Chronic Headache and Potentially Modifiable Risk Factors: Screening and Behavioral Management of Sleep Disorders

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Abstract and Introduction

Abstract

Sleep-relatedvariables have been identified among risk factors for frequent andsevere headache conditions. It has been postulated that migraine,chronic daily headache, and perhaps other forms of chronic headache areprogressive disorders. Thus, sleep and other modifiable risk factorsmay be clinical targets for prevention of headache progression orchronification. The present paper is part of the special series ofpapers entitled "Chronification of Headache" describing the empiricalevidence, future research directions, proposed mechanisms, and riskfactors implicated in headache chronification as well as several papersaddressing individual risk factors (ie, sleep disorders, medicationoveruse, psychiatric disorders, stress, obesity). Understanding thelink between risk factors and headache may yield novel preventative andtherapeutic approaches in the management of headache. The present paperin the special series reviews epidemiological research as a means ofquantifying the relationship between chronic headache and sleepdisorders (sleep-disordered breathing, insomnia, circadian rhythmdisorders, parasomnias) discusses screening for early detection andtreatment of more severe and prevalent sleep disorders, and discussesfundamental sleep regulation strategies aimed at headache preventionfor at-risk individuals.

Introduction

Lipton and Pan[1] recently postulated that migraine might be conceptualized as a chronic progressive disorder. The progression or *chronification* of headache from episodic to "chronic daily headache" is a well-described clinical phenomenon.[2] Potential mechanisms for headache chronification[3] and needed research[4] are described elsewhere. Sleep abnormalities were identified among risk factors associated with chronic headache,[5] along with medication overuse,[6] stress,[7] psychiatric disorders,[8] and obesity.[9] The present paper describes sleep disorders associated with chronicheadache in epidemiological research (that may potentially be relevantto chronification), clinical implications, and sleep regulationstrategies aimed at risk factor reduction.

Sleep "Risk Factors" For Chronic Headache

Representativeepidemiological studies are presented below as a means of quantifyingand conveying risk, while a more complete review of the epidemiologicaland clinical literature concerning sleep-related headache is availableelsewhere.[10] Thisliterature, especially epidemiological studies, tends to lackdiagnostic precision in the classification of headache with manystudies characterizing headache by patterns of frequency or proximityto sleep (ie, chronic daily, "awakening" or morning headache) ratherthan specific International Classification of Headache Disorders orInternational Classification of Headache Disorders-Edition IIdiagnoses. Headache has been most extensively examined in relation tosleep-disordered breathing, but other sleep disorders have also beenaddressed.

Snoring, Habitual Snoring, and Obstructive Sleep Apnea

Epidemiologicalstudies generally find that headache occurs more commonly among snorersthan nonsnorers among adults as well as children, although degree ofrisk varies with headache and snoring definitions and other researchmethods.[10] Forexample, a Swedish cross-sectional study (324 diagnosed obstructiveapneics compared with random sample of the general populationclassified as snorers [*n* = 448] and nonsnorers [*n* = 583])found that

heavy snorers were more likely than nonsnorers in thepopulation to have "headache at least once a week" vs "morningheadache" in men (odds ratio [OR] = 2.2 [1.4-3.2] vs OR=7.9[3.5-18.0], respectively) and women (OR = 2.7 [1.6-4.4] vsOR = 5.8 [3.0-11.0]), and such headache was similar to thatobserved in a comparable sample of confirmed sleep apneics of men(OR = 2.2 [1.4-3.3] vs OR = 8.6 [3.8-20]) and women(OR = 3.0 [1.3-6.8] vs OR = 3.7 [1.3-11]).[11] A similar study of 3323 Danish men only observed headache more commonamong snorers than nonsnorers (OR = 1.5 [1.3-1.8]) afteradjusting for age, body mass index (BMI), alcohol, and tobacco.[12]

In a case—control study in the United States, Scher et al[13] compared the prevalence of habitual snoring in a group of 206 chronicdaily headache sufferers with a group of 507 episodic headachesufferers. Habitual (daily) snoring was more common among chronic dailythan among episodic headache sufferers (OR = 2.02 [1.2-3.3; *P* < .005])and increased after adjusting for traditional risk factors forobstructive sleep apnea (ie, age, gender, BMI, alcohol intake,hypertension) (OR = 2.86 [1.7-5.0; *P* < .005]).The relationship was not accounted for by other factors such ascaffeine consumption and depression. Likewise, considering the studysample authors reported "in addition to and independent of snoring,patients were more likely than control subjects to report sleepproblems, being tired, and sleeping for short or long periods of time"although these sleep variables were not elaborated (p. 490).

Among children, Isik et al[14] reported on 2756 children randomly selected from school districts inIstanbul. Complete data from 2228 children aged 8.4 Ã‚Â± 1.4years included 74 with migraine and 626 other nonmigraine headaches.Snoring (parent-rated child's snoring as often or always) and daytimesleepiness in children were associated with migraine(OR = 1.97 [1.22-3.16; *P* < .005] and OR = 2.17 [1.28-3.65; *P* < .004]) and other nonmigraine headaches (OR = 1.39 [1.14-1.68; *P* < .01] and OR = 1.78 [1.41-2.25; *P* < .001]).Snoring, sleepiness, and parasomnias (below) were more frequent amongchildren with migraine than among nonmigraine headache and no headachegroups. In a Chinese community survey of sleep disorders among 3047children aged 6 to 12 years, habitual (6-7 days/week) snoring wasassociated with morning headache (adjusted OR = 1.53[1.05-2.21; *P* < .05]).[15]

Insomnia

Insomniahas been associated with chronic headache and may be a negativeprognostic indicator at least for tension-type headache. In a UnitedKingdom cross-sectional study, Boardman et al[16] identified a relationship between headache severity and sleep (ie,trouble falling asleep, wake up several times, trouble staying asleep,or waking after usual amount of sleep feeling tired or worn out); among2662 respondents, headache frequency was associated with slight(age/gender adjusted OR = 2.4 [1.7-3.2]), moderate(OR = 3.6 [2.6-5.0]), and severe (OR = 7.5[4.2-13.4]) sleep complaints. Authors identified "likely migraine" butdid not describe migraine separate from other headaches. Likewise,Ohayon[17] reported aEuropean study using 18,980 telephone interviews associated "chronicmorning headache" with insomnia (OR = 2.14 [1.79-2.57]) usingstrict Diagnostic and Statistical Manual of Mental Disorders, 4th Ed.(DSM-IV) and International Classification of Sleep Disorders (ICSD)criteria for insomnia.

In a large cross-sectional epidemiological study conducted in 1989 and using a random sample of 1000 Copenhagen residents[18] found "sleep problems" were more common among tension-type thanmigraine headache sufferers and the general population and wakingnonrefreshed more common among male and female migraineurs and femaletension headache than the population. In 2001, a follow-up survey ofthe cohort from 1989[19] found sleep problems were associated with a poorer outcome fortension-type headache (defined as at least 180 headache days/year atfollow-up due to increased frequency from episodic to chronic orunremitting) with sleep complaints (OR = 2.7 [1.1-6.3]) butnot migraine. Negative prognostic indicators for tension-type headacheincluded fewer hours sleep (OR = 1.4 [1.1-2.0]), wakingnonrefreshed (OR = 2.0 [1.1-3.7]), and fatigue(OR = 2.5 [1.3-4.6]).[20]

Circadian Rhythm Disorders

Althoughcircadian rhythms have been closely linked to migraine, cluster andhypnic headache in clinical studies, circadian rhythm disorders wereaddressed in only one epidemiological study. In the European study byOhayon[17] describedabove, "chronic morning headache" was associated with circadian rhythmdisorder using strict DSM-IV and ICSD diagnostic criteria(OR = 1.97 [1.31-2.94; *P* < .001]), andthe relationship strengthened when the data were reanalyzed in a modelthat only used information obtained from individuals with "daily"morning headache (OR = 2.61).

Parasomnias

Parasomniashave seldom been addressed, but 2 epidemiological studies wereavailable indicating that a number of parasomnias are related toheadache in children and adults. Concerning adults, the Ohayon[17] study (described above in relation to insomnia and circadian rhythmdisorders) also associated chronic morning headache with nightmares Ã¢â€°Â¥ 1per week (OR = 1.76 [1.30-2.39; *P* < .001]) and dyssomnias not otherwise specified (OR = 2.30 [1.94-2.72; *P* < .001]). Concerning children, the Isik et al[14] study (described above in relation to snoring) also observedsignificant ORs in migraine and nonmigraine headache for nightmares(OR = 7.11 [4.07-12.41; *P* <

.001] and OR = 1.93 [1.55-2.41; *P* < .001] respectively), sleep bruxism (OR = 2.80 [1.70-4.61; *P* < .001] and OR = 1.78 [1.43-2.22; *P* < .001]), sleepwalking (OR = 2.77 [1.20-6.39; *P* < .02] and OR = 1.28 [0.80-2.06; *P* < .05]), sleep vocalizations (OR = 3.58 [2.17-5.88; *P* < .001] and OR = 1.87 [1.53-2.29; *P* < .001]), and bedtime struggles (OR = 3.19 [1.81-5.61; *P* < .001] and OR = 1.94 [1.59-2.37; *P* < .001]).

Significance of Snoring

Inepidemiological research, snoring is the cardinal symptom and a markerfor obstructive sleep apnea (high sensitivity/low specificity). Thedesignation "habitual" snoring, typically defined as either "daily" or"6 to 7 days/week," increases specificity while maintaining a highdegree of sensitivity. Snoring frequency positively correlates withpolysomnographic indices of respiratory disturbance and daytime sequela(hypersomnolence).[21] Despite increasing specificity, habitual snoring as a primary exposurevariable probably still represents a range of conditions along thespectrum of sleep-disordered breathing (Table 1), including obstructive sleep apnea and upper airway resistance syndrome (UARS).

Theprevailing viewpoint is that UARS represents an intermediate conditionalong the spectrum of sleep-disordered breathing. Pharyngeal propertiesin patients with UARS are intermediate between those with obstructivesleep apnea and normal controls.[22] UARS may be identified in nonapneic snorers presenting with a varietyof somatic complaints. On polysomnography, UARS is characterized bysustained or repeated airflow limitations (in the absence ofobstructive apnea/hypopnea) correlating with arousals that fragmentsleep, yielding daytime fatigue or sleepiness and increased risk forhypertension.[23] The syndrome was initially described in 1991[24] and is readily identified through polysomnography using esophageal orintranasal pressure monitoring. UARS is associated with significantabnormalities in the macrostructure[25] and microstructure of sleep,[26] and correlates with measures of daytime sleepiness and fatigue.[27]

Unfortunately,UARS is not easily distinguished from other forms of snoring byresearch methods in epidemiological studies and is believed to accountfor some health risks previously assigned to simple snoring. Likewise,UARS is a fairly recently recognized phenomenon and represents apotential confound in earlier polysomnographic research onsleep-related headache, none of which employed the sensitivepolysomnographic measures currently recommended to detect UARS.[28] Likewise, epidemiological research described in this paper linkinghabitual snoring to headache in the absence of prototypical riskfactors for obstructive sleep apnea (eg, age, male gender, obesity,hypertension) does not rule out the possibility of UARS contributing tochronic headache.

Clinical Implications

Headachepatients may benefit from early identification and treatment of atleast the most severe (sleep-disordered breathing) and prevalent(insomnia) sleep disorders. Screening questionnaires and algorithms arereviewed elsewhere.[10] The mnemonic *REST* is a useful prompt for four key questions to screen for the presence of a sleep disorder: the *Restorative* nature of the patient's sleep, *Excessive* daytime sleepiness, tiredness or fatigue, the presence of habitual *Snoring*, and whether the *Total*sleep time is sufficient. A significant proportion of sleepapnea-related headaches will improve or resolve with treatment of apnea[29Ã¢â‚¬â„¢31] and preliminary evidence suggests transformed migraine may improve with behavioral insomnia treatment.[32] Likewise, basic sleep regulation and measures to avoid development of asleep disorder may be considered as preventative measures to reducerisk for chronic headache.

Screening/Management of Sleep-Disordered Breathing

Headacherelated to sleep-disordered breathing may present as tension-type,migraine, cluster, mostly morning, or other nonspecific headaches.[33] Those with chronic or awakening headaches should be questioned aboutsymptoms (eg, habitual snoring, witnessed apnea, hypersomnolence) andrisk factors (eg, obesity, male gender, increasing age,craniofacial/oral/neuromuscular factors that diminish size or patencyofthe airway, chronic alcohol, sedatives, hypnotics, or musclerelaxants) for obstructive sleep apnea.[34,35]Patients with UARS may present at any age, 1:1 male-to-female genderratio, normal body habitus, and with a chief complaint of insomnia moreoften than hypersomnia.[36] Suspected sleep-disordered breathing warrants referral forpolysomnography to diagnose and calibrate treatment efforts to diseaseseverity, symptoms, and comorbidities. Primary treatments for sleepapnea andUARS include weight loss, treatment of nasal allergies,positional treatment for supine-related apnea, upper airway surgery,oral appliances for mandibular advancement, and continuous positiveairway pressure.[37] Because of the potential for headache to improve, reevaluation ofheadache is advised 1 month following treatment of sleep-disorderedbreathing.

Screening/Management of Insomnia

Insomniais the most common sleep complaint in clinical headache populations,observed in half to two-thirds of clinical headache patients.[10] Insomnia is usually diagnosed based on the history of *recurrent*difficulty with onset, maintenance, duration or quality of sleepdespite an adequate opportunity to sleep. Insomnia results in

daytimeimpairment, usually fatigue or sleepiness, or other somatic, cognitiveor emotional complaints. Insomnia is most often diagnosed by clinicalhistory and quantified by sleep diary or questionnaires,[10] although empirically based quantitative diagnostic criteria have beenproposed defining sleep onset latency or wake time after sleep onset>31 minutes, minimum frequency >3 nights/week, and duration ofsymptoms >6 months.[38]

Avariety of behavioral and pharmacologic treatments for sleep regulationare compatible with headache care. Behavioral interventions for bothheadache and insomnia include daily self-monitoring, progressiverelaxation training, behavior modification, and cognitive therapy.[10] Individuals already receiving behavioral treatment for headache may beparticipating in some form of relaxation training orcognitive-behavioral therapy and sleep elements can be easilyintegrated to standard behavioral headache treatments. Behavioral andcognitive-behavioral interventions for insomnia are described in Table 2 .

In a randomized controlled trial of behavioral sleep modification in the headache clinic, Calhoun et al[32] randomized 43 women with transformed migraine to either a behavioralsleep treatment (eg, consistent sleep schedule, avoiding naps,eliminating alerting activities in the sleep environment) or shamcontrol group (eg, consistent meals, acupressure as instructed, rangeof motion exercises) while both groups received usual medical care. Thebehavioral sleep intervention yielded a significant reduction inheadache frequency and intensity relative to the control group in asample of patients diagnosed with transformed migraine. Notably, theimprovement in headache was proportionate to the number of sleepbehaviors changed. Though preliminary, the study suggests that arelatively brief behavioral sleep intervention may favorably impactheadache outcomes.

Sleep Risk Factor Reduction Strategies

Thoughyet untested in headache sufferers, snoring interventions and sleepregulation strategies could be considered for headache sufferers aimedat prevention. The natural history of sleep-disordered breathingindicates a progression of snoring to obstructive sleep apnea.[39] To quantify the risk of developing sleep apnea over time, the longitudinal cohort Cleveland Family Study[34] identified a subgroup of 286 individuals without sleep apnea atbaseline; the 5-year incidence of developing mild-to-moderate sleepapnea (defined as Apnea/Hypopnea Index Ã¢â€°Â¥5/hour) was 16% and theincidence of developing moderate-to-severe sleep apnea (Apnea/HypopneaIndex Ã¢â€°Â¥15/hour) was 7.5%. Untreated snoring may worsen over time,influenced by aging and weight gain.

Weight maintenance or lossas indicated is a recommendation in managing snoring. Weight loss is aneffective treatment for snoring as well as obstructive sleep apnea Ã¢â‚¬â€œmost significantly documented in cases of surgically induced weightloss.[40] As indicated,other snoring treatments include dental appliances (eg,tongue-retaining, mandibular advancement), sleep positional training toavoid supine sleep, antihistamines and anti-inflammatory nasal sprays,nasal/palatal/intrapalatal surgical interventions, smoking cessationand avoiding regular use of muscle relaxants, alcohol, sedatives, andother substances that may suppress respiration.[41]

Basicsleep regulation for headache sufferers would encourage a lifestyle andhabits that optimize the duration, quality, and regularity of sleep.[10] The circadian rhythm is reinforced by maintaining a consistentsleep/wake schedule, avoiding significant schedule changes on weekends,avoiding shift work (eg, rotating, third shift) and phase appropriatelight exposure (dark sleep environment/light day environment). Unless abona fide short- or long-sleeper, the average individual is encouragedto sleep 7 to 8 hours per night consistent with the average homeostaticsleep need and avoiding daytime naps. Generally, individuals shouldavoid or minimize sleep altering substances such as caffeine, nicotine,and alcohol.

Conclusion

Populationstudies are generally consistent in several findings: the prevalence ofsleep disorders is greater among individuals with headache thanindividuals without headache; sleep disorders are more prevalent amongindividuals with chronic headache than episodic headache; and there isevidence from one longitudinal study that sleep complaints may be anegative prognostic indicator at least for tension-type headache. Themajority of studies have addressed sleep-disordered breathing, but awide range of sleep disorders are implicated. This is generallyconsistent with clinical literature suggesting sleep disorders areprevalent among headache sufferers seeking treatment, especiallyinsomnia.[10] Thesevarious sleep disorders linked to headache are diverse in nature butcommon to all is the dysregulation of sleep processes impactingheadache vulnerability or threshold, and possibly progression of theheadache disorder over time.

There is clinicalevidence in the case of obstructive sleep apnea and insomnia thattreatment of the sleep disorder may improve headache. Therefore, it isrecommended that screening and management for the more severe andprevalent sleep disorders be considered in headache practice. It isalso proposed that basic sleep regulation strategies that managesnoring and optimize the duration, quality, and regularity of sleep beencouraged in headache sufferers. Longitudinal studies in the futurewould help determine if regulation of sleep can reduce the risk ofheadache progression.

Table 1. Spectrum of Obstructive Sleep-Disordered Breathing†

• Quiet Breathing
Absence of snoring or breathing-related sleep disturbance
• Primary Snoring (Intermittent to Persistent)
Snoring without apnea or hypopnea or oxygen desaturation; intermittent snoring usually presents without significant daytime sequela while varying degrees of sleep disturbance may occur with persistent snoring
• Upper Airway Resistance Syndrome
Snoring with arousals from sleep, but without apnea, hypopnea or oxygen desaturation (symptomatic with sleep complaint, daytime sleepiness, risk for hypertension, etc.)
• Obstructive Sleep Apnea/Hypopnea Syndrome (Mild to Severe)
Snoring, repeated complete collapse (apnea) or partial collapse (hypopnea) of the pharyngeal airway during sleep, oxygen desaturation, resuscitative arousals from sleep

†Sleep-disordered breathing (abnormalities of the respiratory pattern or quality of ventilation during sleep) may be secondary to varying levels of airway obstruction represented in this Table, dysregulation of respiratory control (eg, central sleep apnea, Cheyne-Stokes respiration), or both (eg, mixed and complex sleep apnea)

Table 2. Behavioral Treatment Strategies Suggested for Insomnia Based on Symptoms

Treatment [*Rationale*]	Indication	Instructions
Relaxation training [*Skills to gain voluntary control over and reduce the state of hypervigilance that is incompatible w/sleep*]	High physiologic, cognitive, or emotional arousal	Progressive relaxation training to reduce physical tension (may be facilitated by EMG or other forms of biofeedback)
		Autogenic training to establish calm mental state and deter intrusive and arousing thoughts
Stimulus control [*Based on operant conditioning principles and reinforces associations between the "state of sleepiness" and the sleep environment*]	Difficulty falling asleep or staying sleep	1. Go to bed only when sleepy.
		2. If unable to fall asleep 10-20 minutes (*without watching clock, 10-20 minutes is equal to repositioning twice to try to fall asleep*), leave the bedroom. Return only when sleepy again.
		3. Use the bed and bedroom for sleep only.
		4. Set alarm and rise daily at a regular time – do not snooze.
		5. Do not nap during the day.
Sleep restriction† [*Maximizes homeostatic "sleep drive" by restricting time in bed to approximatelythe actual sleep time (based on sleep diary)*]	Excessive time spent in bed not sleeping; frequent awakenings	1. Use the sleep diary to determine: "time in bed" and "actual sleep time."
		2. Restrict "time in bed" to approximately the average number of hours of "actual sleep time" per night. (Prescribe specific bed/wake times)
		3. As diary demonstrates actual sleep time is 85% of time in bed, increase by 15-30 minute increments.
		4. Keep a fixed wake time, regardless of the actual sleep duration (*short nights are expected and increase sleep drive on subsequent night*).
		5. If sleeping <85% time in bed for 10 days, restrict time in bed further by 15-30 minutes increments.
Cognitive therapy	Racing, obsessive thoughts at	1. Patients may be asked to self-monitor or solicit beliefs and fears about sleep (*or questionnaire*[42]).
		2. Identify anxiety-provoking insomnia-perpetuating cognitions.

	bedtime; unrealistic expectations; catastrophizing or ruminative worry about sleep	[*to identify, challenge, and replace dysfunctional beliefs and attitudes about sleep and sleep loss and promote rational alternative beliefs and perceptions*] 3. Cognitive techniques are brought to challenge dysfunctional beliefs and promote rational alternative beliefs when the dysfunctional thought or emotional state occurs.
Sleep hygiene education [*Basic sleep-promoting behaviors and avoiding activities not conducive to sleep*]	Any of the above or poor sleep habits	1. Avoid daytime naps.
		2. Eliminate stimulants (caffeine, nicotine, etc.).
		3. Maintain a regular bed/wake schedule 7 days per week.
		4. Dark, quiet, comfortable sleep environment.
		5. Avoid alcohol.
		6. Regular exercise (avoid exercising 5 hours before bed).
		7. Use the bed only for sleep and sex (behaviors conducive to sleep).

†Restriction may initially create a modestly increased sleep loss or sleep deprivation and daytime sleepiness; though this deprivation heightens sleep drive to facilitate sleep at night, it may also result in daytime sleepiness. Patients should be warned about this, especially if often engaged in hazardous activities. Over successive weeks, the sleepiness will remit as time in bed is gradually increased and the individual's maximum efficient sleep time is achieved.

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Abbreviation Notes

DSM-IV = Diagnostic and Statistical Manual of Mental Disorders, 4th Ed.; ICSD = International Classification of Sleep Disorders; OR = odds ratio; UARS = upper airway resistance syndrome

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