



ORIGINAL ARTICLE

Oxidative Stress in Children with Sexual Abuse May Be Elevated and Correlate with History of Psychiatric Treatment: A Cross-Sectional Case-Control Study

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ABSTRACT

Objective: There is an increased oxidative stress process in psychiatric disorders that may result due to chronic stress exposure. Lipid peroxidation and chronic inflammation also increase oxidative stress according to the model of inflammation observed in psychiatric diseases. Oxidative stress can also damage the central nervous system by glutamate-mediated excitotoxicity and hyperstimulation of N-methyl-D-aspartate (NMDA) receptors. Direct studies examining the relationship between sexual abuse and oxidative stress are limited in the literature. In this study, we aimed to examine the oxidative stress parameters, psychopathologies and related sociodemographic factors in adolescents who were exposed to sexual abuse.

Methods: Patients aged between 10-17 years old who had been sexually abused and had a history of at least one year of sexual abuse were compared with age and gender matching control cases. Our sample consisted of 50 cases that had sexual abuse (42 female and 8 male) and 40 controls (32 female and 8 male). The socio-demographic information of the participants was obtained with a detailed form which was constituted by the researchers. Assessment of psychopathology and clinical functioning was carried out with the Turkish version of the Schedule for Affective Disorders and Schizophrenia for School-Age Children-Present and Lifetime Version (K-SADS-PL). Adolescents were also examined with "Beck Depression Inventory," "Beck Anxiety Scale," "Post Traumatic Response Scale," "Ways of Coping Inventory," "Strengths and Difficulties Scale" and "List of Negative Life Events."

Results: The mean age of the cases was 14.88 ± 2.16 years in the abuse group and 14.90 ± 2.18 years in the control group. School continuity in the sexual abuse group was significantly lower. Moreover, sexual abuse cases were coming from distressed families with relatively much lower monthly income. Penetration was 60%, and physical violence was 46% reported during abuse. Suicide attempt was described in 34% of the abuse group. Before the abuse, psychiatric referrals were present in 46% of the cases. The most common diagnoses after abuse were as follows; 78.2% Post Traumatic Stress Disorder (PTSD), 78.2% depression, and 60.8% specific phobia. WISC-R scores in the abuse group were lower compared to the control group. Functionality scores were lower than controls whereas the Beck Depression Inventory, Beck Anxiety Scale, Post Traumatic Response Scale and scores of Negative Life Events Scales were higher in the study group.

Conclusions: Level of oxidative stress assessed by total oxidant status (TOS), total antioxidant status (TAS) and oxidative stress index (OSI) showed a significantly higher oxidative stress and diminished antioxidant process profile in the sexual abuse group. TOS and OSI values were significantly higher while TAS values were significantly lower compared to the controls. Since oxidative stress mechanism accelerates the cell cycle, it leads to premature cell death which may result in many neuropsychiatric illnesses that have been described in this study of abused adolescents. A more detailed study of oxidative stress mechanisms in adolescents in terms of an increase in the risk of physical disease, as well as possible adverse effects on life span and deterioration in the quality of life and increased risk of acquiring a chronic illness, would be meaningful in seeking answers to epigenetic questions.

Keywords: Adolescent, oxidative stress, psychopathology, sexual abuse, total oxidant status, total antioxidant status

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INTRODUCTION

Child abuse affects every age, race, social class, ethnic group, and religion; the estimated prevalence is 6–62% for females and 3–39% for males; however, the actual prevalence is unknown (1). The child's sexual abuse is a clearly defined early life stressor with a prevalence of 10–30%. The increasing evidence suggests that childhood sexual abuse is associated with age-related chronic illness (2). The incidence of psychiatric illness in the lifetime for sexually abused children was 47% in men and 56% in women (3). Although the most common psychopathology is post-traumatic stress disorder (PTSD), it is also associated with depression, suicide attempts, smoking, nicotine addiction, illegal substance abuse, alcohol dependence, personality disorders, learning difficulties, eating disorders, and sleep problems (4).

Although the mechanism underlying this link is not known precisely, the physiological stress experienced triggers the biological response to abuse; which is thought to accelerate the biological aging (5). Telomere length is a reliable indicator of biological age, that can progress independently of chronological age (6). Oxidative stress is an intracellular equilibrium which is observed as a result of interaction with antioxidants which act as neutralization with oxidant substrates produced during aerobic respiration. In low, physiological doses, reactive oxygen species (ROS) act as a signaling molecule, play an essential role in the immunological response and participate in numerous cellular activities such as mitosis. However, ROS can damage cell contents such as proteins, lipids, and DNA, which results with apoptosis and cell death in high doses (7,8). Oxidative stress also stimulates the synthesis of proinflammatory cytokines (9). Glutamate-mediated excitotoxicity in the central nervous system and neuronal damage by N-methyl-D-aspartate (NMDA) receptor hyperstimulation occur (8). These situations cause early cell death by accelerating the cell cycle and leading to many neuropsychiatric diseases (9). Response to antioxidant treatments in psychiatric disorders constitutes indirect evidence that oxidative stress is involved in the pathogenesis of psychiatric disorders (10).

In this present study, we aimed to examine the oxidative stress parameters, psychopathologies, and related sociodemographic factors in adolescents who were exposed to sexual abuse.

METHODS

Study Setting

This study was conducted between May 2016 and November 2016 in a university hospital, child and adolescent mental health and diseases outpatient clinic and the forensic unit, one of the leading centers serving in the field of child and adolescent mental health and diseases in the Anatolian side of Istanbul, Turkey.

Subjects

In this study, we examined 50 sexually abused patients aged between 10 and 17 years who were followed up for at least a year under treatment and 40 age- and- gender matched controls. As a measure of inclusion for all participants, we aimed each participant to have at least 55 points in the total intelligence section of the Wechsler Intelligence Scale for Children-Revised (WISC-R).

Patients and their families who were admitted to the pediatric psychiatry outpatient clinic of our hospital and had no disorder according to DSM-IV-TR were included in the control group. After being informed about the study, those who agreed to participate in the study were administered the WISC-R and Kiddie-Schedule for Affective Disorders and Schizophrenia for School-Age Children-Present and Lifetime Version (K-SADS-PL). Body mass indexes (BMI) were calculated by measuring height and weight. BMI was calculated with kg/m² formula. BMI above 40 was excluded from the study to exclude morbid obesity which is known to alter the oxidative stress markers. Then, the forms and scales were given to the control group as same as the abused group.

Participants were not included in the study and control group in case of the presence of the variables that might affect the oxidative stress level. These variables include history of neurological disease, chronic

inflammatory disease, cancer, autoimmune disease, presence of active infection (total white blood cell count more than $10.000/\text{mm}^3$), active anti-inflammatory and immunosuppressive drug use, oral contraceptive use, pervasive developmental disorder and cortisol or multivitamin treatment and vaccination in the last 6 weeks. All participants and their families were informed about the study and their written, and verbal consent was obtained before the evaluation.

While total antioxidant status (TAS), total oxidant status (TOS) and oxidative stress index (OSI) values were studied, it was not possible to examine all of the results in 2 samples due to the "lack of blood sampling." Oxidative stress parameters were therefore examined in 50 cases of the sexual abuse group and 38 of the control subjects.

Clinical Assessment and Measures

Measurement of the Oxidative Stress Index

It is a fully automatic method developed by Erel (11). Total antioxidant status measures the total antioxidant capacity of the body against potent free radicals. The principle of this method; the Fe^{2+} -o-dianisidine complex forms a Fenton-type reaction with hydrogen peroxide to form OH radical. This potent ROS is reduced to react with the colorless o-dianisidine molecule at low pH, and it creates a yellow-brown dianisidyl radicals. Dianisidyl radicals participate in advanced oxidation reactions and increase color formation. However, antioxidants in the samples suppress these oxidation reactions and stop the formation of color. This reaction is measured by spectrophotometrically in the automatic analyzer.

Total oxidant status: oxidants in the sample oxidize the ferric ion-o-dianisidine complex to the ferric ion. The glycerol accelerates this reaction by tripling it. Ferric ions form a colored complex with xylenol orange in an acidic environment. The intensity of the color associated with the amount of oxidants found in the sample is measured spectrophotometrically.

Oxidative stress index was calculated by dividing the total oxidant level by total antioxidant level.

The blood samples were centrifuged within the first half hour after the blood was taken and the serum portion

that remained above was kept in two samples at -90 degrees in a biochemistry laboratory. Courier sent the samples to the center with specialized protective equipment.

The Assessments Made by the Clinician

Sociodemographic data form prepared by the researchers was filled with the participants in order to determine the factors affecting the familial features and oxidative stress markers. K-SADS-PL was applied to determine the comprehensive psychiatric evaluation and diagnoses. In order to examine the psychological, social and occupational functions of the participants, Children's Global Assessment Scale (CGAS) was used. We also examined intelligence quotient (IQ) with WISC-R. In our study, WISC-R scores were calculated with information, picture completion, picture arrangement, and vocabulary subtests' scores. The researcher measured both the weight and height and BMI was calculated. BMI was found by dividing weight (kg) by the square of height (meters). Blood was collected from the participants for the evaluation of the oxidative stress index.

Psychometric Instruments

Negative Life Events List, Beck Depression Inventory, Beck Anxiety Scale, Strengths and Difficulties Questionnaire, Ways of Coping Inventory, Children's Global Assessment Scale, Post-traumatic Response Scale were all self-reported scales, completed by the study participants. All these scales were adapted to Turkish for children and adolescents, with reliability and validity studies.

The study was approved by Marmara University School of Medicine Research Ethics Committee with the protocol number 09.2016.124 dated January 2016. Our study was also approved by the Scientific Research Projects Unit of Marmara University on October 13th, 2016 with the project number of SAG-C-TUP-131016-0445.

Schedule for Affective Disorders and Schizophrenia for School-Age Children-Present and Lifetime Version (K-SADS-PL). It is a semi-structured interview form developed according to Diagnostic and Statistical Manual

of Mental Disorders- Text Revised (DSM-IV-TR) diagnostic criteria for screening psychopathology in children and adolescents aged between 6 and 18 years (12,13).

Wechsler Intelligence Scale for Children-Revised (WISC-R). It has been developed for 5 to 15 years age group to examine the general mental capacities of children with adequate speech and language skills (14). In 1974, the scale was revised and renamed as WISC-R, and its' age range was changed to 6-16 years (15).

Post-Traumatic Response Scale. A 20-item Likert-type scale developed to examine the severity of PTSD symptoms of traumatized children and adolescents. The scores of 40 and above were correlated with PTSD (16,17).

Negative Life Events List. Includes 29 negative life events about school, friends, and family. Adolescents asked to respond to any negative life events with "yes" or "no" answers (18). In our study, the total number of negative life events answered as "yes" is given.

Ways of Coping Inventory. A 30-item short form developed to examine the cognitive and behavioral coping strategies used in response to stressful situations. Higher scores on one of the subscales mean that the subscale approach is more commonly used in coping with stress (19,20).

Beck Depression Inventory. The scale includes 21 symptom categories, each with four options. In two independent studies, cut-off scores of the scale were taken as 17 and 21, the scores above these differentiate cases from normal to depression (21,22).

Beck Anxiety Scale. It examines the frequency of anxiety symptoms experienced by the individual. It is a self-assessment scale which is composed of 21 items and is scored between 0-3. High scores indicate high anxiety levels (23,24).

Strength and Difficulties Questionnaire. This scale includes 25 questions that examine positive and negative behavior. These questions were collected under five sub-headings, each containing five questions, according to the results of both appropriate diagnostic criteria and factor analysis; attention deficit and hyperactivity, behavioral problems, emotional problems, peer problems, and social behaviors were identified. Each sub-heading can be

examined in its form and a separate score can be obtained for each and also the sum of the first four headings can be calculated as the total difficulty score (25,26).

Children's Global Assessment Scale. This scale is developed to determine the degree of functioning of children for 4–17 years during the interview. The rating scores range from 1 (worst functionality) to 100 (healthiest). Over 70 points generally indicate proper functioning (27).

Statistical Analysis

Statistical analysis of the data was performed using the SPSS 16.0 for Windows program. Frequency, percentage, means, and median values were calculated while descriptive statistics were performed. Chi-square test was used to compare categorical variables between groups. In the comparison of the continuous variables, (student t-test was used for independent groups and the Mann-Whitney U test was used if the distribution of variables were not normal. The Kolmogorov-Smirnov test examined the normality of the distribution. Pearson's correlation analysis was used to examine the relationship between the study data.

RESULTS

Fifty sexually abused children, 40 age- and- gender matching control subjects were examined clinically. Blood sample of 2 patients in the control group was not sufficient. Therefore oxidative stress parameters were examined in 50 cases of the sexual abuse group and 38 of the control subjects. There were no significant differences between the groups in terms of age and gender distribution. However, the number of females in both groups was at least 4 times the number of males. The sociodemographic characteristics of the groups were presented in Table 1.

Sexual abuse is classified in many studies as; verbal sexual abuse, sexual touch, interfemoral intercourse/friction, sexual penetration (anal and/or vaginal), oral-genital intercourse, sexual exploitation/pornography This classification was presented in Table 2.

Table 1: Sociodemographic characteristics of groups

	Sexual abuse group (n-50)	Control group (n-40)	Atatistical analysis
Average age (years)	14.88±2.16	14.90±2.18	p=0.965, t=0.43
Female gender (%)	84	80	p=0.622
School attendance (%)	66	97.5	p=0.001
Breast milk intake period (months)	9.36±10.53	12.73±8.48	p=0.132, t=1.522
Walking time (months)	12.58±4.83	10.80±1.75	p=0.030, t=2.21
First word (months)	12.44±5.70	11.92±3.59	p=0.620, t=0.497
First sentence (months)	22.60±7.78	18.22±4.28	p=0.002, t=3.186
Body mass index (kg/m ²)	22.34±3.83	22.92±4.11	p=0.492, t=-0.690
Exercise regularly (%)	6	37.5	p=0.000
Maternal age	40.36±6.79	39.0±5.29	p=0.473, t=1.038
Paternal age	45.14±6.57	44.22±5.17	p=0.302, t=0.720
Disbanded family (%)	36	12.5	p=0.011
Monthly income is below 2500 liras (%)	62	17.5	p=0.000
Living with nuclear family (%) (%)	68	85	p=0.062
Unwanted pregnancy results (%)	32	5	p=0.001
Birth at home (%)	14	0	p=0.024

Table 2: Classification of sexual abuse

Nature of abuse	n	%
Verbal sexual abuse	10	20
Sexual touch	39	78
Interfemoral intercourse/friction	34	68
Sexual penetration (anal and/or vaginal)	30	60
Oral-genital intercourse	6	12
Sexual exploitation/pornography	15	30

The penetration rate was 60% (n=30) of sexual abuse cases. The average time passed after abuse was 3.98±2.13 years (1-9 years). During sexual abuse, 46% (n=23) of the cases had experienced physical violence, and 92% (n=46) had been threatened. 78% (n=39) had abused more than once. 74% (n=37) of the cases were abused by one person, and 26% (n=13) were abused by more than one person. Only 6% of the cases (n=3) did not recognize the abuser, 94% (n=47) cases previously knew the person who abused them. While the abuser was the first degree relative in 8% of the cases, 34% had no blood ties, but the victim was familiar.

Psychiatric Epidemiology in the Sexual Abuse Group

28% (n=14) of the cases had a suicide, and 6% had more than (n=3) suicide attempt. Self-harm behavior (expressed

as non-life-threatening, planned, socially unacceptable harming his own body) was present in 58% (n=29) of the cases.

Prevalence of psychiatric referral was 46% (n=23) before the abuse. The most common diagnosis was Attention Deficit and Hyperactivity Disorder (ADHD) with a frequency of 82.6% (n=19). ADHD was followed by specific learning difficulty (n=5, 10%), enuresis (n=5, 10%), conduct disorder (n=4, 8%), mild mental retardation (n=4, 8%), depression (n=2, 4%), bipolar disorder (n=1, 2%). There was not any significant difference between the groups in terms of the history of alcohol and smoking.

Only one case was followed up without medication in the abused group. Antidepressants (n=41; 83.6%) were the most commonly used drug groups, followed by second-generation antipsychotics (n=31; 63.2%) and psychostimulants (n=10; 20.4%). The most common combination of psychotropic drugs was antidepressant and second-generation antipsychotics (n=27; 55.1%), followed by antidepressants and stimulant combination (n=7; 14.3%).

Psychopathologies detected during a semi-structured clinical interview with K-SADS-PL were presented in Table 3.

Table 3: Psychopathologies in sexually abused group

Psychiatric diagnosis	n	%
None	4	-
Post-traumatic stress disorders	36	78.2
Depression	36	78.2
Special phobia	28	60.8
Attention deficit and hyperactivity disorders	26	56.5
Generalized anxiety disorder	5	10.8
Enuresis	4	8.6
Oppositional defiant disorder	4	8.6
Panic disorder	4	8.6
Conduct disorder	4	8.6
Obsessive compulsive disorder	3	6.5
Bipolar disorder	1	2.1
Separation anxiety disorder	1	2.1
Social phobia	1	2.1
Encopresis	1	2.1

The intelligence level of sexual abuse and control group was found in normal-low (dull intelligence) level and normal intelligence level, respectively. Control group had significantly higher scores than the sexual abuse group concerning verbal ($p=0.000$) and total intelligence ($p=0.002$) scores. Although the control group had higher scores in terms of performance scores, no statistically significant difference was found ($p=0.085$). Sexual abuse group showed a statistically significantly poorer functioning ($p=0.000$). The mean score of post-traumatic response scale was 48.86 ± 17.70 (range 11-75), and 76% of the cases had above 40 which indicates PTSD severity is high. Sexual abuse cases had significantly higher points in the Beck Depression Inventory ($p=0.000$), Beck Anxiety Inventory ($p=0.000$) and also there were significantly more negative experiences in the abused group ($p=0.000$). Attention-deficit and hyperactivity ($p=0.002$), peer problems ($p=0.002$), behavioral problems ($p=0.015$), emotional problems ($p=0.05$) were

significantly higher in abused group in Strengths and Difficulties Questionnaire. The difference between the total difficulty scores of the groups was significant ($p=0.001$).

Data Related to Oxidative Stress

OSI is calculated as TOS value (mmol/l) x100 / TAS value (mmol/l) x1000. As this value decreases below 1, it explains a better course. Sexual abuse group was found to be significantly disadvantageous in all variables. TOS ($p=0.013$), OSI ($p=0.005$) were significantly higher, and TAS ($p=0.001$) were significantly lower in the sexual abuse group (Table 4). The number of cases with low TAS value (1.19 and below) and the number of cases with high TOS (8.01 and higher) were statistically significantly higher in the abused group ($p=0.008$). In addition none of the cases had a 'very good level' (5 or less) of the TOS ($n=0, 0\%$), however high (between 8.01-12.00) ($n=20; 40\%$) and very high (12.00 and above) ($n=18; 36\%$) cases were found to be 76% ($n=38$). No significant difference was found in the TAS, TOS and OSI values between the genders. However, when the sample was divided as sexual abuse and control group, TOS ($t=1,950$ and $p=0.05$) and OSI ($t=2.052$ and $p=0.046$) values were significantly higher in males. In the control group, there was a significant difference between the genders in all values. Males in each group and the whole sample exhibited a worse profile in terms of TAS (K>E), TOS (E>K) and OSI (E>K). There were not any significant correlation between age and oxidative stress parameters in the whole sample, sexual abuse, and the control group. There was not any significant correlation between the diagnosis of any psychopathologies and oxidative stress parameters.

The relationship between the sociodemographic data and TAS, TOS and OSI values was analyzed by the Pearson's correlation test. Correlation of

Table 4: Comparison of sexual abuse and control group in terms of TAS, TOS, and OSI

	Sex. abuse Mean±SD	Control Mean±SD	t	P
Total Oxidant Status (TOS)	12.74±8.04	8.90±5.56	2.523	0.013
Total Antioxidant Status (TAS)	2.00±0.31	2.20±0.18	-3.477	0.001
Oxidative Stress Index (OSI)	0.65±0.46	0.41±0.27	2.886	0.005

Table 5: Correlation of sociodemographic variables and penetration in terms of oxidative stress parameters

	TAS	TOS	OSI
Height (c)	r=0.323; p=0.048	p=0.737	p=0.978
Weight (c)	r=0.384; p=0.017	p=0.765	p=0.910
Low income (below 2500 liras) (w)	r=0.399; p=0.001	r=-0.214; p=0.045	r=-0.264; p=0.013
Living in hired apartment	r=-0.264; p=0.013	r=0.225; p=0.035	r=0.260; p=0.015
Consanguinity of parents (c)	r=-0.441; p=0.010	p=0.713	p=0.484
Separation of parents (c)	r=-0.394; p=0.014	p=0.488	p=0.327
Education level of mother (c)	p=0.113	r=-0.377; p=0.020	r=-0.410; p=0.011
Education level of father (a)	r=0.302; p=0.033	p=0.767	p=-0.123
History of psychiatric drug use (a)	p=0.657	r=0.209; p=0.050	p=0.126
Penetration (a)	r=-0.236; p=0.021	r=0.300; p=0.005	r=0.308; p=0.004

sociodemographic variables and penetration in terms of oxidative stress parameters were presented in Table 5.

All parameters were examined for the regression analysis of which correlation of TAS was found to be correlated on multiple regression analysis with an R2 value of 1.824 (p=0.046) while other oxidative stress parameters were not found related on regression analysis.

DISCUSSION

There was no statistically significant differences between groups in terms of age and gender distribution. However, females in both groups were at least four times more than males. The rates reported for prevalence vary widely according to study methodology, sexual abuse is more common in females (1,28). In our study, consistent with the literature, female cases were five times higher. The abused group had reached all stages of development later, and it was shown that developmental retardation was a risk factor in both genders and that these children were chosen as target (29).

Leaving formal education (dropout or open and distant education) was significantly higher in abuse group. Staying away from school means that children will have a contrary course in the long term. It leads to behavioral problems, risk-taking behaviors, and adult psychopathologies. In literature, it was emphasized that school dropout rates and clinical school adjustment difficulties might be present in more than half of the cases (27).

No significant differences were found between groups in terms of the average age of parents, working conditions,

educational status, consanguinity, and psychiatric referral rates. Being from dispersed family was significantly higher in sexual abuse group (30). Monthly income was significantly lower in the abused group. Sexual abuse and low socioeconomic level were significantly associated (29). In a publication from Turkey showed that 83.1% of sexually abused cases were on hunger border and 12.3% were on the poverty line (31). While the control group is mostly homeowners, sexual abuse group is mostly living on rented that may also indicate the low socio-economic level.

Incidence of unplanned and unexpected pregnancy was significantly higher in sexual abuse group. Being a parent frequently, coming into the world as a result of unwanted pregnancy reduces control of the child and creates a negative perception about the child; these leads lack of quality time with the child, attachment problems, and weakness in family ties (32,33). Although there were no significant differences between groups in terms of delivery time, birth weight and birth complications; a significant difference was seen in the type of delivery. There were 7 cases of childbirth at home in the sexual abuse group and none in the control group. This result may also be considered as an indicator of low socio-economic level associated with sexual abuse (29).

Rates of sexual touch and penetration were found 78% and 60%, respectively. It has been reported that vaginal-anal penetration is seen in 8-32% of cases of sexual abuse (34). Average years passed after abuse was 3.98 ± 2.13 years. 46% of the cases had experienced physical violence, and 92% of them were exposed to

threats during sexual abuse. It has been stated that physical violence and threats accompanying sexual abuse are pervasive and significantly increase the frequency of having a psychiatric disorder (35). 26% of cases were abused by a single person, and the remaining 74% were abused by more than one person. All of the abusers were men. Regardless of the victim's gender, most of the perpetrators are men and women are often seen as co-abuser. Only 5% of cases identified women abuser (36).

Only 6% of abusers were not recognized by the victim; 42% of cases had been abused by a person with kinship, and familiar individuals who had no kinship had abused 52%. It is stated that sexual abuse is done by family members and other relatives and by a person who is related to care. Recognition rates range from 60% to 90% in many studies (37). Suicide attempt was seen in 34% of cases and 6% of cases the suicide attempt was more than one time. Self-injurious behavior was found in 58% of cases. Sexual abuse increases the risk of suicide within the entire life cycle. They attempt to commit suicide more than four times during their life-span compared to the non-abused group (38). Psychopathologies, impulsivity, maladaptive personality traits and inappropriate coping skills have been shown to be responsible for this. The most frequent self-injurious behavior is cutting the skin or voluntary burning (39). Psychiatric referral rates before sexual abuse were very high (46%). The most frequent diagnosis was ADHD (82.6%). Presence of psychiatric history in cases of sexual abuse is not uncommon in studies. 24.2% reported a psychiatric diagnosis before the abuse. The most common diagnosis was mental retardation and ADHD (40).

92% of cases had at least one psychiatric diagnosis according to K-SADS-PL; the most common diagnoses were PTSD and depression (78.2%). Subsequently, 60.8% had a specific phobia, and 56.5% had ADHD. Incidence of psychiatric illness in the lifetime of sexually abused children was 47% in men and 56% in women (3). PTSD is the most common diagnosis in studies ranging from 10% to 64% (31). In our study, the high rate of psychopathology may be due to the high rate of penetration, physical violence, and recognition of abusers, having previous psychiatric disorders, coming from disbanded family, lower socioeconomic level and family support.

It was found that the intelligence level of the abused group was at normal-low (dull intelligence) limits and the control group had an average intelligence level. Control group had significantly higher scores in verbal ($p=0.000$) and total intelligence ($p=0.002$) scores. Presence of mental disability in the child increases the rates of sexual abuse. Children are generally not randomly selected; Individuals who cannot express themselves and who perceive events difficultly are often chosen as targets (41). It was found that these children had lower performance and lower scores on standardized tests regardless of their socioeconomic status. These children also read up to lower grades (42).

While examining the oxidative stress parameters, TOS and OSI in sexual abuse group were found to be significantly higher, and TAS was significantly lower. Oxidative stress profile measured with this condition appears to be quite contrary in sexual abuse group. In the sexual abuse group, 76% of cases' had high and very high TOS values and that value was just 58% in the control group. This difference reached the statistical significance level. Direct studies examining the relationship between sexual abuse and oxidative stress are limited in the literature. Serum cortisol level, oxidative stress, and DNA damage were examined in a study in which preliminary findings were published. While cortisol levels were significantly higher in the sexual abuse group, no significant difference was found in terms of oxidative stress and DNA damage. Cortisol and superoxide dismutase levels were lower in victims of family sexual abuse (43).

TAS, TOS and OSI values did not show a significant difference between gender, age, height, weight, and BMI whereas there was a significant moderate correlation between TAS and height and weight in the control group. Some of the findings showed an association between oxidative stress and sex hormones (44). However, studies examining the effects of gender and age on the level of oxidative stress are very limited in the literature (45). Also, low-income level (2500 Turkish Lira and below) was associated with TAS, TOS and OSI elevation. In other words, low income caused a significant shift in all parameters.

Oxidative stress studies provide us a cross-sectional evaluation. Many parameters such as drugs, regular

exercise, inflammation, and infection can affect these values. Therefore, repeating these studies with the same sample will enable us to reach more accurate results. Oxidative stress, especially chronic oxidative stress, is known to affect biological systems. In this respect, the use of biological markers such as cortisol level and telomere length in the morning is one of the factors that can increase the strength of the study. There is a significant decrease in the number of forensic cases directed to us because of the latest legal arrangements. In the studies to be carried out with larger samples, it is expected to increase the significance levels, especially in regression analyses.

Patients aged between 10–17 years who had been sexually abused and had a history of abuse at least one year, were compared with a healthy control group regarding oxidative stress parameters and the factors affecting it. The first hypothesis of our study was that the total oxidant level increased, the total antioxidant level decreased, and oxidative stress index increased. In the sexual abuse group, TAS values were significantly lower, TOS and OSI values were significantly higher than the control group. In this context, an increased oxidative stress load can be mentioned in sexually abused adolescents. In addition to mental health process, physical body health is also under threat, possible adverse effects on life span and deterioration in the quality of life, as well as increasing the risk of a diagnosis of chronic diseases in abused adolescents will be more appropriate to consider oxidative stress.

In conclusion; the brain -an organ, which uses high levels of oxygen and produces free oxygen radicals- unsurprisingly appears to be susceptible to oxidative stress. Although the increasing evidence suggests a relationship between oxidative stress, inflammation, and neurotoxicity in neuropsychiatric diseases, these studies are limited, especially in trauma-associated psychiatric disorders and in adolescents. Our research is one of the few studies that examined this model and contributed to positive evidence.

Ethics Committee Approval: The study was approved by Marmara University Faculty of Medicine Research Ethics Committee with the protocol number 09.2016.124 dated January 2016. Our

study was approved also by the Scientific Research Projects Unit of Marmara University on 13.10.2016 with the project number of SAG-C-TUP-131016-0445.

Informed consent: Consent of all patients had taken.

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