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REVIEW

Cognitive impairment and emotional disturbances in young ischaemic stroke patients – scoping review

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Abstract

Aim: To describe current scientific knowledge on cognitive impairment and emotional disturbances (anxiety and depression) in younger adult patients after ischemic stroke. *Design:* A scoping review. *Methods:* For the search, the following scientific databases were utilized: Web of Science, MEDLINE (Ovid), ScienceDirect (Elsevier), PsycInfo (EBSCO), Scopus (Elsevier), and ProQuest. Relevant studies were identified by searching publications from 2000 to July 2023. *Results:* A total of eight studies were ultimately included in the review. Cognitive impairment occurred in a range between 39.4% and 40%. This encompassed various aspects of cognitive function, such as working memory, processing speed, global cognitive function, immediate and delayed memory, attention, and executive functioning. Depression had an incidence rate ranging from 10.8% to 16.8%. Several risk factors were associated with a higher likelihood of developing generalized anxiety. These included younger age, more depressive symptoms, lower education, unemployment, a history of depression, and alcohol use. In the context of depressive symptoms, a higher risk was linked to lower education and unemployment. *Conclusion:* The included studies highlighted the need to assess these issues not only at the time of patient discharge but, more importantly, during the stage of further recovery. This can contribute to the creation of tailored interventions for these individuals.

Keywords: anxiety, cognitive impairment, depression, ischemic stroke, young adult.

Introduction

Stroke is the foremost global cause of both mortality and disability (World Health Organization, 2020). Presently, there is a noticeable global uptick in the incidence of ischemic stroke (IS) among young adults. The occurrence of IS in young adults aged 18 to 55 years is on the rise, as supported by research (Béjot et al., 2016; Putaala, 2016). Surprisingly, approximately 10% of all reported strokes afflict individuals considered 'young', i.e., those below 50 years of age (Maaijwee et al., 2014; Rutten-Jacobs et al., 2013). However, if the upper age limit is extended to 55 years, the incidence surges to 18.6% (Kissela et al., 2012). For these younger adults recovering from IS, the dynamics of family life, employment, and societal expectations differ substantially from those encountered by older post-IS patients (Maaijwee et al., 2014; Synhaeve et al., 2016). Young adults who experience IS confront these challenges at a stage in life when they are aspiring to establish families, make significant career advancements, and maintain active social lives (Synhaeve et al., 2015).

IS, as a debilitating condition, exerts a significant emotional toll on patients. Anxiety, a common complication of IS, affects a substantial portion of patients, ranging from 10% to 29%, as noted in various studies (Mitchell et al., 2017; Rafsten et al., 2018). Even after achieving full functional recovery, IS survivors may grapple with persistent psychosocial challenges (Kapoor et al., 2017). The impact of anxiety symptoms can endure for up to a decade after the stroke (Ayerbe et al., 2014) and is closely linked to reduced quality of life (Morris et al., 2013; Raju et al., 2010) and an increased dependence in daily activities (Chun et al., 2018). When compared to the general population, individuals recovering from IS are significantly more prone to developing generalized anxiety, with rates of 27% versus 8% (Cumming et al., 2016). Prior research has demonstrated that generalized anxiety hampers social functioning and restricts patient independence following IS (Sturm et al., 2004). Depression is another consequence of IS that hinders the recovery process, particularly by impeding social

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and occupational reintegration (Hackett et al., 2010; Sienkiewicz-Jarosz et al., 2010; Tanislav et al., 2015). Various studies have indicated the negative impact of depression and anxiety on functional outcomes months or even years after an IS event (Barker-Collo et al., 2010; Donnellan et al., 2010). The potential adverse effects of depressive or anxious symptoms on functional outcomes are particularly pronounced in younger adult patients, given the vulnerable stage of life they are in with regard to socioeconomic consequences.

Cognitive impairment following IS is not only prevalent but also plays a crucial role as a prognostic factor, as highlighted by Pendlebury and Rothwell (2009). In young patients, IS can result in cognitive impairment in as many as 50% of cases, as revealed in studies such as Schaapsmeerders et al. (2013). Recent research has shed light on the enduring nature of cognitive deficits in young IS patients, persisting for decades after the initial stroke event. This long-term impairment has been attributed to the widespread influence of focal lesions, as observed in studies by de Bruijn et al. (2014) and Schaapsmeerders et al. (2013). Alarming findings have emerged from the limited number of studies that have examined cognitive function in young IS patients, reporting a notably high prevalence of cognitive impairment, as recorded in studies such as Edwards et al. (2018) and Schaapsmeerders et al. (2013). Within the first 4–12 months post-IS, the prevalence of cognitive impairment can surge to a staggering 60%, according to Cao et al. (2007). Strikingly, even after an extended period, such as 11 years post-IS, cognitive impairment remains a concern for about 35% of patients, impacting their daily activities, quality of life, and return to work, irrespective of their physical recovery status, as corroborated by Edwards et al. (2018) and Kauranen et al. (2013). A recent study, encompassing patients aged 18 to 65, demonstrated that cognitive function primarily shows signs of improvement within the initial six months following IS. Beyond this point, the recovery in cognitive function is limited, emphasizing that substantial changes tend to manifest early after the occurrence of IS, as underscored in the study by Turunen et al. (2018).

The majority of research concerning emotional disturbances in post-IS patients have typically encompassed a broad age range, neglecting to specifically consider the unique challenges faced by young adult patients, as pointed out by Tanislav et al. (2015). Only a limited number of studies have delved into the longitudinal patterns of depressive symptoms and anxiety within this particular age group, as highlighted in the study by Waje-Andreassen et al. (2013). Similarly, there has been a dearth of research addressing the long-term cognitive outcomes in young adults who have experienced IS, as evident in the works of Ankolekar et al. (2014) and Schaapsmeerders et al. (2013). Given these gaps in research, numerous authors have advocated a more targeted exploration of the development of cognitive and emotional impairments in young adult patients following IS, including Tanislav et al. (2015).

Aim

To describe current scientific knowledge on cognitive impairment and emotional disturbances (anxiety and depression) in young adult patients after IS.

Methods

Design

A scoping review.

Eligibility criteria

To pinpoint meaningful criteria for this review, we applied the "PCC" mnemonic (population / participants, concept, and context).

- P (population / participants): Only studies with a cohort of patients aged 18 to 65 years were included in the review.
- C (concept): Only studies addressing cognitive impairment and emotional disturbances (anxiety and depression) in younger adult patients after IS were included.
- C (context): Studies that were conducted in the long-term post-IS period or in the chronic phase of IS were included.

The review exclusively incorporated studies employing an observational design. In contrast, study protocols, discussion papers, reviews, conference abstracts, books, reports, and dissertations were deliberately omitted from the analysis. Additionally, grey literature did not form part of the review's scope.

Search strategy

To identify pertinent articles, we employed the subsequent terms and combinations: (anxiety [Title / Abstract] OR anxious [Title / Abstract] OR depression [Title / Abstract] OR depressive symptom *[Title / Abstract] OR cognitive impairment [Title / Abstract] OR cognitive failure * [Title / Abstract]) OR ("Cognitive Dysfunction"[Mesh])) OR ("Anxiety"[Mesh])) OR ("Depression"[Mesh]) AND (ischemic attack * [Title / Abstract] OR ischaemic attack * [Title / Abstract]) OR (ischemic stroke * [Title / Abstract] OR ischaemic stroke * [Title / Abstract])) OR ("Ischemic Stroke"[Mesh]))) AND (young adult * [Title / Abstract] OR

post-stroke [Title / Abstract] OR post stroke [Title / Abstract] OR stroke survivor * [Title / Abstract] OR young stroke [Title / Abstract] OR stroke in young adult * [Title / Abstract] OR stroke in the young [Title / Abstract]).

For the search, the following scientific databases were utilized: Web of Science, MEDLINE (Ovid), ScienceDirect (Elsevier), PsycInfo (EBSCO), Scopus (Elsevier), and ProQuest. The search for relevant articles was conducted from June to July 2023. Relevant studies were identified by searching publications from 2000 to July 2023.

Study selection inc. PRISMA flow diagram

In the initial phase, all retrieved research studies were uploaded into a web-based reference manager, and duplicates were systematically eliminated. The evaluation of these studies based on predefined inclusion criteria was conducted by two researchers (E.G., L.Š.) using their titles and abstracts. Subsequently, two independent researchers (E.G., L.Š.) handled the tasks of assessing eligibility and extracting relevant data. The full texts of selected studies then underwent screening by the same pair of researchers (E.G., L.Š.) to make the final determination for inclusion in the review. In cases where consensus was not achieved, a third researcher (D.Š.) independently assessed the studies without prior agreement on inclusion. Any discrepancies in the inclusion of individual studies were resolved through collaborative discussion until a unanimous decision was reached. The selection of studies was reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Statement (PRISMA), as illustrated in Figure 1.

Evaluation of quality of articles

The study authors conducted a quality assessment of the research independently. Any discrepancies in their evaluations were deliberated upon. All the studies included in the analysis were required to adhere to the criteria for scientific publication, according to the STROBE guidelines for reporting observational studies (Vandenbroucke et al., 2014). In this scoping review, the levels of evidence were not disclosed due to the nature of the paper.

Data extraction

In the first row, data on individual characteristics of the studies were extracted: author, year, country, aim, study design, study population, age mean, cognitive impairment / emotional disturbance scale used, time of assessment, main results, and conclusions. Subsequently, data relating to the stated aims of the review were extracted (data on the incidence of cognitive impairment / emotional disturbance, risk factors for cognitive impairment / emotional disturbance, and specific domains of cognitive impairment).

Results

During the search, a comprehensive pool of 1,197 sources was retrieved. These sources underwent a tiered screening process. First, 658 studies were assessed based on their titles. Subsequently, a refined selection of 113 studies were meticulously scrutinized by analyzing their abstracts, while adhering to predetermined inclusion criteria. Out of this subset, 43 sources warranted a thorough examination of their full texts. Ultimately, only eight studies met the criteria for inclusion in the review, as depicted in Figure 1.

Characteristics of included studies

The included studies were mostly from European countries. A total of four were from the Netherlands (Maaijwee et al., 2014; Maaijwee et al., 2016; Schaapsmeerders et al., 2013; Synhaeve et al., 2015), one from Germany (Tanislav et al., 2015) and one from Austria (Pinter et al., 2019). From outside Europe, one study from China (Huang et al., 2015) and one from Canada (Kapoor et al., 2019) were included in the review. Studies included in the review were published between 2012 (Pinter et al., 2019) and 2019 (Kapoor et al., 2019). Five studies addressed the topic of cognitive impairment (Huang et al., 2015; Maaijwee et al., 2014; Pinter et al., 2019; Schaapsmeerders et al., 2013; Synhaeve et al., 2015) and three addressed the topic of emotional disturbance (Kapoor et al., 2019; Maaijwee et al., 2016; Tanislav et al., 2015). Six studies had a prospective study design (Pinter et al, 2019; Maaijwee et al., 2016; Synhaeve et al., 2015; Huang et al., 2015; Kapoor et al., 2019; Tanislav et al., 2015) and two were cohort studies (Maaijwee et al., 2014; Schaapsmeerders et al., 2013). The size of the research sample varied from 114 (Pinter et al., 2019) to 5,023 (Tanislav et al., 2015) respondents. The mean age ranged from 40 (Maaijwee et al., 2016; Synhaeve et al., 2015) to 65 years (Kapoor et al., 2019). The time of assessment of cognitive impairment / emotional disturbance began three weeks after hospitalization with IS (Pinter et al., 2019). The longest interval until cognitive impairment / emotional disturbance was assessed was 11 years following recovery from IS (Synhaeve et al., 2015; Schaapsmeerders et al., 2013). Various scales were used to assess cognitive impairment / emotional disturbance. A list of these, along with other data, is presented in Table 1.

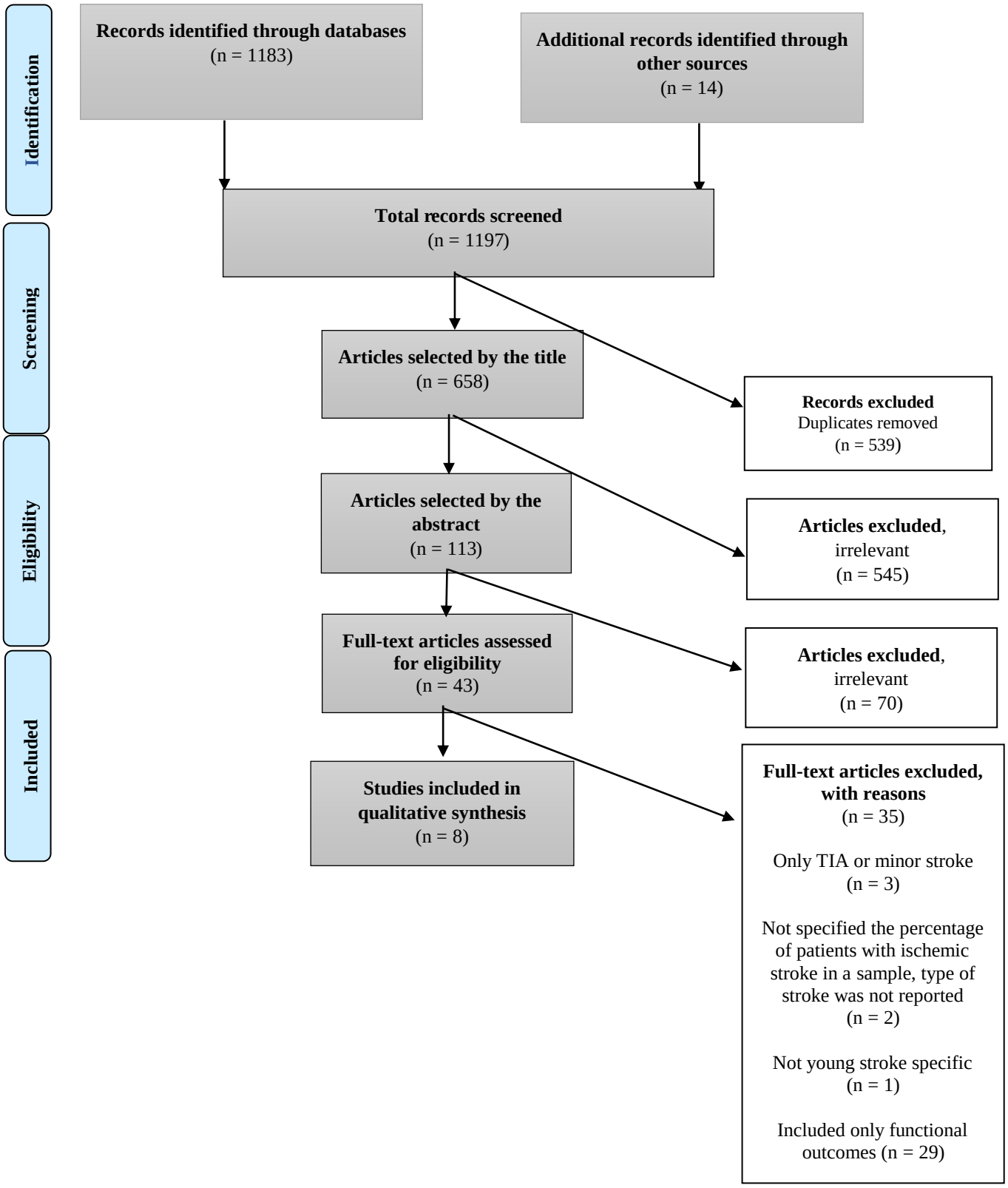

Figure 1 Flow diagram of the study selection process

Table 1 Description of the characteristics of the research studies (Part 1)

Author / Year / Country	Aim	Study design	Participants and sampling	Age mean (SD)	CF / ED used scale	Time measurement (Time of assessment post-stroke)	Main findings and conclusion
Huang et al. (2015) China	To investigate the influence of baseline factors, treatments, and functional outcome on the long-term cognitive outcome in young adults with ischemic stroke.	prospective study	stroke survivors (18–45 years): 350	41.0 (6.8)	TICS-m	5.8 years after IS	Cognitive impairment existed in 39.4% of patients. Stroke severity on admission, functional outcome at discharge, left anterior circulation syndrome, and stroke recurrence were markedly associated with post-stroke cognitive impairment. Post-stroke cognition was also significantly related to mRS at follow-up.
Kapoor et al. (2019) Canada	To explore predictors of high risk of generalized anxiety after stroke / TIA.	prospective study	patients (43–69): 274	65.0 (22.3)	CES-D, GAD-7	ND	Younger patients (≤ 50 years) were significantly more likely to be at high risk for both depression and generalized anxiety than older patients. Anxiety is common after stroke / TIA and is highly correlated with poststroke depressive symptoms and age, even among those without severe depressive symptoms.
Maaijwee et al. (2014) Netherlands	To investigate the long-term prevalence of subjective cognitive failures and to investigate the relationship between these subjective cognitive failures and objective cognitive performance.	cohort study	patients (18–50): 437	44,4	CFQ, PPMST, ROCF, RAVLT, VFSI, MMSE	10.1 years	After a mean follow-up of 10.1 (SD 8.3) years, the prevalence of subjective memory failures was 86.4 %. A weak association between subjective memory failures and objective immediate and delayed memory performance was observed in patients. Subjective cognitive failures are prevalent after stroke in young adults, but not strongly related to objective cognitive impairment.
Maaijwee et al. (2016) Netherlands	To investigate the prevalence of depressive symptoms and anxiety after stroke in young adults.	prospective cohort study	young adult (18–50 years): 325	40 years	HADS	10.6 years after IS	The overall prevalence of depressive symptoms in patients with stroke at a young age was 16.8%. The longest tertile of follow-up had a slightly but significantly higher prevalence of depressive symptoms (19.3%). The overall prevalence of anxiety in patients with stroke at a young age was 23.0%. The longest tertile of follow-up had a significantly higher prevalence of anxiety (30.7%).

CF – cognitive functions; ED – emotional disturbance; MoCA – the Montreal Cognitive Assessment; SDMT – the Symbol Digit Modalities Test; CTMT – the Comprehensive Trail Making Test; RWT – a word fluency test Regensburger Wortflussigkeitstest; HADS – the Hospital Anxiety and Depression Scale; SST – Symbol-Digit Substitution Task; ASCT – Abbreviated Stroop Color – Word Test; ROCF – Rey-Osterrieth Complex Figure; PPMST – Paper and Pencil Memory Scanning Task; RAVLT – Rey Auditory Verbal Learning Test; VSAT – Verbal Series Attention Task; BNIS – Barrow Neurological Institute Screen for higher cerebral functions; IADL – Instrumental Activities of Daily Living; TICS-m – Modified Telephone Interview for Cognitive Status; CES-D – Center for Epidemiological Studies Depression Scale; GAD-7 – Generalized Anxiety Disorder 7-item; CFQ – Cognitive Failure Questionnaire; VFSI – Verbal Fluency and Stroop Interference; MMSE – Mini-Mental State Exam; SDMT – Symbol-Digit Modalities Test; RAVLT – Rey Auditory Verbal Learning Test; VSAT – Verbal Series Attention Test; BDI – Beck Depression Inventory; ND – No Data; CRDS – Clinically relevant depressive symptoms; FU – Follow-up; IS – Ischemic stroke

Table 1 Description of the characteristics of the research studies (Part 2)

Author / Year / Country	Aim	Study design	Participants and sampling	Age mean (SD)	CF / ED used scale	Time measurement (Time of assessment post-stroke)	Main findings and conclusion
Pinter et al. (2019) Austria	To assess the prevalence and course of cognitive dysfunction in a sample of acute young stroke patients.	prospective single-center study	young adult (18–55 years): 114 FU: 87	44.5 (9.5) FU: 43.8 (9.8)	MoCA, SDMT, CTMT, RWT	3 weeks after hospitalization FU – 3 months after IS	At baseline (N = 114) deficits were highly prevalent in processing speed, flexibility /executive function, attention, and general cognitive function. In about one third of patients, cognitive deficits were still present 3 months after stroke. At FU, patients were impaired in the domain flexibility / executive function, processing speed, and attention.
Schaapsmeerders et al. (2013) Netherlands	To investigate the long-term cognitive performance after first ever young ischemic stroke.	cohort study	patients (18–50 years): 277	44.4	SDMT, ASCT, ROCF, PPMST, RAVLT, VSAT, VFSI	11 years	Long-term cognitive outcome after an ischemic stroke was worse in most cognitive domains compared with a non-stroke population. Up to 50% of patients had below average performance or cognitive impairment. Deficits in processing speed, working memory, and attention were most common.
Synhaeve et al. (2015) Netherlands	To investigate the influence of cognitive performance on long-term functional outcome.	prospective cohort study	young adult (18–50 years): 277	40.0 (7.7)	SST, ASCT, ROCF, PPMST, RAVLT, VSAT	11 years after IS	Impairment in none of the individual cognitive domains was related to long-term functional outcome, although impairment in global cognitive function was related to a poor functional outcome on the IADL. On average, 11 years after young IS there was no clear relationship between long-term cognitive deficits and long-term functional outcome or IADL.
Tanislav et al. (2015) Germany	To investigate depressive symptoms and potential determinants in acute young stroke patients.	prospective study	patients (18–55): 5023	46	BDI	ND	Depressive symptoms were present in 10.1% of young stroke patients in the acute phase. CRDS were observed more frequently in women. Patients with CRDS more often had arterial hypertension, diabetes mellitus, and hyperlipidemia.

CF – cognitive functions; ED – emotional disturbance; MoCA – the Montreal Cognitive Assessment; SDMT – the Symbol Digit Modalities Test; CTMT – the Comprehensive Trail Making Test; RWT – a word fluency test Regensburger Wortflussigkeitstest; HADS – the Hospital Anxiety and Depression Scale; SST – Symbol-Digit Substitution Task; ASCT – Abbreviated Stroop Color – Word Test; ROCF – Rey-Osterrieth Complex Figure; PPMST – Paper and Pencil Memory Scanning Task; RAVLT – Rey Auditory Verbal Learning Test; VSAT – Verbal Series Attention Task; BNIS – Barrow Neurological Institute Screen for higher cerebral functions; IADL – Instrumental Activities of Daily Living; TICS-m – Modified Telephone Interview for Cognitive Status; CES-D – Center for Epidemiological Studies Depression Scale; GAD-7 – Generalized Anxiety Disorder 7-item; CFQ – Cognitive Failure Questionnaire; VFSI – Verbal Fluency and Stroop Interference; MMSE – Mini-Mental State Exam; SDMT – Symbol-Digit Modalities Test; RAVLT – Rey Auditory Verbal Learning Test; VSAT – Verbal Series Attention Test; BDI – Beck Depression Inventory; ND – No Data; CRDS – Clinically relevant depressive symptoms; FU – Follow-up; IS – Ischemic stroke

Cognitive impairment following recovery from IS

From articles focusing on cognitive impairment, information was retrieved on the incidence of this impairment, the risk factors for its development, and the specific areas of cognitive impairment that occur in younger adult patients after IS (Table 2). The incidence of cognitive impairment ranged from 39.4% (Huang et al, 2015) to 40% (Pinter et al., 2019). Risk factors for cognitive impairment were as follows: advanced age, NIHSS score on admission, history of atrial fibrillation, functional outcome at discharge (mRS > 2), left anterior circulation syndrome, stroke recurrence and large artery atherosclerosis, undetermined etiologies subtype of IS (Huang et al, 2015), severity of fatigue, and presence of depression and anxiety (Maaijwee et al., 2014). Specific areas of cognitive functions (CF) impairment have also been described: working memory (Synhaeve et al., 2015; Schaapsmeerders et al., 2013), processing speed (Synhaeve et al., 2015; Schaapsmeerders et al., 2013; Pinter et al, 2019), global cognitive function (Synhaeve et al., 2015; Pinter et al., 2019), immediate and delayed memory (Maaijwee et al., 2014; Schaapsmeerders et al., 2013), attention (Pinter et al., 2019; Schaapsmeerders et al., 2013), and executive functioning (Pinter et al., 2019; Schaapsmeerders et al., 2013).

Table 2 Cognitive impairment after overcoming IS

Author	Incidence	Factors associated with cognitive impairment	Impairment in cognitive domains
Huang et al. (2015)	39.4%	advanced age, NIHSS score on admission[1], a history of atrial fibrillation, and functional outcome at discharge (mRS > 2), left anterior circulation syndrome, stroke recurrence and large artery atherosclerosis, undetermined etiologies subtype of IS	ND
Synhaeve et al. (2015)	ND	ND	working memory[2] processing speed and working memory[3] global cognitive function[4]
Maaijwee et al. (2014)	ND	severity of fatigue, presence of depression and anxiety	immediate and delayed memory
Schaapsmeerders et al. (2013)	ND	ND	processing speed, working memory, immediate and delayed memory, attention, executive functioning FU (11 years after IS): immediate and delayed memory, attention, executive functioning
Pinter et al. (2019)	40%	ND	processing speed, flexibility / executive functioning, attention, global cognitive function FU (after 3 months): improvement in CF overall, but still one-third of patients have cognitive deficits, mainly in the areas of: flexibility / executive function, processing speed and attention

CF – cognitive functions; ND – no data
[1] – higher score; [2] – led to a worsened result of mRS; [3] – lead to a worsened IADL outcome; [4] – was related to poor functional outcome in IADL

Emotional disturbances after overcoming IS

Information on the incidence of emotional disorders (depression, anxiety) and risk factors for these disorders was retrieved (Table 3). The incidence of depression ranged from 10.8% (Tanislav et al., 2015) to 16.8% (Maaijwee et al., 2016). The incidence of anxiety ranged from 15.5% (Kapoor et al., 2019) to 23% (Maaijwee et al., 2016). The risk factors associated with a higher risk of developing generalized anxiety were as follows: younger age, more depressive symptoms (Kapoor et al, 2019), lower education, unemployment, history of depression, and alcohol use (Maaijwee et al., 2016). Risk factors associated with a higher risk of depressive symptoms were as follows: lower education, unemployment (Maaijwee et al., 2016), female gender, older age, arterial hypertension, DM, and hyperlipidemia (Tanislav et al., 2015). Only one factor was found to be associated with a lower risk of depressive symptoms, i.e., longer observation time (Maaijwee et al., 2016). Likewise, only one factor was associated with a lower risk of generalized anxiety, i.e., younger age (Maaijwee et al., 2016).

Table 3 Emotional disturbances after overcoming IS

Author	Incidence	Factors associated with anxiety / depression
Kapoor et al. (2019)	15.5% high generalized anxiety (GAD-7 ≥ 10) and also high depression (CES-D ≥ 16)	Higher mRS score[1], younger age[2], severe depressive symptoms[2]
Maaijwee et al. (2016)	16.8% (depressive symptoms) 23% (anxiety)	lower educational level[2,3] and unemployment[2,3], longer observation time[4], history of depression[2], lower age[5], current alcohol use[2]
Tanislav et al. (2015)	10.1% depression	female gender[3], older age[3], arterial hypertension[3], DM[3], hyperlipidemia[3]

GAD-7 – Generalized Anxiety Disorder 7-item; CES-D – Center for Epidemiological Studies Depression Scale; DM – diabetes mellitus
[1] – a consequence of a high GAD-7 score; [2] – associated with a higher risk of generalized anxiety; [3] – associated with a higher risk of depressive symptoms; [4] – associated with a lower risk of depressive symptoms; [5] – associated with a lower risk of generalized anxiety

Discussion

The objective of this scoping review was to assemble the existing knowledge concerning cognitive impairment and emotional disturbances in younger adult patients following IS. This information is of paramount importance for these patients, as they frequently find themselves at a critical juncture in their lives, facing decisions related to family planning and career development. The repercussions of IS can cast a long shadow over their lives, often spanning decades. While there is one published review that addresses a similar topic by Weterings et al. (2023), it delves solely into the realm of cognitive impairment. What sets our review apart is its distinctive approach, since it extends its focus to encompass emotional disorders, an aspect that has yet to be explored in any other published review.

The findings from this review draw attention to the heightened prevalence of cognitive impairment among younger individuals post-IS, with reported rates varying between 39.4% (Huang et al., 2015) and 40% (Pinter et al., 2019). The first study assessed cognitive impairment at three months post-IS and the second study at 5.8 years post-IS. This highlights the fact that cognitive impairment does not only last for a short period of time after overcoming IS, but also persists for longer periods following recovery from IS. However, it is important to emphasize that incidence values were only found in two of the five studies. However, our results support the conclusions of the systematic review and meta-analysis by Weterings et al. (2023), who reported an incidence of cognitive impairment of up to 44%. Another area of focus was risk factors for cognitive impairment. Again, only two studies described these factors (Table 2). These factors should be assessed particularly at discharge and during the recovery period. Their monitoring can be a form of prevention of cognitive impairment and thus its subsequent more serious complications. However, it should be noted that more research examining this issue in younger adults after IS (including from a longitudinal perspective) is needed. Specific areas of CF damage were also found. Overall, the whole spectrum of CF was involved (Table 2). Of particular interest is the assessment of the timing of the actual evaluation of CF in the individual studies. Only one study (Pinter et al., 2019) examined CF at three weeks and then three months after overcoming IS. Other studies looked at this issue from a longitudinal perspective – 10.1 years after overcoming IS (Maaijwee et al., 2014) to 11 years (Synhaeve et al., 2015; Schaapsmeerders et al., 2013). This implies that we can detect in time which specific areas of CF are damaged. At three weeks and then three months after recovery from IS these are: decline in processing speed, flexibility / executive functioning, attention, and global cognitive function. Months after overcoming IS, global cognitive function improves, but nevertheless, one-third of patients have cognitive deficits, mainly in the areas of: flexibility / executive functioning, processing speed, and attention (Pinter et al., 2019). Years after IS, the following CF domains are impaired: working memory, processing speed, global cognitive function (Synhaeve et al., 2015), impairment in immediate and delayed memory (Maaijwee et al., 2014; Schaapsmeerders et al., 2013), attention, and executive functioning (Schaapsmeerders et al., 2013). From the above, it can be deduced that in the long term, CF impairment manifests in many domains. The same claim was made by the authors of a systematic review and meta-analysis (Weterings et al., 2023), who reported that younger adults had cognitive impairment in all CF domains. Based on these results, our recommendation is to regularly assess CF at each patient follow-up, especially during the recovery period, using the mentioned scales (Table 1). These results are also useful in care planning. Impairment of CF has a major impact on adherence to treatment, e.g., memory impairment may lead to patients forgetting to take medication or not being able to pay full attention

to the instructions of the medical regimen. It is important to make sure that the patient understands everything, or it may be appropriate to involve family or close friends in treatment planning. Cognitive impairment also affects the patient's functional status as measured by the IADL and mRS (Synhaeve et al., 2015). At the same time, cognitive impairment affects the younger adult in his or her future family and work life planning, particularly family caregiving and return to work. Our findings could serve as valuable information for clinicians, allowing them to provide more comprehensive insights to young adult patients regarding their post-stroke prognosis. Furthermore, this enhanced understanding of the cognitive profile can contribute to the formulation of more precise neurorehabilitation goals.

The second area covered in this review was emotional disturbances, specifically depression and anxiety. Their incidence is also higher in younger adults after overcoming IS. The incidence of depression ranged from 10.8% (Tanislav et al., 2015) to 16.8% (Maaijwee et al., 2016). The incidence of anxiety ranged from 15.5% (Kapoor et al., 2019) to 23% (Maaijwee et al., 2016). The incidence of depression and anxiety was reported in each of the above studies (Table 3). However, it was not possible to establish the time at which depression and anxiety were assessed following recovery from IS in the two studies (Kapoor et al., 2019; Tanislav et al., 2015). The time of assessment was only found in one study, by Maaijwee et al. (2016). In this study, the assessment was made 10.6 years following recovery from IS (the incidence of depression and anxiety at this time was 16.8% and 23%, respectively). From this, we can declare that the incidence of depression and anxiety also remained high even at longer periods following recovery from IS. For this reason, it is also advisable to continuously assess these two phenomena both in the post-IS period and in the recovery period using the mentioned scales (Table 1). The early detection of these problems can help the patient avoid major complications. Another area our review focused on was risk factors for emotional disorders (Table 3). It is important to stress that these factors should be kept in mind when contacting the patient and planning further care. With a thorough assessment of risk factors, we can prevent the occurrence of depression and anxiety in younger adults who have overcome IS.

This overview has several limitations. The first is the use of different scales to assess CF, depression, and anxiety. Furthermore, studies from different time points following recovery from IS were used. The included studies also came from different countries with different levels of care for patients with IS.

Conclusion

This review addressed the issue of cognitive impairment and emotional disturbance in younger adult patients after IS. The included studies highlighted the need to assess these issues not only at the time of patient discharge but more importantly at the time of further recovery. The outcomes of our review hold the potential to offer a more profound understanding of this matter, shedding light on the complexities involved. This knowledge, in turn, could pave the way for tailored interventions to address the unique needs of these patients. Additional prospective investigations and comprehensive reviews focusing on this subject matter are essential for further advancements.

Ethical aspects and conflict of interest

We are not aware of any conflict of interest relating to this article.

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Author contributions

Conception and design (EG, LŠ), data analysis and interpretation (LŠ, EG), manuscript draft (LŠ), critical revision of the manuscript (LŠ, EG, DŠ), final approval of the manuscript (LŠ, EG).

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