A sleep diary and questionnaire study of naturally short sleepers

TIMOTHY H. MONK, DANIEL J. BUYSSE, DAVID K. WELSH, KATHY S. KENNEDY and LYNDA R. ROSE
Clinical Neuroscience Research Center, Western Psychiatric Institute and Clinic, University of Pittsburgh Medical Center, Pittsburgh, PA, USA

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INTRODUCTION

Although sleep durations less than 6 h are generally associated with suboptimal health (Kojima et al. 2000; Kripke et al. 1979) and performance (Carskadon and Roth 1991; Horne 1991), there is certainly a small but significant proportion of the population for whom short sleep in the 3–6 h range does not seem to be a problem. Indeed, some people can tolerate extremely short durations of sleep for years at a time (e.g. <3 h for two male subjects by Jones and Oswald (1968), and c. 1 h for an older female by Meddis et al. 1973). One can argue that such people may be ‘naturally short sleepers’ whose low sleep need enables them to thrive even with comparatively little sleep. A recent twin study suggests that there may be a genetic basis for such variation in natural sleep duration (Heath et al. 1998).

Hartmann et al. (1971) made a careful study of short ( 6 h) vs. long (>9 h) sleepers (all men), ensuring that the former group were not constrained by temporal demands to be short sleepers, but were true naturally short sleepers. Interestingly, there were few differences between the two groups, except the obvious ones of time spent asleep. Slow Wave Sleep (SWS) appeared to be preserved in short sleepers, but short sleepers had about half as many minutes of REM sleep as long sleepers. This coincided with contemporary findings by Webb and Friel (1971) using college freshmen, and also with later studies by Benoit et al. (1980) and Aeschbach et al. (1996).

Many studies have noted various psychological differences between short and long sleepers, although in several of these studies the short sleepers may have had their sleep shortened by psychiatric disorders, sleep disorders, or self-imposed sleep restriction. Studies which made some effort to exclude subjects with sleep or psychiatric complaints have found naturally short sleepers to be more neurotic (Kumar and Vaidya 1982), more extroverted (Hartmann et al. 1971, 1972), more anxious (Kumar and Vaidya 1984; Sexton-Radek 1998), and to have more eating disorder symptoms (Hicks and Rozette 1986), and fewer sleep-promoting behaviors (Hicks and Youmans 1989).

In this questionnaire study, we examined sleep and personality characteristics of a group of naturally short sleepers, of both genders, covering the 20–59 years age range. We sought to select subjects who were not experiencing daytime sleepiness or the need for extensive ‘catch-up’ sleep at weekends. Measurement instruments included diaries and questionnaires to assess: sleep duration and timing, sleep pathology, chronotype (morningness–eveningness), personality, pathological daytime sleepiness, subclinical hypomania, optimism,

SUMMARY

Whereas most people require more than 6 h of sleep to feel well rested, there appears to be a group of people who can function well on between 3 and 6 h of sleep. The aims of the present study were to compare 12 naturally short (3–6 h) sleepers (9 males 3 females, mean age 39.6 years, SD age 10.1 years) recruited by a media publicity campaign with age, gender and chronotype matched medium length (7–8.5 h) sleepers on various measures. Measurement instruments included diaries and questionnaires to assess sleep duration and timing, as well as questionnaire assessments of sleep pathology, morningness–eveningness, extraversion, neuroticism, pathological daytime sleepiness, subclinical hypomania, optimism, depressive symptoms, exercise, and work habits. Few measures showed reliable differences between naturally short sleepers and controls except the obvious ones related to sleep duration. There was, however, some evidence for subclinical hypomanic symptoms in naturally short sleepers.

KEYWORDS alertness, diary, human, hypomania, personality, sleep
depressive symptoms, exercise, and work habits. We identified subjects for whom 3–6 h of sleep per night is sufficient to maintain good alertness and performance during the day, and who have no reported daytime somnolence, and/or no requirement for extra long ‘recovery sleeps’ on weekends. Specifically, we compared sleep and personality features of 12 naturally short (3–6 h) sleepers to those of age and gender matched normal length (6.5–8 h) sleepers.

**METHODS**

**Subject recruitment**

Media announcements (TV, radio and print) were released in the Greater Pittsburgh market, announcing the research study and specifically inviting naturally short sleepers to get in touch with the research team. A total of 110 calls were received, of whom 76 (36 males and 40 females) were interested enough to complete a preliminary telephone interview in order to determine whether they were appropriate for the study. Exclusion criteria were: age outside the 20–59 years range, habitually sleeping more than 6 h per night, use of medications known to affect sleep, a history of sleep disorders, shift work, children under 2 years living at home, napping, a personal history of mental illness, excessive daytime sleepiness, and extended catch-up sleeps on weekends. A total of 35 subjects initially passed this prescreen and were invited to participate, a total of 16 accepted the invitation, and good data were finally obtained from a total of 14 appropriate subjects. The most frequent reasons for exclusion at prescreening were excessive recovery sleeps, shift work, and mental, physical or sleep disorders.

**Diary verification of naturally short sleeper status**

The 2-week sleep diary (Pittsburgh Sleep Diary – PghSD; Monk et al. 1994) from the 14 eligible subjects was examined to see whether they were truly short sleepers (i.e. averaging 6 h or less sleep per night). The total time spent in bed (TIB) from both nocturnal sleeps and daytime naps, over the 2-week period was calculated. The diary sleep efficiency (proportion of in-bed time spent asleep) was then calculated by summing nocturnal estimates of sleep latency and wake after sleep onset, subtracting that total from TIB, and then dividing the result by TIB. Multiplication of this figure by the total (2-week) TIB and dividing by 14 then yielded the estimated sleep time per 24 h for that subject. The resulting figure ranged from 3.54 to 6.90 h. The two longest sleeping subjects had values of 6.90 and 6.39 h, respectively, and were not studied further. The next longest was 6.15 h which was deemed to be sufficiently close to 6 h to be included. Thus, there were 12 subjects eventually included, with 24 h sleep values between 3.54 h and 6.15 h (mean = 5.18 h). Ages ranged from 20 to 49 years (mean: 39.6 years, SD = 10.1 years); there were three women and nine men. There was one homemaker and one college student; the remainder had jobs involving 40 h or more of work per week. In terms of chronotype [as measured by the Smith et al. (1989) composite scale of morningness], there were no evening types, six intermediate types and six morning types (overall mean score: 41.6, SD = 7.6).

**Control group**

After data collection was complete from the 12 naturally short sleepers, a convenience sample of 12 medium length sleeping (‘control’) subjects were recruited. Most of the control subjects had previously volunteered for University of Pittsburgh sleep experiments and complied with all of the inclusion criteria specified for the naturally short sleepers, except with regard to habitual sleep duration, which for them was required to be between 6.5 and 8 h per night. Each control was paired to a naturally short sleeper of the same gender, similar age, and similar chronotype. Thus, in the control group, there were three females and nine males, with ages ranging from 21 to 50 years (mean: 40.4 years, SD = 10.0 years), and a mean morningness score of 41.8, SD = 7.0).

**Instruments and procedures**

Subjects were sent a packet of material to be completed at home and returned to the research team. This included provision for informed consent, and a mechanism by which the subject could be financially recompensed ($20). The experiment was approved by both the University of Pittsburgh, and the NASA Johnson Space Center, human research ethics committees. All postage was prepaid by the research program. A 2-week diary (PghSD) was completed each morning and evening yielding daily estimates of bedtimes, waketimes, sleep latency, wake after sleep onset, mode of awakening and ratings of sleep quality, mood, and alertness on waking, as well as daytime information on naps, exercise, meals and caffeine and tobacco use.

Subjects also completed a set of one-time questionnaires. First there was a brief form requiring demographic information, as well as answers to questions regarding the time spent working, exercising, and care-giving. As a complement to the PghSD sleep diary, sleep timing and duration was also assessed using the Sleep Timing Questionnaire (STQ), which is included in Appendix A. From the STQ one can derive measures of habitual time in bed on both worknights and rest nights, as well as estimates of sleep latency, wake after sleep onset, and stability of bed and wake times.

Next there was an ‘Attitude to Life’ scale. This scale, based on the self-report inventory for mania developed by Shugar et al. (1992), was used to assess the presence of subclinical (nonpathological) mania-like symptoms. We made two major changes in modifying Shugar et al.’s (1992) ‘Self-report manic inventory’ into our ‘Attitude to Life’ scale. First, instead of asking the subject to compare his behavior in the past week with his ‘normal self’, we now asked subjects to compare themselves with ‘most people’ (in all items). Secondly, in
contrast to the Shugar instrument which was designed to look for pathological behaviors, the present scale sought to measure these same tendencies but in behaviors that were still socially acceptable. We presented similar sentences, but in a socially acceptable form. Thus, for example, sentences like ‘I masturbated more often’ were dropped entirely (because of subject acceptability), as were sentences like ‘I heard voices when people weren’t there’ (because it represented psychotic behavior). Other sentences were simply rephrased. Thus, for example, ‘I spoke on and on and couldn’t be interrupted’ became ‘I less like being interrupted’, and ‘I had sex with people that I usually wouldn’t have sex with’ became ‘I am less careful about new relationships’. A total of 42 sentences were presented (see Appendix B), and the subjects placed a check (tick) beside each sentence with which they agreed. Thus, the more items checked, the greater the tendency towards nonclinical hypomania.

Next there was the PSQI (Buysse et al. 1989), assessing the level of sleep pathology, and the Composite Scale of Morningness [CSM – Smith et al. (1989)] assessing the degree to which the individual was a morning-type vs. an evening-type person (chronotype). The Epworth Sleepiness Scale (Johns 1994) was also given to quantify self-reported daytime sleepiness levels. The packet ended with the Eysenck Personality Inventory (EPI – Eysenck and Eysenck 1963) assessing extraversion, neuroticism, and the tendency to give probably erroneous but socially acceptable answers (‘Lie scale’). At a later date, subjects were sent the Life Optimism scale (LOT) and the CES-D to complete, assessing optimism and depressive symptoms, respectively. Eight of the twelve subjects returned the former, nine the latter. There were also occasional missing data from the other instruments.

RESULTS

Results are given in Table 1. Because matched pairs of naturally short sleepers and controls had been constructed, paired t-tests could be performed. There were few measures on which the two groups reliably differed. As expected, scores relating to sleep duration showed highly significant effects. On nights preceding a workday (‘worknights’), naturally short sleepers reported 5.3 h in bed as compared with 7.1 h for controls (P < 0.001); with corresponding figures of 6.3 vs. 7.8 h (P < 0.02) for nights preceding a day off (‘restnights’). On both worknights and restnights, the naturally short sleepers went to bed later than controls, but awoke at similar times in the mornings. The difference in time in bed (TIB) between worknights and restnights was slightly more for naturally short sleepers (60 min) than for controls (41 min), though this did not achieve significance (t < 1; P > 0.25). Thus, naturally short sleepers did not appear to be excessively making up for lost sleep on weekends. Moreover, Epworth Sleepiness Scale scores were identical for the two groups (at 6.83), indicating no negative daytime alertness consequences for the short sleepers. Thus, it would appear that our screening procedures had succeeded in excluding from study those who were sleeping short unwisely, leaving in those who were truly naturally short sleepers.

From the PSQI, naturally short sleepers had higher overall scores (indicating more problems) than controls (4.6 vs. 2.3; P = 0.01), though neither figure reached the 5.0 cut-off conventionally used to indicate the presence of a clinical sleep disorder. This apparent difference, however, may be attributed to the PSQI items relating to sleep duration. When these items were removed, no reliable difference between the groups emerged (P > 0.50). Thus, there was no evidence that the sleep of naturally short sleepers was being truncated by sleep pathology.

The Attitude to Life scale showed a major difference, with naturally short sleepers endorsing more than twice as many items as controls (15.5 vs. 7.0; P < 0.005). Although no difference emerged for extraversion, there was a slight tendency for naturally short sleepers to be more neurotic (or, more accurately, less stable) than controls (P = 0.08). The ‘lie scale’ from the EPI indicated a slight, but nonsignificant (P = 0.13) tendency for naturally short sleepers to give socially acceptable answers.

DISCUSSION

One of the most intriguing aspects of the present study is the difference observed between naturally short sleepers and controls on the Attitude to Life scale, a scale that essentially comprised of a socially acceptable measure of hypomanic symptoms. This raised the possibility that naturally short sleepers may be more hypomanic in their approach to life.
A close association between short sleep and elevated mood has been known for some time (Vogel et al. 1989; Wehr and Goodwin 1981). Partial or total sleep deprivation, or selective REM sleep deprivation, seems to cause mood elevation, and has been used clinically for the treatment of depression. Patients diagnosed with bipolar disorder (manic-depressive illness) go through discrete episodes of mood elevation sufficient to be labelled mania or hypomania (depending on severity), and during these episodes they have a decreased need for sleep. Indeed, short sleep has been codified as one of the DSM-IV diagnostic criteria defining mania and hypomania (American Psychiatric Association 1994). This association between short sleep and elevated mood is also apparent in certain extreme cases of subjects who spontaneously alternate between short and long sleeps, with elevated mood invariably following the short sleeps (Welsh et al. 1986).

In order to further explore this issue of hypomania, one can revisit the classic studies of Webb and Friel (1971) and Hartmann et al. (1971, 1972). Webb and Friel (1971) studied college students who claimed to have long-standing short sleep patterns, and found no statistically significant personality differences compared with control subjects. Hartmann et al. (1972) studied a wider age range of subjects recruited from media advertising, and described in some detail the care used to exclude subjects complaining of sleepiness, or short sleepers who ‘catch up’ on weekends. In this somewhat different population (more similar to our own), a number of differences were found. The naturally short sleepers reported fewer dreams (consistent with less REM sleep), less exercise time, and fewer mood complaints. Personality tests indicated that they were more extroverted, energetic, aggressive, and ambitious, and less anxious. They also scored higher on the MMPI ‘lie scale’ for social conformity. Clinical interviews gave rise to a summary description of the naturally short sleepers as ‘…efficient, energetic, ambitious persons who tended to work hard and to keep busy. They were relatively sure of themselves, socially adept, decisive, and were satisfied with themselves and their lives. They had few complaints…. They were somewhat conformist…. They were extroverted and definitely were not “worriers”…. They seemed relatively free from psychopathology, but insofar as there was pathology it consisted of a tendency to avoid problems by keeping busy and by denial, which in some cases approached hypomania.’ Early case reports of extremely short sleepers are consistent with this profile, describing the subjects as vigorous, active, and approaching hypomania (Jones and Oswald 1968), or as ‘despising inactivity’ (Meddis et al. 1973). The negative findings of Webb and Friel (1971) may be related to differences in subject selection criteria. Thus, from the previous literature there is some evidence for subclinical hypomania in naturally short sleepers.

One of the objectives of the present study was to examine personality variables in naturally short sleepers using the EPI. No reliable differences were observed in extroversion between naturally short sleepers and controls. In terms of neuroticism, there was some tendency for naturally short sleepers to score higher than controls ($P = 0.08$), although both groups appeared quite stable when viewed against population norms. Naturally short sleepers also had more of a tendency than matched controls to give socially acceptable answers, as determined by the ‘lie scale’, though this result was not statistically significant ($P = 0.13$). Thus, our data show some support for the hypomanic-like personality features found in earlier studies. However, no significant differences emerged in optimism or depressive symptoms, as assessed by the LOT and the CES-D, respectively. In the EPI results, as in the results for the CES-D and LOT, a larger sample size may have led to statistically significant differences.

In designing this study we were careful to match the naturally short sleepers and the controls for chronotype, because we did not wish to complicate the present findings with differences in preferred circadian phase. It is noteworthy that despite the fact that none of the naturally short sleepers rated themselves as evening types according to the morningness–eveningness instrument, it was at the beginning of the night that the shortening of sleep occurred. Thus, the naturally short sleepers went to bed significantly later than the controls (by 87 min on worknights, 127 min on restnights), but awoke at essentially the same time of day as the controls in the morning. It would not therefore seem to be the case that it was circadian pressure towards a phase delay that was causing the naturally short sleepers to select later bedtimes, but rather either a reduced (homeostatic) need for sleep, or an ability to live with higher levels of homeostatic pressure. Evidence from the recent literature suggests it is more likely to be the latter. Aeschbach et al. (1996) studied the physiological basis of naturally short and long sleepers (male college students), subjecting both groups to a night of sleep deprivation, and investigating the consequent recovery sleeps. In the context of a theoretical framework provided by the two-process model of sleep regulation (Daan et al. 1984), they concluded that naturally short sleepers live under a higher non-REM sleep pressure than normal sleepers. The dynamics of Process S accumulation and dissipation did not differ between the two groups. Thus, although the homeostatic (Process S) drive was no different for short sleepers, they chose to accommodate higher sleep pressure on a daily basis (and by subjective measures were also better able to cope with the night of sleep deprivation). In our ongoing and future studies, we aim to further explore the rhythmic and homeostatic aspects of naturally short sleepers by comparing them with controls in an intensive laboratory study in which circadian rhythms and polysomnographic sleep measures will be taken.

In selecting subjects for the present study we sought to avoid simply concentrating upon undergraduate students. As we are increasingly aware, the middle years of life may be characterized by quite different patterns of sleep and sleep fragility than those observed in younger adult years (Carrier et al. 1997). Moreover, few undergraduates would be expected to have the average waketimes we observed in our samples (about 06:00 h on workdays, 07:00–07:30 h on restdays); which are times that
are quite normal for the rest of the local population. Thus, from both biological and behavioral perspectives it may be the case that the study of middle-aged naturally short sleepers yields a different picture than one would see in undergraduate samples. As one moves to the older years of life, these differences may be further exaggerated by differences in rhythmic and homeostatic sleep drives (Reynolds et al. 1991).

It is noteworthy that many of the potential subjects volunteering for our study, and considering themselves to be ‘naturally short sleepers’, were found to fail our fairly rigorous criteria designed to exclude those who were sleeping short, either unwisely in order to accommodate work or caregiving schedules, or in response to poor mental or physical health. As work hours increase and time becomes an ever more precious commodity, it is important that people do not convince themselves erroneously that less than 6 h of sleep per night is alright for everyone.

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Appendix A  Sleep timing questionnaire (STQ)

SLEEP AND CHRONOBIOLOGY CENTER

Name __________________________________________ ID No.__________________________________
Date _______________________________________

Sleep Timing Questionnaire (STQ)

This questionnaire asks about when you normally sleep. We are interested in getting as accurate a picture as we can of the times when you normally go to bed and get up. Please think carefully before giving your answers and be as accurate and as specific as you can be. Please answer in terms of a recent ‘normal average week’, not one in which you traveled, vacationed or had family crises. Thanks.

Please think of GOOD NIGHT TIME as the time at which you are finally in bed and trying to fall asleep.

On the night before a work day or school day,
what is your earliest GOOD NIGHT TIME?: ___:___ pm/am
On the night before a work day or school day,
what is your latest GOOD NIGHT TIME?: ___:___ pm/am
On the night before a work day or school day,
what is your usual GOOD NIGHT TIME?: ___:___ pm/am

How stable (i.e. similar each night) are your GOOD NIGHT TIMES before a work day or school day? (circle one)
0–15 min 16–30 min 31–45 min 46–60 min 61–75 min 76–90 min
91–105 min 106–120 min 2–3 h 3–4 h over 4 h

On a night before a day off (e.g. a weekend),
what is your latest GOOD NIGHT TIME?: ___:___ pm/am
On a night before a day off (e.g. a weekend),
what is your usual GOOD NIGHT TIME?: ___:___ pm/am

How stable (i.e. similar each night) are your GOOD NIGHT TIMES on a night before a day off (e.g. a weekend)? (circle one)
0–15 min 16–30 min 31–45 min 46–60 min 61–75 min 76–90 min
91–105 min 106–120 min 2–3 h 3–4 h over 4 h

Please think of GOOD MORNING TIME as the time at which you finally get out of bed and start your day.

Before a work day or school day,
what is your earliest GOOD MORNING TIME?: ___:___ am/pm
Before a work day or school day,
what is your latest GOOD MORNING TIME?: ___:___ am/pm
Before a work day or school day,
what is your usual GOOD MORNING TIME?: ___:___ am/pm

How stable (i.e. similar each night) are your GOOD MORNING TIMES before a work day or school day? (circle one)
0–15 min 16–30 min 31–45 min 46–60 min 61–75 min 76–90 min
91–105 min 106–120 min 2–3 h 3–4 h over 4 h
Before a day off (e.g. a weekend),
what is your earliest GOOD MORNING TIME?: ___:___ am/pm
Before a day off (e.g. a weekend),
what is your latest GOOD MORNING TIME?: ___:___ am/pm
Before a day off (e.g. a weekend),
what is your usual GOOD MORNING TIME?: ___:___ am/pm

Appendix A (Continued)

How stable (i.e. similar each night) are your GOOD MORNING TIMES on a night before a day off (e.g. a weekend)? (circle one)

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These questions are about how much sleep you lose to unwanted wakefulness:

On most nights, how much sleep do you lose, on average, from waking up during the night (e.g. to go to the bathroom)? ___ min

On most nights, how long, on average does it take you to fall asleep after you start trying? ___ min

These questions are about how much sleep you lose to unwanted wakefulness:

0–15 min 16–30 min 31–45 min 46–60 min 61–75 min 76–90 min

Appendix B

ATTITUDE TO LIFE QUESTIONNAIRE
Please put a check beside each sentence that you agree with:

‘Compared with most people...’

- I have more energy.
- I have trouble sitting still.
- I drive faster.
- I drink more alcohol.
- I change clothes more often.
- I wear brighter clothes.
- I play music louder.
- I eat faster.
- I eat more.
- I sleep fewer hours.
- I more often start things I don’t finish.
- I give away more possessions.
- I buy more gifts for people.
- I spend money more freely.
- I accumulate more debt.
- I make more risky business decisions.
- I party more.
- I flirt more.
- I am more interested in sex.
- I am less careful about new relationships.
- I spend more time on the phone.
- I speak more loudly.
- I speak faster.
- I enjoy puns and rhymes more.
- I break into other conversations more.
- I less like being interrupted.
- I more enjoy being the center of attention.
- I more like to joke and laugh.
- I am more entertaining to be with.
- I feel more ‘on top of the world’.
- I am more cheerful.
- I am more irritated by other people’s bad behavior.
- I am more likely to get into arguments.
- I am more likely to be so full of ideas I don’t have time to do them all.
- My thoughts come more quickly.
- I find it more difficult to concentrate for long periods of time.
- I am more important.
- I feel I can make more of a difference in the world.
- I am more likely to be right most of the time.
- I have greater abilities.
- I am more able to take on jobs for which I am not trained.
- I am more likely to be able to guess what others are thinking.

REFERENCES


