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Applying the Analytic Hierarchy Process (AHP) to Accessible Housing: A Multi-Disability Perspective

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Abstract: Accessible housing plays a vital role in promoting independent living and quality of life for people with disabilities. However, the existing design standards often fail to address the specific needs of diverse disability groups. This study aims to establish architectural and habitability criteria for housing adapted to various disabilities, including wheelchair users, individuals with achondroplasia (little people), Autism Spectrum Disorder (ASD) and Down syndrome, individuals with visual and hearing impairments, and older adults, by integrating international frameworks and prior research. The Analytic Hierarchy Process (AHP) was used to prioritize key factors in the housing design. The factors analyzed included autonomy, independence, safety, comfort, communication, and mobility. Findings reveal that autonomy consistently emerged as the most relevant criterion across groups, particularly for older adults (61.8%), wheelchair users (83%) and little people (64%). Secondary priorities varied: mobility was emphasized by wheelchair users (77%), communication by visually impaired individuals (64%), and comfort by deaf and hard of hearing participants (43%). The results underscore the need for housing solutions that reflect the priorities of each disability group. This study contributes by validating user-centered design criteria and offering a framework to guide inclusive housing policies and practices. By highlighting needs, it bridges the gap between generic accessibility standards and design. These findings support policy development and enrich the literature by incorporating unique resident-centered perspectives and overlooked indicators of housing accessibility and inclusive residential design.



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1. Introduction

Accessible housing has a vital role for human health, directly influencing its inhabitants' physical and mental well-being. Factors such as indoor air quality, safety, accessibility, and structural conditions significantly impact public health.

In highly developed countries, people now spend up to 90% of their lives indoors [1], and so ensuring adequate housing environments for everyone is essential. However, when the built environment fails to accommodate the individuals' functional capacities, it can create limitations in daily activities and restrict social participation [2]. This phenomenon is referred to as a disabling environment, which encompasses societal, physical, economic, and institutional barriers that prevent full participation and inclusion. Rooted in the social model of disability, the concept highlights that disability is not merely a personal condition but is largely shaped by external factors such as inaccessible infrastructure, discriminatory policies, and systemic inequalities [3]. This issue is particularly relevant for people with

disabilities, who face multiple barriers in using their homes due to physical, sensory, and cognitive limitations. Therefore, accessibility must be a central criterion in designing and adapting living spaces, ensuring everyone can live in dignified and healthy conditions.

At a global level, the availability of accessible housing is insufficient, making it difficult for many people with disabilities to find spaces adapted to their needs. The lack of standardized criteria further complicates the identification of accessible housing, creating uncertainty among users. A recurring debate in the field of inclusive design is whether it is preferable to plan accessible housing from the outset or if adaptations should only be implemented when a person or family requires them [4].

However, proactive planning for accessibility offers significant advantages. It ensures long-term inclusivity, reduces the need for costly and often inefficient retrofits, and aligns with the principles of universal design, which aim to create environments usable by all people without the need for later modification [5,6].

The design of spaces must go beyond the mere elimination of physical barriers; it is essential to create inclusive environments from the outset. This approach aims to comply with regulations, guarantee accessibility, and promote full participation for all individuals. To achieve this, it is crucial to understand three key principles of inclusive design: habitability, universal design, and accessibility, which serve as a base for the creation of spaces that answer the needs and capabilities of the population [7,8].

The first of these pillars, habitability, is a set of indicators that measure how individuals perceive the quality of a residential environment. These indicators are structured into four fundamental dimensions: safety, health, comfort, and socialization, all of which are essential for assessing the well-being of residents in their immediate surroundings [9]. Habitability influences quality of life and plays a crucial role in individuals' social and psychological development, fostering a safe and dignified living space [8].

In architecture, universal design emerges as an innovative methodology to create accessible and comfortable buildings and public spaces for all users. This approach's premise is to prevent the need for future adaptations in built environments by ensuring from the outset that spaces are inclusive and functional for individuals with diverse abilities [10]. This design facilitates physical access and promotes an equitable and comfortable experience for users of different ages and abilities [11].

Finally, the concept of accessibility in construction ensures that individuals with disabilities can access all public spaces. This approach fosters equity by enabling the participation of all individuals in social and economic activities, ensuring that no group is excluded from the benefits of the built environment [12].

Various professionals, including occupational therapists, have developed tools to assess housing accessibility, including tools that analyze users' occupational performance [13]. However, the adoption of the International Classification of Functioning, Disability, and Health (ICF) allows for a more comprehensive perspective, as it considers physical barriers and environmental and personal factors that influence the daily lives of people with disabilities [14].

Various studies have explored housing accessibility from different perspectives, identifying existing barriers and strategies to improve the quality of life of people with disabilities. Research ranges from analyzing accessible housing as a public policy issue [15] to reviewing the positive effects of interventions to improve accessibility [16]. In Latin America, Valderrama-Ulloa et al. [17] identified key barriers, including the shortage of accessible housing, economic limitations, and the slow implementation of regulations. Within this context, reviewing strategies such as incorporating adaptive technologies [18] and evaluating home modifications [19] becomes crucial for promoting inclusive and accessible living environments. And Muñoz Cordones [20], in a comprehensive review of accessibility,

highlights that most studies focus on physical accessibility, while other forms, such as communicational or cognitive accessibility, receive less attention. This trend aligns with the predominance of research on mobility-impaired individuals, such as those with physical disabilities and older adults, overlooking other groups with diverse functional needs, including individuals with cognitive or sensory disabilities, as well as children.

This study aims to establish architectural and habitability criteria for housing designed for people with disabilities, integrating international frameworks and prior research conducted by the authors. To achieve this, the study employs the Analytic Hierarchy Process (AHP). This multi-criteria decision-making method systematically evaluates key factors such as autonomy, independence, safety, comfort, communication, and mobility. The objective is to determine which factors are considered most relevant by different user groups—specifically wheelchair users, individuals with achondroplasia, children with Autism Spectrum Disorder or Down syndrome, persons with visual and hearing impairments, and older adults—to support the development of inclusive and user-centered housing solutions.

AHP was chosen for its structured decision-making process and its effectiveness in quantifying subjective criteria based on stakeholder input [21,22]. Compared to other multi-criteria decision-making methods (MCDM), such as the Fuzzy Set Theory (FST) or Multi-Attribute decision-making (MADM), AHP offers a more accessible and transparent framework [23]. While FST handles imprecise data, it is often complex to implement, whereas AHP allows for clear prioritization of accessibility indicators, making it especially suitable for interdisciplinary studies involving diverse participants.

It is hypothesized that autonomy will emerge as the most highly prioritized design criterion across all disability groups, with variations in secondary priorities reflecting the specific needs and lived experiences associated with each condition.

By structuring complex problems into hierarchical levels, AHP facilitates informed decision-making, ensuring that the most impactful criteria are identified to enhance the quality of life for individuals with disabilities. This method, widely used in research [18], incorporates users' perspectives through a survey-based approach, providing a rigorous framework for developing inclusive housing solutions.

This study was conducted in response to the growing need for inclusive housing solutions that adequately address the diverse functional requirements of people with disabilities. Although international accessibility standards exist, they often generalize disability without considering the nuanced needs of specific groups, such as individuals with sensory, cognitive, or growth-related conditions. Thus, this research aimed to systematically identify and prioritize key architectural and habitability criteria from the perspective of end-users, using the AHP to ensure a data-driven, participatory approach.

The following sections summarize the author's previous research, outline the research methodology, and present the main results obtained. An in-depth analysis of these findings allows for identifying areas requiring further exploration and leads to recommendations for future research. The article concludes with a discussion of the implications of the results, highlighting their potential to significantly influence accessibility and habitability standards in housing design.

Previous Research and Conceptual Framework

The foundations of this study are based on previous research that has defined accessibility and habitability criteria for housing. Specifically, the framework Valderrama-Ulloa et al. [4] proposed identifies four fundamental pillars: autonomy, mobility, comfort, and safety. These criteria were later expanded to include six domains of daily activities [24],

leading to a final model that incorporates communication and independence as additional key factors.

In the context of housing design for older adults, Valderrama-Ulloa et al. [25] establish guidelines to reduce risks in daily activities by adapting the environment to address cognitive, physical, and sensory disabilities, including Alzheimer's disease and visual impairments.

Furthermore, validating these criteria followed the methodology outlined in Valderrama-Ulloa et al. [4], applying them to real housing projects and collecting feedback from users and caregivers [26]. Through semi-structured interviews, the study identified persistent barriers and adaptive strategies, allowing for the refinement of these criteria based on the lived experiences of people with disabilities and insights from professionals in accessibility and inclusive architecture.

2. Materials and Methods

The study included a comprehensive documentary and content review [27], conducted as an initial methodological step to identify different types of disabilities and the challenges associated with the housing environment. This background review was incorporated to provide contextual grounding and help situate the reader regarding the needs and barriers faced by individuals with disabilities in residential settings. This phase gathered relevant information on the prevalence, specific issues, and particular needs of various population groups, including individuals with achondroplasia (little people), children with Autism Spectrum Disorder or Down syndrome, people with Alzheimer's, wheelchair users, individuals with visual and hearing impairments, and older adults. The insights obtained during this stage informed the design and focus of the study by establishing a foundational understanding of the specific barriers and challenges these groups encounter within their domestic environments.

The first section of the results outlines the adaptation of the International Classification of Functioning, Disability, and Health (ICF) [28], redefining its key activity categories to better align with housing context. Traditional ICF categories—general tasks, communication, mobility, self-care, and domestic life—were reinterpreted and grouped under accessibility and habitability categories.

The results of a two-part survey incorporating both quantitative and qualitative data are presented. In the first part, participants were asked to prioritize accessibility and habitability categories through a quantitative analysis using the Analytic Hierarchy Process (AHP) method. The second part included an open-ended question to identify the most relevant perceived indicators, with space provided for participants to comment further on these indicators if desired. Details of each analytical approach are provided in the sections below.

2.1. Quantitative Analysis: AHP Method

The quantitative analysis employed the Analytic Hierarchy Process (AHP) [29] to prioritize the habitability and accessibility criteria defined through the ICF model. This process involved several stages (an outline of the process is presented in Figure 1):

1. **Preference Scale:** Participants rated the relative importance of each criterion using a 1 to 9 scale, based on the intensity of preference, ranging from “extremely preferable” to “equally important”.
2. **Pairwise Comparison Matrix:** Based on the ratings, a square matrix was constructed, where each element represented the relationship between two criteria. The Consistency Index (CI) was calculated to ensure internal consistency.

3. Calculation of Relative Weights: The weights for each criterion were derived from the matrix analysis, determining their priority in the habitability assessment.
4. Consistency Ratio (CR): The rationality of judgments was evaluated, with values below 0.10 considered acceptable, those between 0.10 and 0.20 moderately consistent, and values above 0.20 indicating the need to adjust initial judgment.

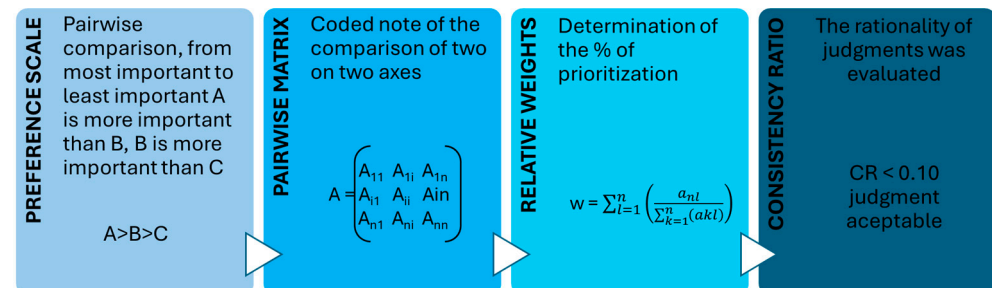


Figure 1. Diagram of the AHP used to estimate priority factors for accessibility and habitability.

2.2. Participant Selection

The selection of disability types and age groups in this study was based on a functional classification of disability, following the approaches defined by the World Health Organization (WHO) [28], which categorizes disabilities into physical, cognitive, sensory, and intellectual types. For this study, we specifically included individuals with physical, sensory, and specific cognitive conditions (such as autism and Down syndrome), as these conditions are more easily differentiated regarding accessibility and habitability within the built environment.

Regarding cognitive disabilities, we focused exclusively on children (<18 years). Previous studies conducted by the authors [24] have highlighted the importance of adaptations for this group, as adults with cognitive disabilities often develop more compensatory mechanisms over time. However, during childhood, improvements in the living environment have the most significant impact, as they can facilitate better development and greater independence in the long term. By focusing on children, the study aims to identify key interventions that can enhance accessibility early, potentially leading to lasting benefits as they grow.

The participant selection process included individuals aged 18 and older, considering different demographic groups: older adults (>60 years) without disabilities (43%), caregivers (daughter) of people with Alzheimer's disease, caregivers or professionals caring for or working with children (<18 years) with Down syndrome (5%) or Autism Spectrum Disorder (11%); individuals with visual impairments (5%) or hearing impairments (11%), wheelchair users (17%), and people of short stature (5%). In the case of caregivers of children with Autism Spectrum Disorder and Down syndrome, all caregivers were mothers, while for the other disabilities, the caregivers were daughters.

In total, 37 participants were involved, completing a structured survey divided into three sections: demographic data, prioritization of accessibility and habitability domains, and selecting indicators composing these domains.

The research team recruited participants using a combination of methods. They first identified and contacted national disability foundations through internet searches. They also reached potential participants via their professional networks. Once initial contacts were established, the team applied a snowball sampling approach by asking participants to share the survey within their networks. This strategy enabled the inclusion of diverse participant groups that are often difficult to reach through conventional recruitment methods [27], allowing the identification of relevant individuals within three key groups:

1. Professionals: researchers or professionals working in the field of disability, contributing a technical perspective.
2. Caregivers: individuals directly assisting people with disabilities, offering practical insights into necessary adaptations.
3. People with disabilities: end-users of housing spaces whose feedback was essential in evaluating the effectiveness of the proposed criteria.

See Table 1 for the descriptive data of the sample used in the study:

Table 1. Descriptive statistics for the study sample.

Variable		Frequency	%
Sex	Male	11	29%
	Female	26	71%
Age	<30 years	6	17%
	31–40 years	11	29%
	41–50 years	10	28%
	51–60 years	5	13%
	>60 years	5	13%
Group	Professionals	16	43%
	Caregivers (mothers and daughters)	14	37%
	People with disabilities	7	20%
Primary disability	Wheelchair users	6	17%
	Little people (achondroplasia)	2	5%
	Down Syndrome	2	5%
	Autism Spectrum Disorder	4	11%
	People with visual impairments	2	5%
	People with hearing impairments	4	11%
	People with Alzheimer's disease *	1	3%
	Older people (>60 years)	16	43%
Total		37	100%

* The survey was eliminated from the analysis because it was not representative.

2.3. Qualitative Analysis

Qualitative analysis complemented the quantitative approach by organizing indicators within each domain based on the experiences and perceptions of key groups. To achieve this, open-ended questions were included, allowing participants to provide written comments on the indicators.

The collected data were analyzed using ATLAS.ti (version 23) [30], a qualitative analysis software that facilitated the identification of key themes, patterns, and relationships within participants' responses. This process helped structure and propose an initial set of habitability and accessibility criteria.

2.4. Validation and Results

The results were validated through consistency index reviews and a cross-evaluation of responses from different groups. This process ensured the integration of diverse perspectives and the identification of priorities to enhance accessibility and habitability in housing environments.

2.5. Ethical Considerations

The study was approved on 2 September 2022, by the Institutional Research Ethics Committee (CEII) of the University. The questionnaire provided to participants included

information on informed consent and details about the data anonymization process for publication.

2.6. Background on Accessibility Types and Housing-Related Issues

The following is a description of the type of people analyzed in this study:

2.6.1. Physical Disability

Wheelchair Users

It is estimated that approximately 130 million people worldwide, representing 1.85% of the global population, are wheelchair users. However, access to this equipment is limited. According to the World Health Organization (WHO), more than 75 million people need a wheelchair, yet only 5% to 15% have access to one [31]. In Chile, although information is scarce, it is estimated that 38% of adults with disabilities experience physical and/or mobility difficulties [32].

Wheelchair users rely on this device to perform their daily activities either independently or with assistance, usually due to mobility impairments caused by injuries such as spinal cord trauma, amputations, acquired brain injury, chronic conditions and neurological disorders like multiple sclerosis, muscular dystrophies, rheumatoid arthritis, or movement disorders like cerebral palsy.

Wheelchair users face challenges related to mobility, maneuverability, and reach in daily activities, as well as difficulties moving within their homes and transferring to and from their wheelchairs into bedrooms and bathrooms [4,33]. In many cases, narrow spaces prevent users from turning or opening doors easily, while uneven floors increase the risk of tipping over or slipping. Additionally, the need for safe transfers from the wheelchair to other household elements (such as beds, regular chairs, or toilets) presents a significant challenge that may lead to falls or injuries if the environment is not adequately adapted [34].

Person with Size Alteration (Achondroplasia)

Various conditions affect bone growth and cause short stature. Achondroplasia, the most common skeletal dysplasia affecting limbs length, is caused by a genetic mutation disrupting endochondral ossification, impairing the growth of long bones. Its incidence is approximately 1 in 25,000 live births annually [35]. Hormonal deficiency related to short stature results from insufficient growth hormone production, preventing proper height development without affecting bone proportions [36]. Key characteristics of individuals with achondroplasia include short stature, disproportionately short limbs, small hands, and limited elbow mobility [37].

People with achondroplasia face significant challenges in daily life, as most environments and products are designed for individuals of average height [38]. Among the primary difficulties are limited access to furniture, shelves, and surfaces, where standard height measurements restrict functionalities in kitchens, bathrooms, and common areas. Additionally, restrictions in the range of motion of the arms, legs, trunk, and hands further impact the usability and accessibility of various spaces and objects [39].

Adaptive solutions, such as adjustable furniture or lower-height designs, must be implemented to reduce these physical barriers. Spaces must also be modified to maximize movement range and enhance autonomy for individuals with achondroplasia.

2.6.2. Cognitive Impairment

Down Syndrome

Down syndrome is a genetic condition caused by an extra chromosome, affecting cognitive abilities and tasks requiring concentration. Children with Down syndrome tend

to perform better visuospatial tasks than visual working memory tasks but may struggle as processing demands increase, particularly in visuospatial working memory [40,41].

The global prevalence of Down syndrome ranges from 15,579,784 cases to 21.51 per 100,000 inhabitants [41], with a local incidence of 3.36 per 10,000 live births [42]. Children with Down syndrome face challenges in developing autonomy, affecting their care and safety at home. As they transition to supported living, many continue to rely on family caregivers for complex tasks, such as financial management and crisis response, making them vulnerable if caregivers age or cannot provide support [43]. Depending on the severity of their condition, they may also experience difficulties with spatial orientation and mobility. Creating environments that support independence is crucial, including safe spaces for personal care and mobility, designs that simplify daily tasks, and environments that enhance visuospatial task performance [24,43].

Autism Spectrum Disorder (ASD)

ASD is a neurodevelopmental condition affecting perception, socialization, and behavior. It can also manifest with motor difficulties like akinesia (loss of movement), hypotonia (low muscle tone), and bradykinesia (slowness of movement) [44,45]. Approximately 1 in 100 children are diagnosed with ASD [46], with about 82,059 minors locally affected, accounting for 14% of children with a disability [32].

Children with Autism Spectrum Disorder face challenges in housing, particularly due to sensory sensitivities. Hypersensitivity or hyposensitivity to stimuli can cause discomfort, emotional dysregulation, or sensory overload, especially in noisy or brightly lit environments. Additionally, atypical behaviors or uncoordinated movements pose risks of accidents. The complexity of using standard electronic devices and stress in disorganized environments further limits autonomy [47].

Addressing these challenges requires designing spaces that control sensory stimuli. This includes using neutral colors, adjustable lighting, sound insulation, and safe furniture with soft materials to minimize injury risks. Organized, predictable spaces can reduce anxiety, and adapting devices with simple, intuitive controls can also help support independence [24,26].

2.6.3. Sensory Disability

People with Visual Impairments

Visual impairments are classified based on the level of vision loss. Total blindness refers to individuals with no perception of light, while low vision describes those whose vision cannot be fully corrected by conventional methods. Visual disability includes both low-vision and blind individuals, as their reduced visual function impacts daily activities [48].

Globally, visual impairments affect at least 2.2 billion people, including those with blindness or visual deficiencies [49]. In 2020, there were 43.3 million blind people, 295 million with moderate to severe visual impairment, and 258 million with mild impairment. Additionally, 510 million suffered from uncorrected presbyopia [50]. In Chile, approximately 850,000 people experience some form of visual impairment [26].

Primary Causes of Visual Impairments

- **Macular Degeneration:** Affects the macula, the central part of the retina, causing progressive loss of central vision. Individuals with macular degeneration experience difficulties perceiving details, as their vision becomes blurred by a central blind spot, impacting tasks such as reading, facial recognition, and food preparation. These individuals require increased lighting in their living spaces and adjustments to contrast levels to aid in night vision and color perception [51]

- Glaucoma: Damages the optic nerve, leading to blind spots in peripheral vision, with central vision remaining intact. Individuals with glaucoma struggle to detect objects in their periphery, making activities such as driving or navigating spaces safely more challenging [52].
- Retinal Detachment: Occurs when fluid accumulates beneath the retina, causing separation from its underlying tissue. Vision loss varies depending on the location of detachment, often leaving individuals with only partial vision in one eye, severely affecting their ability to perceive their environment cohesively [53].
- Cataracts: Characterized by clouding of the eye's lens, resulting in blurred, hazy, or dim vision. Individuals with cataracts have trouble seeing at night, increased light sensitivity, and require brighter lighting for reading or household tasks [54].

With aging, visual impairments often accompany cognitive changes, leading to reduced color discrimination and distorted color perception [55]. This deterioration increases difficulties adapting to varying lighting levels, potentially causing disorientation in poorly lit environments.

Depending on their level of vision, individuals with visual impairments face numerous challenges in the home environment. Identifying spaces and objects can be difficult, as can detecting obstacles such as uneven surfaces, protruding elements, or holes, which increases the risk of accidents. Difficulties in judging distances, orienting themselves correctly, and following routes can further complicate independent navigation [25]. Variations in lighting, particularly glare, may cause disorientation, making it harder to move safely within a space. Additionally, poorly placed objects or structural elements can pose hazards, while accessing written information, such as appliance manuals or instructions, can be challenging. Fine motor activities, including cooking, sewing, crafting, or making repairs, also become more complex.

An environment that minimizes barriers includes eliminating hazards like uneven flooring, loose cables, or improperly positioned furniture, integrating non-slip surfaces to prevent falls, and strategically organizing objects to reduce the effort required for locating and using them [25].

People with Hearing Problems

Hearing impairments encompass various conditions affecting sound perception, categorized into three types. Conductive hearing loss occurs when sound is not efficiently transmitted through the outer or middle ear, while sensorineural hearing loss results from damage to the inner ear or auditory nerve pathways, impairing sound processing in the brain. Mixed hearing loss combines both types.

Globally, hearing impairments affect approximately 1.57 billion people, or 20.3% of the population [56]. The prevalence increases with age, with over 430 million people experiencing disabling hearing loss requiring rehabilitation [49]. In Chile, 18% of individuals with disabilities report hearing-related conditions [32]. The WHO reports that one-third of individuals over 65, two-thirds of those over 70, and 90% of adults over 80 experience hearing loss [49].

To improve accessibility, built environments should accommodate those with hearing impairments. Acoustic insulation reduces background noise, enhancing speech comprehension. Visual signaling systems, such as flashing lights for doorbells and alarms, help compensate for auditory cues. Visual or vibrating alerts for critical notifications further enhance safety and communication in the home [25,57].

2.6.4. Diminished Capacities in Older People Alzheimer's Disease

Alzheimer's disease is the most common form of dementia, accounting for 60% to 70% of cases [58]. It is a progressive neurodegenerative disorder characterized by neuritic plaques and neurofibrillary tangles in the brain. Primarily affecting older adults, it has multifactorial risk factors, including age, genetics, brain injuries, vascular diseases, and environmental exposures. Beyond cognitive decline, individuals with Alzheimer's often experience language comprehension difficulties (aphasia) and motor coordination impairments (apraxia) [58].

Alzheimer's disease has a significant impact worldwide, with an estimated 7.24 million new cases diagnosed annually [59]. Approximately 416 million people over the age of 50, representing 22% of the global population, live with Alzheimer's or other forms of dementia. In Chile, around 180,000 people—1.06% of the population—are affected, making it one of the leading causes of disability and dependency among older adults [60].

Individuals with Alzheimer's disease often experience anxiety, mutism, confusion, or panic when they struggle with spatial orientation, which can significantly impact their sense of safety and independence [61]. As a result, home design should prioritize stability, security, and simplicity. Due to their tendency to become easily disoriented and distracted, organizing objects strategically and intuitively is crucial, facilitating spontaneous and independent use. Additionally, increased risks of falls and accidents arise due to confusion and lack of attention, with progressive memory loss leading to difficulties in recognizing people, objects, or familiar places [25].

Older People Self-Sufficient

In 2020, the global population of older adults was 1 billion, projected to double to 2.1 billion by 2050 [62]. In Chile, older adults made up 18.4% of the population in 2022, totaling 3,651,538 people [63].

As individuals age, the likelihood of developing one or more functional disabilities increases, affecting their ability to carry out daily activities. These disabilities manifest in different ways, with the most common conditions including muscle control loss, musculoskeletal stiffness, muscle weakening (hypotonia), reduced range of motion (akinesia), slower movements (bradykinesia), and sarcopenia, a condition characterized by the loss of muscle mass, strength, and function. Additionally, hearing and visual impairments, as well as cognitive decline, such as dementia, are frequent among aging populations [64].

Older adults often experience reduced sensitivity in the lower extremities, leading to balance issues and instability while walking, which increases the risk of falls [65]. Homes with slippery surfaces or poorly marked elevation changes pose additional hazards. Moreover, poorly designed environments can cause confusion or disorientation, and the absence of preventive measures in key areas such as bathrooms and kitchens further elevates safety risks [66].

Another growing challenge is the difficulty in using digital devices, particularly kitchen appliances that are not adapted to the specific needs of older adults, complicating their autonomy and safety [25].

3. Results

3.1. Presentation Axis from ICF

The International Classification of Functioning, Disability, and Health (ICF) is a model developed by the World Health Organization [28] to provide a universal and standardized framework for understanding, describing, and measuring human functioning, disability, and health in different contexts. It was used to create a set of criteria to be assessed for each

type of disability. This model transcends a purely medical view of disability and adopts an integrative approach that considers the interactions between the health condition, personal factors, and the environment.

The ICF model was born as an evolution of the former International Classification of Impairments, Disabilities, and Handicaps (ICIDH) [67], also from WHO. ICIDH focused more on a medical view, whereas ICF sought a more holistic and inclusive approach [28]. Its main objective is to provide a common language and structure for describing how health conditions affect people, considering the individual and environmental factors that influence functioning.

The model is based on a biopsychosocial framework, combining medical (biological) and social aspects, and integrates two main components of human functioning:

1. Functioning and Disability (health or disability status of the individual and its impact on body functions and structures, activities, and participation).
 - a. Body functions are related to the physiological or psychological systems of the body, such as sensory, muscular, and mental, among others. Body structures are the anatomical parts of the human body, such as organs, limbs, and related structures.
 - b. Activities relate to the execution of tasks or actions by an individual, such as self-care, mobility, communication, and other daily routine tasks. Participation is the possibility of involvement in daily life, such as work activities, education, social interactions, or community activities.

This component, therefore, considers the difficulties people face in performing activities or participating in social situations due to their disability.

2. Contextual factors (environmental and personal circumstances that may influence the person's functioning and disability are composed of environmental and personal components).
 - a. Environmental components correspond to the physical, social, and attitudinal aspects of the individual's environment, such as the built environment, the social support network, the attitude of other individuals, and the accessibility of services. These components can, therefore, facilitate or hinder human functioning.
 - b. The personal component delivers the individual's demographic characteristics, educational level or cultural background, although the ICF does not classify them specifically due to their diversity.

The ICF emphasizes that disability does not arise exclusively from health conditions but from interactions between individual limitations and environmental barriers or facilitators. In this context, these interactions are linked to the design, accessibility and functionality of housing, so the ICF model is used to redefine and adjust its traditional categories to the context of the housing environment, focusing on housing characteristics for people with disabilities.

Thus, the key activities of the ICF, such as general tasks, communication, mobility, self-care, and domestic life, were reorganized and renamed as axes of accessibility and habitability, adapted to the household's specific needs. The details of the indicators that compose it are shown in Table 2, and the new proposal is defined below:

Table 2. Description of the indicators comprising the accessibility and habitability axes. Source: authors.

Autonomy	Communication	Comfort (Indoor Quality)	Independence	Mobility	Safety
A01—Height of bathroom accessories (soap dish, towel rack, toilet paper, etc.)	C01—Type of doorbell and/or buzzer (sound, light and audible in several places)	IQ01—Access to natural lighting in most areas	I01—Height of hardware (door and window handles and locks)	M01—Ample space to avoid obstacles in its route	S01—Window and balcony sill heights
A02—Height of sanitary fixtures (toilet, sink)	C02—Location of artificial light	IQ02—Sound insulation from outside in all areas	I02—Hardware type (door and window handles and locks)	M02—Door characteristics	S02—Height and strength of railings at all openings to the exterior
A03—Height and placement of faucets (kitchen and bathroom)	C03—Strategic location of windows (optimization v/s glare)	IQ03—Quantity of artificial lighting	I03—Window characteristics	M03—Clear width of doors (in access, bathroom, bedroom, kitchen)	S03—Support bars and/or handrails
A04—Clear transfer areas in the bathroom	C04—Use of appropriate colors in furniture (contrast with floor)	IQ04—Indoor temperature control system	I04—Type of door opening (in access, bathroom, bedroom, kitchen)	M04—Staircase characteristics	S04—Emergency button in bathroom
A05—Shower or bathtub seat	C05—Use of separate exhaust fan switch (bathroom or other)	IQ5—On/off control of fixed heating (radiators or air-conditioning)	I05—Height of adaptable lighting fixtures	M05—Existence of slopes	S05—Height and location of gas stopcock
A06—Closet dimensions (or fixed furniture: height and depth)	C06—Control of natural light in enclosures (glare)	IQ6—On/off control of fixed heating (radiators or air-conditioning)	I06—Number of sockets	M06—Existence of stairs	S06—Protection under the stairs (to avoid knocks)
A07—Kitchen appliance dimensions (height and depth)		IQ07—Existence of ventilation (natural or exhaust)	I07—Number of switches	M07—Size of spaces (bathroom, kitchen, bedroom)	S07—Night lighting in the bedroom and on the way to the bathroom
A08—Sink dimension			I08—Type and color of switch buttons	M08—Type of flooring	S08—Protection on windows and balcony
A09—Bathroom furniture dimension			I09—Location and height of sockets	M09—Corridor characteristics (dimension and trajectory)	S09—Type of kitchen appliances (sound and automatic shut-off)
A10—Kitchen furniture dimension			I10—Location and height of switches		S10—Type of staircase flooring
A11—Shower or bathtub dimensions			I11—Color and illumination of switch boxes and sockets to locate them		S11—Existence of alarms (smoke or carbon monoxide)

Table 2. *Cont.*

Autonomy	Communication	Comfort (Indoor Quality)	Independence	Mobility	Safety
A12—Bathtub type (bathtub, shower tray, or floor-level access)			I12—Type of furniture (fixed)		S12—Electrical outlet protection
A13—Faucet type (bathroom and kitchen)			I13—Organization and characteristics of spaces		
A14—Countertop dimension					

Autonomy axis (A): This axis brings together the characteristics of dwellings that allow the individual to perform self-care tasks autonomously, such as eating, dressing, or performing personal hygiene. A total of 14 indicators are evaluated in the bathroom and kitchen areas and the fixed furniture. In the bathroom, aspects such as the height and location of accessories and sanitary fixtures, the characteristics of the faucet, or free transfer areas will be considered. In the kitchen, the dimensions and characteristics of the countertop, faucets, dishwasher, and fixed furniture will be analyzed. Finally, the permanent closet or fixed furniture dimensions will be considered.

The communication axis (C) gathers dwelling characteristics that allow good communication and reception of spoken, nonverbal, written, and conventional sign language messages in domestic life. Its six indicators relate to the characteristics of the buzzer or sound system, the location of lighting and windows (to avoid glare), and the appropriate use of colors in furniture or coverings (flooring, walls).

The comfort axis (indoor Quality—IQ) is composed of housing elements that ensure minimum habitability conditions. Therefore, its seven indicators are related to noise levels, lighting, temperature, and ventilation.

The independence axis (I) brings together the elements of the dwelling that make it possible to perform household tasks such as preparing food, doing chores, or caring for and using household items as independently as possible. The 13 indicators in this group consider aspects such as the height and type of hardware on doors and windows, the characteristics and opening of windows and doors, the type and arrangement of furniture, and the organization and functionality of the spaces. In addition, in the electrical area, the adaptability of lighting, the number, location, and height of sockets and switches are evaluated, along with their design and visibility characteristics for accessible and safe use.

The mobility axis (M) combines the characteristics of dwellings that facilitate unobstructed movement, with or without assistance, within the home, between rooms, and to other areas. Its nine indicators relate to the amplitude, characteristics, and size of spaces, enclosures, corridors, and accesses and the existence and characteristics of slopes and stairs.

Finally, the safety axis (S) regroups elements of the dwelling for daily life that prevent domestic accidents and guarantee a safe environment. This axis is composed of 12 indicators related to the safety, accessibility, and functionality of the dwelling. These include the height and protection of exterior openings, the presence of supports and handrails, preventive measures on stairs, the location of key elements such as stopcocks and emergency buttons, lighting systems, alarms, and electrical protection.

Table 2 shows the indicators that comprise the accessibility and habitability axes.

3.2. Prioritization of the Axes of Accessibility and Habitability According to the AHP Method

The following results of applying the AHP method: autonomy, communication, comfort, independence, mobility, and safety are prioritized according to the perspectives of caregivers, professionals, and persons with impairments (PwI). The values reflect the priorities (%) assigned by the interviewees and highlight the variability in the perception of importance among the different interest groups and types of disability.

As shown in Figure 2, the autonomy axis is the most relevant for almost all groups of respondents, reaching 61.8% in the case of older people. In addition, this axis presents the highest standard deviation among the groups surveyed, with values ranging from 2.76 in the group of Down syndrome and Autism Spectrum Disorder to 15.56 in the group of people with visual impairment.

Primary disability	Groupe	Autonomy	Communication	Comfort	Independence	Mobility	Security	Consistency Ratio (CR)
Wheelchair users	Caregiver	47.1	4.8	9.9	7.4	24.7	6.1	0.04
	Professional	42.9	6.2	9.0	2.2	30.1	9.6	0.13
	PwI	40.4	7.5	12.1	4.7	23.9	11.4	0.12
	Total	35.8	5.3	13.3	4.3	29.6	11.7	0.10
	SD	3.39	1.35	1.59	2.60	3.37	2.70	
Little people		31.5	10.6	15.7	11.6	13.0	17.6	0.08
Down Syndrome	Caregiver	48.9	9.0	11.0	8.4	13.1	9.6	0.07
	Professional	52.8	5.7	10.7	6.6	17.4	6.8	0.08
	Total	40.5	7.9	12.9	10.7	16.9	11.1	0.04
	SD	2.76	2.33	0.21	1.27	3.04	1.98	
Autism Spectrum Disorder	Caregiver	43.0	5.5	10.0	3.1	27.7	10.7	0.07
	Professional	39.1	10.4	10.2	4.9	24.3	11.1	0.30
	Total	41.0	6.3	13.6	3.6	22.3	13.2	0.11
	SD	2.76	3.46	0.14	1.27	2.40	0.28	
People with visual impairments	Caregiver	52.8	6.0	17.2	8.6	8.1	7.3	0.10
	Professional	30.8	12.9	12.9	16.2	15.6	11.6	0.03
	Total	46.7	8.2	14.4	10.0	12.5	8.2	0.09
	SD	15.56	4.88	3.04	5.37	5.30	3.04	
People with hearing impairments	Caregiver	13.3	38.2	12.0	8.8	10.9	16.8	0.08
	PwI	30.2	33.3	12.2	8.3	6.5	9.5	0.05
	Total	23.7	36.9	10.3	7.5	7.3	14.3	0.05
	SD	11.95	3.46	0.14	0.35	3.11	5.16	
Older people	Caregiver	38.3	12.0	13.2	8.8	10.9	16.8	0.08
	Professional	38.6	5.3	10.2	3.5	28.7	13.7	0.12
	PwI	61.8	4.4	9.7	4.0	10.4	9.7	0.10
	Total	42.6	5.7	12.4	3.2	27.6	8.5	0.13
	SD	13.48	4.15	1.89	2.93	10.42	3.56	

Figure 2. Prioritization of accessibility and habitability axes (%) by primary disability group and role of respondents: Heatmap-based Analysis (The colors range from green (lowest value) to red (highest value), indicating the relative magnitude of the ratings). Source: by authors.

Within the group of wheelchair users ($n = 6$), the autonomy and mobility axes emerge as significantly important, and perceived as a top priority. The autonomy axis is rated at 47.1% according to the caregivers' perception, while the mobility axis is valued at 30.1% by professionals. The high standard deviation in both cases (SD 3.39 and 3.37) among the three groups interviewed suggests a substantial variability in the responses, underscoring the significance of these axes in the lives of wheelchair users.

Conversely, the comfort and safety axes present a balanced priority, with moderate averages of 13.3% and 11.7%, respectively. This balance in the priorities of wheelchair users is evident, indicating that while comfort and safety are considered relevant, they do not reach the same level of importance as the autonomy and mobility axes. The communication

and independence axes, with values of 5.3% and 4.3%, respectively, occupy the lower end of the priority scale, suggesting their perceived lesser relevance within this user group.

The results for little people (LP, $n = 2$) indicate that autonomy (31.5%) is the most relevant axis for the respondents. The comfort (15.7%) and safety (17.6%) axes also received moderate scores, underscoring the need to enhance the quality of the indoor environment and mitigate risks in the home. In contrast, the communication axis obtained a lower score (10.6%), suggesting that this aspect is perceived as less of a priority than the other axes evaluated.

For the group of professional interviewees and caregivers of children with Down syndrome ($n = 2$) and Autism Spectrum Disorder ($n = 4$), the results reflect a similar valuation among the different axes, both by caregivers and professionals. Autonomy is the most relevant axis, with scores of 40.5% for Down syndrome and 41% for Autism Spectrum Disorder. This suggests that self-care activities are a key priority for both groups.

Similarly, the comfort (12.9% Down syndrome and 13.6% Autism Spectrum Disorder) and safety (11.1% Down syndrome and 13.2% Autism Spectrum Disorder) axes also receive significant attention, indicating the importance of creating adequate, protected spaces that facilitate well-being and minimize risks. The similarity in these scores, together with the low standard deviations (SD) for the comfort axis: 0.21 in Down syndrome and 0.14 in Autism Spectrum Disorder; SD for the safety axis: 1.98 in Down syndrome and 0.28 in Autism Spectrum Disorder, suggests a balanced distribution of priorities around these essential aspects, reflecting a comprehensive and reassuring approach among respondents.

On the other hand, the axes of communication (7.9% Down syndrome and 6.3% Autism Spectrum Disorder) and independence (10.7% Down syndrome and 3.6% Autism Spectrum Disorder) are the least prioritized within this group. This lower valuation may be because the predominant focus is oriented towards the adequacy of the physical environment, guaranteeing accessibility and safety, rather than promoting social interaction and independence in decision-making, probably because they are assumed to have complementary needs and represent the role of the caregiver.

For people with visual impairment ($n = 2$), the autonomy axis is positioned as the highest priority, with an assessment of 52.8%, being prioritized by 30.8% by caregivers and professionals, respectively. In addition, comfort is a relevant criterion for caregivers (17.2%), while the independence axis is more highly valued by professionals (16.2%).

On the other hand, caregivers consider the axes of communication (6%) and safety (7.3%) to be a lower priority. In contrast, for professionals, the axes of communication and comfort share the same score (12.9%), reflecting a different perception between the respondents.

Due to these variations in the priorities assigned by caregivers and professionals, the standard deviations in the responses are the highest among all the groups surveyed, with values ranging from 15.56 to 3.04, indicating a greater dispersion in the opinions regarding the importance of each axis.

For people who are hard of hearing ($n = 4$), the communication axis is the most relevant, with caregivers rating it 38.2% and people who are hard of hearing themselves 33.3%. This underscores the need to design environments that foster interaction and enhance communicative accessibility, prompting greater awareness and a deeper understanding of their everyday experiences.

In addition, caregivers prioritize the safety axis (16.8%), while the hearing-impaired prioritize the autonomy axis (30.2%), reflecting differences in perceptions of this group's most pressing needs.

On the other hand, the axes of independence (7.5%) and mobility (7.3%) receive lower priority, possibly because these difficulties are not considered significant compared to communication barriers, which represent this group's main challenge.

The autonomy axis is the most relevant for older people (OP, $n = 16$), with 38.3% for caregivers, 38.6% for professionals, and 61.8% for older people. These results reflect the importance of maintaining autonomy in daily life, and it should make the audience feel respectful and considerate of the needs of older adults.

Safety is also prioritized, especially for caregivers (16.8%). Meanwhile, the mobility axis becomes more relevant for professionals (28.7%) and older people (27.6%), which is closely related to the possibility of continuing to carry out activities autonomously.

The three groups interviewed consider comfort moderately important, with scores of 13.2% for caregivers, 10.2% for professionals, and 9.7% for older people. The standard deviation (1.89) is also more homogeneous, indicating less response variability.

Finally, the independence axis is the lowest priority, with scores of 8.8% for caregivers, 3.5% for professionals, and 4.0% for older people. Despite its lower relevance, the results show a similar trend, with a standard deviation of 2.93, suggesting some consistency in the perception of this aspect among the groups surveyed.

3.3. Prioritization of Indicators in Each of the Axes

The results of the indicator selection process for each accessibility and livability axis, organized by primary disability, are presented below. This selection reflects the perspectives of individuals with disabilities, professionals, and caregivers of children with Autism Spectrum Disorder or Down syndrome. Additionally, specific requirements mentioned by respondents have been included to represent their needs and preferences in the built environment more accurately.

3.3.1. Autonomy Axis

Table 3 shows the votes (in %) for the 14 proposed indicators. Wheelchair users, older people, and little people chose the most indicators, with 10, 7, and 9 indicators, respectively.

In A08 "Sink Dimensions" (50%), A09—bathroom furniture dimensions (67%), and A10—kitchen furniture dimensions (50%), in addition to specifying height and depth, it is essential to ensure that wheelchair users have clear space beneath both the furniture and the sink.

For Autism Spectrum Disorder group, in A13—faucet type for bathroom and kitchen (25%), it is recommended to use single-lever faucets, preferably equipped with a temperature control sensor to ensure ease of use and safety. Additionally, in A14—kitchen appliances, the Autism Spectrum Disorder group (25%) suggests that appliances should have an automatic shut-off system when not in use to prevent potential hazards.

Regarding hearing-impaired users (25%), appliances should be low noise to minimize auditory discomfort. For visually impaired users, it is recommended that appliances have Braille-labeled buttons and avoid touchscreen controls, which may be challenging to navigate without visual assistance.

For the little person, the selected indicators primarily focus on the height and dimensions of fixtures and furniture. In A12—bathtub type, a low-profile shower tray or walk-in bathtub is the preferred option to enhance accessibility.

Regarding the preferences of people in wheelchairs and older people, both groups show similarities. However, people in wheelchairs also consider the following indicators: A02—height of sanitary fixtures, A04—free transfer areas, A08—dishwasher size and A11—shower or bathtub size. On the other hand, older people highlight the importance of

indicator A05—seat in shower or bathtub, prioritizing not only the presence of a seat but also the adequate space and geometry for its installation.

Unlike people in wheelchairs, older people also select indicator A13, which is the type of faucet, preferring the single lever system for ease of use.

Table 3. Selection (%) of autonomy axis indicators for different disability types. Source: authors.

Indicator	Wheelchair Users	Little Person	Professionals and Caregivers of Children with Down Syndrome	Autism Spectrum Disorder	Visual Impairments	Hearing Impairments	Older People
A01—Height of bathroom accessories (soap dish, towel rack, toilet paper, etc.)		100%					
A02—Height of sanitary fixtures (toilet, sink)	67%	100%					
A03—Height and placement of Faucets (kitchen and bathroom)	100%	100%					88%
A04—Clear transfer areas in the bathroom	67%						
A05—Shower or bathtub seat							63%
A06—Closet dimensions (or fixed furniture: height and depth)	50%	50%					18%
A07—Kitchen appliance dimensions (height and depth)		50%					
A08—Sink dimension	50%	50%					
A09—Bathroom furniture dimension	67%	50%					56%
A10—Kitchen furniture dimension	50%	50%					50%
A11—Shower or Bathtub Dimensions	67%						
A12—Bathtub type (bathtub, shower tray or floor-level access)	67%	100%					75%
A13—Faucet Type (bathroom and kitchen)	67%		50%	25%			18%
A14—Countertop dimension				25%	50%	25%	

3.3.2. Communication Axis

Results show unanimous acceptance of certain indicators among visually impaired individuals regarding the six proposed indicators for the communication domain. These include C03—strategic window placement, which optimizes natural light while minimizing glare; C04—use of appropriate colors on furniture, ensuring contrast with the floor for better visibility; and C06—control of natural light, preventing excessive glare.

For C02—artificial light placement, 50% of visually impaired participants indicated that lighting should not be direct but rather positioned above the line of sight and strategically placed, particularly at night, to enhance visibility and detection.

On the other hand, 50% of wheelchair users, individuals with hearing impairments, and 62% of older adults selected C01—doorbell and intercom type (with sound, light, and multi-room audibility).

Finally, the C05—separate exhaust fan switch in the bathroom was highly preferred (75%) by participants with hearing impairments, who emphasized the importance of independent ventilation control.

Neither individuals of little people nor caregivers of children with Autism Spectrum Disorder or Down syndrome selected any indicators within this domain. This reinforces previous findings suggesting that communication is not perceived as a priority for these populations.

3.3.3. Comfort Axis

Among the seven proposed comfort indicators, results show the following:

Regarding lighting, IQ01—access to natural light in most rooms was selected by 75% of caregivers of children with Autism Spectrum Disorder, 100% of caregivers of children with Down syndrome, 50% of visually and hearing-impaired individuals, and 33% of wheelchair users. Additionally, IQ03—amount of artificial lighting was preferred by 25% of ASD caregivers, 50% of hearing-impaired individuals, and 100% of visually impaired individuals. Both ASD caregivers and visually impaired participants highlighted the importance of adjustable lighting. Lastly, IQ05—wall and ceiling finishes was exclusively chosen by older adults (18%).

IQ02—exterior sound insulation was identified as a key indicator for acoustic concerns by 100% of ASD caregivers, 75% of hearing-impaired individuals, and 50% of older adults.

Regarding temperature control, 25% of ASD caregivers and 18% of older adults selected IQ04—indoor temperature control system, while IQ06—control for fixed heating systems (radiators or climate control) was chosen only by 50% of ASD caregivers. IQ07—ventilation (natural or mechanical) was also a priority for 31% of older adults.

Like the communication axis, little people did not select any indicators within the comfort domain, further supporting the idea that their primary concerns lie in other areas of accessibility and habitability.

3.3.4. Independence Axis

Table 4 presents the prioritization results for the 13 proposed indicators within the independence axis. The wheelchair users and older adults selected the highest number of indicators, choosing six and eleven indicators, respectively.

For I03—window characteristics, wheelchair users preferred tilt-and-turn windows that could be opened with one hand, while older adults also opted for tilt-and-turn models. However, few people prioritized the windows' weight, as lighter designs would improve ease of use.

Regarding I02—type of hardware (handles and locks for doors and windows), this indicator was selected by 75% of caregivers of children with Autism Spectrum Disorder, who preferred a digitally controlled opening system. Similarly, caregivers of children with Down syndrome recommended that the main entrance door have a controlled, digital locking mechanism. Wheelchair users and older adults, on the other hand, preferred lever-style handles for more straightforward operation.

For the I04 door opening system (for entryways, bathrooms, bedrooms, and kitchens), wheelchair users emphasized the need for a system that allows smooth access to a wheelchair and facilitates easy door operation (opening direction). Meanwhile, caregivers of children with Autism Spectrum Disorder and older adults stressed the importance of

doors opening in the same direction across all rooms, ensuring consistency in movement patterns.

Table 4. Selection (%) of independence axis indicators for different disability types. Source: authors.

Indicator	Wheelchair Users	Little Person	Professionals and Caregivers of Children with Down Syndrome	Autism Spectrum Disorder	Visual Impairments	Hearing Impairments	Older People
I01—Height of hardware (door and window handles and locks)	50%						25%
I02—Hardware type (door and window handles and locks)	50%		100%	75%			44%
I03—Window characteristics	33%	100%	50%				38%
I04—Type of door opening (in access, bathroom, bedroom, kitchen)	75%			50%			68%
I05—Height of adaptable lighting fixtures							18%
I06—Number of sockets							13%
I07—Number of switches							13%
I08—Type and color of switch buttons							31%
I09—Location and height of sockets	50%		50%				44%
I10—Location and height of switches	50%				100%		44%
I11—Color and illumination of switch boxes and sockets to locate them					100%		
I12—Type of furniture (fixed)				25%			56%
I13—Organization and characteristics of spaces			50%	100%		50%	

Regarding I12—type of fixed furniture, caregivers of children with Autism Spectrum Disorder highlighted the importance of accessible, functional, and safe furniture, meaning non-climbable and free of sharp edges. Older adults (56%) also selected this indicator, adding that furniture should be anchored to walls to prevent falls and designed to avoid sharp edges to reduce injury risks such as bruises or cuts.

For I13—organization and characteristics of spaces, this indicator was unanimously selected (100%) by caregivers of children with Autism Spectrum Disorder, who emphasized the need for clearly defined room functions—a preference also shared by 50% of caregivers of children with Down syndrome. Additionally, they recommended that each child have an independent room for calming down when needed. Meanwhile, hearing-impaired individuals suggested that spatial organization follow a simple geometric layout to facilitate lip-reading and ensure noisy areas are separated from quieter spaces to improve communication and comfort.

The result of the selection of the indicators shows differences according to the needs of each group. Indicator I01, referring to the height of hardware (door and window

handles and locks), was chosen mainly by wheelchair users and older people. Regarding lighting and sockets, older people highlighted the importance of the adaptable height of the luminaire (I05, selected by 18%), the number of sockets (I06) and switches (I07), both with a 13% preference, as well as the type and color of the buttons on the switches (I08, chosen by 31%). Indicators I09 and I10, related to the location and height of sockets and switches, were selected by people in wheelchairs (50%), older adults (44%), and visually impaired people (100%), while in the case of sockets, they were also chosen by 50% of Down syndrome group. Finally, indicator I11, which refers to the color and lighting of the switch boxes and sockets to facilitate their location, was selected exclusively by people with visual impairment.

3.3.5. Mobility Axis

Nine indicators were proposed for this axis. The resulting votes are shown in Table 5.

Table 5. Selection (%) of mobility axis indicators for different disability types. Source: authors.

Indicator	Wheelchair Users	Little Person	Professionals and Caregivers of Children with		Visual Impairments	Older People
			Down Syndrome	Autism Spectrum Disorder		
M01—Ample space to avoid obstacles in its route	67%				50%	63%
M02—Door characteristics		100%				18%
M03—Clear width of doors (in access, bathroom, bedroom, kitchen)	83%					75%
M04—Staircase characteristics			100%	50%	100%	50%
M05—Existence of slopes	67%					63%
M06—Existence of stairs	50%					38%
M07—Size of spaces (bathroom, kitchen, bedroom)	50%					50%
M08—Type of flooring	50%				100%	44%
M09—Corridor characteristics (dimension and trajectory)	67%					

Table 5 shows that wheelchair users and older people choose the most indicators in this group, with seven and eight indicators, respectively.

Regarding indicator M02—door characteristics, older people emphasize the importance of contrasting the colors of the door leaf and the frame (18%). Conversely, small people prioritize the door's weight (100%).

For the indicator M03—clear width of doors (in access, bathroom, bedroom, kitchen), wheelchair users (83%) prefer sliding doors, as they allow for an increased clear width and meet the minimum accessibility requirements.

Indicator M04—staircase features, was identified as the most prioritized indicator, both in terms of selection and associated requirements. For Autism Spectrum Disorder group (50%) and Down syndrome (100%), as well as for older people (50%), it is recommended that the stairs be enclosed (no gaps between steps or in the handrails). In addition, older people require a limited number of steps and adequate dimensions in the relationship between the tread and riser. On the other hand, visually impaired people (100%) emphasize the importance of the steps and handrails having colors that generate a good contrast to facilitate their visibility.

Regarding indicator M07—the size of enclosures (bathroom, kitchen, and bedroom), wheelchair users (67%) require spaces that allow turning and proper use of the chair. Visually impaired people (50%) and older people (63%) require an adequate size to avoid bumps due to obstacles (furniture).

For the indicator M08—a type of pavement, wheelchair users (50%) indicate that it should have a texture that facilitates sliding. Visually impaired people (100%) suggest that the colors and brightness should be adequate to avoid glare, while older people (44%) emphasize the need for the pavement to be non-slip.

Regarding indicator M09—characteristics of the corridors, 67% of wheelchair users consider their free width essential and recommend evaluating the trajectory type (no angles).

Finally, people with hearing impairment did not select any indicator within this axis.

3.3.6. Safety Axis

A total of 12 indicators were proposed for the safety axis. Some of them were selected exclusively by one type of user. For example, indicator S04, the emergency button in the bathroom, was chosen by 63% of older people, while indicator S12, outlet protection, was selected by 25% of the Autism Spectrum Disorder group.

The group of hearing and visually impaired people chose only one indicator each. For 50% of people with hearing impairment, the priority was indicator S09—a cooktop (appliance) (with sound and automatic shut-off), which was also chosen by 100% of the group of professionals and caregivers of children with Down syndrome. On the other hand, indicator S06—protection under the stairs (to avoid bumps) was selected by 100% of people with visual impairment, as well as by 33% of wheelchair users and 38% of older people.

Among the most selected indicators were the following:

- S01—Window and balcony sill height, selected by 25% of the Autism Spectrum Disorder group, 67% of wheelchair users, and 31% of older adults.
- S03—Grab bars and handrails, selected by 25% of the Autism Spectrum Disorder group (in hallways), 83% of wheelchair users (in bathtub and toilet), and 94% of older people (in bathtub, toilet, stairs, and hallways).
- S05—The height and location of the gas stopcock, in addition to being hidden and safe, were chosen by 25% of caregivers and professionals in the group of children with Autism Spectrum Disorder, 50% of wheelchair users (for reach issues), and 31% of older people.

The indicators selected by two groups of people were as follows:

- S02—Height and strength of railings at exterior openings, chosen by 33% of wheelchair users and 18% of older people.
- S07—Night lighting in the bedroom and on the way to the bathroom, selected by 50% of wheelchair users and 63% of older people.
- S08—Protection on windows and balconies (or terraces), selected by 25% of the surveyed Autism Spectrum Disorder group and 100% of the Down syndrome group.

- S10—The type of flooring on stairs is indicated by 25% of the Autism Spectrum Disorder group and older people.
- S11—The existence of smoke or carbon monoxide alarms was chosen by 68% of older people and 50% of the Down syndrome group.

Finally, in this axis, little people did not select any indicator.

Table 6 recapitulates the number (in % and frequency) of indicators selected on each axis by each group of people.

Table 6. Summary of selected indicators by axis and group (percentage and frequency). Source: authors.

Primary Disability/AXIS	Autonomy (n = 14)	Communication (n = 6)	Comfort (n = 7)	Independence (n = 13)	Mobility (n = 9)	Safety (n = 12)	Total (n = 61)
Wheelchair users	83%—10	16%—1	14%—1	46%—6	77%—7	50%—6	51%—31
Little people (achondroplasia)	64%—9	0	0	8%—1	11%—1	0	18%—11
Children with Down syndrome (professionals and caregivers)	7%—1	0	14%—1	31%—4	11%—1	25%—3	16%—10
Children with Autism Spectrum Disorder (professionals and caregivers)	14%—2	0	71%—5	31%—4	11%—1	50%—6	30%—18
People with visual impairments	7%—1	64%—4	28%—2	8%—2	33%—3	8%—1	21%—13
People with hearing impairments	7%—1	32%—2	43%—3	8%—1	0	8%—1	13%—8
Older people	50%—7	16%—1	56%—4	85%—11	88%—8	75%—9	66%—40

As can be seen in Table 6, the group of wheelchair users selected 31 of the 61 proposed indicators. The axes with the highest number of selections are autonomy (83%) and mobility (77%), suggesting the importance of these axes in their daily lives.

On the other hand, the group of people of short stature chooses the fewest indicators, with only 11 selections. The most relevant axis within this group is autonomy, with 64% of selections.

The communication axis is not significant for respondents of the Down syndrome and Autism Spectrum Disorder groups. However, both emphasize the importance of independence, with a 31% selection rate. In addition, within the Autism Spectrum Disorder group, comfort indicators are particularly relevant (five out of seven selected), as are safety indicators (six out of twelve selected).

For people with sensory impairment, the axes of autonomy, independence, and safety are the least selected by people with both visual and hearing impairments. However, differences are observed in other aspects: people with visual impairments prioritize the communication axis (64%), while people with hearing impairments select more indicators in comfort (43%) and communication (32%) axes.

Finally, older people choose the most indicators, with 40 of the 61 proposed. In this case, the axes with the highest selection are independence (85%), mobility (88%), and safety (75%), suggesting that these aspects are key to their use and enjoyment of their homes.

4. Discussion

4.1. On the Use of AHP

The AHP method, with its numerous advantages, is an efficient tool for researchers and professionals. It requires a small sample size, offers a validation method, is simple to apply, and has user-friendly open-access software [22]. Its wide use in sustainable construction [68] is a testament to its efficiency, and its application in housing analysis further enhances its value.

The AHP method's adaptability is evident in its diverse applications. For instance, it has been used to assess the quality of smart home care for older adults living in communities [69], focusing on developing a quality-of-care index system. In Switzerland [70] empirical data have been used to analyze perceptions of the environmental quality of residential real estate in different regions. Similarly, in China [71], it has been applied in studies examining young consumers' preference for certain features of the physical and social housing environment using an AHP-based framework.

The main novelty of this study lies in the possibility of converting subjective criteria into objective criteria by applying AHP. This is achieved through a systematic process of pairwise comparisons, where subjective criteria are quantified and compared to each other, resulting in a more structured and informed assessment of accessibility and habitability in housing for people with disabilities. This facilitates the prioritization of improvements more efficiently and evidence based.

The results show that the autonomy axis is a priority factor in the respondents' perception. Autonomy is important in the case of older people (61.8%), suggesting that the design of accessible housing should focus on providing conditions that favor the autonomy of residents.

The AHP is consolidated as a valuable tool for decision-making in the design of accessible housing due to its systematic approach, which allows criteria to be ranked objectively. This systematic approach provides a reassuring framework for the design process, ensuring that the analysis reflects the real needs of people with disabilities. By incorporating the users' perceptions, the AHP increases the relevance and effectiveness of the proposed solutions, instilling confidence in the design outcomes.

However, it is crucial to be aware of the method's limitations. Its reliance on subjective judgments can introduce variability in the results, as individual experiences of the respondents can significantly influence the outcome. This is evident in the high standard deviation recorded in specific axes, with values ranging from 2.76 to 15.56 depending on the group analyzed. Furthermore, the AHP may be susceptible to biases in the criteria weighting, particularly if the sample of respondents is not sufficiently diverse or representative. This potential for bias underscores the need for vigilance and awareness in the design process.

4.2. About the Results

The findings of our study, which echo previous research conducted in Australia [72], reveal the daunting accessibility challenges faced by people with mobility disabilities. A staggering 71% of respondents reported that their dwellings did not fully meet their accessibility needs. The most common modifications identified in the study of Australia, included removing steps, widening internal doorways and hallways, and leveling access throughout the dwelling. Similarly, our study found that 50% of wheelchair users stressed the importance of eliminating stairs, 67% prioritized the width of spaces to avoid obstacles, 83% emphasized the need for adequate clear width in doorways, and 67% indicated that the absence of unevenness is a crucial factor in ensuring safe and efficient mobility within the home.

Consistent with previous research [73], the results of our study confirm that entryways, kitchens, and bathrooms often present environmental barriers that hinder accessibility, especially for older people. These spaces are fundamental for daily life, autonomously enabling essential activities such as cooking or toileting. In this sense, in the autonomy axis, the ability to perform self-care tasks without assistance was identified as the most relevant, with scores of 38.3% by caregivers, 38.6% by professionals and 61.8% by the older people themselves. Among the indicators prioritized by this group, 50% highlighted the absence of stairs, 63% the elimination of unevenness, 50% the adequacy of kitchen furniture dimensions (height and depth) and 94% the presence of grab bars in the bathroom, a fundamental aspect within the safety axis. These results coincide with the findings of Slaug et al. [74], who identified as common barriers the existence of steps and high thresholds between rooms, inadequate location of cabinets and shelves in the kitchen, and the absence of support bars in the bathroom and toilet. Similarly, studies conducted in New Zealand by Kuboshima and McIntosh [75] highlight the importance of design elements such as space layout to avoid turning in confined areas (63% in our study), elimination of differences in floor level (63% in our study), use of furniture without sharp corners (56% in our study), and accessible placement of door handles (25% in our study).

In the case of people with achondroplasia, our study's findings, which align with previous research [76,77] reveal that many require assistance or adaptive devices for daily activities. These findings underscore the significance of autonomy (31.5%) for this group, followed by independence (11.6%) and mobility (13%). Shediach et al. [78] also identified significant challenges in personal hygiene, particularly in reaching sinks or showerheads, which is a crucial insight for improving accessibility for people with achondroplasia.

On the other hand, the study by Pfeiffer et al. [76] analyzed the impact of these barriers on the functionality and daily life of children with achondroplasia, highlighting that 71% faced difficulties in reaching objects or high places. This finding coincides with our results, where 100% of short people identified height as a critical factor in the accessibility of their housing. Likewise, Pfeiffer et al. [76] reported that 58% of respondents had difficulty bathing, showering or toileting, which is reflected in our study, where 100% of participants in this group selected the type of bathtub as a key aspect, in addition to choosing nine indicators related to autonomy. These results position people with achondroplasia as the second group that prioritized the most indicators within the autonomy axis, which underlines the importance of adapting housing design to facilitate self-care and mobility for this population.

The study by Rooney et al. [79] reveals that access inconveniences extend to difficulty reaching and reading heating controls in the home for visually impaired people. Some participants also noted the importance of sockets and switch heights. Our study selected indicators similar to those proposed by Rooney et al. [79] for people with visual impairment. Regarding the six indicators suggested for the communication axis, the results show that some have unanimous acceptance among visually impaired people. These include indicators C03 (strategic placement of windows to optimize their use and reduce glare), C04 (use of contrasting colors in furniture and flooring) and C06 (control of natural light to avoid glare). In addition, indicator I11 (color and illumination of switch boxes and sockets to facilitate their location) was selected by the participants, as was indicator I10 (height of switches). These indicators are similar to those described in the Riazi et al. guidelines [80], as perceived by the participants of this study, who also mentioned the installation of handrails, non-slip mats, safety stair edges in contrasting colors, single-lever faucets, and non-slip floors.

On the other hand, visually impaired people (100%) underlined the importance of having stair treads and handrails in contrasting colors to facilitate their visibility.

In the cognitive disability group, the axes of communication (7.9% Down syndrome and 6.3% Autism Spectrum Disorder) and independence (10.7% Down syndrome and 3.6% Autism Spectrum Disorder) are the least prioritized for the caregiver. This lower valuation may be because the predominant focus is oriented towards the adequacy of the physical environment, ensuring accessibility and safety, rather than promoting social interaction and independence in decision-making. This could indicate the need for additional strategies to strengthen communication and progressive autonomy in these children to improve their integration and participation in different contexts. This lower assessment may be because the predominant approach is oriented towards the adequacy of the physical environment, ensuring accessibility and safety, rather than towards the promotion of social interaction and independence in decision-making, probably because they are assumed as complementary needs and represent the role of the caregiver [81,82].

Regarding the comfort axis indicators, a study conducted on people with physical disabilities in Korea [83] observed a more significant request for lighting and thermal environments criteria, which is related to our study's selection of comfort indicators. This observation underscores the importance of the comfort axis in the daily lives of people with disabilities. The comfort axis is considered relevant in most cases, with values ranging from 10.3% in people with hearing impairment to 15.7% in people with short stature, suggesting that the quality of the indoor environment and livability are essential.

On the other hand, although the results coincide with previous studies, new elements also emerge that expand the existing knowledge at the international level. Relevant indicators were identified for people with hearing disabilities, such as using buzzers with luminous signals, controlling the noise level generated by air extractors, and implementing acoustic insulation measures. Also, as observed by Lee et al. [83], in addition to the accessibility criteria traditionally addressed in the literature, this study incorporates a complete axis dedicated to habitability and a significant set of indicators in the safety field. The latter includes devices not explored in previous research, such as emergency bathroom buttons, automatic shut-off systems for countertops, and smoke and carbon monoxide detection alarms.

Thus, the results of the study show that the priorities in the habitability criteria vary according to the type of disability and the role of the interviewees. This underscores the need to design customized solutions that meet the specific demands of each group. However, it also reinforces the importance of a comprehensive approach in the design of accessible housing. This approach ensures that all aspects of disability need, including autonomy, mobility, and safety, are considered, thereby leading to effective responses to the needs of the different groups of interest.

4.3. Importance of the Study in Public Policy

The findings of this study reinforce the need to incorporate minimum accessibility standards in housing policies since they directly reflect the priorities identified by the users. Unlike general regulations that may not address the specific needs of each group, this approach based on the perception of people with disabilities makes it possible to develop accessibility criteria that respond to the daily reality of those who face barriers in their homes. Previous experiences, such as implementing minimum accessibility standards in the National Building Code in Australia [72], have shown that their adoption, although initially partial, opens the possibility of evaluating their impact in terms of long-term costs and benefits. Similarly, studies in Spain [84] have shown that a significant proportion of older people and vulnerable people face accessibility difficulties in their homes, making this problem a priority for formulating inclusive housing policies. In this context, the results offer an empirical basis that can guide decision-making in designing new regulations,

ensuring that accessibility is not only a technical criterion but a central element in planning inclusive and sustainable housing.

4.4. Limitations

While the findings of this study are valuable for the design of accessible housing, it is important to note the methodological limitations. The small sample size, particularly in groups with a low response rate, such as little people, Down syndrome, and people with visual impairment, could potentially limit the generalizability of the results. The underrepresentation of these groups underscores the need for future studies with greater representativeness. Furthermore, the inability to evaluate the group of people with Alzheimer's disease leaves a significant gap in our understanding of accessibility requirements for this population, emphasizing the importance of future research to address these limitations.

Another limitation is the potential bias in participant selection, which could have influenced the distribution of responses and the weighting of the evaluated axes. Additionally, the AHP-based methodology, despite verified consistency indices, relies heavily on subjective data, potentially impacting the variability of the results. To address these limitations, it is crucial that future studies incorporate qualitative methods, such as in-depth interviews or focus groups, to provide a more detailed and contextualized understanding of the needs of people with disabilities.

Finally, while this study presents an innovative proposal by integrating new activities of the ICF model within the axes of accessibility and habitability, it is important to remember that this structure is not definitive. The organization and order of the indicators within each axis may be subject to review and adjustment in future research. A new organization of the indicators will allow for the refinement and optimization of the criteria, ultimately leading to the design of more inclusive and functional accessible housing.

5. Conclusions

The results of this study are significant, as they reveal that the priorities in the habitability criteria vary according to the type of disability and the interviewees' role. This underscores the need to design customized solutions that respond to the specific demands of each group. Autonomy, mobility and safety emerge as the most relevant axes, reinforcing the importance of a comprehensive approach to accessible housing design. The study also expands existing knowledge by incorporating specific indicators not addressed in the previous literature, such as acoustic control for people with hearing problems and implementing new safety requirements.

The study's findings reveal that autonomy consistently emerged as the most critical design criterion across all groups, particularly for older adults and wheelchair users. However, the results also highlight significant variation in secondary priorities: for example, wheelchair users highly prioritized mobility, while individuals with visual and hearing impairments emphasized communication and comfort, respectively.

This study has analyzed architectural and habitability requirements related to physical, cognitive, and sensory disabilities. Although intellectual disability represents a relevant and significant group, it was not directly addressed in this study due to the overlapping or distinct nature of its accessibility needs compared to the cognitive conditions included.

From a methodological perspective, applying the AHP method has made it possible to transform subjective criteria into structured and quantifiable evaluations, facilitating the more precise identification of priorities. However, the study also reveals limitations inherent to the method, such as the possible variability in the results due to the participants' subjectivity and the sample's representativeness.

This research's main contribution lies in its empirical validation of group-specific housing needs. It offers a practical framework that policymakers, architects, and urban planners can use to inform inclusive housing design standards and public policy. By articulating the differentiated priorities among disability groups, this study helps bridge the gap between generalized accessibility guidelines and truly inclusive, user-centered housing environments.

Finally, these findings provide a solid empirical basis for guiding public policies and regulations on housing accessibility. The evidence obtained underscores the need for minimum standards adapted to the real needs of people with disabilities, such as adjustable features, wider doorways, and accessible common areas. This ensures that accessibility is not only a technical requirement but an essential component in planning inclusive and accessible living spaces.

Recommendations

The study shows that the secondary priorities of the different groups analyzed vary. These findings highlight the need for customized design approaches rather than universal solutions.

Additionally, to gain a deeper understanding of the architectural and habitational needs of people with disabilities, it is important to include individuals with intellectual disabilities in the analysis, as this group was not considered in the present study, as previously stated. Therefore, future research could adopt a more targeted approach to explore the specific needs of this population.

Regarding the methodology applied in this study, future studies must complement the AHP methodology with qualitative approaches to reduce potential research limitations. Furthermore, expanding the participation of underrepresented groups would enhance the validity and applicability of the findings.

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References

1. Capasso, L.; D'Alessandro, D. Housing and Health: Here We Go Again. *Int. J. Environ. Res. Public Health* **2021**, *18*, 12060. [[CrossRef](#)] [[PubMed](#)]
2. World Health Organization Disability. *Key Facts*; World Health Organization: Geneva, Switzerland, 2023.
3. Watson, N.; Vehmas, S. *Routledge Handbook of Disability Studies*, 2nd ed.; Series: Routledge international handbooks, Revised edition of Routledge handbook of disability studies; Watson, N., Vehmas, S., Eds.; Routledge: New York, NY, USA, 2020; ISBN 9780429430817.

4. Valderrama-Ulloa, C.; Ferrada, X.; Rouault, F. A Tool for Universal Accessibility Assessment in the Interior of Dwellings. *Inf. Constr.* **2023**, *75*, e491. [\[CrossRef\]](#)
5. Imrie, R. Universalism, Universal Design and Equitable Access to the Built Environment. *Disabil. Rehabil.* **2012**, *34*, 873–882. [\[CrossRef\]](#)
6. Steinfeld, E.; Maisel, J. *Universal Design: Creating Inclusive Environments*; Wiley: Hoboken, NJ, USA, 2012.
7. Heylighen, A.; Van der Linden, V.; Van Steenwinkel, I. Ten Questions Concerning Inclusive Design of the Built Environment. *Build. Environ.* **2017**, *114*, 507–517. [\[CrossRef\]](#)
8. Badland, H.; Whitzman, C.; Lowe, M.; Davern, M.; Aye, L.; Butterworth, I.; Hes, D.; Giles-Corti, B. Urban Liveability: Emerging Lessons from Australia for Exploring the Potential for Indicators to Measure the Social Determinants of Health. *Soc. Sci. Med.* **2014**, *111*, 64–73. [\[CrossRef\]](#)
9. Kim, M.K.; Kim, M.J. Affordable Modular Housing for College Students Emphasizing Habitability. *J. Asian Archit. Build. Eng.* **2016**, *15*, 49–56. [\[CrossRef\]](#)
10. Mansoori, M.; Gulnaz, K.; Khan, M.A. Evaluating the Effectiveness of Universal Design Principles in Architecture Design Studio. *ShodhKosh J. Vis. Perform. Arts* **2024**, *4*, 151–160. [\[CrossRef\]](#)
11. Ormerod, M.G.; Newton, R.A. Moving Beyond Accessibility: The Principles of Universal (Inclusive) Design as a Dimension in ND Modelling of the Built Environment. *Archit. Eng. Des. Manag.* **2005**, *1*, 103–110. [\[CrossRef\]](#)
12. Machado, L.; de Oliveira, U. Analysis of Failures in the Accessibility of University Buildings. *J. Build. Eng.* **2021**, *33*, 101654. [\[CrossRef\]](#)
13. Harper, K.; McAuliffe, K.; Parsons, D. Barriers and Facilitating Factors Influencing Implementation of Occupational Therapy Home Assessment Recommendations: A Mixed Methods Systematic Review. *Aust. Occup. Ther. J.* **2022**, *69*, 599–624. [\[CrossRef\]](#)
14. Padilla-Muñoz, A. Discapacidad: Contexto, Concepto y Modelos. *Int. Law Rev. Colomb. Derecho Int.* **2010**, *8*, 381–414.
15. Zhou, W.; Lyu, X.; Huang, Y.; Jiang, B.; Jiang, J. A Comparative Bibliometric Analysis of Global Research on Adaptation Interventions for Healthy Aging at Home. *Sage Open* **2025**, *15*, 1–17. [\[CrossRef\]](#)
16. Cho, H.; MacLachlan, M.; Clarke, M.; Mannan, H. Accessible Home Environments for People with Functional Limitations: A Systematic Review. *Int. J. Environ. Res. Public Health* **2016**, *13*, 826. [\[CrossRef\]](#)
17. Valderrama-Ulloa, C.; Ferrada, X.; Herrera, F. Breaking Down Barriers: Findings from a Literature Review on Housing for People with Disabilities in Latin America. *Int. J. Environ. Res. Public Health* **2023**, *20*, 4972. [\[CrossRef\]](#)
18. Lindsay, S.; Ragunathan, S.; Fuentes, K.; Li, Y. Barriers and Facilitators to Obtaining Accessible Housing among Children, Youth and Young Adults with Disabilities and Their Families: A Scoping Review. *Disabil. Rehabil.* **2024**, *46*, 3266–3285. [\[CrossRef\]](#)
19. Struckmeyer, L.; Morgan-Daniel, J.; Ahrentzen, S.; Ellison, C. Home Modification Assessments for Accessibility and Aesthetics: A Rapid Review. *Health Environ. Res. Des. J.* **2021**, *14*, 313–327. [\[CrossRef\]](#) [\[PubMed\]](#)
20. Muñoz Cordones, J.-P. Revisión Sistemática de Iniciativas Que Promueven La Accesibilidad Universal. *Rev. Esp. Discapac.* **2024**, *12*, 185–214. [\[CrossRef\]](#)
21. Saaty, T.; De Paola, P. Rethinking Design and Urban Planning for the Cities of the Future. *Buildings* **2017**, *7*, 76. [\[CrossRef\]](#)
22. Goepel, K. Implementation of an Online Software Tool for the Analytic Hierarchy Process (AHP-OS). *Int. J. Anal. Hierarchy Process* **2018**, *10*, 471–487. [\[CrossRef\]](#)
23. Taherdoost, H.; Madanchian, M. Multi-Criteria Decision Making (MCDM) Methods and Concepts. *Encyclopedia* **2023**, *3*, 77–87. [\[CrossRef\]](#)
24. Valderrama-Ulloa, C.; Schmitt, C.; Marchetti, J.-P.; Bucarey, V. Design Criteria Recommendation to Achieve Accessibility in House to Different Users. *Int. J. Archit. Environ. Eng.* **2024**, *18*, 83–88.
25. Valderrama-Ulloa, C.; Schmitt, C.; Ortiz Velosa, E.; Marchetti, J.-P.; Bucarey, V. Condiciones de Habitabilidad de Viviendas Para Personas Mayores. Revisión de Criterios de Diseño. *Inf. Constr.* **2024**, *76*, 6623. [\[CrossRef\]](#)
26. Valderrama-Ulloa, C.; Bucarey, V.; Marchetti, J.-P. Architectural Needs in Housing for People with Disabilities. *Salud Cienc. Tecnol.* **2023**, *3*, 693. [\[CrossRef\]](#)
27. Hernández Sampieri, R.; Fernández Collado, C.; Baptista Lucio, P. *Fundamentos de Metodología de La Investigación*, 6th ed.; McGraw-Hill: New York, NY, USA, 2005.
28. World Health Organization. *Towards a Common Language for Functioning, Disability and Health: ICF*; World Health Organization: Geneva, Switzerland, 2002.
29. Saaty, T. *The Analytic Hierarchy Process: Planning, Priority Setting, Resource Allocation*; McGraw-Hill: New York, NY, USA, 1980.
30. Muhr, T. ATLAS.ti, Scientific Software Development GmbH. Available online: <https://atlasti.com/> (accessed on 9 December 2024).
31. World Health Organization. *Assistive Technology*; World Health Organization: Geneva, Switzerland, 2018.
32. *Servicio Nacional de la Discapacidad (SENADIS) III Estudio*; Nacional de La Discapacidad En Chile: Iquique, Chile, 2023.
33. Ferrada, X.; Valderrama, C.; Fuentes-Contreras, C. Economic and Technical Analysis of Universal Accessibility in Social and Private Housing in Chile. *IOP Conf. Ser. Earth Environ. Sci.* **2020**, *503*, 012003. [\[CrossRef\]](#)

34. de Brito Prado, B.; Frascareli Lelis, V.; Katayama, E.; Magagnin, R. Spatial Accessibility for Elderly in a Multi Residential Condominium in Brazil. In Proceedings of the 14th International Conference on Mobility and Transport for Elderly and Disabled Persons (TRANSED), Lisbon, Portugal, 28–31 July 2015.
35. Pauli, R. Achondroplasia: A Comprehensive Clinical Review. *Orphanet J. Rare Dis.* **2019**, *14*, 1. [CrossRef] [PubMed]
36. Collett-Solberg, P.F.; Ambler, G.; Backeljauw, P.F.; Bidlingmaier, M.; Biller, B.M.K.; Boguszewski, M.C.S.; Cheung, P.T.; Choong, C.S.Y.; Cohen, L.E.; Cohen, P.; et al. Diagnosis, Genetics, and Therapy of Short Stature in Children: A Growth Hormone Research Society International Perspective. *Horm. Res. Paediatr.* **2019**, *92*, 1–14. [CrossRef]
37. Achondroplasia. Available online: <https://medlineplus.gov/genetics/condition/achondroplasia/> (accessed on 9 December 2024).
38. Parisi, B.; Matos e Silva, C.; Oliveira, K.; Araújo, R. Acessibilidade e Inclusão Social Da Pessoa Com Nanismo: Da Legislação à Realidade. *Rev. Bras. Assuntos Reg. Urbanos* **2021**, *7*, 19–29. [CrossRef]
39. Tavares, A.; Cardoso, R.; Santos, J.; Sampaio, G. Acessibilidade Para Pessoas Com Deficiência: Algumas Dificuldades Em Projetar Para Indivíduos Com Nanismo. In Proceedings of the VI Encontro Nacional de Ergonomia do Ambiente Construido (ENEAC ANO 10), Recife, Brazil, 23–25 May 2016.
40. Brusilovsky, B. Modelo para Diseñar Espacios Accesibles. Espectro Cognitivo. Available online: http://riberdis.cedid.es/bitstream/handle/11181/5484/Modelo_para_dise%C3%B1ar_espacios_accesibles.pdf?sequence=1&rd=0031103474977893 (accessed on 9 December 2024).
41. Chen, L.; Wang, L.; Wang, Y.; Hu, H.; Zhan, Y.; Zeng, Z.; Liu, L. Global, Regional, and National Burden and Trends of Down Syndrome From 1990 to 2019. *Front. Genet.* **2022**, *13*, 908482. [CrossRef]
42. Nazer, H.J.; Aguila, R.A.; Cifuentes, O.L. Vigilancia Epidemiológica Del Síndrome de Down En Chile, 1972 a 2005. *Rev. Medica Chile* **2006**, *134*, 1549–1557. [CrossRef]
43. Cumella, S.; Heslam, S. Supported Housing for People with Down’s Syndrome. *Br. J. Learn. Disabil.* **2014**, *42*, 251–256. [CrossRef]
44. World Health Organization. *Autismo Datos y Cifras*; World Health Organization: Geneva, Switzerland, 2023.
45. World Health Organization. *Autismo*; World Health Organization: Geneva, Switzerland, 2022.
46. Zeidan, J.; Fombonne, E.; Scora, J.; Ibrahim, A.; Durkin, M.; Saxena, S.; Yusuf, A.; Shih, A.; Elsabbagh, M. Global Prevalence of Autism: A Systematic Review Update. *Autism Res.* **2022**, *15*, 778–790. [CrossRef] [PubMed]
47. Mostafa, M. An Architecture for Autism: Concepts of Design Intervention for Autistic User. *Int. J. Archit. Res.* **2008**, *2*, 189–211.
48. Boey, D.; Fitzmaurice, K.; Tse, T.; Chan, M.; Carey, L. Classifying Types of Visual Loss Linked with Function to Inform Referral to Vision Rehabilitation for Older Adults in Singapore. *Gerontol. Geriatr. Med.* **2022**, *8*, 1–18. [CrossRef]
49. World Health Organization. *Blindness and Vision Impairment*; World Health Organization: Geneva, Switzerland, 2023.
50. Steinmetz, J.; Bourne, R.; Briant, P.S.; Flaxman, S.R.; Taylor, H.R.B.; Jonas, J.B.; Abdoli, A.A.; Aburha, W.A.; Abualhasan, A.; Abu-Gharbieh, E.G.; et al. Causes of Blindness and Vision Impairment in 2020 and Trends over 30 Years, and Prevalence of Avoidable Blindness in Relation to VISION 2020: The Right to Sight: An Analysis for the Global Burden of Disease Study. *Lancet Glob. Health* **2021**, *9*, 144–160. [CrossRef]
51. Centro Oftalmológico de Barcelona. *Degeneración Macular Asociada a La Edad*; Centro Oftalmológico de Barcelona: Barcelona, Spain, 2023.
52. American Academy of Ophthalmology. *Understanding Glaucoma: Symptoms, Causes, Diagnosis, Treatment*; American Academy of Ophthalmology: San Francisco, CA, USA, 2024.
53. National Eye Institute. *A Simple Vista: Desprendimiento de La Retina*; National Eye Institute: Bethesda, MD, USA, 2024.
54. National Eye Institute. *A Simple Vista: Cataratas*; National Eye Institute: Bethesda, MD, USA, 2024.
55. Guerry, E.; Caumon, C.; Bécheras, E.; Zissis, G. Influence of Chromatic and Lighting on the Visual Environment of the Elderly: A Critical Literature Review. *Color Res. Appl.* **2021**, *46*, 117–124. [CrossRef]
56. Haile, L.; Kamenov, K.; Briant, P.S.; Orji, A.U.; Steinmetz, J.D.; Abdoli, A. Hearing Loss Prevalence and Years Lived with Disability, 1990–2019: Findings from the Global Burden of Disease Study 2019. *Lancet* **2021**, *397*, 996–1009. [CrossRef] [PubMed]
57. Sowden, J.; Kros, C.; Sirimanna, T.; Pagarkar, W.; Oluonye, N.; Henderson, R. Impact of Sight and Hearing Loss in Patients with Norrie Disease: Advantages of Dual Sensory Clinics in Patient Care. *BMJ Paediatr. Open* **2020**, *4*, e000781. [CrossRef] [PubMed]
58. Organización Panamericana de la Salud Demencia. Available online: <https://www.paho.org/es/temas/demencia> (accessed on 9 December 2024).
59. Li, X.; Feng, X.; Sun, X.; Hou, N.; Han, F.; Liu, Y. Global, Regional, and National Burden of Alzheimer’s Disease and Other Dementias, 1990–2019. *Front. Aging Neurosci.* **2022**, *14*, 937486. [CrossRef]
60. Klaassen, P.G.; Werlinger, E.E.; Contreras, E.L.; González, B.A.; Vera, C.A.; Juica, A.S.; Fuentealba, S.M. Calidad de Vida En Demencia Alzheimer: Un Nuevo Desafío. *Rev. Chil. Neuropsiquiatr.* **2021**, *59*, 361–367. [CrossRef]
61. Dias de Azevedo, M.-C.; Charchat-Fichman, H.; Damazio Vera, M.-M. Environmental Interventions to Support Orientation and Social Engagement of People with Alzheimer’s Disease. *Dement. Neuropsychol.* **2021**, *15*, 510–523. [CrossRef]
62. World Health Organization. *Ageing and Health. Keys Fact*; World Health Organization: Geneva, Switzerland, 2024.

63. Ministerio de Desarrollo Social. *Gobierno de Chile Encuesta de Caracterización Socioeconómica Nacional*; Ministerio de Desarrollo Social: Santiago, Chile, 2022.
64. Glasinovic Peña, A. Prevención de Caídas y Ayudas Técnicas En El Adulto Mayor, Enfoque Para La Atención Primaria Chilena. *Rev. Chil. Med. Fam.* **2020**, *14*, 1–8.
65. Lord, S.; Menz, H.; Sherrington, C. Home Environment Risk Factors for Falls in Older People and the Efficacy of Home Modifications. *Age Ageing* **2006**, *35*, 55–59. [[CrossRef](#)] [[PubMed](#)]
66. Pizzi, M.; Chalmers, J.; Bunout, D.; Osorio, P.; Fernández, V.; Cusato, M.; Avendaño, V.; Rivera, K. Physical Barriers and Risks in Basic Activities of Daily Living Performance Evaluation in State Housing for Older People in Chile. *Hous. Care Support* **2013**, *16*, 23–31. [[CrossRef](#)]
67. World Health Organization. *International Classification of Impairments, Disabilities, and Handicaps. A Manual of Classification Relating to the Consequences of Disease*; World Health Organization: Geneva, Switzerland, 1980.
68. Darko, A.; Chan, A.; Ameyaw, E.; Owusu, E.; Pärn, E.; Edwards, D. Review of Application of Analytic Hierarchy Process (AHP) in Construction. *Int. J. Constr. Manag.* **2019**, *19*, 436–452. [[CrossRef](#)]
69. Chen, H.; Zhang, Y.; Wang, L. A Study on the Quality Evaluation Index System of Smart Home Care for Older Adults in the Community—Based on Delphi and AHP. *BMC Public Health* **2023**, *23*, 411. [[CrossRef](#)]
70. Bender, A.; Din, A.; Hoesli, M.; Brocher, S. Environmental Preferences of Homeowners. *J. Prop. Invest. Financ.* **2000**, *18*, 445–455. [[CrossRef](#)]
71. Wu, F. Housing Environment Preference of Young Consumers in Guangzhou, China. *Prop. Manag.* **2010**, *28*, 174–192. [[CrossRef](#)]
72. Goodwin, I.; Davis, E.; Winkler, D.; Douglas, J.; Wellecke, C.; D’Cruz, K.; Mulherin, P.; Liddicoat, S. Making Homes More Accessible for People with Mobility Impairment: A Lived Experience Perspective. *Aust. J. Social. Issues* **2022**, *57*, 956–969. [[CrossRef](#)]
73. Slaug, B.; Chiatti, C.; Oswald, F.; Kaspar, R.; Schmidt, S. Improved Housing Accessibility for Older People in Sweden and Germany: Short Term Costs and Long-Term Gains. *Int. J. Environ. Res. Public Health* **2017**, *14*, 964. [[CrossRef](#)]
74. Slaug, B.; Granbom, M.; Iwarsson, S. An Aging Population and an Aging Housing Stock—Housing Accessibility Problems in Typical Swedish Dwellings. *J. Aging Environ.* **2020**, *34*, 156–174. [[CrossRef](#)]
75. Kuboshima, Y.; McIntosh, J. Housing Design That Improves the Independence and Safety for Older Adults Using a Walker. *Appl. Ergon.* **2021**, *97*, 103539. [[CrossRef](#)] [[PubMed](#)]
76. Pfeiffer, K.; Brod, M.; Smith, A.; Gianettoni, J.; Viuff, D.; Ota, S.; Charlton, R. Assessing Physical Symptoms, Daily Functioning, and Well-being in Children with Achondroplasia. *Am. J. Med. Genet. A* **2021**, *185*, 33–45. [[CrossRef](#)]
77. Ireland, P.; Pacey, V.; Zankl, A.; Edwards, P.; Johnson, L.; Savarirayan, R. Optimal Management of Complications Associated with Achondroplasia. *Appl. Clin. Genet.* **2014**, *7*, 117–125. [[CrossRef](#)]
78. Shediak, R.; Moshkovich, O.; Gerould, H.; Ballinger, R.; Williams, A.; Bellenger, M.; Quinn, J.; Hoover-Fong, J.; Mohnike, K.; Savarirayan, R.; et al. Experiences of Children and Adolescents Living with Achondroplasia and Their Caregivers. *Mol. Genet. Genom. Med.* **2022**, *10*, e1891. [[CrossRef](#)]
79. Rooney, C.; Hadjri, K.; Mcallister, K.; Rooney, M.; Faith, V.; Craig, C. Experiencing Visual Impairment in a Lifetime Home: An Interpretative Phenomenological Inquiry. *J. Hous. Built Environ.* **2018**, *33*, 45–67. [[CrossRef](#)]
80. Riazzi, A.; Ying Boon, M.; Bridge, C.; Dain, S.J. Home Modification Guidelines as Recommended by Visually Impaired People. *J. Assist. Technol.* **2012**, *6*, 270–284. [[CrossRef](#)]
81. Brugnaro, B.; Fernandes, G.; De Campos, A.; Pavão, S.; Pfeifer, L.; Kraus de Camargo, O.; Hlyva, O.; Rocha, N. Home Participation and Personal and Environmental Factors in Children and Adolescents with Down Syndrome. *Dev. Med. Child Neurol.* **2024**, *66*, 1031–1044. [[CrossRef](#)]
82. Sood, D.; LaVesser, P.; Schranz, C. Influence of Home Environment on Participation in Home Activities of Children with an Autism Spectrum Disorder. *Open J. Occup. Ther.* **2014**, *2*, 2. [[CrossRef](#)]
83. Lee, Y.; Park, J.; Jang, M. Perceived Effects of Home Renovation on Independence of Physically Disabled Koreans Living at Home. *Disabil. Rehabil.* **2018**, *40*, 2380–2387. [[CrossRef](#)]
84. Jiménez-Arberas, E.; Varela, G.R.; Ordoñez Fernández, F.; Méndez Fernández, M.-I. Development of the Home Environmental Scale of Accessibility Instrument for Spain. *Clin. Pract.* **2024**, *14*, 1123–1136. [[CrossRef](#)]

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