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Research

Comparison of Anemic and Non-anemic Iron-deficient Adolescents in Terms of Psychosocial Aspects and Quality of Life: A Case Control Study

Demir Eksikliği Olup Anemik Olan ve Olmayan Ergenlerin Psikososyal Durumlarının ve Yaşam Kalitelerinin Karşılaştırılması: Bir Olgu Kontrol Çalışması

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ABSTRACT

Objective: In this study, anxiety levels, emotional and behavioral problems, self-esteem and quality of life (QoL) in adolescents with iron deficiency (ID) and iron deficiency anemia (IDA) were investigated.

Methods: The sample of this cross-sectional case-control study consisted of 115 adolescents (34 ID, 44 IDA and 37 healthy controls) aged 12–17 years. Strengths and Difficulties Questionnaire, Rosenberg Self-esteem Scale, The Pediatric QoL Inventory, Screen for Child Anxiety-Related Emotional Disorders were used for psychosocial assessment.

Results: The anxiety levels of patients with IDA were higher compared with healthy controls. The total, physical and psychosocial QoL scores of the adolescents with IDA was found to be lower than those with ID or healthy controls. The total iron binding capacity was correlated with total and psychosocial QoL, self-esteem, and anxiety scores.

Conclusion: Findings suggest that adolescents with IDA are affected in terms of anxiety and QoL. A psychosocial evaluation of adolescents with IDA would be appropriate.

Keywords: Quality of life, anxiety, adolescents, iron deficiency, anemia

ÖZ

Amaç: Bu çalışmada demir eksikliği (DE) ya da demir eksikliği anemisi (DEA) olan ergenlerin kaygı düzeyleri, duygusal ve davranışsal sorunlar, benlik saygısı ve yaşam kalitesi (YK) araştırıldı.

Gereç ve Yöntem: Bu kesitsel olgu-kontrol çalışmasının örneklemini 12-17 yaşları arasındaki 115 ergenden (34 DE, 44 DEA ve 37 sağlıklı kontrol) oluşturmuştur. Psikososyal değerlendirme için Güçler ve Güçlükler Anketi, Rosenberg Benlik Saygısı Ölçeği, Pediatrik Yaşam Kalitesi Envanteri, Çocukluk Çağı Anksiyete Tarama Ölçeği kullanıldı.

Bulgular: DEA olan hastaların anksiyete düzeyleri sağlıklı kontrollere göre daha yüksekti. DEA olan ergenlerin toplam, fiziksel ve psikososyal YK puanları, DE olanlara ve sağlıklı kontrollere göre daha düşük bulundu. Total demir bağlama kapasitesi, toplam ve psikososyal yaşam kalitesi, benlik saygısı ve kaygı puanları ile korele idi.

Sonuç: Bulgular, DEA olan ergenlerin kaygı ve yaşam kalitesi açısından etkilendiğini göstermektedir. DEA olan ergenlerin psikososyal yönden değerlendirilmesi uygun olacaktır.

Anahtar Kelimeler: Yaşam kalitesi, anksiyete, ergenler, demir eksikliği, anemi

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INTRODUCTION

Iron is an essential element that has many functions throughout the body and in the central nervous system, including myelination, cell development and neurotransmitter systems (1,2). Therefore, iron is of great importance in cognitive, behavioral and motor development and functions (3,4). Iron deficiency anemia (IDA) and iron deficiency (ID) are among the leading public health problems in children and adolescents in both developed and developing countries (5,6).

In clinical studies, it has been reported that ID causes social, academic and emotional problems (1). There is consistent evidence on the effects of IDA on neurocognitive development (7). However, there is limited information about psychosocial problems in iron-deficient adolescents with or without anemia. To date, studies have reported that children and adolescents with ID or IDA are at high risk of several psychiatric disorders such as major depression, bipolar disorder, anxiety disorder, autism spectrum disorder, and attention deficiency and hyperactivity disorder (8). But limited information reveals the difference between ID and IDA in adolescents in terms of these increased risks.

Quality of life (QoL) is defined by the World Health Organization as 'individuals' perception of their position in life in the context of the culture and value systems in which they live, and in relation to their goals, expectations, standards and concerns. Health-related QoL can also be defined as the whole of a person's physical health, psychological state, beliefs, social relationships and relationships with the environment (9). Despite the increasing focus on QoL issues and outcomes in the past decades, and ID appearing so common, in this context, the consequences of ID and IDA have not been adequately studied. Moreover, there are limited data on the relationship between QoL and psychosocial status of adolescents with ID or IDA. In the studies conducted to date, there is a study stating that there is no relationship between serum iron levels and psychological distress unless anemia develops, while another study reported that regardless of anemia, no significant relationship was found between ID and QoL (10,11).

Consequently, ID related psychosocial problems, and their effects on life in adolescents are not fully understood yet, and many aspects of this issue still need to be investigated. It is also unclear whether ID and IDA differ from each other in mentioned aspects. So, in this study, we compared anemic and non-anemic iron-deficient adolescent, and healthy controls (HC) in terms of anxiety levels, emotional and behavioral problems, self-esteem and QoL. We hypothesized that there are differences between IDA, ID and HCs in these aspects. Moreover, we examined these psychosocial parameters' correlation with hematological parameters in ID regardless of the presence of anemia.

METHODS

The sample of this single-center cross-sectional case-control study consisted of 115 adolescents (34 ID, 44 IDA and 37 HCs) aged 12-17 years. The ID/IDA groups were collected from the pediatric hematology clinic, and HCs were collected from the adolescents who applied for a general health check-up through an announcement. Ethical consent and approval (Van Training and Research Hospital Clinical Research Ethics Committee- decision no: 2019/19, date: 17.10.2019) of the study, and written informed consent was obtained. A power analysis was performed using G*Power version 3.1 to detect a high effect size (0.40) when α=0.05 for a power of 0.95 using control for effects analysis (ANOVA). Based on these criteria, G*Power recommended a minimum sample size of 102, with 34 in each group.

The inclusion criteria were as follows: (1) to have ID (ferritin value below 30 mg/dL, and/or total iron binding capacity (TIBC) is above 350 ug/dL without anemia) or IDA (hemoglobin value below 11 g/dL for girls, 12 g/dL for boys due to ID); (2) to be between the ages of 12-17; (3) attending formal education and (4) not receiving treatment for ID or IDA. Adolescents with a history of psychiatric or neurological disorders, mental retardation or physical disability, or acute infection-like symptoms were excluded from the study. Adolescents with other hematologic conditions (e.g., thalassemia) were also excluded from the study.

The forms and scales used in the study were as follows:

Sociodemographic data form was used to collect information about age, gender, working and educational status of parents, family structure and monthly income.

Strengths and Difficulties Questionnaire (SDQ): This questionnaire is for screening behavioral and emotional problems in adolescents (12). The parent report form was used and cronbach's alpha score was 0.84 for the Turkish version. It contains 5 subscales and these subscales are as follows: attention deficit and hyperactivity, emotional problems, behavior problems, peer problems and prosocial behavior. The prosocial behaviors subscale measures positive social behavior, while the others measure problematic behavior and difficulties, and the total scores of each constitute a total difficulty score of 0-40.

Rosenberg Self-esteem Scale (RSS): To evaluate self-esteem in children and adolescents, the RSS (13). The 10 items are answered on a 4-point scale ranging from strongly agree to strongly disagree. The scale ranges from 10 to 40, with 40 indicating the highest possible score. Higher scores indicate higher levels of self-esteem. Cronbach's alpha score of this self-report scale was 0.75 for the Turkish version.

The Pediatric Quality of Life Inventory: This is an instrument that evaluates health-related QoL in 2-18-year-old children and adolescents. This questionnaire examines four distinct areas of health-related functioning: physical functioning, emotional functioning, social functioning and school functioning. The latter three scales are combined to determine a broad psychosocial summary score (14). The parent form of the scale was administered. Cronbach's alpha score was 0.84 for the Turkish version.

Screen for Child Anxiety-Related Emotional Disorders (SCARED): This instrument is designed to screen for DSM-IV anxiety disorders in childhood. The SCARED total score, derived by adding the responses of the 41 items, ranges from 0 to 82 (15). Cronbach's alpha score was 0.88 for the Turkish version. SCARED includes five distinct factors: somatic/panic, generalized anxiety, separation anxiety, social anxiety, and school refusal. The self-report form of the scale was used.

Statistical Analysis

The statistical data for the groups were expressed using the mean and standard deviation. For continuous normal distributed variables, the One-Way ANOVA test was used for comparison. Variables not normally distributed were compared using the Kruskal-Wallis Test. Comparison of non-parametric parameters between two groups was performed using the Mann-Whitney U test. Bonferroni-corrected Mann-Whitney U test was used for the Kruskal-Wallis test in multiple comparisons. The statistically significant value was $p<0.017$ in the Bonferroni correction. The Tukey honest significant difference test was used for post-hoc comparisons. Comparison between groups the categorical variables were performed using chi-squared tests. Correlations between variables were analyzed using the Pearson correlation coefficient and Spearman's rank correlation coefficient.

RESULTS

The ID, IDA and control groups were statistically similar in age and gender distribution.

There was no statistically significant difference between the groups in terms of monthly income, parental cohabitation, mother education, father education, mother working and father working status. The sociodemographic characteristics of all sample groups are shown in Table 1.

When the data were evaluated, it was observed that SCARED-Panic/Somatic, SDQ-Prosocial Behaviors scales did not fit into the normal distribution.

All anxiety scores were higher in the IDA group compared to HC, except for the social anxiety subscale. No significant difference was found between IDA and ID, or between ID and HC in the anxiety scores.

In terms of QoL, the IDA group's total, physical and psychosocial QoL scores were found to be statistically significantly lower than both the ID and HC. However, the difference between the ID and HC groups was not statistically significant.

In the SDQ, the SDQ-Emotional Problems score of the IDA group was higher than the HC ($p=0.013$). When self-esteem scores were examined, no statistically significant difference was found between the three groups (Table 2).

In the study, correlations of iron parameters with psychosocial measures, and correlations of QoL with other psychosocial measures were evaluated in combined IDA and ID groups.

Among hematologic parameters, solitarily TIBC showed a correlation with psychometric scores other than the QoL. TIBC showed mild positive correlation with the SCARED total, panic-somatic, separation anxiety, school phobia scores, and a mild negative correlation with self-esteem. TIBC showed a mild negative correlation with the total QoL and psychosocial health QoL. None of the SDQ scores showed a statistically significant correlation with any hematologic parameters.

Hemoglobin levels showed a mild positive correlation with all QoL scores. Serum iron levels and transferrin saturation showed mild positive correlation with physical health QoL scores. Ferritin levels showed a mild positive correlation with the total QoL and physical health QoL (Table 3).

All QoL scores showed moderate positive correlation with self-esteem, and mild, moderate, or strong negative correlations with all SCARED scores other than social anxiety. The social anxiety subscale was correlated just with psychosocial health QoL. Physical health QoL scores showed mild negative correlations with the SDQ total, emotional problems and attention deficit hyperactivity disorder (ADHD) problem scores (Table 4).

DISCUSSION

ID and IDA are common public health problems, and the relationship between ID/IDA and psychosocial and

behavioral problems in adolescence is less researched. This study aimed to evaluate the psychosocial and behavioral status, self-esteem and health-related QoL of adolescents with ID or IDA.

In our study, anxiety levels in the IDA group were higher in all areas except social anxiety compared to healthy controls. The total, physical and psychosocial QoL in the IDA group was found to be lower than that in the ID group and healthy controls. Also, emotional problems in the IDA group were found to be higher than in the healthy controls. The data of the ID and IDA combined group showed that ID parameters have a significant relationship with QoL. Furthermore, TIBC was correlated with self-esteem, and anxiety, in addition to the QoL correlation. There were significant relationships between QoL scores and psychosocial and behavioral scores such as anxiety, self-esteem.

There are few studies have examined the possible relationship between IDA/ID and anxiety. One study showed that severe and chronic ID in infancy increased the risk of anxiety, depression and attention problems (16). In a nationwide study in Taiwan about the relationship between IDA/ID and psychiatric morbidity in children and adolescents, it was found that patients with IDA were at higher risk of anxiety disorders (8). Consistent with the results of these studies, our study showed that anxiety levels of adolescents with IDA were higher than those of HCs. Although there was no statistically significant difference between the anxiety scores of ID and IDA or HCs, it was thought that there might be a possible relationship between the progression of ID to anemia and elevation of anxiety levels. Additionally, the correlation between QoL and anxiety scores in IDA/ID was considered as clinically important in terms of the possible effect of anxiety on patient's perceived health and functionality in ID. However, long-term follow-up studies are needed to establish a causal relationship between IDA/ID and anxiety.

Although ID is common, it is insidious and may not have a significant clinical symptoms, and it is difficult for patients to recognize themselves. IDA may lead to many nonspecific clinical symptoms because of disrupted hemoglobin synthesis due to ID. In our study, it was found that the QoL in adolescents with ID was similar to that of HCs,

Table 1. Sociodemographic variables of groups

		HC (n=37)	ID (n=34)	IDA (n=44)	p-value
		n (%)	n (%)	n (%)	
Gender	Female	29 (78.4)	25 (73.5)	41 (93.2)	0.054
	Male	8 (21.6)	9 (26.5)	3 (6.8)	
Age		15.1±1.72	15.05±1.73	14.79±1.65	0.569
Family income	<1500 TL	23 (62.2)	15 (44.1)	24 (54.5)	0.311
	>1500 TL	14 (37.8)	19 (55.9)	20 (45.5)	
Cohabitation of parents	Married	37 (100)	32 (94.1)	38 (86.4)	0.053
	Divorced	0 (0)	2 (5.9)	6 (13.6)	
Mother's educational level	Never went to school	11 (29.7)	5 (14.7)	9 (20.5)	0.211
	Primary school	16 (43.3)	16 (47.1)	23 (52.3)	
	Middle school	3 (8.1)	9 (26.6)	4 (9.1)	
	High school/university	7 (18.9)	4 (11.8)	8 (18.2)	
Mother's employment status	Unemployed	36 (97.3)	29 (85.3)	41 (93.2)	0.162
	Employed	1 (2.7)	5 (14.7)	3 (6.8)	
Father's educational level	Never went to school/primary school	17 (45.9)	19 (55.9)	30 (68.2)	0.345
	Middle school	7 (18.9)	6 (17.6)	4 (9.1)	
	High school/university	13 (35.1)	9 (26.5)	10 (22.7)	
Father's employment status	Unemployed	9 (24.3)	7 (20.6)	11 (25)	0.850
	Employed	28 (75.7)	27 (79.4)	33 (75)	

HC: Health controls, ID: Iron deficiency group, IDA: Iron deficiency anemia group, TL: Turkish Liras

Table 2. Comparison of SCARED, PedQoL, Self-Esteem and SDQ scores of the groups

	HC (n=37)	ID (n=34)	IDA (n=44)	F/Chi²	Comparisons
	M±SD	M±SD	M±SD	p-value	
SCARED-Total anxiety	15.02±8.91	20.67±11.59	25.34±15.71	F=6.684 p=0.002	IDA>HC (p<0.001)
					IDA=ID (p=0.109)
					ID=HC (p=0.063)
SCARED-Panic/somatic	2.24±1.93	3.97±3.03	5.52±5.52	Chi²=9.7 p=0.008	IDA>HC (p<0.001)
					IDA=ID (p=0.088)
					ID=HC (p=0.069)
SCARED-General anxiety	3.48±3.04	4.52±3.71	6.31±4.71	F=5.354 p=0.006	IDA>HC (p=0.002)
					IDA=ID (p=0.050)
					ID=HC (p=0.269)
SCARED-Separation anxiety	2.81±2.42	4.23±3.25	4.68±3.68	F=3.635 p=0.030	IDA>HC (p=0.010)
					IDA=ID (p=0.542)
					ID=HC (p=0.063)
SCARED-Social anxiety	5.43±3.59	6.32±3.49	6.90±4.05	F=1.564 p=0.214	IDA=HC (p=0.080)
					IDA=ID (p=0.496)
					ID=HC (p=0.320)
SCARED-School phobia	1.05±1.24	1.61±1.63	1.90±1.63	F=3.221 p=0.044	IDA>HC (p=0.013)
					IDA=ID (p=0.404)
					ID=HC (p=0.122)
Total PedQoL	82.10±13.9	75.28±14.10	62.25±21.40	F=13.977 p<0.001	IDA<HC (p<0.001)
					IDA<ID (p=0.001)
					ID=HC (p=0.098)
PedQoL-Physical health	81.67±17.6	71.96±21.43	53.19±26.52	F=16.917 p<0.001	IDA<HC (p<0.001)
					IDA<ID (p<0.001)
					ID=HC (p=0.072)
PedQoL-Psychosocial health	82.34±13.8	77.05±12.71	67.08±20.63	F=8.980 p<0.001	IDA<HC (p<0.001)
					IDA<ID (p=0.009)
					ID=HC (p=0.181)
RSS	27.89±5.79	30.47±5.20	29.34±5.18	F=2.044 p=0.134	IDA=HC (p=0.231)
					IDA=ID (p=0.362)
					ID=HC (p=0.047)*
SDQ-Total score	11.86±5.53	11.14±5.44	12.97±6.46	F=0.964 p=0.384	IDA=HC (p=0.398)
					IDA=ID (p=0.176)
					ID=HC (p=0.609)
SDQ-Emotional problems	2.35±2.21	3.0±2.32	3.75±2.77	F=3.240 p=0.043	IDA>HC (p=0.013)
					IDA=ID (p=0.187)
					ID=HC (p=0.272)

Table 2. Continued

	HC (n=37)	ID (n=34)	IDA (n=44)	F/Chi²	Comparisons
	M±SD	M±SD	M±SD	p-value	
SDQ-Behavioral problems	1.64±1.05	1.73±1.56	2.02±1.70	F=714 p=0.492	IDA=HC (p=0.260)
					IDA=ID (p=0.398)
					ID=HC (p=0.806)
SDQ-ADHD problems	3.67±1.90	3.47±2.20	3.97±2.09	F=594 p=0.554	IDA=HC (p=0.515)
					IDA=ID (p=0.286)
					ID=HC (p=0.677)
SDQ-Peer relationship problems	4.08±1.83	3.08±1.31	3.22±2.05	F=3.329 p=0.039	IDA=HC (p=0.035)*
					IDA=ID (p=0.734)
					ID=HC (p=0.021)*
SDQ-Pro-social behaviors	8.51±1.67	7.67±2.02	7.75±2.63	Chi²=3.16 p=0.164	IDA=HC (p=0.120)
					IDA=ID (p=0.883)
					ID=HC (p=0.110)

HC: Health controls, ID: Iron deficiency group, IDA: Iron deficiency anemia group, SCARED: Screen for Child Anxiety-Related Emotional Disorders, PedsQoL: The Pediatric Quality of Life Inventory, RSS: Rosenberg Self-esteem Scale, SDQ: Strengths and Difficulties Questionnaire, *p<0.017 in Bonferroni correction

Table 3. Correlations of iron parameters with psychosocial measures in anemic or non-anemic ID patients

	Hemoglobin	Serum iron	Ferritin	TIBC	Transferrin saturation
Total PedQoL	0.315**	0.218	0.253*	-0.224*	0.218
Physical Health-PedQoL	0.373**	0.248*	0.309**	-0.180	0.237*
Psychosocial Health-PedQoL	0.235*	0.169	0.155	-0.232*	0.179
SDQ-Total score	-0.080	-0.013	-0.074	0.134	-0.017
SDQ-Emotional problems	-0.091	-0.047	-0.028	0.081	-0.043
SDQ-Behavioral problems	-0.089	-0.109	-0.167	0.206	-0.123
SDQ-ADHD problems	-0.107	0.060	-0.101	0.075	0.058
SDQ-Peer relationship problems	0.096	0.064	0.080	0.066	0.058
SDQ-Pro-social behaviors	-0.086	-0.096	-0.001	0.042	-0.102
Total SCARED	-0.125	-0.084	-0.047	0.303**	-0.107
SCARED-Panic/somatic	-0.091	-0.073	-0.095	0.388**	-0.126
SCARED-General anxiety	-0.162	-0.150	-0.051	0.189	-0.159
SCARED-Separation anxiety	-0.055	0.030	-0.044	0.231*	0.017
SCARED-Social anxiety	-0.032	-0.099	0.071	0.189	-0.112
SCARED-School phobia	-0.044	0.074	-0.058	0.229*	0.044
Self-esteem	0.154	0.051	0.108	-0.261*	0.081

**Correlation is significant at the 0.01 level (2-tailed), *Correlation is significant at the 0.05 level (2-tailed).

SCARED: Screen for Child Anxiety-Related Emotional Disorders, PedsQoL: The Pediatric Quality of Life Inventory, SDQ: Strengths and Difficulties Questionnaire, TIBC: Total iron binding capacity, ID: Iron deficiency

Table 4. Correlations of QoL with other psychosocial measures in anemic or non-anemic ID patients

	Total PedQoL	Physical Health-PedQoL	Psychosocial Health-PedQoL
SDQ-Total score	-0.202	-0.239*	-0.151
SDQ-Emotional problems	-0.211	-0.243*	-0.162
SDQ-Behavioral problems	-0.068	-0.108	-0.030
SDQ-ADHD problems	-0.179	-0.232*	-0.119
SDQ-Peer relationship problems	-0.085	-0.060	-0.095
SDQ-Pro-social behaviors	-0.124	-0.178	-0.054
Total SCARED	-0.586**	-0.430**	-0.639**
SCARED-Panic/somatic	-0.577**	-0.465**	-0.590**
SCARED-General anxiety	-0.518**	-0.364**	-0.575**
SCARED-Separation anxiety	-0.467**	-0.361**	-0.495**
SCARED-Social anxiety	-0.220	-0.106	-0.282*
SCARED-School phobia	-0.422**	-0.321**	-0.451**
Self-esteem	0.624**	0.492**	0.653**

**Correlation is significant at the 0.01 level (2-tailed), *Correlation is significant at the 0.05 level (2-tailed).

SCARED: Screen for Child Anxiety-Related Emotional Disorders, QoL: Quality of life, PedsQoL: The Pediatric Quality of Life Inventory, SDQ: Strengths and Difficulties Questionnaire, ID: Iron deficiency

but it was found to be worse in all areas in IDA than in ID or controls. The relationship between IDA and QoL is an expected situation, but the results of the studies in this area are contradictory and the research investigating this issue in adolescents is rare in the literature. Furthermore, the relationship between the presence of anemia in ID and QoL has also been less studied. In a study using a general health questionnaire, it was reported that there was no relationship between serum iron levels and psychological distress in female students unless anemia developed (10). Similar to these results, another study found no significant relationship between ID and QoL (11). However, this study did not check all participants weather they had anemia or not. Contrary to these findings, Patterson et al. (17) reported a lower QoL for women with ID. However, in this study, patients with anemia were also included in the study. Similar to our results, a recent study of female university students in New Zealand reported no significant difference in QoL between patients with ID without anemia and HCs (18). A recent study conducted in Turkey revealed that several sub-dimensions of QoL, such as physical function, energy/fatigue and general health perception in IDA patients were affected (19). As seen, most of the research in this area was conducted in adults, and mostly in women. Our study is one of the few studies on this subject to examine the adolescent age group in this respect and aspect, and supports the findings that the QoL is not affected in ID however it will deteriorate as IDA develops.

The finding that there was no difference between the groups in terms of SDQ, was found to be consistent with the exclusion criteria for the presence of a psychiatric disease-treatment history, and it was considered significant and important in terms of reducing confounding factors in interpreting the results. The SDQ-emotional problems score in the IDA group was found to be higher than the HCs and it was interpreted that IDA may be a predisposing factor for emotional problems or cause conditions mimicking emotional pathologies. This finding is thought to be compatible with the literature on this subject (8,20). No previous study examining IDA/ID in terms of self-esteem has been found in the literature. In our study, results showed that self-esteem was not affected by IDA or ID in adolescents. Self-esteem may also be affected by chronic disease. In a recent study, it has been reported that hemophilia patients have a lower self-esteem score than their peers (21). However, this difference was not observed in adolescents with IDA in our study. Nevertheless, the relations between self-esteem, anxiety, and QoL in ID/IDA suggested that further studies are needed to increase our understanding of this issue.

Given the correlation of TIBC, it was interpreted that TIBC can be used as a sensitive and reliable parameter in future research because it is more specific and sensitive than serum iron and ferritin levels and is less affected by many other factors. The findings of the correlation of hemoglobin, serum iron, ferritin and transferrin saturation levels with the

QoL were interpreted as they will enrich the information and contribute to the literature about the relationships between hematological parameters and psychometric data in IDA/ID. In previous studies; one study reported the relationship between depression and ferritin levels in ID in adults (22); the other one reported the relationship between serum iron and hemoglobin level with physical function, as well as the relationship between hemoglobin level with mental health and general health perception (19); another study reported the relationship between ferritin levels and behavioral problems in patients with ADHD (21). Further studies are required to investigate the relationship between hematological and psychometric data in adolescents.

There are some limitations to our study. First, our study was conducted on a small sample. Secondly, in our study, no further psychiatric evaluation was performed in psychosocial and behavioral evaluations. Finally, our study is a cross-sectional study and it is thought that follow-up studies will provide clinically important information on the psychosocial and behavioral effects of ID/IDA treatments. Strengths of our study; this was one of the few studies conducted on adolescents, ID and IDA were taken as separate groups, psychosocial evaluation was made in several aspects, and their relationship between hematological data was examined.

CONCLUSION

In conclusion, our findings suggest that while iron-deficient adolescents without anemia are not affected, adolescents with IDA are affected in terms of anxiety and QoL. Adolescence is a period in which development accelerates and a period in which the first symptoms of many psychiatric disorders occur. Considering these; psychosocial evaluation of adolescents with IDA would be appropriate. Also, adolescents presenting with psychological problems should be evaluated for ID and IDA. We also recommend psychosocial support and intervention as a part of the treatment of adolescents with IDA in terms of adherence to treatment and improving their QoL.

ETHICS

Ethics Committee Approval: Approval for this study was obtained from the Clinical Research Ethics Committee of Van Training and Research Hospital (decision no: 2019/19, date: 17.10.2019).

Informed Consent: Written informed consent was obtained.

Authorship Contributions

Concept: U.T., S.A.K., H.N.U., Design: U.T., S.A.K., H.N.U., Data Collection or Processing: S.A.K., Analysis or Interpretation: U.T., S.A.K., H.N.U., Literature Search: U.T., S.A.K., Writing: U.T., S.A.K., H.N.U.

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