

Vision Impairment Depression Pathways Model in Older Adults: A Machine Learning-Assisted Concept Mapping Analysis

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Title Page

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Abstract

Background: Older adults with vision impairment face unique challenges that may contribute to depression, including limitations in vision-dependent daily activities (e.g., driving, reading, face recognition). However, existing conceptual models for this population broadly encompass functional and psychosocial outcomes and do not specifically focus on depression.

Objective: This study aimed to: 1) identify key concepts and their interrelationships related to depression experiences from published qualitative studies, and 2) develop a conceptual model that characterizes depression among older adults with vision impairment.

Methods: We included qualitative studies that described depression among adults aged 60 or older with vision impairment. We searched five electronic bibliographic databases (PubMed, Web of Science, Embase, PsycINFO, and CINAHL Complete) in December 2025 in collaboration with a medical librarian. Two reviewers independently screened titles, abstracts, and full texts, and a third reviewer resolved discrepancies. We performed a machine learning-based concept mapping analysis using Leximancer software, followed by researcher-led interpretation of concept relationships and iterative conceptual model development.

Results: Out of 6,084 records identified, 26 qualitative studies representing 508 participants met the eligibility criteria. Concept mapping analysis using Leximancer identified seven themes: loss (204 hits), activities (149), drive (67), time (62), fear (39), cope (30), and depression (14). Notably, loss- and activity-related concepts predominated in the concept map, whereas the explicit concept of depression was relatively infrequent. Based on concept mapping findings, we developed the Vision Impairment Depression Pathways Model (VIP Model), in which vision impairment was linked to depression through functional limitations and three psychosocial pathways: social isolation, loss of independence, and loss of identity.

Conclusions: The concept mapping findings suggest that older adults with vision impairment may describe their experiences of depression using language related to functional and social loss (e.g., difficulties in performing everyday tasks, reduced social interactions) rather than clinical depressive

symptom language. The VIP Model could inform future prevention strategies and assistive technology designs to address late-life depression.

Keywords: depression; older adults; vision impairment; functional limitation; social isolation; independence; identity; machine learning; concept mapping; Leximancer; conceptual model; qualitative study

Introduction

The global burden of vision impairment is escalating rapidly. Approximately 600 million people worldwide had vision impairment or blindness in 2020 [1]. Vision impairment and blindness are most common among adults aged 50 or older, largely attributable to age-related eye conditions, such as cataracts, age-related macular degeneration, glaucoma, and diabetic retinopathy [2]. As the global population ages, the prevalence of vision impairment and blindness is projected to reach 895 million by 2050, with a 50% increase from 2020 [1]. Prior meta-analyses identified that vision impairment is associated with worsening health outcomes, including functional limitations [3], depression [4,5], cognitive decline and dementia [6,7], increased mortality [8], and reduced quality of life [9]. Given the growing number of older adults with vision impairment worldwide, promoting optimal health in this population is a global public health priority.

The association between vision impairment and depression among older adults is well documented by prior cohort studies [10-14]. Meta-analyses estimated that the prevalence of depression ranged from 25.0% to 27.0% among older adults with vision impairment [4,5]. Although these prevalences are comparable to those observed in the older population (28.4–31.7%) [15,16], prior studies have identified several vision-specific factors associated with depression across multiple domains. These vision-specific factors include clinical factors (e.g., severe vision impairment [17], severe self-reported visual difficulty [17], multimorbidity [17,18]), functional factors (e.g., diminished functional independence [17,19,20], limited leisure pursuits [19]), psychological factors (e.g., difficulties adjusting to vision impairment [21], poor acceptance of vision impairment [17,19]), social factors (e.g., social isolation [19,20], negative stereotypes of vision impairment [19]), and healthcare-related factors (e.g., limited mental health service utilization [22]). Among these, our prior systematic review [17] found that severe visual impairment and self-reported visual difficulty were consistently associated with depression in this population, underscoring the clinical relevance of vision-specific factors. Understanding these factors is important because late-life depression tends to be chronic and under-detected. One longitudinal study [23] found that 21.0% of older adults with vision impairment were persistently depressed from

baseline to the two-year follow-up, suggesting that depression may persist over time in a substantial proportion of this population. In addition, the under-detection of depression is often compounded by the overlap between somatic symptoms (e.g., insomnia, fatigue) and cognitive symptoms (e.g., memory difficulty, poor concentration) of depression and the corresponding symptoms of other chronic diseases (e.g., cancer, dementia) [24], delaying the timely detection of depression. Persistent and undetected late-life depression contributes to accelerated cognitive decline [25], increased suicidal behaviors [26], and elevated mortality risk [27,28]. Thus, prevention and early detection of depression are critical for older adults with vision impairment to mitigate these adverse health outcomes.

Despite accumulating evidence on factors associated with depression, there is a lack of conceptual frameworks that illustrate key concepts and their interrelationships with depression among older adults with vision impairment. Our prior systematic review [17] noted that only one of the 13 included studies (7.7%) employed a theoretical framework when examining factors associated with depression among older adults with vision impairment, and no studies used a conceptual or theoretical framework specific to depression in this population. Existing conceptual models of aging and disability, such as the International Classification of Functioning, Disability, and Health (ICF) Model [29] and the Disablement Process Model (DPM) [30], provide useful frameworks for understanding relationships among health conditions, impairments, functional limitations, and broader contextual factors. However, these models do not explicitly focus on depression among older adults with vision impairment. These findings highlight the necessity of developing a novel conceptual framework specifically focusing on depression to guide empirical research in this area.

Several meta-syntheses of qualitative studies [19,20,31] identified key psychosocial concepts related to vision impairment in late life, including psychological adjustment to vision impairment, loss of independence, reduced self-worth, fear of blindness, and social isolation. These syntheses indicate that older adults with vision impairment experience negative emotional responses to a diagnosis of age-related eye diseases (e.g., glaucoma), such as feelings of shock, fear, helplessness, and frustration [19,20,31]. They also experience significant limitations in vision-dependent daily activities (e.g., driving, reading)

[19,20,31]. Further, social interactions often diminish due to difficulties in recognizing faces and non-verbal communication [19,20,31]. Some older adults with vision impairment felt their lives were ending and lost motivation to engage in activities, and some eventually reported suicidal ideation [19,20,31]. However, key concepts and their interrelationships related to depression remain underexplored among older adults with vision impairment. Concept mapping is needed to advance understanding of depression experiences and inform targeted preventive approaches for this population.

Recent advances in artificial intelligence (AI)-powered text analysis offer promising approaches to address these knowledge gaps by integrating qualitative evidence. Leximancer is an unsupervised machine learning-based text mining software designed to conduct automated concept mapping using text data [32,33]. This software identifies frequently occurring concepts and their interconnections based on word co-occurrence patterns, generating a concept map [33,34]. Leximancer enables researchers to analyze large volumes of text data more efficiently than manual qualitative analysis and to identify underlying concepts and their patterns [35]. Further, Leximancer provides a data-driven, reproducible approach to concept identification that may reduce reliance on human-driven coding during the initial analytic process [36]. This methodology has been applied successfully in health research to synthesize qualitative findings of digital health and behavioral science [36-38], demonstrating its utility for developing conceptual frameworks from existing qualitative studies.

This study aims to: 1) identify key concepts and their interrelationships with depression through concept mapping analysis using Leximancer, and 2) develop a new conceptual model that characterizes depression among older adults with vision impairment based on the findings of concept mapping analysis. A novel conceptual model could inform future prevention strategies, screening approaches, and intervention designs to address late-life depression in this population.

Methods

Study Design

This concept mapping study used Leximancer, a machine learning-based text analysis tool [32,33], to analyze qualitative findings from existing literature on the lived experiences of depression among older adults with vision impairment and to develop a new conceptual framework. Leximancer has been applied in prior health research to synthesize qualitative findings [35-38].

Eligibility Criteria

Table 1 summarizes the inclusion and exclusion criteria of this review based on the SPIDER framework (i.e., sample, phenomenon of interest, design, evaluation, research type) [39]. We included peer-reviewed qualitative study papers published in journals, available in full-text written in English. We excluded quantitative study papers, review papers, protocols, theoretical papers, case reports, editorials, letters, expert forum papers, grey literature, conference papers, and dissertations.

Older adults were defined as people aged 60 or older [40]. Studies with mixed-age samples were eligible if data for older adult participants were clearly identifiable, based on one of the following criteria: (1) at least 70.0% of the study sample were aged 60 years or older; (2) the mean or median age of participants was 60 years or older; (3) qualitative findings for the older adult subgroup were reported separately.

Vision impairment was defined as a significant limitation of visual capability attributable to an eye condition. We included studies in which vision impairment was defined by participants' self-reported visual difficulty, objective visual acuity measurement, clinical diagnosis of eye conditions, or other standard criteria used in each study. The cutoff for an acceptable proportion of individuals with vision impairment was 70.0% or above of a total study sample. We excluded studies of people with congenital, inherited, or early-onset eye conditions (e.g., retinitis pigmentosa, Stargardt disease), as well as studies of people with dual sensory impairment.

In this study, we used “depression” as an umbrella term encompassing both clinically diagnosed depressive disorders and depressive symptoms. The definition of depression followed the criteria of major depressive disorder and subthreshold depression in the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition, Text Revision (DSM-5-TR) [41]. According to the DSM-5-TR, the core symptoms of major depressive disorder include depressed mood and diminished interest or pleasure (i.e., anhedonia). Associated symptoms include appetite or weight changes, sleep disturbance (e.g., insomnia, hypersomnia), psychomotor agitation or retardation, fatigue or loss of energy, feeling of worthlessness or inappropriate guilt, diminished ability to concentrate or indecisiveness, and thoughts of death or suicidal ideation. We included studies in which participants reported experiences related to depression, defined as descriptions of one or more depressive symptoms from the DSM-5-TR criteria in the Results section, regardless of whether a formal clinical diagnosis was established. There were no restrictions by type, duration, or severity of depression, or by method of depression assessment. We excluded studies that did not describe depressive symptom component(s) based on the DSM-5-TR criteria (e.g., depressed mood, diminished interest or pleasure, sleep disturbance).

We included studies that used qualitative data collection methods (e.g., interviews, focus groups) and qualitative analysis methods (e.g., grounded theory, ethnography, phenomenology, thematic analysis, content analysis). Mixed methods studies, including randomized controlled trials and quasi-experimental studies, were included if they reported qualitative findings related to experiences of depression among older adults with vision impairment. Case studies were excluded because their limited sample size may not provide sufficient textual data that fully capture core components of experiences of depression in older adults with vision impairment.

Table 1. Eligibility criteria based on SPIDER framework

S	Sample	Inclusion criteria	Exclusion criteria
		Older adults (aged 60 years or older)^a with vision impairment^{b,c}	- Adults with vision impairment who are younger than 60 years of age - Older adults with congenital, inherited, or early-onset eye conditions (e.g., retinitis pigmentosa, Stargardt disease)

PI	Phenomenon of interest	• Depression ^{d,e}	• Older adults with dual sensory impairment • None
	D Design	• Qualitative data collection methods (e.g., interviews, focus groups) • Qualitative analysis methods (e.g., grounded theory, ethnography, phenomenology, thematic analysis, content analysis)	• Case studies ^f
E	Evaluation	• Experiences	• None
R	Research type	• Qualitative studies • Mixed methods studies that reported qualitative findings ^g	• Quantitative studies (e.g., cross-sectional, cohort, case-control, randomized controlled trials without qualitative findings)

Footnotes.

^a Older adults were defined as people aged 60 or older [40].

^b Vision impairment was defined as a significant limitation of visual capability attributable to an eye condition.

^c We included studies in which vision impairment was defined by participants' self-reported visual difficulty, objective visual acuity measurement, clinical diagnosis of eye conditions, or other standard criteria used in each study. The cutoff for an acceptable proportion of individuals with vision impairment was 70.0% or above of a total study sample.

^d The definition of depressive symptoms followed the criteria of major depressive disorder and subthreshold depression in the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition, Text Revision (DSM-5-TR) [41].

^e We included studies in which participants reported experiences related to depression, defined as descriptions of one or more depressive symptoms from the DSM-5-TR criteria in the Results section, regardless of whether a formal clinical diagnosis was established. There were no restrictions by type, duration, or severity of depression, or by method of depression assessment.

^f Case studies were excluded because their limited sample size may not provide sufficient textual data that fully capture core components of experiences of depression in older adults with vision impairment.

^g Mixed methods studies, including randomized controlled trials and quasi-experimental studies, were included if they reported qualitative findings related to experiences of depression among older adults with vision impairment.

Information Sources and Search Strategy

In collaboration with a medical librarian, literature search strategies were developed using medical subject headings (MeSH) terms and various text words related to experiences of depression among older adults with vision impairment. The following five databases were searched: PubMed, Embase, Web of Science, PsycINFO, and CINAHL Complete. **Multimedia Appendix 1** shows examples of comprehensive search strategies for each database. The original search was conducted on December 10, 2025. No date limits were applied to the searches to increase the sensitivity of this study. In addition, we conducted citation searches to identify any additional eligible reports.

Selection Process

All searched literature data were uploaded to Zotero reference management software (Corporation for Digital Scholarship, Vienna, Virginia, United States). All retrieved records were then imported into Covidence software (Veritas Health Innovation Ltd, Melbourne, Victoria, Australia), which supports collaboration with reviewers during the selection process. Duplicates of retrieved records were removed on Covidence. Using Covidence, two reviewers (HS, JC) independently screened the titles and abstracts based on the eligibility criteria (**Table 1**). To ensure consistency in the review process, before starting the full text screening, the reviewers conducted a pilot study that randomly selected 10 reports and discussed the procedure for the full text screening. Then, two independent reviewers (HS, JC) reviewed the full texts of the selected reports to finalize the number of studies to be reviewed. Full text reports were retrieved if they met the pre-specified inclusion criteria. The two reviewers resolved discrepancies through discussion with a third reviewer (MW). The percentage of proportionate agreement was 97.3% (Cohen's Kappa coefficient = 0.39) for the title and abstract screening and 70.3% (Cohen's Kappa coefficient = 0.39) for the full text screening. The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) 2020 flow diagram (**Figure 1**) [42] shows the selection process and the reasons for excluding studies.

Data Extraction

The data from each retrieved report were extracted into one table in a Word file based on the following items: author(s); year of publication; study region/country; study aims; sample size; participants' characteristics (e.g., age, sex/gender); vision-related characteristics (e.g., cause(s) of vision impairment; severity of vision impairment; duration of vision impairment); definition(s) of depressive symptoms; methodological approaches (e.g., study design; sampling method(s); method(s) of data collection; method(s) of data analysis; theoretical framework(s)); depressive symptom components based on the DSM-5-TR criteria; and study strengths and limitations. **Multimedia Appendix 2** presents the coding rules to assess depressive symptom components based on the DSM-5-TR criteria.

For the included studies, text data regarding experiences of depression among older adults with vision impairment from each included study were extracted into one Word file. These text data included themes, subthemes, participants' verbatim quotations, and authors' narrative text from the Results section that described the phenomenon of interest [36,43,44].

Data Analysis

Data analysis encompasses two analytic parts.

Analysis 1: Machine Learning-Based Concept Mapping Using Leximancer

We used Leximancer (UI v5.0.261; Leximancer Pty Ltd, Brisbane, Queensland, Australia) [32,45] to generate a concept map from text data extracted from the included studies. Leximancer applies an unsupervised machine learning algorithm to determine the frequency of concepts and their interconnections based on word co-occurrence patterns [32-34,46,47]. This automated text analytic tool reveals network structures within text data by automatically generating a thesaurus of words based on contextual similarities and semantic extraction. Strengths of Leximancer include its ability to efficiently identify frequently occurring concepts from large volumes of text data and quickly visualize the interrelationships among these concepts. Leximancer helps interpret underlying concept patterns for conceptual model development.

The software extracts “concepts” (i.e., collections of words that travel together throughout the text) and further groups them into “themes” (i.e., sets of highly interconnected concepts) [36,45]. Leximancer can visualize the inter-relationships between “concepts” and “themes” within and across the included studies. The generated concept map by Leximancer illustrates “themes” as colored bubbles that are heat-mapped according to their frequency (i.e., importance), with warmer colors (e.g., red, yellow) indicating higher importance and cooler colors (e.g., blue, purple, green) lower importance [45]. “Concepts” are displayed as dots inside each theme bubble and interconnected across themes [45]. Connectivity between concepts refers to the sum of all text co-occurrence counts between a concept and

every other concept on the map. Closer proximity of the theme bubbles or concept dots indicates higher co-occurrence and stronger linkage.

After data extraction, Word files containing extracted text data from the included studies were imported into Leximancer for automated concept mapping analysis. We created initial concept maps using default settings on Leximancer. Initial concept maps were reviewed for meaning, and redundant conversational words were manually removed outside of the software settings where appropriate (e.g., participants, study, things, and year-old; see **Multimedia Appendix 3**). Concept variations (e.g., vision and visual) were also manually merged where necessary (see **Multimedia Appendix 4**). After reviewing the initial concept maps, we adjusted the calibration settings as follows: theme size = 55%; visible concepts = 100%. All other software settings were kept as the default values. Concept mapping analysis using Leximancer was performed in June 2026.

Analysis 2: Researcher-Led Conceptual Model Development

Based on the concept map generated by Leximancer in Analysis 1, we developed the conceptual model through a researcher-led iterative process. This approach is consistent with published qualitative approaches for developing conceptual models from qualitative findings [47]. First, researchers (HS, JC, HL, and MW) examined the full list of hit counts and relevance percentages of emerged themes and concepts on a concept map, as well as interconnections between concepts. Relevance percentage refers to the proportion of text segments in the Results section of the included studies that were coded with that concept [45]. The topic guide, one tool in Leximancer that represents an automatic subject index for a large document collection, was also used to assist interpretation of the concept map. Second, researchers (HS, JC, HL, and MW) returned to the original text data to interpret the meaning of each theme and concept in the context of depression among older adults with vision impairment. The research team then identified consistently recurring relationships among themes and concepts, including pathways linking vision impairment to depression through intermediate concepts. Concepts were iteratively organized to reflect these pathways. Discrepancies in interpretation were discussed among the research team until consensus was reached. The final conceptual model was reviewed and approved by all authors.

Ethical Considerations

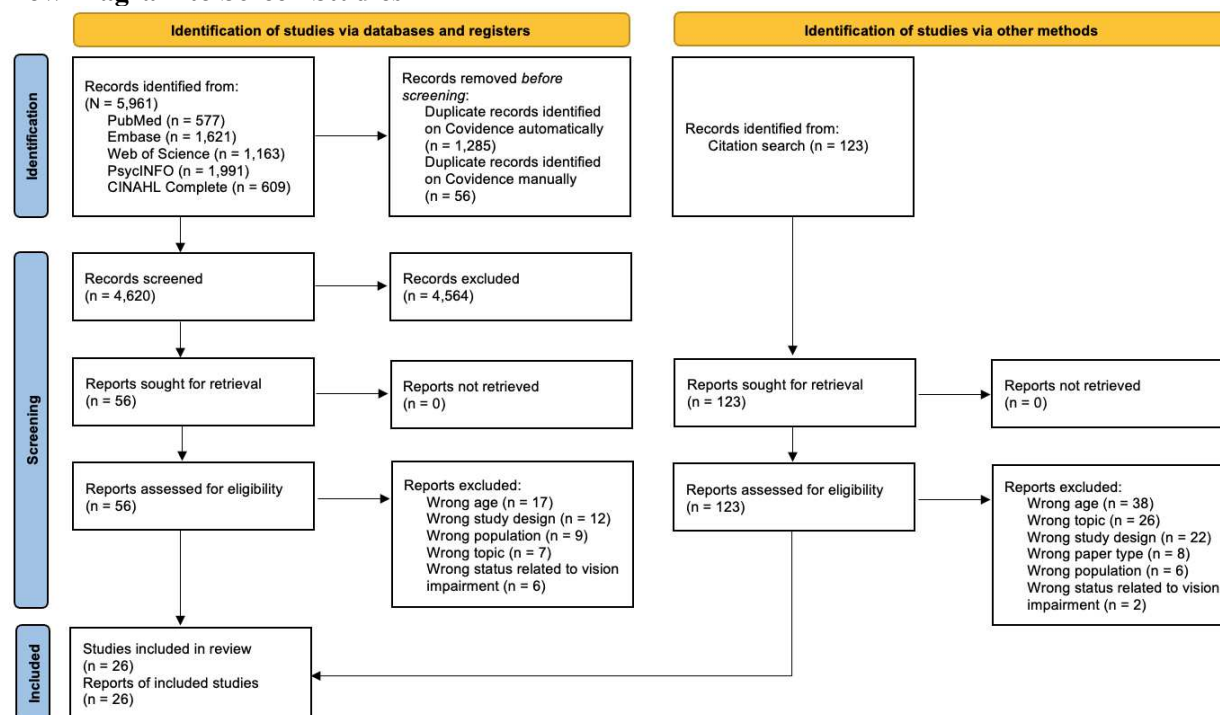
Institutional review board exemption approval was provided by the University of California, San Francisco Institutional Review Board on July 21, 2025 (approval # 25-44442). The data used in this study are publicly available and fully de-identified, obtained from published, peer-reviewed articles.

Results

Study Selection

The initial database search retrieved 5,961 records, from which 1,341 duplicates were removed (Figure 1). The remaining 4,620 records were screened for title and abstract, and 56 reports were screened for full texts. In addition, 123 records identified through citation search were screened for full texts. After full text screening of these 179 reports, a total of 26 studies met the eligibility criteria and were included in the final analysis.

Figure 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 Flow Diagram to Screen Studies



Study Characteristics

The study characteristics of the 26 studies are shown in **Table 2**. One study was published in the 1990s [48], 8 in the 2000s [49-56], 11 in the 2010s [57-67], and 6 in the 2020s [68-73]. Seven studies were conducted in Australia [51,55,59,61,65,67,69] and the United States [48-50,52,58,68,71], 4 in the United Kingdom [53,56,60,73], and 2 in Canada [57,66]. The remaining six studies were conducted in China [64], India [70], Italy [63], the Netherlands [54], Norway [62], and Sweden [72]. All included studies used qualitative study design. None evaluated interventions or employed a mixed methods design.

In total, 508 participants were represented in the 26 qualitative studies, with sample sizes ranging from 7 to 37 participants. Mean age was reported or could be calculated for 18 studies, ranging from 60.0 to 83.5 years. Median age was reported for six studies and ranged from 67 to 81 years. Two studies [49,66] did not report sufficient data to determine a mean or median age for the total sample. The proportion of female participants ranged from 0.0% to 83.3%, and women comprised at least half of the sample in 22 studies (84.6%). Other sociodemographic characteristics, including race/ethnicity, education, living arrangement, marital status, and household income, were inconsistently reported across studies. Regarding the study settings, 17 studies [48,50,53,56,59,61-72] recruited participants from eye clinics, 7 [49,51,55,57,58,60,73] from community-based settings, and 2 [52,54] from low vision rehabilitation services.

Table 2. Study Characteristics of the Included Studies on Depression among Older Adults with Vision Impairment (N = 26)

Author, year, country	Sample size	Age (mean/median, range) ^a	Sex/gender	Settings	Causes of VI
Kleinschmidt, 1999, United States [48]	N = 12	Mean age 79.6 years (SD: NR), 68–93 years old	83.3% female	Eye clinic	AMD 100.0%
Moore et al., 2003, United States [49]	N = 8	Mean age: NR (SD: NR), 68–87 years old	0.0% female	Community-based	AMD 100.0%
Coyne et al., 2004, United States [50]	N = 15	Mean age 61.1 years (SD = 12.3), age range: NR	53.3% female	Eye clinic	DR 100.0%
Wong et al., 2004, Australia [51]	N = 15	Mean age 77 years (SD: NR), 60–85 years old	53.3% female	Community-based	AMD 100.0%
Teitelman et al., 2005, United States [52]	N = 15	Mean age 75.7 years (SD: NR), 55–NR years old	33.3% female	Low vision rehabilitation	AMD 73.3%, DR 13.3%, other 13.4%

Feely et al., 2007, United Kingdom [53]	N = 7	Mean age 76.7 years (SD: NR), 62–83 years old	NR	Eye clinic	AMD 100.0%
Brouwer et al., 2008, Netherlands [54]	N = 10	Mean age 79.9 years (SD: NR), 63–95 years old	80.0% female	Low vision rehabilitation	AMD 33.0%, glaucoma 27.0%, cataract 13.0%, other 27.0%
Girdler et al., 2008, Australia [55]	N = 22	Mean age 78 years (SD: NR), 65–93 years old	59.1% female	Community-based	AMD 72.7%, glaucoma 18.2%, DR 9.1%
Stanford et al., 2009, United Kingdom [56]	N = 37	Mean age 81.6 years (SD = 4.4), 73–92 years old	54.1% female	Eye clinic	AMD 100.0%
Spafford et al., 2010, Canada [57]	N = 34	Mean age 82.0 years (SD: NR), 70–94 years old	76.5% female	Community-based	AMD 70.5%
Weber et al., 2010, United States [58]	N = 30	Mean age 83.0 years (SD: NR), 65–95 years old	83.3% female	Community-based	AMD 40.0%, cataract 26.7%, DR 23.3%, glaucoma 20.0%
McCloud et al., 2014, Australia [59]	N = 34	Median age 81 years (IQR: NR), 56–102 years old	55.9% female	Eye clinic	AMD 100.0%
Glen et al., 2015, United Kingdom [60]	N = 16	Median age 71 years (IQR = 68 to 77), age range: NR	50.0% female	Community-based	Glaucoma 100.0%
McCloud et al., 2015, Australia [61]	N = 25	Mean age 82.7 years (SD: NR), 67–92 years old	52.0% female	Eye clinic	AMD 100.0%
Magnus et al., 2016, Norway [62]	N = 10	Mean age 76.4 years (SD: NR), 55–88 years old	NR	Eye clinic	Multiple causes
Simeone et al., 2017, Italy [63]	N = 16	Mean age 60 years (SD = 5.6), 49–68 years old	56.3% female	Eye clinic	Glaucoma 100.0%
Bian et al., 2018, China [64]	N = 21	Mean age 69.8 years (SD = 7.7), 57–82 years old	66.7% female	Eye clinic	AMD 100.0%
Lane et al., 2018, Australia [65]	N = 21	Mean age 83.5 years (SD = 7.3), 66–92 years old	76.2% female	Eye clinic	AMD 100.0%
Fraser et al., 2019, Canada [66]	N = 21	Mean age: NR, 38–92 years old (95.2% of the total sample was aged 65 or older)	66.7% female	Eye clinic	AMD 52.4%, glaucoma 28.6%, DR 19.0%
Prem Senthil et al., 2019, Australia [67]	N = 17	Median age 73 years (IQR = 65 to 78), 34–85 years old	71.0% female	Eye clinic	Retinal vein occlusion 100.0%
Bicket et al., 2020, United States [68]	N = 28	Median age 67 years (IQR: NR), 42–87 years old	54.0% female	Eye clinic	Glaucoma 100.0%
Dillon et al., 2021, Australia [69]	N = 29	Mean age 78.0 years (SD = 7.0), 56–87 years old	55.2% female	Eye clinic	AMD 100.0%

Madheswaran et al., 2021, India [70]	N = 10	Median age 72 years (IQR = 70 to 74), age range: NR	50.0% female	Eye clinic	AMD 100.0%
Kumar et al., 2022, United States [71]	N = 36	Mean age 78.9 years (SD = 10.1), age range: NR	50.0% female	Eye clinic	AMD 50.0%, glaucoma 50.0%
Källstrand et al., 2024, Sweden [72]	N = 12	Median age 81 years (IQR: NR), 65–87 years old	75.0% female	Eye clinic	AMD 100.0%
Wilson et al., 2025, United Kingdom [73]	N = 7	Mean age 72.9 years (SD: NR), 62–83 years old	57.1% female	Community-based	Multiple causes

Abbreviation. AMD – age-related macular degeneration, DR – diabetic retinopathy, IQR – interquartile range, NR – not reported, SD – standard deviation, VI – vision impairment.

Footnotes.

^a Mean age was calculated when participant-level age data were available but no summary statistic of mean age was reported.

Causes of vision impairment were specified in all included studies. Age-related macular degeneration (AMD) was the most common cause of vision impairment. Twelve studies included only participants with AMD [48,49,51,53,56,59,61,64,65,69,70,72], 3 included only those with glaucoma [60,63,68], and one study each included only those with diabetic retinopathy [50] and retinal vein occlusion [67]. The remaining studies included participants with mixed causes of vision impairment.

Sixteen studies specified the severity of vision impairment (see **Multimedia Appendix 5**). Vision impairment severity was reported inconsistently across studies and was described using a variety of visual acuity thresholds, severity classifications, and summary measures. Eleven studies specified the duration of vision impairment or the duration since a diagnosis of eye conditions. Mean duration of vision impairment was reported for 6 studies, ranging from 2.3 to 21 years.

Depression-Specific Characteristics

Only two studies [48,65] used the Geriatric Depression Scale (GDS) to assess depressive symptoms. One [65] used the 15-item GDS (GDS-15), reporting a mean score of 4.5 (standard deviation [SD] = 2.7; range = 0–10) while the other [48] reported a mean GDS score of 5.2 (SD was not reported; range = 0–10). Only one of these studies [65] defined depression using established GDS-15 cut-off scores (5–9 = mild depression, 10–15 = moderate to severe depression).

Information on the duration of depression was reported for one participant in each of two studies [68,73]. One participant reported experiencing depression for 3 years [68], while another reported 8 years of depression [73].

A current diagnosis of depression was reported by at least two participants in one study [52]. Treatment for depression was reported in two studies [52,68], both involving antidepressant use. In one of these studies [68] the participant reported taking Zoloft and Wellbutrin, whereas in the other study [52] at least two participants reported taking non-specified antidepressants. Overall, depression-specific characteristics were infrequently reported across the included studies.

Methodological characteristics

The methodological characteristics of the 26 studies are presented in **Table 3**. None of the included studies explicitly aimed to explore experiences of depression among older adults with vision impairment. Most studies focused on experiences of psychological adjustment to vision impairment [48,52,55,56,62], coping strategies in response to vision impairment [58,60,70], and the impact of vision impairment on daily activities, social participation, and quality of life [50,54,64-67,70].

Among studies that explicitly reported a sampling method, purposive sampling was the most common approach (n=7), followed by convenience sampling (n=6). Semi-structured interviews were the most commonly used method of data collection (n=14). Five studies used focus groups. The most common method of data analysis was thematic analysis (n=6), followed by content analysis (n=5), grounded theory (n=4), and phenomenology (n=4).

Four studies explicitly reported a theoretical or conceptual framework. These included Parse's Human Becoming School of Thought [49], symbolic interactionism [51], the Behavior Change Wheel framework [69], and a participative and co-productive model based on user-centered design principles and a social justice model [73].

Table 3. Methodological Characteristics of the Included Studies on Depression among Older Adults with Vision Impairment (N = 26)

Author, year	Aim of the study	Sampling method	Method of data collection	Method of data analysis
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Kleinschmidt, 1999 [48]	To explore successful adjustment to vision loss from the perspectives of those who have accomplished it	Purposive sampling*	Semi-structured interviews*	Thematic analysis*
Moore et al., 2003 [49]	To gain an understanding of the experience of severe visual impairment from the perspective of older men with macular degeneration	Purposive sampling*	Unstructured interviews	Phenomenology
Coyne et al., 2004 [50]	To evaluate the symptom experience of diabetic retinopathy, its impact on daily activities and health-related quality of life, and the applicability of two vision-specific questionnaires	Convenience sampling*	Focus groups	Content analysis
Wong et al., 2004 [51]	To conduct in-depth individual interviews to explore a range of issues and perspectives, making sense of individual experiences, and to understand the specific needs in people with AMD	Theoretical sampling	Semi-structured interviews	Grounded theory
Teitelman et al., 2005 [52]	To reveal their emotional challenges and successes in the overall experience of adjusting to vision loss	Purposive sampling*	Focus groups and semi-structured interviews	Thematic analysis*
Feely et al., 2007 [53]	To extend Wong et al.'s findings and to conduct a tentative subjective assessment of eccentric viewing by persons with AMD	Purposive sampling*	Semi-structured interviews*	Phenomenology
Brouwer et al., 2008 [54]	To explore in detail the mobility experiences of 10 older people with a visual impairment	Convenience sampling	Semi-structured interviews*	Phenomenology
Girdler et al., 2008 [55]	To describe the impact of age-related vision loss, identify the factors that influence adaptation, and describe the perceived problem areas in the daily lives of older adults	Purposive sampling	Focus groups	Thematic analysis*
Stanford et al., 2009 [56]	To describe the psychosocial adjustment to visual impairment of a large sample of patients with AMD over 12 months	Subsample from a randomized controlled trial	Semi-structured diaries	Grounded theory
Spafford et al., 2010 [57]	To examine reasons for not using low-vision services among Canadian seniors with low vision	Purposive sampling	Semi-structured interviews	Content analysis
Weber et al., 2010 [58]	To investigate coping strategies of vision loss among older adults	Purposive sampling*	Semi-structured interviews	Thematic analysis*
McCloud et al., 2014 [59]	To understand people's experience with AMD in light of new treatment successes	Convenience sampling	Focus groups and semi-structured interviews	Thematic analysis
Glen et al., 2015 [60]	To explore whether patients with glaucoma use different coping strategies in response to their vision loss	Purposive sampling	Semi-structured interviews	Framework analysis
McCloud et al., 2015 [61]	To understand the participant's experience of neovascular AMD, including ongoing treatment with anti-vascular endothelial growth factor	Purposive sampling	Unstructured interviews	Thematic analysis

Magnus et al., 2016 [62]	To explore how older adults recently diagnosed with age-related vision loss experience and readjust to their new everyday lives	Purposive sampling*	Semi-structured interviews	Grounded theory
Simeone et al., 2017 [63]	To describe the life experiences of subjects in southern Italy suffering from glaucoma	Purposive sampling*	Semi-structured interviews*	Phenomenology
Bian et al., 2018 [64]	To explore which areas of health-related quality of life were affected in Chinese patients, and to identify whether the areas are well covered by validated questionnaires	Purposive and convenience sampling	Semi-structured interviews	Thematic analysis
Lane et al., 2018 [65]	To in-depth examine how impaired face perception impacts social interactions and quality of life in AMD patients	Purposive sampling*	Semi-structured interviews	Thematic analysis
Fraser et al., 2019 [66]	To describe and clarify the factors that shape the social participation of older adults with vision loss	Purposive sampling*	Focus groups	Content analysis
Prem Senthil et al., 2019 [67]	To understand the quality of life issues in people with retinal vein occlusion using a qualitative methodology	Convenience sampling	Semi-structured interviews	Inductive analysis
Bicket et al., 2020 [68]	To explore patients' perspectives and experiences living with moderate to severe glaucoma through qualitative, semistructured interviews and to identify important benefits and risks that patients consider when choosing glaucoma treatments	Convenience sampling	Semi-structured interviews	Framework analysis
Dillon et al., 2021 [69]	To investigate the perspectives of people primarily with late AMD on mental health and mental wellbeing programs	Convenience sampling	Semi-structured interviews	Content analysis
Madheswaran et al., 2021 [70]	To understand the impact on everyday life activities and related adaptive and coping strategies in people with long-standing bilateral central vision loss due to geographic atrophy in India	Purposive sampling	Semi-structured interviews	Thematic analysis
Kumar et al., 2022 [71]	To examine the relationship between vision impairment and stigma by conducting guided interviews with adults with age-related vision impairment	Convenience sampling*	One-on-one guided interviews	Content analysis
Källstrand et al., 2024 [72]	To explore what it means to live with AMD through the eyes of those living with the condition	Purposive sampling*	Semi-structured interviews	Grounded theory
Wilson et al., 2025 [73]	To understand the experience and care needs of older people living with vision impairment in the acute hospital setting	Purposive sampling	Co-productive workshops	Thematic analysis

Abbreviation. AMD – age-related macular degeneration.

Footnotes.

* Sampling methods and methods of data collection and analysis were inferred from study description when not explicitly reported by authors.

Common Depressive Symptom Components

Table 4 summarizes the frequency of depressive symptom components based on the DSM-5-TR criteria across the included studies. Among the 26 included studies, depressed mood was the most frequently described depressive symptom components (80.8%, n=21), followed by diminished interest or pleasure (57.7%, n=15), feeling of worthlessness (42.3%, n=11), thoughts of death (15.4%, n=4), and sleep disturbance (7.7%, n=2). The remaining four depressive symptom components (i.e., appetite or weight changes, psychomotor agitation or retardation, fatigue or loss of energy, and diminished ability to concentrate or indecisiveness) were not identified in the themes, participants' quotes, and authors' narrative data reported in the Results sections of the included studies.

Table 4. Frequency of Depressive Symptom Components Based on DSM-5-TR Criteria Across the Included Studies (N = 26)

No.	Depressive symptom components	% (n)	References
1	Depressed mood	80.8% (21)	Kleinschmidt, 1999 [48]; Moore et al., 2003 [49]; Coyne et al., 2004 [50]; Wong et al., 2004 [51]; Teitelman et al., 2005 [52]; Brouwer et al., 2008 [54]; Girdler et al., 2008 [55]; Stanford et al., 2009 [56]; Weber et al., 2010 [58]; McCloud et al., 2014 [59]; Glen et al., 2015 [60]; Simeone et al., 2017 [63]; Bian et al., 2018 [64]; Fraser et al., 2019 [66]; Prem Senthil et al., 2019 [67]; Bicket et al., 2020 [68]; Dillon et al., 2021 [69]; Madheswaran et al., 2021 [70]; Kumar et al., 2022 [71]; Källstrand et al., 2024 [72]; Wilson et al., 2025 [73]
2	Diminished interest or pleasure	57.7% (15)	Coyne et al., 2004 [50]; Wong et al., 2004 [51]; Teitelman et al., 2005 [52]; Feely et al., 2007 [53]; Brouwer et al., 2008 [54]; Girdler et al., 2008 [55]; Stanford et al., 2009 [56]; Weber et al., 2010 [58]; McCloud et al., 2014 [59]; Glen et al., 2015 [60]; McCloud et al., 2015 [61]; Magnus et al., 2016 [62]; Simeone et al., 2017 [63]; Lane et al., 2018 [65]; Dillon et al., 2021 [69]
3	Feeling of worthlessness	42.3% (11)	Wong et al., 2004 [51]; Teitelman et al., 2005 [52]; Girdler et al., 2008 [55]; Stanford et al., 2009 [56]; Weber et al., 2010 [58]; McCloud et al., 2014 [59]; Glen et al., 2015 [60]; Simeone et al., 2017 [63]; Bian et al., 2018 [64]; Dillon et al., 2021 [69]; Madheswaran et al., 2021 [70]
4	Thoughts of death	15.4% (4)	Wong et al., 2004 [51]; Spafford et al., 2010 [57]; McCloud et al., 2014 [59]; Wilson et al., 2025 [73]
5	Sleep disturbance	7.7% (2)	Stanford et al., 2009 [56]; Bicket et al., 2020 [68]

Abbreviation. DSM-5-TR – The Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition, Text Revision.

Concept Mapping Analysis Using Leximancer

Figure 2, Table 5, and Multimedia Appendix 6 present the results of the concept mapping analysis using Leximancer. This concept map shows the most frequent concepts and their

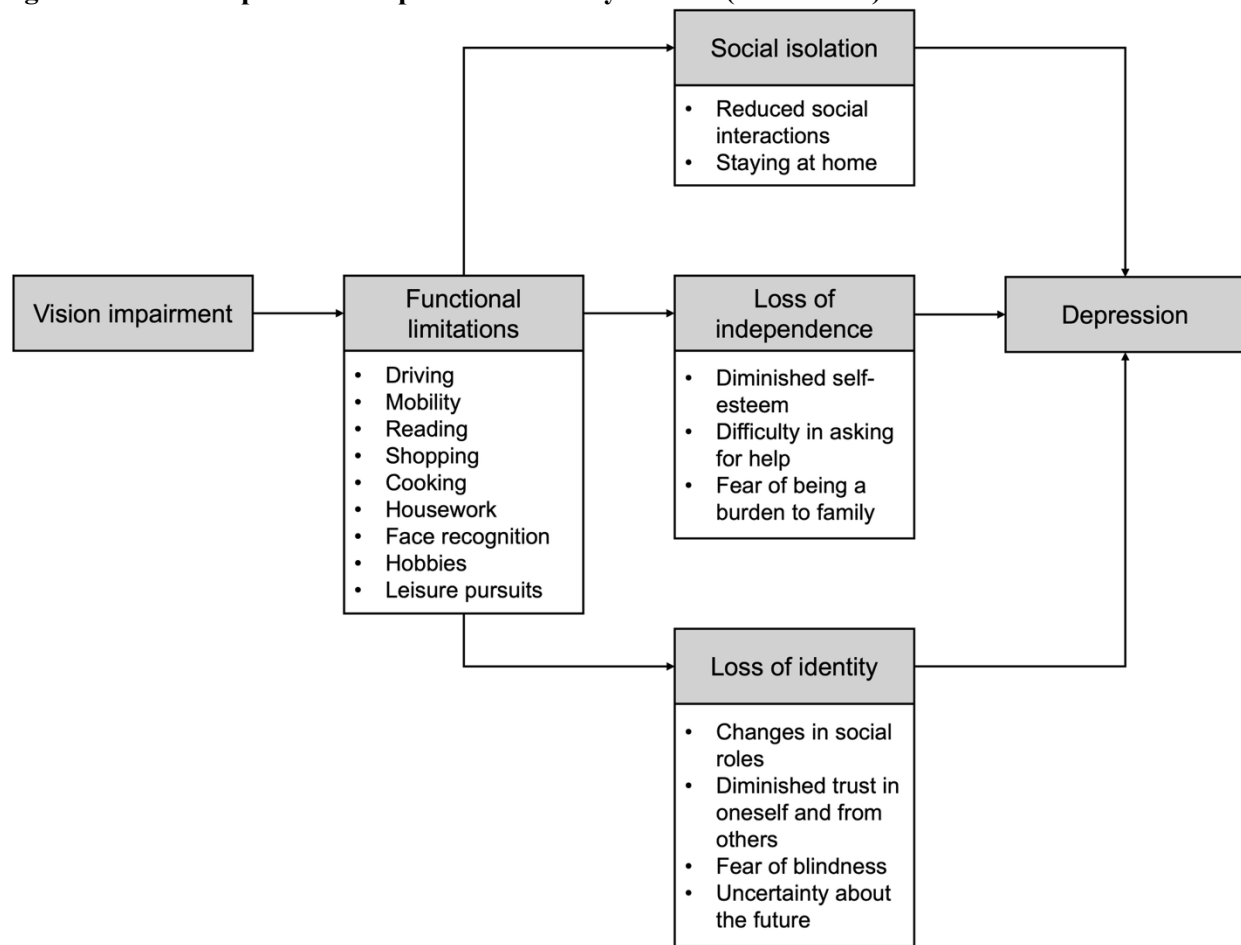
interrelationships derived from the themes, participants' quotes, and authors' narrative data of the included studies. Overall, seven themes were identified by the concept mapping analysis using Leximancer. The theme of "loss" had the highest hit count (n=204), followed by activities (n=149), drive (n=67), time (n=62), fear (n=39), cope (n=30), and depression (n=14). The concepts identifying each theme are listed in Table 5.

Table 5. Leximancer-Generated Themes and Concepts from the Included Studies (N = 26)

Themes (hit count (n))	Concepts (hit count (n), relevance percentage (%)) ^a
Loss (204)	Loss (96, 100%), vision (74, 77%), feelings (59, 61%), life (38, 40%), independence (36, 38%), others (32, 33%), experienced (28, 29%), impact (21, 22%), impairment (17, 18%), ability (16, 17%), result (14, 15%), negative (14, 15%), need (11, 11%), emotional (10, 10%), lost (10, 10%), burden (9, 9%)
Activities (149)	Activities (41, 43%), used (36, 38%), social (31, 32%), difficulties (23, 24%), friends (21, 22%), daily (20, 21%), changes (19, 20%), AMD (18, 19%), family (18, 19%), previously (9, 9%), everything (8, 8%), perform (7, 7%), mobility (7, 7%), having (7, 7%), someone (4, 4%)
Drive (67)	Drive (29, 30%), able (14, 15%), anymore (11, 11%), everyday (8, 8%), doing (8, 8%), longer (8, 8%) members (7, 7%)
Time (62)	Time (30, 31%), home (11, 11%), sense (9, 9%), down (8, 8%), wife (8, 8%), tasks (7, 7%)
Fear (39)	Fear (22, 23%), frustration (14, 15%), world (8, 8%)
Cope (30)	Blind (16, 17%), cope (13, 14%), short (6, 6%)
Depression (14)	Depression (14, 15%)

Footnotes.

^a "Relevance percentage" reflects the proportion of text segments in the Results section of the included studies that were coded with that concept. All themes and concepts generated by the Leximancer program are reported in the table.

Figure 3. Vision Impairment Depression Pathways Model (VIP Model)^a**Footnotes.**

^a Bullet points within each concept represent examples derived from the included studies.

Vision Impairment

Vision impairment served as the starting point of the VIP Model. The Leximancer concept map (Table 5) identified “loss” (relevance percentage = 100%), “vision” (77%), and “impairment” (18%) as key concepts within the “loss” theme, reflecting the central role of vision impairment in shaping the experiences of depression among older adults. In addition, all include studies recruited participants who reported vision impairment or a certain eye condition (e.g., AMD).

Functional Limitations

Functional limitations refer to restrictions in performing daily activities that older adults previously engaged in without difficulty. Examples of functional limitations include driving, mobility,

reading, shopping, cooking, housework, face recognition, hobbies, and leisure pursuits. Functional limitations were positioned as a central consequence of vision impairment in this model since most studies described that participants experienced functional limitations and expressed sadness at relinquishing their daily activities after the onset of vision impairment. The Leximancer concept map showed “activities” (43%), “used” (38%), “difficulties” (24%), “daily” (21%), “perform” (7%), and “mobility” (7%) as key concepts within the “activities” theme; “loss” (100%), “life” (40%), “experienced” (29%), “impact” (22%), “ability” (17%), “negative” (15%) within the “loss” theme; and “drive” (30%), “able” (15%), “everyday” (8%), and “longer” (8%) within the “drive” theme. The following exemplar participant quotes illustrate the impact of functional limitations on daily lives; additional participant quotes are provided in **Multimedia Appendix 7**:

When I lost the vision in the left eye I stopped driving all together. It's been about 2 months now. It's terrible—the worst thing in the world to have happen to me. [50]

Realizing that I'd have to give up driving, it... it's going to take a great part of my life away from me. [52]

It's [AMD] affected my life totally and utterly. I can't read anything at all, without magnification. I couldn't continue to work any longer, so I had to cease working. I couldn't continue to play the sports that I enjoyed playing, I couldn't drive it's had a total and I suppose the word is devastating, effect on my lifestyle. [59]

I was a very avid golfer, and that was probably one of my biggest disappointments was not being able to play golf anymore. It really killed me, because that was my major form of exercise, was golf. [52]

Functional limitations are linked to three intermediate concepts in the pathway to depression: social isolation, loss of independence, and loss of identity.

Social Isolation

Social isolation refers to a reduction in social interactions with others resulting from functional limitations imposed by vision impairment. Examples of social isolation include reduced social interactions and staying at home. Many studies [52,59,63,65,69] reported that participants gave up social

interactions with friends in the way they used to due to functional limitations after the onset of vision impairment. Specifically, some studies [52,59,65] noted that challenges in face recognition due to vision impairment led to feelings of embarrassment and avoidance of social interactions to prevent failures in communication. The Leximancer concept map showed “used” (38%), “social” (32%), “friends” (22%), and “everything” (8%) as key concepts within the “activities” theme; “anymore” (11%) within the “drive” theme; and “home” (11%) within the “time” theme. The following participant quotes illustrate the impact of social isolation:

I do not like to go in a group of people . . . I'm not that forward with people... and to be in a group of people that, even people I know, and I see them across the room and I can't tell who they are. So that has affected me. I don't go out as often, even with [wife]. If she's going somewhere, I'll make an excuse not to go. [52]

Another thing that's very distressing... you don't recognize faces. You can go right by a lifelong friend and not know who they are. [52]

For quite some time now life is confined here, nothing more [with a sad face and sighs, he opens his arms to indicate the room where we carry out the interview]. I have lost much, almost everything that I had, I speak from the point of view of a life of friends, of outings. [63]

Your confidence, for one thing. I do get asked out a lot. I've got nice friends from the church and all that but I think no, I won't go cause they've got to watch me and it's only – I'm the one that's stopping myself, not my friends, they are all eager to come and take me out to whatever's on. It's hard when you've been independent and then this happens. [69]

Loss of Independence

Loss of independence refers to older adults' diminished ability to perform daily activities without assistance. Examples of loss of independence include diminished self-esteem, difficulty in asking for help, and fear of being a burden to family. Participants reported the negative emotional impact of loss of independence when experiencing challenges in performing daily activities after vision impairment [50,55,58-60,63,64]. Multiple studies emphasized that participants valued maintaining their independence

even after experiencing functional limitations due to vision impairment [55,58,59,66]. Specifically, driving cessation was consistently described as a symbol of loss of independence [50,52,58,60,66,69]. Several studies [50,58,59,63,64] reported that participants experienced difficulty in asking for help from others and felt fear of being a burden to family when seeking assistance to perform daily activities. The Leximancer concept map showed “loss” (100%), “feelings” (61%), “independence” (38%), “others” (33%), “experienced” (29%), “impact” (22%), “negative” (15%), “emotional” (10%), “need” (11%), and “burden” (9%) as key concepts within the “loss” theme; “used” (38%), “family” (19%), “everything” (8%), and “someone” (4%) within the “activities” theme; “drive” (30%), “able” (15%), “anymore” (11%), “longer” (8%), and “members” (7%) within the “drive” theme; “wife” (8%) within the “time” theme; and “fear” (23%) and “frustration” (15%) within the “fear” theme. The following participant quotes illustrate the experiences of loss of independence:

I used to love to cook, but now I hate it. You're looking for something, but you can't find it. You drop something and you can't see to pick it up. I'm just totally dependent on other people now. I used to love to go visiting, but now I can't. I'm dependent on people now. Everything is difficult. Since you're dependent, you're restricted in what you can do. [50]

Most of the time, I really don't want to call for help. I feel like that I am rubbish and have to rely on others for everything. I have put too much burden on the family. [64]

Unfortunately, alone I can do little or nothing.... I always need someone, I need whoever accompanies me, who helps me on the street, who helps me in the house.... I know I can do little and only in the home.... Out, no, I fear because I can not move around alone, I do not see well... and I realize that I add to the responsibilities of my children, who already have their own problems... I am sorry but what else can I do?... I try to be as little hindrance as possible but, unfortunately, sometimes I have to be so. [63]

The only thing that I find very hard is when you are losing your eyesight, there are a lot of things that, no matter how much you want to be independent, you can't. [66]

Loss of identity

Loss of identity refers to a disruption in older adults' sense of self, encompassing changes in how they perceive their past, current, and future identities in relation to vision impairment. Examples of loss of identity include changes in social roles, a diminished sense of trust in oneself and from others, fear of blindness, and uncertainty about the future. Several studies [60,64,69] noted that participants felt a great sorrow at the loss of social roles they used to hold in relation to others and society. Furthermore, multiple studies [51,59,63] consistently described that participants reported fear of blindness and uncertainty about the future, which led to challenges in planning for the future and feelings of anxiety. The Leximancer concept map showed "loss" (100%), "feelings" (61%), "life" (40%), "experienced" (29%), "impact" (22%), "negative" (15%), "emotional" (10%), and "lost" (10%) as key concepts within the "loss" theme; "used" (38%), "social" (32%), "changes" (20%), and "previously" (9%) within the "activities" theme; "able" (15%), "anymore" (11%), and "longer" (8%) within the "drive" theme; "fear" (23%) within the "fear" theme; and "blind" (17%) within the "cope" theme. The following participant quotes illustrate the experiences of loss of identity:

I was the breadwinner and in charge of everything in my family before, but now I am not relied on by others anymore. [64]

I've sort of stepped down from positions of responsibility really, being on committees and that sort of thing, because I just felt I was really unreliable and I knew I was going to have to go in for more surgery or something. That really rocked me. I became a patient. So for better or worse I drew back from doing things with any responsibility attached. [60]

Planning things is there for impossible.... I do not know if a year from now I will be able to do a certain thing or not, if I need help or will be completely useless [he clenches his right hand hard, closing it in a fist and trembling]. [59]

I do not know [how well I will see] tomorrow morning as I wake up, let alone thinking ahead to a few months.... Tomorrow morning I may wake up and see much worse than the little that I see now... in a

year I could [weeping, then, breathing deeply] be blind, I hope not, but... in short this disease does not allow you to plan anything.... You live for the day.... Tomorrow is completely uncertain. [63]

These three intermediate concepts, social isolation, loss of independence, and loss of identity, are linked to depression.

Depression

Depression represents the final concept of the VIP Model, reflecting depression that older adults with vision impairment experience through functional limitations and three intermediate pathways: social isolation, loss of independence, and loss of identity. As shown in **Table 4**, examples of depression include depressed mood, diminished interest or pleasure, feeling of worthlessness, thoughts of death, and sleep disturbance. Most studies noted that participants felt sadness, hopelessness, and worthlessness due to vision impairment [48-73], and some participants reported thoughts of death [51,57,59,73]. The Leximancer concept map showed “loss” (100%), “feelings” (61%), “experienced” (29%), “impact” (22%), “negative” (15%), and “emotional” (10%), as key concepts within the “loss” theme; “everything” (8%) within the “activities” theme; “down” (8%) within the “time” theme; and “depression” (15%) within the “depression” theme. The following participant quotes describe the experiences of depression:

Your eyesight affects everything. I get very frustrated and depressed that I can't do the things I used to.... What do I do with myself? [55]

I have to think my eyes cut off everything.... Before it [life] was full of energy; now it is full of nothing. [51]

I had 8 years of depression. Really bad depression. Really bad. I didn't want to live. (Was that due to your eyes?) Yes, you wake up and you, I don't want to get out of bed. [73]

Some days I think, well, suicide is far better than going through this. [51]

Discussion

Principal Findings

We performed a concept mapping analysis using Leximancer to visualize key concepts and their interrelationships from qualitative study articles and developed a conceptual model that illustrates

experiences of depression among older adults with vision impairment. To the best of our knowledge, this is the first study to conduct a concept mapping analysis and develop a conceptual model focusing on depression among older adults with vision impairment. Overall, our findings from the concept mapping analysis suggest that older adults with vision impairment may be more likely to describe their experiences of depression using language related to functional and social loss (e.g., difficulties in performing everyday tasks, reduced social interactions) rather than clinical depressive symptom language (e.g., depressed mood, diminished interest or pleasure). However, these findings should be interpreted with caution since there were no included studies that employed research questions directly focused on depression in this population.

Functional limitations emerged as a central concept in the VIP Model, underscoring the importance of addressing functional limitations to prevent depression among older adults with vision impairment. The findings are consistent with our prior systematic review [17], which identified functional limitations as one of the risk factors for depression in this population. A meta-analysis [3] further demonstrated that vision impairment was associated with increased risk of functional limitations. Examples of functional limitations extracted from the included studies mainly encompass instrumental activities of daily living (IADL), such as driving, shopping, cooking, and housework. Prior mediation analyses [74-76] demonstrated that IADL limitations mediated the association between vision impairment and depression among older adults. Similarly, activities of daily living (ADL) limitations, including walking, dressing, and bathing, mediated the relationship between vision impairment and depression among older adults [13,75-77]. Performing daily activities requires visual information to assess the surrounding environment and safely complete tasks. For example, driving requires rapid visual processing to assess road conditions and avoid hazards. Prior meta-syntheses [19,20,31] also reported that older adults with vision impairment experience challenges in performing daily activities and substantial psychological distress. Together, these findings suggest that functional limitations represent a key mechanism linking vision impairment to depression. Therefore, interventions that maintain or restore

functional ability could play an important role in preventing depression among older adults with vision impairment.

Social isolation was one of the intermediate concepts in the pathways from vision impairment to depression in the VIP Model. Prior studies showed that vision impairment is associated with greater social isolation [11,78,79] and loneliness [80] risk among older adults. Several mediation analyses [74,76,81] consistently supported our findings that reduced social participation, including playing sports with friends and participating in group recreational activities, mediated the association between vision impairment and depressive symptoms among older adults. Another mediation analysis [77] also presented a similar finding that loneliness was identified as a mediator between vision impairment and depression among older adults. Vision impairment may disrupt the balance between the support received and the support provided by friends, which may lead to difficulties maintaining reciprocal relationships and the termination of friendships [82]. Considering another potential reason for reduced social interactions, some included studies [52,59,65] emphasized that older adults with vision impairment experienced challenges with face recognition, felt embarrassed about meeting with others, and wanted to avoid future communication failures. In addition, some included studies [66,71] noted that stigma against vision impairment hindered social interactions and going out of the home, given past experiences in which people expressed negative stereotypes against vision impairment. Furthermore, vision impairment is associated with a greater risk of driving cessation [83-85] and greater difficulty accessing public transportation [86], which may contribute to social isolation due to limited ability to travel to their social networks. Prior meta-syntheses [19,20,31] also reported that social interactions for leisure activities with friends declined significantly after the onset of vision impairment, which subsequently led to diminished pleasure in social engagement compared with before experiencing vision impairment. In summary, these findings imply that social isolation represents a key intermediate pathway linking functional limitations to depression among older adults with vision impairment.

Loss of independence was another intermediate concept in the pathways from vision impairment to depression in the VIP Model. While functional limitations refer to restrictions in performing daily

activities in this model, loss of independence highlights the psychosocial consequences of becoming increasingly reliant on others. These findings are consistent with prior meta-syntheses [19,20,31], which identified maintaining functional independence as a critical need among older adults with vision impairment. Ensuring functional independence is considered a core feature of successful aging [87,88]. According to prior qualitative studies [89,90], older adults perceived the concept of “independence” as a multifaceted concept, including doing things alone, having accessible resources, preserving physical and mental capacity, making their own decisions, doing activities that they pleased, having control and freedom, and the capability to perform IADL and/or ADL independently. Given the concept of independence that embeds various meanings, older adults may be threatened with a wide spectrum of loss of independence after vision impairment and need to adjust to the challenges of acquired disability by rebuilding their lifestyles to accommodate their remaining functioning. Driving cessation was repeatedly described as a symbol of loss of independence across the included studies [50,52,58,60,66,69], suggesting the importance of transportation for maintaining the sense of independence. Multiple studies [86,91,92] reported that access to transportation is important for older adults to perform everyday tasks, such as reaching healthcare services, grocery stores, and recreational activities. In regions with limited public transportation infrastructure, such as many areas in the United States, older adults may rely heavily on personal vehicles, and the loss of driving ability may therefore affect their sense of independence. However, the impact of driving cessation on the sense of independence may be alleviated in areas with robust public transportation systems or emerging access to autonomous vehicles. Nonetheless, one prior systematic review [93] also showed that driving cessation is associated with greater depression risk among older adults, underscoring the need to support transportation to decrease depression risk. Several included studies [50,58,59,63,64] in this study noted that participants experienced difficulty in asking for help and felt feared being a burden to family when seeking assistance with daily activities. One cross-sectional study [94] presented that perceived overprotection from family or friends was associated with a higher risk of depression among adults with vision impairment, implying that facilitating the use of remaining functioning to perform part of everyday activities independently may be essential to enhance

self-esteem and prevent depression in this population. Together, loss of independence may contribute to depression by reducing individuals' self-esteem and increasing feelings of burden on others. The findings suggest the importance of approaches that value independent living, including low vision rehabilitation, mobility training, and assistive technologies, to reduce depression risk among older adults with vision impairment. The data also suggest the value of incorporating the family or other support person into rehabilitation programs in order to promote understanding and develop mutually derived strategies to promote independence and limit overprotection while also assuring safety.

Loss of identity was the final intermediate concept in the pathways from vision impairment to depression in the VIP Model. Across the included studies, the disruption in the sense of oneself in the past, present, and future, consistently emerged. In prior qualitative analyses [89,95], older adults recognized themselves as independent, consciously resisting declining function, not asking for help, and wanting to do things by themselves, thereby preserving a sense of self-identity. This finding indicates that older adults with vision impairment may position the loss of independence as a part of the loss of identity. One ethnographic study [96] revealed that older adults with vision impairment tended to link their experiences of vision impairment to past hardship experiences, present circumstances, and future expectations across temporal layers. This finding highlights the necessity to consider the temporal sequence of their life experiences and their effect on depression. The included studies [60,64,69] consistently reported that older adults with vision impairment stepped down from their responsibilities within their families, workplaces, and communities, and felt sadness due to the loss of social roles. For example, one included study [64] described a participant who stepped down from their financial responsibility to earn money for the family and felt worried about being a burden on the family. In addition, several included studies [51,59,63] noted that participants experienced fear of blindness and uncertainty about the future. These findings are consistent with prior meta-syntheses [19,20,31] and a prior qualitative study [96], which reported that older adults with vision impairment had difficulty envisioning their future and felt uncertain about how their vision would progress in the future. The limited

empirical literature on loss of identity among older adults with vision impairment underscores the need for future studies to further explore this construct and its role in the pathway to depression.

Regarding depressive symptom components based on the DSM-5-TR criteria, depressed mood, diminished interest or pleasure, and feeling of worthlessness were the most frequently described across the 26 included studies. Affective symptom components (e.g., depressed mood, diminished interest or pleasure) were identified in a greater number of the included studies than somatic or cognitive symptom components (e.g., appetite or weight changes, fatigue, diminished ability to concentrate) among older adults with vision impairment. However, prior literature on late-life depression reported inconsistent findings regarding symptom profiles, with some studies suggesting more somatic symptoms in older adults [97], while others found no significant differences [24]. Furthermore, these findings should be interpreted with caution given the frequency and duration criteria (e.g., “most of the day, nearly every day”) specified in the DSM-5-TR were not applied in this study, as participants rarely reported such temporal details about depression. Notably, some participants described thoughts of death, specifically after a diagnosis of eye conditions (e.g., AMD), suggesting the importance of timely mental health support at this critical period. A prior meta-analysis [26] demonstrated that depression severity is associated with a greater risk of suicide among older adults. Periodic monitoring of depression and suicide risk by health care professionals is essential for older adults with vision impairment.

Implications for Theory

The VIP Model could provide new theoretical insights to better understand depression among older adults with vision impairment. Comparing the VIP Model with existing conceptual models in aging and disabilities helps clarify its unique contributions and theoretical positioning. The VIP Model shares some important constructs with these models. For example, the ICF Model developed by the World Health Organization [29] includes constructs of “health condition,” “body functions and structures,” “activities,” and “participation,” which overlap with key constructs in the VIP Model, such as vision impairment and functional limitations, highlighting the importance of daily activity performance in relation to chronic disease or functional impairment. The DPM developed by Verbrugge and Jette [30]

includes “impairments,” “functional limitations,” and “disability,” which correspond to the temporal pathway linking vision impairment to functional limitations in the VIP Model. A Framework for Assessing the Impact of Visual Impairment on Older Adults developed by Swenor et al. [98] focused on older adults with vision impairment and includes “vision impairment,” “functioning,” and “health outcomes,” which reflect comparable constructs to the VIP Model, including the pathway linking vision impairment to functional limitations, subsequently leading to a specific health outcome (i.e., depression). However, unlike the above existing conceptual models, the VIP Model explicitly focuses on depression and uniquely incorporates psychosocial constructs such as loss of independence and loss of identity, which highlights the strength of this model that reflects the lived experiences of depression among older adults with vision impairment. Considering the theoretical appraisal criteria proposed by Chinn and Kramer [99], the VIP Model demonstrates clarity (i.e., each concept and pathway is clearly defined and visualized) and simplicity (i.e., the model comprises six concepts with clearly specified pathways), generality (i.e., applicability across various eye conditions and severity levels of vision impairment), accessibility (i.e., the concepts can be empirically examined in future studies), and importance (i.e., potential contributions to practice, policy, and theory to address late-life depression). Overall, the VIP Model represents a novel theoretical contribution by providing a vision-specific explanation of pathways to late-life depression. Key concepts and pathways in this model may be applicable to older adults experiencing other types of functional impairment, such as hearing or mobility impairment. Future empirical studies are needed to test the generalizability of the VIP Model across diverse older adult populations.

Implications for Practice and Policy

The VIP Model could provide valuable guidance for designing public health initiatives to prevent depression among older adults with vision impairment. Leveraging digital technologies to address functional limitations and social isolation may reduce depression risk in this population. For example, improved access to digital messaging platforms for family and friends may reduce depression risk by increasing virtual social interactions. A prior cross-sectional study [100] demonstrated that video calls

using digital communication apps (e.g., FaceTime, Zoom) buffered against depression among older adults with vision impairment during the COVID-19 pandemic. These findings suggest that improving access to information and communications technology (e.g., smartphones) could enhance social interactions and reduce depression risk in this population.

Furthermore, the VIP Model may guide the design of innovative assistive technologies to support older adults with vision impairment in performing daily activities. For example, Waymo (Waymo LLC, Mountain View, CA, United States) [101], an autonomous vehicle service, has the potential to help older adults with vision impairment maintain mobility for social interactions and leisure pursuits, even after driving cessation following a diagnosis of eye conditions. This approach could assist them in maintaining their previous lifestyles prior to vision impairment, ultimately supporting them in protecting their sense of independence and preventing depression in this population. Prior studies [102,103] reported potential benefits of autonomous vehicles for older adults with disabilities, including the ease of commuting to medical appointments and greater access to employment, suggesting that autonomous vehicles could support travel and facilitate social engagement among older adults with vision impairment.

From a policy perspective, the VIP Model may inform the development of integrated care models that incorporate mental health screening into routine eye care services for older adults with vision impairment. Policymakers could also consider funding programs that improve access to assistive technologies and digital communication tools for older adults with vision impairment.

The findings also suggest that AI-based text mining may facilitate early detection of depression risk among older adults with vision impairment in clinical settings. Older adults with vision impairment, specifically those recently diagnosed with eye conditions (e.g., glaucoma or AMD), may experience significant psychological distress, including shock and anxiety about the future. AI has strengths in efficiently screening large volumes of text data and quickly visualizing an overview of the phenomenon of interest. Analyzing clinical notes, patient-clinician conversations, or speech patterns from electronic health records using machine learning or large language model tools may enable timely identification of depression risk and support mental health monitoring in eye care settings. One review [104] showed that

natural language processing of speech is an emerging, objective biomarker for detecting and monitoring late-life depression, with promising diagnostic accuracy by assessing speech rate or pause duration. Future larger studies are needed to distinguish depression from normal aging and other neurodegenerative conditions, including among older adults with vision impairment. Regardless of the modality of AI-based analysis, human expertise is essential for accurately interpreting AI output. Since Leximancer does not provide us with any information about the reasoning process underlying the process by which it generated the concept map, researchers must apply human expertise to precisely interpret the meaning of emerging concepts and their interrelationships, and to consider their relevance to practice and research. It is important to incorporate human expertise in the loop for interpreting the output from AI tools in clinical settings.

Strengths and Limitations

There are several strengths in our study. From a theoretical standpoint, this study makes a valuable contribution by visualizing key concepts and their interconnections related to depression using Leximancer and developing a new conceptual model to characterize depression among older adults with vision impairment. The VIP Model offers a holistic understanding of experiences of depression in this population. This model could inform new directions in clinical practice, public health policy, and theoretical frameworks for addressing late-life depression. Methodologically, this study also demonstrates several strengths. First, collaboration with three independent reviewers and a medical librarian helped reduce the risk of selection bias. Second, the provision of sample search strategies across five electronic databases and the PRISMA 2020 flow diagram improved reproducibility and transparency of the findings. Third, the use of Leximancer, an unsupervised machine-learning text-mining tool, reduced researcher bias in concept identification compared with traditional manual qualitative analysis. Fourth, the development of systematic coding rules based on the DSM-5-TR criteria for identifying depressive symptom components enhanced the rigor and consistency of data extraction. Overall, these strengths contribute to the methodological quality of this study.

Despite these strengths, several limitations should be acknowledged. First, the publication languages were limited to English, which may have introduced selection bias. In addition, some included studies involved participants who spoke languages other than English, and translation into English may have affected our interpretation of participants' quotes. Second, the findings are generalizable only to older adults aged 60 or older with vision impairment and may not extend to younger adults or those with dual sensory impairment. Third, while the reviewers developed a comprehensive search strategy across multiple databases with clear eligibility criteria, the exclusion of gray literature may have resulted in publication bias. Fourth, preprocessing to remove redundant words and calibration settings in Leximancer may have affected conceptual map generation and subsequent conceptual model development. Furthermore, we did not conduct a quality assessment of the 26 included studies because the primary purpose of this study was conceptual model development rather than qualitative evidence synthesis. Therefore, the generated concepts and pathways in the VIP Model may have been influenced by methodological limitations or biases in the included qualitative studies. In addition, Leximancer identifies conceptual patterns within the available text data and therefore cannot identify experiences or perspectives that were not captured in the included studies. Fifth, given the qualitative nature of the included studies, frequency and duration criteria (e.g., "most of the day, nearly every day") in the DSM-5-TR major depressive disorder criteria were not applied, as participants rarely reported such temporal details about depression. This may have introduced biases in data extraction, potentially resulting in the inclusion of experiences that would not meet the frequency or duration thresholds specified in the DSM-5-TR. Furthermore, our eligibility criteria included studies that described one or more depressive symptom components from the DSM-5-TR criteria, rather than requiring a formal clinical diagnosis of major or subthreshold depressive disorder. In addition, our study did not consider the DSM-5-TR evaluation criteria of whether participants experienced a change from previous functioning or clinically significant distress or impairment in social, occupational, or other important areas of functioning. While this approach captured a broader spectrum of depression experiences, it may have captured experiences that do not meet full clinical depression criteria. Finally, because none of the included studies employed

research questions that directly focused on depression in older adults with vision impairment, the proposed pathways should be interpreted as a conceptual model of depression experiences rather than empirically established mechanisms. Future empirical studies are needed to further explore experiences of depression in this population.

Conclusion

We conducted a concept mapping analysis using Leximancer on published qualitative studies and developed a novel conceptual model characterizing depression among older adults with vision impairment. The VIP Model comprises six core concepts and their pathways in relation to depression among older adults with vision impairment: vision impairment, functional limitations, social isolation, loss of independence, loss of identity, and depression. Functional limitations emerged as a central concept in the VIP Model, underscoring the importance of addressing functional limitations to prevent depression. Future empirical studies are warranted to examine the applicability of the VIP Model across diverse older adult populations. The VIP Model could guide the design of future public health initiatives, intervention strategies, and assistive technologies to prevent late-life depression among older adults with vision impairment.

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Conflicts of Interest

None declared.

Data Availability

The data supporting the findings of this study are available from the corresponding author (HS) upon reasonable request.

Abbreviations

ADL: activities of daily living

AMD: age-related macular degeneration

DPM: Disablement Process Model

DSM-5-TR: The Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition, Text Revision

GDS: Geriatric Depression Scale

IADL: instrumental activities of daily living

ICF: International Classification of Functioning, Disability, and Health

SD: standard deviation

VI: vision impairment

VIP Model: Vision Impairment Depression Pathways Model

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