 men) participants

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