BEYOND THE SURFACE: HOW SKIN DISORDERS AFFECT MENTAL HEALTH IN INDIVIDUALS WITH AUTISM SPECTRUM DISORDER.

by Jana Publication & Research

Submission date: 18-Aug-2025 12:22PM (UTC+0700)
Submission ID: 2690338851
File name: IJAR-53367.docx (891.13K)
Word count: 10277
Character count: 62095

BEYOND THE SURFACE: HOW SKIN DISORDERS AFFECT MENTAL HEALTH IN INDIVIDUALS WITH AUTISM SPECTRUM DISORDER.

Manuscript Info

Manuscript History
Received: xxxxxxxxxxxxxxx
Final Accepted: xxxxxxxxxxx
Published: xxxxxxxxxxxxxxx

Key words:-
Autism spectrum disorder, Skin disease, Inflammation, Psychosocial health

Abstract

Autism spectrum disorder (ASD) is a common, multifaceted neurodevelopmental disorder that can manifest in many ways and varying levels of severity. Research has demonstrated that there is a higher level of inflammation in individuals with ASD, linking it with epidermal dysfunction, most commonly atopic dermatitis and eczema. It has been indicated that there is an upregulation of neuroinflammation and insulin-like growth factors as well as increased activation of astrocytes in the brain, indicating a sign of chronic inflammation. Additionally, elevated levels of circulating inflammatory cytokines have been observed.

In addition to heightened inflammatory pathways, there are elevated challenges when treating patients who have ASD due to behavioral differences and sensory processing difficulties. Individuals with ASD may be rigid in their behaviors, favoring a specific routine with resistance to change. ASD may also come with atypical sensory processing, leading to discomfort with recommended physical exams, procedures, and medications.

This intersection creates a feedback loop in which inflammation increases the prevalence of dermatologic conditions, while behavioral and sensory differences complicate treatment; together, these factors ultimately impact psychological well-being, including self-esteem, anxiety, and overall quality of life. Skin discomfort, visible lesions, and social stigma surrounding certain dermatologic conditions can exacerbate anxiety and lower self-esteem. As a provider, it is essential to adapt, welcome open communication, and set boundaries with patients and their families to create a positive impact on patients' psychosocial development.

Introduction:-

Autism spectrum disorder (ASD) is a heterogeneous neurodevelopmental condition defined by persistent difficulties in social communication and the presence of restricted, repetitive patterns of behavior. According to the U.S. Autism and Developmental Disabilities Monitoring (ADDM) Network, 1 in 36 eight-year-olds met diagnostic criteria in 2020, representing a nearly fivefold increase since 2000 [1]. Similar upward trends have been reported worldwide [1]. A recent three-level meta-analysis, which combined data from 99 studies across six continents, now estimates that ASD affects roughly 0.7–1% of the global population [2]. As prevalence climbs, attention has shifted toward the somatic comorbidities that shape day-to-day functioning and quality of life for people with autism, most notably disorders of the skin.

Inflammatory dermatoses are seen to be over-represented in ASD. Atopic dermatitis (AD) occurs in roughly 28% of autistic children versus 15% of neurotypical peers, while over 50% of autistic cohorts meet criteria for at least one allergic condition [3]. Psoriasis shows a similar pattern. The Kaiser Permanente database revealed a 1.5-fold elevation in pediatric psoriasis among ASD cases (0.34% vs. 0.15%) [4]. Hyperpigmented lesions, such as café-au-

lait macules and pigmentary mosaicism, are also reported at higher frequencies, reinforcing the notion that cutaneous manifestations can serve as markers of neurodevelopmental risk [5].

Multiple biological pathways may underpin this skin–brain link. Evidence shows a characteristic pro-inflammatory cytokine signature in ASD, characterized by elevated interleukin (IL)-1β, IL-6, tumor necrosis factor-α, and interferon-γ, alongside reduced anti-inflammatory mediators, showing a state of chronic low-grade inflammation [6]. Post-mortem and imaging studies further reveal activation of microglia and astrocytes in the brains of people with autism, perpetuating neuroinflammation and disrupted glia–neuron crosstalk in symptom pathogenesis [7]. Because keratinocytes, Langerhans cells, and peripheral immune circuits share many of these cytokine pathways, systemic immune dysregulation may simultaneously predispose individuals to epidermal barrier dysfunction, pruritus, and dysregulated itch-scratch cycles that are characteristic of AD and psoriasis. Conversely, sustained cutaneous inflammation can amplify systemic cytokine load, which can potentially exacerbate neuroinflammatory cascades. This suggests a bidirectional feedback loop between skin and the central nervous system [3].

Clinical management is further complicated by behavioral and sensory traits inherent to ASD. Tactile hypersensitivity, aversion to novel textures, and rigid adherence to routines can make routine skin examinations, topical applications, or procedures such as cryotherapy deeply distressing [8]. Communication barriers mean that issues such as pain, pruritus, or adverse drug effects may be expressed nonverbally, potentially through agitation, self-injurious scratching, or picking, which requires clinical vigilance [9].

The psychosocial repercussions of the interplay between ASD and dermatologic health can be substantial. Pruritic, visibly inflamed skin is linked to sleep disturbance, anxiety, low self-esteem, and social withdrawal in the general population. Adolescents with AD report marked quality-of-life impairment and heightened caregiver stress, and these effects are compounded when ASD-related social differences and bullying intersect with dermatologic stigma [10]. Thus, untreated skin disease can indirectly intensify difficulties that individuals with ASD face, creating a cycle of dysregulation and discomfort.

Taken together, converging immunological, behavioral, and psychosocial evidence demonstrates the need for an integrated, neurodiversity-informed dermatologic model of care. Multidisciplinary collaboration among dermatologists, allergists, neurologists, developmental-behavioral specialists, psychiatrists/psychologists, primary care providers and caregivers, paired with sensory-adaptive clinic environments, visual communication aids, and flexible scheduling, can help break the skin–brain–behavior feedback loop and improve health and well-being for these patients. Figure 1 summarizes the interlocking pathways through which dermatologic conditions, systemic inflammation, and psychological effects converge to influence clinical outcomes. Addressing each domain holistically is essential if we are to advance equitable dermatologic health for the population of people with ASD.

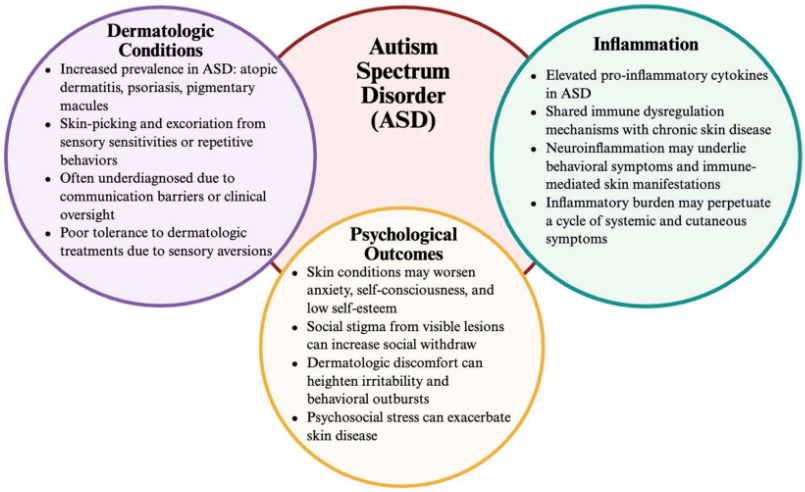

Figure 1: The intersection Between Autism, Inflammation, Skin Disease, and Psychosocial Health

Common Dermatologic Conditions in ASD:-

Atopic dermatitis (AD), commonly referred to as eczema, is notably more prevalent in individuals with ASD than in the general population. Epidemiologic studies report significantly higher incidence rates among children with ASD, with odds ratios starting at 1.485 [11]. This association suggests the presence of underlying biological mechanisms that extend beyond shared environmental exposures or behavioral factors. AD is mediated by immune dysregulation, and an example of this can be seen in an overactive T-helper 2 (Th2) response. Elevated levels of Th2-associated cytokines, such as IL-4 and IL-13, contribute to the chronic inflammation and impaired skin barrier function characteristics of AD [12]. This clinical indication is important to consider as individuals with ASD have been found to exhibit a similar immunological profile, including increased Th2 activation and elevated circulating levels of Th2 cytokines [13].

The same study also found reduced levels of IL-10, a key anti-inflammatory cytokine that normally suppresses Th2 responses, in individuals with ASD. This deficiency may further amplify Th2 dominance, contributing to the increased risk of AD in this population. Taken together, these findings support a shared immunopathological pathway linking ASD and AD through Th2-mediated inflammation and impaired immunoregulation. This connection not only provides insight into the multisystem nature of ASD, but also highlights the importance of early screening and interdisciplinary management of inflammatory comorbidities in this population. Further research into these immune mechanisms may inform targeted therapeutic approaches for both conditions.

In viewing another inflammatory skin condition, a growing body of evidence supports a shared immunological pathway between ASD and psoriasis. Psoriasis is primarily driven by dysregulation of the Th17 immune axis [14]. This is particularly relevant in the context of ASD, as multiple studies have demonstrated increased differentiation of Th17-producing cells in individuals with ASD with IL-17A identified as a key effector cytokine contributing to disease pathogenesis, suggesting a common pro-inflammatory profile [15,16]. Notably, mouse models have shown that maternal IL-17A signaling during pregnancy can induce ASD-like neurodevelopmental phenotypes in offspring, implicating this pathway as a potential contributor to both prenatal neuroinflammation and postnatal immune

dysregulation [17]. This observation raises important clinical considerations, especially in genetically predisposed individuals, and may support future risk-stratification strategies during pregnancy.

From a dermatologic perspective, the co-occurrence of psoriasis in individuals with ASD may signify an exaggerated Th17-mediated immune response and concurrent increased levels of IL-17A that could contribute to worsening neurodevelopmental symptoms. Early identification of psoriasis in this population may serve as a clinical clue to underlying systemic inflammation and may guide more integrated treatment strategies, both for the neurological symptoms of ASD and dermatological symptoms. Epidemiological data suggest that the prevalence of psoriasis is nearly twice as high in children with ASD compared to neurotypical controls, further reinforcing the importance of routine dermatologic screening in this group [18].

In addition to the more frequently discussed dermatologic comorbidities in ASD, less commonly addressed conditions such as alopecia areata (AA) warrant attention. AA is an autoimmune disorder characterized by non-scarring hair loss and is associated with downregulation of IL-10, a key immunomodulatory cytokine previously implicated in AD [19]. While existing studies have yet to directly examine the relationship between AA and AD in individuals with ASD, exploring potential immunological overlaps may reveal important insights. A recurring theme across these dermatologic conditions is dysfunction of immune regulation, particularly suppression of immune tolerance. Notably, immune privilege collapse has been observed even at the fetal stage in mice models, contributing to ASD-like phenotypes. This adds further relevance to investigating AA in the context of neuroimmune dysregulation.

Clinically, AA in individuals with ASD often presents in its patchy form [20], which may be intensified by psychological stress, compulsive behaviors, or self-injurious actions. Behaviors such as trichotillomania or repetitive scalp rubbing, frequently linked to sensory processing abnormalities in ASD, can compound the severity of hair loss. Consequently, behavioral interventions may play an equally critical role as immunomodulatory therapies in managing AA within this population. Further research into the specific ASD phenotypes associated with IL-10 dysfunction could help elucidate whether it concurrently causes AA and even exacerbates its progression through the effects on neuropsychiatric status in ASD patients.

Moving beyond inflammatory skin conditions, hormonal and behavioral factors unique to ASD patients may contribute to their development of acne. Elevated plasma testosterone levels have been associated with increased conduct problems and hyperactivity in pre-pubertal boys with ASD [21]. Testosterone plays a well-established role in stimulating sebaceous gland activity, thereby increasing sebum production, a key driver of acne pathogenesis [22]. This hormonal complex, coupled with behaviors characteristic of ASD may exacerbate local skin inflammation and promote acne lesions. Some parents with ASD children have noted that their children had aversions to skin care products [23]. Without regular hygiene routines, excess oil and debris can accumulate on the skin, further contributing to acne, particularly in the context of elevated androgen levels.

Moreover, psychological stress, which is often heightened in individuals with ASD due to sensory sensitivities and social challenges, may further influence acne development through activation of the hypothalamic-pituitary-adrenal axis and subsequent modulation of androgen levels. This interplay of endocrine and behavioral factors creates a distinct vulnerability to acne in the ASD population, underscoring the need for comprehensive clinical approaches that address both the hormonal underpinnings and the behavioral contributors to skin health. Recognizing these multifactorial influences is essential for early identification and tailored management of acne alongside other dermatologic comorbidities in ASD.

Moving toward dermatological conditions that are primarily behavioral in origin, excoriation disorder, commonly known as skin-picking, emerges as a prominent concern within the ASD population. Individuals with severe ASD often exhibit self-injurious behaviors, which range in severity and presentation [24]. Excoriation, while considered a less severe form of self-harm [25], remains clinically significant due to its frequency and its complex relationship with sensory processing and comorbid psychiatric conditions. Importantly, the motivation behind such behavior is may not be rooted in suicidal ideation but instead reflects underlying sensory or cognitive dysregulation. One major contributing factor is tactile hypersensitivity, a hallmark of sensory processing abnormalities frequently seen in ASD. Research has shown that individuals with ASD process sensory information differently, particularly in terms of temporal integration, meaning that they experience and interpret tactile stimuli with altered timing and intensity [26]. This atypical sensory experience not only contributes to behaviors such as skin-picking but also complicates

the application of topical treatments for comorbid skin conditions like AD, which affects nearly 90% of individuals with ASD [27].

Furthermore, excoriation behaviors may stem from underlying psychiatric comorbidities such as obsessive-compulsive disorder (OCD), a condition commonly observed in ASD populations. Skin-picking is a recognized symptom of OCD and may represent an external manifestation of internal compulsions [28]. In addition, individuals with ASD frequently display overlapping symptoms of anxiety and OCD, both of which are linked to increased repetitive and compulsive behaviors, including excoriation [29]. This convergence of sensory hypersensitivity, dermatologic comorbidity, and psychiatric overlap underscores the multifaceted etiology of skin-picking in ASD and highlights the need for integrated therapeutic strategies that address both behavioral and sensory dimensions. The implications are substantial, as untreated excoriation can lead to secondary infections, poor wound healing, and additional barriers to effective dermatologic care, all of which can further diminish quality of life in this already vulnerable population.

Table 1:- Overview of dermatological conditions in ASD: prevalence, proposed mechanisms, and clinical features

Dermatological Condition	Prevalence in ASD	Proposed Mechanisms	Clinical Features
Atopic Dermatitis (AD)	Significantly increased; odds ratio ~1.485	Immune dysregulation with Th2 dominance; elevated IL-4, IL-13; decreased IL-10 impairing immunoregulation; impaired skin barrier	Chronic pruritic eczema, dry scaly patches, impaired barrier
Psoriasis	Nearly twice as common as neurotypical controls	Dysregulated Th17 axis with elevated IL-17A; prenatal IL-17A exposure causing neuroinflammation; proinflammatory immune profile	Well-demarcated erythematous plaques, potentially dry, cracked, or itchy skin, often on elbows, knees, and scalp
Alopecia Areata (AA)	Significantly increased risk; HR 1.238 (95% CI, 1.100–1.395)	Autoimmune T-cell mediated hair follicle attack; IL-10 downregulation; immune privilege collapse contributing to ASD-like phenotypes	Patchy, non-scarring hair loss, often worsened by psychological stress and repetitive behaviors such as trichotillomania
Acne	10.3% prevenlance in ASD Population	Increased androgen-driven sebaceous activity; behavioral aversion to skincare products; psychological stress activating HPA axis	Inflammatory papules and pustules, commonly on face and back
Excoriation Disorder (Skin Picking)	Self Injury Prevelance is 42% in ASD patients, but this is inclusive of other self harm characterstics, no metadata to provide this singular prevelance	Sensory processing abnormalities (tactile hypersensitivity), OCD and anxiety comorbidity, compulsive behavior; atypical sensory temporal integration	Repetitive skin picking and excoriations, secondary infections, poor wound healing

Contributing Factors:-

Throughout the discussion of dermatologic conditions commonly observed in individuals with ASD, it becomes evident that multiple interrelated factors contribute to their manifestation and severity. Given that ASD itself is a complex, multifactorial neurodevelopmental condition, it is critical to examine not only the immunological

underpinnings of these comorbidities but also the behavioral, sensory, and genetic influences that may exacerbate them. In addition, pharmacologic treatments frequently used in ASD management can have dermatologic side effects, creating an additive burden. Understanding the interplay between these domains is essential to developing comprehensive, multidisciplinary care strategies for this population.

Behavioral rigidity and resistance to change are frequently hallmark features of autism [30]. These can very certainly interfere with routine hygiene or skincare protocols. Alterations such as introducing new lotions, adjusting bathing schedules, or modifying treatment regimens may trigger distress or refusal [31], leading to inconsistent application of topical therapies essential for managing conditions like eczema or acne. In a previously discussed case study done by Yoo, the ASD patient would refuse to apply topical treatments for AD, causing their caregiver to bring them to the dermatology office and be bandaged after application of treatment to prevent removal of the medication [27]. This is a necessary consideration when thinking of treatment, especially the long-term treatment that is necessary for conditions like AD and psoriasis. In Ellis' study, they explore gradual exposure therapy to treat dermatological conditions topically, to ensure that they can overcome the resistance to change characteristic seen in this patient population [31]. Compounding this, many individuals with ASD express discomfort through nonverbal behaviors, scratching, picking, or rubbing, instead of verbalizing symptoms, which can obscure clinical recognition and delay timely dermatologic intervention. This can cause a misattribution of symptoms to behavioral concerns rather than underlying dermatologic disease. In some cases, skin-picking or excoriation disorder may emerge as discussed before, a repetitive, compulsive behavior, particularly in the context of comorbid anxiety or obsessive-compulsive tendencies, further complicating clinical evaluation and treatment.

Sensory processing abnormalities are well-documented adverse effects of ASD and may play a significant role in the manifestation and management of dermatologic comorbidities. As introduced in the context of skin-picking behaviors, tactile hypersensitivity, a hallmark of ASD, can lead to aversion to a range of stimuli, including the sensation or texture of clothing, the application of lotions or topical medications, all of which are integral components of dermatologic care [32]. Consequently, some ASD patients may resist physical contact during clinical evaluations, complicating a proper dermatological assessment. These sensory factors not only hinder diagnosis and treatment compliance but may also increase the risk of trauma to the skin due to repetitive scratching or similar behaviors. Complicating this matter further is the contradictory presence of both hypersensitivity and hyposensitivity to stimuli [33]. This may cause individuals to unintentionally ignore and therefore underreport skin injuries, infections, or irritants, resulting in delayed recognition and management.

At the cellular level, genetic etiologies are increasingly implicated in the presentation of AD, psoriasis, and AA. The dysregulated genetic system of ASD leads to unchecked and dysfunctional cytokine expression, creating a state of chronic systemic inflammation. Biopsies of ASD children reveal abnormal infiltrations of monocytes and lymphocytes, together with increased levels of proinflammatory cytokines in astrocytes [34]. These findings point to persistent inflammation that is directly contributing to the loss of immune privilege in ASD patients. This systemic inflammation and overactive immune system contribute to the production of dermatology comorbidities, but can also exacerbate neurologic abnormalities in the population.

Furthering this theory is the knowledge that there are increased levels of lipopolysaccharides in ASD patients, leading to a decrease in the strength of the blood-brain barrier, allowing more toxic substances to create an environment conducive to inflammation. In addition to the previously discussed Th17, Th2, IL-10, and IL17A dysfunction, a systemic dysfunction of T-regulatory cells in ASD patients has also been discovered [15]. This includes increased levels of STAT3/RORγt and T-Box transcription factor which has been suggested to have a direct impact on the neurodevelopmental phenotype of autism. Thus, it is vital that these genetic and immunologic conditions be further explored to understand their role in the pathogenesis of ASD and its dermatologic comorbidities.

Pharmacologic treatment of ASD prevents another layer to our understanding of the complex dermatologic presentation of this patient population. Several commonly prescribed medications for ASD-related behavioral symptoms are associated with dermatologic side effects. Risperidone, a commonly used antipsychotic in ASD for irritability and aggression, has been associated with maculopapular and bruise-like rashes, photosensitivity reactions, urticaria, and acneiform eruptions in pediatric populations [35]. Published case reports document these skin reactions, including instances of recurrence, highlighting the need for dermatologic vigilance during treatment. In larger cohort studies of children with ASD treated with risperidone, skin rash was reported in 2–5 % of participants

[36]. Similarly, Olanzapine, another medication used to treat behavioral symptoms of ASD, was found to give patients a variety of rashes, ranging from purpuric, itchy urticarial, to erythematopustular rashes [37]. These dermatologic reactions are not limited to a single class of medication and merit broader investigation across the spectrum of pharmacologic agents used in ASD.

Accordingly, stimulants used to treat co-occurring symptoms may induce mild skin irritation, pruritus, or hypersensitivity reactions that can aggravate underlying skin conditions. In more severe cases, one side effect of these medications can be Raynaud's Phenomenon [38]. This effect is dangerous, as the presentation is cutaneous discoloration and coupled with the communication barriers of ASD, it can go undiagnosed. Other patients describe dermatitis on the scalp as a side effect of Methylphenidate [39]. Similarly, this can be undiagnosed and untreated leading to a further weakening of the immune system creating potential for more severe complications.

Collectively, the implications are substantial, as untreated rashes and other dermatological conditions can lead to secondary infections, poor wound healing, and additional barriers to effective dermatologic care, all of which can further diminish quality of life in this already vulnerable population.

Table 2:- Medications that are common for children with autism and their dermatologic side effects

Medication	Class	Reported Dermatological Side Effects
Risperidone	Atypical antipsychotic	Macular erythematous rash, itching, drug-induced intertriginous and flexural exanthems
Aripiprazole	Atypical antipsychotic	Morbilliform maculopapular rash, erythema, rare hypersensitivity reactions
Olanzapine	Atypical antipsychotic	Pruritic pigmented rash, pustular rash, leukocytoclastic vasculitis, purpura
Quetiapine	Atypical antipsychotic	Psoriatic rash
Paliperidone	Atypical antipsychotic	Pruritic rash
Methylphenidate	Stimulant	Hives, itching, exfoliative dermatitis , contact dermatitis, flushing, photosensitivity
Amphetamine salts	Stimulant	Morbilliform rash, hives, itching, angioedema, alopecia, photosensitivity
Lisdexamfetamine	Stimulant	Maculopapular rash, generalized rash, itching, exfoliative skin reaction
Sertraline	SSRI	Rash, itching, hives, angioedema
Fluoxetine	SSRI	Rash, itching, hives, Stevens-Johnson syndrome
Citalopram	SSRI	Rash, itching
Clomipramine	Tricyclic antidepressant	Rash, hives, photosensitivity, flushing
Imipramine	Tricyclic antidepressant	Rash, exfoliative dermatitis, hives, photosensitivity
Buspirone	Anxiolytic	Rash, itching
Diazepam	Benzodiazepine	Rash, hives, angioedema
Clonazepam	Benzodiazepine	Rash, hypersensitivity reaction
Lamotrigine	Anticonvulsant	Rash, Stevens-Johnson syndrome,
Valproic acid	Anticonvulsant	Rash, hives, erythema , toxic epidermal necrolysis, Stevens-Johnson syndrome
Carbamazepine	Anticonvulsant	Rash, hives, erythema , toxic epidermal necrolysis, Stevens-Johnson syndrome

Diagnosis and Management Challenges:-

Communication barriers in reporting symptoms leading to adverse health outcomes

As a neurodevelopmental disorder that causes behavioral differences and an impairment with social interaction, ASD results in patients with increased health needs that must be met to provide them with positive healthcare

experiences and patient-physician relationships [40]. When their needs are not met while seeking healthcare and result in negative experiences, they can become obstacles that prevent these patients from engaging in healthcare in the future. Barriers to accessing primary healthcare may contribute to individuals with ASD having poorer physical and mental health and a shorter life expectancy in comparison to their counterparts without ASD. In Doherty et al.'s study, where individuals with and without ASD completed a self-report survey regarding their barriers to accessing healthcare in a primary care setting, patients with ASD were more likely to report communication difficulties as an obstacle to receiving healthcare [41]. It was reported that not feeling understood and communication difficulties with the physician and administrative staff were reasons that patients with ASD avoided or delayed a visit to their primary care provider more often than patients without ASD. Moreover, patients with ASD reported generally avoiding communication over the telephone, voicemail, and face-to-face verbal communication, preferring to communicate in writing instead [41].

Another aspect of difficulties with communication is that their verbal communication skills make it harder for them to describe their pain or symptoms. Additionally, they may have unconventional, non-verbal ways of conveying pain that could be misunderstood by the physician, leading to distrust in the patient-physician relationship. For some patients with ASD, it may be helpful for physicians to directly ask patients to vocalize when they feel pain during routine medical screenings and procedures, as some patients may not report that they feel pain unless they are explicitly told to do so [42].

Additionally, in the same study, patients with ASD also identified sensory processing issues as reasons to avoid or postpone office visits [43]. Some of the sensory issues pertained to the environment of the waiting room, which included the crowdedness, noise, music, and fluorescent lights, and physical touch during examinations [43]. Along with sensory sensitivities and overstimulation, another shared experience by patients with ASD is difficulties with body awareness and how they would describe pain [44]. For some individuals with ASD, they are unsure of how to accurately describe their pain and identify the source, duration, and intensity of the pain [44].

Patients have reported adverse consequences associated with barriers to healthcare access. More frequently than those without ASD, patients with ASD would miss a referral to visit a specialist, be told that they should have seen a physician sooner, and have their health concerns go untreated. In order to decrease health disparities experienced by individuals with ASD, communication barriers must be addressed, as challenges with communication with the physician and front desk staff were significantly associated with negative health outcomes [44].

Difficulty tolerating dermatological exams and treatments

As many individuals with ASD have sensory processing challenges, such as sensory over-responsivity, there may be challenges associated with performing dermatological exams or procedures when physical touch is involved [45]. Some children with ASD may have a hypersensitivity to physical touch and thus may become distressed when physical contact is necessary during an office visit, specifically head touching. When a child with ASD experiences sensory overstimulation or is in distress from an intense sensory experience, it may lead to challenging behavior, such as crying, spitting, lying on the floor, and biting or hitting staff members [46]. In addition, heightened sensitivity to sensation may lead to difficulties in adherence to dermatological treatments due to different textures of topical agents, such as ointments, and temperatures of treatments like cryotherapy [45].

Modified approaches to meet the unique needs of patients with ASD

Changes can be implemented in an office environment to address the specific needs of patients with ASD and minimize barriers that prevent them from accessing healthcare. Some patients with ASD have expressed a desire to contact their physician in advance to explain what they would like to discuss during the healthcare visit and a preference for making office appointments via text. Individuals with ASD reported certain factors that are significantly associated with adverse patient outcomes, such as uncomfortable waiting room environments that can overstimulate the senses and difficulties with booking appointments over the phone [44]. As a result, using natural

or dimmer lighting in the waiting room, creating a private waiting area, and providing an option for online appointment scheduling can make the patient experience more positive.

There are also changes that physicians can make to provide quality, patient-centered care for individuals with ASD. For instance, patients with ASD who had negative experiences with healthcare and received poor care associated it with physicians who lacked knowledge about ASD in adults and how they should be treated, had incorrect assumptions about their specific needs, and were unwilling to accommodate their needs such as communicating in writing [44]. Negative experiences within healthcare settings can discourage patients with ASD from engaging in healthcare and further increase the health disparities experienced by adults with ASD, so it is critical for healthcare providers to fill in their knowledge gaps regarding ASD in adults and be open-minded about applying accommodations to promote more successful interactions with patients [44].

Clinical Recommendations:-

Role of interdisciplinary care

Providing accommodations and tailoring healthcare delivery to patients with ASD requires an integrated approach that involves interdisciplinary collaboration [45]. An interdisciplinary team that includes dermatologists, behavioral specialists, psychiatrists, psychologists, and pediatricians will lead to an improvement in patient outcomes by providing quality healthcare that addresses the specific needs of adult and pediatric patients with ASD. It is important to consider the impact of skin disorders on mental health and understand that psychological conditions can manifest from skin disorders and vice versa. Skin disorders can negatively affect a person's psychological well-being and result in feelings of stress, social isolation, shame, and low self-esteem [47]. Recognizing that individuals with ASD have a higher likelihood of having a psychiatric disorder compared to those without ASD and that skin health can affect mental health are both vital to understanding the perspective of the patient and their psychosocial needs. Therefore, implementing a multidisciplinary approach that includes psychologists and psychiatrists when treating individuals with ASD and skin disorders helps to address the complex interplay between mental health and skin disorders [45].

Use of visual schedules, social stories for dermatology visits

ASD is characterized by an impairment with social interactions, and individuals with ASD can experience stress from the anticipation of interacting with staff members during a clinic visit, as well as difficulties with communicating with both the physician and staff members [48]. Social stories are a teaching method utilized at home, in schools, and in the community to help children with ASD learn about social norms and situations, and it has been shown to improve social interaction and communication skills [49,50]. Social stories can also be used in healthcare settings to educate patients about vaccinations and surgical procedures. There are challenges associated with needle procedures for children with ASD for several reasons, some of which include a phobia of needles, sensory overload that occurs before the procedure, and unfamiliarity with the procedure [49,51]. Many social stories about needle procedures tend to focus on vaccinations, and these stories provide explanations on the importance of needles, explain sensory-related information throughout the procedure, and sequential steps of the procedure. By supplying patients with accurate and detailed information on what to expect in needle procedures, patients can be better prepared for healthcare visits, and needle procedures can run smoothly [49]. Similarly, social stories can be applied in dermatology offices to ease the anticipation that patients may feel before undergoing any medical screenings and procedures, such as skin examinations and biopsies.

Visual activity schedules (VAS) are tools that are used to teach children with ASD about transition behaviors and social skills. VAS uses pictures or images to illustrate a series of events, and its purpose is to provide a visual depiction that prepares children with ASD of what the next step is in a sequence of activities or events. Individuals with ASD tend to have better visual processing than auditory processing, so VAS is useful in helping them process activities and interactions through visual information. Several studies have demonstrated that the use of VAS has improved a variety of skills in children and adolescents with ASD, such as transitional behavior, on-task behavior, and decreased latency time after they were told to complete an activity [52]. Visual schedules are also shown to be

effective in reducing anxiety and confusion about upcoming medical routines and procedures in pediatric patients. As these schedules provide a layout of the sequential order of events, pediatric patients are able to anticipate what happens next and thus have a better sense of orientation and control regarding an unfamiliar situation [53]. The incorporation of VAS in a clinical setting can therefore provide a more structured way of processing events and help prepare patients for certain steps and expectations during a clinical visit, in addition to teaching patients strategies on how to manage pain, which will also alleviate anxiety about medical procedures and promote self-regulation during overwhelming situations [52,53].

The use of digital technology and virtual reality are helpful tools that allow individuals with ASD to control their sensory processing and immerse themselves in different types of sensory information. Studies have suggested that because virtual reality headsets can stimulate various senses of individuals with sensory processing issues, these headsets encourage multisensory integration and can be used as vestibular rehabilitation for patients with vestibular disorders and as a tool to improve auditory hypersensitivity in patients with ASD [54–56]. Virtual reality can be used in a clinical setting as an educational resource that creates a 3D model of the skin and teaches patients with ASD what is done to the skin during procedures, surgeries, and treatments [45].

Importance of patient-centered care

ASD consists of a heterogeneous group of disorders with different levels of language acquisition, tactile sensitivity, social communication skills, challenging behaviors, and other associated features. As a result, a single intervention is not equally effective for all patients with ASD, and a more patient-centered approach must be implemented. When choosing an intervention that is specific to the needs of a child with ASD, it is important to consider their age and ability level before the intervention. Studies find that beginning interventions at a younger age and already having a level of ability lead to better treatment outcomes. Other aspects of interventions that may be different for each patient are the method of intervention delivery, frequency of the intervention, and what combination of interventions to be utilized. Thus, a generalized approach to treating patients with ASD is not as successful as implementing an approach that is tailored to each patient's specific qualities and abilities [57].

Gentle skincare routines tailored for sensory needs

Another way of being more mindful of patients with atypical sensory processing and sensitive skin is by adjusting skin treatments. Allergic conditions, such as skin, food, and respiratory allergies, are commonly found in children with ASD due to immunological dysregulation in ASD. For sensitive skin and sensory-friendly skincare, hypoallergenic and fragrance-free skincare products are recommended, and it is suggested to gently apply products to the skin to prevent irritation and sensory overactivity [40].

Given that individuals with ASD commonly experience sensory processing issues such as tactile hypersensitivity, it may be challenging to practice sun safety habits to protect themselves from harmful solar ultraviolet radiation. Important sun-safe behaviors include applying sunscreen consistently, wearing hats and sun-protective clothing, and seeking shade outdoors when possible. However, children with ASD may feel discomfort with the texture and consistent reapplication of sunscreen due to their tactile hypersensitivity and may feel averse towards wearing hats and protective clothing. To avoid potential difficulties with sensory hypersensitivity from the texture of sunscreen, roll-on or spray sunscreen may be a more suitable option. Additionally, finding a loose-fitting hat and using beach tents to provide shade can give children with ASD a break from wearing sun-protective clothing [58].

Emerging Research and Future Directions:-

When it comes to future directions in caring for patients with ASD, we would be remiss if we did not mention the gut-brain-skin axis. The connection between the gut and the brain has long been theorized and researched, starting in the second half of the 18th century [59]. More recent research examines how the presence of gut dysfunction in some neurodiverse individuals came to be. Some models indicate how an inadequate microbiome inherited from the parents prevents the proper development of the gastrointestinal (GI) system, which then limits stimulation in the

developing brain and produces asymmetry [60]. An improperly developed gut does not contain all of the same factors that communicate with the brain as a gut that follows typical development. As a result, the presence of ASD may coincide with comorbidities affecting the GI tract. In mouse models, researchers have observed how the administration of probiotics improves both gut health and socialization in patients with ASD, while fecal microbial transplantation in patients with coexisting GI disease and ASD ameliorated both conditions [61]. A plethora of evidence exists to demonstrate how the brain and gut have a reciprocal relationship. The association between the gut and brain is clear, and there is an increased prevalence of GI disease in individuals with ASD [62,63]. While it should be noted that not every neurodiverse patient will have GI disease, there is a notable difference between the microbiomes of patients with ASD and those who do not have ASD [64]. These unique qualities are important in shaping these patients and their needs. Physicians who come to treat neurodiverse individuals need to recognize these differences in order to develop an appropriate care plan.

As for the skin-brain axis, there is also a clear link between the two that has been the subject of investigation. The presence and absence of skin bacteria on the forehead were shown to affect the event-related potentials on electroencephalogram [65]. The skin, with its relays to the brain, shapes the activity that occurs there. Looking at embryological development, the fact that neural tissue and skin tissue develop with each other cannot be overlooked. Brain-derived neurotrophic factor and filaggrin are both found to be expressed abnormally in ASD and AD [66]. Not only does this suggest that the skin and nervous system develop together, but it also implies that the dysfunction of one component can occur simultaneously with the other. When treating psoriasis with certain biologics, some symptoms associated with ASD are improved [16]. The decrease in inflammatory cytokines may contribute to the decrease in ASD symptoms. Although the pathways are not clearly elucidated, it is reasonable to conclude that there are overlaps that suggest an association between a number of skin conditions and ASD.

The gut-brain-skin axis has become a topic of conversation recently, particularly with how the perturbation of the axis leads to various disease states [67]. These imbalances have varying effects that cannot necessarily be predicted at this time. Acne vulgaris is one such skin condition that demonstrates how the interactions between gut flora and neuronal signals influence the expression of this disorder [68]. Another example is psoriasis, where stress contributes to the skin manifestations, as well as separate GI symptoms [69]. The implication is that a disturbance to one part of the system manifests itself in ways that we did not previously consider as related to the condition of interest. In addition, probiotics have additional benefits besides what has already been mentioned; they improve inflammatory skin conditions by increasing anti-inflammatory cytokines [70]. As probiotics appear to modulate multiple arms of the gut-brain-skin axis, this is a promising avenue for further research in an area that greatly affects neurodiverse patients. These points lend further support to the need for specialized care in patients with ASD and that this may be accomplished by understanding the nuanced differences in their gut-brain-skin axis.

A more recent topic relating to skin and skin pathology is neuroinflammation. Numerous skin conditions are linked to triggers that stimulate aberrant components of the nervous system. For instance, heat and spicy foods can lead to rosacea flare-ups since they trigger certain neuronal connections [17] There is also a decreased tolerance to these stimuli within the skin itself, which is due in part to increased sensory neurons and ion channels [17]. In rosacea, individuals are seemingly predisposed to have more sensitive skin, and neuroinflammation is a contributing factor that both responds to the condition and initiates it. Even with trauma to the skin, immunologic processes, including erythema and edema, are mediated by components released from transient receptor potential receptors [71]. Neuroinflammation is a necessary part of dermatologic conditions and other processes occurring in the skin. It is recognized as a process in which proinflammatory cytokines are delivered by leukocytes that invade the central nervous system (CNS), leading to various chain reactions such as heat hypersensitivity [72–74]**.** Taking this a step further, some studies indicate that the effects of neuroinflammation on the immune system contributes to the pathogenesis of ASD [75]. It has been noted that cytokines influence the expression of ASD symptoms. By that token, neuroinflammation has a direct effect on ASD, and it is yet another aspect clinicians need to keep in mind when considering how to care for their patients with ASD. Continuing to investigate the ways in which we may be able to modulate neuroinflammation would allow us to better treat neurodiverse patients.

A significant number of people with ASD have been diagnosed with comorbid conditions [76]. As a result of these comorbidities, it is necessary to adjust the delivery of care to accommodate the unique presentations associated with these patients. As it stands now, it is estimated that only half of individuals with ASD receive primary care that is consistent with the model recommended by the American Academy of Pediatrics [77]. This suggests a notable gap in the delivery of, and access to, care in those with ASD. Many experts and studies have noted the importance of

tailoring care to neurodiverse individuals. Adams and Young note that a facilitating factor in obtaining care identified by study participants with ASD was the adaptability of the therapist to meet the participants' needs [78]. A case study demonstrated how one-on-one interactions and tailored interventions came to benefit the participant in obtaining an appropriate diagnosis [79]. When a patient with ASD feels their unique needs are being acknowledged and met, the patient is able to more easily obtain the care they deserve. By making efforts to accommodate neurodiverse individuals, the healthcare provider can reduce the barriers to care that this population faces.

In recent years, research has focused on how to provide care to neurodiverse patients and their families. There is a growing amount of evidence that supports multidisciplinary care for patients with ASD [80]. Huber, et al, discuss how multidisciplinary care teams may provide patients and their loved ones with the support they need when navigating healthcare. Their Adaptive Behavioral Intellectual/developmental disability Individualized & Integrated Tertiary care for Youth and children (ABILITY) program, while theoretical, is a feasible means to integrate the multidisciplinary approach seen in schools into children's hospitals. Combining the expertise of child psychiatrists, pediatricians, and nursing staff, as well as other individuals, with the feedback from patients and their families will allow for a comprehensive approach that enhances the patient-physician alliance. The emergency department (ED) has been investigated as a setting to implement patient- and family-centered care (PFCC) for patients with ASD [81,82]. Upon implementation of PFCC, parents of children with ASD provided positive feedback about their experiences. Involving the individuals who are most directly affected by ASD creates a welcoming environment, which further demonstrates the need for care that is inclusive of neurodiverse patients.

It has also been shown that using a multimedia approach has provided an avenue to better tailor care for neurodiverse individuals [54]. In addition, adapting psychological therapies, like cognitive behavioral therapy, has been helpful as reported by adult participants with ASD [83]. The increased use of visual aids through tablets and handouts is one way to improve patient comprehension and the delivery of care. Moreover, these approaches recognize the sensory processing differences and comorbidities that exist in many patients with ASD. These interventions have yet to be investigated in the realm of dermatology; however, it is promising to observe how multiple specialties and different forms of media can improve the care neurodiverse patients receive. It is easy to imagine how dermatologists can be implemented into a multidisciplinary team. The use of tablets has become commonplace in many outpatient dermatology clinics, and this tool could be outfitted to better serve these patients.

When it comes to implementing these ideas, the healthcare system is only in the early stages of planning. The recognition of neurodiversity-informed care is beginning to gain traction. In other domains, particularly schools and universities, ASD-friendly designs are already coming to fruition [84]. Specific sound paneling and padding on furniture have been implemented in college buildings that account for the sensory processing differences in neurodiverse students. This type of mindful interior design is certainly an aspect that can be implemented into the initial design, or even the redesign, of a clinic. Color, use of paints and finishes, flooring, and signage are also important considerations [85,86]. Setting up an environment that consciously values the experience of neurodiverse patients is a necessary step to promoting inclusion and equity for this population. It will be valuable to observe how these changes impact these individuals in the years to come.

Change in healthcare for patients with ASD may come from various avenues, and it is not limited to the design and set-up of waiting areas and exam rooms. Among the interventions that can be implemented to make an ASD-friendly experience, clear communication is a strategy that has received positive feedback from study participants [87,88]. When a patient knows what to expect, they can find comfort in an unfamiliar setting, which is particularly helpful for patients with ASD since unfamiliarity can be a significant source of stress. Other components that have been identified as ASD-friendly include flexibility when conducting the physical exam, directly addressing and acknowledging the patient in treatment decisions, and the option of longer appointment times [88]. Many of these items are taught, at least in part, in our medical training. This serves to remind us that, while patients with ASD have unique needs, we should not forget that they are entitled to receive the same care that physicians have been taught to provide to their counterparts who do not have ASD.

Individuals with ASD have been shown to process sensory modalities differently than their counterparts who do not have ASD. Patients with ASD may have increased or decreased sensitivity to auditory, tactile, or visual stimuli [9]. When it comes to dermatologic care among neurodiverse individuals, recognition of these sensory processing differences is integral to providing care. In children with ASD, unfamiliar hospital environments are a source of stress [89]. These differences may affect how the physical exam is conducted, as well as what treatment decisions

are made. Oza, et al, discuss how commonplace events in the dermatology clinic, such as wearing exam gowns or undergoing skin biopsy, may be a source of significant stress to patients with ASD. In addition, encouraging sun safety comes with barriers in neurodiverse patients since sunscreen, as well as protective hats and shirts, may be uncomfortable to wear for these individuals [58]. These challenges demonstrate the necessity for deliberate considerations when counseling neurodiverse patients and their families. While there is a limited amount of insight into improving dermatologic care in neurodiverse populations, forethought and recognition of these potential triggers are of the utmost importance in caring for these patients.

Another aspect of improving care for patients with ASD is to limit the comparisons between them and neurotypical patients [90]. Doing so perpetuates stigmatization, and there is a balance between recognizing the unique needs of a neurodiverse individual and unintentionally leveraging that against them. Access to a streamlined online toolkit provides patients with ASD flexibility and convenience [44]. By filling out the associated questionnaire beforehand, the clinician is able to review how best to accommodate this patient and implement strategies that will align with their situation. Educational training modules for providers have been created in recent years, though it is not necessarily commonplace for physicians, nurses, and other healthcare professionals to receive this training [91]. Several training programs have been evaluated to see how they improve the knowledge base of clinicians and allied health care professionals [92–95]. While these training modules increased the confidence of the participants and added to their understanding of neurodiverse individuals, there is yet to be an investigation into how that training impacts patients with ASD. Observing the reactions of neurodiverse patients would further improve the work that is being done. Participatory training may provide a means with which to study the effects of provider training on individuals with ASD, as this form of training includes trainees with ASD [96]. This is another way to better cater healthcare to neurodiverse patients. Establishing an equitable, accessible experience for these individuals should be a priority, and it would be beneficial to observe the effects in the field of dermatology.

Conclusion:-

The intersection of dermatological health and ASD remains an underexplored yet clinically significant domain. As evidence grows linking immune dysregulation, inflammation, and behavioral factors to skin conditions in individuals with ASD, it becomes increasingly important to raise awareness among clinicians and researchers. Dermatologic manifestations can serve as somatic clues to underlying neurodevelopmental and immune-related processes and profoundly affect quality of life. However, current research is limited by small sample sizes, a lack of longitudinal studies, and insufficient integration of dermatology within multidisciplinary ASD care. Future studies should target the clarity of the biological mechanisms driving these associations and seek to develop treatment strategies that take into account the sensory, behavioral, and psychosocial complexities and needs of the ASD population. With this, the hope is to improve dermatological, neurodevelopmental, and life satisfaction outcomes for individuals with ASD.

References:-

1. Maenner MJ, Warren Z, Williams AR, Amoakohene E, Bakian AV, Bilder DA, et al. Prevalence and Characteristics of Autism Spectrum Disorder Among Children Aged 8 Years — Autism and Developmental Disabilities Monitoring Network, 11 Sites, United States, 2020. MMWR Surveill Summ. 2023 Mar 24;72(2):1–14.

2. Talantseva OI, Romanova RS, Shurdova EM, Dolgorukova TA, Sologub PS, Titova OS, et al. The global prevalence of autism spectrum disorder: A three-level meta-analysis. Front Psychiatry. 2023 Feb 9;14:1071181.

3. Man MQ, Yang S, Mauro TM, Zhang G, Zhu T. Link between the skin and autism spectrum disorder. Front Psychiatry. 2023 Oct 18;14:1265472.

4. Zerbo O, Leong A, Barcellos L, Bernal P, Fireman B, Croen LA. Immune mediated conditions in autism spectrum disorders. Brain Behav Immun. 2015 May;46:232–6.

5. Varala S, George R, Mathew L, Russell P, Koshy B, Oommen SP, et al. The Diagnostic Value of Congenital and Nevoid Cutaneous Lesions Associated with Autism Spectrum Disorders in Indian Children- A Case-Control Study. Indian Dermatol Online J. 2021 Jan;12(1):84–9.

6. Saghazadeh A, Ataeinia B, Keynejad K, Abdolalizadeh A, Hirbod-Mobarakeh A, Rezaei N. A meta-analysis of pro-inflammatory cytokines in autism spectrum disorders: Effects of age, gender, and latitude. J Psychiatr Res. 2019 Aug;115:90–102.

7. Petrelli F, Pucci L, Bezzi P. Astrocytes and Microglia and Their Potential Link with Autism Spectrum Disorders. Front Cell Neurosci [Internet]. 2016 Feb 12 [cited 2025 Aug 4];10. Available from: http://journal.frontiersin.org/Article/10.3389/fncel.2016.00021/abstract

8. Accordino RE, Lucarelli J, Yan AC. Cutaneous Disease in Autism Spectrum Disorder: A Review. Pediatr Dermatol. 2015 July;32(4):455–60.

9. Oza VS, Marco E, Frieden IJ. Improving the Dermatologic Care of Individuals with Autism: A Review of Relevant Issues and a Perspective. Pediatr Dermatol. 2015 July;32(4):447–54.

10. Ng MS, Tan S, Chan NH, Foong AY, Koh MJ. Effect of atopic dermatitis on quality of life and its psychosocial impact in Asian adolescents. Australas J Dermatol [Internet]. 2018 May [cited 2025 Aug 4];59(2). Available from: https://onlinelibrary.wiley.com/doi/10.1111/ajd.12632

11. Tsai T, Chao Y, Hsieh C, Huang Y. Association Between Atopic Dermatitis and Autism Spectrum Disorder: A Systematic Review and Meta-analysis. Acta Derm Venereol. 2020;100(10):adv00146.

12. B. Brandt E. Th2 Cytokines and Atopic Dermatitis. J Clin Cell Immunol [Internet]. 2011 [cited 2025 Aug 10];02(03). Available from: https://www.omicsonline.org/th2-cytokines-and-atopic-dermatitis-2155-9899.1000110.php?aid=1712

13. Molloy C, Morrow A, Meinzenderr J, Schleifer K, Dienger K, Manningcourtney P, et al. Elevated cytokine levels in children with autism spectrum disorder. J Neuroimmunol. 2006 Mar;172(1–2):198–205.

14. De Alcantara CC, Reiche EMV, Simão ANC. Cytokines in psoriasis. In: Advances in Clinical Chemistry [Internet]. Elsevier; 2021 [cited 2025 Aug 10]. p. 171–204. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0065242320300391

15. Ahmad SF, Zoheir KMA, Ansari MA, Nadeem A, Bakheet SA, AL-Ayadhi LY, et al. Dysregulation of Th1, Th2, Th17, and T regulatory cell-related transcription factor signaling in children with autism. Mol Neurobiol. 2017 Aug;54(6):4390–400.

16. Man MQ, Yang S, Mauro TM, Zhang G, Zhu T. Link between the skin and autism spectrum disorder. Front Psychiatry. 2023 Oct 18;14:1265472.

17. Choi GB, Yim YS, Wong H, Kim S, Kim H, Kim SV, et al. The maternal interleukin-17a pathway in mice promotes autism-like phenotypes in offspring. Science. 2016 Feb 26;351(6276):933–9.

18. Zerbo O, Leong A, Barcellos L, Bernal P, Fireman B, Croen LA. Immune mediated conditions in autism spectrum disorders. Brain Behav Immun. 2015 May;46:232–6.

19. Yamaguchi HL, Yamaguchi Y, Peeva E. Pathogenesis of Alopecia Areata and Vitiligo: Commonalities and Differences. Int J Mol Sci. 2024 Apr 17;25(8):4409.

20. Lee SH, Lee S, Kang H, Lee J, Lee WS. Increased risk of alopecia areata in patients with autism spectrum disorders: A Korean nationwide population-based study. J Am Acad Dermatol. 2023 July;89(1):149–51.

21. Pivovarciova A, Durdiakova J, Hnilicova S, Filcikova D, Ostatnikova D. Testosterone in Relation to Behavioral Problems in Pre-Pubertal Boys With Autism Spectrum Disorders. Physiol Res. 2015 Dec 30;S595–601.

22. Hu T, Wei Z, Ju Q, Chen W. Sex hormones and acne: State of the art. JDDG J Dtsch Dermatol Ges. 2021 Apr;19(4):509–15.

23. Ellis E, Alairosales S, Glenn S, Rosalesruiz J, Greenspoon J. The effects of graduated exposure, modeling, and contingent social attention on tolerance to skin care products with two children with autism. Res Dev Disabil. 2006 Nov;27(6):585–98.

24. Abder-Rahman H, Al-Abdallat I, Qaqish LN, Elqasass A, Al-Shaeb A, Abuzaid L, et al. Understanding the link between autism and self-harm from a forensic lens. J Forensic Sci. 2025 May;70(3):1202–7.

25. Ladd MV, Luiselli JK, Baker L. Continuous Access to Competing Stimulation as Intervention for Self-Injurious Skin Picking in a Child with Autism. Child Fam Behav Ther. 2009 Feb 27;31(1):54–60.

26. Ide M, Yaguchi A, Sano M, Fukatsu R, Wada M. Higher Tactile Temporal Resolution as a Basis of Hypersensitivity in Individuals with Autism Spectrum Disorder. J Autism Dev Disord. 2019 Jan;49(1):44–53.

27. Yoo LJH, Stefanovic N, Watchorn RE. Atopic dermatitis and autism: tactile hypersensitivity impeding topical therapy use. Br J Dermatol. 2024 Apr 17;190(5):759–60.

28. Mattina GF, Slyepchenko A, Steiner M. Obsessive–compulsive and related disorders. In: Handbook of Clinical Neurology [Internet]. Elsevier; 2020 [cited 2025 Aug 10]. p. 369–86. Available from: https://linkinghub.elsevier.com/retrieve/pii/B9780444641236000254

29. Postorino V, Kerns CM, Vivanti G, Bradshaw J, Siracusano M, Mazzone L. Anxiety Disorders and Obsessive-Compulsive Disorder in Individuals with Autism Spectrum Disorder. Curr Psychiatry Rep. 2017 Dec;19(12):92.

30. Fisher WW, Felber JM, Phillips LA, Craig AR, Paden AR, Niemeier JJ. Treatment of resistance to change in children with autism. J Appl Behav Anal. 2019 Oct;52(4):974–93.

31. Ellis E, Alairosales S, Glenn S, Rosalesruiz J, Greenspoon J. The effects of graduated exposure, modeling, and contingent social attention on tolerance to skin care products with two children with autism. Res Dev Disabil. 2006 Nov;27(6):585–98.

32. Marco EJ, Hinkley LBN, Hill SS, Nagarajan SS. Sensory Processing in Autism: A Review of Neurophysiologic Findings: Pediatr Res. 2011 May;69(5 Part 2):48R-54R.

33. Siemann JK, Veenstra-VanderWeele J, Wallace MT. Approaches to Understanding Multisensory Dysfunction in Autism Spectrum Disorder. Autism Res. 2020 Sept;13(9):1430–49.

34. Vuong HE, Hsiao EY. Emerging Roles for the Gut Microbiome in Autism Spectrum Disorder. Biol Psychiatry. 2017 Mar;81(5):411–23.

35. Ekinci O, Gunes S. Risperidone-induced bruise-like rash in a child. Ann Saudi Med. 2020 Sept;40(5):436–8.

36. Boon-yasidhi V, Jearnarongrit P, Tulayapichitchock P, Tarugsa J. Adverse Effects of Risperidone in Children with Autism Spectrum Disorders in a Naturalistic Clinical Setting at Siriraj Hospital, Thailand. Psychiatry J. 2014;2014:1–4.

37. Lin J. Antipsychotics and rashes. Ment Illn [Internet]. 2018 Nov 6 [cited 2025 Aug 10];10(2). Available from: https://www.pagepress.org/journals/index.php/mi/article/view/7808

38. Gupta M. Rare Side Effects of Stimulants: Raynaud's Phenomenon. Prim Care Companion CNS Disord [Internet]. 2021 Sept 23 [cited 2025 Aug 10];23(5). Available from: https://www.psychiatrist.com/pcc/rare-side-effects-stimulants-raynauds-phenomenon

39. Warshaw EM, Paller AS, Fowler JF, Zirwas MJ. Practical management of cutaneous reactions to the methylphenidate transdermal system: Recommendations from a dermatology expert panel consensus meeting. Clin Ther. 2008 Feb;30(2):326–37.

40. Al-Ayadhi LY, Elamin NE, Madani A, Al-Ghamdi F, Al-Ghamdi HA, Halepoto DM. Examining the Prevalence, Characteristics, and Potential Links Between Skin Disorders and Autism Spectrum Disorder (ASD). J Clin Med. 2025 Jan 13;14(2):469.

41. Doherty M, Neilson S, O'Sullivan J, Carravallah L, Johnson M, Cullen W, et al. Barriers to healthcare and self-reported adverse outcomes for autistic adults: a cross-sectional study. BMJ Open. 2022 Feb 22;12(2):e056904.

42. Haydon C, Doherty M, Davidson IA. Autism: making reasonable adjustments in healthcare. Br J Hosp Med. 2021 Dec 2;82(12):1–11.

43. Doherty M, Neilson S, O'Sullivan J, Carravallah L, Johnson M, Cullen W, et al. Barriers to healthcare and self-reported adverse outcomes for autistic adults: a cross-sectional study. BMJ Open. 2022 Feb 22;12(2):e056904.

44. Nicolaidis C, Raymaker DM, Ashkenazy E, McDonald KE, Dern S, Baggs AE, et al. "Respect the way I need to communicate with you": Healthcare experiences of adults on the autism spectrum. Autism Int J Res Pract. 2015 Oct;19(7):824–31.

45. Misra R, Chang R, Adebiyi OT, Orbe M, Pham D, Miner K, et al. Advancing Dermatologic Equity for Individuals With Autism Through Awareness and Structural Reform. Cureus [Internet]. 2025 May 10 [cited 2025 Aug 10]; Available from: https://www.cureus.com/articles/346450-advancing-dermatologic-equity-for-individuals-with-autism-through-awareness-and-structural-reform

46. Babalola T, Sanguedolce G, Dipper L, Botting N. Barriers and Facilitators of Healthcare Access for Autistic Children in the UK: a Systematic Review. Rev J Autism Dev Disord [Internet]. 2024 Jan 5 [cited 2025 Aug 10]; Available from: https://link.springer.com/10.1007/s40489-023-00420-3

47. Jafferany M, Pastolero P. Psychiatric and Psychological Impact of Chronic Skin Disease. Prim Care Companion CNS Disord [Internet]. 2018 Apr 26 [cited 2025 Aug 10];20(2). Available from: https://www.psychiatrist.com/pcc/psychiatric-impact-of-skin-disease

48. Saqr Y, Braun E, Porter K, Barnette D, Hanks C. Addressing medical needs of adolescents and adults with autism spectrum disorders in a primary care setting. Autism. 2018 Jan;22(1):51–61.

49. Balakrishnan S, Alias A. Usage of Social Stories in Encouraging Social Interaction of Children with Autism Spectrum Disorder. J ICSAR. 2017 July 10;1(2):91–7.

50. Dobson O, Janssen C, Taddio A, Symons FJ, McMurtry CM. Online environmental scan and content analysis of social stories about needle procedures. J Pediatr Psychol. 2025 June 1;50(6):500–10.

51. Loschiavo K, Danchin M, Murrihy C, Williams K, Ure A, Carter M, et al. Exploring the routine vaccination experience of Australian autistic children and their families: A qualitative study. SSM - Qual Res Health. 2022 Dec;2:100193.

52. Knight V, Sartini E, Spriggs AD. Evaluating Visual Activity Schedules as Evidence-Based Practice for Individuals with Autism Spectrum Disorders. J Autism Dev Disord. 2015 Jan;45(1):157–78.

53. Koekemoer GC, Kuyler A, Johnson E, Van Zijl K, Terblanche AJ, Masuku KP, et al. Reducing anxiety and enhancing confidence in paediatric patients through visual schedules. Health SA Gesondheid [Internet]. 2025 Feb 5 [cited 2025 Aug 10];30. Available from: https://hsag.co.za/index.php/hsag/article/view/2841

54. Farroni T, Valori I, Carnevali L. Multimedia Interventions for Neurodiversity: Leveraging Insights from Developmental Cognitive Neuroscience to Build an Innovative Practice. Brain Sci. 2022 Jan 23;12(2):147.

55. Lubetzky AV, Kelly J, Wang Z, Gospodarek M, Fu G, Sutera J, et al. Contextual sensory integration training via head mounted display for individuals with vestibular disorders: a feasibility study. Disabil Rehabil Assist Technol. 2022 Jan 2;17(1):74–84.

56. Johnston D, Egermann H, Kearney G. SoundFields: A Virtual Reality Game Designed to Address Auditory Hypersensitivity in Individuals with Autism Spectrum Disorder. Appl Sci. 2020 Apr 25;10(9):2996.

57. Kasari C, Sturm A, Shih W. SMARTer Approach to Personalizing Intervention for Children With Autism Spectrum Disorder. J Speech Lang Hear Res. 2018 Nov 8;61(11):2629–40.

58. Kanellis VG. Barriers to sun safety in autism spectrum disorder. Biophys Rev. 2020 Aug;12(4):791–2.

59. Lewandowska-Pietruszka Z, Figlerowicz M, Mazur-Melewska K. The History of the Intestinal Microbiota and the Gut-Brain Axis. Pathogens. 2022 Dec 15;11(12):1540.

60. Smith D, Jheeta S, Fuentes HV, Street B, Palacios-Pérez M. Microbiome–Gut Dissociation in the Neonate: Autism-Related Developmental Brain Disease and the Origin of the Placebo Effect. Gastrointest Disord. 2022 Nov 7;4(4):291–311.

61. Chernikova MA, Flores GD, Kilroy E, Labus JS, Mayer EA, Aziz-Zadeh L. The Brain-Gut-Microbiome System: Pathways and Implications for Autism Spectrum Disorder. Nutrients. 2021 Dec 16;13(12):4497.

62. Salim S, Banu A, Alwa A, Gowda SBM, Mohammad F. The gut-microbiota-brain axis in autism: what Drosophila models can offer? J Neurodev Disord. 2021 Dec;13(1):37.

63. Dargenio VN, Dargenio C, Castellaneta S, De Giacomo A, Laguardia M, Schettini F, et al. Intestinal Barrier Dysfunction and Microbiota–Gut–Brain Axis: Possible Implications in the Pathogenesis and Treatment of Autism Spectrum Disorder. Nutrients. 2023 Mar 27;15(7):1620.

64. Morton JT, Jin DM, Mills RH, Shao Y, Rahman G, McDonald D, et al. Multi-level analysis of the gut–brain axis shows autism spectrum disorder-associated molecular and microbial profiles. Nat Neurosci. 2023 July;26(7):1208–17.

65. Wang X, Li Y, Wu L, Xiao S, Ji Y, Tan Y, et al. Dysregulation of the gut-brain-skin axis and key overlapping inflammatory and immune mechanisms of psoriasis and depression. Biomed Pharmacother. 2021 May;137:111065.

66. Jameson C, Boulton KA, Silove N, Nanan R, Guastella AJ. Ectodermal origins of the skin-brain axis: a novel model for the developing brain, inflammation, and neurodevelopmental conditions. Mol Psychiatry. 2023 Jan;28(1):108–17.

67. Ferraretto A, Donetti E, García-Mena J, Pacheco-López G. Editorial: The gut-skin-brain axis in human health and disease. Front Nutr. 2023 Feb 16;10:1155614.

68. Bowe WP, Logan AC. Acne vulgaris, probiotics and the gut-brain-skin axis - back to the future? Gut Pathog. 2011;3(1):1.

69. Wang X, Zhang C, Xia X, Yang Y, Zhou C. Effect of gender on odor identification at different life stages: a meta-analysis. Rhinol J. 2019 June 1;0(0):0–0.

70. Abdi A, Oroojzadeh P, Valivand N, Sambrani R, Lotfi H. Immunological aspects of probiotics for improving skin diseases: Influence on the Gut-Brain-Skin Axis. Biochem Biophys Res Commun. 2024 Apr;702:149632.

71. Marek-Jozefowicz L, Nedoszytko B, Grochocka M, Żmijewski MA, Czajkowski R, Cubała WJ, et al. Molecular Mechanisms of Neurogenic Inflammation of the Skin. Int J Mol Sci. 2023 Mar 5;24(5):5001.

72. O'Callaghan JP, Miller DB. Neuroinflammation disorders exacerbated by environmental stressors. Metabolism. 2019 Nov;100:153951.

73. Salib AMN, Crane MJ, Jamieson AM, Lipscombe D. Peripheral Ca_V 2.2 Channels in the Skin Regulate Prolonged Heat Hypersensitivity during Neuroinflammation. eneuro. 2024 Nov;11(11):ENEURO.0311-24.2024.

74. Becher B, Spath S, Goverman J. Cytokine networks in neuroinflammation. Nat Rev Immunol. 2017 Jan;17(1):49–59.

75. Eissa N, Sadeq A, Sasse A, Sadek B. Role of Neuroinflammation in Autism Spectrum Disorder and the Emergence of Brain Histaminergic System. Lessons Also for BPSD? Front Pharmacol. 2020 June 16;11:886.

76. Schott W, Nonnemacher S, Shea L. Service Use and Unmet Needs Among Adults with Autism Awaiting Home- and Community-Based Medicaid Services. J Autism Dev Disord. 2021 Apr;51(4):1188–200.

77. Kuo AA, Hotez E, Rosenau KA, Gragnani C, Fernandes P, Haley M, et al. The Autism Intervention Research Network on Physical Health (AIR-P) Research Agenda. Pediatrics. 2022 Apr 1;149(Supplement 4):e2020049437D.

78. Adams D, Young K. A Systematic Review of the Perceived Barriers and Facilitators to Accessing Psychological Treatment for Mental Health Problems in Individuals on the Autism Spectrum. Rev J Autism Dev Disord. 2021 Dec;8(4):436–53.

79. Oommen SP, Bhattacharyya S, Koshy B, Roshan R, Samuel L, Preethi R. Management of Autism Spectrum Disorder: A Case-based Overview. Curr Med Issues. 2017 Jan;15(1):17–27.

80. Strunk J, Leisen M, Schubert C. Using a multidisciplinary approach with children diagnosed with autism spectrum disorder. J Interprofessional Educ Pract. 2017 Sept;8:60–8.

81. Nicholas DB, Muskat B, Zwaigenbaum L, Greenblatt A, Ratnapalan S, Kilmer C, et al. Patient- and Family-Centered Care in the Emergency Department for Children With Autism. Pediatrics. 2020 Apr 1;145(Supplement_1):S93–8.

82. Al Sharif SM. Challenges in managing children with autism spectrum disorder in emergency and hospital settings: strategies for effective care. Emerg Care J [Internet]. 2025 Mar 21 [cited 2025 Aug 10]; Available from: https://www.pagepressjournals.org/ecj/article/view/13366

83. Loizou S, Pemovska T, Stefanidou T, Foye U, Cooper R, Kular A, et al. Approaches to improving mental healthcare for autistic people: systematic review. BJPsych Open. 2024 July;10(4):e128.

84. Mostafa M. THE AUTISM FRIENDLY UNIVERSITY DESIGN GUIDE. Dublin City Univ [Internet]. 2021 May; Available from: https://www.researchgate.net/publication/351936605_THE_AUTISM_FRIENDLY_UNIVERSITY_DESIGN_GUIDE

85. Simpson S. Creating accessible healthcare environments for people with autism. Nurs Times. 2020;116(1):48–50.

86. Simpson S. Checklist for Autism-Friendly Environments. NHS. 2016;

87. Parmar KR, Porter CS, Dickinson CM, Baimbridge P, Pelham J, Gowen E. Autism-friendly eyecare: Developing recommendations for service providers based on the experiences of autistic adults. Ophthalmic Physiol Opt. 2022 July;42(4):675–93.

88. O'Hagan B, Krauss SB, Friedman AJ, Bartolotti L, Abubakare O, Broder-Fingert S, et al. Identifying Components of Autism Friendly Health Care: An Exploratory Study Using a Modified Delphi Method. J Dev Behav Pediatr. 2023 Jan;44(1):e12–8.

89. Huber JF, Loh A, Monga S, Esufali J, Shouldice M. Development of a Novel Multi-Disciplinary Specialized Care Service for Children and Adolescents with Autism Spectrum Disorder and/or Intellectual/Developmental Disability in a Tertiary Children's Hospital Setting. Children. 2022 Dec 27;10(1):57.

90. Wagland Z, Sterman J, Scott-Cole L, Spassiani N, Njelesani J. Promoting Neurodiversity-Affirming Care for Autistic Children: A Scoping Review. Neurodiversity. 2025 July;3:27546330251357479.

91. Bradensen S. Neurodiversity-affirming clinical care for adults with intellectual and developmental disabilities. In: International Review of Research in Developmental Disabilities [Internet]. Elsevier; 2024 [cited 2025 Aug 10]. p. 32–75. Available from: https://linkinghub.elsevier.com/retrieve/pii/S2211609524000010

92. Nancarrow T, Rencher J, Wilcock M, Bonell S, Wolke T, Shankar R. Bespoke STOMP training for learning disability teams—Does it work? Br J Learn Disabil. 2019 Sept;47(3):181–7.

93. Clarke L, Fung LK. The impact of autism-related training programs on physician knowledge, self-efficacy, and practice behavior: A systematic review. Autism. 2022 Oct;26(7):1626–40.

94. Corden K, Brewer R, Cage E. A Systematic Review of Healthcare Professionals' Knowledge, Self-Efficacy and Attitudes Towards Working with Autistic People. Rev J Autism Dev Disord. 2022 Sept;9(3):386–99.

95. Butler I, Marsden D. Effects of learning disability and autism training on healthcare professionals' perspectives and practice: a scoping review. Learn Disabil Pract. 2025 Aug 7;28(4):26–33.

96. Suhrheinrich J, Haine-Schlagel R, Chlebowski C, Lee J, Brookman-Frazee L. Participatory training: Highlighting the need for a more inclusive and interdisciplinary approach to training. Autism. 2024 Oct;28(10):2425–9.

Disclosure

Conflict of interest:NIL Payment/sevices info:All authors have declared that they have no financial support was received from any organization for the submitted work.

BEYOND THE SURFACE: HOW SKIN DISORDERS AFFECT MENTAL HEALTH IN INDIVIDUALS WITH AUTISM SPECTRUM DISORDER.

ORIGINALITY REPORT

8%	5%	6%	1%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	"The Massachusetts General Hospital Guide to Medical Care in Patients with Autism Spectrum Disorder", Springer Science and Business Media LLC, 2018 Publication	1%
2	www.frontiersin.org Internet Source	1%
3	www.mdpi.com Internet Source	<1%
4	iacc.hhs.gov Internet Source	<1%
5	ijsrset.com Internet Source	<1%
6	journals.plos.org Internet Source	<1%
7	Submitted to Missouri Baptist University Student Paper	<1%
8	www.journalijar.com Internet Source	<1%
9	Current Topics in Neurotoxicity, 2015. Publication	<1%
10	mdpi-res.com Internet Source	<1%
11	www.ncbi.nlm.nih.gov Internet Source	<1%

12	Victoria Knight, Emily Sartini, Amy D. Spriggs. "Evaluating Visual Activity Schedules as Evidence-Based Practice for Individuals with Autism Spectrum Disorders", Journal of Autism and Developmental Disorders, 2014 Publication	<1 %
13	Submitted to King's College Student Paper	<1 %
14	"Handbook of Treatments for Autism Spectrum Disorder", Springer Science and Business Media LLC, 2017 Publication	<1 %
15	"Harper's Textbook of Pediatric Dermatology", Wiley, 2019 Publication	<1 %
16	James B. McCarthy. "Psychosis in Childhood and Adolescence", Routledge, 2014 Publication	<1 %
17	zir.nsk.hr Internet Source	<1 %
18	orca.cardiff.ac.uk Internet Source	<1 %
19	paperity.org Internet Source	<1 %
20	pmc.ncbi.nlm.nih.gov Internet Source	<1 %
21	childrenshealthdefense.org Internet Source	<1 %
22	"Development of the Cerebellum from Molecular Aspects to Diseases", Springer Nature, 2017 Publication	<1 %

23	Mohammed Al-Beltagi, Nermin Kamal Saeed, Adel Salah Bediwy, Eman A Bediwy, Reem Elbeltagi. "Decoding the genetic landscape of autism: A comprehensive review", World Journal of Clinical Pediatrics, 2024 Publication	<1 %
24	file.klinikpsikiyatri.org Internet Source	<1 %
25	jeatdisord.biomedcentral.com Internet Source	<1 %
26	link.springer.com Internet Source	<1 %
27	openresearch.lsbu.ac.uk Internet Source	<1 %
28	Corcoran, Jacqueline, Walsh, Joseph. "Clinical Assessment and Diagnosis in Social Work Practice", Clinical Assessment and Diagnosis in Social Work Practice, 2022 Publication	<1 %
29	Ebru Emekli-Alturfan. "Zebrafish Models of Neurodegenerative Disorders", CRC Press, 2025 Publication	<1 %
30	Fay Paxton. "Foundations of Naturopathic Nutrition - A Comprehensive Guide to Essential Nutrients and Nutritional Bioactives", Routledge, 2025 Publication	<1 %
31	Leny Mathew, Elizabeth Kauffman, Rebecca Schmidt, Irva Hertz-Picciotto, Kristen Lyall. "Chapter 102054 Environmental Risk Factors for Autism", Springer Science and Business Media LLC, 2021 Publication	<1 %

32	Panos Katakis, Paige Frankson, Georgia Lockwood Estrin, Jeanne Wolstencroft et al. "Families' and clinicians' experiences with telehealth assessments for autism: A mixed-methods systematic review", PLOS Digital Health, 2025 Publication	<1 %
33	Stephen J. Macdonald, Donna Peacock. "The Routledge Handbook of Disability, Crime, and Justice", Routledge, 2025 Publication	<1 %
34	assets-eu.researchsquare.com Internet Source	<1 %
35	eprints.ncl.ac.uk Internet Source	<1 %
36	livecomplexitytraining.com Internet Source	<1 %
37	swhealthcare.intersearch.com.au Internet Source	<1 %
38	www.psychiatrist.com Internet Source	<1 %
39	www.wjgnet.com Internet Source	<1 %
40	Maria Suprunowicz, Natalia Tomaszek, Agata Urbaniak, Klaudia Zackiewicz, Stefan Modzelewski, Napoleon Waszkiewicz. "Between Dysbiosis, Maternal Immune Activation and Autism: Is There a Common Pathway?", Nutrients, 2024 Publication	<1 %
41	B. Potts, H.P. White. "Student radiographers' confidence of adapting practice for autistic patients: A qualitative survey on the role of placement experiences", Radiography, 2024	<1 %

Publication

42	Mohammed Al-Beltagi, Nermin Kamal Saeed, Adel Salah Bediwy, Reem Elbeltagi, Rawan Alhawamdeh. "Role of gastrointestinal health in managing children with autism spectrum disorder", World Journal of Clinical Pediatrics, 2023 Publication	<1%

Exclude quotes	On	Exclude matches	Off
Exclude bibliography	On		