

The Effect of Postural Mobility Exercises on the Athletic Performance Success, Proprioceptive Sense and Various Strength Parameters of Traditional Archers

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This research was supported by the Bayburt University Student Research Projects Support Programme. Furthermore, this study was presented orally at the International Academic Sports Research Congress on 7 October 2024

Geliş Tarihi/Received 19.09.2025
Kabul Tarihi/Accepted 27.04.2026
Yayın Tarihi/Publication Date 22.06.2026

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Cite this article: Kul, M., Hazar, E.B., Boz, E., & Uçal, M.S. (2026). The effect of postural mobility exercises on the athletic performance success, proprioceptive sense and various strength parameters of traditional archers. *Research in Sport Education and Sciences*, 28(2), 92-101.

Postüral Mobilite Egzersizlerinin Geleneksel Okçuların Sportif Performans Başarı, Proprioseptif Duyu ve Çeşitli Kuvvet Parametrelerine Etkisinin İncelenmesi

ABSTRACT

The aim of this study is to investigate the effects of eight weeks of TheraBand-based postural mobility exercises on athletic performance, strength, and proprioceptive senses in traditional Turkish archers (TTA). The study involved 24 male volunteer athletes enrolled at Bayburt University who had at least six months of regular archery training history. Participants were divided into experimental and control groups; the experimental group underwent postural mobility exercises three days a week for eight weeks, while the control group continued only their routine archery training. Data collection included assessments of grip and squeeze strength, back-leg strength, shoulder proprioception, shoulder mobility, and TTA shooting performance. The findings showed that the experimental group achieved significant improvement in all parameters, while the control group showed only limited increases in shoulder mobility and archery performance ($p < .05$). In conclusion, adding TheraBand exercises to traditional training is recommended as an effective method for increasing archers' muscle strength, joint stability, and performance.

Keywords: Traditional Turkish archery, proprioception, mobility, strength, thera band

ÖZ

Bu araştırmanın amacı, sekiz haftalık TheraBand temelli postüral mobilite egzersizlerinin geleneksel Türk okçularında (GTO) sportif performans, kuvvet ve proprioseptif duyular üzerindeki etkilerini incelemektir. Çalışmaya Bayburt Üniversitesi'nde eğitim gören ve en az altı ay düzenli okçuluk antrenmanı geçmiş olan 24 gönüllü erkek sporcu katılmıştır. Katılımcılar deney ve kontrol gruplarına ayrılmış; deney grubuna sekiz hafta boyunca haftada üç gün postüral mobilite egzersizleri uygulanırken, kontrol grubu yalnızca rutin okçuluk antrenmanlarını sürdürmüştür. Verilerin toplanmasında kavrama ve sıkıştırma kuvveti, sırt-bacak kuvveti, omuz proprioepsiyonu, omuz mobilitesi ve GTO atış performansı değerlendirilmiştir. Bulgular, deney grubunda tüm parametrelerde anlamlı gelişim sağlandığını, kontrol grubunda ise yalnızca omuz mobilitesi ve okçuluk performansında sınırlı artışlar olduğunu göstermiştir ($p < ,05$). Sonuç olarak, TheraBand egzersizlerinin geleneksel antrenmanlara eklenmesi, okçuların kas kuvveti, eklem stabilitesi ve performansını artırmada etkili bir yöntem olarak önerilmektedir.

Anahtar Kelimeler: Geleneksel Türk okçuluğu, proprioepsiyon, mobilite, kuvvet, thera band



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Introduction

Traditional Turkish archery (TTA) is a deep-rooted cultural heritage based on nomadic Turkish tribes who used bows and arrows for hunting and warfare. The bow and arrow played a vital role in the daily lives of Turkish communities living on the Asian steppes, and over time gained importance as a military and sporting skill (Pekel et al., 2023). Due to its cultural significance, UNESCO declared TTA as intangible cultural heritage in 2019 and listed it among the values that should be preserved in contemporary societies (Pekel et al., 2023). Today, TTA stands out not only as a cultural heritage but also as a sport that develops individuals' physical capacities and supports their motor skills.

In archery, physical and neuromuscular elements such as mobility, proprioception, grip strength, and back muscle strength play a critical role in effective athletic performance. Mobility facilitates archers' ability to adjust their stance correctly and transition between changing positions; the literature shows that elite archers have better postural control skills than amateurs (Kim et al., 2021; Lau et al., 2020; Zanjani et al., 2024). Proprioception, the ability to perceive the body's position in space, contributes to balance and coordination, thereby increasing shooting accuracy (Ji, 2024; Jung & Choi, 2019; Lin & Karduna, 2016; Prasetyo et al., 2023; Yoon et al., 2020). Similarly, grip strength is considered a decisive factor in holding the bow correctly and maximising draw force, and is regarded as a parameter directly related to archery performance (Asan, 2023; Handayani et al., 2024; Park et al., 2023).

Archery is a sport that requires the effective use of upper body muscles, particularly the back muscles. During the act of drawing the bow, muscles such as the trapezius and latissimus dorsi play an active role. The ability of these muscles to generate sufficient force helps maintain proper posture and ensures a high accuracy rate during shooting (Wang et al., 2022). Indeed, strong back muscles both enhance performance and reduce the risk of injury (Dar, 2025). In this regard, resistance training applied to strengthen the back muscles plays an important role in supporting archery performance.

Among resistance exercises, the use of Thera-band stands out as a low-cost, portable, and effective method (Borges et al., 2020). Thera-band exercises contribute to the development of muscle strength, endurance, and postural control by creating continuous tension on the muscles, while also reducing the risk of injury (Lee et al., 2022; Lee et al., 2023). TTA Thera-band applications are used to support the dynamics of the archery movement; they can enhance shooting performance by strengthening the activation of upper body muscles, particularly the latissimus dorsi and serratus anterior (Chen et al., 2023; Zhao et al., 2024). Furthermore, these exercises offer a suitable training option for individuals with muscle weakness, contributing to the recovery of motor skills (Chen et al., 2023).

The physical loads encountered in archery enable athletes to develop their neuromuscular systems (Zhang et al., 2021). In this context, applying thera-band exercises at different resistance levels not only increases muscle endurance but also improves coordination between muscle groups (Agopyan et al., 2018; Mahlovanyy et al., 2023). Therefore, Thera-Band exercises can be considered an effective training method for improving the sporting performance achievements of TTAs and reducing their risk of injury.

There are no studies in the literature examining the effects of Thera-Band exercises in TTA sports on elements directly related to performance, such as strength, proprioception, and mobility. This situation indicates that the subject is worthy of research in terms of both practical training planning and scientific research. In this context, the aim of this study is to examine the effects of an eight-week postural mobility exercise programme on TTA sports performance achievements, proprioceptive sensations in the shoulder joint, and various strength parameters.

Methods

Research Design

This study was conducted using a pre-test–post-test control group experimental design. Following pre-test measurements, participants were randomly allocated to either the experimental group or the control group. During the research process, pre-test and post-test measurements were applied to both groups; thus, the effects of postural mobility exercises on athletic performance, proprioceptive sense, and strength parameters were examined comparatively.

This study was approved by the Ethics Committee of Bayburt University on March 31, 2023 under the decision number E-15604681-100-127059. In addition, informed consent (oral and written) was obtained from all participants.

Participants

The participants in the study consisted of 24 adult males who volunteered to participate in the study at Bayburt University. The inclusion criteria for the study were: being between the ages of 18 and 30, having previously trained regularly with TTA for at least 6 months, agreeing to participate regularly in training sessions during the research process, and providing written consent. Exclusion criteria were defined as having undergone serious injury or surgery to the upper extremities within the last six months, having a history of neurological, orthopaedic or cardiovascular disorders, being unable to participate in regular training during the research process, and refusing to complete the tests and measurements. Following the pre-test measurements, participants were randomly assigned to either the experimental group or the control group. Randomization was performed using a computer-generated random number sequence to ensure unbiased group allocation.

Data Collection Tools

Traditional Turkish Archery Performance Test

The scores obtained from each shot were calculated based on the scoring system established by the Turkish Traditional Archery Federation (TGTOF, 2024). Total performance scores were recorded for each participant.

Measurement of Proprioceptive Sensation

Proprioceptive sense was assessed using an active joint position sense (JPS) test of the shoulder joint. Participants, with their eyes closed, were asked to actively reproduce target shoulder angles (60°, 90°, and 120°). The absolute angular error between the target and reproduced position was measured using a universal goniometer (Kılıç et al., 2024). Each measurement was repeated three times, and the mean value was recorded.

Figure 1.
Proprioception Angle Measurements



Shoulder Mobility Measurements

Shoulder mobility was assessed using the Functional Movement Participants stood in an upright position with feet shoulder-width apart and were instructed to actively move both arms simultaneously—one in shoulder flexion and abduction from above, and the other in extension and internal rotation from below—attempting to bring both hands as close as possible or to touch behind the back. The distance between the hands was recorded as the outcome measure. Each trial was performed three times, and the mean value was used for analysis.

Force Measurements

Dominant hand grip strength was assessed using a standardized protocol. Participants were seated in a back-supported chair with the shoulder in adduction, elbow flexed at 90°, forearm in a neutral position, and wrist in 0–30° extension. Grip strength was measured three times using a Jamar Hydraulic Hand Dynamometer, with a 60-second rest interval between trials.

Thumb pinch strength was additionally assessed using a Jamar Hydraulic Pinch Gauge under the same standardized position. The mean value of the three trials was recorded for statistical analysis (Wen et al., 2020).

Back strength, isometric back strength test

Isometric back and leg strength was assessed using a Back and Leg Dynamometer (Altinok et al., 2017). The device consists of a foot platform, a chain system, and a rigid aluminium handle for grip. The lifting platform measures 61 × 61 cm, and the device has a measurement range of 22–272 kg with 2.25 kg increments.

Participants stood on the platform with knees slightly flexed and grasped the handlebar while maintaining an upright trunk position. They were instructed to exert maximal isometric force by extending the knees and hips without jerking. Each participant performed three trials with a 60-second rest interval between attempts. The highest value obtained was recorded for analysis.

Exercise Protocol

The experimental group participated in supervised training sessions three days per week for 8 weeks, with each session lasting 40–60 minutes. Each session consisted of a 10-minute general warm-up, postural mobility exercises using elastic resistance bands, Traditional Turkish Archery (TTA) training, and a 10-minute cool-down period. The control group continued only their regular TTA training with the same weekly frequency and duration, without additional exercise intervention.

Exercise intensity in the experimental group was progressively increased throughout the intervention by adjusting elastic band resistance and/or repetition volume.

The postural mobility exercises were as follows (Kim et al., 2021):

- **Seated Band External Rotation:** Participants sit holding the band with both hands, keeping their elbows at a 90° angle close to their body. After pulling the band outwards, they slowly return to the starting position. Sets/ reps: 3 sets, 10–15 reps.
- **Band Pull Apart:** Participants stand upright, holding the band wide with both hands at shoulder height; they pull the band apart by opening their arms to the sides and then return to the starting position. Sets/ reps: 3 sets, 12–15 reps.
- **Seated Band Shoulder Flexion:** Participants sat with the band secured under their feet, raised their arms to stretch the band, and then returned to the starting position. Sets/ reps: 3 sets, 10–12 reps.
- **Band Resisted Shoulder Extension:** Participants secured the band under their feet, pulled it backwards with their arms held in front, and then returned to the starting position. Sets/ reps: 3 sets, 10–15 reps.
- **Shoulder Stability Exercises:** Participants held the band steady during various dynamic movements and gradually increased resistance was applied to their hands. Sets/ reps: 3 sets, 8–10 reps.

Data Analysis

Following the completion of all measurements, data were analyzed using IBM SPSS Statistics 26.0 (IBM SPSS Corp., Armonk, NY, USA). Descriptive statistics (mean, standard deviation, and frequency distributions) were calculated for all variables.

The normality of data distribution was assessed using the Shapiro–Wilk test. As the data did not meet the assumption of normality, non-parametric tests were applied.

Within-group comparisons (pre-test vs. post-test) were performed using the Wilcoxon Signed-Rank Test. Between-group comparisons (experimental vs. control group) were conducted using the Mann–Whitney U test. The significance level was set at $p < .05$.

Results

The analysis results of the research data are presented in tables in this section (Table 1-4). These data relate to pre-test and post-test values.

Table 1.
Wilcoxon signed-rank test results for the pre-test and post-test data of the experimental group.

Variables	Measurements	n	Rank Average	Rank Totals	Z	p
Grip Strength	Post-Test – Pre-Test	Negative Rank	0	.00	-2.492	.016*
		Positive Rank	12	6.50		
		Equal	0			
Pinching Strength	Post-Test – Pre-Test	Negative Rank	0	.00	-3.086	.003*
		Positive Rank	12	6.50		
		Equal	0			
Back-Leg Strength	Post-Test – Pre-Test	Negative Rank	0	.00	-2.699	.036*
		Positive Rank	12	3.50		
		Equal	0			
Shoulder Proprioception	Post-Test – Pre-Test	Negative Rank	8	4.88	-2.214	.041*
		Positive Rank	3	9.00		
		Equal	1			
Shoulder Mobility	Post-Test – Pre-Test	Negative Rank	11	6.00	-2.032	.039*
		Positive Rank	0	3.00		
		Equal	1			
Traditional Turkish Archery Shooting Performance	Post-Test – Pre-Test	Negative Rank	0	.00	-3.437	.001*
		Positive Rank	12	7.00		
		Equal	0			

* $p < 0.05$

When the pre-test and post-test measurements of the experimental group were compared using the Wilcoxon Signed-Rank Test, statistically significant differences were observed in all examined variables ($p < .05$). Grip strength ($Z = -2.492$, $p = .016$), pinching strength ($Z = -3.086$, $p = .003$), back-leg strength ($Z = -2.699$, $p = .036$), and traditional Turkish archery shooting performance ($Z = -3.437$, $p = .001$) showed significant increases following the intervention. In contrast, shoulder proprioception ($Z = -2.214$, $p = .041$) and shoulder mobility ($Z = -2.032$, $p = .039$) demonstrated statistically significant decreases in post-intervention values compared to pre-test measurements.

When the pre-test and post-test measurements of the control group were analyzed using the Wilcoxon Signed-Rank Test, no statistically significant differences were found in grip strength ($Z = -0.892$, $p = .112$), pinching strength ($Z = -1.423$, $p = 0.155$), back-leg strength ($Z = -1.341$, $p = .183$), and shoulder proprioception ($Z = -1.025$, $p = .207$) ($p > .05$). In contrast, statistically significant changes were observed in shoulder mobility ($Z = -2.819$, $p = .036$) and traditional Turkish archery shooting performance ($Z = -3.243$, $p = .002$). Based on rank distributions, shoulder mobility showed a decrease, whereas shooting performance demonstrated an increase in post-test values compared to pre-test measurements.

Table 2.
Wilcoxon signed-rank test results for the control group's pre-test and post-test data.

Variables	Measurements		n	Rank Average	Rank Totals	Z	p
Grip Strength	Post-Test – Pre-Test	Negative Rank	4	6.75	27.00	-,892	.112
		Positive Rank	6	4.67	28.00		
		Equal	2				
Pinching Strength	Post-Test – Pre-Test	Negative Rank	3	3.50	10.50	-1,423	.155
		Positive Rank	6	5.75	35.00		
		Equal	3				
Back-Leg Strength	Post-Test – Pre-Test	Negative Rank	4	5.80	23.73	-1,341	.183
		Positive Rank	6	4.88	32.00		
		Equal	2				
Shoulder Proprioception	Post-Test – Pre-Test	Negative Rank	7	4.88	39.00	-1,025	.207
		Positive Rank	3	9.00	21.00		
		Equal	2				
Shoulder Mobility	Post-Test – Pre-Test	Negative Rank	12	7.00	54.00	-2,819	.036*
		Positive Rank	0	.00	.00		
		Equal	0				
Traditional Turkish Archery Shooting Performance	Post-Test – Pre-Test	Negative Rank	0	.00	.00	-3,243	.002*
		Positive Rank	12	6.50	78.00		
		Equal	0				

* $p < .05$

The Mann–Whitney U test was conducted to examine differences between elite and amateur archers in pre-test measurements. The results indicated that there were no statistically significant differences between groups for grip strength ($U = 62.50$, $Z = -0.553$, $p = .580$), pinching strength ($U = 55.00$, $Z = -1.000$, $p = .317$), back leg strength ($U = 49.50$, $Z = -1.303$, $p = .192$), shoulder proprioception ($U = 66.00$, $Z = -0.356$, $p = .722$), and traditional Turkish archery shooting performance ($U = 64.50$, $Z = -0.437$, $p = .662$). Although no significant differences were observed, shoulder mobility showed a trend toward statistical significance, with elite archers demonstrating higher mean ranks compared to amateur archers ($U = 40.00$, $Z = -1.871$, $p = .061$).

The Mann–Whitney U test was performed to compare post-test values between elite and amateur archers. The results showed statistically significant differences in favor of elite archers for grip strength ($U = 23.50$, $Z = -2.815$, $p = .005$), pinching strength ($U = 35.50$, $Z = -2.139$, $p = .032$), and back leg strength ($U = 2.50$, $Z = -4.021$, $p < .001$).

No statistically significant differences were found between groups for shoulder proprioception ($U = 54.50$, $Z = -1.038$, $p = .299$), shoulder mobility ($U = 49.00$, $Z = -1.338$, $p = .181$), and traditional Turkish archery shooting performance ($U = 51.00$, $Z = -1.223$, $p = .221$).

Table 3.
Mann–Whitney U Test results comparing elite and amateur archers at pre-test

Variable	Group	Sample Size	Mean Rank	Sum of Ranks	Mann–Whitney U	Z	p
Grip Strength (Pre-Test)	Elite Archers	12	13.29	159.50	62.50	- 0.553	.580
	Amateur Archers	12	11.71	140.50			
Pinching Strength (Pre-Test)	Elite Archers	12	13.92	167.00	55.00	- 1.000	.317
	Amateur Archers	12	11.08	133.00			
Back Leg Strength (Pre-Test)	Elite Archers	12	10.63	127.50	49.50	- 1.303	.192
	Amateur Archers	12	14.38	172.50			
Shoulder Proprioception (Pre-Test)	Elite Archers	12	12.00	144.00	66.00	- 0.356	.722
	Amateur Archers	12	13.00	156.00			
Shoulder Mobility (Pre-Test)	Elite Archers	12	15.17	182.00	40.00	- 1.871	.061
	Amateur Archers	12	9.83	118.00			
Traditional Turkish Archery Shooting Performance (Pre-Test)	Elite Archers	12	11.88	142.50	64.50	- 0.437	.662
	Amateur Archers	12	13.13	157.50			

* $p < .05$

Table 4.
Mann–Whitney U Test results comparing elite and amateur archers at post-test

Variable	Group	Sample Size	Mean Rank	Sum of Ranks	Mann–Whitney U	Z	p
Grip Strength	Elite Archers	12	16.54	198.50	23.50	- 2.815	.005
	Amateur Archers	12	8.46	101.50			
Pinching Strength	Elite Archers	12	15.54	186.50	35.50	- 2.139	.032
	Amateur Archers	12	9.46	113.50			
Back Leg Strength	Elite Archers	12	18.29	219.50	2.50	- 4.021	< .001
	Amateur Archers	12	6.71	80.50			
Shoulder Proprioception	Elite Archers	12	13.96	167.50	54.50	- 1.038	.299
	Amateur Archers	12	11.04	132.50			
Shoulder Mobility	Elite Archers	12	10.58	127.00	49.00	- 1.338	.181
	Amateur Archers	12	14.42	173.00			
Traditional Turkish Archery Shooting Performance	Elite Archers	12	10.75	129.00	51.00	- 1.223	.221
	Amateur Archers	12	14.25	171.00			

* $p < .05$

Discussion

The aim of this study was to investigate the effects of an eight-week postural mobility exercise programme on traditional Turkish archery performance, shoulder proprioception, and strength-related parameters. The findings suggest that TheraBand-based postural mobility training may contribute to improvements in neuromuscular function and muscular strength.

When pre-test and post-test results were compared, greater improvements were observed in the experimental group compared to the control group. In the experimental group, significant increases were found in grip strength, thumb pinch strength, back-leg strength, shoulder proprioception, and shoulder mobility. In contrast, the control group showed significant changes only in shoulder mobility and archery shooting performance. These findings indicate that adding resistance-based postural mobility exercises to traditional Turkish archery training may provide additional benefits, particularly for strength development.

The observed improvements in strength parameters are consistent with previous research demonstrating that elastic resistance training enhances muscle activation, strength production, and functional capacity. TheraBand-based exercises have been reported to improve grip strength and functional performance in various populations by increasing neuromuscular activation and resistance tolerance (Kwon et al., 2019; Wang et al., 2022). Similarly, resistance band training has been shown to enhance upper extremity strength and functional outcomes in clinical and athletic populations (Gönener et al., 2017; Park et al., 2023). These findings support the idea that elastic resistance training can effectively contribute to both upper and lower extremity strength development.

With regard to shoulder proprioception, previous studies have reported that resistance-based and rotator cuff exercises can improve joint position sense and neuromuscular control (Yoon et al., 2020). The combination of resistance training and dynamic movement patterns appears to enhance proprioceptive feedback mechanisms (Jung & Choi, 2019; Lin & Karduna, 2016). In the present study, improvements in shoulder proprioception in the experimental group may be explained by increased neuromuscular activation and repetitive sensorimotor stimulation induced by resistance band exercises. However, between-group differences in proprioception were not statistically significant, suggesting that the magnitude of change may be limited.

Similarly, shoulder mobility improvements have been reported following resistance and scapular stabilization exercises (Zanjani et al., 2024). Although the experimental group demonstrated improvements in this variable, the absence of significant between-group differences suggests that both traditional training and resistance-based interventions may contribute to mobility gains to some extent. Regarding archery performance, both groups demonstrated improvements in shooting scores. This may be attributed to continued sport-specific practice throughout the intervention period, which likely contributed to a practice or training exposure effect. However, greater improvements in strength parameters observed in the experimental group suggest that resistance-based postural mobility exercises provide additional benefits beyond regular archery training.

When post-test values were compared between groups using the Mann–Whitney U test, the experimental group demonstrated significantly higher grip strength, pinch strength, and back-leg strength compared to the control group ($p < .05$). These findings indicate that the intervention had a specific effect on muscular strength development beyond traditional training alone. However, no statistically significant between-group differences were observed in shoulder proprioception, shoulder mobility, or archery performance. This suggests that the intervention was more effective in enhancing strength-related outcomes than functional or performance-based variables.

Overall, the findings indicate that an eight-week TheraBand-based postural mobility programme may be beneficial for improving muscular strength and selected neuromuscular parameters in traditional Turkish archers. However, its effects on shoulder proprioception, mobility, and sport-specific performance appear to be more limited. Therefore, resistance-based supplementary training may be considered as an effective adjunct to traditional archery training, particularly for strength development.

Conclusion and Recommendation

Eight weeks of TheraBand-based postural mobility exercises, when combined with traditional Turkish archery training, may provide additional benefits in improving muscular strength and selected functional performance parameters in archers. The experimental group demonstrated greater improvements in strength-related outcomes compared to the control group, while changes in shoulder proprioception, range of motion, and archery performance were more limited and inconsistent between groups.

These findings suggest that resistance band exercises may serve as a useful supplementary training method for enhancing physical performance components relevant to precision-based sports such as archery. However, their effects appear to be more pronounced in strength development than in all functional or performance outcomes.

Future research should investigate the long-term effects of such training interventions and explore their applicability across different age groups, genders, and competitive levels. Additionally, combined training approaches integrating resistance, proprioceptive, and sport-specific exercises may further clarify their potential role in performance enhancement and injury prevention.

Etik Komite Onayı: Bu çalışma için etik komite onayı Bayburt Üniversitesi'nden (Tarih: 31 Mart 2023, Karar No: 140, Protokol No: E-15604681-100-127059) alınmıştır.

Hasta Onamı: Çalışmaya katılan tüm katılımcılardan sözlü onam alınmıştır.

Hakem Değerlendirmesi: Dış bağımsız.

Yazar Katkıları: Fikir-MK; Tasarım-EB; Denetleme-MK; Kaynaklar-EBH; Veri Toplanması ve/veya İşlemesi- EBH- MK- MSU-EB; Analiz ve/veya Yorum-EB-EBH; Literatür Taraması-EBH-MSU; Yazıyı Yazan-EB-EBH; Eleştirel İnceleme-MK

Çıkar Çatışması: Yazarlar, çıkar çatışması olmadığını beyan etmiştir.

Finansal Destek: Yazarlar, bu çalışma için finansal destek almadığını beyan etmiştir.

Yapay Zekâ Kullanımı: Bu çalışmanın hazırlanması sürecinde yapay zekâ tabanlı araçlardan yalnızca metinlerin dil bilgisi, ifade düzeni ve akıcılığının iyileştirilmesi amacıyla yararlanılmıştır.

Çalışmanın bilimsel içeriği, araştırma tasarımı, veri analizi ve yorumlanması tamamen araştırmacı tarafından gerçekleştirilmiştir.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Bayburt University (Date: March 31, 2023, Decision Number: 140, Protocol No: E-15604681-100-127059).

Informed Consent: Verbal consent was obtained from all the participants.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept -MK; Design-EB; Supervision-MK; Resources-EBH; Data Collection and/or Processing-EBH-MK-MSU-EB; Analysis and/or Interpretation-EB-EBH; Literature Search-EBH-MSU; Writing Manuscript-EB-EBH; Critical Review-MK.

Conflict of Interest: The authors have no conflicts of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

Use of Artificial Intelligence: During the preparation of this study, artificial intelligence-based tools were used solely for improving grammar, clarity, and the overall fluency of the text. The scientific content, research design, data analysis, and interpretation were entirely conducted by the researcher.

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