



## The association of neighborhood characteristics with sleep duration and daytime sleepiness

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### ABSTRACT

**Background:** Neighborhood characteristics have been linked to health outcomes. Various mechanisms link neighborhoods and health outcomes; sleep patterns may be 1 contributor; however, little is known about the social determinants of disordered sleep. We examined the association of neighborhood characteristics with sleep duration and daytime sleepiness.

**Methods:** Participants (n = 801) enrolled as pairs (55 without pair), from 10 churches in the Stroke Health and Risk Education project; 760 were included for analysis (41 withdrew). Sleep duration (hours of sleep at night) and daytime sleepiness (adaptation of Berlin questionnaire; range, 0–3 [more daytime sleepiness]) were self-reported. Neighborhood characteristics included disadvantage, per capita violent crime (census tract level), and safety (self-reported and individual level). We fit generalized linear mixed models and multinomial and binomial logistic regression models to examine the associations between neighborhood characteristics and sleep outcomes while accounting for the clustering within churches and pairs, before and after adjustment for self-reported confounders (age, gender, income, education, body mass index, depressive symptoms, hypertension, and diabetes).

**Results:** The mean hours of sleep duration is  $6.7 \pm 1.2$ , and the mean daytime sleepiness is  $0.8 \pm 0.9$ . Neighborhood characteristics were not associated with sleep duration. Higher perceived neighborhood safety was associated with an 18.4% lower odds of daytime sleepiness in the unadjusted model (odds ratio, 0.82 [95% confidence interval, 0.69–0.96]). The association was attenuated in the fully adjusted model. Neighborhood disadvantage and violent crime were related to lower daytime sleepiness; however, associations were not statistically significant.

**Conclusion:** Self-reported neighborhood safety was associated with lower daytime sleepiness. Future exploration of the pathways linking neighborhood characteristics and sleep is warranted.

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### Introduction

Neighborhood characteristics, including social, economic, and physical features, have been linked to mental health (depressive symptoms) and general health status as well as to specific outcomes including cardiovascular-related end points.<sup>1–5</sup> Several pathways have been proposed to explain the associations between neighborhoods and cardiovascular outcomes, including pathways involving traditional behavioral risk factors as well as traditional medical cardiovascular disease (CVD) risk factors.<sup>6</sup> However, the association of

neighborhood features with cardiovascular risks often persists after adjustment for traditional behavioral risk factors and chronic conditions, suggesting that other mediating mechanisms could be involved.<sup>4</sup>

Sleep disorders are a common phenomenon. A survey conducted by the National Sleep Foundation showed that at least 40 million Americans have at least 1 of more than 70 different sleep disorders.<sup>7</sup> Sleep duration is important for several reasons—primarily, it allows various processes to occur that strengthen or improve cardiovascular function, immune system function, memory, mood, and daily function to name a few.<sup>8</sup> Studies have shown that short sleep duration and daytime sleepiness are associated with high blood pressure, diabetes, coronary artery disease, obesity, and heart failure.<sup>9,10</sup> Most Americans do not receive the recommended 7–9 hours per night<sup>11</sup> and, thus, explorations of the reasons for the high prevalence

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of inadequate sleep are warranted in an effort to potentially reduce the cardiovascular effects of poor sleep quantity. Sleep may be a novel mediating mechanism between neighborhoods and cardiovascular risk, if sleep is patterned by neighborhoods.

Neighborhood characteristics may plausibly affect sleep. There is evidence supporting that neighborhood environments are associated with adverse sleep outcomes in adult populations.<sup>12–23</sup> Low socioeconomic status (SES) neighborhoods are often exposed to more neighborhood problems, which could impact residents sleep patterns.<sup>24</sup> Specific features of the neighborhood, such as crime and violence, have been shown to affect sleep.<sup>13,22,25</sup> Feelings of fear and being unsafe as a result of neighborhood crime could induce chronic stress and potentially poor sleep habits.<sup>22</sup> Many of the existing studies have measured violence by self-report, which measures the perception of proximate aspects of the neighborhood. Weden et al.<sup>26</sup> found that subjective neighborhood measures mediate the association between objective neighborhood characteristics and health. Therefore, solely examining subjective measures may not fully capture the contribution of the objective neighborhood characteristics on sleep outcomes.<sup>26</sup> Research should examine both subjective and objective measures of crime or disorder to more thoroughly characterize the contribution of the neighborhood environments to sleep.

Research on sleep in Hispanic populations is extremely limited. Most sleep research has been conducted among cohorts of non-Hispanic white populations, thus limiting the generalizability of the results to other populations including Hispanics.<sup>27</sup> It is likely that Hispanics have poor sleep based on the high prevalence of risk factors, such as obesity, diabetes, and living in inner cities, which are linked to poor sleep.<sup>27,23</sup> For example, evidence suggests that poor sleep may adversely affect glucose regulation and increase the risk of diabetes, and leptin levels (an appetite-stimulating hormones) are lower among those with poor sleep, which promotes appetite and calorie intake leading to obesity.<sup>28,29</sup> In particular, Mexican Americans have a high burden of CVD risk factors and could have poorer sleep health; thus, it is important to assess the sleep of this subpopulation. A study conducted by Hale and Do<sup>23</sup> on the ethnic differences in self-report of sleep duration found differences for Mexican Americans and other Hispanic populations. Non-Mexican Hispanics had an increased risk of short sleep compared with non-Hispanic whites,<sup>23</sup> whereas Mexican Americans had a higher odds of long sleep compared to non-Hispanic whites (not significant after adjustments for socioeconomic characteristics).<sup>23</sup> Conversely, data from the 2007–2008 National Health and Nutrition Examination Survey (NHANES) survey showed that Mexican Americans were less likely than non-Hispanic whites to report long sleep.<sup>30</sup> There are many within-group differences among Hispanics; therefore, sleep health could vary among Hispanic subpopulations as evidenced by the results of Hale and Do and thus should be considered. In addition, emerging evidence suggests that the neighborhood environment (safety and disorder) may contribute to sleep health among Hispanic populations and should be further studied.<sup>17,19,31</sup>

Examining predictors of sleep in the Mexican American population may inform novel intervention targets to improve sleep quality and subsequently reduce the burden of chronic conditions in this population. Using baseline data from the Stroke Health and Risk Education (SHARE) project, a biethnic behavioral intervention study, we examined the cross-sectional associations of neighborhood characteristics including disadvantage, safety, and crime with sleep duration and daytime sleepiness.

## Participants and methods

SHARE is a cluster-randomized, parallel-group, church-based behavioral intervention trial designed to reduce stroke risk in

Mexican American and non-Hispanic white parishioners in the Corpus Christi, Texas area.<sup>32</sup> Participants in SHARE ( $n = 801$ ) were recruited from 1 of 10 catholic churches selected among those in the Diocese of Corpus Christi. Advertisements were placed in church bulletins, and parish liaisons identified potentially eligible participants for enrollment.<sup>32</sup> At some churches, participation was encouraged by the priests. Participants were encouraged to enroll in friend or family member pairs. A few participants withdrew before baseline, yielding a sample of 760 participants. Of the 760 participants, 738 individuals were enrolled as pairs. The recruitment and enrollment of family or friendship pairs<sup>32</sup> allowed the study to exploit the natural social support system to promote behavior change. A baseline assessment was completed during home visits by trained study coordinators in either English or Spanish.<sup>32</sup> Baseline data included behavioral stroke risk factors as well as biological outcome measures collected between May 2011 and November 2012.

## Neighborhood measures

Census tract-level and self-reported measures of the neighborhood were assessed. Each participant's address was geocoded to 2010 US Census tracts, which were used as proxies for neighborhood of residence. If a participant's address could not be identified for geocoding, the zip code was used (11%). Census tracts were then assigned based on where the zip code centroid was located. SHARE participants resided in a total of 79 census tracts. Census tract-level measures included neighborhood disadvantage and per capita violent crime. Neighborhood disadvantage was assessed by an index of objective neighborhood disadvantage using data from the American Community Survey 2011 5-year estimates. This composite measure, developed by Ross and Mirowsky,<sup>33</sup> is derived to characterize the neighborhood socioeconomic environment. The index consisted of the percentage of female-headed households with children, the percentage of households with incomes below the federal poverty threshold in the last 12 months, the percentage of college-educated adults, and the percentage of housing units that are owner occupied.<sup>33</sup> Higher scores indicate more disadvantage. Per capita violent crime was assessed as the number of violent crimes (murder, manslaughter, forcible rape, robbery, and aggravated assault) in 2009 per census tract with data provided by the Corpus Christi Police Department. Crime data were only available for participants that resided in Corpus Christi, Texas; those outside of the city (22% of sample) were excluded from these analyses.

Self-reported neighborhood safety was assessed by asking each participant his or her level of agreement with the following statement: "I feel safe walking in my neighborhood day or night." Responses were collected using a Likert scale: 1=strongly disagree; 2=disagree; 3=neutral (neither agree nor disagree); 4=agree; 5=strongly agree.

## Sleep measures

We examined sleep duration and daytime sleepiness measured at baseline. Sleep duration in hours was assessed by the question: "How many hours of sleep do you usually get a night (or when you usually sleep)?" Participant responses were recorded in hours and transformed to minutes for the analyses. Sleep duration was also categorized as short ( $\leq 6$  hours), normal (7 or 8 hours), and long ( $\geq 9$  hours) for the analyses. Daytime sleepiness was measured using the daytime fatigue and sleepiness category of the Berlin Questionnaire<sup>34</sup>: (1) How often do you feel tired or fatigued after your sleep? (2) During your wake time, how often do you feel tired, fatigued, or not up to par? (3) Have you ever nodded off or fallen asleep while driving a vehicle? If yes, how often does this occur?

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