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Pyromania/ Firesetters and Attention Deficit Hyperactivity Disorder in children and adolescents: a systematic review

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Pyromania/ Firesetters and Attention Deficit Hyperactivity Disorder in children and adolescents: a systematic review

Short Title: Pyromania and ADHD in children and adolescents

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Abstract

Background: The following article aims to explore the relationship between Pyromania/Firesetters and Attention Deficit Hyperactivity Disorder (ADHD) in childhood and adolescence.

Method: A systematic literature review was carried out using search engines such as PubMed, PsycINFO, Cochrane, and Sicelo, to find relevant articles. Inclusion criteria

included studies that related ADHD and Pyromania/Firesetters, while exclusion criteria included articles not related to the researched variables, articles from other systematic reviews, and articles not related to childhood and/or adolescence.

Results: Of the 71 articles initially identified, five met the eligibility criteria and were included in the analysis, which demonstrated that ADHD and Pyromania/Firesetters are comorbid conditions that can be diagnosed during childhood and/or adolescence. The comorbid relationship was observed to be more prevalent in boys, with an estimated prevalence of approximately 33%. Firesetting behavior was associated with a sixfold increase in the likelihood of boys being diagnosed with ADHD. Moreover, the comorbid relationship between ADHD and Pyromania/Firesetters was linked to conduct disorders and an elevated risk of future delinquent behavior. Mental health professionals should consider investigating firesetting history during the diagnostic assessment of ADHD, as the absence of early diagnosis and treatment increases the risk of adverse social outcomes.

Conclusions: The study concluded that the results demonstrated the comorbid relationship between ADHD and Pyromania/Firesetters in childhood and adolescence, but more research is needed to better understand this relationship.

Keywords: Attention; Pyromania, Firesetters, Impulsivity; childhood and adolescence.

Introduction

Pyromania is a rare impulse control disorder that, according to the DSM-5, is characterized by the deliberate and purposeful setting of several episodes of fire, preceded by excitement, fascination, or curiosity [1]. This behavior is not driven by financial motivations and cannot be explained by other disorders [2]. Although the diagnosis in its full specificity is rare, the act of setting fires is common among children and adolescents. Individuals who engage in this behavior repetitively and impulsively are referred to as firesetters [3-4], placing both their own lives and the lives of others at risk [5-6]. Moreover, this youthful fascination with fire, more prevalent in boys in addition to the high financial costs [7], has long been hypothesized to be a predictor of serious disorders in adulthood [8]. More recently, it has been associated with poor emotional regulation and compulsive, disruptive impulse control and behavior disorders, such as trichotillomania [9], oppositional defiant disorder, and intermittent explosive disorder [10].

Attention deficit hyperactivity disorder (ADHD) is a neurodevelopmental disorder characterized by a triad of symptoms: attention deficit, hyperactivity, and impulsivity [1]. It has a prevalence of approximately 5% in the pediatric population and is more common in males [11]. Although it is classified as a neurodevelopmental disorder in the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5), current evidence suggests that it could have been included in the disruptive and impulse control disorders section [1], due to the central role that impulsivity plays in its symptomatic manifestation, an opinion

supported by some authors [12-13].

Pyromania/ firesetting behaviors and ADHD are disorders that share similar structural, neurochemical, and functional characteristics in the brain's frontal regions [14-15]. These similarities are particularly evident in the frontal and prefrontal areas, including the prefrontal cortex, cingulate cortex, and basal ganglia [16]. Furthermore, deficits in dopaminergic neurotransmission, inadequate modulation of serotonin receptors [17-18], and reduced levels of 5-HIAA (5-hydroxyindoleacetic acid, a serotonin metabolite) in the cerebrospinal fluid [19] have been linked to heightened aggressive responses and impaired impulse control [20]. Such findings, frequently observed in boys with both disorders, are characterized by impulsive behaviors and poor emotional regulation, which may escalate into disruptive disorders [1]. This suggests that the coexistence of pyromania and firesetting behaviors with ADHD, as comorbid phenotypes, is associated with more severe clinical manifestations. Nonetheless, despite these observed similarities, few studies have investigated this comorbidity or proposed a comprehensive analysis for mental health professionals.

Considering the above, this article aims to address the following hypotheses:

Does a comorbid relationship exist between ADHD and pyromania/firesetters?

Does the coexistence of both conditions increase the likelihood of adverse social outcomes? Should the relationship between pyromania/firesetting behaviors and ADHD be incorporated into the diagnostic evaluation of these disorders? A deeper understanding of these questions aims to influence the diagnostic decision-making

process, the formulation of public policies and the minimization of future adverse social outcomes associated with both disorders.

Methods

A systematic review was carried out based on the PRISMA guidelines [21], focusing on comorbidity relationship between ADHD and Pyromania in childhood and adolescence. An electronic search was carried out on July 07, 2024, on the following digital platforms: PubMed, PsycINFO, Cochrane, and SciELO. The descriptors used as keywords in English were as follows: Pyromania and Attention Deficit Hyperactivity Disorder and Firesetting, Firesetting and Attention Deficit Hyperactivity Disorder, Pyromania and Comorbidity, Firesetting and Childhood, Firesetting and Comorbidity, Arson and Attention Deficit Hyperactivity Disorder. The references cited in the systematically searched articles were manually checked. In an effort to avoid publication bias, the search also included non-English language studies and gray literature (for example, conference abstracts). The search used a broadly structured strategy based on the Problem, Intervention/Exposure, Comparator, Outcome, Setting (PICO) [22], framework, where the problem was ADHD or Pyromania symptoms, the intervention/exposure was the comorbidity between ADHD and Pyromania, the comparison was absence comorbidity between ADHD and Pyromania, the outcome was the prevalence of ADHD and Pyromania symptoms and its social outcomes, and any type of study design was allowed. Articles that were unrelated to the researched variables, as well as systematic reviews, book

chapters, and those not focused on childhood or adolescence, were excluded.

Data extraction and quality scoring

The studies were reviewed to extract the following variables: authorship, year of publication, sample, prevalence of comorbidity, and diagnostics instruments listed in table 3, which were used to assess ADHD and Pyromania symptoms. The quality assessment of the articles was evaluated using the Newcastle-Ottawa Scale.

Results

In total, 71 articles were found to be related to the initial identification phase: PubMed (n=48), PsycInfo (n=1), Cochrane (n=19), and SciELO (n=3). Of these, 41 were excluded because they were duplicates, leaving a total of 30 articles. Subsequently, following the criteria previously described, 8 articles were selected for eligibility. The eight articles were read in full, one of which was excluded because it was book chapters, and two others were excluded because they did not present specific data related to ADHD and Pyromania/Firesetters. Therefore, five articles were included in this review (Figure 1). Table 1 summarizes the included studies, and Table 2 presents an analysis of their quality according to the Newcastle-Ottawa scale criteria.

[Insert Figure 1, Table 1, Table 2]

Figure 1 - Flowchart of searches and original articles included in the study, based on the PRISMA guideline.

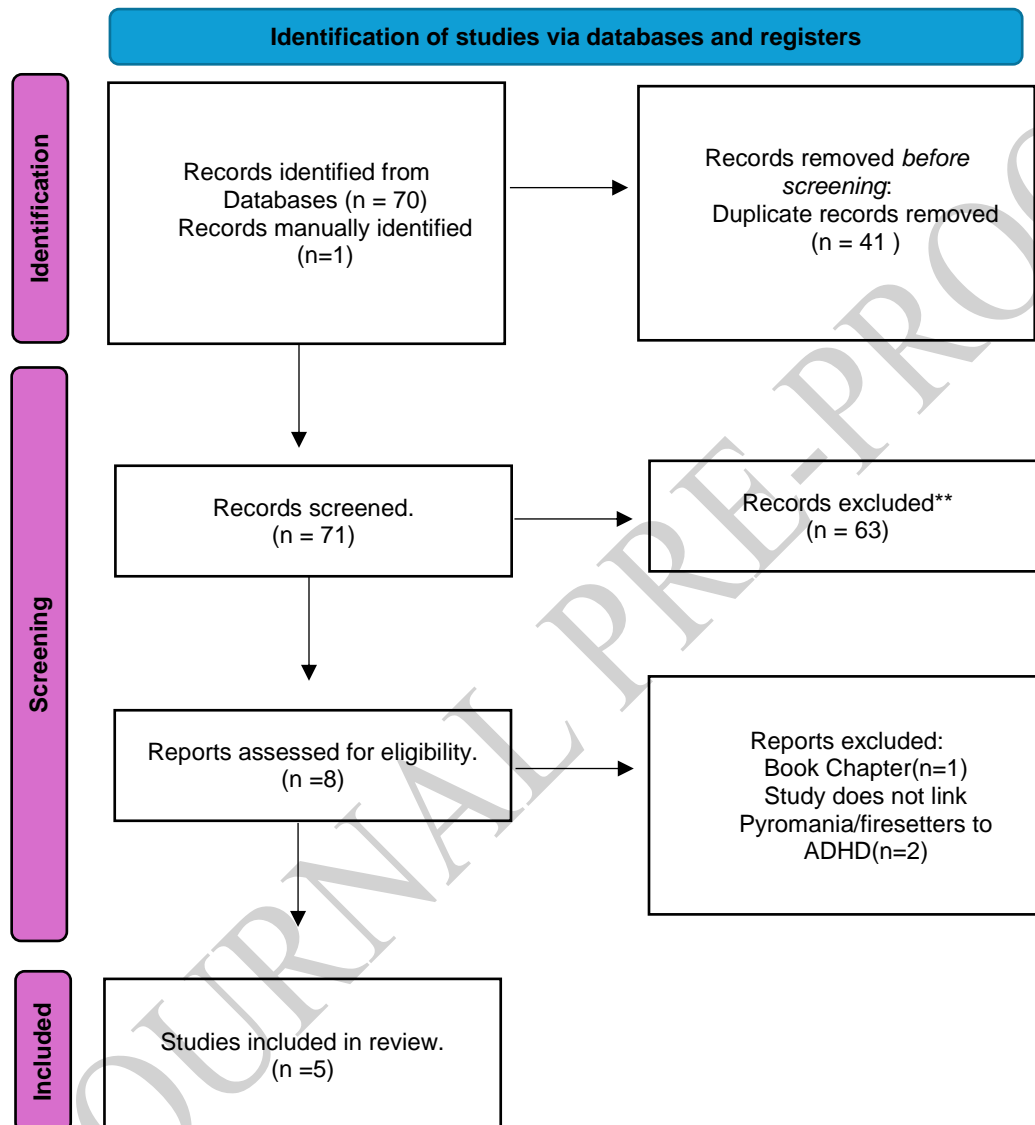


Table 1 - Comparative Analysis of Studies

Comparative Analysis of Studies							
Authors	Year	Country	Sample	Male sex	Female sex	OR	Prevalence comorbid ADHD and Pyromania/Firesetters
<i>Franklin, G. A. et al [7]</i>	2002	EUA	128	118	10	-	17%
<i>Kolko, D. J., Kazdin, A. [23]</i>	2001	EUA	46	46	-	-	54%
<i>Becker, K. D et al [24]</i>	2004	EUA	32	29	3	-	30%
<i>Lambie I. et al [25]</i>	2013	New Zealand	182	166	16	4,97	11%
<i>Sasaki, Y et al [26]</i>	2023	Japan	64	55	9	6,74	57,8%

Table 2 - Quality score

Quality Analysis of Scientific Articles- Newcastle Ottawa Scale						
Reference	Years	Country	Selection	Comparability	Outcome	Total
<i>Franklin, G. A. et al [7]</i>	2002	EUA	3	2	2	7
<i>Kolko, D. J., Kazdin, A. [23]</i>	2001	EUA	4	2	3	9
<i>Becker, K. D et al [24]</i>	2004	EUA	3	2	2	7
<i>Lambie I. et al [25]</i>	2013	New Zealand	4	2	3	9
<i>Sasaki, Y et al [26]</i>	2023	Japan	4	2	3	9

Among the five articles included in this systematic review, three were conducted by institutions in the United States during 2001, 2002, and 2004. The first study was carried out by the University of Pittsburgh School of Medicine and sought to evaluate the efficacy of educational and cognitive-behavioral interventions for children referred by the Pittsburgh Fire Department for repetitive firesetter behavior. A total of 70 children, aged between 5 and 13, were referred, out of which 54 met the inclusion criteria and 46 successfully completed the 1-year follow-up. The study revealed that of the 46 participants, 25 or 54% were diagnosed with ADHD [23].

The second study was undertaken jointly by the University of Michigan Burn Center and the local police department. Its purpose was to assess the usefulness of a burn prevention program for children who exhibited recurrent firesetting behavior and were referred by the juvenile justice system and fire department. The program involved 128 children, aged 4 to 17 years, 118 of whom were boys and 10 of whom

were girls. The participants in the program remained enrolled for a duration ranging from 8 months to 2.5 years. Among the concomitant disorders present in these children, ADHD was the most prevalent, occurring at a rate of 17% [7]. Another article concerns a 10-year prospective study led by professors from the Universities of Hawaii, Arizona, Indiana, and Harvard, during which 363 children aged 6 to 12 years were recruited and accompanied by their mothers. The aim of the study was to investigate the effect of domestic violence on the mental health of children. Of these participants, 32 exhibited repetitive firesetting behavior, and 14% of them were diagnosed with ADHD. The article further emphasizes that engaging in firesetting behavior can increase the likelihood of juvenile delinquency by up to 10 times [24].

A 10-year study conducted by the Department of Psychology at the University of Auckland, New Zealand, evaluated the recurrence of firesetting behavior following an education intervention implemented by the fire department. The study involved 182 children and adolescents aged 3 – 17 years, referred by the fire department for history of repetitive firesetting behavior. The main finding was that children exhibiting firesetting behavior were five times more likely to be diagnosed with ADHD and more likely to engage in delinquent behavior in the future. [25].

In another study, published in 2023 an eight-year retrospective analysis was conducted by the Department of Child and Adolescent Psychiatry at Kohnodai Hospital in Japan. The study included with 5,587 patients among whom 64 children

and adolescents aged 6 to 18 years (55 males and 9 females) exhibited firesetting behavior. The findings revealed a comorbid relationship of 57% between ADHD and firesetting behavior with firesetters being six times more likely to receive an ADHD diagnosis. [26].

Table 3 lists the instruments diagnostics pyromania/ firesetting behaviors, and ADHD in the reviewed articles. These instruments are crucial for collecting reliable data and analysis of the comorbid relationship between the two disorders.

Table 3- Diagnostic Instruments for ADHD and Pyromania/Firesetters

Comparative Analysis of Studies			
Authors	Firesetters	ADHD diagnosis	Diagnostic instruments
Franklin, G. A. <i>et al</i> [7]	132	22	Structured interview and medical diagnosis, DSM III-R
Kolko, D. J. [23]	46	25	Medical interview-DSM III-R. FHS- (Fire History Screen), CFI- (Child Firesetting Interview) and FRI-(Firesetting Risk Interview)
Becker, K. D <i>et al</i> [24]	32	9	CAS-Child Assessment Schedule) DSM III-R
Lambie I. <i>et al</i> [25]	182	20	Semi-structured interview
Sasaki, Y <i>et al</i> [26]	64	37	Structured interview and child psychiatrist interview DSM-5

Discussion

This systematic review is among the first to analyze shared characteristics in the comorbid relationship between disorders, highlighting similarities that include neurochemical, structural, and behavioral alterations, such as impulsivity and aggressiveness. Additionally, it seeks to provide information on prevalence and social outcomes to promote early interventions and greater diagnostic accuracy. The study was guided by three central questions: the existence of a comorbid relationship between ADHD and pyromania/fire-setting behaviors; the impact of this relationship on negative social outcomes; and the necessity of incorporating the investigation of this comorbidity as a fundamental aspect of diagnostic anamnesis.

The results of this study, presented in table 1, suggest the existence of a comorbid relationship between the disorders, with higher prevalence observed among boys, with rates ranging from 11% to 57.8%. Previous fire-setting behavior has been identified as a factor that may increase the likelihood of a future ADHD diagnosis by as much as six times [25]. Moreover, children and adolescents diagnosed with both pyromania and ADHD exhibited a greater propensity for disruptive behaviors [26]. These findings support the hypothesis of the evolutionary progression of ADHD in its most severe form, which may evolve through oppositional defiant disorder (ODD) and conduct disorder, culminating in antisocial behavior [27-28]. As anticipated, both disorders have frequently been linked with difficulties in emotional regulation, impulse control, and anger management [29-30].

Based on these findings, the authors recommend that the diagnostic investigation of both ADHD and firesetting behavior consider the potential comorbid relationship, with particular focus on firesetting behavior in boys. This targeted

approach could serve as an effective tool for the early identification of ADHD in children and adolescents, enabling the development of prevention and treatment strategies that reduce the physical, financial, and social consequences associated with these conditions.

One of the strengths of this review is its foundation in methodologically rigorous observational studies, which analyzed samples of children and adolescents from diverse backgrounds. These samples were drawn from various contexts, including communities, firefighter and police databases, judicial systems, and psychiatric hospitals, across culturally diverse countries and continents, such as the United States, Japan, and New Zealand.

Furthermore, the study employed different research designs, including follow-ups lasting up to 10 years, which enhanced robustness and generalizability of the findings. The systematic review methodology enabled the comparison of data across multiple cultural contexts, improving the global understanding of the phenomenon. Additionally, the study identified gaps in knowledge related to the topic, offering directions for future research and evidence-based interventions.

Among the limitations, it is worth noting that pyromania is a rare condition, with its specificities described in the DSM-5, which complicates the acquisition of representative samples. This characteristic increases the likelihood of selection bias, as the analyzed cases may not reflect the general population, making it challenging to draw objective conclusions about the relationship between pyromania and ADHD. Nevertheless, the analyzed samples unequivocally correspond to children and adolescents with repetitive fire-setting behaviors, indicating the existence of a comorbid relationship between fire-setters and ADHD.

Another potential limitation is that the studies selected for the review used administrative data from firefighter, police, and judicial systems. Consequently, the possibility of information bias cannot be ruled out, as these records were not created for academic purposes and may contain inconsistencies, incomplete data, or subjectivities related to their original purpose.

Finally, research should investigate whether the comorbid relationship between these disorders is linked to increased ADHD symptom severity and whether it correlates with a higher likelihood of progression to conduct disorder and antisocial personality disorder. Furthermore, attention should be given to the scarcity of scientific literature addressing this topic and the absence of a recommendation in the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) to investigate previous firesetting behavior in boys as an additional criterion in ADHD diagnostic evaluation. Such a recommendation could significantly aid mental health professionals in making timely and accurate diagnoses.

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