

Original article

## Chronic Insomnia and Its Negative Consequences for Health and Functioning of Adolescents: A 12-Month Prospective Study

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Manuscript received June 14, 2007; manuscript accepted September 4, 2007

### Abstract

**Purpose:** To estimate prevalence and chronicity of insomnia and the impact of chronic insomnia on health and functioning of adolescents.

**Methods:** Data were collected from 4175 youths 11–17 at baseline and 3134 a year later sampled from managed care groups in a large metropolitan area. Insomnia was assessed by youth-reported *DSM-IV* symptom criteria. Outcomes are three measures of somatic health, three measures of mental health, two measures of substance use, three measures of interpersonal problems, and three of daily activities.

**Results:** Over one-fourth reported one or more symptoms of insomnia at baseline and about 5% met diagnostic criteria for insomnia. Almost 46% of those who reported one or more symptoms of insomnia in Wave 1 continued to be cases at Wave 2 and 24% met *DSM-IV* symptom criteria for chronic insomnia (cases in Wave 1 were also cases in Wave 2). Multivariate analyses found chronic insomnia increased subsequent risk for somatic health problems, interpersonal problems, psychological problems, and daily activities. Significant odds ( $p < .05$ ) ranged from 1.6 to 5.6 for poor outcomes. These results are the first reported on chronic insomnia among youths, and corroborate, using prospective data, previous findings on correlates of disturbed sleep based on cross-sectional studies.

**Conclusions:** Insomnia is both common and chronic among adolescents. The data indicate that the burden of insomnia is comparable to that of other psychiatric disorders such as mood, anxiety, disruptive, and substance use disorders. Chronic insomnia severely impacts future health and functioning of youths. Those with chronic insomnia are more likely to seek medical care. These data suggest primary care settings might provide a venue for screening and early intervention for adolescent insomnia. © 2008 Society for Adolescent Medicine. All rights reserved.

**Keywords:** Insomnia; Prevalence; Persistence; Outcomes; Adolescents

Sleep disturbance is common among adolescents, and the most common sleep symptoms reported by youths involve insomnia [1–3]. Symptoms of insomnia affect about one-fourth of adolescents in several large epidemiologic studies [1–3]. Point prevalence of diagnosable insomnia has been reported to affect 4% to 5% of adolescents [1–3]. One study

has estimated the lifetime prevalence of insomnia to be almost 11%, with 88% occurring in the past year [2].

Although evidence from prospective studies on the effects of sleep deprivation on functioning of adolescents is still limited [4,5], overall, the evidence suggests that poor sleep (most studies focus on insomnia) is associated with both behavioral and emotional problems among adolescents [4,6,7]. Most data have come from cross-sectional studies. Adolescents with insomnia report more depression, anxiety, irritability, fearfulness, anger, tenseness, emotional instability, inattention and conduct problems, drug use, and alcohol

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use [8–15]. Youths also report more suicidal ideation and attempts [11,16]. Adolescents with symptoms of insomnia also have been found to have more fatigue, less energy, symptoms of headache, stomachache, backache, and worse perceived health [9,11,12,17].

From the available evidence, however, it is not possible to specify what the temporal associations might be. Do symptoms of insomnia lead to deficits in functioning, or do deficits in functioning lead to sleep deprivation? This is because there have been few longitudinal studies of adolescents that have examined this question. Strauch and Meier [18] found that insomnia at baseline did not predict future psychological problems. Fredriksen et al [19] found that adolescents with sleep loss over time reported more symptoms of depression and lower self-esteem. Others also have reported that insomnia increases risk of future psychological dysfunction [8,20]. Roberts, Roberts, and Chen [21] found that symptoms of insomnia at baseline increased the odds of dysfunction a year later across 11 indicators of somatic, psychological, and interpersonal functioning. The average odds ratio was 2.5, and for nine of the 11 outcomes there was a clear dose–response relation such that moderate levels of insomnia increased risk of negative outcomes and risk increased with greater insomnia.

Clearly, there is a paucity of prospective studies that focus on the epidemiology of sleep deprivation or insomnia among adolescents, as our review indicates. In addition, very few of the available studies focus on consequences of insomnia using prospective designs to address this issue. Furthermore, definitions of sleep problems have varied enormously. Only three previous studies have examined sleep disorders using diagnostic nomenclature [1–3]. Only five studies have focused on consequences of disturbed sleep, and only two of these did so using insomnia as the focus [21]. None have examined chronic insomnia. The purpose here is to reexamine the question of the effects of insomnia on adolescent functioning, focusing on chronic insomnia. We do so using a large, community sample of adolescents studied prospectively over 12 months, for which data are available on a broad array of measures of functioning, using symptoms that operationalize *DSM-IV* criteria for insomnia. Based on the literature reviewed, we expect chronic insomnia to increase the risk of negative sequelae across multiple domains of adolescent functioning, with the greatest impact on psychological functioning.

## Methods

### Sample

The data were from Teen Health 2000 (TH2K), a community-based, prospective study of the epidemiology of psychiatric disorders among adolescents [3]. The sample

was selected from households in the Houston metropolitan area enrolled in local health maintenance organizations (HMOs). One youth, age 11–17 years, was sampled from each eligible household, oversampling for ethnic minority households. Every household with a child 11–17 years of age was eligible. Initial recruitment was by telephone contact with parents. A brief screener was administered to confirm ethnic status, age, and gender of youths. Because there were proportionately fewer minority subscriber households, sample weights were developed and adjusted by poststratification to reflect the age, ethnic, and gender distribution of the five-county Houston metropolitan area in 2000. The precision of estimates are thereby improved and sample selection bias reduced to the extent that it is related to demographic composition [22]. Thus, the weighted estimates generalize to the population 11–17 years of age in a metropolitan area of 4.7 million people. Chi-square tests were used to compare ethnicity, gender, and age distributions between census data for the five-county area and sample data. After the weighted procedure, no difference was identified between the two distributions with respect to the three demographic factors of age, gender, and ethnic group ( $p = .99$ ,  $p = .93$ ,  $p = .99$ ).

Data were collected at baseline on sample youths and one adult caregiver using computer-assisted personal interviews and self-administered questionnaires. Data collection was face to face, in the household or rarely, in another location specified by the family. The computerized interview contained a structured psychiatric interview (see below), demographic data on the youths and the household, as well as queries about stress exposure. The interviews were conducted by trained, lay interviewers and took on average 1–2 hours, depending on the number of psychiatric problems present. The questionnaires contained questions on symptoms of sleep deprivation and insomnia and items assessing different risk and protective factors. These took about 30 minutes to complete. Interviews and questionnaires were completed with 4175 youths (66% of the eligible households). There were no significant differences among ethnic groups in completion rates. Youths and caregivers were followed up approximately 12 months later using the same assessment battery used at baseline. The Wave 1–Wave 2 cohort consisted of 3134 youths plus their caregivers (75% of Wave 1 dyads). All youths and parents gave written informed consent prior to participation. All study forms and procedures were approved by the University of Texas Health Sciences Center Committee for Protection of Human Subjects.

### Measures

There have been almost no studies of insomnia using *DSM-IV* diagnostic criteria for adolescents [1], and few thus far in the United States [2,3]. None of the existing diagnostic interviews designed for epidemiologic research on psy-

Table 1  
Unweighted sample characteristics, Teen Health 2000

Characteristics	Wave 1	Wave 1 cohort	Wave 2 cohort
	N = 4175	N = 3134	N = 3134
	%	%	%
Gender of youths			
Male	51.14	50.77	50.77
Female	48.86	49.23	49.23
Age of youths			
16 +	24.91	23.42	40.36
Between 13 and 15	48.05	49.74	48.63
12 or less	27.04	26.83	11.01
Ethnicity of youth			
European American	35.43	37.01	37.01
African American	35.35	34.59	34.59
Latino American	24.57	23.64	23.64
Others	4.65	4.75	4.75
Family income			
\$65,000 +	35.29	22.33	40.73
\$ 35,000–\$ 64,999	40.71	39.86	39.16
<\$35,000	24.00	37.87	20.11
Parental Marital status			
Married	75.71	76.26	76.10
Others	24.29	23.74	23.90

Note: No significant differences were found comparing distribution for each characteristic of W1 sample and W1 cohort using chi-square analyses.

Note: Age (W1 cohort vs. W2 cohort):  $p < .0001$ . Income (W1 cohort vs. W2 cohort):  $p = .03$ .

chiatric disorders originally included modules eliciting symptoms of sleep disorders. TH2K used the National Institute of Mental Health diagnostic Interview Schedule for Children, Version IV (DISC-IV) [23].

To operationalize *DSM-IV* symptom criteria [24] for a diagnosis of insomnia, the insomnia items are: difficulty initiating asleep, difficulty maintaining sleep (1 and 2, two items), early morning awakening, and nonrestorative sleep. The time referent is the past 4 weeks. The *DSM-IV* symptom criteria for insomnia include all of these symptoms, and the symptoms should cause significant distress or impairment. To qualify for a diagnosis of primary insomnia, the symptoms must not occur exclusively during another sleep disorder, another psychiatric disorder, or be due to the effects of alcohol, drugs, or medication.

A number of risk factors and sequelae of sleep deprivation or insomnia among adolescents have been examined (for a review, see Roberts et al [21]). Covariates included here are age and gender of youths, family income, ethnic status, physical health functioning, mental health functioning, and life stress. Age was treated as continuous variable as was family income. Ethnic contrasts at baseline are limited to European ( $n = 1479$ ), African ( $n = 1476$ ), and Mexican Americans ( $n = 857$ ). For these analyses the Wave 1 sample is 3812 rather than 4175, and the Wave 1–Wave 2 cohort is 2855. The smaller sample reflects the fact that

there were not sufficient numbers of ethnic groups other than European, African, or Mexican Americans to permit analyses.

Psychiatric disorders among youths were assessed with the DISC-IV, a highly structured instrument administered by lay interviewers. TH2K included anxiety disorders (agoraphobia, generalized anxiety, panic, social phobia, posttraumatic stress disorder), mood disorders (major depression, dysthymia, mania, hypomania), behavioral disorders (conduct, oppositional defiant, attention-deficit/hyperactivity disorders), eating disorders (bulimia, anorexia nervosa), and substance use (alcohol, marijuana, and other substance disorders). Three measures were constructed from the DISC-IV modules on mood disorders and substance use disorders. Because diagnostic criteria for depression include indicators of suicidal behaviors, disturbed mood was measured (whether youths had experienced depressed mood, anhedonia, or irritable mood) for a period of at least 2 weeks in the past year. Alcohol use was measured by reports of consuming any alcohol in the past year. Drug use similarly was assessed by use of marijuana and any other substances in the past year. The effects of substance use using a more stringent definition of six or more times in the past year also were examined. The results were essentially unchanged in terms of odds ratios. The less stringent definition increased effective sample size.

Outcomes examined are drawn from three conceptual domains representing somatic, psychological, and interpersonal functioning, and constitute major components of the lives of adolescents. See previous research by the authors [21,25]. Psychological functioning was measured with two other indicators. One item asked youths to rate their life satisfaction as very satisfied, pretty satisfied, about equal, pretty dissatisfied, and very dissatisfied. A second item asked youths to rate their emotional or mental health as excellent, good, fair, poor and very poor.

Interpersonal functioning was measured by three items that inquired about the extent of problems (a lot, some, only a few, no problems) experienced with friends or peers, at home with family members, and at school. These measures have been used in previous research by the authors [21].

Somatic functioning, or physical health problems, was measured with three indicators. One item asked youths to rate how they perceived their health: excellent, very good, good, fair, or poor. A second measure consisted of a scale asking how difficult in the past 4 weeks had physical health problems made it to perform nine activities of daily living. Responses were not difficult, a little difficult, somewhat difficult, or very difficult. The score ranged from 0 to 27 (Cronbach's  $\alpha = 0.88$ ). A third measure assessed how often in the past 4 weeks health problems impacted six types of family activities. Responses were very often, fairly often, sometimes, almost never, and never. Scores ranged from 0–24 (Cronbach's  $\alpha = 0.87$ ).

Table 2  
Wave 1 and Wave 2 prevalence of symptoms of insomnia for cohort

Insomnia	Point prevalence		W1–W2 chronicity <sup>a</sup>
	Wave 1	Wave 2	
	%, 95% CI	%, 95% CI	
One or more symptoms (P1)	26.83 (25.36–28.31)	26.48 (24.79–28.17)	45.85 (42.14–49.55)
At least one symptom plus daytime fatigue or sleepiness or both (P2)	7.15 (6.29–8.01)	8.11 (7.06–9.15)	33.52 (26.80–40.24)
P2 plus exclusion for mood, anxiety and substance use disorders (P3)	5.08 (4.37–5.79)	6.65 (5.69–7.60)	22.31 (15.44–29.18)

CI = confidence interval.

<sup>a</sup> Percent of cases in Wave 1 who were also cases in Wave 2.

Evidence cited earlier suggests school and work activities may impact sleep. Accordingly, the analyses included three items related to these domains. Each inquired whether during the past 4 weeks, the respondent slept less than usual (1) because of studying or homework, (2) because of school activities such as sports, clubs, and so forth, and (3) because of having a job. The percent still attending school in the initial wave was 97.8.

Covariates included in the current paper were age and gender of youths, ethnic status, family income, puberty status, and perceived body weight. Puberty status was measured by asking youths to rate the growth of their body parts (height, body hair, breast, or voice). The score ranged from 0 to 9 ( $\alpha = 0.75$  for females and 0.74 for males) [26]. Youths were asked to describe their body weight with five categories: skinny, somewhat skinny, average weight, somewhat overweight, or overweight. This item was adapted from the Oregon Adolescent Depression Project [27,28]. Although there is a literature on body weight and sleep disturbance [29], there also is evidence that body image and related attitudes may be more important than body weight per se in relation to psychosocial outcomes [30]. For that reason, we included body image rather than body weight per se. Age, family income, puberty status, and perceived body weight were treated as continuous variables. Ethnic status was treated as a categorical variable (European, African American, and Mexican Americans).

### Analyses

Analyses are presented defining insomnia several ways. First, data are presented on prevalence of any symptoms of insomnia. Youths with at least one of the insomnia symptoms without any exclusions were cases. This is termed P1. We then present prevalences of insomnia following *DSM-IV* criteria as closely as our data permitted. This is done in two ways. First, prevalence is estimated of at least one symptom of disturbed sleep with either daytime fatigue or daytime sleepiness (as indicators of impairment). This is termed P2. Second, that rate is then adjusted by excluding any subject who met the first two criteria who also met *DSM-IV* diag-

nostic criteria for a mood disorder, an anxiety disorder or a substance use disorder in the past year. This is termed P3. This is not equivalent to a full *DSM-IV* diagnosis of primary (or secondary) insomnia, but approximates such a diagnosis as measures permit.

Chronicity is defined as youths who met criteria for P1, P2, or P3 in Wave 1 and again in Wave 2. Here the focus is on the impact on functioning among youths who met criteria for P1, P2, or P3 in both Wave 1 and Wave 2. That is, they had to be a case in both waves.

For generation of confidence intervals for prevalence and the odds ratio, survey mean (Proc surveymeans) and survey logistic regression (Proc surveylogistic) procedures in SAS V9.1 [31] were employed. This procedure uses Taylor series approximation to compute the standard error of the odds ratio. Lepowski and Bowles [32] have indicated that the difference in computing standard error between this method and other repeated replication methods such as the jackknife is very small.

Definitions of functioning outcomes for analyses are as follows. Perceived health (self-evaluated health status) has two categories: fair or poor (10%) and good and above (90%); Lower 50% of cumulative distribution of limitations and lower 50% of cumulative distribution of impact of illness were defined as low risk. Caseness groups for interpersonal problems were some/a lot problems (23%), a few/some/a lot problems (54%), some/a lot problems (27%) for home, peers, and school, respectively. In terms of psychological problems, satisfied and dissatisfied/pretty dissatisfied/very dissatisfied were categorized as lower life satisfaction; any one who had at least one of three depression symptoms was defined as depressed mood; overall emotional or mental health of fair or below were in the high risk group. Alcohol use/other drug use were set to anyone who used alcohol/other drugs in the past 12 months. Sleep less because of activities has three categories: sleep less often/almost everyday because of school work/school activities in the past 4 weeks was the high risk; sleep less sometimes/often/almost everyday because of having a job was the high risk group.

Table 3  
Relations<sup>a</sup> between chronic insomnia and functioning (odds ratio [OR] and confidence intervals [CI])

Chronic insomnia	Somatic problems, W2 (n = 3108)			Interpersonal problems, W2 (n = 3087)			Psychological problems, W2 (n = 3131)			Substance use, W2 (n = 3134)		Activities, W2 (n = 3086)		
	OR, 95% C.I.			OR, 95% C.I.			OR, 95% C.I.			OR, 95% CI		OR, 95% CI		
	Perceived health	Limitations	Impact of illness	Problems at home	Problems with peers	Problems at school	Life satisfaction	Perceived mental health	Depressed mood	Alcohol use	Other drug use	School work	School activities	Job
P1	1.87 <sup>b</sup> (1.24–2.82)	1.42 <sup>b</sup> (1.11–1.81)	1.65 <sup>b</sup> (1.28–2.13)	2.42 <sup>b</sup> (1.86–3.16)	1.59 <sup>b</sup> (1.10–2.30)	2.09 <sup>b</sup> (1.56–2.79)	3.27 <sup>b</sup> (2.48–4.32)	2.74 <sup>b</sup> (2.04–3.66)	1.86 <sup>b</sup> (1.45–2.37)	1.38 <sup>b</sup> (1.00–1.89)	1.63 <sup>b</sup> (1.10–2.41)	2.33 <sup>b</sup> (1.74–3.11)	2.64 <sup>b</sup> (1.93–3.59)	2.64 <sup>b</sup> (1.78–3.92)
P2	2.77 <sup>b</sup> (1.19–6.45)	2.44 <sup>b</sup> (1.39–4.27)	2.81 <sup>b</sup> (1.54–5.10)	2.87 <sup>b</sup> (1.72–4.78)	2.44 <sup>b</sup> (1.29–4.61)	2.25 <sup>b</sup> (1.26–4.03)	4.45 <sup>b</sup> (2.58–7.67)	5.27 <sup>b</sup> (2.98–9.32)	2.69 <sup>b</sup> (1.56–4.64)	2.00 <sup>b</sup> (1.15–3.48)	2.60 <sup>b</sup> (1.21–5.59)	2.86 <sup>b</sup> (1.70–4.81)	3.23 <sup>b</sup> (1.78–5.88)	4.06 <sup>b</sup> (1.95–8.47)
P3	3.08 <sup>b</sup> (1.18–8.07)	2.36 <sup>b</sup> (1.02–5.45)	2.45 <sup>b</sup> (1.14–5.23)	1.75 (0.85–3.61)	2.85 <sup>b</sup> (1.20–6.80)	3.47 <sup>b</sup> (1.63–7.38)	4.22 <sup>b</sup> (1.85–9.58)	5.33 <sup>b</sup> (2.24–12.66)	2.01 (0.97–4.17)	0.99 (0.45–2.16)	0.86 (0.28–2.67)	2.34 <sup>b</sup> (1.16–4.72)	3.48 <sup>b</sup> (1.53–7.92)	3.65 <sup>b</sup> (1.26–10.51)

P1 = chronicity of one or more symptoms.

P2 = chronicity of at least one symptom plus daytime fatigue or sleepiness or both.

P3 = chronicity of P2 plus exclusion for mood, anxiety and substance use disorders.

<sup>a</sup> Adjusting for Wave 1 values of functioning problems.

<sup>b</sup> Odds ratios are statistically significant ( $p < .05$ ) using logistic regression analyses.

Table 4  
Multivariate relations<sup>a</sup> between chronic insomnia and functioning (odds ratio [OR] and confidence intervals [CI])

Chronic Insomnia	Somatic problems, W2 (n = 3108)			Interpersonal problems, W2 (n = 3087)			Psychological problems, W2 (n = 3131)			Substance use, W2 (n = 3134)		Activities, W2 (n = 3086)		
	OR, 95% CI			OR, 95% CI			OR, 95% CI			OR, 95% CI		OR, 95% CI		
	Perceived health	Limitations	Impact of illness	Problems at home	Problems with peers	Problems at school	Life satisfaction	Perceived mental health	Depressed mood	Alcohol use	Other drug use	School work	School activities	Job
P1	1.63 <sup>b</sup> (1.02–2.60)	1.31 (0.99–1.31)	1.63 <sup>b</sup> (1.23–2.16)	1.98 <sup>b</sup> (1.47–2.66)	1.32 (0.86–2.02)	2.07 <sup>b</sup> (1.50–2.85)	3.25 <sup>b</sup> (2.37–4.44)	2.73 <sup>b</sup> (1.97–3.77)	2.00 <sup>b</sup> (1.52–2.64)	1.27 (0.88–1.85)	1.33 (0.82–2.14)	2.21 <sup>b</sup> (1.58–3.07)	2.45 <sup>b</sup> (1.73–3.47)	2.73 <sup>b</sup> (1.75–4.26)
P2	2.62 <sup>b</sup> (1.02–6.71)	2.76 <sup>b</sup> (1.30–2.76)	3.11 <sup>b</sup> (1.57–6.14)	5.02 <sup>b</sup> (4.00–6.30)	1.49 (0.61–3.66)	1.74 (0.86–3.54)	3.58 <sup>b</sup> (1.78–7.20)	4.95 <sup>b</sup> (2.45–9.97)	2.74 <sup>b</sup> (1.44–5.21)	1.70 (0.83–3.48)	1.30 (0.45–3.76)	2.67 <sup>b</sup> (1.46–4.88)	2.48 <sup>b</sup> (1.23–5.01)	2.71 <sup>b</sup> (1.07–6.84)
P3	2.08 (0.63–6.86)	2.46 (0.82–2.46)	3.47 <sup>b</sup> (1.50–8.04)	2.03 <sup>b</sup> (1.10–3.75)	2.67 (0.96–7.41)	3.17 <sup>b</sup> (1.33–7.58)	4.32 <sup>b</sup> (1.74–10.70)	5.30 <sup>b</sup> (1.92–14.61)	2.80 <sup>b</sup> (1.22–6.44)	0.64 (0.23–1.75)	0.23 (0.03–1.78)	2.25 <sup>b</sup> (1.07–4.72)	2.82 <sup>b</sup> (1.18–6.77)	3.90 <sup>b</sup> (1.23–12.38)

P1 = chronicity of one or more symptoms.

P2 = chronicity of at least one symptom plus daytime fatigue or sleepiness or both.

P3 = chronicity of P2 plus exclusion for mood, anxiety, and substance use disorders.

<sup>a</sup> Adjusting for Wave 1 values of functioning problems, age, gender, ethnicity, family income, puberty status, and perceived body weight.

<sup>b</sup> Odds ratios are statistically significant ( $p < .05$ ) using logistic regression analyses.

Table 5  
Multivariate relations<sup>a</sup> between chronic insomnia and functioning (odds ratio [OR] and confidence intervals [CI])

Chronic symptoms	Somatic problems, W2 (n = 3108)			Interpersonal problems, W2 (n = 3087)		
	OR, 95% CI			OR, 95% CI		
	Perceived health	Limitations	Impact of illness	Problems at home	Problems with peers	Problems at school
DIS	2.39 <sup>b</sup> (1.02–5.63)	1.66 (0.90–1.66)	1.75 (0.95–3.22)	1.49 (0.85–2.63)	1.44 (0.61–3.42)	3.00 <sup>b</sup> (1.62–5.55)
DMS1	6.98 <sup>b</sup> (2.20–22.08)	2.65 (0.82–2.65)	3.47 (0.98–12.24)	1.74 (0.66–4.53)	0.47 (0.09–2.49)	1.88 (0.54–6.51)
DMS2	1.55 (0.41–5.90)	1.81 (0.74–1.81)	1.78 (0.62–5.13)	1.89 (0.66–5.42)	0.49 (0.10–2.49)	0.98 (0.31–3.14)
EMA	19.37 <sup>b</sup> (4.60–81.60)	2.75 (0.55–2.75)	3.35 (0.76–14.81)	5.40 <sup>b</sup> (1.53–19.02)	2.85 (0.41–19.62)	3.95 (0.87–17.97)
NRS	1.65 (0.91–2.97)	1.17 (0.82–1.17)	1.40 (0.97–2.01)	1.99 <sup>b</sup> (1.37–2.90)	1.34 (0.75–2.38)	2.32 <sup>b</sup> (1.55–3.47)

## Results

Table 1 presents characteristics of the Wave 1 sample and the Wave 1–Wave 2 cohort. The only difference in Wave 1 was lower income of the two minority groups. The only difference in the Wave 1–Wave 2 cohort was that youths were older and family income increased modestly.

Table 2 presents data on prevalence of the array of sleep outcomes in both Wave 1 and Wave 2. There was little change between waves. About one-fourth reported P1, 7% to 8% P2, and 5% to 6% P3. Nearly 46% of those in Wave 1 who reported one or more symptoms of insomnia (P1) again reported such problems in Wave 2, and thus are defined as chronic. Over a third (33.5%) had symptoms and daytime fatigue or sleepiness (P2) in Wave 1 and again in Wave 2. Nearly a fourth (22.3%) met our definition for chronic clinical insomnia (P3), for example, had insomnia in Wave 1 and again in Wave 2.

Table 3 presents odds for subsequent problems in functioning for those with chronic insomnia problems, adjusting for prior levels of functioning. Out of 42 contrasts, only four were not statistically significant. After adjusting for *DSM-IV* disorders, problems at home seemed little affected by chronic sleep problems. The remaining odds ratios were mostly in the twofold to fivefold risk categories. In fact, several nonsignificant odds ratios (ORs) were in the range of two or more, but the wide confidence intervals resulted in the associations not being significant.

Table 4 reexamines the data in the previous table using multiple logistic regression analyses in which the effects of prior functioning, age, gender, ethnicity, and family income are controlled. As can be seen, out of 42 contrasts, 13 are not significant. P3 seems to have the fewest consequences. Only 9 of 14 ORs were significant. On closer inspection, all of these are 2 or greater, but because of low prevalence the confidence intervals are quite wide.

We then examined the same set of outcomes looking at

individual chronic symptoms of insomnia. Table 5 presents the relationship between chronicity of individual items of insomnia and functioning problems controlling for prior functioning, age, gender, ethnicity, family income, puberty status, and perceived body weight. Out of 70 contrasts, only 27 were statistically significant. However, a third (32.6% of nonsignificant ORs) were in the range of 2 to 7, but the wide confidence intervals resulted in the associations not being significant. Chronic nonrestorative sleep predicted 8 of the 14 outcomes, with ORs ranging from 2.0 to 3.3, followed by chronic difficulty initiating asleep with six significant outcomes, with ORs ranging from 2.5 to 6.7. Chronic difficulty maintaining sleep was least predictive of the symptoms examined. Chronic early morning awakening was strongly related to perceived health (OR = 19.4), life satisfaction (OR = 15.1), and school work (OR = 19.0).

## Discussion

This is the first study to examine the effects of chronic *DSM-IV* insomnia on subsequent functioning of adolescents using a prospective design. Rates of chronicity were substantial, with 46% reporting symptoms of insomnia in both Wave 1 and Wave 2, and nearly one-fourth meeting our definition of clinical insomnia. Our data on chronicity corroborate earlier studies of stability of symptoms of insomnia among adolescents [2,8,20,33].

The implications of the chronic burden of insomnia for adolescent well-being also are profound. With minor exceptions (e.g., peer relations), chronic insomnia increased the odds of poor outcomes across multiple indicators of interpersonal, somatic, and psychological functioning. For most of these outcomes, the odds of poor functioning were increased from twofold to fivefold without adjustment for covariates. Even after adjustment, most of the prospective associations remained. These results extend the findings

Psychological problems, W2 (n = 3131)			Substance use, W2 (n = 3134)		Activities, W2 (n = 3086)		
OR, 95% CI			OR, 95% CI		OR, 95% CI		
Life satisfaction	Perceived mental health	De-pressed mood	Alcohol use	Other drug use	School work	School activities	Job
6.69 <sup>b</sup> (3.61–12.40)	5.19 <sup>b</sup> (2.81–9.58)	2.50 <sup>b</sup> (1.36–4.60)	1.11 (0.49–2.52)	1.36 (0.51–3.61)	1.72 (0.89–3.34)	0.96 (0.39–2.35)	2.78 <sup>b</sup> (1.18–6.51)
2.78 <sup>b</sup> (1.16–6.66)	4.44 <sup>b</sup> (1.38–14.21)	0.73 (0.27–1.97)	2.04 (0.75–5.55)	0.72 (0.04–12.21)	6.57 <sup>b</sup> (1.82–23.66)	1.83 (0.59–5.71)	3.23 (0.59–17.70)
4.82 <sup>b</sup> (1.85–12.59)	3.12 <sup>b</sup> (1.08–9.04)	2.13 (0.79–5.74)	3.40 <sup>b</sup> (1.38–8.40)	2.43 (0.53–11.14)	2.19 (0.74–6.48)	1.79 (0.61–5.30)	5.22 <sup>b</sup> (1.48–18.48)
15.05 <sup>b</sup> (3.12–72.62)	7.06 (0.82–60.45)	2.28 (0.49–10.52)	0.82 (0.10–6.47)	0.35 (0.02–6.91)	19.01 <sup>b</sup> (2.62–138.12)	4.94 (0.81–30.20)	7.92 <sup>b</sup> (1.27–49.43)
2.56 <sup>b</sup> (1.70–3.87)	2.59 <sup>b</sup> (1.73–3.86)	1.76 <sup>b</sup> (1.23–2.51)	1.21 (0.74–1.96)	1.34 (0.74–2.40)	2.51 <sup>b</sup> (1.66–3.78)	3.27 <sup>b</sup> (2.13–5.03)	2.54 <sup>b</sup> (1.48–4.38)

DIS = chronicity of trouble falling asleep.

DMS1 = chronicity of waking up in the middle of the night and find it hard to go back sleep.

DMS2 = chronicity of waking up frequently but able to go back to sleep.

EMA = chronicity of waking up very early.

NRS = chronicity of nonrestorative sleep.

<sup>a</sup> Adjusting for Wave 1 values of functioning problems, age, gender, ethnicity, family income, puberty status, and perceived body weight.

<sup>b</sup> Odds ratios are statistically significant ( $p < .05$ ) using logistic regression analyses.

from prior prospective studies concerning the impact of sleep problems on future functioning of adolescents [19–21]. Only two previous epidemiologic studies have provided data on changes in sleep over time and their impact on adolescents. Data from these studies are corroborated by our results. Fredriksen et al [19] reported sleep deprivation over time increased risk of depression and lower self-esteem but not poor academic functioning. Gregory and O'Connor [20] reported that the correlation of sleep problems (including symptoms of insomnia) with depression and anxiety increased over time. Other measures of functioning were not examined in either paper. Roberts et al [21] found that symptoms of insomnia at baseline increased future risk of poor functioning for multiple indicators of somatic, psychological, and interpersonal functioning. However, they did not examine the effects of chronic insomnia nor insomnia approximating *DSM-IV* criteria.

When individual symptoms of insomnia were examined, chronic nonrestorative sleep posed the greatest risk for Wave 2 outcomes, followed by chronic difficulty initiating sleep in terms of number of outcomes affected.

Taken together, these previous prospective studies, together with the results presented here, confirm the findings on factors associated with insomnia reported from numerous cross-sectional studies of both adolescents [2,4,5] and adults [34].

The key contribution of the results reported here is that many of the findings about factors associated with the occurrence of insomnia, which emanate overwhelmingly from cross-sectional studies, may be the consequences rather than the causes of insomnia. Like many other emotional and behav-

ioral disorders, insomnia often is a chronic disorder, with a multifactorial etiology. In fact, in a recent paper based on analyses of TH2K prospective data, Roberts et al [35] report that risk of incident insomnia is predicted by many of the same somatic, psychological, and interpersonal factors included in the analyses reported here. The implications seem clear. There appear to be strong reciprocal relations over time between insomnia and psychosocial risk factors, such that these factors increase future risk of insomnia and, in turn, insomnia particularly chronic insomnia predicts negative psychosocial outcomes.

## Limitations

The nature of our study imposed certain limitations on our analyses and interpretations. First, we were not able to distinguish between primary and secondary sleep disorders, nor were we able to examine the role of comorbid sleep disorders in relation to ethnicity. Although our measures permitted us to assess Criteria A, B (to a limited degree), D, and E, we were not able to assess Criterion C (presence of other sleep disorders). Nonetheless, our symptom criteria capture the major core research diagnostic criteria for insomnia proposed by the AASM Work Group [36]. As noted by the Work Group, there is great diversity in definitions of insomnia in the literature. Our inability to assess comorbid sleep disorders, however, may have little effect on our overall prevalence estimate for insomnia. Based on their analyses of data on adolescents, Ohayon and Roberts [37] concluded that multiple diagnoses of sleep disorders are a

minor issue, and affect rates of individual disorders very little.

Another limitation is that we did not have objective data on insomnia. That is, we did not have physiologic studies. Although such data would be useful to have, self-reports and interview-based measures remain the most viable strategies in community surveys. Our study was no exception. We should note that there are data suggesting that subjective measures of sleep from children and adolescents are correlated with objective measures of disturbed sleep [10]. Even so, future strategies could improve the knowledge base by incorporating more clinically based assessments of sleep functioning. One option might be to use a two-stage design in which a sample of cases and noncases identified by interview or questionnaire would be assessed using actigraphy, sleep diaries, and in-home polysomnography.

We should also note that although our results provide much needed prospective data on chronic insomnia and functioning, the followup period was relatively brief (12 months on average). Also, as noted in Methods, the sample was from one large metropolitan area and should not be interpreted as necessarily generalizable to the United States as a whole.

## Conclusion

Although there are limited data on the chronicity of symptoms of insomnia, our results add to growing evidence that the burden of insomnia among adolescents is comparable to that of other major psychiatric disorders such as mood disorders, anxiety disorders, disruptive disorders and substance abuse [38,39].

Furthermore, our data presented here and those from other studies [2,8,20,33] suggest one-fourth to one-half of adolescents report experiencing insomnia for periods of 1 to 4 years. Clearly, insomnia is not only a major public health problem, but a major chronic disease affecting a substantial proportion of the adolescent population.

The results presented here, as well as the results from the limited number of studies published on chronicity, also suggest that chronic insomnia severely impacts future functioning and provides prospective confirmation of results emanating from cross-sectional or prevalence studies.

We further examined impact of chronic insomnia by analyzing data on medical care. Parents reported that nearly half of the youths in Wave 1 (50%) and in Wave 2 (44%) had two or more medical care contacts in the previous year for somatic health problems. Many fewer received mental health services in a school setting (about 6%) or in an outpatient mental health services (12%). The odds for two or more medical care contacts were 1.65 for P2 and 1.50 for P3 ( $p < .05$ ). Those with chronic sleep problems also received more mental health services at school (P1: OR = 1.8; P2: OR = 2.2) and other outpatient mental health services: P1 (OR = 1.6), P2 (OR = 2.0), and P3 (OR = 2.0).

One implication is that screening and intervention for chronic insomnia may present a potential opportunity for reducing its impact on functioning and, in the longer term, perhaps reduce burden on the health care system. Pediatric and adolescent medical care settings may provide one venue for such screening. However, in many cases, it is difficult to differentiate between insomnia and related psychiatric problems such as depression, attention-deficit/hyperactivity disorder, and substance abuse [5]. As noted by the American Academy of Pediatrics Working Group on Sleepiness in Adolescents/Youth Adults [6], there is no established and validated algorithm for clinicians to use for diagnosing and treating sleep disorders in this age group. Suggested strategies include the BEARS Pediatric Sleep History and the clinical assessment flowchart developed by Mindell and Owens [40]. Greater attention to symptoms of insomnia may contribute to more accurate differential diagnosis, and thus, more effective treatment. However, much of the remedy for adolescent sleep deprivation lies in the broader societal context of adolescent lives, particularly as related to school, leisure, and work [4,5].

## Acknowledgments

This research was supported in part by Grant No. MH 49764 and Grant No. MH 65606 from the National Institutes of Health awarded to the first author. Yun Xing, M.S., provided statistical support for data analyses. The authors have no financial ties, past or present, regarding the conduct or publication of this research.

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