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Original Article

# A comparative study of sensory function, pain threshold and tolerance, grip strength, and joint range of motion in healthy females with and without smartphone addiction

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**Abstract**

**Aim:** Smartphone use has rapidly increased worldwide, and the negative effects of excessive use have become increasingly apparent, including reductions in fine and gross motor skills, impairments in touch sensation, and psychological problems. This study aims to identify differences in hand functions and touch sensation between women with and without smartphone addiction.
**Materials and Methods:** A total of 50 healthy women with smartphone addiction and 50 without, all aged 18–40 years, participated in the study. The participants' two-point discrimination, touch sensation, pain threshold and tolerance, thumb pinch strength, hand grip strength, and normal joint range of motion (ROM) were evaluated.
**Results:** Significant differences were found between the groups on the dominant side in tactile monofilament, two-point discrimination, pain threshold, pain tolerance, thumb pinch strength, and hand grip strength ($p<0.05$). No significant differences were found between the groups in the ROM of the thumb joints ($p>0.05$). On the nondominant side, while pain threshold and thumb pinch strength showed significant differences between the groups ($p<0.05$), no significant differences were detected in tactile monofilament, two-point discrimination, pain tolerance, ROM of the thumb joints, or hand grip strength ($p>0.05$).
**Conclusion:** This study comprehensively examined the effects of smartphone addiction on hand grip strength, pain threshold and tolerance, and sensory functions in women and demonstrated that the increase in the level of addiction negatively affects both the motor and sensory performance of the hand.

**Keywords:** Smartphone addiction, fine motor skills, joint range of motion, pain, touch sensation

## INTRODUCTION

The use of smartphones has increased in recent years and has surpassed 50% of the global population. In high-income countries such as North America and Europe, more than 80% of the population uses smartphones (1). Today, smartphone addiction emerges when smartphone use reaches a level that interferes with an individual's daily life activities. Smartphone addiction is associated with uncontrolled and intensive usage behavior and is characterized by repetitive and prolonged execution of specific hand and finger movements. While smartphones facilitate daily life, excessive use may lead to psychological and physical problems in individuals (2). Among the psychological problems that arise due to the excessive use of smartphones are loneliness and asocial behaviors that develop as individuals prefer messaging instead of face-to-face communication in real life. Loss of attention and concentration

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caused by the compulsive notification-checking behavior, fear of being scammed or threatened due to being easily accessible in online environments, and concerns that privacy may be violated as a result of illegal applications have also been reported (3). Among the physical problems caused by smartphone addiction are numbness in the hand due to nerve damage, structural deformities in the thumb and little finger, decreases in muscle strength, stiffness in the neck muscles resulting from focusing on the screen in the same position for a long time, and signs of fatigue observed during the day due to insomnia (4). Such prolonged and repetitive loading is thought to adversely affect muscle strength, joint mobility, pain perception, and sensory feedback processes, particularly in the dominant hand. Increasing concerns about the effects of smartphone addiction on various aspects of users' lives, including fine and gross motor skills and sensory functions, have led to a remarkable rise in research conducted in this field in recent years and have made the topic an increasingly popular area of study (5–8). However, studies on hand–finger function and sensation in individuals with smartphone addiction are limited. Most existing studies have focused on general musculoskeletal complaints or psychosocial consequences of smartphone addiction. Studies simultaneously evaluating finger sensitivity, two-point discrimination, pain threshold and tolerance, as well as grip and pinch strength within the same sample remain limited (9–12). Moreover, potential differences between dominant and nondominant hands have not been sufficiently addressed in the literature.

The primary aim of hand and finger rehabilitation is to enable individuals to gain independence in daily life activities such as eating and bathing. For this reason, improving tactile and proprioceptive sensitivity in the fingers during the rehabilitation process plays an important role in increasing the individual's functional independence. In studies related to hand rehabilitation, while emphasis is placed on motor functions, it can be seen that sensory impairments may at times be neglected (8,13). In smartphone use, the thumb and index finger are generally used actively, and these become the fingers that are more sensitized compared to the others (14). This repetitive usage pattern may contribute to alterations in nerve conduction, pain perception, and sensory discrimination mechanisms. In this context, smartphone addiction becomes an important risk factor that should be addressed in rehabilitation in terms of potential motor and sensory impairments that may occur in the hand. Accordingly, the present study aims to address an important gap in the literature by simultaneously evaluating pain, sensory, and strength parameters in both hands within the same population in the context of smartphone addiction. Specifically, finger sensitivity, two-point discrimination, pain threshold and tolerance, thumb pinch strength, hand grip strength, and thumb joint range of motion (ROM) were evaluated on the dominant and nondominant sides in healthy women with and without smartphone addiction.

## MATERIALS AND METHODS

### Ethical Approval and Study Design

A total of 100 healthy women aged between 18 and 40, including 50 women who were smartphone addicts and 50 women who were not smartphone addicts, were included in this study. The participants' two-point discrimination, touch sensation, pain threshold and tolerance, thumb pinch strenght, hand grip strength, and thumb joints ROM were evaluated. All assessments were conducted according to a standardized protocol, with the smartphone addiction questionnaire administered by one researcher and the physical measurements performed by a trained physiotherapist who was blinded to group allocation. Individuals who had a history of fracture or tendon injury in any part of the upper extremity, had rheumatic disease, had deformity in the fingers, or had experienced upper extremity trauma or undergone surgical operation in the last 6 months were excluded from the study.

The study was approved by the Local Ethics Committee of Düzce University (Decision No. 2023/183, Dated 04.12.2023), and all procedures were conducted in accordance with the Declaration of Helsinki and with careful attention to the protection of personal data.

### Measured Parameters

### Smartphone Addiction Scale

To measure individuals' smartphone addiction, the "Smartphone Addiction Scale – Short Version (SAS-SV)," developed by Kwon et al. and consisting of 10 items evaluated with a six-point Likert scale, was used. The items in the questionnaire were scored from 1 to 6. The total scores ranged from 10 to 60. The scale has a single-factor structure and has no subscales. In the Korean sample, the cutoff score was determined as 31 for males and 33 for females. The Cronbach's alpha coefficient for consistency and concurrent validity of the questionnaire is 0.91. In our study, female participants scoring 33 points or above were recorded as smartphone addicts (15). Objective smartphone usage data, such as daily screen time, were not collected in this study. Participant classification was based solely on the validated self-reported Smartphone Addiction Scale.

### Pain threshold and tolerance

A Baseline 11IB/5 kg device was used to measure pain threshold and tolerance. The body of the first dorsal interosseous muscle was used as the reference point in the measurements. The disk of the algometer was positioned at a 90-degree angle to the skin. To assess pain threshold, pressure was applied, and the participant was asked to report the moment when pain was first perceived. Measurements were repeated three times on both the dominant and nondominant sides, with a 1-minute interval between each measurement. The average of the three measurements was recorded (lbf: pound-force). To evaluate pain tolerance, unlike the pain threshold procedure, pressure was applied until the participant stated that they could no longer endure it (16).

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### Touch sensation test

Touch sensation was assessed in the individuals using the Semmes-Weinstein Monofilament test. This test consists of nylon filaments resembling fishing lines with varying diameters but equal lengths. The filaments are identified by specific colors. There are 20 types of filaments with thicknesses ranging from 1.65 to 6.65. These numbers represent the logarithm, in milligrams (mg), of the force required to bend the monofilament (Table 1). Starting with the thickest monofilament, force was applied to the fingertip until bending occurred, and the participant was then asked whether they felt it. The first monofilament number that the participant did not perceive was recorded (17).

**Table 1. Semmes–weinstein monofilament classification**

| Monofilament value | Force required to bend (mg / g) | Color | Sensory level |
|---|---|---|---|
| **1.65–2.83** | 0.07 mg | Green | Normal sensation |
| **3.22–3.61** | 0.04 mg | Blue | Diminished light touch |
| **3.84–4.31** | 2 mg | Purple | Diminished protective sensation |
| **4.56–6.65** | 4 mg | Red | Loss of protective sensation |
| **6.65** | 300 g | Pink | Severe sensory loss / Anesthesia |

### Two-point discrimination

A Baseline brand discriminator was used for two-point discrimination. The individual was asked to sit and close their eyes. The minimum distance at which the participant could distinguish between two points from proximal to distal was determined. This distance is referred to as the discrimination threshold. The participant's hand was placed on a firm surface, and it was ensured that both points of the instrument were in contact with the skin. The participant was asked to report whether they felt one or two points. The minimum distance between the two points that allowed the participant to perceive them as two separate points was accepted as the two-point discrimination value and recorded in millimeters. The classification of this discrimination value was as follows: if the measured distance was less than 6 mm, it was recorded as normal sensation; between 6–10 mm, diminished–moderate sensation; between 11–15 mm, poor–impaired sensation; if only one point was perceived, protective sensation; and if no perception occurred, anesthetic (18).

### Measurement of range of motion

The measurement of joint ROM of the fingers was performed using a finger goniometer. Joint ROM values were measured in the carpometacarpal, metacarpophalangeal, and interphalangeal joints of thumb. The individual was asked to place the hand flat on the table, and while the stationary arm of the finger goniometer was kept parallel to the proximal bone, the movable arm was positioned parallel to the distal bone. At the end of the movement, the joint being measured remained between the arms of the goniometer, and the angle value was recorded in degrees (19).

### Finger pinch strength

Finger pinch strength was assessed using a Baseline pinch gauge. Measurements were performed using the lateral pinch technique, with the participant positioned as follows: shoulder adducted, elbow flexed at 90°, forearm in a neutral position, and wrist in 0–30° extension and 0–15° ulnar deviation. Three trials were performed for each hand with a 30-second rest interval between trials, and the mean value was recorded in kilograms (kg) (20).

### Hand grip strength

Hand grip strength was assessed using a Baseline hand dynamometer. The device was adjusted to fit the participant's hand size, and measurements were taken with the shoulder positioned in 10–15° abduction. Three trials were performed for each hand, and the highest value was recorded in kilograms (kg) (21).

### Statistical analysis

SPSS 22.0 (Statistical Package for Social Science) was used for the statistical analysis of the study. The normal distribution of the data was examined using the Shapiro–Wilk test. The Mann–Whitney U test was used to compare individuals with and without smartphone addiction. Spearman's rho correlation analysis was applied to examine the relationship between the questionnaire score and the parameters in the study. Quantitative variables were presented as median, minimum (min), and maximum (max) values. A p-value of <0.05 was considered statistically significant.

## RESULTS

The descriptive statistics of the data obtained from individuals with and without smartphone addiction who participated in the study are presented in Table 2. As a result of the Mann–Whitney U test performed to compare the measured parameters in individuals with and without smartphone addiction, significant differences were found between the groups on the dominant side in tactile monofilament, two-point discrimination, pain threshold,

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pain tolerance, thumb pinch strength, and hand grip strength (p<0.05). No significant differences were observed between the groups in carpometacarpal joint ROM, metacarpophalangeal joint ROM, or interphalangeal joint ROM (p>0.05). On the nondominant side, while pain threshold and thumb pinch strength showed significant differences between the groups (p<0.05), no significant differences were detected in tactile monofilament, two-point discrimination, pain tolerance, carpometacarpal joint ROM, metacarpophalangeal joint ROM, interphalangeal joint ROM, or hand grip strength (p>0.05).

**Table 2. Descriptive statistics and comparison results between the addicted group and the non-addicted group for all measured parameters**

| Parameters | | Addicted group | | | Non-addicted group | | | p* |
|---|---|---|---|---|---|---|---|---|
| | | Min. | Max. | Median | Min. | Max. | Median | |
| **Survey result** | | 33 | 58 | 44 | 1.65 | 1.65 | 1.65 | **<0.001** |
| **Tactile monofilament** | D | 2.36 | 4.08 | 1.65 | 1.65 | 1.65 | 1.65 | **<0.001** |
| | ND | 1.65 | 2.83 | 2.0 | 2.0 | 2.00 | 1.65 | 0.317 |
| **Two-point discrimination** | D | 3.0 | 6.0 | 2.0 | 2.0 | 2.00 | 2.00 | **<0.001** |
| | ND | 2.0 | 3.0 | 5.0 | 10.0 | 8.00 | 2.00 | 0.317 |
| **Pain threshold** | D | 3.0 | 3.0 | 5.0 | 10.0 | 9.00 | 8.00 | **<0.001** |
| | ND | 5.0 | 10.0 | 9.0 | 11.0 | 10.00 | 9.00 | **<0.001** |
| **Pain tolerance** | D | 5.0 | 10.0 | 9.0 | 11.0 | 11.00 | 10.00 | **<0.001** |
| | ND | 9.0 | 11.0 | 4.5 | 8.9 | 6.60 | 11.00 | 0.223 |
| **Thumb pinch strength** | D | 3.1 | 7.8 | 3.7 | 8.5 | 6.10 | 6.60 | **<0.001** |
| | ND | 2.1 | 5.9 | 15.0 | 60.0 | 35.00 | 6.10 | **<0.001** |
| **Carpo-metacarpal joint ROM** | D | 20.0 | 45.0 | 15.0 | 55.0 | 30.00 | 35.00 | 0.767 |
| | ND | 20.0 | 50.0 | 35.0 | 85.0 | 65.00 | 30.00 | 0.187 |
| **Metacarpo-phalangeal joint ROM** | D | 50.0 | 90.0 | 35.0 | 80.0 | 60.00 | 65.00 | 0.286 |
| | ND | 50.0 | 90.0 | 70.0 | 105.0 | 95.00 | 60.00 | 0.087 |
| **Interphalangeal joint ROM** | D | 80.0 | 100.0 | 75.0 | 100.0 | 90.00 | 95.00 | 0.362 |
| | ND | 65.0 | 95.0 | 13.70 | 37.90 | 27.30 | 90.00 | 0.884 |
| **Hand grip strength** | D | 0.00 | 38.80 | 12.1 | 34.4 | 24.75 | 27.30 | **<0.05** |
| | ND | 7.7 | 38.6 | 1.65 | 1.65 | 1.65 | 24.75 | 0.161 |

* Mann-Whitney U test. D: dominant, ND: nondominant

In non-addicted individuals, it was determined that all participants had normal sensation on both the dominant and nondominant sides according to the monofilament test. In addicted individuals, the distribution of sensory characteristics on the dominant and nondominant sides according to the monofilament test is presented in Figure 1. In the dominant side of the individuals, the monofilament test results showed 46% normal light touch sensation, 52% diminished light touch sensation, and 2% reduced protective touch sensation, while on the nondominant side, 98% normal sensation and 2% diminished light touch sensation were found.

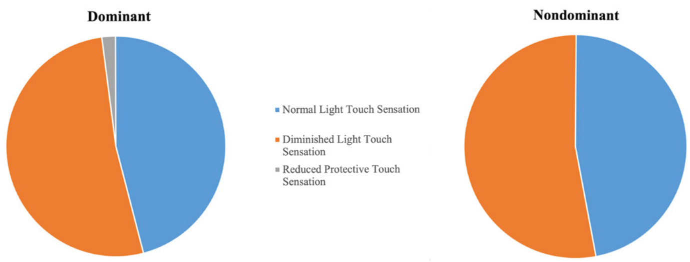


**Figure 1.** Distribution of sensory characteristics on the dominant and nondominant sides in women with smartphone addiction

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When the relationship between the questionnaire score and the parameters in the study was examined, statistically significant negative correlations were found on the dominant side between the questionnaire score and pain threshold, pain tolerance, thumb pinch strength, and carpometacarpal joint ROM; whereas statistically significant positive correlations were detected between the questionnaire score and tactile monofilament as well as the sensory characteristic group (Table 3). No significant correlation was found between the questionnaire score and the parameters measured on the nondominant side (p>0.05) (Table 3). Pain threshold and pain tolerance were observed to be positively correlated with the sensory characteristic group on the dominant side (Table 3). A strong positive relationship was observed between pain threshold and pain tolerance on the dominant side, while a weak relationship was observed on the nondominant side (Table 3).

When the correlation between the data on the dominant and nondominant sides was examined, a very strong relationship was found between hand grip strength on the dominant side and hand grip strength on the nondominant side. A positive relationship was also observed between the dominant and nondominant sides in pain threshold, pain tolerance, thumb pinch strength, and joint ROM (Table 4).

**Table 3. Institutions where the studies were conducted**

| Variable | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | — | | | | | | | | | | |
| | 2 | .299* | — | | | | | | | | | |
| | 3 | .348* | .898** | — | | | | | | | | |
| | 4 | .206 | .372** | .258 | — | | | | | | | |
| | 5 | -.433** | -.267 | -.274 | -.415** | — | | | | | | |
| Dominant side | 6 | -.481** | -.296* | -.291* | -.116 | .627** | — | | | | | |
| | 7 | -.280* | -.435** | -.413** | -.073 | .117 | .122 | — | | | | |
| | 8 | -.398** | -.047 | .048 | .162 | .006 | -.026 | .179 | — | | | |
| | 9 | -.052 | -.086 | -.041 | -.177 | .251 | .140 | .243 | .224 | — | | |
| | 10 | -.004 | -.100 | -.079 | -.052 | .072 | -.053 | .193 | .295* | .339* | — | |
| | 11 | .005 | .178 | .119 | .077 | -.087 | -.041 | .385** | -.085 | .052 | .097 | — |
| | 1 | — | | | | | | | | | | |
| | 2 | .134 | — | | | | | | | | | |
| | 3 | .134 | 1.000** | — | | | | | | | | |
| | 4 | .149 | -.020 | -.020 | — | | | | | | | |
| | 5 | .192 | .025 | .025 | -.096 | — | | | | | | |
| Nondominant side | 6 | .209 | .106 | .106 | .106 | .388** | — | | | | | |
| | 7 | -.169 | -.199 | -.199 | -.184 | .247 | .083 | — | | | | |
| | 8 | -.264 | -.021 | -.021 | .256 | -.190 | -.044 | .098 | — | | | |
| | 9 | -.232 | -.088 | -.088 | .237 | .013 | .019 | .049 | .344* | — | | |
| | 10 | .135 | -.011 | -.011 | .209 | -.005 | -.216 | .147 | .255 | .199 | — | |
| | 11 | -.011 | -.233 | -.233 | -.203 | -.070 | .114 | .544** | -.083 | -.067 | -.156 | — |

*p<0.05,**p<0.01. 1: Survey score, 2: Tactile monofilament, 3: Sensory characteristic group, 4: Two-point discrimination, 5: Pain threshold, 6: Pain tolerance, 7: Thumb pinch strength, 8: Carpometacarpal joint range of motion, 9: Metacarpophalangeal joint range of motion, 10: Interphalangeal joint range of motion, 11: Hand grip strength

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**Table 4. Spearman's rho correlation analysis comparing the dominant and nondominant sides**

| Variable | | Nondominant side | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Dominant side | 1 | .249 | .249 | .046 | -.158 | -.161 | -.189 | -.259 | -.027 | -.045 | .145 |
| | 2 | .278 | .278 | .125 | -.134 | -.091 | -.201 | -.189 | .056 | -.108 | .074 |
| | 3 | .177 | .177 | .177 | -.277 | .079 | -.074 | .143 | -.030 | .090 | .063 |
| | 4 | .072 | .072 | -.246 | **.331*** | .175 | .087 | -.171 | .127 | -.229 | -.071 |
| | 5 | .036 | .036 | -.218 | -.154 | **.295*** | -.045 | .064 | .007 | **-.380**** | .057 |
| | 6 | -.228 | -.228 | -.228 | .036 | .060 | **.767**** | .222 | .082 | .001 | **.333*** |
| | 7 | .098 | .098 | .221 | -.058 | -.037 | .113 | **.726**** | **.399**** | .239 | -.111 |
| | 8 | -.026 | -.026 | -.194 | .204 | .220 | .215 | .112 | **.695**** | .240 | .096 |
| | 9 | .105 | .105 | .105 | .148 | .118 | **.346*** | .196 | .179 | **.512**** | .148 |
| | 10 | -.213 | -.213 | -.119 | -.009 | .150 | **.591**** | -.076 | -.029 | -.198 | **.925**** |

*p<0.05,**p<0.01. 1: Tactile monofilament, 2: Sensory characteristic group, 3: Two-point discrimination, 4: Pain threshold, 5: Pain tolerance, 6: Thumb pinch strength, 7: Carpometacarpal joint range of motion, 8: Metacarpophalangeal joint ROM, 9: Interphalangeal joint range of motion, 10: Hand grip strength

## DISCUSSION

Smartphone addiction is a behavioral disorder associated with excessive and compulsive use and increases repetitive, single-function–focused motor movements of the hand during use. In this study, we investigated how the sensory and motor skills of the hand are affected. It was determined that women with smartphone addiction exhibited decreases particularly in touch sensation, two-point discrimination, hand grip strength, and finger strength in the dominant hand. In addition, significant differences were observed between women with and without smartphone addiction in terms of pain threshold and pain tolerance. As the level of smartphone addiction increased, decreases were observed in pain threshold, pain tolerance, hand grip strength, and carpometacarpal joint ROM. Marked impairments in touch sensation were also observed. Our findings demonstrated that repetitive thumb and hand movements may lead to reductions in motor functions while also adversely affecting nerve functions.

Studies examining the motor, sensory, and psychological effects of smartphone addiction on daily life reveal that this phenomenon has a multidimensional mechanism of impact. The findings of our study, in which different results related to hand skills, strength, and sensory functions were observed in the literature, show parallels with some studies while contradicting others. Mohamed et al. reported a significant relationship between smartphone addiction and hand and wrist pain; however, they stated that it did not have a significant effect on manual skills, coordination, and grip strength (9). This finding is inconsistent with our results, which demonstrated that grip and pinch strength decreased as the level of addiction increased. Similarly, Ahmed et al. showed that addiction was associated with wrist pain (10). Karataş reported that the duration of smartphone use negatively affected grip strength in firefighters, particularly in females; however, no significant change in hand skills was detected (22). In Lin's study, fine motor sensitivity and motor skills were found to be significantly lower in children who used tablets; in the study by Shah et al., hand skills and grip strength were shown to be significantly affected in children who used technological devices for more than two hours per day (23,24). Erğun Keşli et al. reported that smartphone addiction reduced grip strength and upper extremity function, but did not affect pain threshold or pain tolerance (11). Karagülle et al. stated that smartphone addiction led to a decrease in lateral pinch strength and pain in the thumb joint; however, no differences were observed in joint position sense or light touch sensation (12). Hundekari et al. reported that as smartphone usage duration increased, median motor nerve conduction velocity decreased significantly, while a non-significant decrease in grip strength was observed (25). The decreases observed in two-point discrimination and touch sensation in our study are consistent with the reduced nerve conduction velocity reported in this study. These findings suggest that compression and slowing of conduction velocity due to repetitive loading of the median nerve may lead to impairments in sensory

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functions. The significant decreases observed in pain threshold and pain tolerance, grip and pinch strength, and joint ROM may be associated with joint degeneration, tendon friction, nerve compression, and increased local sensitivity related to repetitive movements of the thumb and the second and third fingers. While the findings regarding hand and wrist pain in the literature are consistent, variations in results related to hand skills and sensory functions may be influenced by differences in age distributions, sex differences, assessment scales used, daily usage durations, and standardization of test procedures.

This study is one of the few investigations that simultaneously evaluated pain, sensory, and strength parameters within the same population and therefore has an original contribution to the literature; however, it has certain limitations. The fact that the study was conducted including only women prevented the identification of sex-related differences. The limited age distribution of the participants and the lack of separate analyses for different age groups made it difficult to evaluate the effects of age on sensorimotor functions. The assessment of smartphone addiction levels using self-report scales and the absence of objective data such as screen time may limit the accuracy of the findings. Addiction was assessed using a self-reported scale, and objective usage metrics (e.g., screen time) were not collected. In addition, the use of clinical tests and the lack of electrophysiological measurements (e.g., nerve conduction studies) did not allow for the direct demonstration of the neurophysiological basis of the detected changes. Therefore, advanced and longitudinal studies conducted in different age and sex groups, in which objective usage data and electrophysiological measurements are evaluated together, are needed.

## CONCLUSION

In conclusion, with the rapid development of technology, the use of smartphones and other digital devices is increasing; accordingly, the emerging advantages and disadvantages remain a current topic in the literature and highlight the need for stronger evidence in this field. This study comprehensively examined the effects of smartphone addiction on hand grip strength, pain threshold and tolerance, joint ROM, and sensory functions in women. It demonstrated that an increase in the level of addiction negatively affects both the motor and sensory performance of the hand. The obtained findings indicate that phone use imposes a non-negligible load on hand functions and that repetitive use patterns may affect both neuromuscular and sensory integrity. Therefore, in hand rehabilitation processes, it is important that phone use habits are questioned in detail, included in assessment protocols, and, if necessary, that use modifications are integrated into treatment planning. Conducting further studies in different age and sex groups accompanied by objective usage data and electrophysiological measurements will provide important contributions to the literature by clarifying the mechanisms of this relationship.

**Conflict of Interests**
*The authors declare that there is no conflict of interest in the study.*

**Financial Disclosure**
*The authors declare that there is no financial support.*

**Ethical Approval**
*The study protocol received approval from the Local Ethics Committee of Düzce University (Decision No. 2023/183, Dated 04.12.2023).*

***Patient Consent***
*All participants provided written informed consent.*

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