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Sleeping Position, Pillow and Mattress Type Linked to Neck Pain, Headache and Sleep Quality

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Abstract

Objective: Neck pain and headache are common issues among the working-age population. Recent studies have shown that sleeping position, pillow and mattress may have a significant role in neck symptoms and headaches, highlighting the importance of considering sleep ergonomics for improving sleep quality and reducing discomfort. The objective of this cross-sectional general population survey study was to assess the correlation between neck pain, headache, and sleep quality and various sleep-related factors, including sleeping position, pillow type, and mattress choice, within the adult population.

Design: A cross-sectional general population survey study.

Settings: Department of Physical Medicine and Rehabilitation, NOVA, Central Hospital of Central Finland, Jyväskylä and Tampere University of Applied Sciences, Tampere.

Methods: Subjects were invited to take part in the sleep ergonomic survey by an announcement in a nationally daily newspaper. The study was completed using Webropol® survey and reporting platform. The survey questionnaire comprised 24 items covering demographic data, sleeping position, mattress type, neck symptoms, sleep comfort, and vitality.

Results: A total of 10,116 participants (6 422 females and 3 694 males) aged 18 years or over answered the questionnaires. Analysis revealed that individuals sleeping in the supine position experienced significantly less frequent occurrences of neck pain, stiffness, and headaches ($p<0.001$). Furthermore, they reported more peaceful sleep and better vitality upon awakening compared to those adopting other sleeping positions ($p<0.001$). Compared with those using an ordinary pillow, respondents using a memory foam pillow exhibited significantly lower incidences of neck pain, stiffness, and headaches ($p<0.001$). They also reported a greater frequency of easily finding a comfortable sleeping position and enjoying restful sleep ($p<0.001$).

Conclusions: Adoption of a supine sleeping position was linked to a lower incidence of neck pain, stiffness and headaches. The use of both a memory foam pillow and a mattress correlated with a diminished frequency of neck symptoms and headaches. These findings underline the importance of considering sleep-related variables in addressing musculoskeletal issues and promoting overall sleep quality among adults.

Keywords: Working-Age Population; Epidemiologic Study; Memory Foam; Spring Mattress; Pillow Type; Sleeping Position; Sleeping Ergonomics; Cephalgia; Cervicalgia

Abbreviations: XS: Extra Small; S: Small, M: Medium; L: Large; XL: Extra Large; NRS: Numeric Rating Scale; SD: Standard Deviations; ANOVA: Analysis of Variance

Background

Neck pain, a ubiquitous phenomenon globally, represents a considerable challenge to individual well-being and poses a strain on healthcare systems [1]. The prevalence of neck pain, ranging widely from 0.5% to 41.5%, underscores its multifaceted impact, with a distinct predilection in high-income countries and among women [2]. Sleep accounts for one-third of the human lifespan and is not merely a passive state but a dynamic process crucial for both physical and psychological recovery [3]. Studies have shown weak to moderate evidence for an association between sleep parameters and chronic neck pain, with more severe pain accompanied by more disturbed sleep [4]. The pillow plays an important role in providing support for the neck and shoulder areas to support the neutral position of the cervical spine posture and prevent stress on cervical spine structures [5]. A Korean sleep survey of different pillow types suggested that a lack of proper pillow support for the neck can induce neck pain and affect sleep quality by disrupting the alignment of the cervical spine [6]. In a systematic review, Radwan et al. [7] found moderate evidence that several pillow parameters could improve spinal alignment and decrease sleep-related neck pain; a latex pillow material, a contoured pillow with higher sides to accommodate the shoulder of side sleepers; and a lower middle area to accommodate back sleepers and a cooling surface. Chun-Yiu et al. [8] concluded that cervical alignment is not affected by the pillow material but rather by the pillow shape and height. Additionally, Lei et al. [9] reported that the most important parameter is the pillow height, which should be adjusted according to the physique of each patient with chronic neck pain.

Exercise therapy is generally recommended as a first-line treatment for chronic neck pain. However, utilizing an ergonomic pillow alongside exercise therapy has been proven to be more effective in reducing neck pain and disability than using these treatments separately in randomized studies [10,11]. A supportive mattress has been suggested to promote healthy spinal alignment during sleep and help the muscles relax. Hong et al. [12] reported that an increased craniocervical height when lying supine on a soft mattress led to significantly increased cervical loading. Thus, a softer or thinner pillow with a soft mattress was recommended. Previously our survey study evaluated associations of low back pain with habitual sleeping positions and mattress types in the general population [13]. The aim of this study was to investigate the links between neck pain, headaches, the quality of sleep, and aspects of sleep ergonomics, including the effects of sleeping positions, pillow varieties, and mattress types in the same population.

Methods

Study Design

This cross-sectional general population survey study aimed to investigate the relationships between sleep ergonomics, specifically sleeping position, pillow type, and mattress choice, and the occurrence of neck pain, headaches, and overall sleep quality in adults. Participants were recruited through a national daily newspaper advertisement. The only inclusion criterion was 18 years of age [13]. There were no exclusion criteria to confirm that the study population corresponds as closely as possible to the normal population. Ethical approval was not needed, as this was a survey study without a treatment intervention. Informed consent was given by the participants who completed the survey. The procedure of the study was performed according to the relevant guidelines and regulations of the Declaration of Helsinki [14].

The Data were collected through the Webropol® survey platform. The participants were asked basic demographic information [13]. Participants self-reported whether they suffered from neck pain and stiffness and headache. The survey included assessments of neck pain, headache and vitality using the Numerical Rating Scale, ranging from 0 to 10. Otherwise, the questions were asked to be answered with straightforward yes or no. The participants were also asked about their sleeping, position, pillow and mattress type. Pillow types were categorized as ordinary (cotton or polyester-filled), memory foam, or other. Mattresses were classified as foam, spring or memory foam, which was subcategorized as memory foam A (several brands and unbranded) or memory foam B (Tempur®). The research data were collected and deposited by the Tampere University of Applied Sciences and analysed by the Departments of Physical Medicine and Rehabilitation, NOVA, Jyväskylä and Kuopio University Hospital, Kuopio, Finland.

Statistical Analysis

The descriptive statistics were presented as means with Standard Deviations (SD) or counts with percentages (%). Statistical comparisons between the groups were made using a chi-square, t-test or analysis of variance (ANOVA), as appropriate. Correlations were estimated by Spearman's correlation coefficient method. A level was set at 0.05 for all tests. Stata 13.1 (Stata Corp LP, College Station, TX, USA) statistical package was used for the analyses.

Results

A total of 10,116 participants aged 18 years and older completed the Webropol survey questionnaire. The participants' demographic data and sleeping position by sex are presented in (Table 1), which is similar as reported in our previous study report added with shoulder size information, which affects sleeping position while sleeping on side [13]. Women were the dominant group among participants (63%), and middle-aged participants were the most represented. Side and combination of side and supine were the most frequent sleeping positions in all age categories, regardless of mattress type (Table 2). Men were more likely to sleep in the supine position compared to women, while women showed a small but statistically significant preference for sleeping in the side-lying position, reflecting a sex-related difference in sleep habits. The purely supine position was the least

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favoured among all age groups except for the elderly group, which was aged older than 65 years and showed the least preference for the prone position. Supine sleepers reported significantly less neck pain, stiffness, and headaches than people in other positions.

The ordinary pillow was the most common choice, comprising 58% of the total amount. It was predominant among prone sleepers and individuals who are likely to alter their sleeping position. The memory foam pillow was chosen by 35% of the surveyed population. This approach was preferred, especially for those who slept on their side or were in the supine position. Over half of the participants who slept on the side and/or in the supine position felt that the pillow supported their head and neck well, but those who were prone to sleep or who often changed their sleeping position were less likely to be satisfied. In these positions, participants also more commonly supported their head by keeping their hand under the pillow while sleeping. Only a few participants preferred to sleep without any pillows. Participants who slept with a memory foam pillow had significantly less frequent neck pain and stiffness as well as headache than did those who slept with an ordinary pillow (Table 3). They also felt significantly more often that it was easy to find a good sleeping position and that they had restful sleep. Those sleeping with ordinary pillows were more likely to turn while sleeping and to experience nighttime awakening and insufficient energy while rising.

Table 1: Age, Shoulder Size and Sleeping Position by Sex (N=10116).

	Female N=6422	Male N=3694	p Value
Age (years), N (%)			<0.001
18-25	589 (9)	293 (8)	
26-35	1530 (24)	981 (27)	
36-55	2782 (43)	1765 (48)	
56-65	995 (15)	422 (11)	
66+	526 (8)	233 (6)	
Shoulder Size, N (%)			<0.001
XS	227 (4)	11 (0)	
S	1311 (20)	116 (3)	
M	2800 (44)	1060 (29)	
L	1550 (24)	1503 (41)	
XL	534 (8)	1004 (27)	
Sleeping Position, N (%)			<0.001
Side	2319 (36)	1242 (34)	
Side and Supine	1928 (30)	1179 (32)	
Prone	405 (6)	225 (6)	
Supine	160 (2)	152 (4)	
Several	1610 (25)	896 (24)	

XS = Extra Small, S = Small, M = Medium, L =Large, XL = Extra Large

The spring mattress was the most common mattress type, comprising 58% of the total amount, followed by the memory foam, accounting for 22% (Table 4). Neck pain and stiffness and headache occurred significantly less often in those who slept on the memory foam B mattress. Additionally, the amount of average neck pain and headache were significantly lower in the memory foam B group (Figure 1). Participants who slept on memory foam mattress B experienced finding sleeping position easily and slept peacefully significantly more frequently (Table 4). They were less likely to turn while sleeping, and they felt less frequent powerlessness after waking. Participants sleeping supine awakened due to an uncomfortable posture or numbness less often than those sleeping in the other positions. They also reported better vitality and feeling powerless less often. Memory foam B mattresses were the most common in the foam category, comprising almost half of the total. This mattress type was also more frequently associated with peaceful sleep and a feeling of powerlessness less often after waking compared to other mattresses.

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Table 2: Patient neck symptoms, headache status, age, shoulder size, pillow and mattress type and preferred sleeping position were recorded (N=10116).

	Side	Side and Supine	Prone	Supine	Several	p Value
Neck Pain, N (%)	2021 (57)	1789 (58)	377 (60)	164 (53)	1543 (62)	<0.001
Neck Pain, NRS, Mean (SD)*	5.7 (1.9)	5.5 (1.9)	5.6 (1.9)	5.4 (2.1)	5.6 (2.0)	0.19
Neck Stiffness, N (%)	2756 (77)	2516 (81)	503 (80)	230 (74)	2029 (81)	<0.001
Headache, N (%)	1579 (44)	1442 (46)	299 (47)	109 (35)	1276 (51)	<0.001
Headache, NRS, Mean (SD)*	5.8 (2.0)	5.8 (2.0)	5.8 (2.1)	5.6 (2.1)	5.9 (2.1)	0.80
Age, N (%)						<0.001
18-25	226 (6)	261 (8)	83 (13)	24 (8)	288 (11)	
26-35	720 (20)	762 (25)	189 (30)	68 (22)	772 (31)	
36-55	1628 (46)	1458 (47)	284 (45)	133 (43)	1044 (42)	
56-65	622 (17)	424 (14)	58 (9)	45 (14)	268 (11)	
66+	365 (10)	202 (7)	16 (3)	42 (13)	134 (5)	
Shoulder Size, N (%)						0.13
XS	85 (2)	76 (2)	12 (2)	6 (2)	59 (2)	
S	482 (14)	421 (14)	98 (16)	43 (14)	383 (15)	
M	1318 (37)	1241 (40)	229 (36)	122 (39)	950 (38)	
L	1096 (31)	913 (29)	199 (32)	98 (31)	747 (30)	
XL	580 (16)	456 (15)	92 (15)	43 (14)	367 (15)	
Pillow, N (%)						<0.001
Ordinary	2022 (57)	1696 (55)	410 (65)	173 (55)	1531 (61)	
Memory Foam	1324 (37)	1210 (39)	174 (28)	118 (38)	751 (30)	
Other Type	211 (6)	199 (6)	39 (6)	18 (6)	218 (9)	
No	4 (0)	2 (0)	7 (1)	3 (1)	6 (0)	
Pillow Supports Neck	1829 (51)	1640 (53)	276 (44)	182 (58)	1160 (46)	<0.001
Sleeping Hand Under the Pillow	1785 (50)	1310 (42)	511 (81)	58 (19)	1689 (67)	<0.001
Mattress Type						<0.001
Spring	2121 (60)	1778 (57)	393 (62)	148 (47)	1478 (59)	
Memory Foam	773 (22)	763 (25)	111 (18)	84 (27)	485 (19)	
Foam	435 (12)	381 (12)	84 (13)	61 (20)	350 (14)	
Other	232 (7)	185 (6)	42 (7)	19 (6)	193 (8)	

*Average for those with pain

Table 3: Memory foam versus ordinary pillows according to neck symptoms, headache and sleeping experience.

	Memory Foam N=3577	Ordinary N=5832	P Value
Neck Pain, N (%)	1911 (53)	3590 (62)	<0.001
Neck Stiffness, N (%)	2740 (77)	4742 (81)	<0.001
Headache, N (%)	1576 (44)	2805 (48)	<0.001
Easy to Find Good Sleeping Position N (%)	2462 (69)	3558 (61)	<0.001
Sleep Peacefully, N (%)	1612 (45)	2172 (37)	<0.001
Often Turning While Sleeping, N (%)	2826 (79)	4837 (83)	<0.001
Night Time Awakening, N (%)	1838 (51)	3302 (57)	<0.001
Insufficient Energy Upon Rising, N (%)	1715 (48)	3182 (55)	<0.001

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Table 4: The relationship between different mattress types and neck symptoms, headaches, sleep satisfaction and recovery (N=10116).

	Foam N=1311	Spring N=5918	Memory Foam A N=1230	Memory Foam B N=986	Other N=671	P Value
Neck Pain, N (%)	811 (62)	3561 (60)	723 (59)	401 (41)	398 (59)	<0.001
Neck Pain, NRS, Mean (SD)*	5.7 (1.9)	5.5 (1.9)	5.6 (1.9)	5.4 (1.9)	5.8 (2.0)	0.036
Neck Stiffness, N (%)	1070 (82)	4827 (82)	989 (80)	623 (63)	525 (78)	<0.001
Headache, N (%)	668 (51)	2819 (48)	602 (49)	308 (31)	308 (46)	<0.001
Headache, NRS, Mean (SD)*	5.9 (2.1)	5.8 (2.1)	5.9 (2.1)	5.6 (2.1)	6.0 (2.0)	0.062
Easy to Find Sleeping Position, N (%)	778 (59)	3593 (61)	859 (70)	817 (83)	429 (64)	<0.001
Often Turning While Sleeping, N (%)	1093 (83)	4999 (84)	955 (78)	649 (66)	542 (81)	<0.001
Sleep Peacefully, N (%)	510 (39)	2119 (36)	539 (44)	643 (65)	263 (39)	<0.001
Insufficient Energy Upon Rising	742 (57)	3230 (55)	636 (52)	294 (30)	356 (53)	<0.001

*Average for those with pain

Memory Foam A (several memory foam brands except Tempur), Memory Foam B (Tempur)

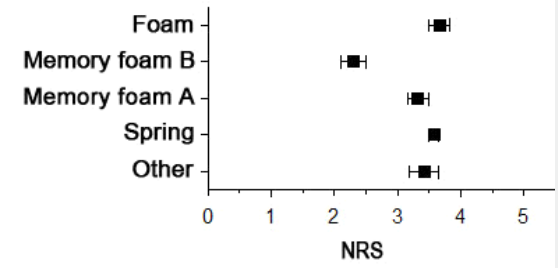

Figure 1: Average neck pain on the numeric rating scale (NRS) according to mattress type in the entire study population. The values are expressed as the means, and the whiskers show the 95% confidence intervals.

Discussion

The study confirms the results of previous research showing that sleeping position, pillows and mattresses may be important for neck symptoms, headaches and general well-being. The prevalence of neck pain was at the same level as reported in previous epidemiologic studies [2]. In the present study, neck pain and stiffness as well as headache were experienced less often among those participants sleeping in a supine position than among those sleeping in other sleeping positions. In contrast low back pain did not correlate with sleeping position in our previous report of this study, although subjects sleeping in the supine reported sleeping peacefully and better vitality more often than those sleeping in the other positions [13].

This is presumably related to the fact that the cervical spine is more likely to remain straight aligned while lying in a supine position than in a side-lying or prone position. The prone sleeping position was associated with often changing sleeping positions and the need to keep one's hand under the pillow for support while sleeping. Sleeping in the side lying position will cause side bending and rotation of the cervical spine if the pillow is not at the right height [9]. In the prone position, the head is turned even more, and passive rotation may cause excessive static stretching of the cervical spine. Long-term static stretching of the cervical spine while lying has been shown to cause neck pain and restricted movement even in healthy subjects [15,16]. As a person ages, the static stretching of connective tissues in the cervical spine becomes more prominent while the cervical spine is twisted or bent because the range of motion becomes increasingly limited [17]. Moreover, neck pain with or without a history of trauma, has been linked to decreased mobility in the cervical spine [18].

It is widely believed that an optimal pillow for appropriate neck support maintains cervical lordosis during sleep [19]. Jeon et al. [5] compared three different pillows for cervical lordosis by measuring the Cobb angle on a lateral cervical radiograph in the standing and supine positions. They found that the angle significantly increased with the use of an orthopedic pillow, but there was no significant change with the use of a memory foam pillow, and the angle decreased with the use of a feather pillow. However, individually, the degree of cervical lordosis can differ

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and may even be flat or kyphotic. The degree of lordosis of the cervical spine does not depend primarily on the type of pillow but rather on its height, which varies among all types of pillows. The correct thickness of the pillow is therefore important regardless of its type [8]. Gordon et al. [20] reported significant differences in the segmental slopes of the cervical spine between feather, latex, foam and polyester pillows in the side-lying position. Thus, changing the pillow may alter the posture of the cervical spine while sleeping. However, they found that the contour foam pillow does not support the cervicothoracic spine any differently from a regular foam pillow. In the present study, participants most often slept on their side or/and supine, as reported previously [21].

Men were more likely to sleep only on their backs than women, which has also been reported previously [22]. This is presumably due to wider shoulders in men, which cause greater pressure in this area in the side-lying position [23]. Wide shoulders also mean that the distance between the head and the mattress increases, which causes side bending to the neck if it is not supported by a sufficiently high pillow [9]. However, the height of the pillow does not directly correlate with the shoulder width because the sinking of the mattress may compensate for it and depends on its type. Memory foam mattress type 2 was connected to lower neck pain frequency, better sleep comfort and functional capacity recovery. The spring mattress and ordinary pillow were used most frequently, which probably reflects the greater supply and current pricing of pillows on sale than perceived comfort or health benefits. In the present study, memory foam mattress 2 was associated with feelings of peaceful sleep and good vitality after waking.

The present study has several strengths, including the large number of participants and the use of an internet survey, which eliminates the possibility of interviewer bias. Recognizing that sleep is not a passive state but rather a dynamic process involving intricate biomechanical interactions, we posit that a deeper understanding of sleep ergonomics holds the potential to unveil targeted interventions. This knowledge, in turn, may contribute to the enhancement of overall well-being and the mitigation of burdens on healthcare systems attributed to sleep-related discomfort. This study has some limitations. The participants were adults, and the study therefore does not apply to children and adolescents. The results may not be generalized to countries where different types of pillows and mattresses are used compared to Western industrialized countries. While the study aimed to be general population survey, there were no inclusion and exclusion criteria. The survey was conducted by recruiting volunteers through an advertisement to target people, who read the newspaper and were interested in participating.

However, selection bias of this type is difficult to avoid even when using random population sampling, as a large proportion of the population is unlikely to respond to surveys. Unfortunately, we were unable to differentiate all brands of mattresses and pillows due to the participants' difficulty in remembering them.

Besides neck pain and headache several musculoskeletal disorders have shown to be associated with sleep position and poor sleep like arthralgia, dental disorder, low back pain and myalgia [24,25]. Poor sleep and pain interaction share a complex and reciprocal relationship: pain can disrupt sleep and poor sleep can exacerbate pain [26]. Moreover, disturbed sleep has shown to be associated negative health effects such as cancer, cardiovascular disease, defective immune system, mental health, obesity, obstructive sleep apnea and type 2 diabetes, and the impact has shown to be again reciprocal [27]. Hence, the findings of the present study may not be relevant to people with particular conditions.

The etiology of chronic neck pain often remains obscure, as specific conditions e.g. ankylosing spondylitis, torticollis spasmodica, trauma or tumour are found only in a minority of cases of working age individuals. Systematic reviews of the literature have identified several physical and psychosocial risk factors for neck pain [28,29]. Neck strain is not always a result of forceful trauma, but it may be due to long lasting stretching with low force. Stress to ligaments and capsules, during prolonged stretching of joints has been shown to cause pain in healthy subjects, when the cervical spine in healthy individuals was hold in an extreme position while lying [15,16]. Receptors sense abnormal stretching in tissues and respond by activating motor neurons, which produce an intense static muscle contraction. This may lead to vicious cycle as long-standing muscle contraction causes muscle oxygen deprivation and increases pain. Static stretching may occur especially during sleep, because neck is often in a side bending and rotation position for long periods of time and people may not react to an uncomfortable position like in the waking state.

The cause of neck pain has been shown to be multifactorial, and thus various treatment approaches may need to be incorporated into patients' care plans. In large systematic review of the European Clinical Practice Guidelines concluded that there is strong evidence for exercise for both neck and low back pain, additionally advices to be active and return to daily activities favor the good clinical outcome [30]. In general many of non-pharmacological therapy modalities may have consistent effect. Guidance regarding sleeping position may be a good addition to treatment. The good quality pillow and mattress supporting the whole spine may include this consistent category making less painful sleeping position.

Conclusions

The findings of this study highlight the intricate relationships between sleep ergonomics and neck symptoms, headaches, and overall sleep experience in the adult population. A supine sleeping position was associated with less frequent neck pain and stiffness as well as headache. Both a memory foam pillow and mattress type B were associated with less frequent neck symptoms and headache.

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