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The Pittsburgh Sleep Diary

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SUMMARY Increasingly, there is a need in both research and clinical practice to document and quantify sleep and waking behaviors in a comprehensive manner. The Pittsburgh Sleep Diary (PghSD) is an instrument with separate components to be completed at bedtime and waketime. Bedtime components relate to the events of the day preceding the sleep, waketime components to the sleep period just completed. Two-week PghSD data is presented from 234 different subjects, comprising 96 healthy young middle-aged controls, 37 older men, 44 older women, 29 young adult controls and 28 sleep disorders patients in order to demonstrate the usefulness, validity and reliability of various measures from the instrument. Comparisons are made with polysomnographic and actigraphic sleep measures, as well as personality and circadian type questionnaires. The instrument was shown to have sensitivity in detecting differences due to weekends, age, gender, personality and circadian type, and validity in agreeing with actigraphic estimates of sleep timing and quality. Over a 12–31 month delay, PghSD measures of both sleep timing and sleep quality showed correlations between 0.56 and 0.81 ($n = 39$, $P < 0.001$).

KEYWORDS diary, human, log, sleep

INTRODUCTION

The purpose of this paper is to describe a diary instrument which is useful for the quantification of subjectively reported sleep and waking behaviours. The instrument has been used on more than 700 different individuals over the past five years including sleep disorders centre patients, psychiatric patients, seniors and healthy young and middle-aged adults. Selections from these data are used to confirm the sensitivity, validity and reliability of the instrument.

Ever since the groundbreaking studies of Tune (1968, 1969) and McGhie and Russell (1962), sleep diaries have been demonstrated to be useful research tools. As several authors have pointed out, however, one must be careful to distinguish between *subjective* and *objective* patterns of sleep and evaluations of sleep quality (e.g. Knab and Engel 1988). Several sleep diaries involving only the *patterning* of sleep are currently in use (e.g. Weitzman *et al.* 1982). In our diary we sought to extend the information obtained to include factors related to the activities of the day (in an evening 'bedtime' questionnaire) and evaluations of the night of sleep (in a morning 'waketime' questionnaire).

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The bedtime questionnaire was concerned with: (1) the timing of breakfast, lunch and dinner, (2) the consumption of caffeine, alcohol and tobacco products, (3) the use of prescribed and over-the-counter medications, and (4) the timing and duration of daytime exercise and naps.

The waketime questionnaire was concerned with: (1) the timing of going to bed, turning out lights [referred to in our laboratory as 'Good Night Time' (GNT)], minutes to sleep onset, and final waketime [referred to as 'Good Morning Time' (GMT)]; (2) the method of final waking; (3) the incidence, duration and reasons for wake after sleep onset; (4) three 10 cm visual analogue scales measuring: the subjective sleep quality of the sleep episode, mood on awakening (tense vs. calm) and alertness on awakening (sleep vs. alert). The three visual analogue scales (VAS) were based on the factor analytic work of Herbert Johns and

SLEEP DIARY **BEDTIME** KEEP BY BED study ID#.....

Please fill out this part of the diary last thing at night.

day..... date..... initials.....

Today, when did you have: breakfast.....
(if none, write "none")
lunch.....
dinner.....

How many of the following did you have in each time period?
(if none, leave blank)

	before or with breakfast	after breakfast before/with lunch	after lunch before/with dinner	after dinner
caffeinated drinks	.....	.....	.....	.....
alcoholic drinks	.....	.....	.....	.....
cigarettes	.....	.....	.....	.....
cigars/pipes/plugs (of chewing tobacco)	.....	.....	.....	.....

Which drugs and medications did you take today?
(prescribed & over the counter)

name	time	dose
.....	.....	.....
.....	.....	.....
.....	.....	.....
.....	.....	.....

What exercise did you take today? (if none, check here.....)

start..... end..... type.....

start..... end..... type.....

How many daytime naps did you take today? (if none, write 0).....
give times for each:

start..... end..... start..... end.....

SLEEP DIARY **WAKETIME** KEEP BY BED study ID#.....

Please fill out this part of the diary first thing in the morning.

day..... date..... initials.....

went to bed last night at.....

lights out at.....

minutes until fell asleep.....

finally woke at.....

awakened by: (check one) alarm clock/radio.....
someone whom I asked to wake me.....
noises.....
just woke.....

after falling asleep, woke up this many times during the night (circle)
0 1 2 3 4 5 or more

total number of minutes awake.....

-woke to use bathroom (circle # times)
0 1 2 3 4 5 or more

-awakened by noises/child/bedpartner (circle # times)
0 1 2 3 4 5 or more

-awakened due to discomfort or physical complaint (circle # times)
0 1 2 3 4 5 or more

-just woke (circle # times)
0 1 2 3 4 5 or more

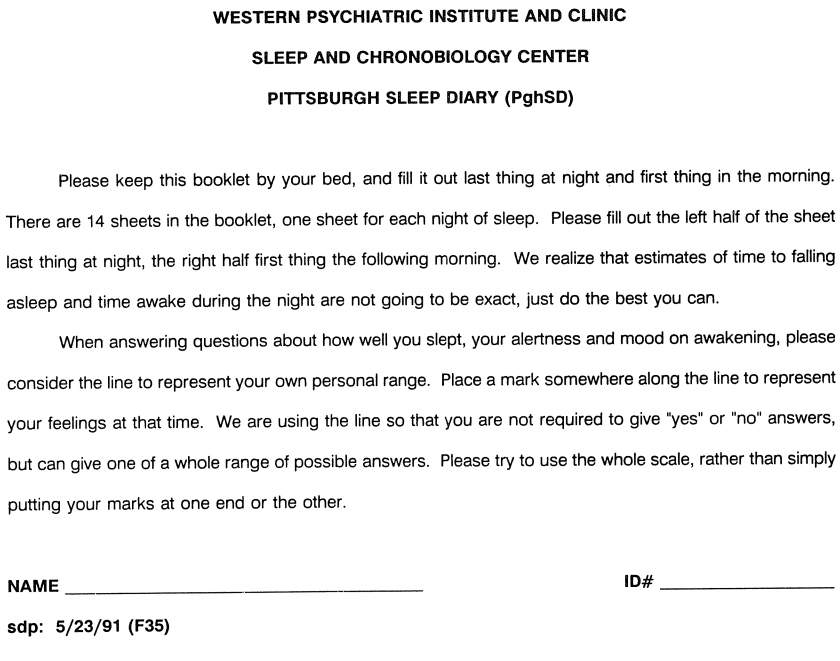
RATINGS (place a mark somewhere along the line)

SLEEP QUALITY:
very bad _____ very good

MOOD ON FINAL WAKENING:
very tense _____ very calm

ALERTNESS ON FINAL WAKENING:
very sleepy _____ very alert

Figure 1. A sample page of the Pittsburgh Sleep Diary (PghSD)



WESTERN PSYCHIATRIC INSTITUTE AND CLINIC

SLEEP AND CHRONOBIOLOGY CENTER

PITTSBURGH SLEEP DIARY (PghSD)

Please keep this booklet by your bed, and fill it out last thing at night and first thing in the morning. There are 14 sheets in the booklet, one sheet for each night of sleep. Please fill out the left half of the sheet last thing at night, the right half first thing the following morning. We realize that estimates of time to falling asleep and time awake during the night are not going to be exact, just do the best you can.

When answering questions about how well you slept, your alertness and mood on awakening, please consider the line to represent your own personal range. Place a mark somewhere along the line to represent your feelings at that time. We are using the line so that you are not required to give "yes" or "no" answers, but can give one of a whole range of possible answers. Please try to use the whole scale, rather than simply putting your marks at one end or the other.

NAME _____ ID# _____

sdp: 5/23/91 (F35)

Figure 2. The header page to the PghSD diary booklet

RESULTS

Study 1 ($n = 96$)

Because of differences due to the presence or absence of work commitments with respect to sleep timing, separate analyses were made for week nights (Sun–Thur nights) and weekend nights (Fri, Sat nights). Results are detailed in Table 1. Related-means t-tests confirmed significant weeknight vs. weekend night differences for all measures ($t > 4.9$, $P < 0.0001$, all cases). Figure 3 illustrates frequency histograms for these findings. When data were averaged throughout the whole week, 7.7 h was spent in bed.

On average, subjects awoke 1.24 (±0.78) times per night, remaining awake for an average total of 11 min (±13 min). The most frequently stated reason for final awakening at the end of the night was "alarm clock/radio" (41%) followed by "just woke" (38%), "noises" (12%), and "someone whom I asked to wake me" (9%). As Fig. 4 reveals, the three VAS subjective ratings showed approximately Gaussian distributions, truncated at the top end. Means and standard deviations are presented on the figures.

Study 1 gender differences

From various studies (e.g. Wever 1979) it has been suggested that women have a greater need for sleep than men. Our data confirmed a gender difference with a mean time in bed of 478 min (±52 min) for females vs. 448 min (±44 min) for males ($t = 3.16$, $P < 0.005$). This was achieved by bedtimes that were significantly earlier in the females (23.39 hours vs. 24.06, hours $t = 2.22$, $P < 0.05$). No other significant gender differences emerged.

Study 1 correlations with personality

Personality was assessed by the Eysenck personality inventory which yielded measures of extraversion–introversion, and neuroticism–stability (considerations of subject burden forbade a more rigorous or exact evaluation of personality). Extraversion correlated with time of going to bed and attempting to fall asleep (rho = 0.238, rho = 0.212; $P < 0.05$ both cases) with extraverts going to bed later. Neurotics experienced more awakenings during

Variable	*Weeknight*	*Weekend*	*t*	*P*
Bedtime (hours)	23.37 (60)	00.31 (77)	9.24	0.0001
Tried to sleep at (hours)	23.53 (59)	00.44 (76)	8.87	0.0001
Minutes until sleep	13 (8)	10 (7)	4.96	0.0001
Waketime (hours)	07.10 (66)	08.40 (84)	12.71	0.0001
Time in bed	7.33 (52)	8.09 (71)	5.33	0.0001

Table 1 Mean times from two-week diary ($n = 96$). Standard deviations (minutes) are given in parentheses.