

Increased Nocturnal Activity Associated With Adverse Childhood Experiences in Patients With Primary Insomnia

Klaus Bader, PhD,* Valérie Schäfer, MSc,* Maya Schenkel, MSc,* Lukas Nissen, MSc,*
Hans-Christian Kuhl, MSc,* and Jürg Schwander, MD†

Abstract: The present study examined to what extent adverse childhood experiences (ACE), in addition to demographic characteristics, current level of stress, depression, and arousability predisposition, are associated with sleep measures in adult insomnia. Thirty-nine adults suffering from primary insomnia completed self-report questionnaires assessing ACE, current level of stress, predisposition towards increased arousability, and depression. They were monitored for 7 consecutive nights at home with wrist actigraphs to evaluate objective sleep-related activity. Blockwise multiple regression analyses were performed to determine which variables were the most important predictors of sleep measures. ACE proved to be important predictors of actigraphically assessed sleep onset latency, sleep efficiency, number of body movements, and moving time, whereas the set of the remaining variables had no significant impact on these sleep measures. These findings suggest that there is an association between childhood maltreatment history and sleep in patients with primary insomnia. We presume that sleep-related nightly activity can be regarded as an aftereffect of long-lasting stressful experiences in childhood.

Key Words: Actigraphy, adverse childhood experiences, primary insomnia, sleep, traumatic experiences.

(*J Nerv Ment Dis* 2007;195: 588–595)

According to clinical impression and empirical studies conducted in the last 2 decades, there is no doubt that sleep is severely disrupted after exposure to a traumatic event (e.g., Kato et al., 1996; North et al., 1999; Ohayon and Shapiro, 2000). Sleep disturbances are normally transient, occurring immediately after exposure to extreme stress, but can also become long-lasting, particularly in people suffering from posttraumatic stress disorder (PTSD). Complaints of delayed sleep onset, nightmares, and sleep-maintaining difficulties are the most frequently endorsed symptoms among

traumatized populations, affecting up to 70% of individuals with PTSD (Ohayon and Shapiro, 2000). Investigations with victims of traumatic events, such as veterans of combat, prisoners-of-war camp survivors, Holocaust survivors, and sexually abused women, reveal even years after the trauma numerous reports of difficulties with falling asleep, frequent awakenings from sleep with further difficulties returning to sleep, shorter duration of sleep, restless sleep, nonrestorative sleep, nightmares, and anxiety dreams (Lavie, 2001).

The long-term effects of trauma exposure in children seem to be similar to those of adults. Childhood physical and sexual abuse are common traumatic experiences, often presumed to be associated with sleep disruption and nightmares. In a study by Sadeh et al. (1995b), physically and sexually abused children from a psychiatric inpatient unit were examined using actigraphy. Abuse history was found to be significantly related to sleep measures. Physically abused children had decreased sleep efficiency and spent proportionally less time in quiet-motionless sleep compared with nonabused inpatients or sexually abused children. Glod et al. (1997) compared actigraphic sleep parameters of abused, normal, and depressed children. Abused children, whether or not they fulfilled diagnostic PTSD criteria, displayed higher activity levels during the night and more disruptions in sleep initiation and continuity than both the nonabused normal volunteers and the depressed children. Long-term sleep disturbances were also reported in children and adolescents after burn injury (Kravitz et al., 1993) and minor head injury (Kaufman et al., 2001; Pillar et al., 2003). However, so far there have been no studies concerning the impact of childhood trauma history on objective sleep measures in later adulthood.

Stressful negative life events seem to be the most common precipitating factors of insomnia (Bastien et al., 2004). The vulnerability to react to these stressors with hyperarousal and to maintain this arousal at a certain level may be related to a variety of biological and/or psychological factors (Riemann and Vorderholzer, 2003). According to Barlow (2002), hypervigilance (i.e. hyperarousal) in traumatized individuals may be interpreted as reflecting the promptness and preparation to deal with potentially negative events. In this sense, early trauma history can be understood as a risk factor for the development of insomnia in the course of a lifetime. A long history of neglect and abuse in childhood may lead to an adaptive process of the organism and predispose a patient to hyperarousal reactions when confronted with

*Department of Psychology, CBT Unit, University Psychiatric Clinics, Basel, Switzerland; and †Clinic for Sleep Medicine, Lucerne, Switzerland.

Supported by the Swiss National Foundation grant 1114-067146.

Send reprint requests to Klaus Bader, PhD, University Psychiatric Clinics UPK, Wilhelm Klein-Strasse 27, CH-4025 Basel, Switzerland. E-mail: klaus.bader@upkbs.ch.

Copyright © 2007 by Lippincott Williams & Wilkins

ISSN: 0022-3018/07/19507-0588

DOI: 10.1097/NMD.0b013e318093ed00

acute stressors in adulthood. Therefore, we assume that adults with an early history of severe adverse life experiences (e.g., childhood maltreatment) may be more vulnerable to react to acute stressors with sleep disturbances.

The purpose of this study was to explore to what extent adverse childhood experiences (ACE) are related to actigraphically assessed sleep in nontreated adults suffering from primary insomnia. The study was conducted under natural conditions at home for several days, recording wrist motor-activity. We hypothesized that sleep measures reflecting sleep continuity or sleep efficiency could be predicted both by the extent of recently perceived stress and by the severity and duration of ACE.

METHODS

Sample Selection

Participants were recruited via newspaper advertisements. Inclusion criteria were (a) age 20–55 years; (b) reported insomnia, defined as difficulty initiating or maintaining sleep or as nonrestorative sleep for at least 1 month; and (c) reports that the insomnia was causing significant distress or clearly affecting daytime functioning. Exclusion criteria were (a) presence of other sleep disorders such as narcolepsy, sleep apnea, restless legs syndrome, circadian sleep disorders, or parasomnias; (b) evidence that the insomnia was related to a somatic disorder; (c) presence of major depression, anxiety disorder, alcohol or substance abuse, or any other psychopathology; (d) currently in psychotherapy; and (e) regular use of sleep medication or use of other sleep-affecting medication (e.g., sedatives, anxiolytics, antidepressants, neuroleptics, beta-blockers) for the last 4 weeks before study entry. Participants with irregular use of sleep medication (i.e., less than twice weekly) were permitted to participate in the study after a drug-washout period of at least 7 days. These criteria are consistent with those of the DSM-IV (APA, 1994) for primary insomnia.

Ninety persons attended the screening interview. Of these 31 were excluded, withdrew, or did not attend (reasons for exclusion were the following: not meeting full insomnia criteria, meeting criteria for any additional axis-I disorder, being suspected of suffering from sleep-related breathing disorder or restless legs syndrome, or using hypnotics regularly or antidepressants). Of the 59 participating persons, we obtained utilizable and valid actigraphic data from 39. Thus, the final sample consisted of 39 participants with primary insomnia (29 women and 10 men) with a mean age of 43.0 years ($SD = 9.5$; range: 21–55 years). From these, 2 participants needed a drug-washout period because of the use of antidepressants and 1 because of an irregular use of sleep medication. They stopped taking their medication 4 and 1 week respectively before study entry.

Procedure

Initial Screening and Clinical Evaluation

Participants underwent a two-step evaluation process. First, each person was interviewed by telephone to establish his or her eligibility for the study. Participants were ruled out if they did not fulfill the inclusion criteria or if they met any

exclusion criteria as described above. Second (after the telephone screening), all potential participants were interviewed by one of our clinical research coordinators. The interview included a structured sleep-history interview to diagnose primary insomnia according to DSM-IV (APA, 1994), the German version of the Structured Clinical Interview for DSM-IV/Axis I Disorders (SCID-I; Wittchen et al., 1997), to evaluate the presence of other psychiatric disorders, a questionnaire to assess relevant somatic disorders, and a questionnaire to obtain demographic information.

The study protocol complied with the ethical principles of the Declaration of Helsinki and was approved by the Ethics Committee of Lucerne (Switzerland). At the end of the initial screening interview, details of the study protocol were discussed with each participant individually, after which participants gave their written informed consent.

Actigraphy

The rest-activity cycle was recorded over 7 consecutive nights at home with a small activity monitor (Actiwatch, Cambridge Neurotechnology Ltd., UK) worn on the non-dominant wrist. This monitor contains a piezo-electric linear accelerometer; activity counts are accumulated at selected time intervals and data are downloaded into a computer. Acceleration signals of movements were collected in one-minute epochs. Participants were given an explanation of the monitor's function and instructed to wear it for 7 consecutive 24-hour periods, except when bathing. Participants were instructed to record bedtime and rise time by pressing the event button on the actigraph. All actigraphic data were checked for potential quality problems by one of our research coordinators. Because there were some missing data resulting from technical problems or incorrect use of the actigraphs (e.g., participants forgot to press the event button), it was not possible to use all 7 nights for all participants. Only data of participants with correct actigraphic monitorings for 3–7 nights were included. One participant was excluded from the analysis of actigraphic data, because all of the measures deviated more than 2.5 standard deviations from the mean values.

Actigraphic data were analyzed by using the algorithm supplied by the Actiwatch Sleep Analysis Software (Actiwatch Sleep Analysis 2002, Cambridge Neurotechnology Ltd., UK). The following actigraphic sleep measures were used in the present study:

1. Sleep onset latency: latency before sleep onset following bedtime
2. Sleep efficiency: percentage of time spent asleep while in bed
3. Percentage of number of body movements: percentage of total number of activity counts during the sleep period
4. Moving time: percentage of minutes spent moving (i.e., number of minutes where scores of greater than zero were recorded) during the sleep period.

According to a review by Sadeh et al. (1995a), which summarizes the empirical data on the validity of actigraphy in assessing sleep-wake patterns, wrist actigraphy provides

valuable information about sleep-wake schedule and sleep quality that could be useful in both clinical and research application. Actigraphy has been found to be a useful, cost-effective method for assessing specific sleep disorders, such as insomnia and schedule disorders, and for monitoring their treatment process (Sadeh et al., 1995a).

Adverse Childhood Experiences

For the assessment of traumatic experiences in childhood and adolescence, the German version of the Childhood Trauma Questionnaire (CTQ; Bernstein and Fink, 1998) was used. The CTQ is a 28-item self-administered questionnaire to identify childhood maltreatment. It comprises 5 subscales (5 items each), which assess different types of childhood trauma: physical, sexual, and emotional abuse, and physical and emotional neglect. The questionnaire also includes a Minimization/Denial Scale to detect individuals who may be under-reporting traumatic events. Respondents are presented with a series of statements about childhood experiences (e.g., "When I was growing up I was punished with a belt, a board, or some other hard object") and are asked to choose from responses on a 5-point Likert-type scale that ranges from "never true" to "very often true." Per each CTQ-subscale, a scale total score is calculated by summing the respective items, which ranges from 5 to 25. The higher the score, the more childhood maltreatment is being reported. Validation studies of the CTQ have been conducted in 7 different clinical and nonreferral samples with more than 2200 respondents (Bernstein and Fink, 1998). These studies have demonstrated that self-reports on the CTQ-scales are highly stable over time and show good convergent and divergent validity with traumatic histories that have been ascertained by other measures. The CTQ-scales are highly sensitive to identifying adolescents with verified histories of abuse and neglect. Guidelines are established for classifying subscale scores depending on the severity of the abuse and/or neglect. These guidelines specify the range of scores that constitute "none to minimal," "low to moderate," "moderate to severe," and "severe to extreme" for each subscale. According to Bernstein and Fink (1998), these ranges are based on data from a nonclinical sample and are successful in identifying "cases" of these specific types of abuse and neglect, with therapist interview ratings as criteria.

To quantify the duration of stressful time periods in childhood, the participants filled in a separate questionnaire to retrospectively evaluate each year of life until age 18, choosing between answering options "mostly good," "balanced," or "mostly stressful." In addition, for the first 9 years there was the category "no recollection." For statistical analysis, we used the sum of all years until age 18 that were rated as mostly stressful.

Current Level of Stress

To assess participants' current stress levels, 3 aspects of stress were considered: (a) critical life events in the last 6 months, (b) daily hassles in the last month, and (c) the current stress level in several life domains.

The occurrence of critical life events in the last 6 months was measured by means of the self-report inventory Fragebogen zu kritischen Lebensereignissen (FKL; questionnaire assessing critical life events; Bodenmann, 1998), which consists of 27 events such as unemployment, house moving, death of a dear person, handicaps, illness, increased occupational demands, separation, divorce, etc. Each item is rated on a dichotomous scale ("yes"/"no") with regard to the occurrence of the critical life event in the last 6 months. The level of stress resulting from this event is rated on a three-point scale (ranging from 1 = "slightly incriminating" to 3 = "very incriminating"). The total score is averaged over the 27 items, and ranges from 0 to 3, with higher scores indicating a greater occurrence critical life events. The FKL has been validated in several studies and has a satisfactory discriminative validity (e.g., Bodenmann, 1998; Bodenmann et al., 2000).

The German version of the Daily Hassles Scale (DHS; Bodenmann, 1998) measures stress resulting from confrontation with daily hassles during the last month in the domains "family responsibility," "partnership," "time pressure/work," "social engagement," and "external stressors." The 37 items are rated on a five-point scale, ranging from "not at all incriminating" to "very incriminating." The total score is averaged over all items, and ranges from 1 to 5, with higher scores indicating a greater level of stress. The German version of the DHS has good internal consistency with $\alpha = 0.90$ (Bodenmann, 1998). The correlation between the total score of the DHS and the FKL amounts $r = 0.16$, which supports the independence of these 2 measures.

The current level of stress was measured by the questionnaire Allgemeines Stressniveau ("general level of stress"; Bodenmann, 1998). In this 17-items self-report questionnaire, current levels of stress are assessed in several life domains such as partnership, household, work, child rearing, finances, well-being, leisure time, and social contacts. Current stress (i.e., concerning the last week) in the different domains is rated on a five-point scale, ranging from "not at all" to "very severe." Factor analysis did differentiate 5 subscales: "general life situation and partnership," "well-being," "social contacts," "household," and "extramarital relationships." The total score is averaged over all items, and ranges from 1 to 5, with higher scores indicating a greater level of stress. Internal consistency of the total scale is satisfactory with Cronbach's $\alpha = 0.84$ (Bodenmann, 1998).

Predisposition Towards Increased Arousability

This parameter was measured by means of the German version of the Arousal Predisposition Scale (APS; Coren, 1988). The APS is a 12-item self-report inventory and measures arousability as a predisposition or long-term trait. Each item is a statement in the format of a self-description (i.e., "I get excited easily") and participants can select 1 of 5 responses: "never," "seldom," "occasionally," "frequently," or "always." The total score is calculated by summing all items, and ranges from 12 to 60, with higher scores indicating a greater predisposition towards increased arousability. The APS has been cross-validated on a sample of 693 persons and shown to be both a valid and reliable predictor of several

indexes of sleep disturbance (Coren, 1988). Also, the APS has been shown to predict task-related arousal changes measured via self-report indexes (Coren and Aks, 1991) and physiological measures of arousal (Coren and Mah, 1993), which seems to validate the usefulness of the APS as a measure of individual differences in predisposition toward arousability.

Depression

Current depressive pathology was measured by the German short version of the Center for Epidemiological Studies Depression Scale (Radloff, 1977), the Allgemeine Depressions-Skala—Kurzform (ADS-K; General Depression Scale—Short version; Hautzinger and Bailer, 1993). The ADS-K is a 15-item self-report scale, designed to measure depressive symptoms in the general population. The items include depressed mood, somatic complaints, attention deficit, loss of energy, motivational deficits, and negative patterns of thought. Participants rate the frequency of 15 symptoms over the past week on a 4-point scale (ranging from “rarely” to “mostly”). The total score is calculated by summing all items, and ranges from 0 to 45, with higher scores indicating greater depression. The ADS-K has been validated in a study with the following samples: respondents from the general population ($N = 1298$), 156 psychiatric patients mainly suffering from depression, 29 neurological patients, and 105 patients suffering from chronic pain. Results support the validity and reliability of reports of current depressive symptoms obtained with the ADS-K (Hautzinger and Bailer, 1993).

The CTQ and APS were completed at the beginning of the actigraphic monitoring. The completion of the FKL, Allgemeines Stressniveau, DHS, and ADS-K followed 1 day after end of the actigraphic monitoring.

Data Analysis

Data were analyzed with the Statistical Package for Social Sciences Version 13.0 (SPSS Inc., Chicago, IL). First, descriptive statistics were generated for the participants' demographic and psychometric characteristics. Second, for each participant mean values of the actigraphic measures over the accurate monitored nights were calculated, then the night-to-night stability of these measures was computed for each participant. In the next step, blockwise multiple regression analyses were conducted to evaluate the amount of variance in the sleep measures that can be explained by ACE and other variables (including demographic characteristics, current level of stress, depression, and arousability predisposition) respectively. Variables were entered into the model in the following order: block I: variables representing current level of stress, depression, predisposition towards increased arousability, sex, and age; and block II: variables representing ACE. α -level was set at 0.05 for all analyses.

RESULTS

Sample Characteristics

Global characteristics of our sample are described in Table 1. The sample included 39 participants (29 women and

TABLE 1. Sample Characteristics ($N = 39$): Depression, Predisposition Toward Increased Arousability, Adverse Childhood Experiences, Current Level of Stress, and Actigraphic Sleep Measures

	Mean	SD	Range
Age	43.0	9.5	21–55
Education level (number of school years)	9.9	1.8	7–14
Self-reported duration of insomnia	9.3	7.6	1–33
Depression (ADS-K)	9	5.67	2–24
Arousability predisposition (APS)	33.49	8.74	16–50
Adverse childhood experiences			
Emotional abuse (CTQ)	6.79	2.18	5–14
Physical abuse (CTQ)	5.85	1.57	5–12
Sexual abuse (CTQ)	6.23	3.12	5–19
Emotional neglect (CTQ)	12.46	4.94	5–21
Physical neglect (CTQ)	7.31	1.98	5–11
Sum of burden years till 18	3.33	3.70	0–13
Current level of stress			
Critical life events, last 6 mo (FKL)	0.24	0.19	0.00–0.78
Daily hassles, last month (DHS)	1.58	0.39	1.08–2.97
Current level of stress, last week (ASN)	1.47	0.32	1.06–2.53
Actigraphic sleep measures*			
Sleep onset latency (min)	12.79	14.02	0.75–63.43
Sleep efficiency (%)	82.18	11.13	45.3–96.3
Number of body movements (%)	24.59	26.67	2.77–149.06
Moving time (%)	16.66	8.71	6.66–46.23

*Mean values over all nights.

10 men) and comprised 32 employed workers, 3 unemployed participants, 3 students, and 1 housewife.

Table 2 shows the distribution of the CTQ scale total scores according to the guidelines of Bernstein and Fink (1998). As can be seen in Table 2, most of the traumatic experiences rated as “moderate” or “severe” pertain to the domains' emotional and physical neglect.

Stability of the Actigraphic Sleep Measures

To assess the stability of the actigraphic sleep measures Cronbach's α -coefficients for the last 3 nights were computed for each measure. As can be seen in Table 3, the stability of the actigraphic data is good, with the exception of the variable for sleep onset latency.

The Impact of the Different Variable Sets on Sleep

To explore the extent to which an early history of adverse life experiences in addition to demographic characteristics, current level of stress, and personal characteristics like depression and arousability predisposition (non-ACE) can predict actigraphic sleep measures, for each sleep parameter a blockwise multiple regression analysis with 2 blocks was performed. In the first step of the regression analysis, variables known from previous research to have influence on sleep were entered into the model. Therefore block I included the non-ACE-variables predisposition towards increased arousability, depression, stress level of the last week, daily hassles of the last month, critical life events of the last 6

TABLE 2. Number of Subjects ($N = 39$) Fulfilling the Respective Criterion for the Severity of a Traumatic Experience in the CTQ Scales

Scale	Severity of the Traumatic Experience				Sum
	None (or Minimal)	Low (to Moderate)	Moderate (to Severe)	Severe (to Extreme)	
Emotional Abuse	32	6	1	0	39
Physical abuse	34	3	2	0	39
Sexual abuse	30	4	2	3	39
Emotional neglect	12	14	5	8	39
Physical neglect	20	12	7	0	39

months, sex, and age. To explore whether ACE can account for the unexplained variance in the sleep variables, in block 2, we entered the variables emotional, physical, sexual abuse, physical and emotional neglect, and the sum of stressful years till 18.

We chose blockwise regression analyses because single regression weights may show only a low stability due to the small sample size and should therefore be interpreted with caution. Thus, we decided to apply blockwise regression analyses and relate our interpretations mainly to the blocks "non-ACE" and "ACE," because they are less liable to coincidental fluctuation. We further realize that because of the rather small sample size, the number of predictor variables must be viewed with precaution. Nevertheless, we considered it important to include all the relevant variables, because we were especially interested in the analysis of all these variables in context. According to Backhaus et al. (1996), who recommend at least twice as many participants as predictor variables, we meet the minimum criteria with $N = 39$ and 13 predictor variables quite well.

Because the SPSS-program does not provide a comparable nonparametric method and for reasons of comparability, for all variables, the same blockwise regression analyses were conducted, although sleep latency and number of body movements are not normally distributed.

Table 4 presents the results of these regression analyses with the actigraphic sleep measures as the dependent variables. The results of these analyses indicate that the non-ACE-variables (block 1) had no significant impact on the sleep measures, explaining only between 9.2% and 25.3% of the variance. When the variables representing ACE were entered into the model (block 2), the percentage of explained variance increased by about 40% to between 47.9% and 61% for all 4 sleep parameters.

Examining the single correlations between the variables representing ACE and the sleep measures, in the majority of cases, ACE demonstrated positive correlations with the sleep variables "sleep latency," "moving time," and "number of body movements" and negative correlations with "sleep efficiency." These findings indicate as expected that reporting more negative childhood experiences is related to more disturbed sleep.

DISCUSSION

The purpose of this study was to determine whether adverse experiences in childhood in addition to demographic characteristics, current level of stress, and personal characteristics like depression and arousability predisposition would significantly predict nocturnal activity in adults suffering from primary insomnia. Our results indicate that stressful negative life experiences such as emotional, physical, and sexual abuse in childhood seem to be associated with sleep in patients with primary insomnia. In our regression analyses, ACE explained a significant amount of variance in all actigraphic measures (sleep onset latency, sleep efficiency, number of body movements, and moving time). Surprisingly, these early life-stress conditions exerted higher effects on all calculated actigraphic sleep measures than the non-ACE-variables.

The present findings are consistent with results from other studies, which suggest a long-term effect of maltreatment on sleep in children (Famularo and Fenton, 1994; Glod et al., 1997; Sadeh et al., 1995b). Sleep disturbances as long-term effects have also been reported for children, adolescents, or young adults who experienced minor head injuries (Kaufman et al., 2001; Pillar et al., 2003), road traffic accidents (Ellis et al., 1998), or burns (Kravitz et al., 1993). Gregory et al. (2006) found a longitudinal link between level of family conflict experienced during childhood and insomnia reported at 18 years. They demonstrated also a dose-response relationship, whereby the greater the number of assessments at which a participant's family reported high levels of conflict, the more likely that individual was to develop insomnia later in life. In various samples of healthy individuals, we also found a significant correlative relationship between subjective sleep quality ratings and stressful negative experiences in childhood (Bader et al., 1999).

TABLE 3. Stability of the Actigraphic Data Over 3 Nights (Cronbach's α ; $N = 38$)

	Reliability
Sleep onset latency	0.62
Sleep efficiency	0.95
Number of body movements	0.87
Moving time	0.90

TABLE 4. Results of Blockwise Regression Analyses of the Effects of Non-ACE (Block 1) and ACE (Block 2) on Actigraphically Assessed Sleep Measures

Variables in the Model	Standardized Regression Coefficients (β)							
	Sleep Onset Latency (min)		Sleep Efficiency (%)		No. Body Movements (%)		Moving Time (%)	
	Block 1*	Blocks 1 and 2 [†] Together	Block 1	Blocks 1 and 2 Together	Block 1	Blocks 1 and 2 Together	Block 1	Blocks 1 and 2 Together
Depression (ADS-K)	0.40	0.15	-0.49 [§]	-0.16	0.50 [§]	0.17	0.51 [§]	0.19
Arousal predisposition (APS)	-0.15	-0.04	0.28	0.14	-0.30	-0.15	-0.19	-0.03
Stress level, last week (ASN)	-0.08	0.17	-0.28	-0.62 [§]	0.07	0.51 [‡]	0.47	0.94 [¶]
Daily hassles, last month (DHS)	-0.21	-0.45	0.34	0.48	-0.25	-0.45	-0.54 [‡]	-0.72 [¶]
Critical life events, last 6 mo (FKL)	0.08	-0.03	0.06	0.22	-0.10	-0.26	-0.02	-0.18
Sex	-0.16	0.06	0.07	-0.24	-0.08	0.21	0.01	0.27
Age	-0.04	-0.15	0.10	0.13	-0.09	-0.14	-0.13	-0.14
Emotional abuse (CTQ)		0.33		-0.40 [§]		0.36 [‡]		0.43 [§]
Physical abuse (CTQ)		0.05		0.33 [‡]		-0.41 [§]		-0.45 [§]
Sexual abuse (CTQ)		0.11		-0.10		0.35 [‡]		0.27
Emotional neglect (CTQ)		-0.37		0.30		-0.24		-0.32
Physical neglect (CTQ)		0.13		-0.14		0.11		0.12
Sum of burden years until 18		0.59 [¶]		-0.57 [¶]		0.43 [§]		0.40 [§]
Percent of explained variance (R^2)	0.092	0.479	0.175	0.541 [§]	0.163	0.566 [§]	0.253	0.610 [¶]
Adj. R^2	-0.113	0.209	-0.011	0.302	-0.026	0.340	0.084	0.408
Increment of Block 2, ACE (R^2)		0.387 [§]		0.366 [§]		0.403 [‡]		0.357 [‡]

*Block 1 included the variables depression (ADS-K), arousal predisposition (APS), stress level of the last week (ASN), daily hassles of the last month (DHS), critical life events of the last 6 mo (FKL), sex, and age.

[†]Block 2 included the 5 CTQ-variables emotional, physical, sexual abuse, and physical and emotional neglect as well as the sum of burden years until 18.

[‡] $p < .10$.

[§] $p \leq .05$.

[¶] $p \leq .01$.

For adults, strong long-term effects of traumatic experiences on sleep have been reported for combat veterans (Neylan et al., 1998) and Holocaust survivors (Kaminer and Lavie, 1991). Cuddy and Belicki (1992) studied a sample of undergraduate women and found higher nightmare and night terror frequencies, and greater difficulties returning to sleep after awakenings from nightmares for those students who reported a history of sexual or physical abuse. Also, Noll et al. (2006) found in a longitudinal, prospective study that women sexually abused in childhood reported significantly greater rates of sleep disturbances in later adulthood than comparison participants.

It is still unclear how early maltreatment history effects sleep in the later course of a lifetime. Severity and duration of stressful experiences in childhood seem to play an important role in long-term effects on sleep. Long-lasting exposure to stress in childhood may lead to an adaptation process of the organism over time, to enable the individual to deal with potentially negative events and threats in the future. Increased readiness for physiological and cognitive arousal may lead to higher nocturnal activity and difficulties initiating and maintaining sleep. This assumption corresponds to recent models of primary insomnia in which hyperarousal is assumed to play a central role in the development and maintenance of sleep disturbances (Morin, 1993; Perlis et al., 1997). Hyperarousal may be considered as both an adaptive reaction of the individual to an acute psychological or psychosocial stressor and a predisposing factor for insomnia. However, in the

present study general arousal predisposition was irrelevant as predictor variable.

The influence of mental activity during sleep could play a central role to explain long-term effects of trauma history on sleep. Early stressful life experiences are stored in the biographical memory system and may be reprocessed in dreams. Nightmares and anxiety dreams are major symptoms of PTSD (Krakow et al., 2002; Mellman et al., 1995). More than 40 years after the occurrence of the original events, war victims often report intrusive re-experiencing in dreams (Schreuder et al., 2000). Processing memories related to traumatic experiences during sleep may lead to arousals, increased rates of body movements, and breathing related problems (Krakow et al., 2001).

Diagnostic routines for sleep disorders do not normally include the assessment of trauma history, except when someone is suspected of having PTSD. Adults with a history of childhood abuse and neglect do not necessarily develop PTSD or other psychological disorders. Thus, childhood maltreatment or trauma history may be overlooked as a possible predisposing factor of sleep disturbances in the diagnostic process. For diagnosis and treatment of primary insomnia, the assessment of trauma history may be useful. Such an inquiry enables better understanding of the mechanisms mediating stressful situations, stress reactions, and sleep related phenomena. Corresponding stress prevention and coping strategies could be derived in therapy. Additionally, strategies to promote emotional processing and expo-

sure-based interventions may be applied similar to the treatment strategies for PTSD.

Although the present study suggests that stressful experiences in childhood are associated with sleep-related activity in adulthood, there are some methodological limitations that should be taken into account. First, because nocturnal activity of the participants was monitored at home, in a natural environment, there were potential sources for error that could not be controlled (i.e., sleep environment, noises, events immediately before going to sleep, etc.).

Second, although several studies have reported the validity and reliability of actigraphy to quantify sleep disruptions (Sadeh et al., 1995a; Vallières and Morin, 2003), it is not as valid or reliable as polysomnography.

A third limitation concerns the statistical methodology. Given the large number of predictor variables, the rather small sample size should be viewed with caution. Nonetheless, we decided to include all the relevant variables, as we were particularly interested in the analysis of all these variables in context. According to Backhaus et al. (1996), who recommend at least twice as many participants as predictor variables, we meet the minimum criteria. Because of the small sample size, the individual regression weights should be viewed with precaution; hence, we based our interpretation mainly on the analysis of the blocks non-ACE and ACE. These are generally less liable to coincidental fluctuations. Furthermore, although 2 of the 4 dependent sleep variables were not normally distributed, blockwise multiple regression analyses were conducted for all variables, which lowers the significance of these findings. On the other hand, for the not-normally distributed variables, results similar to those for the normally distributed ones were achieved.

Maltreatment and abuse history was assessed only by self-report inventories. Thus, significant results about the impact of abuse history on sleep are based on participants' current view concerning traumatic experiences in childhood and adolescence, and not on objectively proven events and circumstances. It is a well-documented phenomenon that biographical memories normally become distorted over time and that reports of life experiences are influenced by retrospective memory bias (Schacter, 2001). Several psychological factors such as infant amnesia, a general tendency to seek meaning in memories, current life conditions, psychopathology, and mood state may influence the retrospective judgment. Recently, Hardt and Rutter (2004) reviewed studies from 1980 to 2001 in which there was a quantified assessment of the validity of retrospective recall of sexual/physical abuse, physical/emotional neglect, or family discord. The authors concluded that retrospective reports of serious abuse, neglect, or conflict are sufficiently valid, as long as they are reasonably operationalized.

Additional research is needed to replicate these findings and to extend inquiry by use of polysomnography. Although actigraphy has the advantage of being a nonintrusive tool for assessing sleep in a natural environment, complete polysomnographic studies are necessary to provide more accurate and detailed evaluations of sleep. To prove whether results of the present study may be generalized to populations other than

patients with primary insomnia, further research with different samples is needed. Because our data do not provide evidence for a causal link between ACE and later sleep disturbances, longitudinal studies with high-risk groups would be the most appropriate approach.

CONCLUSION

According to the results of the present study, reports of abuse and neglect in childhood seem to be important predictors of actigraphic sleep measures in adults suffering from primary insomnia. These findings suggest a relationship between long-lasting and severe adverse experiences in childhood and extent of sleep disturbance in later adulthood. These findings have implications for treatment of insomnia and further research in this field. They suggest that clinicians should integrate the assessment of trauma history in their diagnostic routines for sleep disorders in order that childhood trauma history is not overlooked. Further prospective studies are needed to clarify the relationship between ACE and sleep in adulthood.

REFERENCES

- American Psychiatric Association (APA) (1994) *Diagnostic and Statistical Manual of Mental Disorders (DSM-IV)* (4th ed). Washington DC: APA.
- Backhaus K, Erichson B, Plinke W, Weiber R (1996) *Multivariate Analyse—method—Eine Anwendungsorientierte Einführung*. Berlin: Springer.
- Bader K, Goetschel R, Caposcale Y, Hobi V (1999) Einschätzung der Schlafqualität Erwachsener im Zusammenhang mit Schwere und Dauer von Belastungen in Kindheit und Jugend. *Verhaltenstherapie*. 9(Suppl 1):3.
- Barlow DH (Ed) (2002) *Anxiety and Its Disorders: The Nature and Treatment of Anxiety and Panic* (2nd ed). New York: Guilford.
- Bastien CH, Vallières A, Morin CM (2004) Precipitating factors of insomnia. *Behav Sleep Med*. 2:50–62.
- Bernstein DP, Fink L (Eds) (1998) *Childhood Trauma Questionnaire: A Retrospective Self-Report*. San Antonio: The Psychological Corporation.
- Bodenmann G (Ed) (1998) *Dyadisches Coping: Eine systemisch-prozessuale Sicht der Stressbewältigung in Partnerschaften: Theoretischer Ansatz und empirische Befunde*. Unveröffentlichte Habilitationsschrift. Fribourg: Universität Fribourg.
- Bodenmann G, Scherzmann S, Cina A (2000) Kritische Lebensereignisse und Alltagsstress bei Depressiven und Remittierten. *Zeitschrift für Klinische Psychologie, Psychiatrie und Psychotherapie*. 48:1–17.
- Coren S (1988) Prediction of insomnia form arousability predisposition scores: Scale development and cross-validation. *Behav Res Ther*. 26:415–420.
- Coren S, Aks DJ (1991) Prediction of task related arousal under conditions of environmental distraction. *J Appl Soc Psychol*. 21:189–197.
- Coren S, Mah KB (1993) Prediction of physiological arousability: A validation of the Arousal Predisposition Scale. *Behav Res Ther*. 31:215–219.
- Cuddy MA, Belicki K (1992) Nightmare frequency and related sleep disturbance as indicators of a history of sexual abuse. *Dreaming*. 2:15–22.
- Ellis A, Stores G, Mayou R (1998) Psychological consequences of road traffic accidents in children. *Eur Child Adolesc Psychiatry*. 7:61–68.
- Famularo R, Fenton T (1994) Early developmental history and pediatric posttraumatic stress disorder. *Arch Pediatr Adolesc Med*. 148:1032–1038.
- Glod CA, Teicher MH, Hartman CR, Harakal T (1997) Increased nocturnal activity and impaired sleep maintenance in abused children. *J Am Acad Child Adolesc Psychiatry*. 36:1236–1243.
- Gregory AM, Caspi A, Moffitt TE, Poulton R (2006) Family conflict in childhood: A predictor of later insomnia. *Sleep*. 29:1063–1067.
- Hardt J, Rutter M (2004) Validity of adult retrospective reports of adverse childhood experiences: Review of the evidence. *J Child Psychol Psychiatry*. 4:260–273.
- Hautzinger M, Bailer M (Eds) (1993) *Allgemeine Depressions-Skala (ADS): Manual*. Weinheim: Beltz Test.

- Kaminer H, Lavie P (1991) Sleep and dreaming in Holocaust survivors: Dramatic decrease in dream recall in well-adjusted survivors. *J Nerv Ment Dis.* 179:664-669.
- Kato H, Asukai N, Miyake Y, Minakawa K, Nishiyama A (1996) Post-traumatic symptoms among younger and elderly evacuees in the early stages following the 1995 Hanshin-Awaji earthquake in Japan. *Acta Psychiatr Scand.* 93:477-481.
- Kaufman Y, Tzischinsky O, Epstein R, Etzioni A, Lavie P, Pillar G (2001) Long-term sleep disturbances in adolescents after minor head injury. *Pediatr Neurol.* 24:129-134.
- Krakow B, Hollifield M, Johnston L, Koss MP, Schrader R, Warner TD (2001) Imagery rehearsal therapy for chronic nightmares in sexual assault survivors with posttraumatic stress disorder: A randomized controlled trial. *JAMA.* 286:537-545.
- Krakow B, Schrader R, Tandberg D, Hollifield M, Koss MP, Yau CL, Cheng DT (2002) Nightmare frequency in sexual assault survivors with PTSD. *J Anxiety Disord.* 16:175-190.
- Kravitz M, McCoy BJ, Tompkins DM, Daly W, Mulligan J, McCauley RL, Robson MC, Herndon DN (1993) Sleep disorders in children after burn injury. *J Burn Care Rehabil.* 14:83-90.
- Lavie P (2001) Sleep disturbances in the wake of traumatic events. *N Engl J Med.* 345:1825-1832.
- Mellman TA, Kulick-Bell R, Ashlock LE, Nolan B (1995) Sleep events among veterans with combat-related post-traumatic stress disorder. *Am J Psychiatry.* 152:110-115.
- Morin CM (Ed) (1993) *Insomnia: Psychological Assessment and Management.* New York: Guilford Press.
- Neylan TC, Marmar CR, Metzler TJ (1998) Sleep disturbances in the Vietnam generation: Findings from a nationally representative sample of male Vietnam veterans. *Am J Psychiatry.* 155:929-933.
- Noll JG, Trickett PK, Susman EJ, Putnam FW (2006) Sleep disturbances and childhood sexual abuse. *J Pediatr Psychol.* 31:469-480.
- North CS, Nixon S, Shariat S, Mallonee S, McMillen JC, Spitznagel EL, Smith EM (1999) Psychiatric disorders among survivors of the Oklahoma City bombing. *JAMA.* 282:755-762.
- Ohayon MM, Shapiro CM (2000) Sleep disturbances and psychiatric disorders associated with posttraumatic stress disorder in the general population. *Compr Psychiatry.* 41:469-478.
- Perlis ML, Giles DE, Mendelson WB, Bootzin RR, Wyatt JK (1997) Psychophysiological insomnia: The behavioural model and a neurocognitive perspective. *J Sleep Res.* 6:179-188.
- Pillar G, Averbuch E, Katz N, Peled N, Kaufman Y, Shahar E (2003) Prevalence and risk of sleep disturbances in adolescents after minor head injury. *Pediatr Neurol.* 29:131-135.
- Radloff LS (1977) The CES-D Scale: A self-report depression scale for research in the general population. *J Appl Psychol Measures.* 1:385-401.
- Riemann D, Voderholzer U (2003) Primary insomnia: A risk factor to develop depression? *J Affect Disord.* 76:255-259.
- Sadeh A, Hauri PJ, Kripke DF, Lavie P (1995a) The role of actigraphy in the evaluation of sleep disorders. *Sleep.* 18:288-302.
- Sadeh A, McGuire JPD, Sachs H, Seifer R, Tremblay A, Civita R, Hayden RM (1995b) Sleep and psychological characteristics of children on a psychiatric inpatient unit. *J Am Acad Child Adolesc Psychiatry.* 34:813-819.
- Sehacher DL (2001) *The Seven Sins of Memory: How the Mind Forgets and Remembers.* Boston (MA): Houghton Mifflin Company.
- Sehreuder BJN, Kleijn WC, Rooijmans HGM (2000) Nocturnal re-experiencing more than forty years after war trauma. *J Trauma Stress.* 13:453-463.
- Vallières A, Morin CM (2003) Actigraphy in the assessment of insomnia. *Sleep.* 26:902-906.
- Wittchen HU, Wunderlich U, Gruschwitz S, Zaudig M (Eds) (1997) *SKID-I: Strukturiertes Klinisches Interview für DSM-IV—Achse I: Psychische Störungen.* Göttingen: Hogrefe.