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Neuropedagogy of Albinism: Visual Impairment, Neurodevelopment, Mental Health and Educational Inclusion

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Abstract: *Albinism is a rare and heterogeneous genetic condition traditionally defined by reduced or absent melanin synthesis and by dermatological and ophthalmological manifestations. However, its functional consequences, particularly congenital visual impairment, extend beyond the biomedical dimension and may influence children's neuropsychological development, behavioural adaptation, educational participation, emotional functioning and social inclusion. This narrative review aims to examine albinism from a neuropedagogical perspective, integrating medical, psychological, neurodevelopmental and educational dimensions. Within this interdisciplinary framework, the review explores the relationship between visual impairment, neuroeducational functioning, anxiety, depression, autism-spectrum features, emotional dysregulation, bullying and school inclusion. Visual impairment associated with albinism should not be understood only as a sensory limitation, but also as a factor that may affect access to information, nonverbal communication, autonomy, peer interaction and classroom participation. Particular attention is given to the differential interpretation of autism-like behaviors, since reduced eye contact, limited access to facial expressions and difficulties in interpreting visual social cues may reflect sensory limitations rather than autism spectrum disorder. Rather than proposing a direct causal relationship between albinism and psychiatric or neurodevelopmental disorders, this article adopts a biopsychosocial and neuropedagogical perspective. Emotional vulnerability may result from the interaction between visual limitations, stigma, bullying, reduced accessibility, limited autonomy, and insufficient educational support. From this perspective, functional vision assessment, individualised educational adaptations, assistive technologies, psychopedagogical support, family counseling and anti-bullying strategies are essential for reducing exclusion and supporting children's development. The review concludes that an interdisciplinary neuropedagogical approach can provide a more comprehensive understanding of albinism and can guide ethical, individualised and inclusive interventions.*

Keywords: *albinism; neuropedagogy; visual impairment; neurodevelopment; anxiety; depression; autism-spectrum features.*

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1. Introduction

Albinism represents a heterogeneous group of rare genetic disorders characterized by reduced or absent melanin synthesis, with cutaneous, ocular and, in some cases, systemic manifestations. In oculocutaneous forms, pigmentation abnormalities are frequently accompanied by ophthalmological alterations, including foveal hypoplasia, nystagmus, photophobia, strabismus and reduced visual acuity. These visual impairments extend beyond ophthalmological limitations, influencing children's functional independence, communication abilities, educational participation and social experiences. Therefore, albinism should not be considered exclusively a dermatological or ophthalmological disorder, but rather a condition with broader educational, psychological and neurodevelopmental implications (Thomas et al., 2023; Federico & Krishnamurthy, 2023).

From a neurodevelopmental perspective, congenital visual impairment associated with albinism may influence the way children explore their environment, acquire information, develop motor coordination, establish adaptive strategies and engage in learning activities. Although many children with albinism demonstrate neurological development within functional limits, early visual deprivation may represent a developmental vulnerability requiring appropriate assessment and support. Recent studies have emphasized the importance of evaluating not only visual function, but also neurovisual abilities, cognitive development, behavioral adaptation and everyday functioning in children with oculocutaneous albinism (Galli et al., 2023; Kutzbach et al., 2008).

From a psychological perspective, children and adolescents with visual impairment may present increased vulnerability to emotional difficulties, including anxiety, depressive symptoms, social withdrawal and reduced self-esteem. However, these difficulties should not be interpreted as intrinsic consequences of albinism, but rather as potential outcomes emerging from the interaction between visual limitations, reduced autonomy, school experiences, stigmatization and the availability of social support. Meta-analytical evidence indicates that the pooled prevalence of depression among visually impaired children and adolescents is approximately 14% (95% CI: 9–20%), with individual studies reporting estimates ranging from 3.3% to 35.6%, reflecting substantial methodological and population heterogeneity. Although these findings are not specific to albinism, they suggest that congenital visual impairment may increase vulnerability to emotional difficulties and support the inclusion of psychological assessment within multidisciplinary care and educational planning (Bakhla et al., 2023).

An important challenge in evaluating children with albinism and visual impairment is distinguishing behaviors associated with limited visual access from those reflecting autism-spectrum characteristics. Reduced eye contact, difficulties interpreting facial expressions, limited recognition of gestures or reduced spontaneous social interaction may result from impaired visual information processing and should not automatically be interpreted as signs of a neurodevelopmental disorder. Nevertheless, recent clinical reports indicate an increased occurrence of autism diagnoses among some children with albinism, highlighting the importance of careful differential assessment performed by interdisciplinary teams (Gunz et al., 2024; Ludwig et al., 2022; Molinaro et al., 2020). The coexistence of oculocutaneous albinism and autism-spectrum manifestations has also been described, reinforcing the need for individualized evaluation rather than generalized interpretations of social or communicative behaviors (Gokul Raj et al., 2022).

School represents a critical developmental environment for children with albinism, as it may either facilitate inclusion or amplify psychosocial vulnerability. Educational participation may be affected by inaccessible learning materials, inadequate lighting conditions, inappropriate classroom positioning, limited access to assistive technologies, reading difficulties and visual fatigue. Beyond academic performance, reduced participation in peer interactions and extracurricular activities may influence quality of life, belonging and psychosocial development. Research on children with visual impairment emphasizes that educational accessibility and social support are essential factors for maintaining participation and well-being (Elsman et al., 2021).

Within this context, neuropedagogy offers an integrative perspective linking sensory functioning, neurocognitive development, emotional processes, behavior and learning. Applied to

albinism, a neuropedagogical approach involves individualized educational adaptations based on each child's functional visual profile, supported by assistive technologies, psychopedagogical interventions and inclusive educational practices.

Although the literature addressing albinism has expanded considerably, existing studies have generally examined ophthalmological, genetic, psychological or educational aspects independently. A comprehensive framework integrating visual functioning, neurodevelopment, emotional well-being, psychosocial adaptation and educational inclusion remains insufficiently explored. The novelty of the present review lies in proposing a neuropedagogical framework that connects these domains into a unified biopsychosocial perspective. Unlike traditional approaches focused primarily on visual accessibility and educational accommodations, this framework emphasizes the interaction between sensory functioning, neurodevelopmental processes, emotional regulation, social experiences and environmental factors in shaping learning and participation outcomes in children and adolescents with albinism.

The central research question guiding this review is: How can an interdisciplinary neuropedagogical framework integrate visual functioning, neurodevelopmental processes, emotional well-being, and educational factors to better understand and support children and adolescents with albinism? By synthesizing evidence from multiple scientific fields, this review aims to contribute to a more holistic understanding of the educational and psychosocial challenges associated with albinism and to provide relevant implications for clinicians, educators, psychologists and researchers involved in supporting this population. Accordingly, this review aims to examine how visual impairment associated with albinism interacts with neurodevelopmental, psychological and educational factors, and to propose an interdisciplinary neuropedagogical framework that integrates these domains to guide individualized support strategies for children and adolescents with albinism.

2. Methodology

This study was conducted as an interdisciplinary narrative review aimed at examining the neuropedagogical implications of albinism, with particular emphasis on the interactions among congenital visual impairment, neurodevelopment, mental health, autism-spectrum characteristics, emotional regulation and educational inclusion. A narrative review approach was selected because the research question requires the integration and critical interpretation of findings from multiple disciplines, including ophthalmology, neuroscience, psychology, psychiatry, education and rehabilitation sciences.

2.1. Literature Search Strategy

The literature search was conducted between June and July 2026 using the electronic databases PubMed, PubMed Central, NCBI Bookshelf, Google Scholar, ERIC and PsycINFO. Biomedical and clinical databases (PubMed, PubMed Central and NCBI Bookshelf) were primarily used to identify studies related to albinism, visual impairment, neurodevelopment and mental health, whereas educational and psychological databases (Google Scholar, ERIC and PsycINFO) were consulted to retrieve literature concerning educational inclusion, psychosocial functioning, school participation, bullying, educational adaptations and neuropedagogical approaches.

The search strategy combined controlled vocabulary and free-text keywords using different Boolean combinations. The main search terms included albinism, oculocutaneous albinism, visual impairment, low vision, neurodevelopment, neurovisual functioning, adaptive behaviour, autism spectrum disorder, autistic-like features, mental health, anxiety, depression, emotional regulation, bullying, quality of life, school participation, inclusive education, educational adaptations and neuropedagogy. Additionally, the reference lists of relevant publications were manually screened to identify additional studies that met the objectives of the review and contributed to the interdisciplinary synthesis. Representative search strings included: (albinism OR oculocutaneous albinism) AND visual impairment; (albinism) AND (autism spectrum disorder OR autistic-like

features); (albinism) AND (mental health OR anxiety OR depression); (visual impairment OR low vision) AND (inclusive education OR educational adaptations); (albinism) AND (school participation OR bullying OR quality of life); and (neuropedagogy) AND (visual impairment OR neurodevelopment).

2.2. Eligibility Criteria

Publications were selected based on their relevance to the objectives of the review. Inclusion criteria consisted of peer-reviewed original research articles, systematic reviews, meta-analyses, narrative reviews and academic book chapters addressing one or more of the following domains: ophthalmological manifestations of albinism, visual functioning, neurodevelopment, autism-spectrum characteristics, mental health, emotional regulation, psychosocial functioning, educational inclusion, school participation, assistive technologies, educational adaptations and neuropedagogical interventions. Priority was given to peer-reviewed studies and recent evidence whenever available.

Exclusion criteria included duplicate publications, conference abstracts without accessible full texts, studies lacking relevance to the objectives of the review, research focused exclusively on molecular or genetic mechanisms without implications for neurodevelopment, mental health, education or psychosocial functioning, and non-scientific sources.

2.3. Study Selection

Relevant publications were identified through an iterative search and selection process. Titles and abstracts were initially screened according to their relevance to the objectives of the review, followed by evaluation of the full texts of relevant publications. Articles were retained when they provided meaningful contributions to understanding the relationship between albinism, visual functioning, neurodevelopment, psychological outcomes, or educational participation.

When evidence from broader populations with visual impairment was included, it was considered complementary rather than direct evidence specific to albinism. This distinction was maintained throughout the synthesis to minimise overgeneralisation and ensure an appropriate interpretation of findings within the specific context of albinism. The identified literature was evaluated based on title, abstract and full-text relevance to the objectives of the review. Studies were selected according to their scientific contribution, methodological relevance and ability to inform the proposed interdisciplinary neuropedagogical framework. As this manuscript represents a narrative review rather than a systematic review, the selection process was guided by conceptual relevance and qualitative synthesis rather than by a quantitative screening approach.

2.4. Data Synthesis

The selected literature was analysed using a thematic narrative approach. The evidence was organised within an interdisciplinary framework, integrating findings from ophthalmology, neuroscience, psychology, psychiatry, rehabilitation sciences and education according to their contribution to functional development, psychosocial adaptation and educational participation in children and adolescents with albinism.

Evidence was interpreted according to population specificity. Findings derived directly from individuals with albinism were considered primary evidence for condition-specific conclusions, whereas studies involving broader populations with visual impairment were considered complementary evidence for understanding mechanisms related to accessibility, education, psychosocial functioning and rehabilitation. This distinction was maintained throughout the synthesis to minimise overgeneralisation and ensure accurate interpretation of the available evidence. The reviewed evidence was structured into major conceptual domains, including ophthalmological characteristics, neurodevelopment, neuroeducational functioning, mental health, autism-spectrum features and differential diagnosis, emotional regulation, psychosocial participation, bullying, educational inclusion, assistive technologies and neuropedagogical

interventions. The synthesis focused on identifying recurring themes, areas of convergence, knowledge gaps and implications for clinical practice, educational strategies and future research. Given the narrative nature of this review, no quantitative synthesis or meta-analysis was performed. The narrative synthesis approach was selected to integrate findings from heterogeneous scientific fields and to identify conceptual relationships, knowledge gaps and future research directions, consistent with methodological recommendations for narrative literature reviews (Barry et al., 2022).

2.5. Ethical Considerations

This review was based exclusively on previously published scientific literature and did not involve human participants, personal data or identifiable clinical information. Therefore, institutional ethical approval and informed consent were not required. The available evidence was interpreted cautiously, avoiding unsupported causal assumptions and maintaining respectful, non-stigmatising terminology when discussing individuals with albinism or visual impairment.

3. Neuropedagogical Framework of Albinism

To clarify the interdisciplinary perspective proposed in this review, *Figure 1* presents a conceptual neuropedagogical model of albinism. The model illustrates the dynamic interaction between congenital visual impairment, access to visual information, neuroeducational functioning and psychosocial development. It emphasises that the consequences of albinism are shaped not only by the degree of visual impairment but also by environmental factors, including educational accessibility, family support and the availability of appropriate interventions.

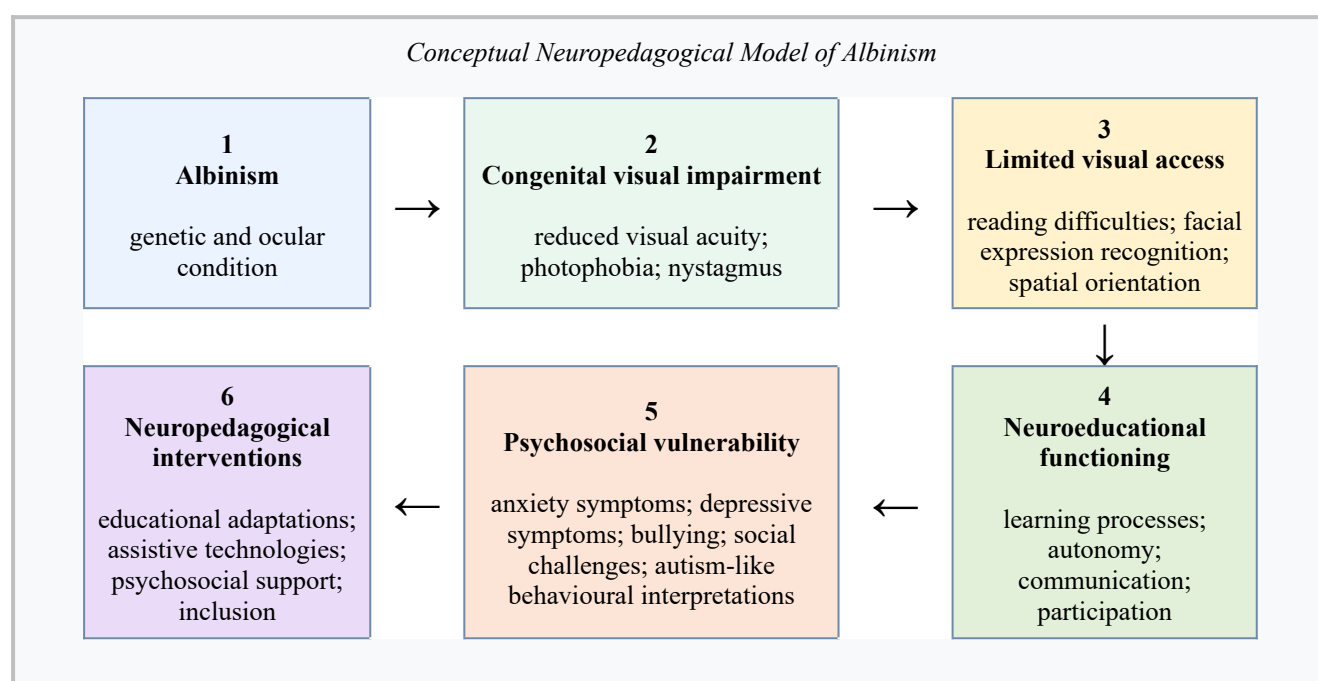


Figure 1. Conceptual neuropedagogical model of albinism illustrating the interaction among congenital visual impairment, neuroeducational functioning, psychosocial vulnerability and educational inclusion. The model represents conceptual relationships and does not imply direct causal pathways. Colors are used solely for visual differentiation of conceptual domains and do not represent quantitative differences, causal relationships or hierarchical organization.

Within this framework, neuropedagogical interventions represent a bridge between biological characteristics and educational needs by integrating visual adaptations, assistive technologies, psychopedagogical support, family involvement and inclusive educational practices. The model

highlights the importance of addressing each child's individual functional profile rather than focusing exclusively on the medical characteristics of the condition.

4. Ophthalmological and Neuroeducational Markers in Albinism

Albinism comprises a heterogeneous group of rare genetic disorders characterised by altered melanin synthesis or distribution. Clinically, it includes oculocutaneous albinism, affecting the skin, hair and eyes, and ocular albinism, in which manifestations are predominantly visual. In childhood, the functional impact of albinism is primarily determined by the severity of visual impairment and its consequences for daily activities, learning and independence.

Reduced visual acuity, nystagmus, photophobia, strabismus, foveal hypoplasia and impaired stereopsis may interfere with reading efficiency, spatial orientation, visual attention and participation in classroom activities. Therefore, assessment should extend beyond diagnostic classification and include functional vision evaluation in real educational contexts, such as reading from the board, accessing printed or digital materials and participating in collaborative learning activities (Abadi & Pascal, 1989; Neveu et al., 2022).

Foveal hypoplasia and nystagmus are particularly relevant because they may reduce visual performance and increase visual effort during tasks requiring sustained visual attention, including reading and writing. Studies using optical coherence tomography have demonstrated associations between the degree of foveal hypoplasia and visual acuity, supporting the importance of combining structural and functional visual assessments.

Because visual functioning varies considerably among individuals with albinism, educational strategies should be individualised according to the child's specific visual profile rather than based solely on diagnosis. From a neuropedagogical perspective, understanding these visual characteristics is essential because they influence how children access information, interact with learning environments and develop adaptive strategies (Bathelt et al., 2019; Seo et al., 2007; Talsma et al., 2023).

5. Visual Impairment and Neuroeducational Functioning

Vision represents a fundamental pathway for acquiring information, orienting within the environment, recognising facial expressions, imitating behaviours and participating in social and educational activities. In children with albinism, reduced visual acuity, photophobia and visual fatigue may limit efficient access to classroom information and increase the cognitive effort required for visually demanding tasks. These difficulties may affect reading from the board, following projected materials, completing written assignments and participating spontaneously in classroom interactions. Importantly, such challenges should not be interpreted as indicators of reduced intellectual ability or lack of motivation, but rather as consequences of limited visual accessibility and insufficient environmental adaptation.

From a neurodevelopmental perspective, congenital visual impairment may influence the maturation of neural networks involved in visual perception, visuospatial processing, multisensory integration and social information processing. During early development, reduced visual input may modify the way children acquire environmental information, interpret nonverbal cues and develop adaptive learning strategies. Neuroplastic mechanisms allow partial compensation through increased reliance on auditory, tactile and proprioceptive information; however, these adaptive processes may also require greater cognitive effort during learning and everyday activities. Consequently, neuroeducational assessment should consider not only visual acuity but also how visual impairment influences attention, information processing, executive functioning and participation within educational environments.

From a neuropedagogical perspective, educational support for children with low vision should integrate assistive technologies with modifications of the learning environment. Optical devices and digital accessibility tools may improve access to educational content; however, their effectiveness depends on appropriate selection, user training and consistent integration into daily

educational activities. Consequently, assistive technologies should be considered part of an individualised educational strategy rather than isolated compensatory tools (Thomas et al., 2015).

Environmental adaptations and individualised accessibility measures may reduce visual effort and facilitate participation in learning activities (Negiloni et al., 2018). Nevertheless, the implementation of such measures may be influenced by financial limitations, availability of resources, teacher preparedness and institutional support.

Therefore, effective neuropedagogical adaptation requires a multidimensional approach combining environmental accessibility, educational strategies, family involvement and professional collaboration. The objective is not merely to compensate for reduced vision, but to create conditions that allow children with albinism to participate actively and independently in the educational process (Senjam et al., 2021).

6. Anxiety and Depression in Children and Adolescents with Visual Impairment

Visual impairment may increase emotional vulnerability in children and adolescents, particularly when it affects autonomy, mobility, social participation and confidence in everyday activities. In children with albinism, this vulnerability may be influenced by the early onset of visual difficulties, visible phenotypic differences, barriers to participation and experiences of social misunderstanding or stigma. However, emotional difficulties should not be considered direct consequences of albinism. Rather, they may emerge from the interaction between visual limitations, environmental accessibility, interpersonal experiences and the availability of psychological and educational support.

Anxiety may be associated with social insecurity, difficulties in navigating unfamiliar environments, fear of failure or concerns regarding peer acceptance. Similarly, depressive symptoms may be related to reduced participation, social isolation, decreased self-esteem and limitations in independent functioning. Studies involving children and adolescents with visual impairment indicate associations between reduced vision, emotional difficulties and decreased quality of life. Although these findings are not specific to albinism, they provide relevant contextual information regarding the potential psychosocial consequences of congenital visual limitations and may help explain vulnerability mechanisms in children with albinism. Quantitative evidence also supports the increased emotional vulnerability observed in children and adolescents with visual impairment. A recent systematic review and meta-analysis including 13 studies and 822 participants reported a pooled prevalence of depression of 14% (95% CI: 9–20%) among visually impaired children and adolescents. The same analysis suggested a higher prevalence among females (18%) than males (6%), although this difference did not reach statistical significance. Although these findings are not specific to albinism, they provide important quantitative evidence supporting the need for routine psychological assessment and multidisciplinary support in children with congenital visual impairment.

Therefore, comprehensive assessment should extend beyond visual function and include emotional well-being, social adaptation, school participation and access to psychological support as integral components of multidisciplinary care (Demmin & Silverstein, 2020; Magdalene et al., 2021).

7. Autism-Spectrum Features and Differential Diagnosis in Visual Impairment

The assessment of autism-spectrum characteristics in children with visual impairment requires careful interpretation because some behaviours commonly considered relevant for autism diagnosis may also result from reduced visual access to social information. Reduced eye contact, limited facial expression recognition, decreased visual imitation and difficulties interpreting gestures may reflect sensory limitations rather than deficits in social motivation or communication. This distinction is particularly important in albinism because congenital visual impairment may influence early acquisition of nonverbal communication skills.

To facilitate the differential interpretation of these behaviours, *Table 1* summarizes common manifestations related to visual impairment and distinguishes them from features that may warrant further assessment for autism spectrum disorder.

Table 1. Differential interpretation of behaviours that may resemble autism spectrum characteristics in children with albinism and visual impairment

Observed behaviour	Possible explanation related to visual impairment	Findings suggesting further assessment for autism spectrum disorder	References
Reduced eye contact	Reduced visual acuity, nystagmus or photophobia may limit eye contact	Persistent deficits in reciprocal social interaction beyond visual limitations	Senju & Johnson, 2009
Difficulty recognising facial expressions	Limited access to facial visual information	Persistent difficulties interpreting social-emotional cues despite appropriate sensory support	Tadić et al., 2010
Reduced visual imitation	Difficulty observing and reproducing visually presented actions	Impaired imitation across multiple contexts and sensory modalities	Dale & Sonksen, 2002
Reduced response to gestures or non-verbal cues	Gestures may not be perceived accurately because of visual impairment	Persistent deficits in non-verbal communication not explained by visual limitations	Parr et al., 2010
Preference for auditory or tactile information	Adaptive compensatory strategy for reduced visual input	Accompanied by restricted interests and repetitive behaviours	Occelli et al., 2013
Social withdrawal	May reflect visual barriers, reduced accessibility or previous negative social experiences	Persistent social communication difficulties across settings requiring comprehensive assessment	Lanza et al., 2024

Previous studies suggest that congenital sensory impairments may be associated with behavioural characteristics overlapping with autism-spectrum presentations. Recent evidence also suggests that autism spectrum disorder may occur more frequently in children with albinism than in children with visual impairment due to other causes. In a retrospective cohort including 401 children with albinism, 14 were diagnosed with autism spectrum disorder, corresponding to a prevalence of approximately 3.5% (about 1 in 28 children), compared with approximately 1 in 102 children with visual impairment from other etiologies. Nevertheless, these findings originate from a single-center study and require confirmation in larger multicenter populations (Gunz et al., 2024). However, these findings require differential interpretation because social behaviours dependent on visual information may be altered by the sensory condition itself.

However, evidence specifically addressing autism-spectrum characteristics in individuals with albinism remains limited, and findings derived from broader populations with visual impairment should therefore be interpreted cautiously. Further studies focused specifically on children with albinism are needed to clarify the relationship between congenital visual impairment, social communication development and autism-spectrum manifestations. Consequently, evaluation of children with albinism should incorporate ophthalmological findings, developmental history, psychological assessment and educational observations in order to distinguish visual-access limitations from an independent neurodevelopmental disorder (Pili et al., 2021).

Although associations between congenital sensory impairments and autism-spectrum disorders have been reported, clinical interpretation remains complex. A diagnosis should therefore be established only after considering the child's complete developmental and functional profile, avoiding conclusions based solely on visually mediated behaviours (Do et al., 2017).

8. Emotional Regulation Difficulties and Psychosocial Vulnerability

Adolescence represents a developmental period characterised by increased sensitivity to peer relationships, identity formation and social acceptance. For adolescents with albinism, repeated experiences of exclusion, bullying, stigma or difficulties in peer integration may contribute to emotional vulnerability and challenges in regulating affective responses. However, these experiences should not automatically be interpreted through the lens of personality pathology. A more appropriate approach is to examine emotional regulation difficulties, referring to challenges in managing the intensity, duration and expression of emotions, particularly during stressful interpersonal situations.

This perspective allows emotional difficulties to be discussed without assigning premature diagnostic labels. Although emotional dysregulation is recognised as a transdiagnostic feature present across several psychological conditions, emotional regulation difficulties in adolescents with albinism should be understood within a broader biopsychosocial context rather than interpreted as indicators of personality pathology. Negative social experiences, reduced belonging and chronic stress may increase emotional vulnerability; however, these factors should not be interpreted as evidence that albinism itself produces specific personality traits or psychiatric disorders (Paulus et al., 2021; Ibraheim et al., 2017).

9. School Inclusion, Bullying and Psychosocial Participation

School represents a major developmental context for children with albinism, functioning either as a protective environment or as a source of additional vulnerability. The educational experience is shaped not only by the child's visual abilities but also by the accessibility, knowledge and attitudes present within the school environment. Insufficient adaptations, negative peer perceptions, difficulties participating in visually demanding activities and experiences of stigmatization may negatively influence academic engagement and social belonging. Conversely, supportive educational environments can promote autonomy, confidence and meaningful participation.

Bullying represents an important psychosocial risk factor because it is associated with anxiety, depressive symptoms, social withdrawal and reduced self-esteem. In students with albinism, vulnerability to victimization may result from the combination of visible differences and functional challenges associated with visual impairment. Therefore, bullying prevention should be integrated into neuropedagogical strategies and considered part of creating an inclusive educational environment rather than approached only as a disciplinary concern (Rivara & Le Menestrel, 2016; Brunes et al., 2018).

Psychosocial participation is influenced by multiple factors, including family support, teacher preparation, accessibility of learning materials and availability of adapted resources. For children with albinism, improving participation requires interventions directed not only toward the individual child but also toward the surrounding educational community (Šemrov et al., 2023).

10. Neuropedagogical Interventions and Educational Adaptations

Neuropedagogical interventions for students with albinism should begin with a functional assessment of vision and an analysis of how the child accesses, processes and uses information within learning environments. Educational adaptations may include enlarged fonts, high-contrast materials, accessible digital resources, reduction of glare, appropriate classroom positioning, low-vision devices, additional time during assessments and assistive technologies. The purpose of these adaptations is to ensure equal access to education rather than provide an advantage over other students.

The effectiveness of assistive technologies depends not only on their availability but also on appropriate selection, training and integration into daily educational activities. For children with low vision, technology should function as part of an individualised educational strategy adapted to their specific visual needs (Senjam et al., 2023). Beyond visual accessibility, psychopedagogical

support is essential for promoting emotional adjustment, preventing social withdrawal and strengthening self-esteem. Teachers require appropriate knowledge regarding the characteristics of albinism, while classmates benefit from education promoting acceptance and inclusion. Interdisciplinary collaboration among families, teachers, psychologists, psychopedagogues, ophthalmologists and genetic specialists enables the development of individualised educational plans focused on functional abilities, autonomy and participation.

Following the analysis of the ophthalmological, neuroeducational, emotional and psychosocial dimensions of albinism, *Table 2* summarizes the main neuropedagogical implications of this condition.

This synthesis reinforces the need for an interdisciplinary approach integrating medical assessment, educational adaptation and psychosocial support in order to optimise autonomy, participation and inclusion among children and adolescents with albinism (Abadi & Pascal, 1989; Bathelt et al., 2019; Demmin & Silverstein, 2020; Negiloni et al., 2018; Senjam et al., 2021; Thomas et al., 2015).

Table 2. Neuropedagogical implications of albinism: functional challenges and individualised support strategies

Domain	Possible difficulties	Educational implications	Recommended interventions	References
Functional challenges	Reduced visual acuity, photophobia, nystagmus, foveal hypoplasia	Difficulties in reading, writing, following the board and using visual materials	Enlarged font, high contrast, optimal seating, reduced glare, accessible digital materials	Proudlock et al., 2024
Learning access	Limited access to visual information and increased visual effort	Slower task completion, visual fatigue and reduced classroom participation	Additional time, adapted materials, assistive technologies and individualised educational planning	MacDonald et al., 2012
Social communication	Limited access to facial expressions, gestures and nonverbal cues	Risk of social misunderstanding or interpretation of visual-access limitations as autism-spectrum features	Differential assessment, peer support, explicit social communication guidance	Pili et al., 2021
Emotional functioning	Anxiety, low self-esteem, social withdrawal or emotion regulation difficulties	Increased psychosocial vulnerability and reduced sense of belonging	Psychopedagogical support, counseling, family involvement and emotional monitoring	Lanza et al., 2024
School inclusion	Bullying, stigmatisation, inaccessible activities or lack of adaptations	Reduced participation, exclusion and lower educational engagement	Anti-bullying strategies, teacher training, inclusive classroom climate and collaboration with family	Gaigher et al., 2002

11. Discussion

The findings synthesised in this review indicate that the impact of albinism is shaped by the interaction between visual functioning, developmental processes, psychosocial experiences and environmental support. Beyond altered melanin synthesis, the functional experience of individuals with albinism is shaped by visual impairment, educational accessibility, social attitudes and available support systems. Therefore, a biopsychosocial perspective is essential for understanding its impact on quality of life and inclusion (Maia et al., 2015).

Congenital visual impairment represents a major factor influencing educational experiences in children with albinism. Reduced access to visual information, increased visual effort and difficulties with visually demanding classroom tasks may affect learning efficiency and participation. These findings emphasise that educational outcomes should be interpreted in relation to accessibility, individualised support and environmental adaptation rather than visual status alone.

Consequently, academic functioning should be evaluated in relation to the availability of appropriate adaptations, accessible educational materials and adequate professional support. This perspective emphasises that educational outcomes are not determined solely by visual impairment, but also by the extent to which educational systems respond to individual needs (Loh et al., 2024).

From a psychosocial perspective, visual impairment may influence autonomy, peer relationships, participation and quality of life. Evidence from broader low-vision populations provides relevant contextual information regarding mechanisms that may also influence development and participation in individuals with albinism, although condition-specific evidence remains limited. Recent qualitative research in individuals with albinism highlights the importance of social experiences, family context and environmental factors in shaping psychosocial adaptation and quality of life (Fournier et al., 2024). These findings support the need for neuropedagogical approaches that address both educational accessibility and broader developmental needs, including autonomy, emotional adaptation, social competence and belonging within the school environment (Lanza et al., 2024).

Emotional difficulties such as anxiety, depressive symptoms or social withdrawal should not be considered direct consequences of albinism. Instead, they may emerge from a complex interaction among visual limitations, social experiences, stigma, bullying, reduced participation and insufficient environmental support. Thus, emotional vulnerability in individuals with albinism is better understood through a biopsychosocial model, in which psychological outcomes result from the interaction between biological characteristics, personal experiences and contextual factors (Ishtiaq et al., 2016). The evaluation of autism-spectrum characteristics in children with visual impairment requires particular clinical caution. Behaviours such as reduced eye contact, difficulties interpreting facial expressions or limited engagement in visually mediated social interactions may reflect reduced access to social information rather than an independent neurodevelopmental disorder. Nevertheless, evidence specifically addressing autism-spectrum characteristics in children with albinism remains limited. Therefore, findings derived from broader populations with congenital visual impairment should be considered complementary rather than directly representative of albinism, and conclusions should be formulated cautiously.

Accordingly, differential assessment should integrate developmental history, ophthalmological findings, psychological evaluation and educational observations to distinguish sensory-related behaviours from autism-spectrum manifestations (Pili et al., 2021). The neuropedagogical perspective proposed in this review provides a conceptual framework connecting medical, psychological and educational dimensions of albinism.

Rather than focusing exclusively on compensation for visual limitations, this framework emphasises the optimisation of the child's overall developmental potential through individualised educational strategies, assistive technologies, emotional support and interdisciplinary collaboration (Ghasemi Fard et al., 2023).

From a practical perspective, clinicians should integrate ophthalmological findings with developmental history, functional vision assessment, emotional screening and school participation when evaluating children with albinism. Educators should implement individualised classroom adaptations, including enlarged learning materials, optimised seating, appropriate assistive technologies, additional time for visually demanding tasks and continuous monitoring of academic participation and psychosocial adjustment. Regular communication among families, teachers, psychologists and healthcare professionals is essential to ensure that educational interventions correspond to each child's functional abilities and developmental needs rather than diagnosis alone.

Novel Contribution of the Proposed Neuropedagogical Framework

Previous studies have generally examined these domains independently, focusing either on visual characteristics, genetic mechanisms, psychological outcomes or educational challenges. The present framework emphasises that these domains are interconnected and that congenital visual

impairment may influence educational participation through complex interactions involving neurodevelopment, emotional functioning, social experiences and environmental accessibility.

Unlike traditional educational frameworks for visual impairment, which primarily focus on accessibility, assistive technologies and curricular adaptations, the proposed neuropedagogical framework integrates biological, neurodevelopmental, emotional and educational dimensions into a unified conceptual model. Its originality lies in linking visual functioning with learning processes, emotional regulation, social participation and environmental factors, emphasising that educational outcomes are shaped by the interaction between the child's functional profile and the surrounding educational context.

Rather than conceptualising albinism exclusively as a genetic or ophthalmological condition, the proposed model highlights the importance of individualised educational planning that simultaneously considers visual accessibility, cognitive functioning, emotional well-being, social participation and family support.

Therefore, this framework extends beyond a compensatory approach focused only on visual limitations and may support clinical decision-making, individualised educational planning and interdisciplinary collaboration. In practice, it may assist clinicians in differentiating sensory-related behaviours from neurodevelopmental disorders, guide educators in selecting individualised classroom adaptations and provide researchers with a conceptual basis for developing standardised neuropedagogical assessment protocols and intervention studies.

Future research should focus on the empirical validation of the proposed neuropedagogical framework through prospective and longitudinal studies involving children and adolescents with albinism. Standardised assessments integrating functional vision, neuropsychological development, educational participation, psychosocial functioning and quality of life would help determine how these domains interact over time. In addition, intervention studies evaluating individualised educational adaptations, assistive technologies and multidisciplinary support programs are needed to establish evidence-based neuropedagogical recommendations and refine the proposed conceptual framework.

12. Limitations

This review has several limitations that should be considered when interpreting its conclusions. First, it represents a narrative review rather than a systematic review or clinical investigation. Therefore, it does not include primary data, standardised assessments or quantitative analyses and cannot establish causal relationships.

The objective of this review was not to estimate prevalence or determine statistical associations, but to synthesise existing knowledge and develop an interdisciplinary conceptual framework for understanding the neuropedagogical implications of albinism (Green et al., 2006).

A further limitation is the relatively limited number of studies directly investigating the relationships among albinism, mental health, autism-spectrum characteristics, emotional regulation and educational outcomes. Consequently, some interpretations rely on broader evidence from pediatric populations with visual impairment. Although such extrapolation is useful for developing theoretical models, findings should be interpreted cautiously until more empirical research specifically focused on children and adolescents with albinism becomes available (Fournier et al., 2023).

Additionally, available studies vary considerably regarding albinism subtype, severity of visual impairment, family context, socioeconomic conditions, access to healthcare, educational setting and assessment methods. These variables may substantially influence developmental and psychosocial outcomes (Fournier et al., 2023).

Future research should include larger samples, longitudinal designs and standardised interdisciplinary assessments to clarify the complex relationships among visual functioning, emotional development, social participation and educational achievement in individuals with albinism.

13. Conclusions

The findings of this review indicate that the consequences of albinism extend beyond visual impairment, involving developmental, emotional, educational and social dimensions that require an integrated approach. Therefore, individualised and interdisciplinary assessment should consider not only ophthalmological characteristics, but also functional vision, psychological well-being and participation in everyday activities.

The proposed neuropedagogical framework does not replace existing clinical or educational approaches; rather, it provides an integrative perspective that connects visual functioning, neurodevelopment, psychosocial adaptation and educational needs within a unified framework for individualised support.

For clinicians and healthcare professionals, comprehensive management should include functional vision assessment, monitoring of emotional and psychosocial difficulties, and collaboration among ophthalmologists, psychologists and other specialists. For educators, effective support requires accessible learning environments, individualised classroom adaptations, assistive technologies and inclusive practices that promote autonomy and social participation.

For researchers, future studies should focus on longitudinal investigations, albinism-specific assessment of neurodevelopmental and psychosocial outcomes, and empirical validation of the proposed neuropedagogical framework. Such approaches may contribute to the development of evidence-based interventions tailored to the educational and psychosocial needs of children and adolescents with albinism.

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