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REVIEW

Association Between Atopic Dermatitis and Aging: Clinical Observations and Underlying Mechanisms

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Abstract: As one of the most prevalent chronic inflammatory skin diseases, atopic dermatitis (AD) increasingly affects the aging population. Amid the ongoing global aging trend, it's essential to recognize the intricate relationship between AD and aging. This paper reviews existing knowledge, summarizing clinical observations of associations between AD and aging-related diseases in various systems, including endocrine, cardiovascular, and neurological. Additionally, it discusses major theories explaining the correlation, encompassing skin-mucosal barriers, systemic inflammation and stress, genes, signal transduction, and environmental and behavioral factors. The association between AD and aging holds significant importance, both in population and basic perspectives. While further research is warranted, this paper aims to inspire deeper exploration of inflammation/allergy-aging dynamics and the timely management of elderly patients with AD.

Keywords: atopic dermatitis, aging, age-related diseases, clinical observations, mechanical theories

Introduction

Overview of Atopic Dermatitis and Its Elderly Subtype

Atopic dermatitis (AD) stands as the predominant chronic inflammatory skin condition, representing a significant health burden among non-fatal skin diseases.[1] The onset and progression of AD are largely influenced by the complex interaction between environmental factors, neuro-immune responses, and skin barrier integrity.[2] Characterized by recurrent eczematous lesions and severe itching, AD significantly impairs quality of life.[1] Recognizing the variability in clinical manifestations across the lifespan, AD is traditionally divided into three age-based categories: infancy, childhood, and adolescence/adulthood. Recent empirical research has identified a distinct subtype of AD that affects the elderly, often manifesting lichenified eczema around the typically uninvolved flexural areas of the elbows and knees.[3,4] Dupilumab has shown rapid efficacy for this phenotype.[5] The distinctions between elderly AD and classic AD are elucidated in Table 1.

AD has seen a marked rise in global prevalence and incidence,[12] with up to 10% of adults affected.[13] Small-scale studies indicate significant international variation in AD prevalence among the elderly, ranging from 1.6% to 4%, and increasing with age.[1,14–19] However, it's crucial to note that the reported prevalence may underestimate the true impact, due to factors such as limited healthcare access for seniors, especially in underserved regions, and diagnostic challenges that can lead to AD being obscured or misdiagnosed.

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Table 1 The Differences Between Elderly AD and Classic AD

	Classic AD (Infant/Teenager)	Elderly AD
Pathogenesis	Th2 type inflammation predominant[6]	Bias toward mixed Th2/Th17/Th22 inflammation[7]
Rash	Acute or chronic eczema mainly on the head, face, and flexors of the extremities	Reverse symptoms of lichenified eczema around the extremities, back, etc.[3,8]
Endophenotype	Extrinsic AD (elevated total IgE levels and/or positive specific IgE) predominant	Intrinsic AD (normal total IgE levels and negative specific IgE) predominant[7]
Peripheral blood eosinophil count	Elevated	Normal or reduced[7]
Comorbidity	Atopic diseases such as allergic rhinitis, asthma, and food allergy	Cardiovascular,[9] psychiatric diseases,[10] Atopic diseases, osteoporosis,[11] etc

Association Between Aging and AD

Aging once deemed an inevitable aspect of the life cycle, is now understood to be a dynamic and modifiable biological process.[20] Globally, the population aged 65 and over is rising, with forecasts predicting a continued increase, surpassing 14% of the global population by 2040.[14] These demographic transformations present both opportunities and challenges for the study of age-related maladies and their biological foundations, a field that is already evolving and expected to grow.

AD demonstrates a biological connection with the aging process, evident in its disease profile. The research underscores the elevated prevalence of active AD among both children and the elderly,[12] possibly shifting primary AD care towards older demographics.[21,22] Subsequent investigations have uncovered unique immune responses in elderly AD sufferers, characterized by reduced serum IgE and eosinophil counts, and suggest links between AD and the aging of multiple systems, from both diseased and pre-diseased aspects.[7,18]

While these associations are apparent, a comprehensive synthesis of existing evidence is lacking. This narrative review consolidates clinical findings and foundational researches on AD and the aging process, utilizing a broad search across multiple databases and incorporating reverse citations up to September 2023. It summarizes recent clinical observations (Figure 1) and underlying mechanisms (Figure 2), aiming to clarify the relationship between AD and aging. However, it is important to note that narrative reviews may inherently lack an objective appraisal of the research evidence.

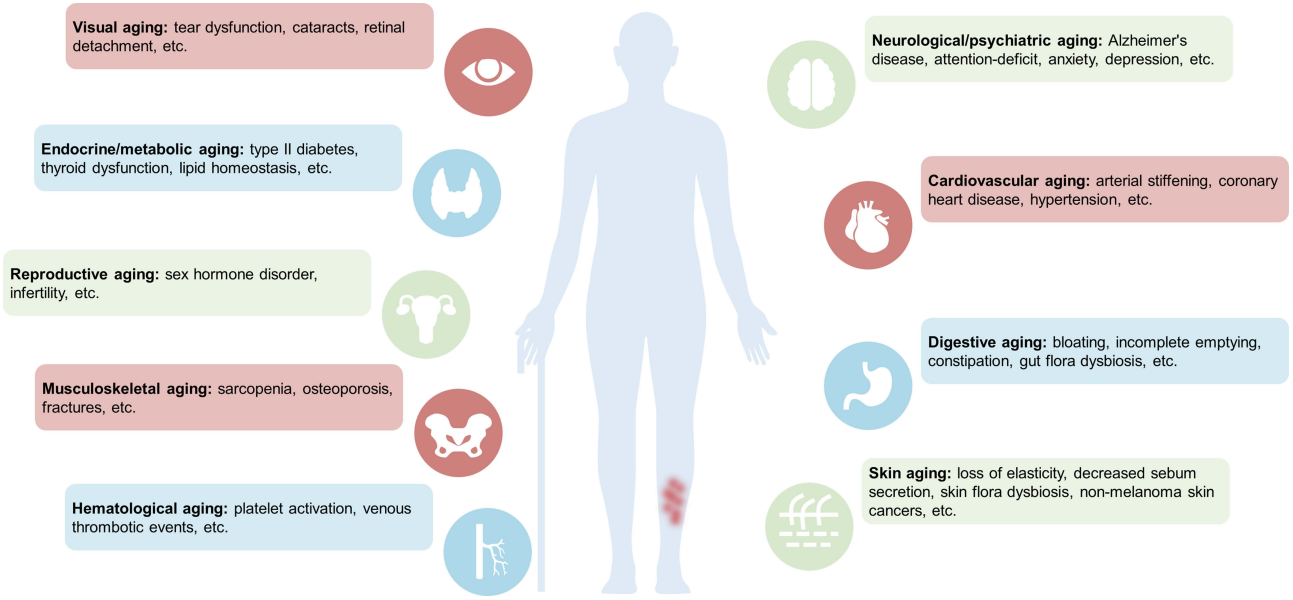

Figure 1 Clinical observations of the possible relationship between AD and aging.

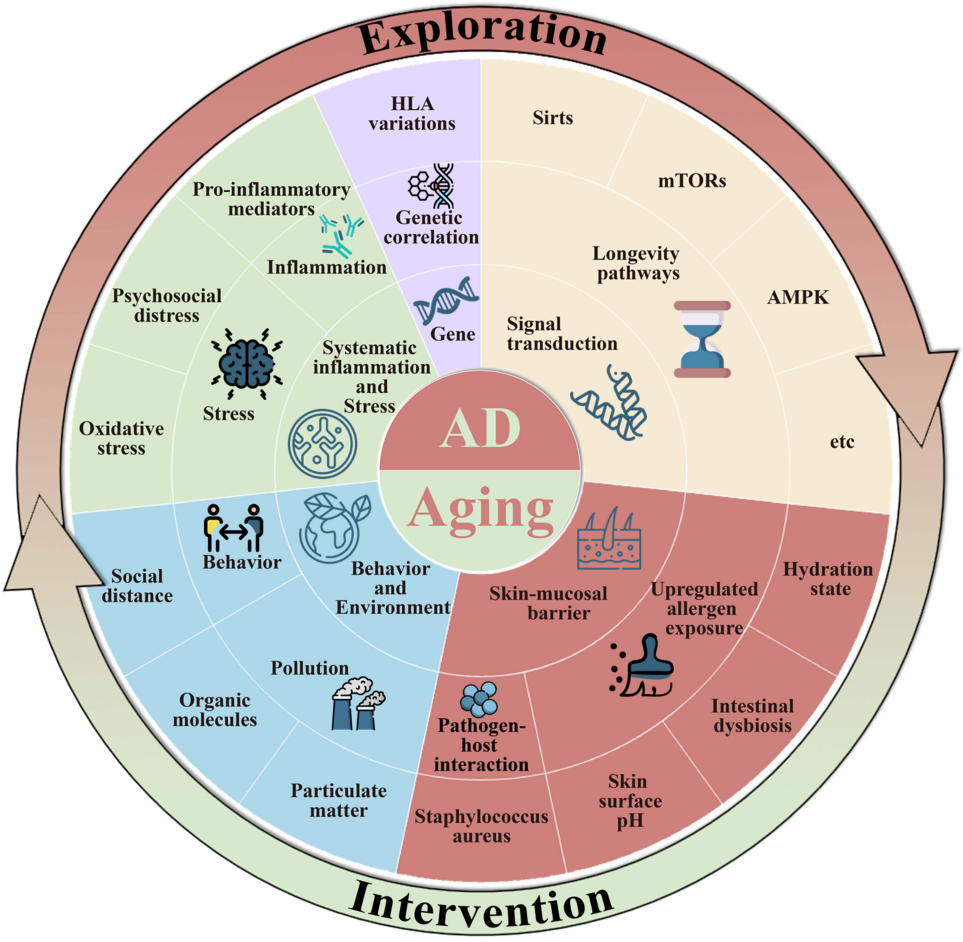

Figure 2 Potential mechanisms underlying the association between AD and aging.

Evidence from Clinical Observation

AD and Skin Aging

Skin aging, influenced by intrinsic factors like genetics and hormones, and extrinsic factors like ultraviolet radiation and pollutants, presents clinically with pigmentation changes, tissue atrophy, reduced elasticity, and impaired damage repair.[23] Additionally, it involves alterations in skin appendages, resulting in dryness and itching due to decreased sebum and sweat gland secretion.[24] Notably, aging also correlates with an increased incidence of non-melanoma skin cancers (NMSC).[25]

There is evidence linking skin aging, particularly in the elderly, to the development of AD. Age-related skin changes, such as a weakened skin barrier, increased colonization by *Staphylococcus aureus* (SA), innate immune system dysregulation, and pro-inflammatory type 2 T helper cell responses, may contribute to AD.[8] Researches show a positive correlation between AD severity and reduced skin lipid composition, including triglycerides, and decreased skin elasticity.[26–28] Patients with AD are also more susceptible to skin microbiome dysbiosis, characterized by increased SA and decreased *Staphylococcus epidermidis* (SE),[1,29,30] and bacteriotherapy may be beneficial.[30,31] Furthermore, AD may be associated with certain types of NMSC, possibly due to the chronic inflammatory state.[32] In summary, both AD and skin aging share immune response alterations, microflora changes, and reduced sebum content, and they tend to mutually reinforce each other.

AD and Cardiovascular Aging

Aging-related pathologies affecting the cardiovascular system primarily manifest as arterial stiffening, calcification, and myocardial cell function decline.[33] The aging process leads to arterial wall hardening, driven by an accumulation of

collagen and a loss of elastic proteins, possibly mediated by the expression of transforming growth factor-β and altered activity of elastic proteinases like matrix metalloproteinases (MMPs).[34] These pathological changes contribute to the development of essential hypertension and other cardiovascular diseases, including coronary heart disease.

The relationship between atopic dermatitis (AD) and cardiovascular diseases is a topic of active discussion, with a focus on whether systemic inflammation or traditional cardiovascular risk factors—such as obesity, smoking, and alcohol consumption—are the underlying links.[35–37] Studies that have accounted for these risk factors suggest that patients with AD do not have an inherently higher risk of cardiovascular diseases.[37–39] However, there is a stronger positive association with hypertension in cases of severe AD.[40] Moreover, foundational researches have identified elevated levels of cardiovascular risk biomarkers in patients with moderate to severe AD, indicating the potential presence of proteins, possibly skin-derived, that are upregulated in the bloodstream.[41–43] Recent US research, based on a nationally representative sample, has shown a correlation between coronary heart disease and AD, particularly in women and younger individuals, which may be associated with Th2 inflammation.[44] This suggests that previous studies with negative findings may not have adequately classified AD or its patient subgroups, resulting in an incomplete understanding of the cardiovascular risks exacerbated by AD-induced vascular inflammation. Therefore, the interplay between AD and cardiovascular aging requires continued and meticulous scrutiny and investigation.

AD and Hematological Aging

Aging profoundly impacts the hematological system, influencing immune system development, the microenvironment of hematopoietic stem cells, and the functionality of blood cells. It is commonly linked to decreased platelet counts and enhanced platelet reactivity, particularly in terms of aggregation.[45,46] Additionally, aging affects the coagulation system, predisposing individuals to a hypercoagulable state and raising the incidence of thrombotic conditions, such as venous thrombotic events (VTE).[47]

Research by Willeit et al has identified elevated levels of miRNA-24 and miRNA-191 in the plasma of patients with AD, which are associated with biomarkers of platelet activation.[48] Recent studies have also revealed a significantly heightened risk of VTE in patients who exhibit moderate to severe AD, are aged 45 and over, and do not have diabetes or use systemic corticosteroids.[49–51] In light of these findings, a more proactive screening and preventative approach to thrombosis may be warranted for elderly AD patients with additional risk factors for VTE, such as extended periods of immobility or the presence of malignancies.

AD and Endocrine/ Metabolic Aging

The aging process significantly affects the endocrine system, resulting in notable impacts on nutrient metabolism and hormonal fluctuations.

Aging impairs insulin secretion and blood glucose control by reducing the frequency and amplitude of insulin pulses and hindering the conversion of glucose to muscle glycogen.[52,53] The link between allergic diseases and blood glucose regulation has garnered attention. While epidemiological studies suggest an elevated risk of type II diabetes (T2D) in adults with AD,[54,55] this association is complex and not fully understood, with potential confounding factors such as age and glucocorticoid use needing further consideration.[56,57] A study that controlled for these factors found no significant differences in glucose metabolism between patients with AD and non-AD controls,[58] However, this study had limitations, involving only 16 young patients with mild to moderate AD, failing to demonstrate AD's impact on blood glucose fluctuations. Moreover, pathways associated with both complement and diabetes are reportedly more prevalent in adult AD.[59] Thus, AD may not directly affect glucose metabolism, but close monitoring of blood glucose in elderly patients with AD is a prudent precaution to detect potential metabolic changes linked to systemic inflammation.

Lipid metabolism is also impacted by aging, with increased levels of plasma LDL-C and total triglycerides observed, particularly in post-menopausal women.[60–64] In contrast, HDL-C levels remain relatively stable or slightly increase in elderly men but may decrease in post-menopausal women.[60,65] Recent research has identified an inverse correlation between triglyceride/LDL levels and AD, supported by Mendelian randomization.[66]

Age-related thyroid dysfunction is another area of concern, with a decline in serum T3 levels and a rise in TSH levels associated with an increased incidence of subclinical or overt hypothyroidism.[67–69] While research on the link

between AD and thyroid dysfunction in adults is limited, a study by Smith et al reported a significant association between the two, particularly in younger males, after accounting for potential confounders.[70] This connection may be due to shared immune dysregulation and cytokine pathways, and is further supported by overlapping genetic susceptibility loci.[71]

AD and Reproductive Aging

The maturation of the reproductive system marks the transition to puberty, while the aging process brings about a decline in reproductive function, including reduced sex hormones and fertility.[72] In males, aging often results in primary testicular failure, leading to lower androgen levels and a decrease in sperm count and quality.[73,74] Females experience a more rapid aging of the reproductive system,[75] which significantly impacts ovarian function, resulting in a decline in the number of oogonia and a reduction in estrogen levels.[76–79] Additionally, aging affects reproductive capacity and egg quality, with maternal age being a key determinant of pregnancy success and clinical outcomes.[80,81]

The association between sex hormones and AD has long intrigued researchers. Estrogen is believed to benefit the skin barrier and potentially alleviate AD, whereas progesterone and testosterone may exert negative effects.[82,83] However, findings from numerous studies on the link between AD and sex hormone levels are inconsistent[84–87] and have methodological limitations. For instance, the study by Vinnik et al may not be representative due to the selection of new-onset AD cases and the short duration of observation. Similarly, the population-based data from Kische et al may not accurately reflect the incidence, severity, or subtypes of AD. Future research should concentrate on life stages with significant hormonal changes, such as adolescence, pregnancy, and the menopausal transition. It should also consider subgroup analyses that account for both endogenous and exogenous factors, AD severity, and not just individual sex hormone levels but also receptor levels and sensitivity.[87,88] Alternatively, cytokines like IL-4 and IL-13 are known to stimulate the upregulation of 3β-hydroxysteroid dehydrogenase 1, which can promote androgen secretion in individuals with AD.[89] Furthermore, patients with AD often exhibit lower Vitamin D levels, which may be associated with hormonal fluctuations and reduced fertility.[90–93] A nationwide retrospective cohort study revealed that both mild and moderate-to-severe AD were significant risk factors for infertility.[94]

AD and Visual Aging

Aging significantly impacts the visual system, leading to an increased incidence of eye diseases, including tear dysfunction, age-related macular degeneration, cataracts, glaucoma, retinal detachment, and a general decline or loss of vision.[95–101] Patients with AD may experience premature aging of the visual system, which can manifest as tear film dysfunction and a heightened risk of spontaneous retinal detachment, potentially related to chronic eye rubbing and underlying connective tissue issues.[102–105] A study by Thyssen et al has identified a significant association between cataracts and individuals under 50 with both mild and severe AD.[106] For elderly individuals with AD, it may be thoughtful to closely monitor vision and overall eye health, particularly if they have facial or periocular involvement of AD.

AD and Digestive Aging

Digestive system aging is marked by a decline in digestive and absorptive efficiency, attributable to the degeneration of endogenous digestive enzymes,[107] alterations in endocrine hormone activity,[108] and atrophy of the small intestinal villi.[109] Additionally, age-related gastrointestinal motility disorders can precipitate difficulties in swallowing, gastro-esophageal reflux, constipation, and fecal incontinence, potentially linked to neural degeneration within the myenteric plexus of the gastrointestinal nervous system.[110] The gut microbiota also undergoes compositional changes, reflecting an ecological imbalance with a decrease in beneficial microorganisms like *Bifidobacteria* and a relative increase in potentially inflammatory bacteria, such as *Staphylococcaceae, Enterobacteriaceae*, and *Enterococcaceae*.[108,111]

Individuals with AD are more susceptible to gastrointestinal symptoms such as bloating, a sense of incomplete bowel emptying, and constipation.[112] The gut microbiota, a key regulator of the gut-skin axis, is integral to the interplay between AD and digestive health. Studies have shown that patients with AD often have a diminished diversity of gut

microbiota, with a reduction in beneficial bacteria like *Bifidobacterium* and a concurrent rise in SA,[113] mirroring changes observed with aging. Notably, Bifidobacterium's ability to metabolize indole derivatives may offer therapeutic potential for AD through the aryl hydrocarbon receptor signaling pathway.[114] This suggests that future research could benefit from exploring the specific metabolic pathways and metabolites of the gut microbiota to better understand the intricate dynamics among gut microbiota, AD, and the aging process.

AD and Musculoskeletal Aging

Aging has a profound impact on the musculoskeletal system, often resulting in skeletal muscle atrophy and metabolic imbalances of calcium and phosphate, which can lead to conditions such as sarcopenia and osteoporosis. These changes can manifest in negative health outcomes like fatigue, increased susceptibility to falls, and fractures.[115–117]

Recent research, encompassing observational studies and Mendelian randomization analysis, has shed light on the relationship between AD and sarcopenia.[118] Elderly patients with AD, especially those with longer disease duration, lower vitamin D levels, and systemic inflammation, face higher osteoporosis and fracture risks, recognized by the American Academy of Dermatology.[11,119–123] Hence, appropriate exercises programs, proactive osteoporosis intervention, and education on fall prevention might be considered essential for elderly patients with AD, whose benefits still require further research for substantiation.

AD and Neurological/Psychiatric Aging

Aging profoundly impacts the nervous system, leading to often irreversible neurological changes. This process results in a decline in cognitive abilities, emotional regulation, and autonomic function, which can negatively affect the quality of life, including social engagement, mental health, and physical performance.[124] Aging is also the leading risk factor for neurodegenerative diseases.[125–128] Furthermore, it also significantly influences the peripheral nervous system, particularly the cardiac and gastrointestinal components. Aging diminishes the ability of β-adrenergic stimulation to augment heart rate and cardiac output.[129] Age-related changes in the quantity and distribution of neurons in the gastrointestinal nervous plexus can lead to increased incidences of autonomic disorders such as arrhythmias and constipation.[130]

Patients with AD may experience a gradual decline in cognitive function, with an increased risk of developing dementia, especially Alzheimer's disease.[10,131] Childhood AD correlates with elevated rates of memory impairment, developmental delay, and attention-deficit/hyperactivity disorder.[132] Prospective and retrospective studies indicate that adult patients with AD are more prone to anxiety and depression, suggesting a possible bidirectional relationship between psychological distress and the severity of AD.[133,134] These observations underscore the complexity of psychological distress in elderly AD, necessitating further comprehensive research while considering confounding factors like social support, the level of national development, and gender differences.

Possible Mechanisms

Skin-Mucosal Barrier

Research on AD has highlighted the critical role of the skin and mucosal barriers. This barrier function intricately involves interactions among various innate and adaptive immune cells.[135] In AD, compromised epithelial cells release key cytokines such as thymic stromal lymphopoietin (TSLP), IL-33, and IL-25, which activate dendritic cells (DCs). These, in turn, prompt a type 2 immune response by stimulating Th2 cells and group 2 innate lymphoid cells (ILC2s).[136] This response involves a cascade of interactions among DCs, ILC2s, Th2 cells, and tissue cells, amplifying pathological immune reactions and further disrupting the skin barrier, perpetuating a detrimental cycle.[137] Specifically, Th2-derived cytokines like IL-4, IL-13, and IL-33 can impair the skin barrier by downregulating the expression of human beta-defensin (hBD)-3 and filaggrin, and by inhibiting the upregulation of tight junction proteins and hBD-2.[138] Additionally, the normally beneficial SE, which aids in ceramide synthesis and barrier maintenance, is less prevalent in individuals with AD.[139]

The integrity of the skin barrier is a focal point in dermatological research, particularly in the context of aging. With age, there is an increase in transepidermal water loss and a decrease in the integrity of the stratum corneum, along with a slower recovery from barrier disruption.[140,141] Aging also diminishes hydration of the stratum corneum and elevates skin surface pH due to decreased sebum and filaggrin, thereby increasing pro-inflammatory cytokines such as TNF-α, IL-6, and IL-1a.[139,142–145] Additionally, aging promotes colonization by SA on the skin, which suppresses the expression of fatty acid elongase enzymes through the production of pro-inflammatory cytokines.[8,146] These age-related factors collectively weaken the skin barrier, triggering cytokine release that activates a type 2 immune response in epithelial cells.

Attention has also been drawn to the role of a compromised mucosal barrier in exacerbating inflammation by facilitating the entry of allergens and environmental factors. In the context of AD and aging, there is a growing interest in how intestinal dysbiosis can lead to mucosal barrier disruption and increased sensitivity to food allergens.[147,148] The gut microbiota from younger individuals has been shown to enhance the physical fitness of the elderly by altering skin gene expression, such as increasing the transcription of *Drebrin 1* (*Dbn1*), which aids in restoring barrier function.[148]

Systematic Inflammation and Stress

The link between allergic diseases, including AD, and aging is often explained by the concept of "inflammaging", which denotes a subtle, chronic, and low-grade inflammatory state associated with aging.[149] This state is characterized by a persistent activation of the innate immune system, leading to elevated levels of pro-inflammatory cytokines such as TNF-α, IL-1β, and IL-6 in the bloodstream.[150] Unlike the acute inflammation that serves as a protective response to infection or injury, chronic inflammation with age is implicated in the development of various diseases, including type 2 diabetes, cardiovascular disease, and neurodegenerative disorders.[20] Moderate to severe or poorly controlled AD often coincides with the similar chronically activated innate immune state,[151] heightening the risk of age-associated disease progression.

Stress is also a critical factor in aging, with acute yet non-lethal stressors like oxidative stress and DNA damage capable of inducing cellular senescence. This process triggers the release of signals that can cause nearby healthy cells to also become senescent, leading to a buildup of senescent cells and contributing to the aging process.[152] In AD, the compromised skin barrier increases the likelihood of allergens and environmental stressors affecting the skin, enhancing the production of reactive oxygen species and further fueling the chronic inflammation characteristic of AD, which can lead to cellular senescence.[153,154] Furthermore, senescent cells secrete a class of substances known as senescence-associated secretory phenotype, encompassing diverse cellular factors associated with AD.[155] Consequently, senescent cells themselves may partially contribute to AD progression.

At the individual level, stress refers to the body's response to new challenges—physical, emotional, or psychosocial—that disrupt homeostasis and trigger adaptive responses aimed at restoring balance.[156] Aging is generally thought to reduce the body's resilience to stressors, which can in turn accelerate the aging process.[157] Although AD is not typically life-threatening, it can cause significant stress due to chronic symptoms like itch-induced sleep disturbances, psychosocial challenges, and a tendency for relapses.[149,158] This chronic stress may increase the stress burden on an individual and could potentially accelerate the aging process.

Genes

Aging, age-related ailments, and AD, are complex traits that have been extensively studied through genome-wide association studies. Consequently, numerous susceptibility loci associated with these traits have been revealed, prompting geneticists to explore the role of these loci in trait expression.[159,160] For instance, as mentioned in Chapter 3.1, the gene *Dbn1* can enhance skin hydration and cognitive function, potentially offering protective effects against both AD and the aging process.[148]

Researchers have also used genomic association analysis to uncover shared susceptibility loci among different comorbidities, providing insights into why certain conditions often co-occur.[159,160] Recently, Zhou et al performed a comprehensive genome-wide linkage analysis for asthma, various cardiovascular diseases or traits, and pinpointed 145 overlapping susceptibility loci encompassing 99 genes linked to asthma and heart failure.[161] This finding suggests

a potential genetic link between asthma, AD, and other aging-related diseases, indicating a shared genetic predisposition. Additionally, AD has been observed to have a protective effect against dyslipidemia, which may be due to the unique genetic profile of individuals with allergic diseases.[66]

Variations in human leukocyte antigen (HLA) have been extensively proven to be significantly associated with allergic diseases.[162] Studies have suggested a correlation between *HLA-DR* expression and serum triglyceride levels, as well as a link between *HLA-DQB1* variations and lipid metabolism, which could influence longevity.[163,164] It is hypothesized that individuals with allergies may possess specific HLA variants that help maintain lipid balance and potentially extend life expectancy. Overall, future research may focus on genetically defining AD subtypes and elucidating the molecular mechanisms that underlie the genetic regulation of AD and aging traits, which could lead to more targeted and effective treatments.

Signal Transduction

Cellular functions are governed by complex molecular processes that are regulated through various signal transduction pathways. Recent progress in the fields of aging biology and immunology has highlighted how these interconnected pathways can impact both the aging process and the development of immunological diseases. Certain gene-related signal pathways have emerged as key regulators of aging and lifespan, including insulin-like growth factor-1, the target of rapamycin (TOR), AMP-activated protein kinase (AMPK), and Sirtuins.[33,165,166]

Researchers have found that the Sirtuin protein family, particularly Sirtuin6, influences the regulation of AMPK/TOR and genome integrity.[33] Sirtuins, a class of histone deacetylases, consist of seven members with varying substrate affinity and subcellular localization.[167,168] An increase in Sirtuin6 expression is associated with improved repair of genomic damage and extended longevity in various species.[169] While the role of Sirtuins in AD is still under investigation, studies indicate reduced Sirtuin1 levels in AD. Epithelial-specific Sirtuin1 removal leads to AD-like skin issues, increased sensitivity to allergens, and reduced expression of the *Filaggrin* gene.[170] Additionally, MMP-1 expression induced by transient receptor potential vanilloid-1 (TRPV1) is crucial in skin aging and in the development of itch associated with histamine, IL-31, and TSLP.[166]

In summary, specific signal transduction pathways are likely to be essential in the interplay between AD and aging, potentially through their regulation of inflammation and disease progression.

Environment and Behavior

VCharacteristics of modern urban living and industrialization, such as increased night-time exposure to artificial light, air pollution, and a more sedentary lifestyle, are known to exacerbate atopic conditions, including AD.[171–174] These factors not only influence the incidence of AD but also potentially affect the aging process. A prominent example is particulate matter (PM), with epidemiological studies firmly establishing a link between PM exposure and AD incidence.[175] Experimental studies have demonstrated that PM2.5 exposure can compromise the skin barrier and provoke keratinocytes to release pro-inflammatory cytokines, thereby facilitating the onset of AD.[176,177] Additionally, the impact of PM on aging and aging-related diseases has gained attention. A study of 730 mother-infant pairs has shown that maternal exposure to PM2.5 during pregnancy correlates negatively with telomere length in neonatal cord blood and placental tissue.[178] PM-like particles have also been implicated in the development of age-related conditions such as dementia, cognitive decline, and hypertension,[179–181] suggesting a commonality of environmental risk factors between AD and aging.

Behavioral factors also elucidate the connection between AD, aging, and age-related diseases. Individuals with AD frequently face bullying, self-isolation, and difficulties in social interaction and forming close relationships.[182–184] These negative experiences can diminish social participation and lead to psychological and behavioral issues that are often associated with age-related diseases.[185–187] Consequently, AD may heighten susceptibility to age-related diseases through its impact on social behavior and mental health.

The mechanisms outlined above are visually summarized in Figure 3 for representation.

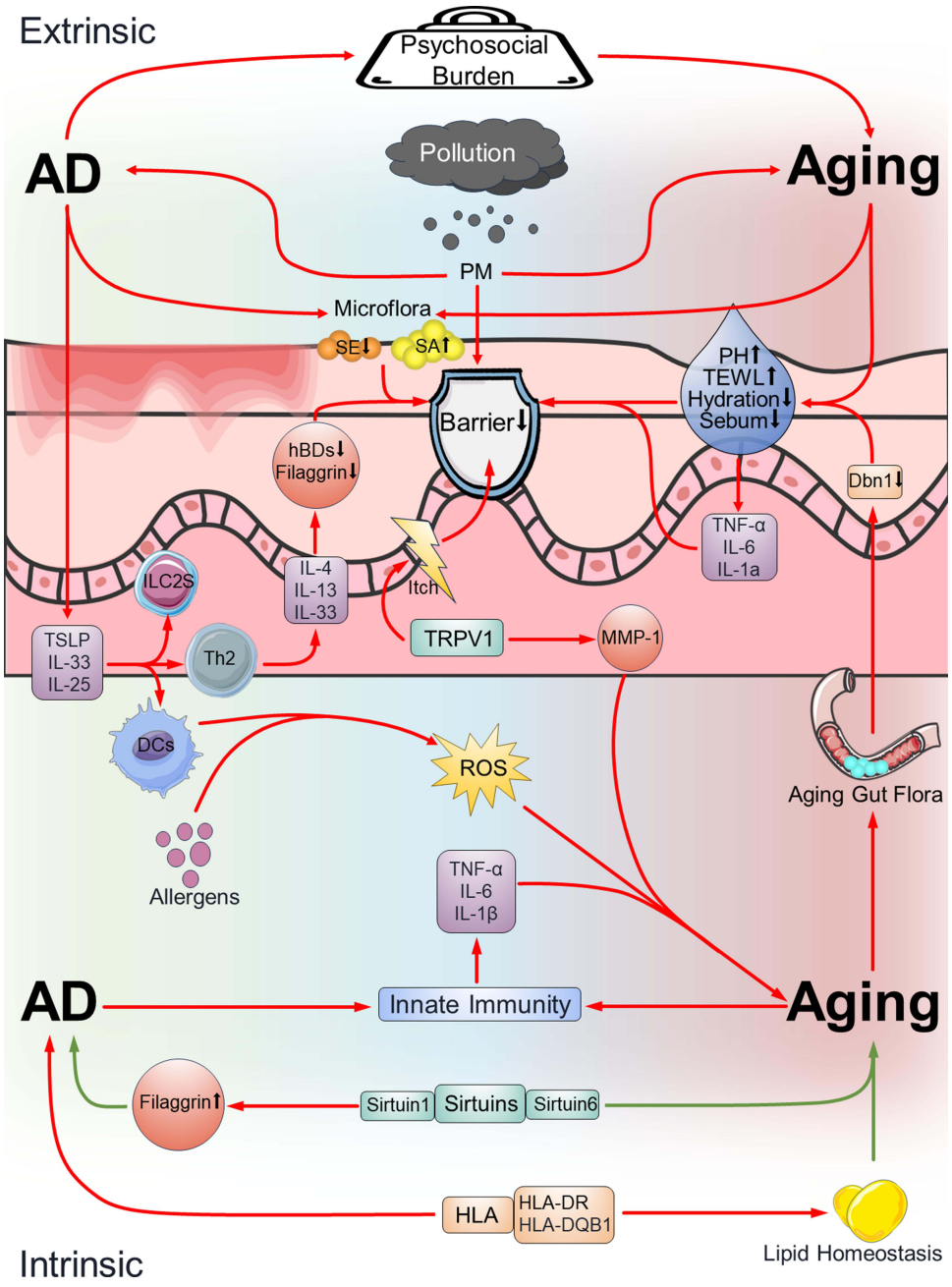

Figure 3 The network of representative mechanisms connecting AD and aging Red lines represent promotion, and green lines represent inhibition.
Abbreviations: AD, atopic dermatitis; PM, particulate matter; TEWL, transepidermal water loss; SA, Staphylococcus aureus; SE, Staphylococcus epidermidis; IL, interleukin; MMP, matrix metalloproteinase; TSLP, thymic stromal lymphopoietin; DCs, dendritic cells; ILC2s, activate group 2 innate lymphoid cells; hBDs, human beta-defensins; Dbn1, drebrin 1; ROS, reactive oxygen species; HLA, human leukocyte antigen; TRPV1, transient receptor potential vanilloid.

Conclusion

In conclusion, AD exhibits a positive correlation with aging and aging-related diseases in clinical practice, with exceptions such as the relationship between AD and dyslipidemia. While high-quality evidence for these associations is limited, some prospective cohort studies and Mendelian randomization analyses have begun to explore potential causal relationships. In the treatment of elderly patients with AD, it is crucial to consider both comorbid conditions and age-related factors.[188]

Mechanistically, the association between AD and aging is multifaceted, involving a complex interplay among various theories and forming a sophisticated regulatory network. Examining the relationship between AD and aging is significant,

whether from a population health or a basic science perspective. Firstly, a clear understanding of this association, particularly the element of causality, is essential for developing effective prevention and treatment strategies for AD in our aging population, thereby improving the health outcomes of older adults with AD. Secondly, insights into the underlying mechanisms can enhance our knowledge of the pathophysiology of both AD and aging, paving the way for more targeted interventions. Lastly, this review underscores the significant impact of chronic systemic inflammation, such as that seen in AD, which can accumulate and worsen with age. This realization encourages further research to improve the longevity and quality of life for all individuals.

Abbreviations

AD, atopic dermatitis; NMSC, non-melanoma skin cancers; MMP, matrix metalloproteinase; VTE, venous thrombotic events; T2D, type II diabetes; SA, Staphylococcus aureus; SE, Staphylococcus epidermidis; TSLP, thymic stromal lymphopoietin; DCs, dendritic cells; ILC2s, activate group 2 innate lymphoid cells; hBD, human beta-defensin; Dbn1, Drebrin 1; HLA, human leukocyte antigen; TOR, target of rapamycin; AMPK, AMP-activated protein kinase; TRPV1, transient receptor potential vanilloid 1; PM, particulate matter.

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors declare that they have no competing interests.

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