

Risk of Problematic Internet Use According to Dominant Handedness in Adolescents

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ABSTRACT

Objective: To investigate whether left or right-handedness influences adolescents' risk of problematic internet use (PIU).

Methods: The study conducted with Çanakkale Onsekiz Mart University students utilized a cross-sectional method. A self-reported questionnaire was completed by the participants regarding demographics. To ascertain the dominant hand and evaluate the extent of problematic internet usage (PIU), the short version of the Edinburgh Handedness Inventory (EHI) and Young's internet addiction test (IAT) were used. Young's IAT scores were analyzed according to handedness and in between left-handers.

Results: The questionnaires were filled out by 1186 university students aged 18-21. The rate of left-handedness was 10.5%, which was more common in males than females (12.6% vs. 9.5%, $p < .01$). The IAT score of the left-handed males was 37.02 ± 24.02 , while the score of the left-handed female was 32.74 ± 16.74 ($p < .05$). The overall prevalence of PIU was 18.8%. Males also had higher IAT scores ($p < .05$). There was no difference in test scores based on the dominant hand ($p > .05$). The risk of problematic internet use increased by 1.42 times more for males ($p > .05$ and $p < .05$, 95% CI: 1.04–1.94, respectively).

Conclusion: Adolescents' PIU cannot be predicted by their dominant hand. However, male left-handers are more prone to PIU behavior.

Keywords: Left-handedness, problematic internet use, internet addiction, adolescents

1. INTRODUCTION

In contemporary society, the internet has become an integral part of our everyday routines. Despite its undeniable convenience, however, the internet also presents a potential hazard in the form of addiction. Most studies on problematic internet use (PIU) prevalence show that the rate is increasing significantly yearly (1-3). Research on PIU has shown different prevalence levels in several countries, and the worldwide rate is estimated to be 10%. The prevalence of PIU among adolescents in Turkey exhibits a significant degree of regional variability, ranging from 1.6% to 19% (3-7). Problematic internet use is defined as "(a) internet maladaptive preoccupation experienced as irresistible use for periods longer than planned, (b) significant distress resulting from behavior, and (c) absence of other axes I pathology that might explain the behavior, i.e., mania or hypomania" (8). During adolescence, the distinct neuro-developmental plasticity of the brain may lead to an elevated susceptibility to PIU which can potentially result in detrimental impacts on

the mental health and overall well-being of young individuals in their daily lives (9). PIU may adversely affect the self-regulation and control abilities of individuals who are not yet fully mature physically and psychologically, which may significantly negatively impact an individual's overall well-being and life outcomes (10,11). There are other additional factors involved with PIU. Research has indicated that Internet addiction is closely associated with various factors, including personality traits, familial characteristics, parenting style, peer relationships, perceived social support, and the ability to regulate emotions (12-15). These findings suggest a comprehensive approach is necessary to address this complex issue (16) effectively. Dominant hand preference has been associated with substance use and addictive behavior in some publications (17,18). Some studies consistently show that alcohol-dependent patients are left-handed more often than healthy individuals (19). The connection between

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handedness and other addictions led us to hypothesize the possible association with PIU.

The brain's left hemisphere is more dominant than the right hemisphere in approximately 95% of individuals (20). It is well-known that handedness originates in the brain (21). Hand preference is established instinctively through hand activities (22). The preferred hand is the dominant one and is regulated by the opposite hemisphere (23). It is a natural variation for either the right or left hemisphere to be dominant in individuals. However, the reason for the prevalence of right-handedness over left-handedness remains to be determined. It has been observed that left-handedness is present in 5% to 25.9% of people across different cultures, with a higher prevalence in men than women (24). In the past, being left-handed was deemed unfavorable and an indication of inferiority in certain nations (25).

Additionally, up until the 1960s, it was typical to attempt to change left-handed individuals to right-handedness, with children being particularly compelled to write with their right hand (26). There is a potential connection between being left-handed and certain developmental issues, such as dyslexia and autism, as well as psychoneurological disorders such as epilepsy, depression, and schizophrenia, as indicated by research (29). It is worth noting that neuroscience and neurogenetics studies sometimes exclude left-handed individuals to minimize data variance (27-29).

The connection between left-handedness and addiction, particularly alcohol addiction, has been studied for many years. Left-handed individuals tend to drink more alcohol and are more likely to struggle with addiction than right-handed individuals (30-32). Reports indicate that left-handed individuals may have a greater propensity towards substance use, explicitly concerning heroin, ecstasy, and hallucinogens, compared to non-lefthanders (33). Considering the prior research on handedness and addiction, this paper investigated whether there is a link between PIU and handedness in university students.

2. METHODS

2.1. Ethics

In the central faculties of Çanakkale Onsekiz Mart University It was conducted with healthy university students between the ages of 17-21. All participants were provided with complete information about the purpose of the study and were invited to participate voluntarily. The students provided written consent letters. The Research Ethics Committee of the Çanakkale Onsekiz Mart University approved the study (Dated 22 March 2022 and numbered 2011-KAEK-27/2022.220.0065766).

2.2. Study Population

A cross-sectional study was conducted on Çanakkale University students between March and July 2022. We

recruited 1186 students who met the inclusion criteria. Inclusion criteria included (i) being between the ages of 17 and 21; (ii) circumstances that may prevent students from participating without assistance; (iii) does not have any known chronic disease; (iii) regularly enrolled college students; (iv) have access to at least one social networking site; (v) actively using the internet.

2.3. Procedure of the Study

Participants were contacted at the schools they attended. After the participants were informed before the study and their informed consent was obtained, the participants who agreed to participate in the study were asked to submit a socio-demographic data form (age, gender, height, weight, birth week and weight, type of birth, dominant hand use, parents' age, parents' education level, smoking/alcohol use, department of education) and the Young internet addiction scale (form with 20 questions). To determine the participants' dominant hand preferences, the 4-item form of the Edinburgh hand preference inventory (writing, throwing, toothbrush, spoon) was questioned.

2.4. Sociodemographic Information and Anthropometric Measurement Form

The authors created this form to gather information about the participants' age, gender, current anthropometric measurements (height and weight, self-reported), birth week, mode of delivery, alcohol consumption habits, smoking status, and parents' age and education level. Those who used alcohol regularly weekly were marked as "yes," and less frequent users were labeled "no." Smoking was marked as "yes" if at least one use per day and as "no" for less frequent users. Parental education level was categorized as less and more than eight years.

2.5. Defining the Handedness

The 4-item (writing, throwing, toothbrush, spoon) form of the Edinburgh Handed Preference Inventory (EHI) was used to objectively determine the subjects' hand preference in daily living activities (34). For each item, the participant is asked to verbally indicate which hand they used to perform the given activity.

2.6. Internet Addiction Survey (Internet Addiction Test, IAT)

Young's Internet addiction scale was used to assess the extent and intensity of self-reported compulsive Internet use (35). It has been validated and adapted into Turkish by Bayraktar. The internal consistency of the standardized Cronbach alpha coefficient and the Spearman-Brown coefficient's reliability is quite high, with values of 0.91 and 0.87, respectively (36). The results obtained from validity and reliability studies show that the validity and reliability of the Young Internet Addiction Test Form are ensured. The scale includes 20 items that use a 6-point Likert-type scale, ranging from 0

(never) to 5 (always). To determine the severity of internet disorder, the total score is computed by adding up the item responses, which range from 0 to 100. A higher score, closer to the theoretical maximum, denotes a more severe disorder. Individuals who score below 50 are identified as having control over their screen usage. A score ranging from 50 to 80 points is categorized as PIU, while a score between 80 and 100 is classified as a “pathological internet user” (37,38).

2.7. Statistical Analysis

We employed the SPSS (Statistical Package for the Social Sciences) software version 23.0 for Windows, developed by SPSS Inc. in Chicago, IL, USA, to conduct our statistical analysis. The criterion for statistical significance was set at $p < 0.05$. The Shapiro-Wilk method was utilized to verify if the data followed a normal distribution. To analyze total scale scores, the student's t-test was utilized for those with normal distribution, while the Mann-Whitney U test was employed for those without normal distribution. To compare normally distributed characteristics among multiple groups, we utilized ANOVA (with post hoc analysis using LSD). For non-normally distributed scale scores, we employed the Kruskal Wallis test (with post hoc analysis using Dunn). The correlation between quantitative variables was determined using the Pearson correlation coefficient. Binary logistic regression analysis was conducted to explore the potential correlation between the independent variables and Young's IAT scores. The report displayed descriptive statistics such as mean, standard deviation, and median values for numerical

variables. For categorical variables, the report provided the number and percentage values.

3. RESULTS

After excluding 510 people who did not agree to participate in the study and 184 people with more than 10% of the data missing, a total of 1186 participants were reached, aged between 18-21 (20.26 ± 0.80). When the quantitative demographic data and scale score values obtained from the participants were evaluated, it was observed that the proportion of female participants was higher (68.1%). Body mass index (BMI) values were determined as 22.58 ± 3.44 kg/m², it was found that 36.2% of the participants were born by cesarean section, while 63.8% were born by normal spontaneous vaginal delivery. Depending on the week of birth, 7.1% were born preterm and 92.9% were born term. It was determined that 48.3% of the participants consumed alcohol and 38% smoked. 125 (10.5%) of the participants were predominantly left-handed. According to the overall chi-square test of independence, left-handedness was more prevalent in males (12.5% vs. 9.5%, $p < .01$). We performed a post-hoc analysis with Bonferroni correction to determine which pairwise group differences were significant. The difference in the proportion of males between right-handed and ambidextrous individuals was statistically significant ($p < .01$), indicating that this subgroup contributed significantly to the overall effect. None of the other sociodemographic variables examined were significantly associated with dominant hand use (Table 1).

Table 1. Comparison of the demographics of the participants according to the dominant hand status

		Dominant hand						p
		Left-handers (n=125)		Right-handers (n=1008)		Ambidextrous (n=53)		
		n	%	n	%	n	%	
Gender	Male	48	38.4	303	30.1	27	50.9	.002*
	Female	77	61.8	705	69.9	26	49.1	
Delivery type	C/S	45	36.0	359	35.6	25	47.2	.233*
	NVD	80	64.0	649	64.4	28	52.8	
Birth week	Term	114	91.2	939	93,2	49	92.5	.718*
	Preterm	11	8.8	69	6.8	4	7.5	
Mother’s education	≤8 years	52	41.6	510	50.6	23	43.4	.112*
	>8 years	73	58.4	498	49.4	30	56.6	
Father’s education	≤8 years	32	25.6	349	34.6	19	35.8	.125*
	>8 years	93	74.4	659	65.4	34	64.2	
Alcohol usage	Yes	61	48.8	479	47.5	33	62.3	.111*
	No	64	51.2	529	52.5	20	37.7	
Active smoking	Yes	50	40.0	373	37.0	28	52.8	.061*
	No	75	60.0	635	63.0	25	47.2	
Mean±SD								
BMI		22.60±3.55		22.58±3.44		22.60±3.35		.996*
Mother’s age		46.4±4.63		46.68±5.12		47.66±6.04		.317*
Father’s age		49.44±4.7		50.26±5.48		51.44±7.11		.076*
NVD: normal vaginal deliverv. C/S: cesarean section. BMI: body mass index. SD: standard deviation. * Pearson Chi-Square test. * One-Way ANOVA test								

NVD; normal vaginal delivery, C/S; cesarean section, BMI; body mass index, SD; standard deviation, * Pearson Chi-Square test, * One-Way ANOVA test

The mean Young's IAT score of subjects was 32.68 ± 17.82 (Mean $\pm$ SD). Young's IAT scores were higher in males than females ($p < .05$). No significant difference was observed in IAT scores based on hand preference ($p > .05$).

According to Young's IAT threshold of 50 or higher, the estimated point prevalence of PIU is 18.8%, as shown in Table 2. Comparison of the characteristics of patients with and without PIU in terms of gender, mode of delivery, week of birth, maternal and paternal education levels, and alcohol and cigarette use according to Young's IAT score (Table 3). There was no significant difference in terms of delivery method between participants with and without problematic internet use ($p > .05$). In terms of birth week, 10.8% of participants with problematic internet use were born preterm, while this rate was 6.2% in participants without problematic internet use. This difference is statistically significant ($p < .05$). While 57.0% of the participants with PIU were using alcohol, only 46.3% of the participants without PIU were using alcohol. This difference is statistically significant ($p < .01$). While 45.7% of the participants with PIU smoked, only 36.2% of the participants without PIU smoked. This difference is also statistically significant ($p < .01$). According to the IAT score, it was determined that the BMI and the average age of the mother and father of the participants with and without problematic internet use were at similar values ($p > .05$).

Young's IAT score of the left-handed males was 37.02 ± 24.02 , while the score of the left-handed female was 32.74 ± 16.74 ($p > .05$). Young's IAT score was slightly higher in left-handed males than in right-handed males. However, it was insignificant (37.02 ± 24.02 vs. 34.74 ± 18.52 ; $p > .05$).

Nearly half of the participants (48.3%) reported regular alcohol use, with a significantly higher prevalence among males (60.3%, $p < .001$) compared to females. While 51.9% of males were smokers, the rate was 31.6% for females ($p < .001$). The rates of alcohol consumption and smoking did not exhibit a significant difference among the groups of individuals with varying handedness ($p > .05$ and $p > .05$, respectively). The left-handed males exhibit a statistically significant higher rate of regular alcohol consumption when compared to females (60.4% vs. 41.6%; $p < .05$).

According to logistic regression analysis results (Table 4), males had a 1.4 times higher rate of PIU than females ($p < .05$). It shows that the risk of addiction may increase as the birth week decreases. However, it is not statistically significant ($p > .05$). Although it is observed that the risk of PIU may increase with alcohol and cigarette use, it is not statistically significant ($p > .05$, $p > .05$).

Table 2. Young's IAT scores with three-dimensional cut-offs

			*p	Young's IAT scores						
				≥80		50-79		≤49		*p
		Mean±SD		n (10)	% (0.8)	n (213)	% (18)	n (963)	% (81.2)	
Dominant hand	Right-handers	32.46±17.39	.588 KW-H =1.06	7	0.7	175	17.4	826	81.9	.187
	Left-handers	34.38±19.87		3	2.4	27	21.6	95	76	
	Ambidextrous	32.85±20.64		-	0	11	20.8	42	79.2	
Gender	Male	34.85±19.47	.011 U=138769	4	1.1	87	23	287	75.9	.006
	Female	31.66±16.91		6	0.7	126	15.6	676	83.7	

IAT; Internet addiction test, SD; standard deviation, * Pearson Chi-Square test, U value was obtained from Mann Whitney U test, KW-H Kruskal Wallis analysis.

IAT; Internet addiction test, SD; standard deviation, * Pearson Chi-Square test, U value was obtained from Mann Whitney U test, KW-H Kruskal Wallis analysis.

Table 3. Comparison of demographics of those with and without PIU according to Young's IAT score

		Young's IAT scores				P
		<50		≥50		
		n	%	n	%	
Gender	Male	287	29.8	91	40.8	<.001*
	Female	676	70.2	132	59.2	
Delivery type	C/S	343	35.6	86	38.6	.409*
	NVD	620	64.4	137	61.4	
Birth week	Preterm	60	6.2	24	10.8	.017*
	Term (≥37)	903	93.8	199	89.2	
Mother's education	≤8 years	491	51.0	94	42.2	.018*
	>8 years	472	49.0	129	57.8	
Father's education	≤8 years	334	34.7	66	29.6	.148*
	>8 years	629	65.3	157	70.4	
Alcohol usage	Yes	446	46.3	127	57.0	.004*
	No	517	53.7	96	43.0	
Active smoking	Yes	349	36.2	102	45.7	.008*
	No	614	63.8	121	54.3	
Mean±SD						
BMI		22.49±3.34		22.98±3.84		.051*
Mother's age		46.61±5.13		47.04±5.05		.204*
Father's age		50.09±5.53		50.81±5.31		.069*
IAT; Internet addiction test, NVD; normal vaginal delivery, C/S; cesarean section, BMI; body mass index, SD; standard deviation, * Student's t-test, * Pearson Chi-Square test						

Table 4. Binary logistic regression results according to Young's IAT scores ≥50 vs. <50

	B	S.E.	Wald	p	OR	95% C.I. for OR	
						Lower	Upper
Gender	.353	.159	4.962	.026	1.424	1.043	1.943
Birth week	-.491	.258	3.625	.057	0.612	0.369	1.015
Mother's education	.226	.176	1.645	.200	1.254	0.887	1.772
Father's education	.049	.187	0.070	.792	1.051	0.728	1.517
Alcohol use	.236	.169	1.962	.161	1.266	0.910	1.762
Smoking	.197	.168	1.379	.240	1.218	0.876	1.693

B; regresyon katsayısı, S:E.; standart hata

Table 5. Post-hoc Analysis of Gender Differences by Dominant Hand Preference

Comparison	p-value	Bonferroni corrected p-value
Left-handers vs Right-handers	.072	.216
Left-handers vs Ambidextrous	.166	.499
Right-handers vs Ambidextrous	.0023	.0069

Bonferroni correction was applied. The significance level was accepted as $p < 0.05$.

4. DISCUSSION

The current research has established that PIU is unaffected by one's preference for the dominant hand. The fact that alcohol addiction has been found more frequently in left-handed individuals in previous studies led us to conclude that there may also be a possible link between left-handedness and other addictions (17). Therefore, in our study, it is thought that the risk of PIU behavior, which has become a

serious problem today, may be affected by hand dominance and may be a determinant before the development of PIU. The prevalence of PIU among university students has been reported to be between 6% and 40% (39). Our data reveal a PIU rate of 18.8% in the previously reported range. The current study observed that the most associated factor with PIU risk was the male sex, which was in line with the literature. However, some recent research state that the female sex has an increasing rate of PIU, while others indicate that gender is

not determinative in this regard. Since these studies mainly focus on the difference in the purpose of using the internet, as stated in the majority of literature, it seems stable that the male sex is more prone to PIU (40-42).

On the other hand, dominant hand use and gender distribution were examined in the study, and it was determined that left-handedness was more common in the male gender. It was determined that 12.7% of men and 9.53% of women were left-handed. In interpreting the significant association between gender and handedness ($p < .01$), a post-hoc analysis was performed to assess pairwise differences. The results indicated that the only statistically significant difference occurred between right-handed and ambidextrous participants (Bonferroni-corrected $p < .01$), with a notably higher proportion of males in the ambidextrous group. This finding suggests that the overall association was driven specifically by the gender composition difference between these two subgroups, rather than a generalized difference across all handedness categories. The testosterone hypothesis can explain this relationship, which indicates that genetic basis is more influential than environmental factors. Studies indicate that the presence of testosterone during pregnancy may hinder the growth of the brain's left hemisphere, leading to a proclivity for the right hemisphere and the ability to manipulate the movements of the right hand. As a result, heightened testosterone levels correlate with an increased probability of left-handedness (43).

In our study, it was observed that the IAT scores of obese individuals were significantly higher than the scores of normal weight participants. Studies have found that adolescents with internet addiction have a higher risk of obesity (44-46). Internet addiction and excessive internet use are conditions associated with obesity, likely due to their negative impact on physical activity, such as reduced regular exercise and unhealthy eating habits. In addition, excessive internet use may also increase the risk of eating disorders, which may be associated with obesity. However, more research is needed to fully explain this relationship (44-47). It means that obese individuals may experience social and psychological stress and can use the internet to reduce this stress. Obese individuals limited physical activity may increase their internet use. Obese individuals may spend more time on the internet instead of exercising (48,49). In the study, no significant difference was found in the mean YIAT scores based on birth week or delivery method. However, a high rate of premature births was observed in the group with problematic internet use. Research on internet addiction based on birth week or delivery method is quite limited. Some studies in the literature have found that premature children have a higher risk of internet addiction (50,51). Overall, there is insufficient information about the effect of birth week or delivery method on internet addiction. Therefore, further research is needed in this area. In our study, no significant difference was found in the IAT scores of the participants according to their smoking and alcohol use. However, smoking and alcohol use rates were found to be higher in participants with PIU. A meta-analysis that

included 13 studies to examine the relationship between alcohol consumption and internet addiction showed that alcohol consumption increases the risk of internet addiction (52). Although the results of these studies are contradictory, it is generally thought that there is a relationship between smoking or alcohol use and internet addiction. However, more research is needed on the direction of this relationship and how strong it is.

In our study, when the education levels of mothers and fathers were compared separately with the YIBÖ scores, no statistically significant difference was found between them. However, it was found that the participants with problematic internet use behavior had a higher rate of mothers with higher education levels ($p > .05$). In a study conducted in Turkey, they examined the effect of the education level of the mother and father on internet addiction and it was revealed that students with highly educated mothers and fathers had lower levels of internet addiction and also showed better academic success (53). Similar studies in the literature have observed that children of low-educated parents have a higher risk of internet addiction (54-56). These studies are based on the idea that the education level of the mother and father has a significant impact on internet addiction, that the children of highly educated parents can be more rational, develop healthy habits and manage digital technologies more effectively, while low-educated parents have a negative impact on their children's use of technology. It was interpreted that they did not have sufficient information, had difficulties in providing supervision, and were inadequate in controlling their children's internet use.

Alcohol and cigarette use were evaluated according to dominant hand use, and no significant differences were found. When the literature was scanned, the relationship between alcohol use and dominant hand use was examined and it was found that the alcohol consumption rate of left-handers was higher than that of right-handers (17,57). On the other hand, considering gender in our study, alcohol and cigarette use were found to be more common in left-handed males than in females.

No significant differences were found when comparing birth method and birth week with dominant hand status. Research on the relationship between birth method, birth week, and dominant hand use is limited. In a study conducted in the literature, dominant hand use of children born through normal vaginal delivery (NSVD) and cesarean section (C/S) was examined, revealing that children born through NSVD more frequently used their left hand. This is attributed to the positioning of the baby's head on the left side during birth, leading to more frequent use of the left arm (58). Further research is needed to identify differences in dominant hand use among children born via C/S. Studies on the relationship between birth week and dominant hand use have yielded conflicting results, indicating the need for additional research.

5. CONCLUSION

Addressing a robust relation between the dominant hand and PIU appears premature once we clarify and understand the possible determinants better. This research offers further understanding regarding how gender impacts the development of problematic internet use (PIU).

Some limitations need to be mentioned. The measurement of PIU was solely based on self-reporting, without the inclusion of any clinical evaluation or other pertinent data sources. This approach might have impacted the accuracy and consistency of the data collected. The fact that the rates of PIU and left-handedness preference vary according to the societies enabled us to represent the general population. Therefore, it is recommended not to overgeneralize. A high educational level also characterizes the investigated cohort.

Internet addiction or inappropriate use of the Internet is not a problem that can be solved through technology or policies alone. This situation is a new social struggle that must be determined through education. Within the scope of this struggle, field studies are urgently needed. Such research can contribute to developing policies to recognize and prevent the problem and to provide effective guidance and psychological counseling services.

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Revising it critically for important intellectual content: NK

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