Low Cardiac Output And Brain Function In The Prognosis Of Adult Patients With Heart Failure

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KEYWORDS

Heart failure, cardiac output, cognitive dysfunction, memory disorders

ABSTRACT

Objective: Synthesize the best evidence from the literature describing the relationship between low expenditure and brain function in the prognosis of adult patients with heart failure.
Methods: Descriptive integrative review, which performed a search in limited databases from 2009 to 2019, using MeSH and DeCS terms, such as Heart Failure, cardiac output, cognitive dysfunction, memory disorders in the analysis of 20 articles found.
Results: It was identified that there is evidence that patients with heart failure suffer from prevalent mental disorders associated with numerous processes, including attention and learning deficits, decreased psychomotor speed, memory dysfunction, difficulties in solving problems and decreased executive function which worsens the prognosis because it is associated with poor adherence to treatment and lower quality of life
Conclusion: In heart failure, cognitive resources decrease and cognitive demands increase, therefore, nursing must establish strategies for promotion and prevention, timely detection that comprehensively address the patient, aiming to improve self-care, in order to control medication, therapeutic regimens. and dietary, to ensure adherence to treatment and thus improve the quality of life of the patient and his family.

1. Introduction

Heart failure (HF) has been recognized as a growing pathology for more than two thousand years, and its evolution has been different compared to other cardiovascular diseases, such as ischemic heart disease and high blood pressure. This condition has a widespread impact on bodily functions, affecting vital organs and generating what is called cardiocerebral syndrome(1).

This is a systemic disease with serious implications for bodily functions, the brain among other vital organs, often suffers injuries as a result of insufficiency and functional and anatomical brain abnormalities have been found in the population with this pathology (2). The reduction of cardiac output and the high burden of cardiovascular risk factors are the predominant explanations for these findings, there are data that show the participation of neurohormonal, nutritional and inflammatory mechanisms in this complex process (3).

Patients with severe heart failure have decreased cerebral blood flow, leading to cerebral hypoperfusion and brain cognitive changes (4). It was found that cognitive dysfunction is present in patients suffering from a variety of cardiovascular disorders, in addition, it is shown that patients with this condition present cognitive alterations such as memory loss and attention deficit, which are related to a worse clinical prognosis. Cognitive symptoms not only indicate more advanced heart disease, but are also associated with poor adherence to treatment, lower quality of life, and higher mortality(5).

In relation to this, it is important to recognize from the diagnosis the patients with greater brain problems, who can benefit from timely treatment and that nursing care and interventions can be directed towards a more efficient management of patients with this pathology(6). Currently, one of the

greatest concerns worldwide is cardiovascular pathologies due to their high prevalence registered in recent years and the costs they imply for the health sector that frequently lead to repeated hospitalizations, poor quality of life and deterioration of functional capacity due to the severity of the pathology together with a lower life expectancy in patients who suffer from it (7).

2. Methodology

An integrative review of the literature was carried out following the methodology described by Grove and grey (8)), to describe the relationship between low cardiac output and brain function; The steps followed in this review were summarized and have four dimensions: preparing the literature review, conducting a search, processing literature, and writing the literature review.

The exhaustive search of scientific articles was carried out in the Pubmed, ScienceDirect, Clinical Key and Scielo databases using the following Mesh terms: heart failure, chronic heart failure, low cardiac output, brain injury, cognitive dysfunction, memory disorders and DeCS: heart failure, cardiac output, cognitive dysfunction, memory disorders, the Boolean operators AND and OR. Studies and publications were included such as; systematic reviews or meta-analyses, randomized clinical trials, cross-sectional case-control studies; published between January 1, 2009 and 2019 in Spanish and English and carried out in adult patients.

For the critique of the quality of the scientific literature, the STROBE statement (strengthening the reporting of observational studies in epidemiology) was used (9) for cohort, case-control, and cross-sectional study designs and the PRISMA statement (Preferred Reporting Ítems for Systematic Reviews and Meta-Analyses) (10), for the assessment of systematic reviews. The level of evidence was determined with the OXFORD tool.

3. Result and Discussion

Heart failure (HF) has been recognized as a growing pathology for more than two thousand years, and its evolution has been different compared to other cardiovascular diseases, such as ischemic heart disease and high blood pressure. This condition has a widespread impact on bodily functions, affecting vital organs and generating what is called cardiocerebral syndrome. The initial strategies of the search identified 66,351 references, related to each equation proposed, of these 10 were duplicated, 6,680 remained, to which filters were applied and submitted to the exclusion and inclusion criteria, resulting in 561, a study was carried out by title and critical reading, leaving a total of 20 articles for final review in full text. as evidenced in the flow chart, after including the information in this matrix, Pubmed database stands out with the largest number of articles on the existing between low cardiac output and brain function; Regarding the types of studies, eight systematic reviews, three comparative articles, three controlled clinical trials, two cohort studies, one longitudinal study, two descriptive studies, and one cross-sectional analysis were obtained, which support the object of this study

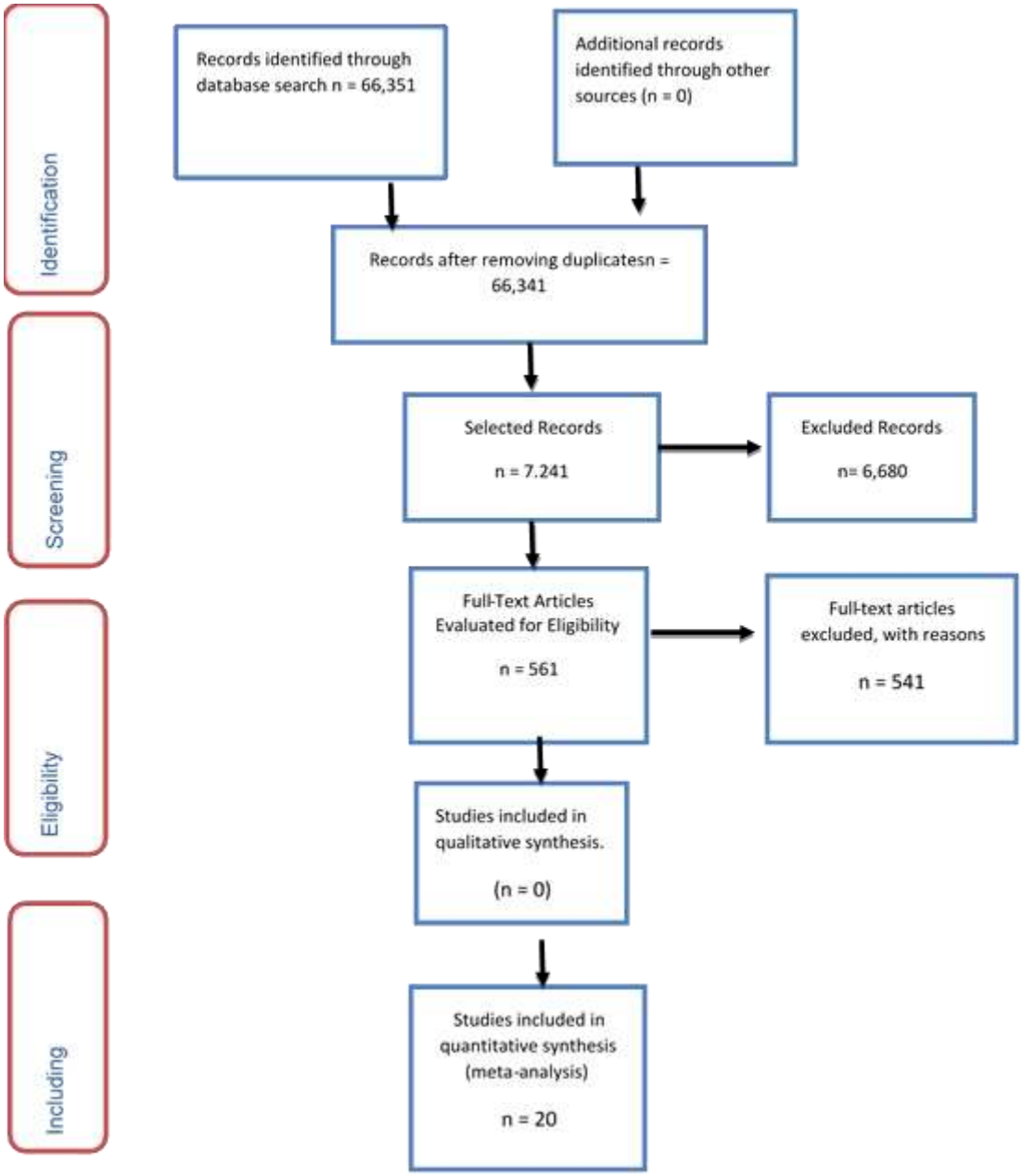

Figure 1. Flowchart

Source: own elaboration .

Characteristics of the studies found

The country in which the most publications were found was the United States, the language that predominated in the publications was English since it is a universal language that together with French and German have reached their international diffusion as carriers of the main scientific advances in medicine. The analysis of the levels of evidence and degree of recommendation was used using the OXFORD tool in the items that declare; treatment, prevention, etiology and harm, which are cataloged between recommendation grade A and evidence level 1a and the lowest article are in c and recommendation grade 4, within the evaluation of the level of evidence 9 articles were found with evidence A and recommendation grade 1a and 1c, and the others are in B and recommendation grade 2a. Table 1 lists the results by article.

Relationship between low cardiac output and brain function

The authors' synthesis agrees that there is evidence that patients with heart failure suffer from prevalent mental disorders associated with numerous processes, including attention and learning deficits,

decreased psychomotor speed, memory dysfunctions, difficulties in problem solving and decreased executive function, this is because they develop cognitive deficits as the disease evolves. Probably associated with a reduction in cerebral blood flow caused by low cardiac output, which alters the source of oxygen and nutrients in the brain (11), as well as with the presence of multiple microemboli of cardiac origin that produce areas of cerebral infarction, additionally most authors state in their studies that in patients with congestive heart failure, it is observed that the presence of cognitive alterations is directly associated with elevation of right atrial pressure and decrease in ejection volume, Supporting the theory that cognitive deficit in patients with congestive heart failure is caused by failures in the brain autoregulation mechanisms that maintain cerebral blood flow, producing severe hypoperfusion and hypoxia (12)

On the other hand, it was found that the predominant lesion in these studies is brain atrophy, white matter lesions, and cerebral infarctions associated with greater cognitive impairment. The risk of cognitive deficit in patients with congestive heart failure increases with age, affecting patients over 70 years of age more frequently, however, studies were found in which it is shown that these alterations are not exclusive to senile patients, in some studies, a high frequency of cognitive alterations was found (50%) in relatively young patients between 35 and 45 years of age with heart failure(13).

Such disability may interfere with the prognosis and control of the disease because the treatment and monitoring of heart failure require a high degree of understanding, self-management and compliance with treatment recommendations; therefore, it increases the risk of mortality from 3 years to 1 year. The presence of cognitive alterations has a direct impact on the quality of life of patients with congestive heart failure as it is associated with decreased self-care, reduced independence from carrying out daily activities and worsening of clinical symptoms(14)

According to the above, it was evidenced that hospitalizations for congestive heart failure are associated with lack of adherence to treatment. Because cognitive deficit has a significant impact on the patient's ability to understand and adhere to their therapeutic regimen, a greater understanding of these alterations may be reflected in the development of more cost-effective therapeutic strategies for these patients(15).

Table 1. Distribution of reviewed articles according to the methodology used

TITLE/ TYPE OF STUDY	AUTHOR	OBJECTIVES	RESULTS	LEVEL OF EVIDENCE
Heart failure: induced brain injury. Systematic review	Havakuk O, King KS, Grazette L, Yoon AJ, Fong M, Bregman N, Elkayam U, Kloner RA./2016	To review the pathophysiology of brain damage in HF, and to describe its effect on the evolution of patients, offering a diagnostic approach and analyzing possible therapeutic options.	It was found that the prevalent mental alterations associated with HF include numerous processes, including attention and learning impairments; decreased psychomotor speed.	1A
Heart and brain interconnection on: clinical implications of changes in brain function during heart Systematic review	Kim MS, Kim JJ 2014	Describe the effects of the brain on the progression of heart failure	Cognitive impairment from stroke or hypoperfusion is associated with adverse outcomes, including death.	1C
Cardiac output as a potential risk facto for abnormal brain aging Systematic review	Jefferson Alzhéimer Dis 2010	Summarize more recent data suggesting that subtle heart dysfunction or low normal levels of heart function.	It suggests that reduced cardiac output may be a risk factor for Alzheimer's disease and abnormal brain aging through the spread or exacerbation of neurovascular processes.	1B
Heart Failure and Cognitive Function in the General PopulationComparative Study	van den Hurk K, Reijmer YD, van den Berg E, Alssema M, Nijpels G, Kostense PJ, Stehouwer CD, 2011	Examine whether reduced cognitive functioning can be observed in the early stages of left ventricular dysfunction and heart failure.	Poorer cognitive functioning can already be seen in the early stages of heart failure dysfunction.	2a
Hippocampal Blood Flow Abnormality	Suzuki H, Matsumoto Y, Ota H, Sugimura K,	To review by clinical trial whether abnormality of hippocampal blood flow is	It was evidenced that abnormalities of the	1a

Associated with Depressive Symptoms and Cognitive Impairment in Patients with Heart FailureClinical Trial	Takahashi J, Ito K, Miyata S, Furukawa K, Arai H, Fukumoto Y, Taki Y, Shimokawa H2016	associated with depressive symptoms and cognitive impairment in patients with chronic heart failure	hippocampus are associated with depressive symptoms and cognitive impairment in patients with heart failure	
Design and rationale for cognitive intervention to improve memory in patients with heart failure **Randomized controlled trial**	Pressler SJ, Giordani B, Titler M, Gradus-Pizlo I, Smith D, Dorsey SG, Gao S, Jung M. 2018	To assess the efficacy of computerised cognitive training intervention using BrainHQ to improve primary outcomes of memory and neurotrophic factor levels.	This research will provide new insights into the efficacy of BrainHQ in improving memory and increasing serum levels of brain-derived neurotrophic factor in heart failure	1a
Usefulness of Cognitive Dysfunction in Heart Failure to Predict Cardiovascular Risk at 180 DaysObservational Cohort Clinical Study	Gelow, jill m.Mudd, james o.Chien, christopher v.Lee, christopher s.	to determine the influence of cognitive dysfunction, identified using the Montreal Cognitive Assessment (MoCA), on 180-day cardiovascular events	In conclusion, in HF patients, cognitive dysfunction identified with a MoCA score <26 is associated with an increased risk of cardiovascular events at 180 days.	2nd
Structural Alterations of the Brain in Heart Failure: A Review of the Literature **Systematic Review**	Alosco ML, Hayes SM 2015	Review structural MRI studies in people with heart failure.	The hypothesis that HF may contribute to Alzheimer's risk through widespread structural brain changes is supported.	1a
Cognition in heart failure: an overview of the concepts and their measures. **Systematic review**	Bauer LC, Johnson JK, Pozehl BJ2011	Review of research articles to determine cognitive decline and explore current measurement issues faced by nurses caring for people with heart failure.	Cognitive decline is common among people with heart failure. Disability frequently involves one or more domains, including attention, memory, and executive function.	3a
Cognitive status in hospitalized patients with acute decompensated heart failureClinical study	Levin SN, Hajduk AM, McManus DD, Darling CE, Gurwitz JH, Spencer FA, Goldberg RJ, Saczynski JS.2014	To assess cognitive decline in 3 domains (memory, processing speed, executive function) using standardized measures.	Impairments in executive function, processing speed, and memory are common among patients hospitalized for HF. .	1a
The Influence of Heart Failure on Longitudinal Changes in Cognition Among Individuals 80 Years of Age and OlderA prospective longitudinal design.	Hjelm C, Dahl A, Broström A, Mårtensson J, Johansson B, Strömberg A.2012	The aim of this study was to examine the relationship between heart failure and specific cognitive abilities	People diagnosed with heart failure scored significantly lower in spatial skills and memory.	4
Reduction of regional cerebral cortical thickness in patients with heart failure. Comparative study	Kumar R, Yadav SK, Palomares JA, Park B, Joshi SH, Ogren JA, Macey PM, Fonarow GC, Harper RM, Woo MA2015	Objective: To evaluate regional cortical thickness across the brain in HF, compared to control subjects.	Pathological mechanisms that contribute to reduced cortical thickness include hypoxia/ischemia, accompanied by brain perfusion altered by reduced cardiac output and other comorbidities in heart failure.	4
Regional damage of the hippocampus in heart failure. Comparative study	Woo MA, Ogren JA, Abouzeid CM, Macey PM, Sairafian KG, Saharan PS, Thompson	To assess regional volume loss in hippocampus in patients with heart failure (HF)	The hippocampus shows a regional reduction in heart failure volume, which may contribute to short-term memory loss and depression associated with the condition.	4
Cognitive Impairment, Symptoms of Depression, and Health-Related Quality of Life in Patients With Severe Stable Heart FailureObservational Descriptive Study	Joanna M. Moryś ,Maria Pąchalska , Jerzy Bellwon , Marcin Gruchała2016	To assess the relationship between quality of life, severity of depressive disorders and memory impairment, as well as some aspects of executive functions in people with heart failure	Memory deficits are the most common, followed by psychomotor decline, decreased visual ability and executive function that impacts the quality of life of patients with heart failure.	4
Impaired Heart Function and Cognitive Brain AgingSystematic	Isabelle F. van der Velpen ,Clyde W. Yancy , Farzaneh A. Sorond ,	Describe emerging scientific evidence on the importance of the heart-brain link in patients with cognitive impairment	It was found in scientific evidence that the importance of the heart-brain link requires a comprehensive assessment of cardiovascular risk in patients	1A

Review			with cognitive impairment and neurocognitive status	
Heart Failure and Cognitive DysfunctionSystematic Review	James Ampadu, John A. Morley2015	Analyze in some studies the factors that influence the occurrence of cognitive impairment in recently hospitalized patients with heart failure and patients with advanced left systolic dysfunction	Cognitive declines seen in heart failure include declines in memory, executive functioning, attention, language, and psychomotor speed	1A
Prevalence of depression in the cohort of patients in a chronic heart failure unit Clinical cohort study	Patricia Muñiz Prechac*, Pablo Álvarez Rocha, Anaulina Silveira, Gabriela Ormaechea, Gabriela Silvera Pérez	To determine the prevalence of depression in the follow-up cohort and to analyze the possible association of depression with clinical and paraclinical variables NYHA functional class (CFNYHA) and left ventricular ejection fraction (LVEF).	The presence of depression identifies a group of patients with a worse prognosis of HF severity, such as CFNYHA or LVEF.	2b
Cognitive impairment and 30-day rehospitalization rate in patients with acute heart failure: **a systematic review and meta-analysis**	Jakrin Kewcharoen, Angkawipa Trongtorsak, Chanavuth Kanitsoraphan, Narut	To assess the association between cognitive impairment and 30-day rehospitalization in patients with heart failure.	The meta-analysis demonstrated that the presence of cognitive impairment is associated with 30-day rehospitalization in patients with heart failure.	1a
Chronic heart failure with memory and attention dysfunctionClinical trial	Susan J. Pressler PhD, RN Miyeon JungPhD, RN2018.	To provide the best substantial evidence on chronic heart failure with cognitive dysfunction and brain changes.	Patients with chronic heart failure experience memory and attention dysfunction, and this dysfunction is associated with brain changes, including medial temporal lobe atrophy and mortality.	1a
Prevalence of Cognitive Impairment in Older Adults with Heart Failure Cross-Sectional Analysis	Tanya R. Gure Caroline S. Blaum MD, MS Bruno Giordani PhD Dr. Todd M. 2012	To determine the prevalence of cognitive impairment in older adults with heart failure (HF).	Cognitive decline is common in older adults with heart failure and is associated with dementia risk.	4

Source: Authors.

Discussion

In reference to the results obtained, the following findings from the reviewed articles stand out, Riley and Arslanian-Engoren in their review state that the mechanism of brain damage in heart failure is multifactorial and is not yet well understood, because numerous data indicate that patients with heart failure can suffer from brain dysfunction. since the brain structures are irrigated by the middle and posterior cerebral artery, therefore they are exposed to decreased blood flow, this causes ischemic aggression, by cerebral hypoperfusion as usually happens in states of decreased cardiac output.

On the other hand, Hjelm mentions that the effects of heart failure are systemic, and that many therapeutic targets focus on cardiac dysfunction, without taking into account that the brain is closely related to the heart, but there are few reports on the relationship between these organs, and previous studies on altered brain metabolism and reduced cerebral blood flow during heart failure demonstrate that there are clinical implications of such conditions in terms of predicting prognosis such as cognitive impairment, stroke and hypoperfusion (43).

Jefferson A" states that systemic hypoperfusion disrupts brain perfusion, contributing to clinical brain injury and suggests that reduced cardiac output may be a risk factor for Alzheimer's disease (AD) and abnormal brain aging through the spread or exacerbation of neurovascular processes, microembolism due to thrombosis, and neuropathological processes (44). According to Mene-Afejoku, several factors have been attributed to the high readmission and mortality rates of patients with heart failure, among which are: poor adherence to therapy, inability to keep up with clinical appointments that may be the result of cognitive impairment. This is why the links between heart failure and cognitive decline are documented; as a prognostic consequence that complicates heart failure (45).

On the other hand, Shajduk and Mamcmanus, in their study, demonstrate that cognitive impairment is highly prevalent in patients with heart failure and is associated with adverse outcomes, particularly in specific cognitive abilities such as memory, processing speed, and the ability to do some executive

activities (46) Bauer and Jpozehl state that it is imperative that clinicians are aware of cognitive impairment and its implications for their patients with heart failure. heart failure, as cognitive impairment probably contributes to a decrease in the ability to care for and understand the disease (47).

Nurse Pressler in her research on chronic heart failure with memory and attention dysfunction shows that there are some types of cognitive dysfunction and that it is most frequently found in memory domains, both verbal and visual memory, working memory, attention, processing speed and executive function, the dysfunction varies from mild to severe (48).

For this reason, it is considered that older patients with heart failure have an increased risk of cognitive dysfunction and memory loss, in addition to structural and functional changes of the brain as a result of inadequate cerebral perfusion associated with low cardiac output and cerebral microembolisms, these are the most likely mechanisms of cognitive dysfunction in heart failure. In this way, it could be said that heart failure is directly related to cognitive damage supported by research from the authors stated in this review.

Application For Nursing

The disciplinary relevance of the research lies in showing a different vision of the care given to patients with heart failure, since this study addresses a clinical problem that generates findings for application in nursing practice. Knowing the lesions that cause injury to the brain in patients with heart failure gives us a broader perspective to intervene in this pathology based on scientific evidence. In heart failure, cognitive resources decrease and cognitive demands increase, therefore nursing must establish strategies for promotion and prevention, timely detection that address the patient in a comprehensive way, tending to improve self-care, in order to control medication, therapeutic and dietary regimens, ensure adherence to treatment and thus improve the quality of life of the patient and their family. In addition, training and supervision programs should be promoted to help improve and understand the mechanisms of this syndrome. These actions reduce morbidity and mortality, as well as reduce healthcare and hospital costs.

It is recommended that we increase management strategies that help nurses to identify patients with brain problems suffering from heart failure in a timely manner, and that evidence-based research should be developed to provide the best evidence-based care in the treatment of patients with this condition. and engage patients, family caregivers, and providers about the variety of assessment and treatment options available to manage memory dysfunction, attention, and brain changes.

Based on what has been found in the literature, the association between brain function and heart failure is not entirely clear, therefore, future studies should focus on the search for the pathophysiological mechanisms of the relationship between cognitive impairment and congestive heart failure, in order to formulate effective interventions that reduce the complications derived from these conditions. in addition to promotion programs that nurses would lead for patients with heart failure at risk, where deterioration and dementia could be prevented.

4. Conclusion and future scope

After having carried out a thorough investigation of each of the articles, it is evident that the authors respond to the objective of this work where a correlation was found between low cardiac output and brain function in the prognosis of adult patients with heart failure. According to the studies identified and depending on the types of research, it is concluded that cognitive impairment in patients with heart failure can be associated with a decrease in cardiac output, which alters the source of oxygen and nutrients in the brain and the appearance of cognitive alterations has a direct impact on the decrease in quality of life and self-care. Added to this is the greater consumption of medical resources, the increase in mortality and frequent hospitalizations. A greater understanding of the dynamics of cognitive impairment and its relationship with the degree of heart failure and the brain areas involved can help clarify the underlying mechanisms and open paths to improve the treatment of this pathology and

improve comorbidity.

Note: In this work there are no conflicts of interest with any funding entity; the general objective of this research is to determine which are the psychosocial factors that affect the mental health of older adults, with the purpose of providing knowledge to improve the intervention and care of this population.

Reference

[1] Ruiz K. DAÑO CEREBRAL INDUCIDO POR INSUFICIENCIA CARDIACA – Cardio HMC [Internet]. Cardio HMC. 2017 [cited 2019 Jun 8]. Available from: http://cardiohmc.com.ar/archivos/3564

[2] Doehner W, Ural D, Haeusler KG, Čelutkienė J, Bestetti R, Cavusoglu Y, et al. Heart and brain interaction in patients with heart failure: overview and proposal for a taxonomy. A position paper from the Study Group on Heart and Brain Interaction of the Heart Failure Association. Eur J Heart Fail [Internet]. 2018 Feb 1 [cited 2019 Apr 27]; 20(2):199–215. Available from: http://onlinelibrary.wiley.com/journal/10.1002/(ISSN)1879-0844%0Ahttp://ovidsp.ovid.com/ovidweb.cgi? T=JS&PAGE=reference&D=emexb&NEWS=N&AN=619959845

[3] Naveiro-Rilo JC, Diez-Juárez M. D, Flores-Zurutuza L, Rodríguez-García MÁ, Rebollo-Gutiérrez F, Romero Blanco A. Quality of life in patients with heart failure: a view from primary health care. Gac Sanit [Internet]. 2012 Sep [cited 2019 Jun 10]; 26(5):436–43. Available from: https://linkinghub.elsevier.com/retrieve/pii/S021391111200009X

[4] Kim MS, Kim JJ. Heart and brain interconnection - Clinical implications of changes in brain function during heart failure. Circ J. 2015; 79(5):942–7.

[5] Havakuk O, King KS, Grazette L, Yoon AJ, Fong M, Bregman N, et al. Heart Failure-Induced Brain Injury. Vol. 69, Journal of the American College of Cardiology. Elsevier USA; 2017. p. 1609–16.

[6] Kim M-SS, Kim J-JJ. No Title. Circ J [Internet]. 2015 [cited 2019 May 9]; 79(5):942–7. Available from: http://www.ncbi.nlm.nih.gov/pubmed/25891994

[7] Colombian Society of Cardiology. SL, Dueñas RE, Gómez JC, García RG. Colombian Journal of Cardiology: official organ of the Colombian Society of Cardiology. [Internet]. Vol. 16, Colombian Journal of Cardiology. Colombian Society of Cardiology; 2009 [cited 2019 May 8]. 249–255 p. Available from: http://www.scielo.org.co/scielo.php?script=sci_arttext&pid=S0120-56332009000600004

[8] Suzuki H, Matsumoto Y, Ota H, Sugimura K, Takahashi J, Ito K, et al. Hippocampal blood flow abnormality associated with depressive symptoms and cognitive impairment in patients with chronic heart failure. Circ J. 2016; 80(8):1773–80.

[9] Correa-Serna LPedraza J. Disaster Emergency Care, [Internet]. 2009 [cited 2019 May 22]. Available from: https://www.minsalud.gov.co/Documentos and Publications/Guidelines for Emergency Management -Volume III.pdf

[10] Ruiz SL, Dueñas RE, Gómez JC, García RG. Determining factors of cognitive deficit in congestive heart failure. Rev Colomb Cardiol November/December [Internet]. 2009 [cited 2019 Apr 25]; 16(6). Available from: http://www.scielo.org.co/pdf/rcca/v16n6/v16n6a4.pdf

[11] Pauline Anderson. Heart function is related to brain function [Internet]. 2017 [cited 2020 Jan 6]. Available from: https://espanol.medscape.com/verarticulo/5902081

[12] González RRM. National Association of Cardiologists of Mexico, Nursing Chapter "20 years is nothing.....". [Internet]. 2011 [cited 2020 Jan 6]. Available from: https://www.medigraphic.com/cgi-bin/new/resumen.cgi?IDARTICULO=28022

[13] Nieminen MS, Böhm M, Cowie MR, Drexler H, Philippates GS, Jondeau G, et al. Clinical Practice Guidelines on the diagnosis and treatment of acute heart failure. Short version. Rev Española Cardiol [Internet]. 2005 Apr 1 [cited 2019 Jun 11]; 58(4):389–429. Available from: https://linkinghub.elsevier.com/retrieve/pii/S030089320573918X

[14] Flickr: C.C. Dave McLear. Heart Failure: Colombia Has a Novel Drug to Treat Heart Failure | Healthy | Caracol Radio [Internet]. 10/07/2017. [cited 2019 Jun 9]. Available from: https://caracol.com.co/programa/2017/07/10/sanamente/1499721979_703710.html

[15] Ciapponi A, Alcaraz A, Calderón M, Matta MG, Chaparro M, Soto N, et al. Disease burden of heart failure in Latin

America: systematic review and meta-analysis. Rev Española Cardiol [Internet]. 2016 Nov 1 [cited 2019 May 8]; 69(11):1051–60. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0300893216302469

[16] Almeida OP, Garrido GJ, Beer C, Lautenschlager NT, Arnolda L, Flicker L. Cognitive and brain changes associated with ischaemic heart disease and heart failure. Eur Heart J [Internet]. 2012 Jul 1 [cited 2019 Jun 8]; 33(14):1769–76. Available from: https://academic.oup.com/eurheartj/article-lookup/doi/10.1093/eurheartj/ehr467

[17] Ruiz K. Heart Failure-Induced Brain Damage [Internet]. Heart Failure-Induced Brain Damage. 2017 [cited 2019 Jun 8]. Available from: http://cardiohmc.com.ar/archivos/3564

[18] Ortiz lidia garcia/leticia cacique-casique. Nursing Process in Congestive Heart Failure Based on Self-Care Deficit.

[19] Pujalte Aznar Ma Faz, Ma Angeles Casillas Jiménez Ma Angeles FFC. Implementation of the Nursing consultation in cardiac rehabilitation, use of care planning and diagnostic taxonomy. 3er Cuatrimestre 2011, Vol 9, No 21. 2011;

[20] Ramírez O, Gámez A, ... AG-A in, 2011 undefined. A current look at patient safety culture. revistas.unal.edu.co [Internet]. [cited 2019 Oct 3]; Available from: https://revistas.unal.edu.co/index.php/avenferm/article/view/35831

[21] Vélez Peláez S, Navarrete Hurtado S, Gómez López EA, Bermúdez Echeverry JJ, Gómez Echeverri CA, Restrepo Jaramillo CA, et al. CHAPTER VIII HEART FAILURE Pathophysiology of heart failure Classification and diagnosis of heart failure Pharmacological treatment of heart failure Acute heart failure Cardiac resynchronization therapy Mechanical circulatory assist devices Surgical treatment of heart failure Transplantation cell phone in heart failure [Internet]. [cited 2019 Jun 8]. Available from: http://scc.org.co/wp-content/uploads/2012/08/capitulo8.pdf

[22] Shatil E, Mikulecká J, Bellotti F, Bureš V. Novel Television-Based Cognitive Training Improves Working Memory and Executive Function. Paterson K, editor. PLoS One [Internet]. 2014 Jul 3 [cited 2019 Jun 8]; 9(7):e101472. Available from: http://dx.plos.org/10.1371/journal.pone.0101472

[23] Cardio-Alianza Journal. Heart Failure: What It Is, Causes, Symptoms & Treatment | Cardioalianza [Internet]. 2019 [cited 2020 Jan 6]. Available from: https://cardioalianza.org/las-enfermedades-cardiovasculares/insuficiencia-cardiaca/

[24] Jiménez Gómez. "The work of the nurse before the patient with heart failure" - Diario Dicen [Internet]. 2014 [cited 2020 Jan 6]. Available from: https://www.enfermeria21.com/diario-dicen/la-labor-de-la-enfermera-ante-el-paciente-con-insuficiencia-cardiaca-DDIMPORT-027805/

[25] Kim M, circulation JK-D de, 2015 undefined. Interconnection of the Heart and Brain - Clinical Implications of Changes in Brain Function During Heart Failure -. jstage.jst.go.jp [Internet]. [cited 2019 Apr 25]; Available from: https://www.jstage.jst.go.jp/article/circj/advpub/0/advpub_CJ-15-0360/_article/-char/ja/

[26] Vogels RLC, Scheltens P, Schroeder-Tanka JM, Weinstein HC. Cognitive impairment in heart failure: A systematic review of the literature. Eur J Heart Fail [Internet]. 2007 May 1 [cited 2019 Apr 25]; 9(5):440–9. Available from: http://doi.wiley.com/10.1016/j.ejheart.2006.11.001

[27] Tuma, J. M., & Pratt, J. M. (1982). Clinical child psychology practice and training: A survey. \ldots of Clinical Child & Adolescent Psychology, 137(August 2012) 37–41. http://doi.org/10.1037/a0022390, Gobry, F. (1999). {T}his is a title. {M}y Journal, 1 120–130., Osment SE (1980). TA of R 1250-1550. … and RH of LM and R…. R from http://scholar. google. com/scholar?hl=en&btnG=Search&q=intitle:THE+AGE+OF+REFORM+125.-1550#2%5Cnhttp://scholar. google. com/scholar?hl=en&btnG=S., Caprara, G., & Fida, R. (2008). Longitudinal analysis of the role of perceived self-efficacy for self-regulated learning in academic continuance and achievement. … of Educational …, 100(3) 525–534. http://doi.org/10.1037/0022-0663.100.3.525, Shanker, S. (2003). Philosophy of science logic and mathematics in the twentieth century. … PL and NYR http://doi. org/10. 4324/978020302947., Marenbon J (1998). RH of PI… PL and NYR http://doi. org/10. 4324/978020306227., et al. Theory-Ladenness and Scientific Instruments in Experimentation. In: The Philosophy of Scientific Experimentation. 2003.

[28] Havakuk O, King KS, Grazette L, Yoon AJ, Fong M, Bregman N, et al. Heart Failure-Induced Brain Injury. J Am Coll Cardiol [Internet]. 2017 Mar 28 [cited 2019 Apr 25]; 69(12):1609–16. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0735109717302899

[29] Senior J. Colombian guidelines on the assessment and management of chronic adult heart failure View project. 2009 [cited 2019 Jun 8]; Available from: https://www.researchgate.net/publication/255635921

[30] Doehner W, Ural D, Haeusler KG, Čelutkienė J, Bestetti R, Cavusoglu Y, et al. Heart and brain interaction in patients with heart failure: overview and proposal for a taxonomy. A position paper from the Study Group on Heart and Brain

Interaction of the Heart Failure Association. Eur J Heart Fail. 2018 Feb 1; 20(2):199–215.

[31] Von Elm E, Altman DG, Egger M, Pocock SJ, Peter /, Go C, et al. ARTÍCULO ESPECIAL Declaración de la Iniciativa STROBE (Strengthening the Reporting of Observational studies in Epidemiology): directrices para la comunicación de estudios observacionales (The Strengthening the Reporting of Observational Studies in Epidemiology [STROBE] statement: guidelines for reporting observational studies) [Internet]. Vol. 22, Gac Sanit. 2008 [cited 2020 Jan 5]. Available from: http://www.epidem.com/

[32] Urrú Tia G, Bonfill X. PRISMA Statement: A Proposal to Improve the Publication of Systematic Reviews and Meta-Analyses. Med Clin [Internet]. 2010 [cited 2020 Jan 6]; 135(11):507–11. Available from: www.elsevier.es/medicinaclinicahttp://www.elsevier.esel22/02/2011.Copy for personal use, it is forbidden to transmit this document by any means or format.

[33] Manterola D C, Zavando M D. How to interpret the "Levels of Evidence" in the different clinical scenarios. Rev Chil Cir. 2009; 61(6):582–95. of Health M. RESOLUTION NUMBER 8430 OF 1993 . 1993.

[34] Manterola C, Asenjo-Lobos C, Otzen T. Hierarchy of evidence: Levels of evidence and degrees of recommendation for current use. Vol. 31, Chilean Journal of Infectology: official organ of the Chilean Society of Infectology. 2014. p. 705–18.

[35] Qiu C, Winblad B, Marengoni A, Klarin I, Fastbom J, Fratiglioni L. Heart failure and risk of dementia and Alzheimer disease: A population-based cohort study. Arch Intern Med. 2006 May 8; 166(9):1003–8.

[36] Pressler SJ, Jung M. Chronic Heart Failure With Memory and Attention Dysfunction: Old Problem, Thinking Anew ∗. Vol. 6, JACC: Heart Failure. Elsevier Inc.; 2018. p. 593–5.

[37] Hooghiemstra AM, Bertens AS, Leeuwis AE, Bron EE, Bots ML, Brunner-La Rocca HP, et al. The Missing Link in the Pathophysiology of Vascular Cognitive Impairment: Design of the Heart-Brain Study. Cerebrovasc Dis Extra. 2017 Oct 2; 7(3):140–52.

[38] Valdés King M, Alberto González Cáceres J, Salisu Abdulkadir M. Prevalence of depression and risk factors associated to cognitive impairment in elderly [Internet]. Vol. 33, Revista Cubana de Medicina General Integral. 2017 [cited 2020 Jan 6]. Available from: http://scielo.sld.cu

[39] Levin S, Hajduk A, McManus D, … CD-A heart, 2014 undefined. Cognitive status in patients hospitalized with acute decompensated heart failure. Elsevier [Internet]. [cited 2020 Jan 6]; Available from: https://www.sciencedirect.com/science/article/pii/S000287031400547X

[40] Cline CM, Björck-Linné AK, Israelsson BY, Willenheimer RB, Erhardt LR. Non-compliance and knowledge of prescribed medication in elderly patients with heart failure. Eur J Heart Fail [Internet]. 1999 Jun [cited 2020 Jan 6]; 1(2):145–9. Available from: http://www.ncbi.nlm.nih.gov/pubmed/10937924

[41] Kumar R, Yadav SK, Palomares JA, Park B, Joshi SH, Ogren JA, et al. Reduced regional brain cortical thickness in patients with heart failure. PLoS One. 2015 May 11; 10(5).

[42] Riley PL, Arslanian-Engoren C. Cognitive dysfunction and self-care decision making in chronic heart failure: A review of the literature. Vol. 12, European Journal of Cardiovascular Nursing. 2013. p. 505–11.

[43] Amaral JJ, Santos D, Erwin J, Plewka A, Roberto P, Brofman S. "Cardiac output as a potential risk factor for abnormal brain aging.

[44] Mene-Afejuku TOPMIUNCSMSVFPG. Heart Failure and Cognitive Impairment: Clinical Relevance and Therapeutic Considerations. 2019; 291–303.

[45] Moryś JM, Pąchalska M, Bellwon J, Gruchała M. Cognitive impairment, symptoms of depression, and health-related quality of life in patients with severe stable heart failure. Int J Clin Heal Psychol. 2015 Sep 15; 16(3):230–8.

[46] Bauer LC, Johnson JK, Pozehl BJ. Cognition in heart failure: An overview of the concepts and their measures. J Am Acad Nurse Pract. 2011 Nov; 23(11):577–85.

[47] Gallagher R, Sullivan A, Burke R, Hales S, Gillies G, Cameron J, et al. Mild Cognitive Impairment, Screening, and Patient Perceptions in Heart Failure Patients. J Card Fail [Internet]. 2013 Sep 1 [cited 2019 Apr 25]; 19(9):641–6. Available from: https://www.sciencedirect.com/science/article/abs/pii/S107191641300568X