

Sleep Disturbance and Risk Behaviors among Inner-City African-American Adolescents

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ABSTRACT *Adolescents tend to experience more problems with sleep loss as a natural consequence of puberty, whereas teens from impoverished urban areas are likely to witness neighborhood violence and/or engage in risk behaviors that may affect sleep. Data from the Mobile Youth Survey, a longitudinal study of impoverished inner-city African-American adolescents (1998–2005; N=20,716; age range=9.75–19.25 years), were used to compare paired years of annual surveys elicited by questions about how sleep was affected when bad things happen to friends or family. Using a cross-lagged panel multivariate approach comparing reports for two sequential years and controlling for age/gender plus exposure to traumatic stress and violence, prior sleep disturbance was associated with carrying a knife/gun, brandishing a knife/gun, using a knife/gun, quick temperedness, warmth toward mother, worry, and belief in the neighborhood street code in the latter year. Conversely, seeing someone cut, stabbed, or shot, using alcohol, worry, and internalized anger were associated with sleep disturbance in a latter year. Although a limited measure of sleep disturbance was used, these findings support further research to examine sleep disturbance and risk behaviors among low-income adolescents.*

KEYWORDS *Sleep, Adolescent, Risk behaviors, Poverty Area, African Americans*

INTRODUCTION

In a 2006 report from the Institute of Medicine, sleep and sleep loss were identified as a major contributor to public health problems in the United States.¹ Insufficient sleep and sleep disturbance have serious consequences on personal health, mood, learning, performance, and safety, as well as societal costs in terms of decreased productivity and diminished quality of life.² Sleep disturbance in children is associated with behavioral problems, learning deficits, poor attention span, hyperactivity, attention deficit hyperactivity disorder, aggression, anxiety, and depression symptoms.^{3,4} Sleeplessness in teens is associated with behavioral problems such as impaired mood regulation, depression, poor academic performance, substance use (alcohol, in particular), somatic health problems, accidents, and injuries.^{5–11} Many of these behavioral problems are common issues among teens who live in distressed urban neighborhoods.^{12–17} In addition, socioeconomic status is known to confound the examination of behaviors, mood, and attitudes associated with sleep in both adults and in teens.^{7,18}

Sleep is particularly important for brain maturation and sleep deprivation in teens has a potent effect on behavior, emotion, and attention.¹⁹ Adolescents tend to experience more problems with sleep loss as a natural consequence of puberty. Teens

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develop a natural propensity for staying awake later in the day, but retain a stable need for sleep.^{20,21} The circadian timing system, the natural biologic drive for sleep and wakefulness, undergoes developmental changes in adolescence.²² That is, teens will prefer to delay bed time even though they have a consistent sleep need, which is approximately 9.2 hours per night across all pubertal stages.²³ Because school and social schedules do not match this circadian delay, teens often obtain less sleep than they need as a result of foreshortening time available for sleep.²¹ For example, the 2006 Sleep in America Poll conducted by the National Sleep Foundation reported that 45% of adolescents get an insufficient amount of sleep on a school night and that high school seniors miss 11.7 hours of sleep on a weekly basis.²⁴ Older teens (9th–12th grade) typically reported more problems such as falling asleep in school (59%), sleepiness when doing homework (22%), or feeling too tired to exercise or perform other physical activities (32%). This national phone survey also found that teens who reported being unhappy or sadder than their peers were also more likely to report falling asleep in school, difficulty falling asleep, or thought they had a sleep problem. This group also reported more trouble getting along with their family. In addition, depressed mood was associated with both insufficient sleep and poor quality sleep, particularly among older teens (21%) and among girls (21%).

Purpose and Rationale

Teens that live in high-poverty inner-city neighborhoods are likely to witness violence and encounter other stressors that can independently evoke sleep disturbances. Scarpa²⁵ asserts that chronic community violence generates heightened levels of depressed mood, posttraumatic stress disorder symptoms, aggressive and criminal behavior, and interpersonal problems. The purpose of this study was to examine the temporal relationship between reports of sleep disturbance and risk behaviors (e.g., violence, sexual activity, suicide ideation, etc.) in minority teens using data from the Mobile Youth Survey (MYS).^{13–15,17} The MYS is a longitudinal study of high-risk adolescents (9.75–19.25 years of age) who live in impoverished inner-city neighborhoods in the southern United States. Prior MYS reports have examined hopelessness, violent behavior, and substance abuse using a longitudinal approach.¹⁷ In this predominantly African-American sample (males 60%, females 36%), many teens report being involved in fights during the previous three months and also carried either a knife or gun at least once (males 47%, females 30%) during the same interval. Furthermore, hopelessness was predictive of carrying and pulling a knife or gun among males and predicted fighting and carrying a knife among females. In an analysis including additional cohorts, hopelessness was also a significant risk factor for aggressive/violent behavior, weapon use, substance use, sexual intercourse, and accidental injury in both males and females.¹²

Conceptual Framework

The brains of adolescents are, by their nature, immature and can be acutely and chronically affected by insufficient or poor quality sleep in important ways.^{10,19,26,27} Thus, disrupted or insufficient sleep in teens may contribute to “the perfect storm”—impaired decision making that leads to a wide range of “terrible”²⁸ social, academic, and emotional outcomes among disadvantaged adolescents. We view the issue of disrupted or insufficient sleep among disadvantaged urban adolescents as a salient force in affecting behavioral outcomes. Beebe and Gozal²⁹ propose a direct interaction between disturbed sleep and prefrontal cortex dysfunction that is consistent with studies of executive function among adults^{30,31} and in children.³²

Their model also includes the adverse behavioral consequences of sleep disruption including “problems in mentally manipulating information, poor planning and haphazard execution of plans; disorganization, poor judgment and decision making; rigid thinking, difficulty in maintaining attention and motivation, emotional lability (mood swings); and overactivity and impulsivity (especially in children).”²⁹ In adolescents, disrupted or insufficient sleep has been associated with violent behavioral problems such as fighting, bullying, and shoplifting,³³ as well as aggression, anger, and impulsivity.^{27,34} A recent report from the 2003 National Survey of Children’s Health³⁵ found that inadequate sleep in teens (N=21,641, age 12–17 years) was associated with “parental reports of family disagreements involving heated arguing” and “concern that the child was not always safe at home, at school or in their neighborhood.” Teens with inadequate sleep were “more likely to be perceived as a difficult child” and the “object of parental anger.” These findings have serious implications for adolescents and their families regarding violence and also reinforce the developmental and physiological importance of sleep among teens.

METHODS

In 1998, the MYS began face-to-face surveys among adolescents (age 9.75–18.25 years) in 13 impoverished neighborhoods in the Mobile Metropolitan Statistical Area (MSA). Mobile is a city of 200,000 located in the Gulf Coast. It is the major city in the MSA which has a population of nearly 540,000 people. In 2000, 46.1% of Mobile’s population was African American and 22.4% lived in poverty. Median household income was US \$31,445. Prichard, a city of nearly 30,000, borders Mobile on its north side. In 2000, 83.3% of the population was African American and 44.1% lived in poverty; the median household income was US \$19,544. In 1990, 42% of African Americans in the MSA lived in high-poverty census tracts, placing Mobile third in the nation in this measure of concentrated poverty.³⁶ Although data have been collected each year between 1998 and 2009, in this analysis only data collected between 1998 and 2005 were used (Table 1).

These eight years of longitudinal data permit a cross-lagged panel design to examine subjects at one point in time and again one year later. Because this large sample is relatively homogenous by virtue of culture, neighborhood influences, poverty status, and schools, the analysis of within-subject reports in two consecutive years will provide a unique view of sleep under stressful conditions as potentially a predictor and/or an outcome of high-risk behaviors among disadvantaged teens.

Procedure

Subject Recruitment In 1998, a 50% random sample of public housing addresses and non-public housing neighborhoods in Mobile and Prichard were selected for door-to-door recruitment annually in June and July. In homes with youths, the study was explained, parental consent was obtained, and the youths were scheduled to come to a community youth center to be surveyed. A passive recruitment sample was also enrolled using fliers posted in grocery stores and youth centers. In each year since 1998, researchers have attempted to survey respondents from prior years, actively recruiting all prior participants and a small sample of new randomly selected households plus non-active recruitment in the MYS target neighborhoods. The response rate has increased since 1998, to the point where approximately 90%

TABLE 1 *Mobile youth survey—multiple cohort design: number of individuals who have participated repeatedly from 1998 to 2005*

Year	N	New cohort	Nine times	Eight times	Seven times	Six times	Five times	Four times	Three times	Two times	One time	Not verified ^a
1998	1,775	1,775	32	77	89	174	172	240	257	352	280	101
1999	2,465	1,213		70	73	87	127	130	147	199	272	108
2000	2,196	616			55	66	63	68	75	93	128	68
2001	2,459	869				124	75	132	109	146	195	88
2002	2,258	687					103	108	85	136	159	96
2003	2,273	651						127	123	158	188	55
2004	2,309	543							202	152	140	49
2005	2,635	742								369	309	64
Total	20,716	7,693	32	147	217	451	540	805	998	1,605	1,671	608

^aThis group (9.7% of the total) could not be verified as area residents or former participants. These may have been adolescents visiting from out of town or who fabricated their identity. These data are not used in this analysis.

of actively recruited youths participate in the MYS each year. The sample size each year has ranged between 1,774 (1998) and over 3,500 (2010). Annual cohorts consistently include a comparable number of males and females who are predominantly African American (99%). Annual retention rates have ranged between 70% and 80%.

Data Collection When teens come to the neighborhood youth centers, they are checked in according to a master list of current participants to avoid duplicate participation. Small groups (ten or less) of teens were surveyed in classroom settings; to the extent possible, we attempted to group respondents by age and gender. The data collector reads questions aloud to ensure that poor reading skills did not affect any respondent's ability to answer the questions; respondents mark their response choices in a scannable survey booklet. When respondents appear to have difficulty keeping up with the group, data collectors will move the subject to a separate area for individual survey administration. Each respondent is reimbursed for their effort as approved by the university's Institutional Review Board guidelines, which was initially US \$10, but increased to US \$15 in 2006. Total time for data collection (check-in, survey administration, payment) averages about 90 minutes.

Measures

The MYS survey includes 294 questions addressing a wide range of social, psychological, and economic variables: risk behaviors; attitudes and beliefs; family, peers, and neighborhood; personality; coping mechanisms; affect; and developmental status.^{12,17} The MYS survey includes risk behaviors that are comparable to those used in the Youth Risk Behavior Surveillance System.³⁷ Risk behavior items that were deemed as potentially sleep-sensitive or reflective of outcomes of sleep disturbance were selected for this analysis. These variables have been described elsewhere^{12,14,17} and are briefly described as follows:

- *Risk behaviors*—violent behaviors (physical fighting, weapon carrying, brandishing a weapon, weapon use); substance use and abuse (tobacco, alcohol, and marijuana use; getting drunk or high); and sexual intercourse;³⁸
- *Attitudes and beliefs*—attitudes toward violence associated with belief in the *Code of the Street*³⁹ that dictates an aggressive and violent response to disrespect or personal affront;⁴⁰
- *Warmth toward mother*—a positive emotional connection with the subject's mother;⁴¹
- *Quick temper*—a single question: How often do you have a quick temper?
- *Anger management*—includes two components of anger management: internalization and externalization;⁴²
- *Affect*—behavioral self-worth (e.g., I usually don't like the way I behave vs. I usually like the way I behave) and general self-worth (e.g., I am usually happy with myself vs. I am usually unhappy with myself.);⁴³
- *Exposure to violence*—witnessing violence (seeing someone being cut or shot) and violent victimization (i.e., someone brandishing a weapon against you);³⁸
- *Traumatic stress*—a revised version of the MYS Traumatic Stress Scale by removing the two items about sleep;¹⁴ and
- *Worry*—a form of anxiety or concern.⁴⁴

To create a measure of sleep disturbance for statistical analysis, two questions taken from the MYS Traumatic Stress Scale were selected that address aspects of

sleep. These items are as follows: (1) I have trouble sleeping at night when bad things happens to a family member or friend; (2) I have bad dreams about the bad things that have happened to a family member or friend. Negative events are relatively common among the truly disadvantaged,⁴⁵ and these items tap into both prior experience with personal stressors and the adolescents' sensitivity or propensity for disturbed sleep under stressful conditions. Using these two items, a simple measure of sleep disturbance was computed by summing response values (range 0–4), which yielded a median correlation between the items equal to $r = 0.399$. This measure of sleep disturbance was used as both an independent variable and as a dependent variable in the two separate cross-lagged panel multivariate analyses of paired sequential years using within subject data.

Protection of Subjects

An informed consent was obtained from the parent, guardian, or caregiver of each MYS participant and assent was obtained from the adolescents at the time of data collection. The MYS protocol and study was reviewed and approved by the university Institutional Review Board. Each year since, the MYS procedures and the parental consent/adolescent assent process have been reviewed and re-approved. In addition, a Certificate of Confidentiality for the MYS data is in effect.

Data Analyses Plan

A cross-lagged panel multivariate approach was used to examine the potential non-recursive relationships between sleep disturbance and variables that are hypothesized as sleep-sensitive variables. This approach allows us to examine the effects of the independent variables at time $t-1$ on the dependent variable at time $t-2$, controlling for the dependent variable at time t . Thus, we are able to examine how the independent variable effects change in the dependent variable using a Granger causality framework.^{46,47} This provides us with weak (but not strong; see Van Meter 1974) inference about causation. The details of this approach to modeling the MYS data are described elsewhere.¹³ Because the data are longitudinal (and therefore not independent), we used a multilevel modeling approach with both random and fixed factors, as implemented in SAS PROC MIXED.

In recognition that a study of this nature can be taxing for adolescents, additional measurement controls are added to MYS data management to screen for inconsistent respondents and thus control for response error. This technique employs a set of duplicate items interspersed in the survey. Twenty sets of behavioral questions ask respondents to indicate whether they had ever engaged in the behavior and whether they had engaged in the behavior during increasingly recent periods of time (e.g., 90, 30, 7 days). Inconsistent responses (e.g., answering no to "Have you ever carried a gun" and yes to "Have you carried a gun during the past week") are an indicator of randomness in the data and may infer when the subject is overly fatigued, confused, or not capable of answering the survey or did not take the task seriously. Thus, this method of checking response consistency is employed as a conservative measure of data validity. Data from MYS subjects who are inconsistent across more than two items in any year were excluded from further analysis.^{13,14}

RESULTS

Preliminary Analyses

Before executing the primary statistical plan, two preliminary analyses were conducted: one describing trajectory of sleep disturbance over time and the second describing the relationship between sleep disturbance and inconsistency in survey responses. For the first of these preliminary analyses, we employed a random coefficients modeling procedure to assess the latent growth of sleep disturbance as a function of age and gender.⁴⁸ The results show a generally negative effect of age on sleep disturbance, although this is moderated somewhat by a statistically significant quadratic effect for age. Males experience more sleep disturbance than females, although this, too, is moderated by a linear age effect (and weakly by a quadratic age effect). Using a random coefficients growth curve framework, the trajectories for sleep disturbance for males and females were computed for the total sample; the results are plotted by age at the time of measurement (Figure 1).

A second preliminary analysis considered the effect of reported sleep disturbance on survey response inconsistency (without any lag). This analysis showed that sleep disturbance in a first year ($t-1$) is a statistically significant positive predictor of response inconsistency in the latter year ($t-2$; $b = 0.042$, $SE = 0.012$, $p < 0.001$), controlling for age and gender at time $t-1$. In all subsequent analyses reported henceforth, cases with more than two inconsistent responses in any given year were not included in the analysis.

Sleep Disturbance as an Independent Variable with Lagged Dependent Measures

To test our hypothesis related to sleep disturbance contributing to risk behaviors in a subsequent year, three statistical models were tested using sleep disturbance as the principal independent variable (complete results are available upon request). For clarity, an example of the lagged analysis procedure is described here; the analysis uses data from two sequential years of within-subject data. The first year is noted as $t-1$ and the second year as $t-2$. In model 1, we use measures of the dependent variable (e.g., hopelessness) at time $t-2$ sleep disturbance measured at time $t-1$ as the independent variable, and age, gender, and the dependent variable all measured at

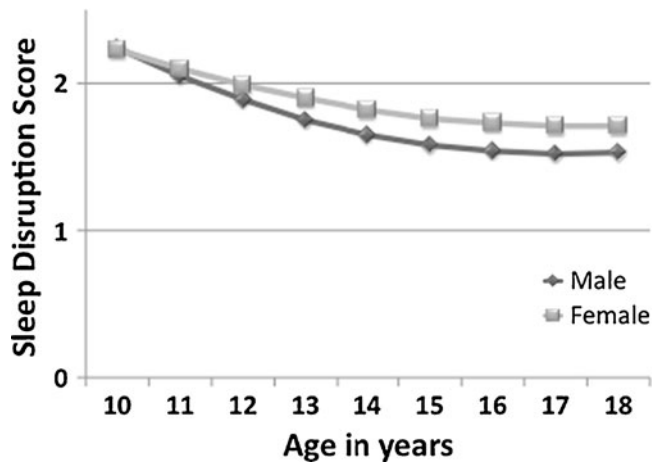


FIGURE 1. Growth curve analysis of sleep disturbance by age and sex.

time $t-1$ as control variables. Thus, only MYS cases with data for at least two consecutive years were used for this analysis. Statistical models based on changes in outcomes from one time period to the next are recommended for poverty research because they greatly reduce bias by controlling for unobserved influences associated with both outcomes and predictors.^{49,50}

For simplicity, the results in Table 2 include only dependent variables that were statistically associated with sleep disturbance reported in the earlier year. Thus, sleep disturbance did not statistically predict change in the following variables: sexual intercourse; cigarette use, marijuana use, getting drunk or high; internalized anger, externalized anger; internal street code; or caring. However, sleep disturbance was associated with change in 19 dependent risk behaviors reported in a subsequent year.

Using a conservative approach, we note that the results from the model 1 analysis may be biased because traumatic stress may produce changes in both sleep disturbance and the dependent variable. To correct for this potential bias, in model 2, we added two more control variables that are associated with traumatic stress: witnessing violence and violent victimization, both measured at time $t-1$. Model 2 results show that model 1 findings were greatly attenuated, particularly those associated with violent behaviors subsumed in a dependent variable. This may be because exposure to violence at time $t-1$ is associated with violent behavior at time $t-2$ (suggesting underreported exposures) and with sleep disturbance at time $t-2$.

TABLE 2 Lagged linear mixed model analysis—**independent variable: disrupted sleep in the prior year**

Dependent variables: risk behaviors	Independent variable—disrupted sleep _{$t-1$}		
	Model 1 b (SE _{b})	Model 2 b (SE _{b})	Model 3 b (SE _{b})
Fighting	0.035 (0.015)*	—	—
Carrying a knife	0.047 (0.020)*	—	—
Carrying a gun	0.038 (0.015)*	—	0.037 (0.018)*
Brandishing a gun/knife	0.035 (0.011)*	—	0.035 (0.013)**
Using a gun/knife	0.014 (0.006)*	—	0.019 (0.007)**
Using alcohol	—	-0.037 (0.015)*	—
Hopelessness	0.049 (0.014)***	0.039 (0.015)**	—
Self-worth	-0.062 (0.018)***	-0.060 (0.019)**	—
Behavioral self-worth	-0.029 (0.013)*	-0.027 (0.013)*	—
General self-worth	-0.043 (0.010)*	-0.041 (0.010)***	—
Worry	0.196 (0.036)***	0.194 (0.037)***	0.115 (0.041)**
Warmth toward mother	0.042 (0.012)***	0.045 (0.012)***	0.043 (0.014)**
Quick tempered	0.048 (0.010)*	0.041 (0.010)***	0.028 (0.012)*
Street code	0.050 (0.020)*	—	—
Neighborhood street code	0.012 (0.003)***	0.007 (0.003)*	0.007 (0.004)*
Cynicism	0.019 (0.008)*	0.018 (0.008)*	—
Callousness	0.042 (0.013)**	0.036 (0.014)**	—
Positive neighborhood sentiment	0.037 (0.018)*	—	—
Negative neighborhood sentiment	0.053 (0.015)***	0.046 (0.016)***	—

Model 1 controls for gender, age _{$t-2$} , independent variable _{$t-2$}

Model 2 controls for gender, age _{$t-2$} , independent variable _{$t-2$} , exposure to violence, or victimization _{$t-2$}

Model 3 controls for gender, age _{$t-2$} , independent variable _{$t-2$} , traumatic stress _{$t-2$}

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

However, again using a conservative approach, by controlling for exposure to violence at time $t-1$, too much of the common variance between sleep disturbance at time $t-1$ and violent behavior at time $t-2$ may have been removed. As a solution to this issue, exposure to violence was removed from the model and the revised traumatic stress scale (i.e., traumatic stress without the two sleep items) was added as a covariate to model 3.

Sleep Disturbance as a Lagged Dependent Measure

To examine the effect of risk behaviors on reports of sleep disturbance in a subsequent year, sleep disturbance measured at time $t-2$ was entered into a single equation as the dependent measure; the variables measured at time $t-1$ were entered into the equation as independent variables; and sleep disturbance, gender, and age at time $t-1$ were entered into the equation as statistical controls. Table 3 summarizes the findings of these analyses that were computed in the same fashion described previously for three models. The results show that relatively few risk behaviors reported in a prior year predict sleep disturbance in the latter year. When comparing the significant variables listed in model 3 from both analyses (Tables 2 and 3), only reports of worry appear to have a non-recursive relationship with sleep disturbance.

DISCUSSION

The purpose of this analysis was to examine reports of risk behaviors and sleep disturbance as measured by responses to two questions about difficulty sleeping and nightmares “when bad things happen to a family member or friend.” This conservative analysis suggests that sleep disturbance among disadvantaged minority teens is associated with aggressive behaviors, worry, quick temperedness, and warmth toward mother. This combination of aggressive factors may lead to negative socio-emotional outcomes. The association between sleep disturbance, aggressive behaviors, and negative emotions are consistent with the assertion that good sleep is antithetical to perceptions of threat.¹⁹ This is an evolutionary approach to sleep that alludes to the primal need of animals to sleep in safe places such as “burrows, nests, and temporal niches relatively safe from predators.” Likewise, humans and social primates have learned to assure safe sleeping conditions by forming social groups to

TABLE 3 Lagged linear mixed model analysis—dependent variable: disrupted sleep in consequent year

Independent variables: risk behaviors	Dependent variable—disrupted sleep _{$t-2$}		
	Model 1 b (SE _{b})	Model 2 b (SE _{b})	Model 3 b (SE _{b})
Traumatic stress	0.051 (0.006)**		
Seeing someone cut, stabbed, or shot	—	0.038 (0.008)*	0.041 (0.017)*
Using alcohol	—	0.026 (0.013)*	0.026 (0.013)*
Worry	—	0.019 (0.004)***	0.025 (0.004)***
Internalized anger	—	0.026 (0.011)*	0.029 (0.011)**

Model 1 controls for gender, age _{$t-2$} , independent variable _{$t-2$}

Model 2 controls for gender, age _{$t-2$} , independent variable _{$t-2$} , exposure to violence, or victimization _{$t-2$}

Model 3 controls for gender, age _{$t-2$} , independent variable _{$t-2$} , traumatic stress _{$t-2$}

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

create physically and emotionally safe environments. Using this logic, social stresses and “negative neighborhood sentiment” may represent feelings of threat and result in sleep disturbance. Conversely, “positive neighborhood sentiment” and “warmth toward mother” may contribute toward a sense of safety and thereby promote sleep. Thus, vigilance under threatening conditions may be an adaptive component of maturation; threat-related arousal in sleep may be a normal aspect of human development during adolescence. The growth curve analysis also provides tentative support for this notion; adolescents become somewhat less sensitive to threat as they age and males become less sensitive than females after 11 years of age. However, adolescents have a natural propensity for emotional intensity and risk taking, but lack sufficient cognitive and affective self-control to inhibit or modify behaviors that may produce “terrible” consequences.²⁸ That is, although adolescents are immature, they are fully capable of choosing behaviors that yield highly morbid emotional, physical, and social outcomes—that “perfect storm” situation.

Finally, this study has several limitations that should be acknowledged. First, although not our intent, the model described may infer causality because the concepts have been ordered in a linear manner and because of the omission of other variables included in the analysis. The decision to use this model was based on theory and prior research to offer a parsimonious illustration of the hypothesized role of sleep disturbance in violent and problem behaviors among teens. In addition, other models may represent the data equally well and may be valuable in understanding linkages not pursued in this analysis. The main limitation of this report is the measurement of sleep disturbance in the sample. Like many other studies developed more than 10 years ago, the MYS investigators did not include an adequate measure of sleep. The findings presented here confirm that additional investigations of aspects of sleep (e.g., sleep disorders, sleep duration, sleep quality) in this vulnerable and high-risk population are warranted. Furthermore, it can be said that the measures used precisely address whether the subjects report having trouble sleeping in the presence of stressors and that subjects must also be capable of appreciating the effect of stress on sleep. In contrast to these limitations, special procedures were included to validate responses using response consistency. The MYS survey is lengthy and may be viewed by teens as burdensome; elimination of data from inconsistent respondents offers validity for the findings presented. In addition, conservative statistical methods and multiple models were tested to parse out the potential influences of emotional context in this high-risk sample.

However, reports on sleep among minority youth are limited and there are no extensive studies of sleep and violence among economically disadvantaged African-American youth. For example, even the National Sleep Foundation telephone survey of teens²⁴ only included 16% African-American teens, but probably did not include very many low-income respondents. Interrupted telephone service is more common in impoverished families; they may have a cellular phone instead because they can purchase service in small increments. Also, they may be unlikely to answer a call from someone they do not recognize on the caller ID.⁵¹ Thus, the poorest members of our society may be unlikely to participate in telephone surveys.⁵²

Sleep disruption can also serve as an indicator of stress, much like a barometer showing when stress levels are high. Disrupted or insufficient sleep may also be a biobehavioral factor that contributes to negative behavioral and emotional consequences. Future studies of sleep in minority and low-income adolescents need

to be conducted and should include optimal measures of sleep, employ longitudinal methods, non-recursive approaches, as well as careful control of social and environmental influences that may affect sleep.

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