9th North American Conference on Industrial Engineering and Operations Management
Washington D.C., USA, June 4-6, 2024
Publisher: IEOM Society International, USA DOI: 10.46254/NA09.20240024
Published: June 4, 2024

A Proposed Ergonomic Memory Foam Cervical Curve Pillow Made with Alternative Organic Wool Material Designed Specifically for Patients with Scoliosis

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Abstract

Scoliosis is a musculoskeletal condition characterized by an irregular sideways curvature of the spine, often leading to difficulties in sleeping due to associated symptoms such as back pain, neck instability, and difficulty breathing. In a recent study, a new ergonomic memory foam cervical curve pillow was developed specifically for scoliosis patients to alleviate discomfort and improve sleep quality. This pillow, made with alternative organic wool material, aimed to provide better support and comfort for individuals with scoliosis. The study found that the proposed pillow significantly reduced discomfort and pain compared to traditional pillows, leading to improved sleep quality for patients. Data collected through survey questionnaires and focus interviews supported these findings, with a paired t-test analysis confirming the pillow's effectiveness. The study recommended the integration of this ergonomic pillow into scoliosis pain management practices, emphasizing the importance of consulting healthcare professionals before use. Patients with scoliosis are encouraged to incorporate this specialized pillow into their sleep routine under medical supervision to optimize comfort and support.

Keywords
Scoliosis, Sleep Quality, Pillow, Comfort. and Support.

1. Introduction
Sleep comprises one-third of a person's life; using an optimal pillow for appropriate neck support to maintain the cervical curve may contribute to improving the quality of sleep. The design of an orthopedic pillow conforms to orthopedic guidelines and ensures the right support for the cervical curve. Scoliosis is a complex spinal condition that causes various symptoms, including pain and discomfort. While pillows can be helpful for some patients with scoliosis, they are not always effective for everyone. Here is some information and literature that suggests memory foams and new pillows may not be effective for scoliosis patients.

The study of Haleem and Nnadi (2018) focuses on the natural history of scoliosis, the classification of scoliosis, the treatment plan, and the possible progression of the condition. Curves of scoliosis are classified based on the apical location: Cervical C1-C- 6, Cervicothoracic C7-T1, Thoracic T2-T12, thoracolumbar T12-L1, Lumbar L2-L4, and Lumbosacral L5-S. Given the location of the abnormal curvature of the spine, diagnosing the type of scoliosis will be necessary as the treatment plan will depend on it.

Soer (2023) evaluated the effectiveness of a new pillow in reducing pain and disability in patients with scoliosis. The study found that while the new pillow did provide some relief, it was not significantly better than a regular pillow. Another study published in the Journal of Physical Therapy Science compared the effects of several types of pillows on spinal alignment in patients with scoliosis. The study found that while memory foam pillows did provide some benefits, they were not significantly better than other types of pillows.

Gunzberg (2023) concluded that there is limited evidence to support the use of new pillows for the management of scoliosis-related pain. A study published in the Journal of the Canadian Chiropractic Association found that while new pillows can help improve sleep quality in patients with scoliosis, do not necessarily improve spinal alignment or reduce pain.

The aim of the study on an ergonomic memory foam cervical curve pillow with an alternative organic wool material design specifically contoured to patients is to evaluate its effectiveness in addressing cervical spine pain and discomfort by assessing its support and comfort levels, assisting stomach, back, and side sleepers alike in the impact on spinal alignment and sleep quality, the advantages of organic wool material, and comparing it to traditional memory foam pillows. The study aims to determine whether any patient population could benefit more from this pillow and provide insights into its potential benefits for clinical practice and patient care management.

When compared to another cushion or method of pain management, a synthesis of the existing research that focused on spinal pain—including neck pain but not precisely whiplash—found that pillows were ineffective in alleviating pain. A spring pillow, on the other hand, was found in a randomized controlled experiment to be superior to education for treating individuals with chronic non-specific neck pain who also had headaches and thoracic and cervical discomfort. The use of new pillows in the treatment of whiplash is not supported by any research. According to the Mayo Clinic, (2022, February) Whiplash is a neck injury due to forceful, rapid back-and-forth movement of the neck, like the cracking of a whip.

An increasing number of individuals are opting for memory foam pillows owing to their unique appearance and superior construction quality, as their market size is projected to reach millions by 2030, according to Memory Foam Pillow Market Research (2023). These pillows are created using high-density viscoelastic foam conforms to the head and neck's contours to provide personalized support and pressure relief (Noyed, 2023). Furthermore, the pillows feature a contoured design that provides additional support for the neck and shoulders (refer to Figure 1). Although memory foam is considered safe, as stated by Fountain, L. 2022), it may pose a problem for certain people, such as those who suffer from allergies, asthma, or other respiratory conditions. Parents prefer to use natural materials for their children’s mattresses, and memory foam is not recommended for young children or babies, as it requires a firmer surface to lower the risk of suffocation. A opular substitute is a natural latex, material derived from the sap of rubber trees that is breathable, durable, and bouncier than memory foam. More rarely, some hybrid beds may combine an innerspring core with naturally derived comfort layers made of organic wool, cotton batting, or feathers. natural latex, material derived from the sap of rubber trees that is breathable, durable, and bouncier than memory foam. More rarely, some hybrid beds may combine an innerspring core with naturally derived comfort layers made of organic wool, cotton batting, or feathers.

Figure 1. Current Cervical and Memory Foam Pillow Design

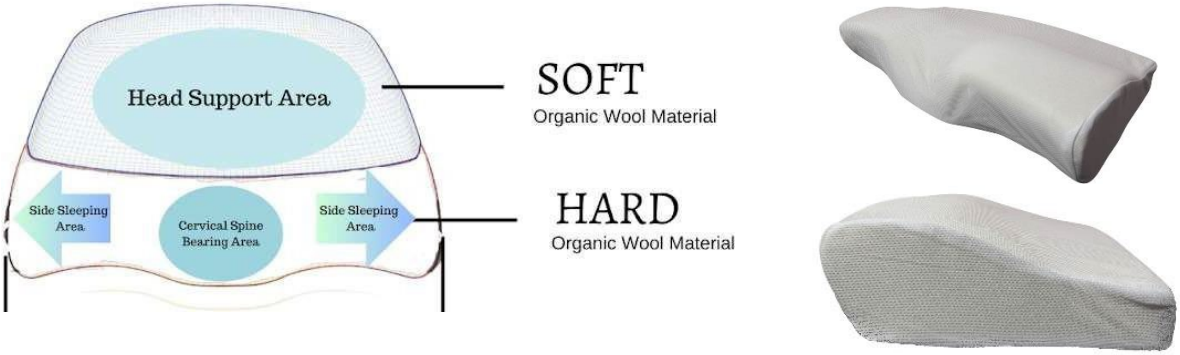

Figure 2. Memory Foam Cervical Curve Pillow with Alternative Organic Wool Material Design

The study of an Ergonomic Memory Foam Cervical Curve Pillow Made with Alternative Organic Wool Material Designed Specifically for Patients with Scoliosis benefits the improvements in effectiveness, comfort, durability, sustainability, and cost (Figure 2). The effectiveness of the pillow was evaluated through a test with a range of patients and measured factors such as comfort, pain, and number of hours of sleep. The pillow's durability was also evaluated, as should its sustainability if it is made from organic wool. The difference between Latex and organic wool, both used in commercial products like mattresses and bedding, differed in characteristics and applications. Latex, derived from rubber tree sap, offered resilience and durability, though allergenic concerns existed. Organic wool, sourced from sheep raised organically, provided a soft feel and natural temperature regulation. While wool might lack latex's support, it was hypoallergenic. Both materials had environmental merits; latex was renewable, and wool was considered eco-friendly. Cost-wise, both were relatively expensive, reflecting quality and sustainable practices. Ultimately, the choice depended on individual preferences, comfort needs, and considerations like allergies and environmental impact, with certifications recommended for informed decisions.

The research study aims to highlight the importance of research in designing an ergonomic memory foam cervical curve pillow with an alternative organic wool material design specifically contoured to patients with scoliosis that effectively address discomfort and pain associated in the patient’s neck, back, and cervical spine. Scoliosis causes abnormal spinal curvature, leading to uneven pressure points during sleep. To address this, a study by Chou and Lin, as well as Kim et al. discussed how ergonomic pillows must feature a central ridge or contour that cradles the head and neck, promoting a more neutral spinal alignment. This can reduce muscle strain, pain, and nerve compression in the neck and upper back, which are areas commonly affected by scoliosis. (Chou & Lin, 2019; Kim et al., 2023).

Studies like Chen and Chang suggest pillows with neck support, allowing tailoring to the individual's scoliotic curve as well as a gentle, gradual elevation on the concave side of the curve for optimal head and neck alignment (Chen & Chang, 2019). While Sharma et al. highlight the effectiveness of using wedge pillows to fill the gap between the lower back and the mattress. This helps maintain a natural lumbar curve, reducing pressure on the discs and alleviating pain (Sharma et al., 2021). Scoliosis often creates uneven shoulder heights. Research by Kim et al. highlights the benefit of asymmetric pillow designs, featuring a higher bolster on the side of the lower shoulder, promoting neutral spinal alignment and pressure relief. It is recommended to design the pillow with side wings or bolsters that provide additional support for the shoulders. This helps keep the shoulders aligned with the spine and prevents them from rolling forward during sleep (Kim et al., 2023)

Ergonomic pillow design and shape can significantly impact sleep quality and comfort for scoliosis patients by addressing spinal asymmetry, reducing pain and pressure, promoting proper sleep posture, and improving breathing. With careful consideration and expert guidance, the researchers designed the ergonomic memory foam cervical curve pillow that is wedged to elevate the head and upper body. It has contour that follow the natural curve of the spine and conforms to the patient's spinal curvature providing targeted support and minimizing pressure points. This helps maintain proper alignment and reduce pressure on the uneven curves of the spine.

1.1 Objectives

The general objective of the study was to produce an ergonomic memory foam cervical curve pillow made with alternative organic wool material specifically contoured for patients with scoliosis that takes into consideration the curvature of their spine to provide comfort and optimal support as well as reduces and alleviates pain and discomfort experienced while sleeping. This research study aims to evaluate the proposed pillow's effectiveness in addressing cervical spine pain and discomfort by assessing comfort and pain levels as well as its impact on patients' sleep quality. Comfort and pain play crucial roles in analyzing the study of an ergonomic memory foam cervical curve pillow designed for scoliosis patients. This research paper aims to evaluating comfort and pain levels as well as the number of hours of sleep to get a holistic overview of the pillow's impact on patients' sleep quality. Analyzing comfort, pain provides a comprehensive understanding of the pillow's potential to alleviate symptoms, improve sleep, and ultimately enhance the quality of life for scoliosis patients. By investigating comfort and pain, as well as the acquired number of hours of sleep, the study gains valuable insights into the pillow's effectiveness and its potential role in managing scoliosis-related discomfort and improving patient well-being. It aims to determine provide insights into its potential benefits for clinical practice and patient care management.

2. Literature Review

The use of ergonomic pillows can reduce muscle strain, pain, and nerve compression in the neck and upper back, which are areas commonly affected by scoliosis. (Chou & Lin, 2019; Kim et al., 2023). Pillows with neck support allow tailoring to the individual's scoliotic curve as well as a gentle, gradual elevation on the concave side of the curve for optimal head and neck alignment (Chen & Chang, 2019). While Sharma et al. highlight the effectiveness of using wedge pillows to fill the gap between the lower back and the mattress.In the study of Sharma et al. (2021) highlight the effectiveness of using wedge pillows to fill the gap between the lower back and the mattress. This helps maintain a natural lumbar curve, reducing pressure on the discs and alleviating pain. Scoliosis often creates uneven shoulder heights. Research by Kim et al. highlights the benefits of asymmetric pillow designs, featuring a higher bolster on the side of the lower shoulder, promoting neutral spinal alignment and pressure relief. It is recommended to design the pillow with side wings or bolsters that provide additional support for the shoulders. This helps keep the shoulders aligned with the spine and prevents them from rolling forward during sleep (Kim et al., 2023).

3. Methods

The research respondents include the entire population of both male and female patients who are clinically diagnosed with scoliosis with ages ranging from 18-65 years old (Table 1). The researchers politely asked if they were willing to participate in the research study by answering survey questions and testing out the proposed ergonomic pillow design. The researchers targeted patients who resided in the NCR region, because of the easy access. Based on The Medical City (2017), 3–5 of 1,000 people is diagnosed with or affected by scoliosis. Also, based on the Philippine Statistics Authority (2021), the total population in the NCR region for the year 2023 would be 13,884,896. Given the percentage from The Medical City, which was 0.5%, the estimated population of people diagnosed with scoliosis within the NCR region would be 69,424 people.

Table 1. List of Variables of the Study

Variable	Description of Variable
Level of Comfort	In the study of Bolton et al. (2022), the first objective was to determine whether an experimental mattress that was made to lessen spine curvature in lateral sleeping postures was effective at easing lower back discomfort and enhancing sleep. The study indicates improved comfort and reduced pain while lying on the experimental mattress. Results suggest that a sleeping surface that encourages spinal neutrality may benefit pain and comfort, which affirms that the level of comfort is significant in improving quality of sleep.
Level of Pain	The study by Afolalu et al. (2018) supports claims that sleep-related alterations have a negative impact on health and getting enough and consistent sleep can significantly improve pain-related health outcomes.

4. Data Collection

The researchers have done volunteer sampling (Figure 3), where Statistics Canada (2021), explained that volunteers must be screened to get a set of characteristics suitable for the purposes of the survey (e.g., individuals with a particular disease). The researchers sorted the volunteer respondents into people diagnosed with scoliosis and people willing to be part of the study and participate in the experiment of the proposed design the researchers designed. Based on the results given by the application GPower, the total sample size that the researchers acquired is 34 respondents. Having an effect size of 0.5, the value of alpha or the error probability would be 0.05, and a power of 0.95.

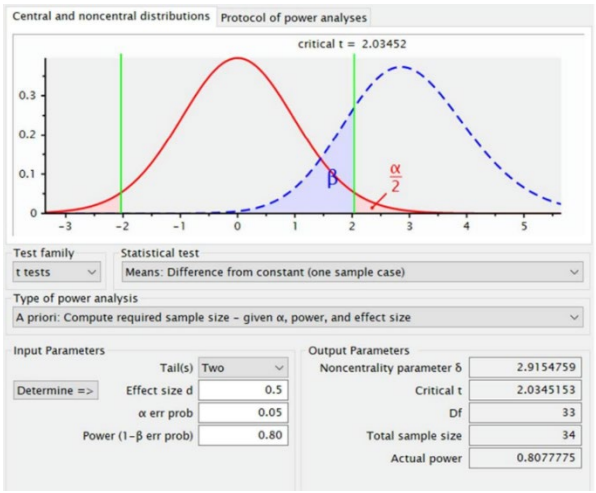

Figure 3. GPower Results for Total Sample Size

5. Results and Discussion

Assumptions for Paired t-test of Level of Comfort is presented in Table 2. Assumptions for Paired t-test of Level of Pain is presented in Table 3. Assumptions for Paired t-test of Level of Duration of Sleep is described in Table 4.

Table 2. Assumptions for Paired t-test of Level of Comfort

Assumption	Compliant / non-compliant	Evidence
Subjects are independent	Compliant	The data were independent of one another because each participant has done the experiment on their own
Measurements for one subject do not affect measurements for any other subject	Compliant	The data were obtained from the same person to compare the before and after of the participant's experience with the pillow
The measured differences are normally distributed	Compliant	The data is normally distributed. The variable has shown a bell-like curve histogram that was plotted in Microsoft Excel Data Analysis

Table 3. Assumptions for Paired t-test of Level of Pain

Assumption	Compliant / non-compliant	Evidence
Subjects are independent	Compliant	The data were independent of one another because each participant has done the experiment on their own
Measurements for one subject do not affect measurements for any other subject	Compliant	The data were obtained from the same person to compare the before and after of the participant's experience with the pillow
The measured differences are normally distributed	Compliant	The data was normally distributed. Each variable has shown a bell curve-like shape histogram that was plotted in Microsoft Excel Data Analysis

Table 4. Assumptions for Paired t-test of Level of Duration of Sleep

Assumption	Compliant / non-compliant	Evidence
Subjects are independent	Compliant	The data were independent of one another because each participant has done the experiment on their own
Measurements for one subject do not affect measurements for any other subject	Compliant	The data were obtained from the same person to compare the before and after of the participant's experience with the pillow
The measured differences are normally distributed	Not Compliant	The data is not normally distributed. The variable has shown non-symmetric bimodal distribution that was plotted in Microsoft Excel Data Analysis

5.1 Numerical Results

Numerical Results are presented in Table 5 -Table 7.

Table 5. Data Analysis: Level of Comfort

t-Test: Paired Two Sample for Means		
	Before	*After*
Mean	17.31428571	18.8
Variance	2.398319328	2.929411765
Observations	35	35
Pearson Correlation	0.06879693	
Hypothesized Mean Difference	0	
df	34	
t Stat	-3.945445792	
P(T<=t) one-tail	0.000189263	
t Critical one-tail	1.690924255	
P(T<=t) two-tail	0.000378526	
t Critical two-tail	2.032244509	

H0: The mean score of the level of comfort before the designed pillow was used is greater than or equal to than that after the designed pillow was used

H1: The mean score of the level of comfort before the designed pillow was used is less than that after the designed pillow was used

H0: $\mu B > \mu A$

H1: $\mu B < \mu A$

CR: $t < -1.69$

t-stat = -3.945

P-value = 0.00019

Reject H0

Table 6. Data Analysis: Level of Pain

t-Test: Paired Two Sample for Means		
	Before	*After*
Mean	8.428571429	4.971428571
Variance	5.134453782	2.087394958
Observations	35	35
Pearson Correlation	0.03080242	
Hypothesized Mean Difference	0	
df	34	
t Stat	7.719294203	
P(T<=t) one-tail	2.80416E-09	
t Critical one-tail	1.690924255	
P(T<=t) two-tail	0.00000000561	
t Critical two-tail	2.032244509	

H0: The mean score of the level of pain before the designed pillow was used is less than or equal to than that of after the designed pillow was used

H1: The mean score of the level of pain before the designed pillow was used is greater than that of after the designed pillow was used

H0: mB < mA
H1: mB > mA
CR : t > 1.69
t-stat : 7.719
P-value = 0.00009
Reject H0

Table 7. Data Analysis: Number of Sleep

Number of hours of sleep		
t-Test: Paired Two Sample for Means		
	Before	*After*
Mean	4.514285714	6.542857143
Variance	1.315966387	1.255462185
Observations	35	35
Pearson Correlation	-0.06341625	
Hypothesized Mean Difference	0	
df	34	
t Stat	-7.257533229	
P(T<=t) one-tail	1.05649E-08	
t Critical one-tail	1.690924255	
P(T<=t) two-tail	2.11297E-08	
t Critical two-tail	2.032244509	

H0: The mean score of the number of hours of sleep before the designed pillow was used is greater than or equal to than that after the designed pillow was used
H1: The mean score of the number of hours of sleep before the designed pillow was used is less than that after the designed pillow was used

H0: μB > μA
H1: μB < μA
CR: t < -1.69
t-stat = -7.258
P-value = 0.00000001056
Reject H

5.2 Graphical Results

Based on the results of the data analysis (Figure 4), the level of comfort with the critical region of t < - 1.69, and a test statistic of -3.945. The analysis shows a P-value for comfort level was 0.000189 below the chosen threshold of 0.05. This means the test statistic landed within the critical region, wherein the null hypothesis is rejected, and the alternative hypothesis is accepted.

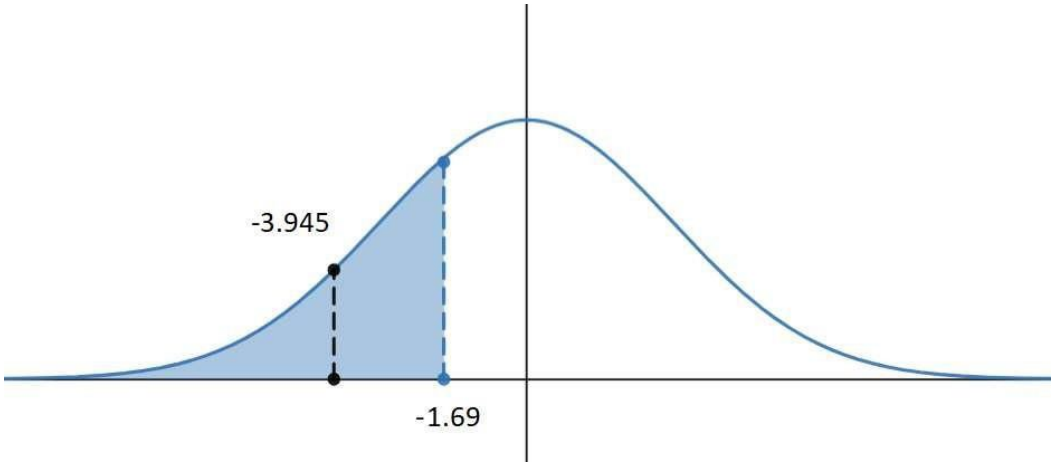

Figure 4. Normal Curve of Level of Comfort

With this, it concludes that the null hypothesis was rejected and that the mean score of the level of comfort before the designed pillow was used is less than that after the designed pillow was used. Hence, the proposed pillow design provided a much higher level of comfort to scoliosis patients than ordinary pillows currently offered in the market. It shows that the proposed pillow is much more comfortable than the current one that the participants use.

This explains that through the gathered data from the respondents the researchers were able to conclude that the proposed pillow was more comfortable than the pillow that the patients were using before. Out of the 35 patients who participated, it proved that the proposed pillow was more comfortable than the before pillow (Figure 5).

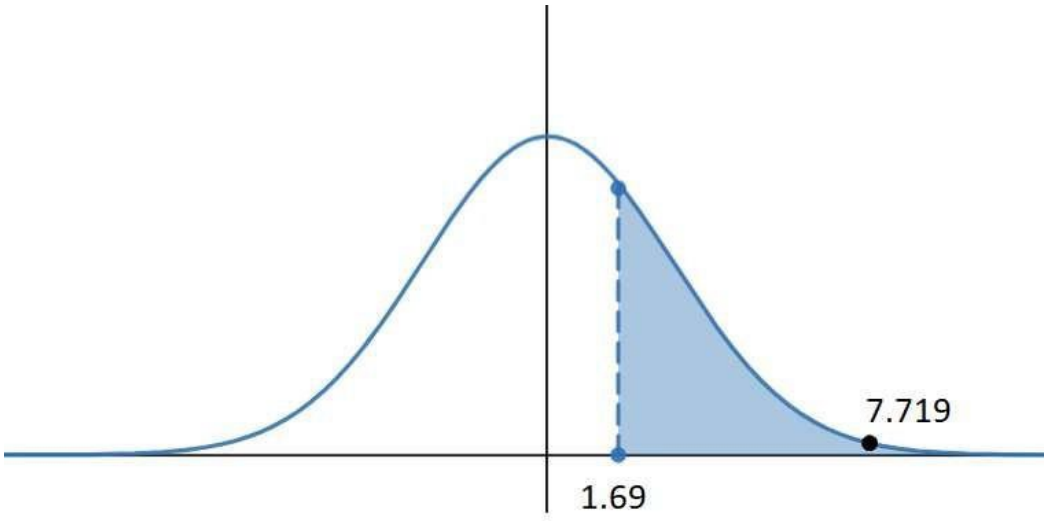

Figure 5. Normal Curve of Level of Pain

5.3 Validation

Based on the results of the data analysis, the level of pain with the critical region of $t > 1.69$, and a test statistic of 7.719. The analysis shows a P-value for comfort level was 0.000000002804 below the chosen threshold of 0.05. This means the test statistic landed within the critical region, wherein the null hypothesis is rejected, and the alternative hypothesis is accepted.

With this, it concludes that the null hypothesis is rejected and that the mean score of the level of pain before the designed pillow was used is greater than that of after the designed pillow was used. Hence, the proposed pillow lessens the pain experienced by scoliosis patients. It shows that compared to the current pillow, the participants experience less pain when using the proposed pillow and lessen the frequency of the pain they experience during their sleep.

This explains that through the gathered data from the respondents the researchers were able to conclude that the proposed pillow was less painful for the patients rather than the pillow that the patients were using before. Out of the 35 patients who participated, it proved that the proposed pillow was more comfortable than the before pillow in the sense that the patients experienced less pain with the proposed pillow.

6. Conclusion

The table above shows the conclusive results of hypothesis tests conducted on various aspects of the proposed ergonomic memory foam cervical curve pillow for scoliosis patients. According to the data, the proposed ergonomic memory foam cervical curve pillow showed positive effects on comfort and pain reduction for scoliosis as supported by the rejection of the null hypothesis of these aspects. However, the null hypothesis in the aspect of incorporation of organic wool to the pillow was accepted, indicating no significant impact on the sustainability of the product. Nevertheless, the data gathered supports the proposed ergonomic memory foam cervical curve pillow's effectiveness for scoliosis patients. The results from the survey demonstrate that the proposed pillow design significantly provides comfort and reduces sleeping discomfort for patients diagnosed with scoliosis.

The benefits of the ergonomic pillow, namely improved sleep quality, reduced pain, and enhanced comfort, outweigh the associated costs. That being stated, an observable positive impact on scoliosis patients can be assessed. According to the cost-benefit analysis, potential developments in both human and organizational aspects justify investing in the development and implementation of the ergonomic cushion. As the study ends, the importance of the research emphasizes the potential for beneficial improvements in the well-being of individuals suffering from scoliosis and the greater healthcare environment with the proposed ergonomic pillow for scoliosis pain management.

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