

# Hematological and biochemical changes in volatile substance abusing street children in İstanbul

Ömer Doğru<sup>1</sup>, Tiraje Celkan<sup>1</sup>, Türkey Demir<sup>2</sup>

<sup>1</sup>Cerrahpasa Medical Faculty, İstanbul Turkey

<sup>2</sup>Bakirkoy State Hospital for Psychiatric and Neurologic Diseases, İstanbul Turkey

✉ tirajecelkan@yahoo.com

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## ABSTRACT

The aim of the study is to assess the hematological and biochemical changes of inhalant abusing adolescences in İstanbul, Turkey.

The study subjects comprised 24 street children. Demographic characteristics, hematological markers, complete blood count tests and white blood cell differential and liver function tests (alanine transaminase, aspartate transaminase, alkaline phosphatase) were evaluated.

The blood cell counts and studied biochemical parameters were within normal range for age and sex matched adolescences. Anemia was observed in only one girl who had hypermenorea. The duration and the amount of substance abuse were investigated for a correlation with the blood parameters, only the amount showed the possibility of a trend associated with Hb and Hct ( $p < 0.05$ ). There was no significant relationship between the parameters except for the age.

Although volatile abuse has been supposed to be related with anemia or other hematological abnormalities, we found no significant relation between volatile abuse and hematological or studied biochemical parameters. Alkaline phosphatase was the parameter found to be most affected, though being in normal range.

**Key Words:** Substance abuse, volatile, adolescence, inhalants, street children

## ÖZET

### İstanbul'daki volatil madde bağımlısı sokak çocuklarının hematolojik ve biokimyasal değerleri

Çalışmaya 24 sokak çocuğu alındı. Olguların demografik özellikleri, hematolojik değerleri (tam kan sayımı parametreleri, periferik kan yayması) ve karaciger fonksiyon testleri (ALT, AST ve alkalin fosfataz) incelendi.

Olguların kan sayım ve biyokimyasal değerlerinin sonuçları yaş ve cins olarak denk oldukları adolesanların sonuçları ile benzerdi. Sadece hipermenoresi olan bir kız olguda anemi saptandı. Olguların maddeye maruz kaldıkları süre ve kullandıkları miktar ile kan parametreleri arasındaki ilişki araştırıldı, sadece kullanılan miktar ile Hb ve Hct arasında sınırdaki ( $p < 0,05$ ) bir ilişki saptandı. Yaş haricinde parametreler arasında bir ilgi saptanmadı.

Uçucu madde bağımlısı çocuklarda anemi ve diğer hematolojik anomaliler olmasını beklediğimiz halde, çalışılan parametrelerle madde bağımlılığı arasında bir ilişki gösteremedik. En fazla etkilenen parametre alkalin fosfataz olarak saptandı, ancak sonuçlar yine de normal sınırlar içinde bulundu.

**Anahtar Sözcükler:** Madde bağımlısı, uçucu madde, adolesan, inhalanlar, sokak çocukları

## INTRODUCTION

Inhalants are volatile substances producing chemical vapors that can be inhaled to induce a psychoactive, mind-altered euphoric state. This is an under-recognized form of substance abuse beginning with children as young as six years of age and may cause significant morbidity and mortality<sup>[1,2]</sup>.

Three main routes of inhalation are "sniffing", "huffing" and "bagging". Sniffing is breathing in a substance directly from its container, huffing is placing a piece of cloth soaked in the volatile substance against the nose and mouth and inhaling vapors, and bagging is pouring the substance into a bag and breathing the vapors.

A wide variety of chemicals can be abused as inhalants. They are generally inexpensive and easily accessible products used for common household and industrial purposes. These include cigarette lighter gas, cleaning fluids, spray paint, paint thinners and removers, correction fluid, nail polish remover, petrol, glues, dry-cleaning fluids, degreasers, gasoline, and felt-tip marker fluids.

Inhalants are readily absorbed in the lung and produce an altered mental state within seconds, but the effects last for only about 5 to 15 minutes<sup>[3]</sup>. The exact mechanism of action for volatiles is unknown, but two common theories are generalized slowing of axonal ion channel transport and potentiation of hyperpolarization of gamma-aminobutyric acid receptors<sup>[4]</sup>.

Acute effects of volatiles include sudden sniffing death syndrome, asphyxia, and serious injuries generally caused by falls, burns or frostbite<sup>[5]</sup>. Within seconds of inhalation, the user experiences intoxication effects similar to those produced by alcohol. The user is initially stimulated, becomes euphoric and shows impulsive behaviors. Speech and gait become deteriorated. Hallucinations are frequent. This state is followed by drowsiness and sleep. Coma is unusual, because as the user becomes sleepy, exposure to the inhalant is terminated before a large enough dose is absorbed. The chief organic morbidity, usually an outcome of chronic abuse, is central nervous system damage, resulting in dementia and cerebellar dysfunction<sup>[1]</sup>.

The most serious acute consequence of inhalant abuse is death, which usually occurs secondary to aspiration, accidental trauma, or as-

phyxia<sup>[6]</sup>. Other acute causes of death include cardiac arrhythmias, anoxia, vagal inhibition, and respiratory depression. About 50% of inhalant-related deaths are caused by sudden sniffing death syndrome<sup>[7]</sup>.

Inhalant use may also be associated with substantial hematological, renal, hepatic, and neurological morbidity and mortality<sup>[7-9]</sup>. Aplastic anemia, bone marrow suppression, and leukemia are among the hematological adverse effects of inhalants<sup>[10]</sup>. Long-term inhalant use can result in bone marrow suppression, leading to leukopenia, anemia, thrombocytopenia, and hemolysis<sup>[11]</sup>. Inhalant users frequently become psychologically and physically dependent<sup>[12-14]</sup>.

Street children are homeless children who live on the street and are not looked after by parents or other adults. The number of children living in the streets of İstanbul is thought to be about 1500-2000, with the number rising daily. In the following study, we present the hematological and biochemical evaluation of inhalant use in adolescent street children, a group that previously has been seldomly analyzed.

## MATERIALS and METHODS

We conducted a study to evaluate the hematological changes in inhalant-abusing adolescents in İstanbul, Turkey during January-July 2002. İstanbul is the largest city in Turkey, with a population of about 15 million. The number of children living in the streets of İstanbul is thought to be about 1500-2000.

The study subjects comprised 24 street children. Each child completed a questionnaire with items covering demographic characteristics and history of substance abuse. Venous blood was withdrawn into ethylenediamine tetra-acetic acid vacutainer tubes to measure hematological parameters, complete blood count with white blood cell (WBC) differential, and absolute neutrophil count (ANC). Two additional tubes of venous blood were withdrawn for sedimentation rate and biochemical analysis [alanine transaminase (ALT), aspartate transaminase (AST), and alkaline phosphatase (ALP)]. All blood tests were analyzed in the laboratory of the Department of Psychiatric and Neurologic Diseases, Bakirkoy State Hospital. The hematological values were compared with normal adolescent hematologic values for Turkish children<sup>[15]</sup>.

**Table 1.** The hematological and biochemical results of study subjects

	Age (years)	Sex	WBC (/ml)	ANC (/ml)	Hb (mg/dl)	Hct (%)	MCV (fl)	PLT (10 <sup>3</sup> /ml)	AST (mlU/ml)	ALT (mlU/ml)	ALP (mlU/ml)	SEDIM (mm/h)	Duration of abuse year	Amount of abuse L
S.Y.	16	M	5790	2440	14.5	44.4	87.9	246	44	28	143	4	3	1.5
K.I.	15	M	8810	2660	12.8	39.3	81.0	280	36	32	232	29	2	2
M.U.	16	M	7690	3430	14.9	44.5	88.9	194	25	17	404	9	1.5	1
O.B.	17	M	9400	5220	15.0	45.4	89.1	332	33	27	203	8	5	1
E.K.	12	M	5460	2830	12.9	38.5	86.0	218	21	14	666	25	1	0.5
F.G.	15	M	8120	6000	12.7	38.6	81.4	348	16	9	787	31	2	1
U.G.	16	M	6380	3030	15.3	46.2	89.0	245	20	32	201	12	2	1
S.C.	14	M	8660	4870	12.4	37.3	81.7	213	20	13	572	8	3	1.5
U.G.	17	M	9860	5330	17.2	51	92.4	215	29	19	353	15	3	2
G.I.	18	M	7270	4350	16.5	49.3	89.3	173	25	18	310	14	2	2.5
Ç.Ç.	14	M	4870	2620	13.2	39.9	85.6	192	25	14	585	36	3	1
S.Y.	17	M	9270	4260	16.5	49.3	92.3	229	37	61	233	4	2	1
S.Y.	17	M	5400	3140	13.4	40.2	86.5	272	20	14	192	12	4	1.5
Ş.A.	15	M	5990	2760	14.8	44.7	89.6	310	18	13	582	20	3	1
İ.Ç.	17	M	5890	2960	14.4	42.5	89.2	244	21	28	234	37	2	1
M.K.	16	M	6890	3300	16.3	47.9	93.9	261	20	12	280	4	2	1.5
H.Y.	14	M	6530	3280	15.2	45.9	85.3	289	20	10	373	2	1	2
A.Y.	15	F	9860	5560	13.7	41.7	83.8	297	16	8	249	8	1	0.5
Y.Y.	16	F	7170	3410	13.2	39.6	90.8	245	16	14	83	17	2	1
D.K.	14	F	9540	7170	11.2	34.6	69.9	351	15	15	196	36	1	1
F.D.	17	F	5390	2230	12.5	36.6	88.5	201	19	23	212	13	2	1
S.A.	17	F	5280	3050	13.1	39.9	89.0	255	22	17	496	12	2	1
F.D.	17	F	6600	4620	13.9	42.3	88.6	315	21	18	361	20	1	1.5
O.A.	13	M	9620	3700	13.5	40.0	80.7	160	25	19	219	18	3	1

All statistical analyses were performed using SPSS 11.0. P values <0.05 were considered significant.

## RESULTS

Hematological and biochemical results of the cohort are presented in Table 1. The blood cell counts of children were within normal limits: the total WBC, absolute neutrophil and lymphocyte counts, RBC count, hemoglobin (Hb), hematocrit (Hct), mean corpuscular volume (MCV) and platelet

counts were all within normal limits. Anemia was detected in one 14-year-old girl only. Serum AST, ALT and ALP levels and sedimentation rates are also shown in the Table. There was only one case with elevated ALT, while ALP level elevation was detected in 13 cases (for males <15 years: 525 U/L, >15 years: 260 U/L; for females <15 years: 230 U/L, >15 years: 130U/L). Erythrocyte sedimentation rate (ESR) >20 mm/hour was found in six cases.

As expected, we found Hb, Hct and MCV values of the children correlated directly with age

and indirectly with ALP ( $p < 0.05$ ). There was no significant correlation between ESR and WBC or ANC.

The duration and the amount of substance abuse were investigated for a correlation with the blood parameters. There was a correlation between the amount of the substance abused per day and Hb and Hct ( $p < 0.05$ ).

## DISCUSSION

Inhalant abuse among young children has been usually described in the media and popular press rather than in medical journals. As with any substance abuse, there can be social, psychological, and physical complications. Examination of abusers must be done, so that more knowledge can be gathered about morbidity. Biochemical organ profiling plays an important role in this respect. The observed changes in biochemical assay activity in this age group have seldomly been reported.

Chronic inhalant abuse can damage cardiac, renal, hepatic, and neurologic systems. Inhalant abuse may result in bone marrow suppression, leading to leukopenia, anemia, thrombocytopenia, and hemolysis<sup>[11]</sup>. We conducted this study to evaluate the hematological and biochemical changes in inhalant-abusing adolescents living in İstanbul, Turkey. We aimed to determine whether or not inhalant abuse is associated with any laboratory findings of bone marrow suppression.

Complete blood count values with WBC differential have been reported to provide a way to assess the effects of exposure to volatile organic compounds<sup>[16,17]</sup>. In another study, CBC with WBC differential has also been suggested as a biological marker in the medical surveillance program for exposure to inhalants<sup>[18]</sup>. We also aimed to evaluate hematologic parameters of substance-abusing children, and we presumed that such children would have anemia, either due to toxic effects of the volatiles or due to poor nutrition. However, this was not the case, and only one child, a 14-year-old girl with menorrhagia, was found to be anemic. Although we thought that these children would have anemia of malnutrition (iron, folic acid, vitamin B12 deficiency), surprisingly the erythrocyte indexes of children were found to be in normal limits. Of course, as we did not evaluate these deficiencies in erythrocytes and blood, there might be a

deficiency that would not yet affect the indexes. The other explanation for normal blood indexes might be that these children living in the streets were finding food from the garbage, etc. as they found volatiles, enough for iron and hematinic supplementation. This report confirms the findings of Watson<sup>[19]</sup> that biochemical monitoring of solvent abusers does not show serious biochemical abnormalities. Although an inverse relation was thought to exist between the amount of abuse and Hb and Hct values in children, this was not established. The higher abuse amounts were related with higher Hb-Hct values. This might be due to lower ingestion of fluid with higher amounts of abuse, resulting in relative Hct increase.

Serum enzymes [AST, ALT, ALP, gamma-glutamyl transferase, creatine kinase (CK)] were measured in 296 young persons who admitted to recent inhalation of solvents, usually toluene-based glues<sup>[20]</sup>. In general, results fell within expected adult reference ranges except for CK. About 60% of subjects had CK activities above the upper reference limit<sup>[20]</sup>. In that study, only seven cases were found to have elevated ALP levels. Our results revealed that ALP levels of 13 (54%) children were elevated, but we did not evaluate CK in our cohort. The elevation of ALP may be a sensitive indicator of intra- or extrahepatic cholestasis. As a simultaneous elevation of 5' nucleotidase was not established in our study, it is hard to say that this increase is related with liver toxicity rather than with other causes.

Serum aminotransferases (ALT and AST) levels were in normal range, which is consistent with the literature<sup>[20]</sup>. Chronic use may result in non-toxicological laboratory results, such as abnormal AST, ALT, prothrombin time (PT), and activated partial thromboplastin time (aPTT) results, due to impaired liver function. Furthermore, toluene abuse may result in low potassium and phosphorus and elevated CK. As the longest duration of abuse was four years in our cohort, the follow-up period was not enough to detect the possibility of liver injury. Chronic inhalation abuse may also cause bone marrow depression resulting in leukopenia, anemia, thrombocytopenia, leukemia, or hemolysis, none of which was found in our children.

There were certain limitations to this study. The number of cases was insufficient, demographic values were not evaluated adequately and the follow-up period was short.

In conclusion, the hematologic and biochemical parameters, serum aminotransferases (ALT, AST) and ALP levels, were within normal range in substance abusers. Although we expected to find anemia in substance-abusing children, we found no significant difference between the

study group and sex- and age-matched healthy children. This report confirms that solvent abusers do not show serious biochemical abnormalities; however, more detailed biochemical surveillance is necessary with a longer follow-up period.

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