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Sleep Position, Age, Gender, Sleep Quality and Waking Cervico-Thoracic Symptoms

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Abstract

Purpose: An epidemiological study was undertaken to investigate the association between sleep position, age, gender, sleep quality and prevalence of waking cervical pain and stiffness, headache and aching between the scapulae and/or in the arm. **Method:** A randomly administered telephone survey was completed by 76% of prospective participants, yielding 812 completed surveys. **Results:** This study confirmed that the majority of subjects sleep in the side lying position and that this sleep position significantly protected against waking cervical, scapular and arm pain and significantly promoted high sleep quality ratings. Anecdotally, supine sleep position has been recommended for the prevention of cervical symptoms however, this study identified no advantage in adopting the supine sleep position in relation to the prevalence of waking symptoms. The adoption of an upright sleep position was significantly associated with increased prevalence of all waking symptom categories and low sleep quality ratings. These findings were of greater significance in the presence of medication use, or a medical condition which affected sleep quality. Prone sleep position was not significantly related to waking symptom reports. Small subject numbers confounded this analysis and further research in this area with larger subject numbers is required. **Conclusions:** The findings of this study support the need for health professionals to consider individuals' sleep position and waking symptom history when developing a management plan for troublesome waking symptoms.

Introduction

Adoption of habitual sleep position

At about three months of age, when infants begin to move freely and turn over by themselves, a definite sleep position starts to develop and by the age of seven years a definitive individual sleep position is assumed.¹ Adults provide valid, reliable and consistent self-reports of their sleep position.² Most commonly they report sleep in the semi-foetal position, followed by the full-foetal, prone and supine positions.¹ Although individuals have a pattern of constancy with regard to sleep position as age advances 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, lasting between 45 and 110 minutes.^{3,7} Videotape studies observing adult body position changes

during the night reported an average of 11 to 13 body position shifts per night with the majority of sleep time spent in a side lying position.^{2,4,7}

Sleep position and cervico-thoracic symptoms

It has been hypothesised that poor cervical spine posture during the night compromises pain sensitive structures of the cervico-thoracic spine and may be responsible for the production of waking cervical pain and stiffness, headache and scapular and/or arm pain.⁸⁻¹⁴ Cervico-thoracic pain may arise from any structure of the cervico-thoracic spine that has a nerve supply. Cervical headaches are attributed to the upper three levels of the cervical spine while scapular and arm pain can be referred from the lower three levels of the cervical spine.^{11,15} Waking symptoms attributable to the cervico-thoracic spine have been reported by 46% of

subjects in a large epidemiological study.¹⁶ It has been suggested that individuals who wake in the morning with symptoms that were not present the night before, or whose symptoms are worse in the morning than when they retired the preceding night, are probably either using an unsuitable pillow or adopting a compromising sleeping posture overnight.¹⁷ Hence in the clinical setting, health practitioners often ask patients about the position in which they sleep to determine if sleep posture could be associated with reports of nocturnal and waking musculo-skeletal symptoms.¹⁸

Supporting the cervico-thoracic spine during sleep

McDonnell was the first to provide written advice regarding sleep position.⁸ He suggested that people should side lie with the gap between the head and mattress filled (with a pillow) so that the head was equidistance from each shoulder in a semi-foetal position. Although most authors suggest that a neutral position of the cervical spine is optimal for spinal health, some suggest a supine sleep position while others suggest either the side or supine sleep positions.^{10,12-14} However, there is consensus that the prone sleep position should be avoided.^{10,12-14} A search of the literature identified only one paper pertaining to sleep position and spinal symptoms. Miller identified 23 subjects, aged 13 to 64 years, with spinal symptoms who also reported being prone sleepers.¹⁹ He altered their sleep position to a normal sleep position, which he did not describe, and found that 74% of these subjects reported a satisfactory improvement in their symptoms. Therefore, at present, advice regarding the adoption of a sleep position for spinal health is anecdotal, based on what appears to be a sound biomechanical model for symptom production.

Sleep position and sleep quality

It is clinically accepted that a change in sleep position may benefit the systemic health of individuals. Sleep apnoea patients are advised to avoid the supine position while asthma sufferers have been advised to adopt a right side sleep position.²⁰⁻²¹ Patients with respiratory disorders, heartburn or chronic indigestion can gain nocturnal relief by sleep in a more upright position.²² However, the relationship between the presence of medical conditions, sleep quality, the adoption of a specific sleep position and the prevalence of waking cervico-thoracic symptoms has not previously been investigated using an epidemiological approach.

This paper reports the findings of an epidemiological study undertaken to investigate the association between self-reports of sleep position, age, gender, medical status, sleep quality and waking cervico-thoracic symptom reports.

Methodology

This study was conducted in Port Lincoln, a regional fishing community in South Australia with a total population of

12,183.²³ Every third household in the Port Lincoln telephone directory was selected to complete a structured telephone interview. The principal researcher and a trained research assistant shared the task of telephoning households. Whoever answered the telephone call was provided with a verbal outline of the study, asked if they were over the age of 18 years and were willing to complete a survey over the telephone. If the first telephone call was unanswered, the household was telephoned a second time, on a different day and at a different time of the day. If the second telephone call was unanswered no further contact was attempted.

The survey instrument items were developed specifically for the purpose of the research, and were validated by discussion with an internationally recognised expert in cervical spine disorders, an experienced epidemiologist and nocturnal and waking musculo-skeletal symptom sufferers recruited from patients attending the principal investigator's practice. The instrument was pilot tested on a small group (N=20) of sufferers from waking symptoms, and modified in wording and content. It was subsequently tested for usability for a telephone survey by testing it on the same sample of subjects over the telephone. The survey instrument is provided as an appendix to this paper.

Subjects nominated the position in which they believed they spent most of the night when asleep, by choosing from side, supine, prone and upright positions. An option 'varies' was provided for those subjects who were unable to nominate one position. Subjects were also asked to report:

- the presence of waking symptoms at least once during a usual week in the categories of cervical pain, cervical stiffness, headache and scapular and/or arm pain
- the presence of a medical condition which affected sleep quality and use of medication, and
- their estimation of sleep quality in a usual week by choosing from the categories of excellent, good, fair and poor

Statistical Analysis

Comparative and descriptive statistical analysis was conducted using SAS Version 8.2 (Copyright (c) 1999-2001 by SAS Institute Inc., Cary, NC, USA. SAS (r) Proprietary Software Release 8.2 (TS2M0 DBCS2944). Percentages were used for descriptive analysis of factors of interest, and for reporting purposes the percentages were rounded to the nearest full unit. The association between outcome measures and potential exposures was determined using univariate logistic regression models, and expressed as odds ratios (OR) and 95% Confidence Intervals (CI).

When considering the relationship between gender and position of most sleep, the data was categorised using

females as the exposure of interest compared to males, and each individual sleep position compared with all others as the outcome of interest. For the estimation of the association between age groups and sleep position, sleep position was treated in the same way, and individual age groups were compared with all others. Considering medical condition and medication, the data was organised into binary form (medication taken or not, medical condition affecting sleep or not). Sleep quality was organised into binary form combining excellent and good sleep quality responses as high sleep quality and fair and poor responses as low sleep quality. Each waking symptom was considered as an outcome of interest, compared with no reports of that symptom on waking.

Significance was determined by whether the value One was encompassed within the upper and lower confidence intervals surrounding the OR. Confidence intervals provide an opportunity to consider the size of the association within the context of its variability. When the lower 95% CI of the OR exceeds 1, the odds are significantly elevated for at least 95% of subjects. On the other hand when the upper 95% CI of the OR is less than 1, the odds are significantly protective for at least 95% of subjects. Thus, in this study, where an odds ratio was reported to be greater than one, there was increased risk of symptoms due to exposure to

the risk factor of interest, whereas if the odds ratio was less than one there was decreased risk of waking symptoms due to exposure to these factors.

Results

Response Rate

The demographic sampling frame for this study has been reported elsewhere.¹⁶ To summarise for this paper, some of the response rate data is re-reported here. Of the households telephoned, 66.5% (N=966) were able to be contacted, and 76% of these had one or more inhabitants eligible, and willing, to complete the survey (yielding 812 responses). The questionnaire was completed by 551 females (68%) and 261 males (32%). Two hundred and sixty-four participants (33%) were aged between 18 and 39 years (young age group), 300 (37%) between 40 and 59 years (middle age group) and 248 (31%) were aged 60 years or over (older age group). Gender was relatively evenly distributed across the age groups.

Sleep position

The majority of respondents (female 72.6%, male 70.9%) reported that they mostly slept in the side lying position. Females were significantly less likely than males to report supine sleep position (OR 0.5 CI 0.3-0.9) (see Table 1). No other gender effect on sleep position was observed.

Table 1. Gender association with reported position of sleep. Odds ratios represent females as the exposure of interest. Statistically significant findings are marked with an asterisk (*).

	N (%)	N (%)	OR	CL
Position of Females	Females	Males	F:M	
Side	400 (72.6)	185 (70.9)	1.1	0.8-1.6
Supine	50 (9.1)	41 (15.7)	0.5	0.3-0.9*
Prone	32 (5.8)	8 (3.1)	2.0	0.9-4.7
Upright	25 (4.5)	6 (2.3)	1.7	0.6-4.6
Varied	44 (8)	21 (8)	1.0	0.6-1.8
Total	551 (100)	261 (100)		

Sleep position and age.

There was a distinct age effect on several choices of most frequent sleep position (see Figure 1). A significantly increasing percentage of subjects across the age groups chose sidelying and upright sleep positions, while there

was a decreasing percentage, with increasing age, who chose the prone sleep position. No consistent age pattern was observed for supine or varied sleep position; however, the oldest age group was least likely to sleep in the supine position.

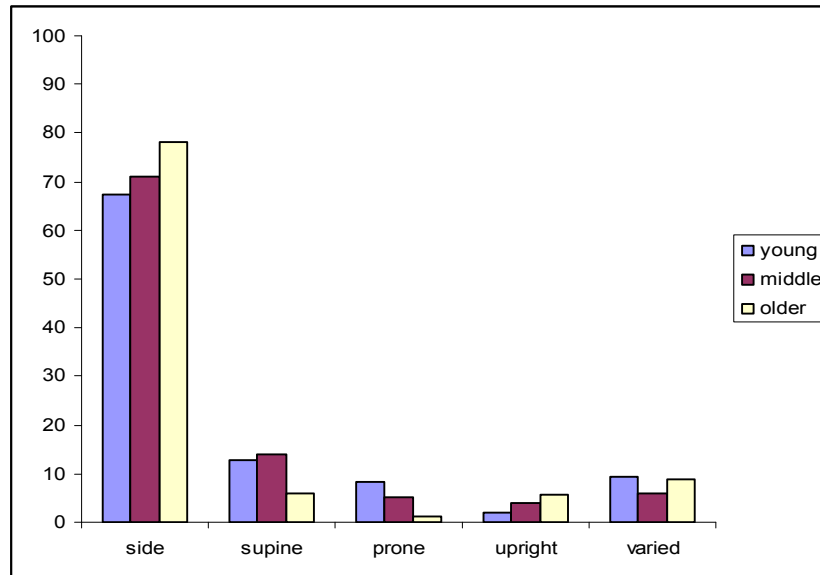


Figure 1. Percentage of position of most sleep reported within each age group.

Statistically significant associations were observed comparing the youngest age group with all others with respect to preference for prone sleep position and non-preference for side sleep position. This finding was corroborated by the findings for the older age group, who were significantly more likely to adopt a side sleep position

and significantly less likely to adopt a supine or prone position than the younger age groups (see Table 2). The small number of subjects sleeping prone in this age group, however, reduced confidence in this finding (N=3), compared with N=22 in the young age group, and N=12 in the middle age group.

Table 2. Association between reported position of sleep and age. Statistically significant findings are marked with an asterisk(*).

Position	Young age		Middle age		Old age	
	OR	95% CI	OR	95% CI	OR	95% CI
Side	0.7	0.5-1.00*	0.9	0.7-1.3	1.6	1.1-2.3*
Supine	1.3	0.8-2.1	1.5	1.0-2.4*	0.4	0.2-0.8*
Prone	2.7	1.4-5.3*	1.0	0.5-2.1	0.2	0.04-0.6*
Upright	0.4	0.1-1.1	1.1	0.5-2.4	1.9	0.9-4.2
Varied	1.3	0.8-2.3	0.6	0.4-1.1	1.2	0.7-2.1

Sleep position and waking symptoms

Waking symptoms at least once in a usual week were reported by 371(45.6%) subjects. Of those subjects who reported preference for side sleeping, 261 (44.6%) reported waking symptoms. Considering those subjects who reported preference for the supine sleep position, 37 (40.7%) reported waking symptoms. Nineteen (47.5%) subjects reported sleeping prone and experiencing waking symptoms, and another 19 (61%) subjects reported sleeping upright and experiencing waking symptoms. Thirty-five (53.8%) subjects reported having no fixed sleep position and experiencing waking symptoms.

Association between sleep position and waking symptoms

Subjects who reported that they slept mostly on their side were significantly less likely to report waking cervical pain, or waking scapular or arm pain compared with subjects who slept in any other position. Significant associations were found between upright sleep position and all waking symptoms of interest, while varied sleep position was significantly associated with reports of waking scapular and/or arm pain. In contrast side sleep position was protective of waking cervical and scapular and/or arm pain (see Table 3).

Table 3. Association between reported position of most sleep and waking symptoms. Statistically significant findings are marked with an asterisk(*)

Position	Cervical Pain	Cervical Stiffness	Headache	Scapular/Arm pain
	OR(95%CI)	OR(95%CI)	OR(95%CI)	OR(95%CI)
Side	0.6 (0.4-0.9)*	0.9 (0.6-1.3)	1.1 (0.8-1.7)	0.7 (0.5-0.9)*
Supine	1.4 (0.8-2.5)	0.9 (0.5-1.6)	0.8 (0.4-1.4)	1.1 (0.7-1.9)
Prone	1.5 (0.7-3.2)	1.1 (0.5-2.6)	0.8 (0.3-2.0)	0.7 (0.3-1.6)
Upright	2.5 (1.1-5.5)*	2.6 (1.1-5.8)*	2.2 (1.0-5.0)*	2.5 (1.1-5.3)*
Varied	1.1 (0.5-2.1)	0.9 (0.4-1.9)	0.7 (0.3-1.4)	1.9 (1.1-3.3)*

Factors related to adoption of sleep position

Of the 31 subjects who slept in an upright position, 18 reported doing so due to a medical condition that regularly affected the quality of their sleep, most commonly asthma (39%), a musculo-skeletal condition (33%), a gastro-intestinal condition (17%), snoring (5.5%) and throat cancer (5.5%). Four of these subjects reported having two medical conditions. Thirteen of the subjects reporting a medical condition which could influence their sleep also took medication. Subjects who slept in an upright position were

significantly more likely to report the presence of a medical condition that regularly affected their sleep quality (OR 4.5 (95%CI 2.0-10.0)) and medication usage (OR 7.1 (95% CI 2.7-19.6)) than subjects who reported sleeping in any other position. Small cell sizes reduced confidence in the findings; however, subjects who reported that they mostly slept in the prone position (N=40) were significantly less likely to report the presence of a medical condition which affected their sleep quality (OR 0.3 (95%CI 0.1-1.0)) and medication usage (OR 0.3 (95%CI 0.1-0.7)) (see Table 4).

Table 4. Association between reported position of sleep and factors considered to influence the adoption of that sleep position. Statistically significant findings are marked with an asterisk(*)

Position of most sleep	Medical condition		Medication use	
	N	OR(95%CI)	N	OR(95%CI)
Side	138	0.8 (0.6-1.1)	224	0.9 (0.7-1.3)
Supine	25	1.2 (0.7-2.0)	32	0.8 (0.5-1.4)
Prone	4	0.3 (0.6-1.0)*	6	0.3 (0.1-0.7)*
Upright	18	4.5 (2.0-10.0)*	13	7.1 (2.7-19.6)*
Varied	17	1.1 (0.6-2.0)	28	1.1 (0.7-2.1)

Sleep position and sleep quality

Those subjects who reported sleeping mostly in the side position were significantly more likely to report a high sleep quality rating than subjects who slept in other positions.

Conversely those subjects who reported sleeping in an upright position were significantly less likely to report a high sleep quality rating than subjects who slept in other positions (see Table 5).

Table 5. Association between high sleep quality rating and sleep position. Statistically significant findings are marked with an asterisk(*)

High sleep quality	N	OR(95%CI)
Supine	60	1.1 (0.7-1.8)
Prone	28	1.4 (0.7-2.9)
Side	384	1.4 (1.0-1.9)*
Varies	35	0.6 (0.4-1.1)
Upright	10	0.3 (0.1-0.6)*

Discussion

This paper presents the first known estimates of association between sleep position, medical conditions, taking medication, waking cervico-thoracic symptoms and sleep quality. It provides much needed information for health professionals and researchers concerned with ensuring high quality, symptom-free sleep for patients.

Importantly this study found that waking symptoms are strongly associated with specific sleep positions. Subjects who reported sleeping mostly in an upright position were significantly more likely to report all waking symptoms of interest compared to subjects who slept in other positions. It has been postulated that sleep in an upright position does not allow unloading of spinal structures from the effect of gravity, causing musculo-skeletal fatigue and symptom production.¹⁴ As small subject numbers constrained confidence in the findings, further research is required into the contributors to waking symptoms for upright sleepers, particularly sleep quality, the effect of medications and underlying medical conditions.

The Supine sleep position which has anecdotally been recommended for the prevention of cervical symptoms was not found in this study to be significantly protective of waking symptoms when compared to other sleep positions.^{10,12,14} In contrast, prone sleep position which has not been recommended in the literature was not significantly associated with waking symptom reports. However, small numbers of prone sleepers indicate that caution should be taken when interpreting these findings.^{10,12,14}

Concurring with the findings of other research, this study found that the majority of subjects reported sleeping in the side lying position.⁴ Not only was side sleep position significantly protective of waking cervical and scapular or arm pain, it was also significantly associated with a higher sleep quality rating. Hence on the basis of this research side lying can be confidently recommended as the best sleep position in terms of minimising waking symptoms and maximising sleep quality.

This study's findings support previous reports of a significant decrease in prevalence of reported prone sleep

position and an increase in prevalence of reported side sleep position with increasing age.⁴ It has been postulated that this change in preferred sleep position with increasing age is due to loss of flexibility of the spine and/or the extra effort required to breathe in the prone position.⁴ Cardiac inefficiency and angina pectoris have historically been linked to the adoption of the side sleep position in older subjects.^{24,25} However, more recent research has provided conflicting reports regarding the effect of sleep position on cardiac output.²⁶⁻³⁰ Certainly this study identified that people with medical conditions were less likely to adopt the prone sleep position. It has previously been reported that the prevalence of waking cervico-thoracic symptoms decreases with increasing age.¹⁶ The findings of this study suggest that this occurs in conjunction with increased preference for the side sleep position. It is likely therefore that the adoption of the side sleep position in the older age group affords protection from waking cervico-thoracic symptoms. This finding is of note when one considers the increased potential in older people for compromised spinal performance due to degenerative disease or habitual postures. The adoption of the side sleep position in the older age group and the concomitant decrease in prone sleep position may be attributable to a combination of the physical and physiological changes that occur with age.

The findings of this study support the need for health professionals to consider individuals' sleep position and waking symptom history, as part of clinical reasoning for treatment, and when developing a management plan for patients with troublesome waking symptoms.

Conclusion

This large scale epidemiological study established that the side sleep position is significantly protective of waking cervico-thoracic symptoms and is associated with significantly higher sleep quality ratings when compared with all other sleep positions. It is therefore recommended as the sleep position of choice. Upright sleep position was associated with increased waking symptom reports but this finding may be related to the medical status of those who adopt this sleep position. Support for the adoption of a supine sleep position and/or avoidance of a prone sleep position to prevent waking cervico-thoracic symptoms was not supported by this study.

Appendix: Telephone survey

The survey provided includes those questions pertinent to this study. The full survey is available from the principal investigator.

	Section One		
1	ID number		
2	Date of birth		
3	Today date		
4	Gender		
5	Phone number		
	Section Two		
6	In a usual week do you wake in the morning at least once with a sore or painful neck?	Yes	No
7	In the last week have you woken with a sore or painful neck?	Yes	No
8	If yes, how many times in the last week have you woken with a sore or painful neck?		
9	How long did the pain or soreness in your neck last?	An hour or less	
		Half a day	
		All day	
		Varies	
10	In a usual week do you wake in the morning at least once with a headache?	Yes	No
11	In the last week have you woken with a headache?	Yes	No
12	If yes, how many times in the last week have you woken with a headache?		
13	How long did the headache last?	An hour or less	
		Half a day	
		All day	
		Varies	
14	In a usual week do you wake in the morning at least once with a stiff neck?	Yes	No
15	In the last week have you woken with a stiff neck?	Yes	No
16	If yes, how many times in the last week have you woken with a stiff neck?		
17	How long did the stiffness in your neck last?	An hour or less	
		Half a day	
		All day	
		Varies	
18	In a usual week do you wake in the morning at least once with aching between your shoulder blades or in your arm?	Yes	No
19	In the last week have you woken in the morning with aching between your shoulder blades or in your arm?	Yes	No
20	How long did the aching between your shoulder blades or in your arm last?	An hour or less	
		Half a day	
		All day	
		Varies	
	Section Three, Part One.		
21	Do you have any medical condition which regularly affects the quality of your sleep?	Yes	No
22	If so what is/are the medical condition/s?		
23	Do you have any of the following: Diabetes Rheumatoid Arthritis Fibromyalgia	Yes	No
		Yes	No
		Yes	No
24	Do you usually have to sleep in an upright position?	Yes	No
25	If yes, for what reason do you sleep in an upright position?		
26	Has your doctor advised you to take medication for any condition?	Yes	No
27	If yes, what is the name of your medication or what is it used for?		
28	In a usual week how would you rate the quality of your sleep?	Excellent	
		Good	Fair
		Poor	
	Section Three, Part Two.		
29	In what position do you usually go to sleep?	Side	Front
		Back	Varies
		Upright	
30	In what position do you usually wake up?	Side	Front
		Back	Varies
		Upright	
31	In what position do you think you spend most of your night?	Side	Front
		Back	Varies
		Upright	

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