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# The Impact of Attention-deficit/Hyperactivity Disorder Assessments on Predicting Occupational Foreign Body Penetration Injuries

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#### Abstract

**Aim:** Our hypothesis was that individuals who suffer from penetrating foreign body injuries from work-related accidents are more likely to exhibit attention deficit hyperactivity disorder (ADHD) symptoms than those without such a history. The purpose of this study was to reveal whether there is a difference in ADHD diagnosis between patients who suffered penetrating foreign body injuries in a work accident and health volunteers who have not had a work accident before.

**Methods:** This study was designed as a retrospective, controlled, comparative study. Between January 2023 and December 2023, 47 patients who underwent surgery due to penetrating foreign body injury and 48 control group patients who were actively working and had no previous penetrating foreign body injury were included in the study. Attention deficit and hyperactivity disorder in patients was evaluated with the adult ADHD self-report scale version 1.1 (ASRS-v1.1) test administered by a specialist psychiatrist.

**Results:** The study included 95 patients-42 women and 53 men, with an average age of 35.1±11.5 in the patient group and 38.4±13.5 in the control group. When attention deficit subtype scores and ASRS-v1.1 total scores were examined, a statistically significant difference was found such that the patient group had higher scores than the control group in all three scoring systems.

**Conclusion:** This retrospective randomized controlled study set forth a broader perspective on a frequently seen trauma in the orthopedic emergency department. The ASRS-v1.1 test can be used as a tool to prevent further work-related accidents in work groups that use sharp objects and require maintaining attention.

Keywords: ASRS-v1.1, attention deficiency and hyperactivity disorder, foreign body injury, work accident

# Introduction

Penetrating foreign body injuries constitute a significant portion of cases in emergency orthopedic trauma; by definition, they cover the events in which foreign objects penetrate the tissues (1,2). Accidents resulting in foreign object penetration injuries particularly involve workers in industries involving textiles, construction, manufacturing, or agriculture (2). Workers in these areas may be exposed to sharp tools, machinery, or objects that can cause penetrating injuries (3). These injuries can bring various complications, such as infection and foreign body retention in the body, and in some cases, penetrating injuries can even damage nerves, vessels, and internal organs; therefore, careful examination and appropriate intervention are required to minimize such complications (4-8). Prevention can be achieved by taking additional

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safety measures in environments and for individuals that may be prone to such accidents (9).

Attention deficit hyperactivity disorder (ADHD) is a pathological condition characterized by symptoms such as difficulty paying attention, difficulty in impulse control, and poor organizational skills; in addition, it is usually diagnosed in childhood (10,11). Attention deficit hyperactivity disorder can affect a person's ability to maintain attention, follow instructions, and anticipate dangers at work. Work accidents may occur as a result of carelessness due to distraction or hyperactivity (12,13). Making quick decisions, taking actions without thinking, and ignoring risky situations can lead to accidents (11).

The purpose of this study was to reveal whether there is a difference in ADHD diagnosis between patients who suffered penetrating foreign body injuries in a work accident and healthy volunteers who have not had a work accident before. We hypothesized that ADHD symptoms would be more dominant in individuals who suffered penetrating foreign body injuries after a work accident.

### **Materials and Methods**

## **Compliance with Ethical Standards**

This study was approved by the the Clinical Research Ethics Committee of University of Health Sciences Turkey, Istanbul Haseki Training and Research Hospital (approval no.: 257-2023, date: 27.12.2023) and conducted in accordance with the ethical standards. Written informed consent was obtained from all participants before enrollment. The authors declare that they have no conflict of interest and received no financial support for this research.

## **Study Design**

This study was designed as a retrospective, controlled, comparative study. Forty-seven patients, who were admitted to the emergency orthopedics clinic with penetrating foreign body injuries and were operated on between January 2023 and December 2023, and forty-eight actively working control group patients, without previous penetrating foreign body injuries, were included in the study. Patients who were unable to communicate verbally, had a history of moderate to severe cognitive impairment, had alcohol and/or sedative-hypnotic addiction, had a psychiatric diagnosis, had mental retardation, and were using psychotropic medications were excluded from the study. The patients' age, gender, whether a patient had any previous accidents and whether these previous accidents required surgical treatment, years of work experience, work hours per week, amount of work hours after 5 pm, past medical history, use of tobacco products, amount of sleep (hours), if a family member with an ADHD diagnosis,

and part of the body injured by a penetrating foreign body were recorded (Figure 1).

# Adult ADHD Self-report Scale Version 1.1 Test

Adult ADHD self-report scale version 1.1 (ASRS-v1.1) is a self-rating scale used to assess symptoms of ADHD in adults within the scope of DSM-4 criteria (14). This scale consists of two parts: Part A (6 questions) and Part B (12 questions). For each item, participants are asked to indicate how often the specified symptom has occurred in the past six months. Answers are scored from 0 to 4; a score of 0 is given for never, 1 for rarely, 2 for sometimes, 3 for often, and 4 for very often. For all 18 items, responses of "often" or "very often" are considered positive, as indicated by shaded boxes on the questionnaire (14). If a patient endorses 4 or more of the Part A questions on the ASRS-v1.1 at these threshold levels, then the patient is considered positive. Although Part B is not used for diagnostic purposes, these items provide information



Figure 1. Flowchart of included and excluded patients

about the frequency of symptoms and may be helpful in determining what other symptoms the patient may be suffering from (14). The scale was adapted into Turkish by Doğan et al. (15). Since the ASRS-v1.1 scale is used in different ways in the literature, the scale is used both in scoring and with cut-off values (16,17). The ASRS-v1.1 test was administered by a psychiatrist who is an expert in the field.

# **Statistical Analysis**

The relationship between the categorical information obtained in the study and the experimental and control groups was examined with the SPSS 20.0 software. The Kolmogorov-Smirnov test was used to examine whether the data of quantitative variables conformed to normal distribution. Whether the quantitative data differ significantly between groups is determined using a t-test for independent groups on data that conform to a normal distribution. Data that did not comply with the normal distribution were examined with the Mann-Whitney U test. Analysis among categorical variables was performed with a chi-square test. The statistical significance level was determined as p<0.05.

# Results

The study included 95 patients, comprising 42 females and 53 males, with an average age of 35.1±11.5. In contrast, the control group had an average age of 38.4±13.5. Among these, 47 patients experienced work accidents, and the control group comprised 48 healthy individuals without work accidents. Demographic and social characteristics were comparable between the two groups (Table 1). No statistically significant difference in ASRS-v1.1 positivity was observed between the patient and control groups (p=0.093). The only notable distinction in working conditions was longer working hours after 5 pm in the group with work accidents (p=0.034).

Table 1. Comparison of demographic and social characteristics of individuals in the patient and control groups					
		Patient	Control	p-value	
Age		35.1±11.5	38.4±13.5	0.206 (2)	
Gender	Female	17 (36.2%)	25 (52.1%)	0.089.(1)	
	Male	30 (63.8%)	23 (47.9%)	0.088 (1)	
Individuals with ADHD diagnosis in the family	No	45 (95.7%)	45 (93.8%)	0 5 10 (1)	
	Yes	2 (4.3%)	3 (6.3%)	0.510(1)	
ASRS-v1.1 Part A+*		8 (17.0%)	3 (6.3%)	0.093	
Smoking	No	22 (46.8%)	25 (52.1%)	0.270 (1)	
	Yes	25 (53.2%)	23 (47.9%)	0.379(1)	
Sleep duration (hours)		6.9±1.2	7.1±0.8	0.215 (2)	
Weekly working hours		37.3±27.8	39.7±22.6	0.635 (2)	
Working hours after 5 pm		1.8±2	1±1.4	0.034 (2)	
Duration of employment (years)		8.2±8.7	10.3±14	0.383 (2)	
Insurance status	No	25 (53.2%)	21 (43.8%)	0.227 (1)	
	Yes	22 (46.8%)	27 (56.3%)	0.237 (1)	
	No	31 (66%)	37 (77.1%)		
	HT	4 (8.5%)	4 (8.3%)		
	DM	3 (6.4%)	2 (4.2%)		
	Thyroid hormone disorder	1 (2.1%)	1 (2.1%)		
Comorbidities	Cardiac disease	1 (2.1%)	0 (0%)	0.679 (1)	
	Lung disease	2 (4.3%)	2 (4.2%)		
	Rheumatic disease	0 (0%)	1 (2.1%)		
	Epilepsy	2 (4.3%)	0 (0%)		
	Multiple diseases	3 (6.4%)	1 (2.1%)		

(1): Chi-square test, (2): Independent samples t-test

HT: Hypertension, DM: Diabetes mellitus, ADHD: Attention deficit and hyperactivity disorder, ASRS-v1.1: Adult ADHD self-report scale version 1.1 \*Less than four shaded boxes were selected in ASRS-v1.1 Part A In the patient group that experienced work accidents, a comparison between individuals with a notable ASRS-v1.1 Part A score ( $\geq$ 4) and those without a significant score (<4) revealed no discernible difference in various accident-related aspects. This includes factors such as how the accident occurred, the location of the foreign object entry, and the history of previous accidents, as detailed in Table 2.

We evaluated the scores of patient and control groups in three different scoring systems. When analyzing attention deficit subtype scores, hyperactivity/impulsivity scores, and ASRS-v1.1 total scores, it was statistically significant that there were higher scores in all three scoring systems, in the patient group compared to the control group (Table 3).

# Discussion

Attention deficit hyperactivity disorder stands out as a crucial factor influencing accidents, injuries, and associated treatment costs. Characterized by attention deficit, hyperactivity, and impulsivity, ADHD has traditionally been a focus in pediatric studies. However, recent research emphasizes its role in adult accidents and unintentional injuries (18,19). This study specifically investigates cases where ADHD, identified through the ASRS V1-1 scale, intersects with workplace accidents involving foreign object penetration. Statistical analyses reveal noteworthy disparities in ADHD symptom severity between the accident-involved and non-accident groups. Total ASRS-v1.1 scores, attention deficit subtype scores, and hyperactivity-impulsivity subtype scores all exhibit statistically significant differences.

The association between ADHD and various health risks has been extensively explored in numerous studies. Chien et al.'s (20) study highlights a heightened total injury risk in individuals with ADHD. In another study, Ahn et al. (21) have shown that adults with ADHD are at increased risk of sustaining various types of injuries. Hailer et al. (22) observed a correlation between Legg-Calvé-Perthes patients and hyperactive behavior, coupled with increased physical activity during childhood. Ettinger et al. (23) reported an elevated frequency of seizures in epilepsy patients with a positive ASRS test. Moreover, studies consistently underscore the link between ADHD and an increased risk of unintentional injuries and accidents (24). Scans in this domain offer valuable insights into accident prevention (19). Notably, investigations into the connection between prior trauma, injuries, and ADHD symptoms reveal a significant relationship (24,25). Similar to these studies, this study aimed to evaluate the

Table 2. Effects of different characteristics of injury to ASRS-v1.1 part A score in the patient group								
		ASRS-v1.1 negative patients in patient group*	ASRS-v1.1 positives in patient group**	p-value				
Part of the body injured by a foreign object	Hand/Fingers	24 (61.5%)	7 (87.5%)					
	Feet/Toes	13 (33.3%)	1 (12.5%)	0.358				
	Other lower extremity	2 (5.1%)	0 (0%)					
Whether there been any previous accidents	No	31 (79.5%)	4 (50%)	0.101				
	Yes	8 (20.5%)	4 (50%)					
Whether previous accidents required surgery	No	36 (92.3%)	7 (87.5%)	0.539				
	Yes	3 (7.7%)	1 (12.5%)					

Chi-square test

ASRS-v1.1: Adult ADHD self-report scale version 1.1

\*Less than four shaded boxes were selected in ASRS-v1.1 Part A

\*\*Four or more shaded boxes were selected in ASRS-v1.1 Part A

Table 3. Comparison of the patient and control groups in total ASRS-v1.1 scores, attention deficit subtype scores, hyperactivity/ impulsivity subtype scores

	Patient group	Control group	7	p-value			
	Mean±SD/Median	Mean±SD/Median	2				
Attention deficit subtype	11.60±5.53/10.00	8.90±4.21/8.50	-2.314	0.021*			
Hyperactivity/impulsivity subtype	11.89±6.85/11.00	9.10±4.40/9.00	-2.034	0.042*			
ASRS V.1.1 total score	23.30±11.30/20.00	17.98±6.39/18.00	-2.013	0.044*			
Comparison of sub-type and total ASRS-v1.1 scores by Mann-Whitney U test							

Comparison of sub-type and total ASRS-v1.1 scores by Mann-Whitney U test ASRS-v1.1: Adult ADHD self-report scale version 1.1 \*Mann-Whitney U test relationship between penetrating foreign body injury and ADHD and revealed that ADHD is associated with foreign body injury.

Baran Tatar et al. (26) utilized the ASRS-v1.1 for ADHD diagnosis, considering a positive ADHD subtype in individuals scoring over 24 points in 8 questions. In line with this approach, this study assessed the ASRS-v1.1 test, categorizing individuals into ADHD subtypes. Notably, 17% of the injured group tested positive for ADHD in Part A, compared to 6.3% in the control group. While the difference in ADHD-positive evaluations was not statistically significant, there was a proportionally higher incidence of ADHD in the accident group. Additionally, the injury group exhibited significantly higher scores on both hyperactivity-impulsivity and attention deficit subscales of ASRS, aligning with existing literature (18,27-29).

Adler et al. (30) highlighted that ASRS-v1.1 test results might be influenced by demographic factors such as age, gender, and race, indicating potential variations in ADHD diagnosis frequency. Consequently, comparing ADHD diagnosis frequency in specific patient groups with the general population may not yield accurate results. To address this, the study compared ASRS-v1.1 test results between the patient group with penetrating foreign body injury and a control group matched for age, gender, race, and occupation. The general population's ADHD prevalence is known to be 4.4%, yet in this study, ADHD diagnosis occurred in 17% of the patient group and 6.3% of the control group (27). The higher prevalence in the control group underscores the critical role of a wellmatched control group in the study.

The study found no disparity in age and gender ratios between the injured and non-injured groups. Previous research indicates a "U"-shaped distribution of accidents and injuries across age groups, irrespective of ADHD presence (19,31). It's suggested that young men might experience more accidents and injuries than young women, which might emphasize the role of inexperience and high-risk behaviors (19,31). Adler et al. (30) noted the impact of demographic factors on ASRS-v1.1 test results, indicating potential variations in ADHD diagnosis frequency. Thus, comparing ADHD diagnosis frequency with the general population may not yield accurate results for specific patient groups. To address this, the study compared ASRS-v1.1 test results between the patient group with penetrating foreign body injuries and a wellmatched control group in terms of age, gender, race, and occupation. In the general population, ADHD prevalence is reported as 4.4% or 5% (31,32). In this study, ADHD diagnosis occurred in 17% of the patient group and 6.3% of the control group, highlighting the crucial role of an adequately matched control group in interpreting study findings.

# **Study Limitations**

While this study provides valuable insights, it is important to acknowledge its limitations. Firstly, the study is single-centered, potentially limiting the generalizability of findings to broader populations. The lack of inquiry into the duration of individuals' job tenure and the absence of specific questions about the duration of performing the same tasks could be considered a limitation, as experience levels might influence the likelihood of injury. Additionally, the categorization of injuries as work-related accidents, without a detailed exploration of psychosocial stressors, may overlook crucial factors influencing ADHD symptoms. The potential for a more defensive response in individuals perceiving their injuries as work-related accidents might introduce bias when completing the self-report scale. Despite these limitations, the study has several strengths. Firstly, it is one of the few controlled investigations focusing on the association between ADHD symptoms and penetrating foreign body injuries in occupational settings. Secondly, ADHD assessment was conducted using a standardized and widely accepted tool (ASRS-v1.1), administered by a specialist psychiatrist, which increases diagnostic accuracy and minimizes measurement bias. Moreover, the study addresses a relatively underexplored area, contributing valuable data to both orthopedic trauma and occupational mental health literature. Further investigations incorporating a more nuanced evaluation of psychosocial factors are warranted to enhance our understanding of the interplay between ADHD and occupational injuries.

# Conclusion

This study establishes a significant association between penetrating foreign body injuries and ADHD. The findings suggest that implementing pre-employment ADHD assessments, specifically utilizing the ASRS-v1.1, could serve as a preventive measure in occupational settings prone to such injuries. We recommend the adoption of these assessments, particularly in industries involving manual work with sharp objects, where sustained attention is crucial.

## **Conclusions for Practice**

- Attention deficit hyperactivity disorder symptoms may have an impact on the risk of occupational accidents, especially in occupations that require a high level of attention and involve handling sharp objects.

- The patients with foreign body penetration injuries had statistically significantly higher scores than the control group in all three scoring systems.

- Fatigue and working conditions, especially working hours after 5 pm, increase the likelihood of such accidents, especially in people with ADHD. - Implementation of ADHD screening, particularly using the ASRS-v1.1, could be useful as a preventive measure in work environments where such injuries are common.

# Ethics

**Ethics Committee Approval:** This study was approved by the the Clinical Research Ethics Committee of University of Health Sciences Turkey, Istanbul Haseki Training and Research Hospital (approval no.: 257-2023, date: 27.12.2023).

**Informed Consent:** Written informed consent was obtained from all participants before enrollment.

## Footnotes

#### **Authorship Contributions**

Surgical and Medical Practices: M.A., A.I., M.Y., Concept: A.E., A.I., Design: M.A., M.B.G., S.S., M.Y., Data Collection or Processing: A.I., S.S., Analysis or Interpretation: M.A., M.B.G., M.Y., Literature Search: M.B.G., S.S., Writing: M.A., A.I.

**Conflict of Interest:** No conflicts of interest were declared by the authors.

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