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Self-Reported versus Recorded Sleep Position: An Observational Study

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ABSTRACT
Writing is an important tool in the process of learning and communication. Many universities across the United States recognize the importance of implementing writing into respective learning disciplines through a number of approaches. A respiratory therapy program at a large urban university recently assimilated a writing intensive course into their baccalaureate curriculum over a two-year period. A faculty member and a graduate teaching assistant planned as co-instructors various writing assignments that would incorporate writing as an activity to promote critical thinking and learning. The instructors made a dedicated effort to improve professional communication skills through various writing-to-learn strategies and observed the students appreciating an opportunity to be creative.

INTRODUCTION
Confidence in people's self-reported sleep position is important in several settings. Allied health professionals rely on patients to supply accurate and reliable information about their 'usual' and 'recent' sleep positions, and reasons for changes to these, in order to construct appropriate health management strategies.[1] For example patients who present to allied health practitioners with nocturnal and or waking musculoskeletal symptoms are often asked about their 'usual' and 'recent' sleep positions to determine if these could be stressing anatomical structures and contributing to the presenting problem.[2] Moreover, a change in sleep position is reported as being beneficial to the health of people who suffer a range of medical conditions such as heartburn, chronic indigestion, [3] asthma or other respiratory illnesses, [4] and sleep apnoea.[5]

Manufacturers are increasingly producing pillows that are claimed to be specifically designed for side or supine sleepers. Key assumptions are that purchasers are familiar with their 'usual' sleeping positions, and that 'usual' sleep positions are habitual.

People first begin to develop a definite sleep position, at about three months of age, when infants begin to move freely and turn over by themselves, by the age of seven years a definitive sleep position is assumed (6). In adults the most common reported sleep position is the semi-foetal position, with other common positions being full-foetal, prone and supine.[6,7,8] Although individuals have a pattern of constancy with regard to sleep position [9] as age increases this pattern changes with increased preference for the side sleep position, decreased preference for the prone sleep position, decreased position shifts and increased amounts of postural immobility [10] lasting between 45 and 110 minutes.[11,12]

Adult subjects are reported to change their position of sleep between three and 36 times per night. [6,7,11,13] Reports of position shifts vary considerably between studies due to the sensitivity of the recording or observation technique and the definition of position shift.[14] A videotape study undertaken to observe only body position changes in adults reported that participants averaged 13 body position shifts per night.[11] Good sleepers change sleep position during the night less often than poor sleepers.[7,12,15] Subject self-estimates of body movement frequency during the night are reported to be significantly related to recorded gross body movements.[16] Position shifts during the night have been related to stage of sleep,[17,18] medication usage, [19,20] level of comfort which may be related to temperature, hardness of the bed surface, [18] soft tissue compression[21] uncomfortable pillow,[22] unfamiliar surroundings, noise, anxiety and stress,[17] medical and musculo-skeletal condition,[9, 23, 24, 25, 26] and partner movement.[27]

This study does not concern itself with issues of sleep laterality but investigates the validity, consistency and reliability of self reported supine, prone and side sleep positions and specifically asks the questions:

- Do people sleep in the position they report they sleep in?
- Is there agreement over time with regard to self reports of sleep position?
- Is there agreement over time between self reported sleep position and recorded sleep position?

Ethics approval for this study was gained from the University of South Australia, the Queen Elizabeth Hospital, Woodville, South Australia and complied with the Helsinki Declaration.

METHOD

Location

This study was conducted at the Centre for Sleep Research of the University of South Australia, which is housed at The Queen Elizabeth Hospital, Woodville, South Australia. The sleep laboratories are modern and comfortable with a bed, chair, desk and TV provided in each room. Subjects have access to a lounge room, bathroom and kitchen facilities to allow them to perform their usual bedtime rituals in privacy and comfort.

Subjects

Subjects were eligible for the study if at the time of the study they were not suffering from any sleep disorder or any current medical or emotional condition which altered their usual sleep behaviours. Twelve eligible male and female volunteers were recruited from individuals known to the Sleep Centre from other studies, and from colleagues of the researchers. Recruitment was in age strata of 18 to 39 years, 40 to 59 years and 60 years and over.

All participants were mailed an information sheet two weeks prior to commencement of the study and written informed consent was obtained from each subject at the commencement of the study.

Considering the 'first night' effect

It is general practice in sleep research not to use data collected on the first night of sleep in the sleep laboratory. This is considered to be an adaptation night to take account of the effect of a different sleep environment which may influence usual sleeping patterns. It is known that during a subject's first night of sleep in a laboratory they have an increased state of vigilance or arousal, which is considered to be a normal stress response to a novel or uncomfortable situation.[28.29] The first night effect in normal subjects is characterised by a longer rapid eye movement (REM) sleep latency, increased wakefulness within total sleep time, and decreased sleep efficiency.[30]

It has been shown that the first night effect is strongly associated with the experimental surroundings and the recording method itself (31). When the physical imposts of providing recordings in a sleep laboratory are reduced and a comfortable friendly environment is provided, the first night effect has been shown to diminish.[29,30,32] To ameliorate any first night effect, subjects in this study were encouraged to follow their usual bed time rituals. They used their own pillow and were encouraged to undertake their usual routine prior to retiring (including time of retiring). This maintained subjects' test environment as closely as possible to their usual sleep environment.

Procedure

Subjects slept at the Sleep Centre for one night, returned home to sleep for two nights and then spent a second night at the Sleep Centre. Two nights sleep at home between test nights were required to allow subjects who experience sleep deprivation (such as after sleeping in an unfamiliar environment such as a sleep laboratory) to recover.[30]

Data collection

Self-reports of sleep position were collected by questionnaire, administered twice, on each occasion of testing at the Sleep Centre (See Appendix). Prior to retiring, subjects recorded the position in which they believed they spent most time during a 'usual' night's sleep, and the following morning, they recorded the position in which they believed they had spent the most time during the previous night. They also reported whether this position differed from their 'usual' sleep position, and if so why this may have occurred. Actual sleep behaviours were captured on video tape.

Each sleep laboratory was lit by an infra-red light source. A video camera was attached to the ceiling directly over the bed and connected to monitors and video recorders in the control area. Subjects were videotaped for the entire time spent in bed (going to sleep, asleep and waking up) on both nights spent in the sleep laboratory. As no polysomnography was used in this study, it was not possible to determine the actual time of onset of sleep or waking, or the presence of physiological variations related to a first night effect. Thus 'sleep' was determined as a gross measure of the time spent by each subject in bed, with the intention of sleeping.

The videotapes were viewed later by one of the research team (SG), who used the video counter, which measured time in hours, minutes and seconds, to determine how much time was spent in the side, supine and prone positions whilst in bed, and the number of times subjects changed position. As described in a previous study body position was defined as prone if the subject lay on the stomach, supine if the subject lay on their back with both shoulders on the bed and left or right side, if the subject was judged to be neither on the stomach or the back and was to some degree turned either to the right or left side, as judged by the position of the shoulders.[11]

Statistical Analysis

To test validity: From the video data, the amount of time spent by each subject in side, prone and supine positions throughout the night was summed, and expressed as a percentage of the total time spent in bed. Per subject, the most common sleep position from the video data was compared with questionnaire responses. Validity was reported as the sensitivity with which subjects' reports of their 'usual' and 'last night' sleep position correlated with the video data.

To determine consistency of sleep positions, the number of hours, and the percentage of total sleep time spent in each position (calculated from the video data) was compared across both nights using paired two tailed Student t-tests. Using the same data and the same approach to testing, the number of times subjects changed position during sleep was compared.

To test reliability of self reports, the two sets of questionnaire responses were compared in three ways (nights 1 and 2 'usual' sleep, mornings 1 and 2 'last night sleep', and 'usual' and 'last night' sleep for both occasions of testing). Percent agreement was reported for each calculation. Kappa scores could not be calculated because of lack of numbers in some cells. The effect of age was assessed for all investigations, using Student t-tests, ANOVA models or chi squared tests as appropriate.

RESULTS

Subjects

The twelve subjects consisted of one male and three females in each of three age groups (18-39 years, 40-59 years and 60 years and over). All subjects reported that they experienced no usual sleep disturbance due to medical or emotional problems.

Actual sleep behaviours

Sleep positions

Calculated from the video data, the number of hours spent in side, supine and prone positions, and the percentage that these values represented of the total amount of 'sleep' is shown in Table 1 for each subject on both occasions of testing. As reported in table 2 overall 73.2% of the total amount of sleep time over the two nights was spent in the side lying position. Supine sleeping reflected a considerably lower percentage of total sleeping time, 22.3%, with prone sleeping taking up the remainder of the time. Over the two nights of testing there were no statistically significant differences between the amounts of time subjects were observed (via video) to spend in each sleep position (Table 3).

Table 1. The amount of time (hours and minutes), and the percentage of the total amount of time, spent in sleep positions by each subject as recorded by video.

Subject	Night	Age group	Gender	Side	%	**Supine**	%	Prone	%
1	1	18-39	F	8.21	96.9	0.16	3.1		
	2			4.32	69.2	2.01	30.8		
2	1	18-39	F	2.26	37.4	2.52	44.1	1.12	18.5
	2			4.06	57.7	2.03	28.9	0.57	13.4
3	1	18-39	F	3.33	55.3	1.31	23.7	1.21	21
	2			1.29	24.1	3.27	56.1	1.13	19.8
4	1	18-39	M	4.23	60.5	2.52	39.5		
	2			5.21	79	1.26	21		
5	1	40-59	F	4.33	70.9	1.52	29.1		
	2			4.25	73	1.38	27		
6	1	40-59	F	5.45	72.3	2.12	27.7		
	2			4.41	73	0.56	14.5	0.48	12.5
7	1	40-59	F	4.30	76.3	1.24	23.7		
	2			4.55	79.5	1.16	20.5		
8	1	40-59	M	4.56	72.2	1.54	27.8		
	2			3.29	84.6	0.38	15.4		
9	1	60+	F	7.43	93.5			0.32	6.5
	2			5.27	100				
10	1	60+	F	5.55	85.1	0.28	6.7	0.34	8.2
	2			4.12	58.6	1.17	17.9	1.41	23.5
11	1	60+	F	5.18	70.8	1.34	20.9	0.37	8.3
	2			5.29	87	0.46	12	0.03	1
12	1	60+	M	7.20	87.6	0.01	0.2	1.01	12.2
	2			7.07	91.8	0.03	0.6	0.35	7.5

Table 2 **The amount of time spent in each position per night (mean & standard deviation)) and the percentage of total time spent in each position per night.**

Whole Sample	Side		Supine		Prone	
Night 1 Mean (SD)	5.2 hrs (1.7)	73.2% (16.8)	1.3 hrs (0.3)	22.4% (14.1)	0.7 (0.4)	12.5% (6.0)
Night2 Mean (SD)	4.4 hrs (1.4)	73.1% (19.9)	1.2 hrs (0.2)	22.2% (14.1)	0.7 (0.5)	13.0% (8.1)

Table 3. Between night differences for time spent in each sleep position.

Position of sleep	T-test
Side	P=0.21
Supine	P=0.91
Prone	P=0.93

Position change

Subjects changed position between three and 17 times a night, with an average of 11 body position shifts per subject per night over the two nights (Table 4). Time spent in any one position ranged from 45 seconds to three hours and 46 minutes.

Table 4. Number of position shifts per night per person, per age group and per total sample (mean & (standard deviation)).

Subject	Number of position shifts	
	Night one	Night two
Subject 1.	15	12
Subject 2.	17	16
Subject 3.	10	14
Subject 4.	17	11
Mean (SD) 18-39 age group	**15 (3)**	**13 (2)**
Subject 5.	12	8
Subject 6.	9	8
Subject 7.Female	6	8
Subject 8.	9	5
Mean (SD) 40-59 age group	**9 (2)**	**7 (2)**
Subject 9.	7	3
Subject 10.	12	7
Subject 11.	16	15
Subject 12.	15	14
Mean (SD) 60+ age group	**13(4)**	**10 (6)**
Mean (SD) whole sample	**12 (4)**	**10 (4)**
Average body position shifts per night over the two nights	**11**	

Validity of recalled sleep position

Table 5 reports subjects' self reports of the position in which they believed most sleep occurred 'usually', and in which most sleep occurred 'last night', and compares these with the most common sleep position as determined by analysis of the video data. The sensitivity of patients' self report of 'usual' side lying sleep position compared with the Gold Standard video data for Night 1 was 90%, and for 'last night's' side lying sleep position there was 92% sensitivity. There was zero sensitivity for subjects' nominated supine and prone positions of 'usual' sleep, as the video data recorded these subjects as mostly sleeping on their sides. No subject nominated these positions for 'last night' sleep on Night 1.

Table 5. **Self report of most common 'usual' and 'last night' sleep positions, and the position in which most sleep occurred (video record). S = side, B = supine and P = prone.**

Subject	Night one			Night two		
	'Usual night'	'Last night'	Video	'Usual night'	'Last night'	Video
1.	S	S	S	S	S	S
2	S	S	B	B	P	S
3	S	S	S	S	B	B
4	S	S	S	S	S	S
5	S	S	S	S	S	S
6	S	S	S	S	S	S
7	S	S	S	S	S	S
8	B	S	S	B	S	S
9	S	S	S	S	S	S
10	S	S	S	S	S	S
11	P	S	S	P	S	S
12	S	S	S	S	S	S

For Night 2, the sensitivity of subjects' nominated 'usual' side lying sleep position compared with the video data was 89%, and the sensitivity of 'last night's' nominated side lying sleep position was 100%. There was 0% sensitivity of the nominated 'usual' supine sleeping position, but 100% sensitivity for 'last night's' nominated supine sleeping position. By combining the data from both occasions of testing, the sensitivity of 'usual' side lying sleep position was 89%, and 'usual' supine sleep position was zero. The sensitivity of 'last night's' side lying sleep position was 95%, and 'last night's' supine sleep position was 100%.

Consistency

There was no statistically significant difference between the two nights in the number of hours (or the percentage of total sleep time) spent by subjects in any sleep position, and there was no statistical evidence of an age effect. There was however, a statistically significant difference between the number of position shifts on nights one and two over the whole group ($p<0.05$), with the greater number of position shifts occurring on the first night. This may suggest the occurrence of a first night effect. While post-hoc testing, using an ANOVA model in which age group was applied as a covariant detected that this difference was underpinned by the sleep behaviours of the oldest age group, the effect was observed for 83.3% of the sample.

Reliability of self-reported sleep position

Table 5 provides the raw data of repeated self reports of 'usual' and 'last night' sleep position. One subject (Subject 2) was unable to correctly report her true position of sleep on both occasions. This subject reported having a very disturbed sleep on both nights of testing. However, there were high levels of agreement over the whole group between the self reports of sleep position on two occasions of testing, indicating high reliability of patients' recall of their most common position of sleep:

- Agreement between recall of 'usual' sleep position (92%)
- Agreement between recall of 'last night' sleep position (83%)

There was no influence of age on any of these calculations of agreement.

DISCUSSION

The results of this study support side-lying position as the most common adult sleep position [6,7,8] and finding an average of 11 body position shifts per night closely parallels previous reports of 13 body position shifts per night.[11]

Details of 'usual' sleep position are regularly sought by allied health professionals to direct management of nocturnal and waking symptoms. This study provides evidence that sleep positions assumed by people without sleep disorders or medical or emotional reasons for sleep disturbance are consistent. The findings also suggest that the position in which study subjects spent most time whilst asleep can be reliably recalled, both in a 'usual' sense, and relating to the previous night. These findings concur with those of Domino and Bohn, who found that subjects reliably nominated their position of 'usual' sleep over a six month period.[33]

Age does not appear to exert an influence on the reliability of self reported sleep position. Unlike previous research which has reported decreased position shifts during the night with increased age[10] this study found that age did not influence the frequency of position shift on any one night. It is recognised that the small sample of subjects in each age group may have introduced a Type 2 error into the interpretation of the data.

Corroborating evidence regarding people's ability to appropriately nominate their most common sleep position, was subjects' perceptions of the effect on their usual sleep behaviour of the orientation of the furniture in the sleep laboratory rooms. A number of subjects reported that this caused them to sleep in a position different from their habitual position at home. Two subjects whose reports of usual sleep position were in total concordance with the video reported that they had slept on the side opposite to their usual side because of the test environment. They reported this was due to the position of the bed in relation to the window and door.

These findings suggest that subjects are well aware of their usual sleep position, and can determine whether and why it differs from 'usual'. Moreover, one subject (ID=2), who was unable to accurately report her position of sleep on either occasion, commented that she had "no idea" of the position in which she slept. On the second night she commented that her sleep was restless and disturbed by dreams. This subject also exhibited the largest number of position shifts over the two nights of the study, and on night one spent 37.4% of her sleep in the side position and 44.1% in the supine position. The restless nature of her sleep combined with similar amounts of time spent in each position may be connected to her inability to report the position in which she spent most of the night. Allied health professionals should therefore consider that patients who are unable to report their 'usual' position of sleep may indeed have no specific position of sleep, and may spend similar amounts of time in several positions.

These results can not be extrapolated to subjects with known sleep disorders who have wide discrepancies between their subjective judgements of sleep and their laboratory monitored sleep.[14,17]

CONCLUSIONS

Questioning by allied health professionals regarding patients' reported 'usual' and 'recent' sleep positions are a standard method of eliciting information that directs symptom and sleep environment management. This study reports high validity, reliability and consistency in self reports of 'usual' and 'recent' sleep positions in subjects without sleep disorders or medical or emotional reasons for disturbed sleep. Confidence can thus be placed in these patients' reports of 'usual' sleep behaviours, and also in their perceptions of why their usual sleep behaviours have changed. Subjects who are unable to report their usual position of sleep may indeed have no specific position of sleep.

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Appendix

Questionnaire Before Sleep

1. In what position do you think you usually sleep most of the night?

Questionnaire After Sleep

1. In what position did you mostly sleep last night?

2. Was this different from the position that you usually sleep in? If yes, why do think you slept in a different position last night?