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Prevalence of ADHD (Attention-Deficit/Hyperactivity Disorder) Among Patients With Atopic Dermatitis Attending Healthcare Centers in Zahedan During 2022–2023

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A B S T R A C T

Children with atopic dermatitis exhibit a higher prevalence of psychiatric disorders, particularly attention-deficit/hyperactivity disorder (ADHD), compared with their healthy peers. Nocturnal pruritus, sleep disturbance, and chronic inflammation have been proposed as potential mechanisms underlying this comorbidity. The present study aimed to determine the prevalence of ADHD among patients with atopic dermatitis attending healthcare centers in Zahedan. In this descriptive cross-sectional study, 60 patients with atopic dermatitis aged 7–16 years were selected through convenience sampling and assessed using a demographic information form including age and sex and the standardized Conners Parent Rating Scale. Data were analyzed using SPSS version 24, the chi-square test, and Fisher's exact test, with the significance level set at $p < .05$. The findings showed that the prevalence of ADHD among patients with atopic dermatitis was 10%. The prevalence was 13.1% in boys and 4.5% in girls and was significantly higher in boys than in girls ($p = .021$). The prevalence of ADHD was 9.7% among children aged 10 years or younger and 10.5% among children older than 10 years, with no significant difference between the two age groups ($p = .72$). In addition, the prevalence of ADHD increased significantly with increasing severity of atopic dermatitis ($p = .01$). Based on these findings, screening patients with atopic dermatitis for ADHD, particularly boys and patients with more severe disease, may contribute to improving their mental health and clinical course.

Keywords: *attention-deficit/hyperactivity disorder, atopic dermatitis, children, healthcare centers in Zahedan.*

1. Introduction

Atopic dermatitis (AD) is a chronic, relapsing inflammatory skin disorder characterized by pruritus, xerosis, eczematous lesions, and recurrent exacerbations. Although its most visible manifestations involve the skin, contemporary evidence increasingly supports the view that AD is a systemic and multidimensional disorder with immunological, neurological, behavioral, and psychological consequences. The disease frequently begins during childhood, a developmental period in which persistent itching, sleep disruption, restrictions on daily activities, and repeated treatment requirements can affect emotional regulation, cognitive functioning, family relationships, school performance, and overall quality of life. Accordingly, the clinical implications of AD extend beyond the control of cutaneous lesions and require consideration of its potential neuropsychological and psychiatric comorbidities (1, 2). Studies examining psychological manifestations in affected individuals have also demonstrated associations between AD and clinically relevant emotional symptoms, including depressive manifestations, emphasizing the importance of integrating psychological assessment into dermatological care (3).

The pathophysiology of AD is complex and involves interactions among epidermal barrier dysfunction, immune dysregulation, genetic susceptibility, environmental exposures, and alterations in inflammatory signaling. Impairment of the epidermal barrier facilitates penetration of irritants and allergens and promotes immune activation, while dysregulated immune responses contribute to chronic inflammation and recurrent disease activity. The contribution of biological susceptibility is also reflected in research on genetic factors associated with atopic conditions; for example, immunogenetic investigations have demonstrated associations between major histocompatibility-related alleles and atopic dermatitis phenotypes in animal models, further illustrating the biological complexity of susceptibility to atopic inflammation (4). Among children, additional biological factors may influence disease expression and severity. Vitamin D status, for example, has been investigated in relation to the severity of AD, with findings supporting a relationship between vitamin D3 levels and disease severity in infants and children (5). These findings collectively support a model of AD in which inflammatory, genetic, and environmental mechanisms interact rather than a model limited to an isolated dermatological abnormality.

The chronic and fluctuating nature of AD can impose substantial burdens on children and their families. Persistent pruritus is particularly important because it promotes scratching, skin damage, secondary inflammation, and a self-perpetuating itch–scratch cycle. Nocturnal pruritus may further interfere with sleep onset, sleep continuity, and sleep quality. Repeated sleep disruption during childhood can adversely affect attention, behavioral inhibition, emotional regulation, daytime alertness, and academic functioning. Psychological distress may also intensify perceptions of itching and contribute to disease exacerbations, creating reciprocal interactions between psychological functioning and dermatological symptoms (2). The clinical importance of controlling disease activity is therefore reflected in ongoing efforts to improve topical and systemic treatment strategies. Iranian studies have evaluated interventions such as creams containing oat and chamomile extracts for mild-to-moderate AD (6), while other investigations have examined adjunctive melatonin treatment alongside topical corticosteroids (7). Such research highlights both the burden of persistent symptoms and the need for therapeutic approaches capable of addressing clinical features that may indirectly affect sleep, behavior, and psychological functioning.

Epidemiological studies have shown that AD occurs across different age groups and is frequently accompanied by other atopic conditions. Research conducted in Iran has documented AD among adults and demonstrated associations with respiratory allergic diseases, further supporting the systemic and comorbid nature of atopic disorders (8). In childhood, however, the clinical importance of AD may be particularly pronounced because chronic inflammatory disease occurs simultaneously with rapid neurodevelopmental and psychosocial changes. Increasing attention has therefore been directed toward possible associations between AD and neurodevelopmental disorders, particularly attention-deficit/hyperactivity disorder (ADHD). This relationship is clinically important because both disorders commonly begin early in life, may persist for extended periods, can negatively affect family

Health Nexus
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functioning, and may contribute to academic, social, and behavioral impairment.

ADHD is a neurodevelopmental disorder characterized by developmentally inappropriate and persistent patterns of inattention and/or hyperactivity-impulsivity that interfere with functioning across important settings. Difficulties in behavioral inhibition, sustained attention, executive control, self-regulation, planning, and delayed gratification are central to many theoretical accounts of ADHD. The behavioral inhibition model emphasizes impaired inhibitory control and related deficits in self-regulatory processes as important mechanisms underlying ADHD symptoms (9). These impairments may manifest in the classroom, at home, and in social interactions, and their consequences can extend beyond overt hyperactive behavior. Research among children with ADHD has demonstrated difficulties in higher-order social-cognitive processes such as theory of mind, further illustrating that ADHD may influence interpersonal understanding as well as attention and behavioral regulation (10).

The psychosocial consequences of ADHD can also involve the family system. ADHD symptoms in children may increase parental stress, require substantial behavioral management, and interact with parental psychological characteristics. Research examining parents of children with ADHD has documented the relevance of ADHD and personality-related characteristics within the family context, underscoring the broader familial dimensions of the disorder (11). At the same time, psychological and behavioral interventions can improve core symptoms. Positive parenting programs have been reported to reduce inattention and hyperactivity-impulsivity among children with ADHD (12), while therapeutic approaches such as sand play therapy have also been investigated for reducing hyperactivity, inattention, and anxiety symptoms (13). Consequently, early identification of ADHD is important because appropriate recognition and intervention may reduce functional impairment and improve developmental outcomes.

The potential association between AD and ADHD has received increasing scientific attention over the past decade. One of the important Iranian studies in this field reported an association between ADHD and AD among children, providing local evidence that the relationship observed internationally may also be relevant within the Iranian population (14). Similar findings have emerged from studies conducted in other populations. Among Chinese children aged 6–12 years, AD has been associated with increased symptoms of attention deficit, hyperactivity, and oppositional defiance (15). Longitudinal evidence has further suggested that childhood AD may precede the subsequent development of ADHD, raising the possibility that AD is not merely coincident with ADHD but may function as an early marker or contributing factor in a subgroup of children (16). The association is not necessarily limited to childhood; research in adults using the large United States “All of Us” Research Program also identified an association between AD and ADHD (17). These findings suggest that the relationship may persist across developmental stages.

Evidence from systematic reviews and meta-analyses has strengthened the epidemiological basis for this association. A systematic review and meta-analysis examining the relationships of AD with ADHD and autism spectrum disorder concluded that AD is significantly associated with neurodevelopmental conditions, including ADHD (18). More recent meta-analytic evidence has specifically evaluated the potential bidirectional association between AD and ADHD, suggesting that the relationship may operate in both directions rather than representing a simple unidirectional pathway (19). Such findings are important because they imply shared risk factors or reciprocal mechanisms. Children with chronic AD may become more vulnerable to attention and behavioral difficulties through inflammatory, sleep-related, or psychosocial pathways, whereas ADHD-related behaviors and self-regulatory problems may complicate adherence to dermatological treatment, scratching control, sleep routines, and other disease-management behaviors.

Several mechanisms have been proposed to explain the relationship between AD and ADHD. Sleep disturbance is among the most plausible. Children with active AD frequently experience nocturnal itching and scratching, which may fragment sleep and reduce restorative sleep duration. Chronic insufficient or disrupted sleep can produce daytime inattention, impulsivity, irritability, and hyperactivity-like behavior, potentially worsening pre-existing ADHD symptoms or contributing to ADHD-like clinical presentations. Psychological stress represents

Health Nexus
E-ISSN: 2981-2569

another possible pathway. Chronic visible skin disease can lead to embarrassment, social difficulties, reduced self-esteem, emotional distress, and family strain, all of which may interfere with behavioral regulation (2). Because sleep disturbance and psychological distress can themselves exacerbate itching and inflammatory responses, these mechanisms may form mutually reinforcing cycles rather than isolated causal processes.

Another increasingly investigated mechanism concerns systemic inflammation and communication between the immune system and the central nervous system. AD is characterized by altered cytokine signaling, particularly pathways involving type 2 inflammation, and inflammatory mediators may influence neural development and neurobehavioral functioning. The concept of a skin–brain axis proposes that immune signals originating in the skin may interact with neural, endocrine, and behavioral pathways. Recent work has specifically explored the potential importance of interleukin-4 signaling in the comorbidity between childhood AD and ADHD and has proposed targeted IL-4-related mechanisms as a possible therapeutic avenue through modulation of the skin–brain axis (20). Although these mechanistic models remain under investigation, they provide a biologically plausible framework linking chronic peripheral inflammation with neurodevelopmental symptoms.

The severity and longitudinal course of AD may be particularly relevant to the likelihood of ADHD. If chronic inflammation, recurrent pruritus, sleep disruption, and psychosocial stress contribute cumulatively to neurobehavioral symptoms, children with more persistent or severe disease would be expected to demonstrate a greater burden of ADHD symptoms. Recent cross-sectional evidence supports this possibility. Assessment of ADHD symptoms across different levels of AD severity has indicated that the expression of attention-deficit/hyperactivity symptoms may vary according to dermatological disease severity (21). This relationship has important clinical implications because disease severity may help clinicians identify patients who would benefit most from psychological or behavioral screening rather than applying the same level of surveillance to all patients.

Longitudinal patterns may provide additional information beyond disease severity at a single point in time. Childhood AD is heterogeneous: some children experience early transient disease, whereas others develop persistent, recurrent, or progressively changing symptom trajectories. Recent research examining trajectories of childhood AD found that different longitudinal patterns of disease were associated with subsequent ADHD, suggesting that the duration and developmental timing of exposure to atopic inflammation may be important (22). Such findings complement evidence identifying childhood AD as a potential precursor of ADHD (16) and support the need to examine not only whether AD is present but also its clinical intensity and course.

Despite increasingly consistent evidence of an association, important questions remain regarding the magnitude of ADHD prevalence among children with AD in different populations. Prevalence estimates may vary because of differences in study design, sampling procedures, diagnostic criteria, age distribution, disease severity, cultural context, and instruments used to assess ADHD. Some studies use formal psychiatric diagnoses, whereas others use standardized parent- or teacher-report rating scales. Moreover, differences in access to healthcare, awareness of behavioral symptoms, family reporting practices, and dermatological treatment may affect observed prevalence. The heterogeneity reported across individual studies reinforces the need for population-specific research rather than direct extrapolation of estimates derived from other countries or healthcare systems (18, 19).

The Iranian context is especially relevant because local research has documented both the clinical burden of AD and the presence of an association between AD and ADHD (14). Nevertheless, evidence remains limited across different geographical regions of Iran. The country includes substantial variation in climate, environmental exposures, socioeconomic characteristics, healthcare accessibility, population composition, and patterns of allergic disease. Studies from different Iranian settings have investigated the epidemiology, severity, and treatment of AD (5-8), but findings from one region cannot necessarily be generalized to another. Zahedan, as a major healthcare center in southeastern Iran, serves children from diverse demographic and socioeconomic backgrounds, yet region-specific information regarding the coexistence of AD and ADHD remains limited.

Health Nexus
E-ISSN: 2981-2569

Determining ADHD prevalence among children with AD has practical implications for both dermatological and psychological care. Failure to recognize ADHD may lead clinicians and parents to attribute inattention, restlessness, irritability, or academic difficulties solely to sleep disturbance or chronic illness, while overlooking an underlying neurodevelopmental disorder. Conversely, behavioral difficulties associated with ADHD may interfere with treatment adherence and symptom management in AD. A child with impaired impulse control may find it more difficult to resist scratching, follow skin-care routines, take medications consistently, or avoid known triggers. Such interactions illustrate why integrated assessment can be clinically valuable and why the association between these conditions should not be viewed solely as an epidemiological observation.

Moreover, identifying demographic and clinical correlates of ADHD within the AD population may improve targeted screening. Sex is particularly relevant because ADHD is more frequently recognized in boys, especially when hyperactive and impulsive behaviors are prominent. Age may also influence symptom presentation and detection, while disease severity could reflect cumulative inflammatory and sleep-related burden. Examining these variables simultaneously can therefore provide a more clinically informative picture of ADHD distribution among children with AD. International findings indicating increased ADHD symptoms among children with AD (15), evidence of severity-related differences (21), longitudinal associations between AD trajectories and ADHD (22), and meta-analytic evidence of a bidirectional relationship (19) collectively underscore the importance of investigating these relationships within specific clinical populations.

From a broader conceptual perspective, the coexistence of AD and ADHD exemplifies the increasing recognition that boundaries between dermatological, immunological, and psychiatric conditions are not absolute. Chronic inflammatory diseases can influence psychological functioning, and psychological or neurodevelopmental characteristics can, in turn, affect the experience, management, and potentially the course of physical illness. Contemporary models of AD therefore emphasize multidisciplinary care that takes account of psychological well-being in addition to skin symptoms (1, 2). Emerging mechanistic research on immune–brain communication further strengthens this integrated perspective and may eventually contribute to interventions targeting shared biological pathways (20). Until such mechanisms are more clearly established, epidemiological studies remain essential for identifying the populations most likely to experience clinically meaningful comorbidity.

Accordingly, generating local evidence concerning ADHD among children and adolescents with AD may contribute to earlier recognition, appropriate referral, improved family education, and more comprehensive management. Standardized screening instruments can provide a feasible method for detecting children with clinically relevant symptoms who may require more detailed psychological or psychiatric assessment. In a region where data on this particular comorbidity are scarce, determining prevalence and examining differences according to demographic and dermatological characteristics may also provide a basis for future longitudinal and mechanistic investigations.

Therefore, the present study aimed to determine the prevalence of attention-deficit/hyperactivity disorder among patients with atopic dermatitis attending healthcare centers in Zahedan and to examine its distribution according to sex, age, and disease severity.

2. Methods and Materials

3. 3.1. Research Procedure

The present research was a descriptive cross-sectional study conducted in the teaching hospitals of Zahedan during 2022–2023. Following approval of the research proposal by the Vice-Chancellery for Research and Technology and the Ethics Committee of Zahedan University of Medical Sciences and after obtaining the necessary permissions, data collection commenced. At the beginning of the study, the necessary coordination was established with the authorities of the participating centers, and the objectives of the research were explained to them. Eligible participants were subsequently identified, and the objectives of the study and confidentiality of the information were explained to the patients and their parents. If they agreed to participate, written informed consent was obtained from the parents. The Conners questionnaire was then completed by the parents,

Health Nexus
E-ISSN: 2981-2569

and information regarding each patient's age, sex, and disease severity was recorded.

4. 3.2. Study Population and Sampling Method

The study population consisted of all patients with atopic dermatitis who attended the teaching hospitals of Zahedan during 2022–2023. Convenience sampling was used, and a total of 60 patients with atopic dermatitis were enrolled in the study. The inclusion criteria were age 7–18 years, physician-confirmed diagnosis of atopic dermatitis, and informed consent from the patients and their parents. In practice, the oldest eligible participant was 16 years of age; therefore, the age range of the final sample was 7–16 years. The exclusion criteria included incomplete completion of the questionnaire and the presence of any underlying psychiatric or neurological disorder, such as cerebral palsy, autism, epilepsy, or intellectual disability. Adherence to these criteria helped ensure greater homogeneity of the sample regarding comorbid conditions that could affect the primary study variable.

5. 3.3. Data Collection Method and Instruments

The primary data collection instruments consisted of a demographic information form including age and sex and the standardized Conners Parent Rating Scale. This 26-item scale is scored on a four-point Likert scale ranging from "never" to "very much" and assesses symptoms of attention-deficit/hyperactivity disorder. Total scores range from 26 to 104, and a score above 34 was considered indicative of ADHD. Completion of the questionnaire by the parents took approximately 10–15 minutes. The severity of atopic dermatitis was also assessed through physician observation according to the Eczema Area and Severity Index (EASI) criteria and was recorded across six severity grades.

6. 3.4. Validity and Reliability of the Instrument

The Conners Rating Scale is a standardized international instrument whose validity and reliability have been confirmed in numerous studies conducted in different countries. The reliability coefficient of the scale was reported to be .90 in the study by Conners et al. (1998). The validity coefficient of the Persian version was also reported to be .85 by Alizadeh through the Institute for Cognitive Science Studies (Alizadeh, 2005). These values indicate that the instrument has adequate psychometric properties for assessing ADHD symptoms in the target population.

7. 3.5. Data Analysis

The collected data were entered into SPSS version 24 and subjected to statistical analysis. Frequency distribution tables were used to describe qualitative variables, while measures of central tendency and dispersion, including the mean and standard deviation, were used to describe quantitative variables. The prevalence of ADHD was estimated using point estimates and 95% confidence intervals, and these estimates were also reported for sex and age subgroups. The chi-square test and Fisher's exact test were used to compare proportions between groups, and the significance level was set at $p < .05$ for all analyses. This study was approved by the Ethics Committee of Zahedan University of Medical Sciences under ethics code IR.ZAUMS.REC.1401.258.

8. Findings and Results

In this study, 60 children with atopic dermatitis who attended teaching hospitals and selected private clinics in Zahedan during 2022–2023 were examined. The children ranged in age from 7 to 16 years, with a mean age of 8.01 years and a standard deviation of 4.1 years. Regarding age distribution, 41 children (68.3%) were aged 10 years or younger, whereas 19 children (31.7%) were older than 10 years. Regarding sex distribution, 38 children (63.3%) were boys and 22 (36.7%) were girls. The demographic characteristics and distribution of disease severity according to the EASI criteria are presented in Table 1.

Table 1

Frequency Distribution of Demographic and Clinical Characteristics of Patients With Atopic Dermatitis

Variable	Subgroup	Frequency	Percentage
Sex	Boys	38	63.3
	Girls	22	36.7
Age	10 years or younger	41	68.3
	Older than 10 years	19	31.7
Disease severity (EASI)	Grade 1	12	20.0

Health Nexus
E-ISSN: 2981-2569

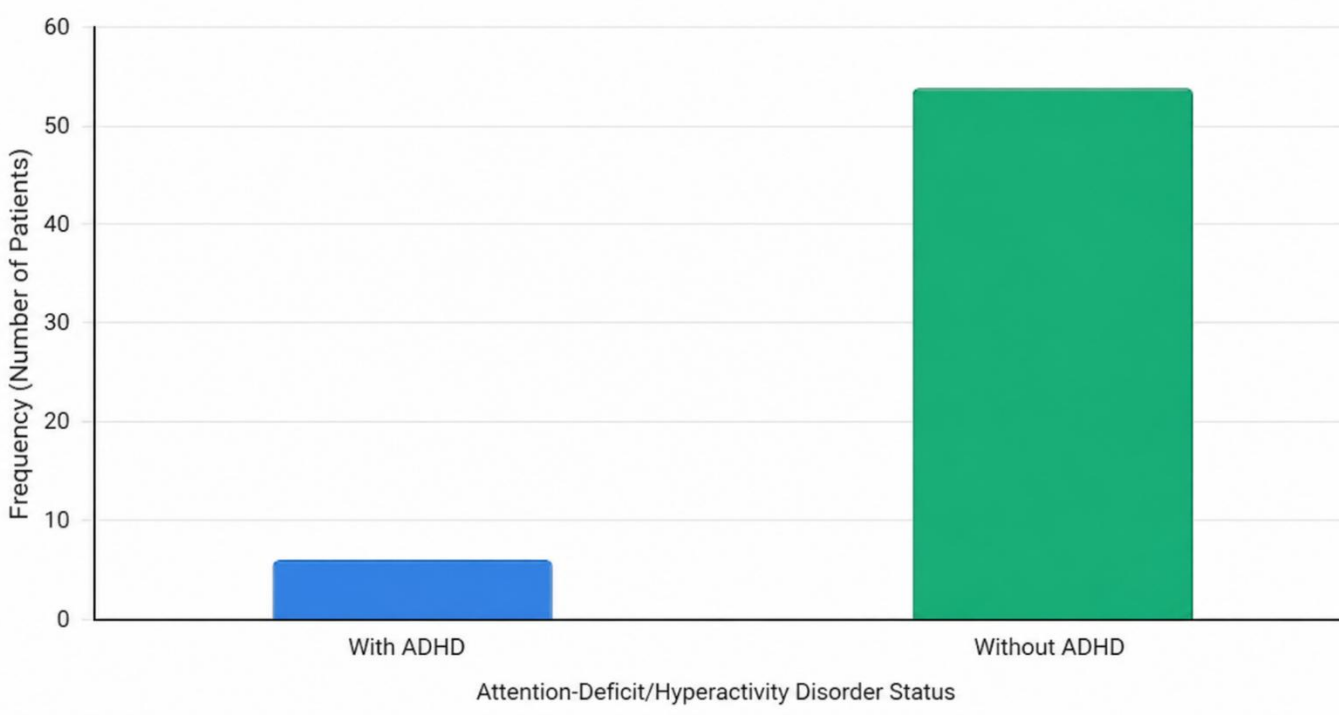
	Grade 2	18	30.0
	Grade 3	15	25.0
	Grade 4	10	16.7
	Grade 5	2	3.3
	Grade 6	3	5.0
Total		60	100

The results presented in Table 1 showed that most patients were boys and were aged 10 years or younger. Regarding disease severity, Grade 2 had the highest frequency, with 18 patients, followed by Grade 3, with 15 patients. In total, 45 patients had disease severity of Grade 3 or lower, whereas 15 patients had disease severity of Grade 4 or higher. This distribution indicates that most patients had mild-to-moderate disease severity, while severe cases were less frequent.

The Conners CPRS-26 was used to assess ADHD. This scale consists of 26 items rated on a four-point Likert scale and has a total score range of 26–104. Children who obtained a score above 34 were classified as having ADHD. The frequency distribution of ADHD among children with atopic dermatitis is shown in Figure 1. The findings indicated that the prevalence of ADHD among these children was 10%, with 6 of the 60 patients classified as having the disorder. The overall mean questionnaire score was 59.3, with a standard deviation of 11.2. This mean indicates that the scores of most patients were below the diagnostic threshold for the disorder.

Figure 1

Frequency distribution of attention-deficit/hyperactivity disorder among children with atopic dermatitis attending healthcare centers in Zahedan.



One of the objectives of this study was to compare the prevalence of ADHD between boys and girls. The frequency distribution of ADHD among patients with atopic dermatitis according to sex is presented in Table 2. Fisher's exact test was used to determine whether the difference between the two groups was statistically significant. This analysis allowed comparison of the proportion of affected individuals between girls and boys.

Health Nexus
E-ISSN: 2981-2569

Table 2

Frequency Distribution of Attention-Deficit/Hyperactivity Disorder Among Patients With Atopic Dermatitis According to Sex

Sex	ADHD Present, *n* (%)	ADHD Absent, *n* (%)	Total, *n* (%)
Girls	1 (4.5)	21 (95.5)	22 (100)
Boys	5 (13.1)	33 (86.9)	38 (100)
Total	6 (10)	50 (90)	60 (100)

The results presented in Table 2 showed that the prevalence of ADHD was 4.5% among girls and 13.1% among boys. Of the 22 girls, only 1 had ADHD, whereas 5 of the 38 boys had the disorder. Fisher's exact test indicated that the prevalence of ADHD was significantly higher among boys than among girls ($p = .021$). This finding suggests that male sex was associated with an increased likelihood of ADHD among patients with atopic dermatitis. Therefore, the first research hypothesis concerning differences in prevalence according to sex was supported.

The second comparison in this study examined the prevalence of ADHD according to age group. The frequency distribution of ADHD among patients with atopic dermatitis according to age is presented in Table 3. Patients were divided into two age groups: 10 years or younger and older than 10 years. Fisher's exact test was used to determine whether the difference between the two age groups was statistically significant.

Table 3

Frequency Distribution of Attention-Deficit/Hyperactivity Disorder Among Patients With Atopic Dermatitis According to Age

Age Group	ADHD Present, *n* (%)	ADHD Absent, *n* (%)	Total, *n* (%)
10 years or younger	4 (9.7)	37 (90.3)	41 (100)
Older than 10 years	2 (10.5)	17 (89.5)	19 (100)
Total	6 (10)	50 (90)	60 (100)

The results presented in Table 3 showed that the prevalence of ADHD was 9.7% among children aged 10 years or younger and 10.5% among children older than 10 years. Of the 41 children in the younger age group, 4 had ADHD, whereas 2 of the 19 children in the older age group had the disorder. Fisher's exact test indicated that the difference in ADHD prevalence between the two age groups was not statistically significant ($p = .72$). This finding suggests that age did not have a significant role in differences in ADHD prevalence among patients with atopic dermatitis. Therefore, the second research hypothesis concerning differences in prevalence according to age was not supported.

In addition to sex and age, the prevalence of ADHD was examined according to the severity of atopic dermatitis. The frequency distribution of ADHD according to disease severity is presented in Table 4. Based on the EASI criteria, patients were divided into two groups: Grade 3 or lower and Grade 4 or higher. Fisher's exact test was used to determine whether the difference between the two groups was statistically significant.

Table 4

Frequency Distribution of Attention-Deficit/Hyperactivity Disorder Among Patients With Atopic Dermatitis According to Disease Severity

Disease Severity	ADHD Present, *n* (%)	ADHD Absent, *n* (%)	Total, *n* (%)
Grade 3 or lower	3 (6.7)	42 (93.3)	45 (100)
Grade 4 or higher	3 (20.0)	12 (80.0)	15 (100)
Total	6 (10)	50 (90)	60 (100)

Health Nexus
E-ISSN: 2981-2569

The results presented in Table 4 showed that the prevalence of ADHD was 6.7% among patients with disease severity of Grade 3 or lower and 20% among patients with disease severity of Grade 4 or higher. Of the 45 patients in the lower-severity group, 3 had ADHD, whereas 3 of the 15 patients in the higher-severity group had the disorder. Fisher's exact test indicated a statistically significant difference in the prevalence of ADHD according to disease severity (p = .01). This finding indicates that the prevalence of ADHD increased as the severity of atopic dermatitis increased. Therefore, disease severity was identified as a factor associated with the likelihood of ADHD.

9. Discussion and Conclusion

The present study investigated the prevalence of attention-deficit/hyperactivity disorder (ADHD) among children and adolescents with atopic dermatitis (AD) attending healthcare centers in Zahedan and examined differences according to sex, age, and disease severity. The findings showed that 10% of the patients with AD met the study criterion for ADHD based on the Conners Parent Rating Scale. ADHD was identified in 13.1% of boys compared with 4.5% of girls, and this difference was statistically significant (p = .021). In contrast, the prevalence of ADHD was very similar across the two age groups, with rates of 9.7% among children aged 10 years or younger and 10.5% among those older than 10 years; this difference was not statistically significant (p = .72). Disease severity was also significantly associated with ADHD: the prevalence was 6.7% among patients with AD severity of Grade 3 or lower and 20% among those with Grade 4 or higher (p = .01). Overall, these results indicate that ADHD symptoms constitute a clinically relevant comorbidity among children with AD and that male sex and greater dermatological disease severity may be associated with a higher probability of ADHD in this population.

The overall finding that 10% of children with AD had ADHD is consistent with a growing body of evidence demonstrating an association between dermatological inflammation and neurodevelopmental disorders. In an Iranian pediatric sample, Atefi et al. reported a significant association between ADHD and AD, suggesting that the coexistence of the two conditions is also observable within the Iranian clinical context (14). International evidence provides similar support. Feng et al. found increased attention-deficit/hyperactivity and oppositional-defiant symptoms among Chinese children aged 6–12 years with AD (15). Likewise, Xu et al. reported that childhood AD may precede the development of ADHD, suggesting that AD may represent an early risk marker for later attention and behavioral difficulties (16). The present finding therefore corresponds with previous epidemiological observations indicating that children with AD may have a greater burden of ADHD-related symptoms than would be expected if the two disorders were completely independent.

The consistency of this finding with systematic evidence further strengthens its interpretation. Cheng et al., in a systematic review and meta-analysis, demonstrated an association between AD and neurodevelopmental disorders, including ADHD (18). More recently, Wang et al. reported evidence for a bidirectional association between AD and ADHD, indicating that the relationship may not simply reflect AD preceding ADHD but may involve shared vulnerabilities and reciprocal effects (19). Evidence from adults also suggests that this association is not necessarily limited to childhood. Fan et al. identified an association between AD and ADHD among adults in the United States "All of Us" Research Program (17). Taken together, these findings suggest that the 10% prevalence observed in the present study is compatible with a broader pattern in which AD is accompanied by an elevated burden of attention and behavioral difficulties across different populations and developmental periods.

Several mechanisms may explain this association. One of the most plausible is chronic pruritus and the resulting disruption of sleep. Children with AD frequently experience nocturnal itching and scratching, which can interfere with sleep continuity and reduce restorative sleep. Persistent sleep disturbance may subsequently impair sustained attention, inhibitory control, emotional regulation, and daytime behavioral functioning. These manifestations can overlap with or intensify ADHD symptoms. The psychological burden of AD may also contribute to this process. AD is increasingly understood as a disorder with substantial psychological consequences rather than merely a disease of the skin (2). Persistent itching, recurrent visible lesions, treatment demands, and restrictions on everyday activities may contribute to distress, irritability, and difficulties with

Health Nexus
E-ISSN: 2981-2569

self-regulation. Mesjasz et al. similarly emphasized that AD should not be conceptualized solely as a cutaneous disorder because its systemic inflammatory processes and comorbidities extend beyond the skin (1). These perspectives provide a plausible framework for understanding why neurobehavioral problems may be relatively common among affected children.

The neurobehavioral characteristics of ADHD itself may further clarify why sleep disruption and chronic discomfort associated with AD are clinically important. ADHD involves impairments in behavioral inhibition and self-regulatory processes, including difficulties controlling attention, delaying responses, and organizing behavior (9). Children who already have vulnerabilities in these domains may be particularly sensitive to the cognitive consequences of insufficient sleep or persistent physical discomfort. Moreover, ADHD is associated with broader difficulties in social cognition and interpersonal functioning, as demonstrated by studies reporting impaired theory of mind among children with ADHD (10). Therefore, when AD and ADHD occur together, the cumulative effects may influence not only symptom burden but also academic performance, family functioning, peer relationships, and overall quality of life.

A particularly important finding of the present study was the significantly higher prevalence of ADHD among boys than among girls. ADHD was identified in 13.1% of boys compared with 4.5% of girls. This result is compatible with the well-established clinical observation that ADHD is more commonly recognized among boys, particularly because hyperactive and impulsive manifestations are often more externally visible in boys. In contrast, girls may more frequently exhibit less disruptive patterns dominated by inattention, which may be underrecognized by parents or healthcare professionals. The behavioral presentation of ADHD may therefore influence screening results based on parental observations. Previous Iranian research has also emphasized the heterogeneity of ADHD manifestations and their relationships with familial and behavioral variables (11). The significant sex difference observed in the present study may consequently reflect both genuine sex-related differences in ADHD vulnerability and differences in symptom recognition.

The finding regarding sex may also have practical implications for screening children with AD. Because behavioral dysregulation, impulsivity, and hyperactivity can interfere with adherence to treatment instructions, children with concurrent ADHD may experience additional challenges in controlling scratching, applying topical medications consistently, following skin-care routines, and avoiding known triggers. At the same time, it is important not to assume that the lower prevalence observed among girls indicates absence of clinically relevant symptoms. Girls with predominantly inattentive manifestations may remain undetected if screening focuses primarily on overt hyperactivity. Evidence that parenting-based interventions can improve both inattention and hyperactivity-impulsivity further underscores the importance of recognizing the full range of ADHD symptoms rather than restricting assessment to disruptive behavior (12). Likewise, behavioral interventions such as sand play therapy have been investigated for reducing hyperactivity, inattention, and anxiety in children with ADHD (13), illustrating the potential benefits of identifying affected children and facilitating appropriate intervention.

In contrast to sex, age was not significantly associated with ADHD prevalence in the present sample. The prevalence was 9.7% among children aged 10 years or younger and 10.5% among those older than 10 years, indicating an almost identical distribution between the two age groups. This finding suggests that within the 7–16-year age range examined in this study, the coexistence of ADHD and AD may not be strongly dependent on chronological age. One possible explanation is that both conditions generally emerge relatively early in development and may persist across childhood and adolescence. Therefore, when children with established AD are assessed during school age, age differences within this range may be less influential than other variables such as disease severity, persistence, sleep disturbance, or individual biological susceptibility.

Recent longitudinal findings provide an important context for interpreting the lack of an age effect. Zhang et al. demonstrated that trajectories of childhood AD were associated with ADHD, suggesting that the longitudinal pattern of the dermatological condition may be more informative than age alone (22). Similarly, Xu et al. identified childhood AD as a possible precursor to

Health Nexus
E-ISSN: 2981-2569

subsequent ADHD (16). These studies imply that timing, persistence, and cumulative exposure to inflammatory disease may be more relevant than a simple cross-sectional division of children into younger and older groups. Thus, the absence of a significant age difference in the present study does not necessarily indicate that developmental processes are unimportant; instead, it may indicate that chronological age alone is an insufficient marker of the developmental relationship between AD and ADHD.

The most clinically notable finding was the relationship between AD severity and ADHD prevalence. ADHD was observed in 20% of patients with Grade 4 or higher AD compared with only 6.7% of those with Grade 3 or lower disease severity. This substantial difference suggests that increasing dermatological severity may be accompanied by increasing neurobehavioral burden. The result is closely aligned with the findings of Molla et al., who specifically examined ADHD symptoms according to AD severity and demonstrated that ADHD-related manifestations vary with the severity of dermatological disease (21). Therefore, the present study adds region-specific evidence supporting the proposition that children with more severe AD represent an especially important group for ADHD screening.

Several mechanisms may contribute to the association between greater AD severity and higher ADHD prevalence. More severe disease is generally accompanied by greater pruritus, larger areas of affected skin, recurrent exacerbations, and greater disruption of sleep and daily activities. As the frequency and intensity of nocturnal symptoms increase, cumulative sleep loss may become more pronounced, which may negatively affect attention and inhibitory control. Severe AD may also impose a greater psychological burden through visible skin lesions, frustration related to persistent symptoms, and increased treatment demands. Research examining the psychological dimensions of AD indicates that disease burden is closely connected with mental and emotional functioning (2). Iranian research examining depression among patients with AD likewise reflects the importance of considering psychological symptoms alongside dermatological manifestations (3). Consequently, the association observed between disease severity and ADHD in the present study may reflect the combined influence of inflammatory, sleep-related, and psychological mechanisms.

Biological pathways may also be involved. AD is characterized by chronic immune activation, and growing evidence suggests that inflammatory mediators can influence central nervous system functioning. Recent work has proposed the skin–brain axis as a potential mechanism connecting cutaneous inflammation with neurodevelopmental and behavioral manifestations. Zhou et al. specifically highlighted the potential role of IL-4-related signaling in the comorbidity between AD and ADHD and discussed targeted IL-4 therapy as a possible approach to this comorbidity through modulation of the skin–brain axis (20). Although the present cross-sectional study cannot establish such biological mechanisms, the substantially higher prevalence of ADHD among children with more severe AD is compatible with the hypothesis that greater inflammatory activity may be associated with greater neurobehavioral vulnerability.

Other biological factors associated with AD severity may indirectly contribute to this relationship. Houshmand et al. examined vitamin D3 levels in infants and children with AD and reported an association between vitamin D3 status and disease severity (5). Although vitamin D was not assessed in the present investigation, such findings illustrate that AD severity is influenced by broader biological factors that may themselves have implications for neurological and psychological functioning. Similarly, research examining genetic susceptibility to atopic dermatitis has demonstrated the biological complexity of atopic phenotypes (4). These lines of evidence suggest that the association between severe AD and ADHD may arise from a combination of immune, genetic, environmental, and behavioral pathways rather than a single causal factor.

The observed severity relationship also has implications for dermatological treatment. Effective control of AD symptoms may potentially reduce some of the secondary factors that exacerbate behavioral difficulties, particularly itching and sleep disruption. Clinical investigations in Iran have explored treatments designed to improve AD symptoms, including topical preparations containing oat and chamomile extracts (6) and combined oral melatonin and topical betamethasone therapy (7). The investigation of melatonin is particularly relevant because sleep disturbance represents one of the proposed pathways between AD and behavioral symptoms. Nevertheless, the present findings

Health Nexus
E-ISSN: 2981-2569

should not be interpreted as demonstrating that dermatological treatment alone can prevent or resolve ADHD. Rather, they highlight the need for coordinated assessment because primary ADHD and behavioral manifestations secondary to sleep disruption may coexist and require different clinical responses.

The findings also reinforce the broader concept that AD frequently occurs within a pattern of comorbidity. Darabi et al. documented associations between AD and respiratory allergic diseases in an Iranian population (8), while systematic evidence has expanded this comorbidity framework to include neurodevelopmental conditions (18). From this perspective, clinical evaluation of AD should extend beyond the severity of skin lesions and incorporate attention to allergic, psychological, behavioral, and developmental factors. This multidimensional approach may be particularly important in pediatric populations because difficulties with attention and impulse control can affect treatment adherence, educational functioning, family relationships, and the child's ability to cope with chronic disease.

Overall, the findings of the present study are consistent with the accumulating evidence that AD and ADHD are meaningfully associated. The observed 10% prevalence supports previous Iranian and international findings demonstrating increased ADHD-related symptoms among individuals with AD (14, 15). The significant relationship with disease severity is particularly consistent with recent severity-based research (21) and with broader models emphasizing cumulative inflammatory and psychosocial burden. The absence of a significant age difference may indicate that disease trajectory and severity are more informative than chronological age alone, as suggested by longitudinal studies (22). Finally, the significantly higher prevalence among boys emphasizes the importance of considering sex-related differences in ADHD presentation while remaining alert to potentially underrecognized inattentive symptoms among girls. Collectively, these findings support an integrated dermatological and psychological perspective in the evaluation of children with AD.

Several limitations should be considered when interpreting the findings of this study. First, the relatively small sample size of 60 patients limits statistical power, particularly for subgroup analyses based on sex, age, and disease severity. Second, convenience sampling from teaching hospitals and selected healthcare settings in Zahedan may limit the generalizability of the findings to all children with atopic dermatitis in the region or to populations in other parts of Iran. Third, the cross-sectional design does not permit conclusions regarding causal or temporal relationships between atopic dermatitis and ADHD. Fourth, ADHD status was determined using a parent-report rating scale rather than a comprehensive clinical diagnostic interview conducted by a child and adolescent psychiatrist or psychologist. Parent-reported symptoms may be influenced by parental perceptions, expectations, or awareness of behavioral difficulties. Fifth, potentially important confounding variables such as sleep quality, duration of atopic dermatitis, age at disease onset, medication use, socioeconomic status, family psychiatric history, allergic comorbidities, and severity of pruritus were not assessed. Finally, dividing disease severity and age into broad categories may have reduced the ability to detect more subtle dose-response or developmental patterns.

Future studies should recruit larger and more representative samples from multiple hospitals, outpatient clinics, schools, and geographical regions to improve the generalizability and precision of prevalence estimates. Longitudinal cohort designs are recommended to clarify the temporal direction of the relationship between atopic dermatitis and ADHD and to determine whether persistent or severe atopic dermatitis predicts the subsequent emergence or worsening of ADHD symptoms. Future research should also combine standardized rating scales with structured clinical interviews and, where possible, teacher reports to improve diagnostic accuracy. Important potential mediators and moderators—including sleep quality, nocturnal pruritus, inflammatory biomarkers, disease duration, age at onset, treatment adherence, family psychiatric history, allergic comorbidities, vitamin D status, psychological distress, and socioeconomic factors—should be examined. Investigating distinct trajectories of atopic dermatitis and different ADHD presentations may also provide a more detailed understanding of which children are at greatest risk. Intervention studies could additionally determine whether successful control of severe atopic dermatitis and improvement of sleep are associated with

Health Nexus
E-ISSN: 2981-2569

subsequent changes in attention, hyperactivity, and behavioral functioning.

Healthcare professionals treating children and adolescents with atopic dermatitis should consider routine behavioral and psychological screening as part of comprehensive clinical care, particularly when the skin disease is severe, persistent, or accompanied by substantial sleep disturbance. Greater attention may be warranted for boys because of the higher prevalence observed in this study, while clinicians should also remain alert to less conspicuous inattentive symptoms among girls. Brief parent-report screening tools may be incorporated into dermatology or pediatric visits to identify patients who require more comprehensive evaluation by mental health professionals. Parents should be educated about the possible coexistence of attention, behavioral, sleep, and dermatological problems and encouraged to report difficulties in school performance, concentration, impulse control, or daily functioning. Collaboration among dermatologists, pediatricians, child and adolescent mental health professionals, and families may facilitate earlier identification of comorbid ADHD, improve treatment adherence, reduce the psychosocial burden of chronic skin disease, and support more integrated management of affected children.

Authors' Contributions

All authors contributed substantially to the study and to manuscript development, and all approved the final version.

Declaration

The authors declare that artificial intelligence tools were used only to assist with language editing, translation, and improvement of the manuscript's readability. All conceptualization, study design, data collection, data analysis, interpretation of findings, and final approval of the manuscript were performed by the authors. The authors take full responsibility for the accuracy, integrity, and originality of the content.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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Declaration of Interest

The authors report no conflict of interest.

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Ethics Considerations

The study placed a high emphasis on ethical considerations. Informed consent obtained from all participants, ensuring they are fully aware of the nature of the study and their role in it. Confidentiality strictly maintained, with data anonymized to protect individual privacy. The study adhered to the ethical guidelines for research with human subjects as outlined in the Declaration of Helsinki.

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Health Nexus
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Health Nexus
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