



# The Relationship of University Students' Internet Addiction Level Through Telephone Use and 2d:4d Ratio

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## Abstract

**Aim:** To evaluate the relationship between the 2nd and 4th finger measurement ratio (2d:4d) ratio of university students' internet addiction level through phone use.

**Material and Method:** 322 students were questioned about their demographic data, dominant extremity, and the device while using the internet. Hand width (HW), length (HL), grip strength (HGS), 2d:4d measurements were taken. Young Internet Addiction Scale (YIAS) was used for internet addiction, Smartphone Addiction Scale-Short Form (SAS) was used for smartphone addiction.

**Results:** In men, it was determined that there was a statistically significant difference between the groups in terms of Right-Left HL, Left HGS, Right/4d, YIAS and SAS values. In addition, it was determined that the device preference, HL right, HL left, HGS left and Right/4d parameters originated from normal and dependent groups. It was determined that there was a statistically significant difference between the groups in women in terms of Left HL, Right/2d, Right/4d, Left/2d, Left/4d, Young and SAS values. It was determined that the device preference was due to individuals falling into the normal group of Left HL according to the YIAS, and the statistical difference of the Right/2d, Right/4d, Left/2d and Left/4d parameters. It was determined that there was a moderately strong negative correlation between SAS and Right/2d, Right/4d, Left/2d, Left/4d parameters in addicted men.

**Conclusion:** The gender relations of the accepted scales regarding phone and internet addiction may be due to the length of the left hand and the movement function of the right 4d to provide control in phone use, rather than the 2d:4d finger ratios.

**Keywords:** 2nd and 4th finger measurement ratio, internet, smartphone, addiction, university students

## INTRODUCTION

Mobile phones, which entered our lives in the 90s with functions such as calling and message, have become important with the development of technology due to their many features such as internet use, video, photo taking, navigation and document transfer (1). While this developing technology makes life easier, it has also brought about internet addiction, which we can call the new concept of addiction (2). In the literature, Young defined internet addiction as the desire to use the internet excessively, the urge to constantly stay online, and extreme irritability and aggression due to deprivation (3). It is reported that university students, who are the group that uses the internet most intensively, have a high risk of internet addiction (4).

Nowadays, it is seen that unidirectional perspectives have begun to be replaced by multidisciplinary perspectives in

the evaluation of conditions affecting mental health such as attention deficit and hyperactivity disorder, autism spectrum disorder, substance use, addiction, anorexia nervosa, schizophrenia, depression, borderline personality disorder, antisocial personality disorder (Fusar-Poli et al., 2021). One of these approaches is the neurodevelopmental approach. The basis of neurodevelopmental diseases is related to development. In this context, developmental psychopathology may result from the interaction of both prenatal and postnatal periods (5). The ratio of the lengths of the second finger and fourth finger on the hand, known as 2d:4d is formed at the end of the first trimester in the prenatal period. This ratio is considered an indicator of testosterone and estrogen exposure. There is increasing data showing that high testosterone exposure is associated with behavioral problems, alcohol and substance use disorders, addictions and physical aggression (6).

## CITATION

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Additionally, at the systemic neuroscientific level, dysfunctions in the frontostriatal-limbic cycle have been observed in people suffering from internet addiction (7). While less is known at the molecular level underlying these neural dysfunctions, this study aimed to evaluate the relationship between university students' level of internet addiction through phone use and the 2d:4d ratio.

## MATERIAL AND METHOD

This study is a cross-sectional analytical study. A total of 322 volunteer students, 126 male and 196 female, from Bandirma University Nursing and Physical Therapy and Rehabilitation Department students participated in the study. Criteria for inclusion in the study; being a university student, volunteering to participate in the study, and using a smartphone. Participants with hand and wrist diseases or a history of trauma were excluded from the study when measuring hands. This work was implemented with the approval of the Bandirma University Non-Interventional Clinical Ethics Committee (2022-165). The study complies with the ethical standards of the Declaration of Helsinki as revised in 2013.

Descriptive statistics median (min-max) values for the ages of male and female students: male-normal 19 (17-41), male-risky 19 (17-28), male-addicted 21 (17-28), female-normal 19 (17-33), female-risky 19 (17-39), female-addicted 20 (17-28) (Table 1).

A structured survey was administered to the participants regarding sociodemographic characteristics, telephone and internet usage. In the evaluation form (age, gender, height, weight, body mass index (BMI), dominant extremity, device used while using the internet) were recorded by the practitioner. In addition, hand width, hand length, hand grip strength, and 2d:4d measurements of the fingers were taken. Young Internet Addiction Scale was used for internet addiction, and Smartphone Addiction Scale-Short Form was used for smartphone addiction.

### Evaluation Parameters

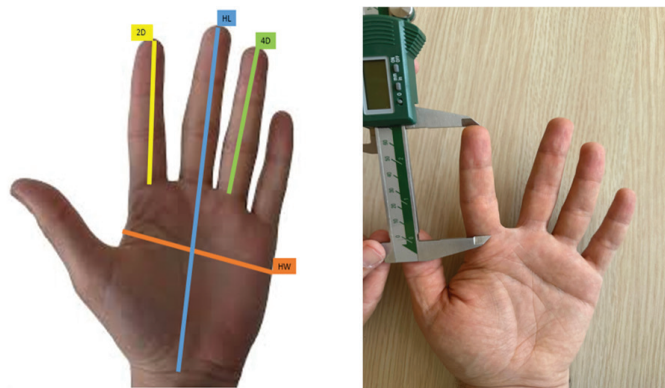
**Hand Width (HW):** The distance between the second and fifth metacarpophalangeal joints was measured with an electronic digital caliper (150 mm, 0.01 mm/0.0005 inch precision, Shan brand) (8) (Figure 1).

**Hand Length (HL):** The distance between the distal part of the styloid process of the radius and the tip of the longest finger was measured with a non-flexible tape measure (8) (Figure 1).

**Hand Grip Strength (HGS):** While the individual stood with his arms at his side and stood ready with a Saehan brand hand dynamometer in his hand, the measurement part of the dynamometer was held facing outwards. The dynamometer was tightened with maximal force. The test was applied twice for both hands and the best result was recorded in kilograms (8).

**2nd and 4th finger measurement ratio (2d:4d):** The length of the second finger and the fourth finger was measured twice with an electronic digital caliper (150 mm, Shan

brand with 0.01 mm/0.0005 inch precision) and written in cm (8) (Figure 1).



**Figure 1.** Hand width (HW), Hand length (HL), 2D (2th finger measurement), 4D (4th finger measurement)

### Young Internet Addiction Scale (YIAS)

It is a 20-question self-assessment scale developed by Dr. Young and whose validity and reliability in Turkish has been proven by Balta et al. In studies on internet addiction, participants are asked to mark one of the "Never - 0 points", "Rarely - 1 point", "Sometimes - 2 points", "Often - 3 points", "Often - 4 points" or "Always - 5 points" options in response to the questions asked. From the survey, a total score of "80 and above" is defined as an internet addict, "between 50-79 points" is defined as a risky internet addict, and "49 points and below" is defined as an "average internet user" (9).

### Smartphone Addiction Scale-Short Form (SAS)

The scale assessing smartphone addiction consists of 10 items with a 6-point Likert scale (1: I strongly disagree, 6: I strongly agree). While scores from the scale can be between 10 and 60, an increase in score indicates an increase in smartphone addiction (10).

### Statistical Analysis

The suitability of the data for normal distribution was checked with the Kolmogorov Smirnov test and it was determined that the data did not show a normal distribution. Median, minimum (min) and maximum (max) values of data that did not show normal distribution were given. Kruskal Wallis H test was applied to compare men and women according to addiction groups. According to the results of the Kruskal Wallis H test, Mann Whitney U test was applied to the data as a Post Hoc test to find out which group caused the statistically significant difference. IBM SPSS Statistics 22.0 package program was used in the analyses.  $P < 0.05$  was considered statistically significant.

## RESULTS

A total of 322 volunteers, 126 men and 196 women, participated in our study. According to the Young scale, addiction levels of individuals were divided into 3 groups: normal, risky and addicted individuals. Among men, it was determined that there were 46 participants considered normal, 35 participants considered risky, and 45 participants considered addicted according to their scale scores. Among women, it was determined that there

were 126 participants considered normal, 28 participants considered risky, and 41 participants considered addicted according to their scale scores. Median (min-max) values of the results showing age, height, weight and Body Mass Index (BMI), dominant extremity, and the technological device they use most in daily life according to the addiction

levels of men and women are given in Table 1. According to the analysis results of the Kruskal Wallis H Test between the groups, it was determined that there was no statistically significant difference in terms of demographic data, dominant extremity, and device preference according to the addiction levels of men and women ( $p>0.05$ ), (Table 1).

**Table 1. Demographic data, dominant extremity and device preference results of male and female participants**

Gender	Group	Age	Height	Weight	BMI	Dominant ekstremity		Device preference			
						R	L	Phone	Tablet	Computer	All
Male	Normal	19 (17-41)	175 (157-189)	65 (50-88)	21.6 (17.3-27.7)	42	3	39	2	4	0
	Risky	19 (17-28)	174 (156-190)	69 (42-93)	22.4 (15.7-28.7)	32	4	27	2	3	4
	Addicted	21 (17-28)	173 (160-190)	70 (50-92)	23.1 (17.9-31.8)	39	6	28	4	2	11
	p value	.051	.148	.257	.056	.575		.014			
Female	Normal	19 (17-33)	163 (150-180)	57 (35-90)	20.8 (14.5-34.7)	121	5	123	2	1	0
	Risky	19 (17-39)	165 (150-172)	58 (45-94)	21.4 (18-34.5)	24	4	21	3	4	0
	Addicted	20 (17-28)	162 (150-179)	55 (45-89)	21.4 (16.5-29.7)	36	5	28	3	0	10
	p value	.052	.628	.766	.416	.061		<0.001			

R: right, L: left

Median (min-max) values of measurements taken from the right and left hands of men and women according to their addiction levels and 2D:4D ratios are given in Table 2. According to the results of the Kruskal Wallis H Test analysis, it was determined that there was a statistically significant difference between the groups in terms of right

hand length, left hand length, HGS left, Right/4d, Young and SAS values in men ( $p<0.05$ ). According to the Kruskal Wallis H Test analysis results, it was determined that there was a statistically significant difference between the groups in terms of hand length left, Right/2d, Right/4d, Left/2d, Left/4d, Young and SAS values in women ( $p<0.05$ ) (Table 2).

**Table 2. Measurement values taken from the hands of men and women**

	Parameters	Normal addicted	Risky addicted	Addicted	p value
Male	R-Hand width	86 (76.3-94.3)	87.7 (76.3-94.9)	86.4 (73.2-94.1)	.259
	L-Hand width	84.7 (74.3-95.6)	85.7 (75.8-99.1)	84 (71-93.3)	.226
	R-Hand length	189.7 (161.5-206.7)	192.6 (178.8-214)	187.4 (107.8-214)	.040
	L- Hand length	188 (160-207)	192 (173-215)	185.5 (107.8-215)	.048
	R-HGS	30.8 (18-41)	45.2 (25-78)	40 (15-78)	.111
	L-HGS	31.15 (18-43)	43.6 (17-62)	38 (17-62)	.039
	R/2d	71.8 (62.5-80.7)	73.7 (61.6-82.8)	74.5 (61.6-106.2)	.159
	R/4d	72.6 (60.3-84.7)	74.7 (63.8-85.2)	75.3 (62-95.1)	.025
	R (2d:4d)	.988 (.93-1.14)	.981 (.86-.1.08)	.985 (.91-1.12)	.822
	L/2d	71.4 (62.5-82)	73.1 (63.8-82.1)	73.1 (62-98.4)	.319
	L/4d	72.6 (60.8-84.4)	74.9 (65-85.1)	75.4 (60.4-94.4)	.216
	L (2d:4d)	.981 (.92-1.07)	.974 (.92-.1.1)	.980 (.91-1.10)	.539
	Young	37 (10-47)	53 (50-65)	81 (80-88)	.000
	SAS	30 (13-51)	38.5 (18-58)	45 (26-60)	.000
Female	R-Hand width	76.6 (64.6-89.7)	76.8 (67.5-90)	77.2 (67.5-92.4)	.439
	L-Hand width	74.9 (65.6-85.2)	75.4 (68.1-86.9)	75.5 (68.1-90.7)	.962
	R-Hand length	175.5 (148-196)	176.1 (159.9-193.1)	173 (140.1-199.1)	.209
	L- Hand length	175 (149.6-202)	177.1 (159.6-195)	170 (138.5-194)	.008
	R-HGS	23.9 (7-38)	24.9 (9-37)	24.5 (9-46)	.694
	L-HGS	21.8 (9-36)	24.3 (11-34)	23 (11-49)	.242
	R/2d	68 (57.7- 82.8)	68.5 (61.6-77)	70 (60-89.8)	.027
	R/4d	67.8 (59-83.8)	67.6 (60.9-78)	69.2 (60.1-89.8)	.034
	R (2d:4d)	.999 (.86-1.12)	1.00 (.94-.1.12)	1.01 (.94-1.10)	.450
	L/2d	67 (58.2-86.7)	67.3 (60.9-76.8)	70.2 (59.3-89.3)	.003
	L/4d	67 (58.4-84.9)	67.8 (61.8-78.1)	70.3 (58-84.6)	.003
	L (2d:4d)	.993 (.93-1.14)	.996 (.93-1.04)	1.00 (.92-1.10)	.394
	Young	28 (6-49)	52.5 (50-74)	81 (80-84)	.000
	SAS	26 (10-45)	37.5 (18-50)	45 (30-55)	.000

R: right, L: left, HGS: hand grip strength, SAS: Smartphone Addiction Scale

According to the analysis results, the device preference was determined by the normal-dependent groups of hand length right, hand length left, HGS left and Right/4d parameters. As a result of the analysis, it could not be concluded which group caused the difference for Young and SAS parameters in all pairwise comparisons (Table 3). In order to determine

which addiction group caused the difference in the men's device preference and the measurements taken from their hands, Mann Whitney U test was applied to the data as a Post Hoc test and a Pairwise Comparison table was created. Model viewer image of the analysis result is given in Table 4.

**Table 3. Pairwise comparison results of parameters that differ between groups in men**

Male	Device preference	R-Hand length	L-Hand length	L-HGS	R/4d	Young	SAS
Normal-risky	.568	.999	.999	.999	.127	.000	.005
Normal-addicted	.011	.049	.047	.037	.032	.000	.000
Risky-addicted	.457	.108	.126	.233	1.000	.000	.005

R: right, L: left, HGS: hand grip strength, SAS: Smartphone Addiction Scale

In order to determine which addiction group caused the difference in the women's device preference and the measurements taken from their hands, Mann Whitney U test was applied to the data as a Post Hoc test and a Pairwise Comparison table was created. According to the results of the analysis, it was determined that the device preference and hand length left were from

individuals in the normal group according to the Young scale, and the statistical difference in the parameters Right/2d, Right/4d, Left/2d, Left/4d was from the Normal-dependent groups. As a result of the analysis, it could not be concluded which group caused the difference for Young and SAS parameters in all pairwise comparisons (Table 4).

**Table 4. Pairwise comparison results of parameters that differ between groups in women**

Female	Device preference	L-hand length	R/2d	R/4d	L/2d	L/4d	Young	SAS
Normal-risky	.008	.010	1.000	1.000	1.000	.727	.000	.000
Normal-addicted	.000	.033	.021	.029	.002	.003	.000	.000
Risky-addicted	1.000	1.000	.466	.281	.222	.439	.038	.014

R: right, L: left, SAS: Smartphone Addiction Scale

Spearman Rho correlation analysis was applied to the data to determine how SAS, hand measurements and 2d:4d ratios changed. According to the analysis results, it was determined

that there was a moderately strong negative correlation between SAS and the parameters Right/2d, Right/4d, Left/2d, Left/4d in the group of men identified as addicts (Table 5).

**Table 5. Spearman Rho correlation analysis results**

Parameter	Test statistics	Male			Female		
		Normal	Risky	Addicted	Normal	Risky	Addicted
R-Hand width	r	-.164	.062	-.238	.056	-.082	.188
	p	.276	.722	.115	.533	.678	.239
L-Hand width	r	-.211	.043	-.147	-.029	-.070	.132
	p	.158	.807	.335	.744	.725	.410
R-Hand length	r	-.062	-.225	.155	.046	.263	.066
	p	.682	.195	.309	.605	.177	.683
L-Hand length	r	-.088	-.239	.173	.028	.246	.285
	p	.559	.168	.257	.756	.208	.070
R-HGS	r	.056	-0.30	-.289	.015	.270	-.125
	p	.713	.862	.054	.866	.164	.435
L-HGS	r	.129	-0.46	-.177	-.038	.189	-.021
	p	.392	.792	.244	.671	.336	.898
R/2d	r	-.088	-.214	-.421	.074	.123	-.171
	p	.559	.217	.004	.409	.532	.285
R/4d	r	.031	-0.90	-.378	.005	.168	-.199
	p	.839	.605	.010	.960	.393	.212
R (2d:4d)	r	-.221	-1.44	-.212	.092	-.076	.044
	p	.140	.409	.163	.307	.701	.786
L/2d	r	-.180	-.305	-.454	.044	.118	-.143
	p	.233	.075	.002	.624	.551	.374
L/4d	r	-.026	-.247	-.396	-.052	.071	-.104
	p	.864	.153	.007	.566	.715	.517
L (2d:4d)	r	-.255	-.076	-.094	.165	.127	-.121
	p	.087	.665	.540	.064	.519	.452

R: right, L: left, HGS: hand grip strength

## DISCUSSION

In this study, it could not be concluded which group caused the difference in hand width, hand length, hand grip strength, and 2d:4d measurements of fingers for Young and SAS parameters among male and female university students. However, it was determined that there was a moderately strong negative correlation between SAS and Right/2d, Right/4d, Left/2d, Left/4d parameters in male students.

Zhang et al.'s (10) meta-analysis study, which evaluated the results of 10 articles from 6 different countries in 2018, showed that approximately 30% of medical students were addicted to the internet. In addition to this study, Haroon et al. (11) observed in their study that most of the students participating in the study were internet addicts, and that women were more internet addicted than men. Shek and You (12) revealed that gender has nothing to do with internet addiction. According to the results of our study, in terms of internet addiction level of all students, 55% are normal (F: 39%, M: 14%), 19% are at risk addicts (F: 9%, M: 10%), 26% are in the addict group (F: 12%, E: 13%) was observed to be. With this result, we found that the prevalence of internet addiction in university students was approximately similar to the Zhang et al. meta-analysis. In addition, the similar rate of internet addiction results in both genders supported Shek and You's study. In the study where we evaluated physical therapy and nursing students, we think that the difficulty of the academic program related to the department, such as the students' busy schedules, long internships, and compulsory attendance, caused a decrease in the time spent on the internet, and gender did not affect this situation.

With the ability to use the Internet from desktop computers to mobile phones, it has become a great comfort to use it whenever and wherever you want. Kuyucu et al. (13) stated that mobile phones are mostly used in internet usage. Özsoy and Kulu (14) also found similar results for our country in their study. In our study, in terms of device preference for internet use, the phone was at the forefront for 82% of all participants (74% for men, 88% for women). In addition, in terms of device preference for internet use, 94% of normal addicts, 76% of risky addicts, and 65% of addicts were using phones.

In our study, it was determined that there was no statistically significant difference in terms of height, weight, BMI, dominant extremity, and device preference according to the addiction levels of the genders (Table 1). In our literature review, we could not find any studies on height, weight, dominant extremity and device preference according to the addiction level of the genders. However, regarding BMI, Canan et al., in a study conducted on 1938 students in 2013, showed that there was a relationship between BMI and internet addiction in Turkish adolescents, but it was reported that there was no difference between genders (15). Since the sample population in our study consisted of young healthcare professionals, we think that normal values were recorded in terms of BMI in both genders.

It is known that sex hormones in men and women are related to the 2d:4d ratio and that these lengths affect physiological, psychological and behavioral characteristics (16). Studies have found that low 2d:4d due to prenatal androgens is associated with alcohol addiction, substance addiction, and phone and computer game addiction in men (17,18). The 2d:4d marker, which we know can be easily included as a biomarker to understand the biological basis of excessive internet use, has been reported to regulate prenatal sex steroids, brain structure and function, and finger development during embryogenesis (19). In a study by Canan et al. (15), the right hand was associated with internet use disorder with lower 2D:4D values in men, and in another study by Kornhuber et al. (20), young men diagnosed with video game addiction had lower 2D:4D values compared to healthy controls. It was observed that the 4D result was obtained. In our study, we found that there was no difference regarding 2d:4d in both male and female individuals. We concluded that these parameters are decisive in investigating the relationship with addiction status, regardless of gender.

It is known in the literature that there is a relationship between finger length and hand grip strength (21). It has been found that dominant side grip strength decreases due to smartphone use (22). In our study, we concluded that there were significant differences in left hand length, right 4d, young, SAS in both male and female individuals, and that these parameters were decisive in investigating the relationship with addiction status, regardless of gender. We thought that the significant difference in left HGS in men was due to the muscle strength of men and that the parameters affected by muscle strength could not yield results in the difference parameters between genders. In addition, we think that the effect of the right 4d is on the fact that the phone is generally held with the right hand and the 2nd finger is generally fixed in the grip, while the 4th finger has the task of being mobile to control the thumb movements.

## CONCLUSION

We have concluded that the scales accepted for phone and internet addiction in male and female individuals may be decisive in their gender relations rather than the 2d:4d finger ratios, as hand length, especially the right 4d, acts as a mobile device that provides control in phone use. In other words, we think that the biomechanical factor may be effective rather than the 2d:4d anthropometric measurement of addiction.

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