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A Gerontological Analysis of Functional Dependence and Socio-Familial Risk in Older Adults in Bucaramanga, Colombia

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Abstract

Objective: To examine patterns and interconnections between functional dependence and socio-familial risk in older adults and identify critical co-occurrence patterns through network analysis within a gerontological framework. **Materials and methods**: A cross-sectional analysis was conducted using data from the ARENA study involving 196 older adults in Bucaramanga, Colombia. Functional status was assessed using the Barthel and Lawton indexes, while socio-familial risk was measured using the Gijón Socio-Familial Assessment Scale. Basic and instrumental activities of daily living with the highest dependency rates were cross-referenced with five social risk domains. A co-occurrence matrix was constructed and visualised using VOSviewer. **Results**: Functional limitations were observed in 59.69% of participants for basic activities of daily living, and in 44.90% for instrumental activities of daily living. Socio-familial risk was present in 47.45% of participants, particularly in the domains of economic hardship and limited social support. Network analysis identified three functional-social clusters, with stair use, telephone use and bladder control emerging as central nodes linked to multiple social risks. These intersections suggest that functional decline is embedded within broader structures of social vulnerability. **Conclusion**: Functional assessment of older adults should incorporate socio-environmental factors to prevent fragmented care. Co-occurrence network analysis is a novel tool for identifying critical areas for

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intervention and informing complexity-based approaches in gerontology and geriatrics. The findings support the integration of interdisciplinary, context-sensitive strategies to promote autonomy and dignity in ageing.

Keywords
Health of the Elderly, Activities of Daily Living, Cross-Sectional Studies, Socioeconomic Factors, Social Network Analysis.

Análisis gerontológico de la dependencia funcional y el riesgo sociofamiliar en personas mayores en Bucaramanga, Colombia.

Resumen
Objetivo: Examinar los patrones e interconexiones entre la dependencia funcional y el riesgo sociofamiliar en personas mayores, e identificar patrones críticos de coocurrencia mediante análisis de redes, dentro de un enfoque gerontológico. **Materiales y Métodos:** Se realizó un análisis transversal utilizando datos del Estudio ARENA, con la participación de 196 personas mayores en Bucaramanga, Colombia. El estado funcional fue evaluado mediante los índices de Barthel y Lawton; el riesgo sociofamiliar se midió con la Escala de Valoración Sociofamiliar de Gijón. Las actividades básicas e instrumentales de la vida diaria con mayores tasas de dependencia se cruzaron con cinco dominios de riesgo social. Se construyó una matriz de coocurrencia y se visualizó con VOSviewer. **Resultados:** Se observaron limitaciones funcionales en el 59.69% de los participantes en actividades básicas de la vida diaria y en el 44.90% en actividades instrumentales de la vida diaria. El riesgo sociofamiliar estuvo presente en el 47.45%, especialmente en los dominios de dificultades económicas y escaso apoyo social. El análisis de red identificó tres clústeres funcionales-sociales, con el uso de escaleras, uso del teléfono y control de esfínteres como nodos centrales vinculados a múltiples riesgos sociales. Estas intersecciones sugieren que el deterioro funcional está inmerso en estructuras más amplias de vulnerabilidad social. **Conclusión:** La valoración funcional en personas mayores debe integrar los dominios socioambientales para evitar atenciones fragmentadas. El análisis de redes de coocurrencia ofrece una herramienta innovadora para identificar áreas críticas de intervención e informar enfoques complejos en gerontología y geriatría. Los hallazgos respaldan la integración de estrategias interdisciplinarias y contextualizadas para promover la autonomía y la dignidad en el envejecimiento.

Palabras clave: Salud del Anciano, Actividades de la Vida Diaria, Estudios Transversales, Factores Socioeconómicos, Análisis de Redes Sociales.

Análise gerontológica da dependência funcional e do risco sociofamiliar em idosos de Bucaramanga, Colômbia.

Resumo
Objetivo: Examinar os padrões e interconexões entre dependência funcional e risco sociofamiliar em pessoas idosas, e identificar padrões críticos de coocorrência por meio de análise de redes, dentro de uma abordagem gerontológica. **Materiais e Métodos:** Foi realizada uma análise transversal com dados do Estudo ARENA, envolvendo 196 idosos em Bucaramanga, Colômbia. A capacidade funcional foi avaliada pelos índices de Barthel e Lawton; o risco sociofamiliar foi medido com a Escala de Avaliação Sociofamiliar de Gijón. As atividades básicas e atividades instrumentais da vida diária com maiores taxas de dependência foram cruzadas com cinco domínios de risco social. Uma matriz de coocorrência foi construída e visualizada com o software VOSviewer. **Resultados:** Limitações funcionais foram observadas em 59.69% dos participantes nas atividades básicas da vida diária e em 44.90% nas atividades instrumentais da vida diária. O risco sociofamiliar esteve presente em 47.45%, especialmente nos domínios de dificuldades econômicas e baixo apoio social. A análise de rede identificou três agrupamentos funcional-sociais, com destaque para uso de escadas, uso do telefone e controle urinário como nós centrais conectados a múltiplos riscos sociais. Essas interseções sugerem que o declínio funcional está inserido em estruturas mais amplas de vulnerabilidade social. **Conclusão:** A avaliação funcional em idosos deve incorporar os domínios socioambientais para evitar cuidados fragmentados. A análise de redes de coocorrência

é uma ferramenta inovadora para identificar áreas críticas de intervenção e apoiar abordagens complexas em gerontologia e geriatria. Os achados apoiam a integração de estratégias interdisciplinares e sensíveis ao contexto para promover autonomia e dignidade no envelhecimento.

Palavras-chave
Saúde do Idoso, Atividades da Vida Diária, Estudos Transversais, Fatores Socioeconômicos, Análise de Redes Sociais.

Introduction

The human aging process is complex, multidimensional, and heterogeneous, unfolding across the life course in response to accumulated experiences, life events, and individual decisions, all situated within a social context and a personal worldview [1]. Within this framework, functional capacity is understood as the set of health-related attributes shaped by the interaction between intrinsic capacity and environmental characteristics. This interaction enables individuals to function and to participate in activities they perceive as meaningful [1,2].

Intrinsic capacity comprises physical, cognitive, and psychosocial abilities, which are shaped by genetic factors, lifestyle, and age-related physiological changes [1]. These elements may act as protective or risk factors, depending on whether they contribute to preserving or diminishing physiological reserve, thereby directly influencing the development of disease and functional dependence [3].

The environment, in turn, encompasses the physical, social, and cultural factors surrounding older adults, including the home, the community, and public policies [1]. Elements such as interpersonal relationships, physical infrastructure, and access to services may facilitate healthy aging or, conversely, act as barriers that contribute to socio-familial risk and disability [3,4].

Within this environmental dimension, socio-familial risk emerges as a central determinant, reflecting the extent to which family structure, economic security, and social support interact to either sustain or erode autonomy. From a gerontological perspective, social vulnerability is not limited to social isolation or income deprivation; rather, it represents a multidimensional construct that shapes individuals' ability to adapt, participate, and maintain functional capacity within their environment, ultimately influencing trajectories of dependency and wellbeing [5].

The interplay between functional capacity, intrinsic capacity, and the environment is essential for understanding aging as a dynamic and context-dependent process [6]. Preserved intrinsic capacity combined with a supportive environment promotes autonomy and health, whereas deterioration in these domains, together with adverse contextual conditions, increases vulnerability and accelerates functional decline [2,4].

However, this relationship is neither linear nor static; the intersections among these dimensions are shaped by life trajectories, available resources, and meaningful sources of support. It is within these shifting intersections that the real opportunities for older adults to exercise autonomy and participate effectively in their environment are configured [1].

The growing recognition of intrinsic capacity underscores the need for comprehensive assessments that consider both individual abilities and environmental conditions [7]. Functional capacity reflects the interaction among physical, cognitive, and social dimensions, making it a core determinant of autonomy in older adults [8]. An exclusive focus on functional performance, without adequate consideration of the social context, may lead to fragmented care. From a gerontological perspective, this highlights the importance of integrated strategies and interprofessional coordination across health and community services.

In this context, the assessment of older adults should be understood as a complex intervention, whose effectiveness depends not only on its sustainability but also on its capacity to evolve and adapt at scale [9]. Complementarily, there is a need to advance toward a Comprehensive Gerontological Assessment grounded in a holistic and interprofessional approach that acknowledges the diversity of factors involved in the human aging process [10].

This study uses cross-sectional data from older adults participating in the ARENA Study in Bucaramanga, Colombia [11], with the objective of applying a

gerontological approach to examine functional capacity and socio-familial risk in the study population. A co-occurrence network analysis was conducted to identify key functional–social vulnerability patterns and to visualize the structural links between functional dependence and socio-familial domains [12]. The findings provide a basis for discussing implications for gerontological and geriatric practice.

Materials and Methods

Study Setting and Sampling

The ARENA Study was a cross-sectional study based on secondary data. Information was obtained from the gerontological nursing assessment database of an adult day care center. Further details regarding the study design have been described elsewhere [11].

Sample size calculation was based on the comparison of means, using a 95% confidence level ($\alpha < 0.05$) and 80% statistical power ($\beta = 0.8$). The selected variable for this calculation was the Activities of Daily Living (ADLs) functionality score. The final sample consisted of 196 older adults who met the inclusion criterion of having a complete record in the database between 2019 and 2020. The exclusion criterion was residence outside the city of Bucaramanga. The study was approved by an accredited ethics committee in accordance with national regulations and international ethical standards.

Measurements

Functional capacity was assessed using the Barthel Index, which evaluates performance in ten ADLs: feeding, bathing, grooming, dressing, bowel and bladder control, toilet use, transfers (bed to chair and back), mobility, and stair use. Each activity is scored on a scale ranging from 0 to 15, allowing classification into categories of independence, partial assistance, or total dependence [13].

Instrumental functional capacity was evaluated using the Lawton Index, which assesses eight Instrumental Activities of Daily Living (IADLs): ability to use the telephone, shopping, food preparation, housekeeping, laundry, mode of transportation, responsibility for own medications, and ability to manage finances. Each activity is scored dichotomously as “Yes” (1 point) or “No” (0 points), with higher total scores indicating greater instrumental functional independence [14].

Socio-familial risk was assessed using the Gijón Socio-Family Assessment Scale. The instrument comprises five domains: family situation, economic situation, housing, social relations, and social network support. Each domain is rated on a Likert scale from 1 to 5, with higher scores indicating greater social risk or the presence of social problems [15,16].

Control variables

Two sets of control variables were included in the analysis. The first set comprised demographic variables: age (in years), gender (female/male), and socioeconomic status, based on the national classification system. The second set included health-related variables: presence of chronic conditions (self-reported medical history), polypharmacy (defined as the regular use of five or more medications), and cognitive status, assessed using the Mini-Cog screening test.

Statistical Analysis

A univariate descriptive analysis was conducted using absolute and relative frequencies for qualitative variables. To address the study objective, functional status was categorized according to independence or functional dependence in ADLs and IADLs. Socio-familial risk was analyzed by social domain according to the corresponding scores. Data analysis was performed using STATA© software, version 15.1 for Windows.

Network analysis was conducted to identify structural patterns of functional and social vulnerability by cross-referencing the ADLs and IADLs with the highest levels of dependence against the five socio-familial risk dimensions [17]. A co-occurrence matrix was constructed, weighting each link by the product of the percentage of functional dependence and the prevalence of social risk. This matrix served as the input for network construction and visualization in VOSviewer, applying a modularity-based clustering algorithm to identify groups of highly interconnected domains. The network analysis was exploratory and non-inferential, facilitating hypothesis generation and the identification of key targets for future research.

Results

Table 1 presents the sociodemographic and health-related characteristics of the 196 participants. The mean age was 72.91 years (SD ±7.88). Notably, 22.45% of the sample were aged 80 years or older, reflecting the inclusion of individuals in advanced stages of aging. The majority were women (58.16%), all participants belonged to the lowest socioeconomic strata.

Regarding health status, 42.35% of participants reported a history of high blood pressure, followed by hyperlipidemia (26.53%) and non-insulin-dependent diabetes mellitus (15.82%). Additionally, 52.55% met the criteria for polypharmacy. In terms of cognitive function, 17.35% demonstrated likely cognitive impairment according to the Mini-Cog screening test.

Table 1. Demographic characteristics and health status.

Sociodemographic Variables	*Total n=196 (%)*	*CI 95%*
Gender		
Women	114 (58.16%)	(51.07-64.92)
Men	82 (41.84%)	(35.07-48.92)
Age-(Years)		
≤67	54 (27.55%)	(21.70-34.28)
>67-≤72	50 (25.51%)	(19.85-32.13)
>72-≤79	48 (24.49%)	(18.93-31.05)
≥80	44 (22.45%)	(17.10-28.88)
*Socioeconomic Status**		
Status 1	147 (75%)	(68.40-80.60)
Status 2	49 (25%)	(19.39-31.59)
Health Variables		
*Pathological History***		
High Blood Pressure	83 (42.35%)	(35.56-49.43)
Hyperlipidemia	52 (26.53%)	(20.77-33.21)
Non-insulin dependent Diabetes Mellitus	31 (15.82%)	(11.31-21.67)
Osteoarthritis	10 (5.10%)	(2.75-9.26)
Hypothyroidism	8 (4.08%)	(2.04-7.99)
*Other medical conditions****	31 (15.82%)	(10.7 – 20.9)
Polypharmacy		
Yes	103 (52.55%)	(45.49-59.50)
No	93 (47.45%)	(40.49-54.50)
Cognitive Assessment		
Test Mini-Cog		
Likely deterioration (0-2 points)	34 (17.35%)	(12.62-23.35)
Very unlikely deterioration (3-5 points)	162 (82.65%)	(76.64-87.37)

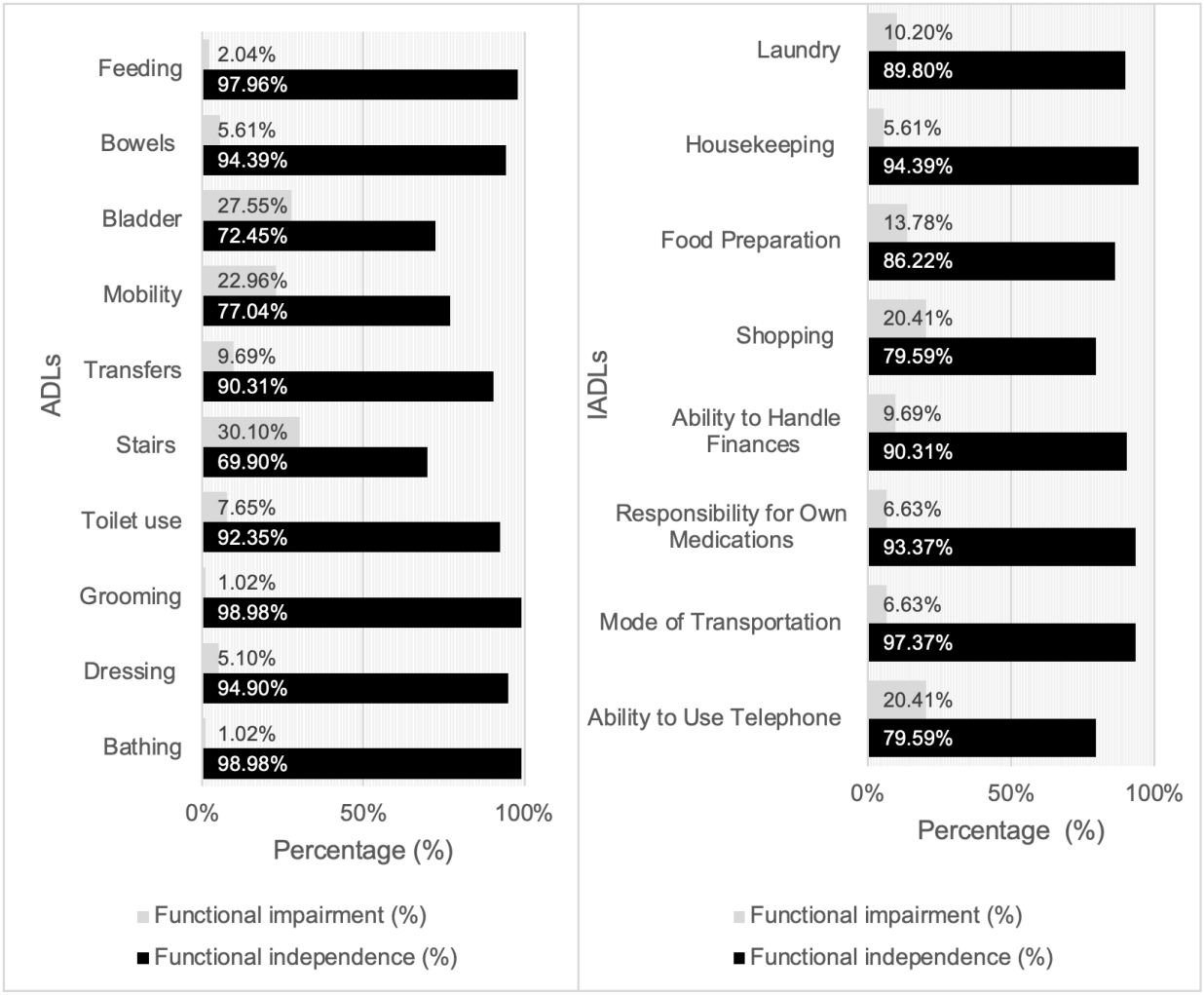
** Strata 1 and 2 represent low-income households.*
***International Statistical Classification of Diseases and Related Health Problems 10th Revision. ICD-10 Version: 2016.*
****Percentages exceed 100% because participants could report more than one medical condition.*
Source: prepared by authors

Functional Capacity in ADLs and IADLs

Figure 1 illustrates the distribution of functional capacity across Activities of Daily Living (ADLs) and Instrumental Activities of Daily Living (IADLs). Among ADLs, the highest levels of functional dependence were observed in stair use (30.10%), bladder control (27.55%), and mobility (22.96%). In contrast, activities such as bathing, personal hygiene, and feeding exhibited very high levels of independence, exceeding 97%.

Regarding IADLs, most participants maintained functional independence. Nevertheless, notable levels of dependence were identified in telephone use and shopping (both 20.41%), followed by food preparation (13.78%).

Figure 1. Distribution of functional capacity to perform ADLs (Barthel Index) and IADLs (Lawton Index) (n = 196)



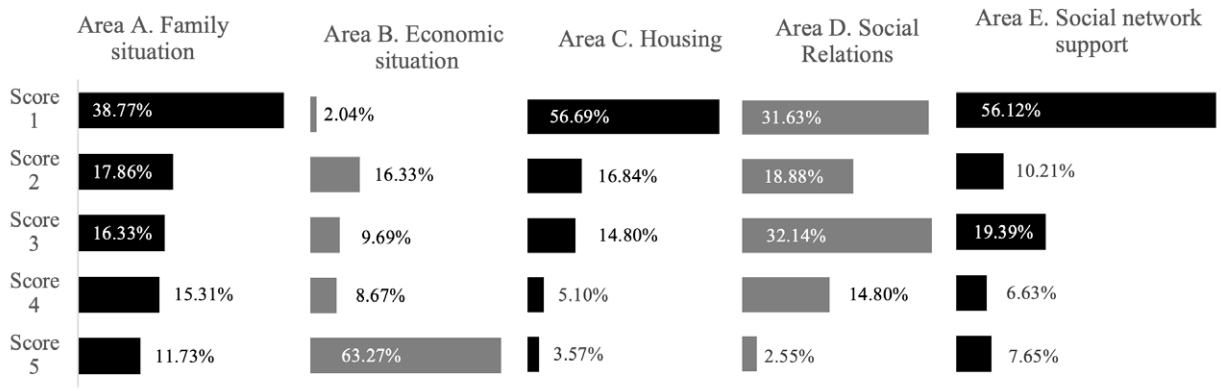
Note: *The graphic presents the relative frequencies of independence and functional impairment in ADL and IADL of the older people studied.*

Source: prepared by authors.

As shown in Figure 2, economic vulnerability emerged as the most critical dimension, with nearly two-thirds of participants (63.27%) classified in the highest risk category. In contrast, housing conditions appeared largely adequate, as 59.69% of participants scored in the lowest risk level.

Family situation and social support networks displayed more heterogeneous profiles. While over one-third of participants reported low family-related risk (38.77%), 11.73% were classified in high-risk categories. Social relations indicated moderate vulnerability, with 32.14% of participants scoring in the mid-range and 14.80% approaching the upper risk threshold.

Figure 2. Distribution of Socio-Familial Risk Scores by Domain: Gijon Socio-Family Assessment Scale



Note: *This graphic presents the distribution of scores across the five domains of the Gijon Socio-Familial Evaluation Scale among older adults.*

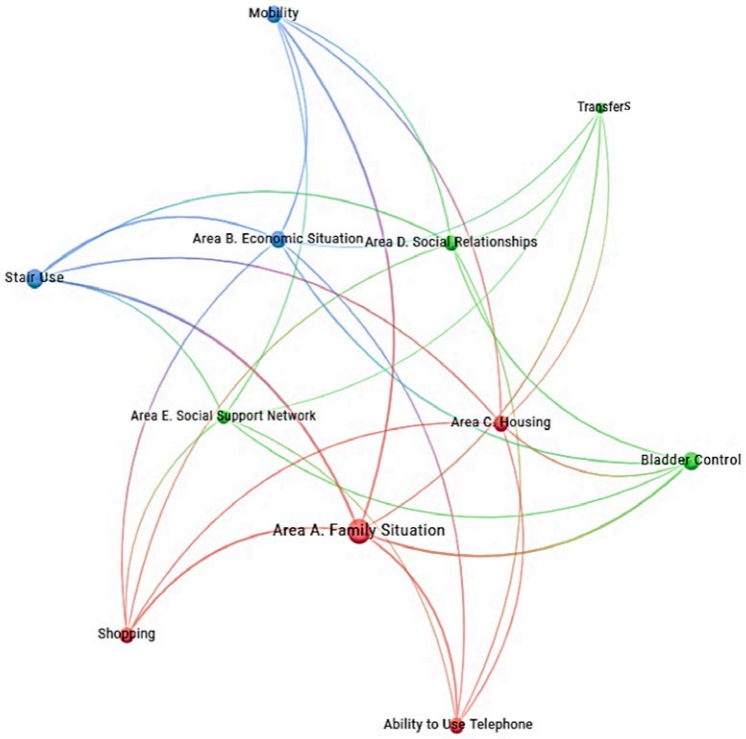
Source: prepared by authors.

Co-occurrence Network of Functional and Social Domains

The network illustrated in Figure 3 reveals three key clusters linking functional limitations with dimensions of social risk. The first cluster associates instrumental activities, such as telephone use and shopping, with economic hardship, family strain, and housing instability, highlighting how domestic autonomy depends on both material conditions and relational support.

The second cluster centers on stair use, a highly demanding basic activity, which exhibits strong connections with all social dimensions and functions as a central node within the network. The third cluster links intimate activities, such as bladder control and mobility, with weak social ties and limited support networks, suggesting that loss of autonomy in these areas affects not only physical functioning but also social participation and perceived dignity.

Figure 3. Co-occurrence Network between Functional Dependency and Socio-Familial Risk Domains in Older Adults



Note: *The network reveals three functional clusters, with central nodes such as stair use, bladder control, and telephone use that show high relational density.*

Source: VOSviewer

Discussion

This study demonstrates how socio-familial vulnerability—characterized by inadequate housing, weak social support, and economic hardship—intersects with functional decline. High levels of dependence were identified in stair use (30.10%), bladder control (27.55%), and mobility (22.96%), together with limitations in telephone use and shopping. These frequently overlooked activities reflect not only physical decline but also processes of social disconnection. Overall, the findings support a gerontological understanding of functional capacity as the result of both intrinsic and social determinants.

Functional Characterization and Context of Vulnerability

The functional limitations observed should be interpreted within the context of a population characterized by advanced age, chronic conditions, and the convergence of gender- and life-course–related inequalities. Nearly 25% of participants were aged 80 years or older, and 75% belonged to the lowest socioeconomic stratum. More than half reported polypharmacy, and 17.35% exhibited indicators of possible cognitive decline, outlining a complex profile shaped by cumulative disadvantage. These results are consistent with previous evidence linking comorbidity, poverty, and limited social support to functional loss in older adults [18,19].

The prevalence of limitations in ADLs (59.69%) and IADLs (44.90%) indicates a higher functional burden than that reported in national studies [20,21], possibly attributable to differences in sociodemographic contexts and assessment approaches. Nevertheless, a clear pattern of functional dependence emerges, concentrated in activities that require mobility and bodily control—such as stair use, bladder control, and transfers—similar to patterns reported in another study [22], where these functions also present high levels of difficulty, particularly among adults aged 80 years and older.

The observed socio-familial risk prevalence of 47.45% represents an intermediate level compared with reports by other authors [20,22], yet it highlights a persistent pattern: old age in Colombia remains

exposed to structural determinants such as poverty and insufficient social support. This evidence suggests that social risk should not be interpreted as an individual attribute, but rather as the cumulative expression of historical inequalities, which calls for more robust and context-sensitive social responses [23,24].

Co-occurrence analysis: identifying structural dependency patterns

The network analysis applied in this study offers a relational representation of functional dependence and social risk, allowing the identification of co-occurrence patterns that are not easily detected through conventional statistical methods [17]. Although this approach remains innovative within the Latin American context, its interpretive validity is supported by international research [12,25].

The analysis highlights the "stairs" cluster, which is connected to all analyzed social dimensions, underscoring its relevance as an indicator of structural frailty. This activity requires not only muscular strength but also flexibility, static and dynamic balance, and adequate cardiorespiratory capacity. Its performance is closely associated with environmental conditions—such as the presence of handrails, elevators, or urban topography—and often depends on the availability of support networks or assistive devices, such as canes, to ensure safety and autonomy [26].

The association between stair use and family and economic conditions suggests that difficulty with this activity reflects not only functional impairment but also broader processes of exclusion. In this sense, stair use represents more than physical decline; it reflects the extent to which older adults are able to exercise their right to inhabit and move through spaces with autonomy and dignity [27].

Another relevant cluster involves the ability to use the telephone, which shows a strong association with the social support dimension. Although classified as an instrumental activity, telephone use has a substantial relational component, as it facilitates the maintenance of social ties, activation of support, and social participation. Its decline may indicate not only cognitive or sensory difficulties but also technological, economic, and cultural barriers that limit access to connectivity [27].

The identification of this cluster as dependent suggests a form of silent exclusion: the progressive disconnection of older adults from social networks due to obstacles in accessing information and communication technologies (ICTs) [28]. This relationship reinforces the idea that functionality extends beyond individual capacity and encompasses participation potential, where each activity may function either as a bridge or as a barrier to social integration [29].

Although less prominent in the network structure, the bladder control cluster marks a critical intersection between dignity and social exclusion. Its association with social support and interpersonal relationships indicates that incontinence extends beyond physiological decline, becoming a self-restricting factor for social participation. Older adults frequently limit mobility and avoid social interactions, thereby reinforcing isolation [30]. Furthermore, managing this condition under conditions of economic hardship and fragile social support imposes a physical and emotional burden not only on older adults but also on their caregivers.

This finding calls for a reconsideration of bladder control not as a minor aspect of functional decline, but as a complex indicator of vulnerability, with profound implications for well-being, self-perception, and the exercise of citizenship in later life.

Analysis of Demographic and Health Variables within the Co-occurrence Model

The configuration of the co-occurrence network indicates that functional limitations are embedded within a broader matrix of demographic and health-related inequalities. The central position of activities such as stair use, mobility, and bladder control reflects the cumulative impact of multimorbidity and polypharmacy within a predominantly female older population. These patterns indicate that age and health burden do not merely coexist with dependency, but intersect with social disadvantage—particularly low income and limited caregiving networks—thus forming vulnerability configurations across the functional–social spectrum [31].

The identified clusters show that functional dependency is not an isolated condition, but rather an expression of accumulated social constraints. The convergence of mobility, stair use, and bladder control with domains such as economic hardship, weak social support, and strained family relations demonstrates that dependence develops within unequal systems of care and opportunity. In this context, loss of autonomy is more accurately understood not as an individual limitation, but as a social manifestation of environments that fail to provide adequate conditions

for older adults' participation and dignity [27]. The most frequent network links—those connecting physical dependence with lack of support and financial instability—illustrate a structural imbalance in which functional and social vulnerabilities reinforce one another, transforming dependency into a persistent state rather than a temporary phase of aging [24].

Implications for Gerontological and Geriatric Practice

The findings of this study emphasize that care for older adults can no longer rely on fragmented or isolated functional interventions, but must instead follow a logic of complexity [32]. This perspective requires rethinking not only assessment strategies, but also the conceptual foundation upon which interventions are designed. In parallel, the results underscore the need to strengthen cooperative approaches in both clinical and community settings. Identifying key functional clusters and linking them to social risk requires not only clinical expertise, but also interdisciplinary collaboration, a core competency in gerontological practice [33].

At this level, postgraduate education assumes a central role, given the need for training programs that equip health professionals with greater social sensitivity, critical reasoning skills, and tools for comprehensive gerontological and geriatric care. This entails adopting functional activities as a shared operational language across disciplines. Such an approach enhances communication within healthcare teams and enables the identification of shared priorities, thereby facilitating more coherent coordination of interventions and the integration of diverse disciplinary perspectives around a common focus of clinical and social observation [34].

The incorporation of micro-level strategies for social reconnection—such as encouraging telephone communication or facilitating community participation—into functional care plans not only supports autonomy and perceived social support, but also improves the effectiveness of comprehensive care and reduces reliance on exclusively pharmacological interventions [35].

The presence of multimorbidity and polypharmacy in gerontological practice reinforces the need for a comprehensive understanding of health in old age, one that recognizes social outcomes as essential for interpreting clinical manifestations. Intervention from this perspective requires not only adjustments to pharmacological regimens, but also modifications to physical and social environments, strengthening of support networks, and coordination of care that responds to the complexity of individual life trajectories [36].

The main strength of this study lies in its integration of standardized gerontological assessment tools with an exploratory network-based approach, resulting in a design that combines quantitative rigor with interpretive depth. Nevertheless, the study was conducted in a single urban setting, which may limit the generalizability of the findings to older adults living in rural or socio-territorially diverse contexts. In addition, selection bias cannot be fully excluded, as participants were recruited from a day care center with prior gerontological assessments, which may reflect a subgroup with greater access to services or support. Future research should incorporate broader sampling strategies across multiple settings in order to enhance external validity.

Although network analysis offers valuable relational insights, it relies on relative frequencies and co-occurrence weights that may be sensitive to sample size and data distribution. Further studies are therefore recommended to validate the identified functional–social clusters using external datasets or longitudinal designs, as well as to develop standardized protocols for the application of network analysis in gerontological contexts.

Conclusions

This study highlights the coexistence of functional limitations and socio-familial risk among older adults living in vulnerable contexts. High levels of dependence in ADLs—such as stair use, bladder control, and mobility—as well as difficulties in socially mediated IADLs reflect a condition of structural frailty shaped by cumulative social determinants. The integration of validated assessment instruments with co-occurrence network analysis enabled the identification of critical functional clusters and their associations with dimensions such as lack of social support, economic hardship, and weakened social networks.

The visualization of links between daily activities and social factors provides a practical tool for anticipating vulnerability and planning context-sensitive care. These findings reinforce the notion that functionality underpins autonomy and dignity in later life. Through co-occurrence network analysis, each physical limitation emerges not only as a biological phenomenon, but also as a condition shaped by social, historical, and relational factors, underscoring

the need for gerontological and geriatric practices grounded in contextual, interdisciplinary perspectives across both clinical and educational settings.

Future research should prioritize longitudinal designs to examine the evolution of functional clusters over time, integrate mixed methods, and include diverse populations—such as rural, Indigenous, and intergenerational groups—while advancing external validation and standardization of network models to ensure their replicability and clinical relevance.

Ethics: The study was approved by the Research Ethics Committee of the Universidad Autónoma de Bucaramanga-UNAB (Reference: CIEI-UNAB-003-2021).

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Conflict of Interest: The authors have no conflict of interest to declare.

Data Availability Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

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