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EXPLORING THE BIDIRECTIONAL RELATIONSHIP: HEART FAILURE AND ANXIETY/DEPRESSION

EXPLORANDO A RELAÇÃO BIDIRECIONAL: INSUFICIÊNCIA CARDÍACA E ANSIEDADE/DEPRESSÃO

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Abstract
Background: Heart failure (HF) is a complex syndrome associated with high morbidity, mortality, and impaired quality of life. Anxiety and depression are common comorbidities in HF, contributing to poorer prognosis, reduced treatment adherence and diminished quality of life. Screening for psycho-emotional disturbances and integration of multidisciplinary, patient-centered can significantly improve patient outcomes. Objectives: The study explored correlations between HF, anxiety, and depression in order to optimize management strategies. Methods: This observational study

Resumo
Contexto: A insuficiência cardíaca (IC) é uma síndrome complexa associada a alta morbidade, mortalidade e comprometimento da qualidade de vida. Ansiedade e depressão são comorbidades comuns na IC, contribuindo para um pior prognóstico, menor adesão ao tratamento e diminuição da qualidade de vida. A triagem para distúrbios psicoemocionais e a integração de uma abordagem multidisciplinar e centrada no paciente podem melhorar significativamente os desfechos clínicos. Objetivos: O estudo explorou as correlações entre IC, ansiedade e depressão, a fim de

was conducted over a three-month period across five family settings. A total of 103 patients diagnosed with HF were enrolled based on specific inclusion and exclusion criteria. Data collection involved three questionnaires assessing demographic, clinical, and psycho-emotional characteristics. The Hospital Anxiety and Depression Scale (HADS) was used to quantify anxiety and depression. Statistical analyses included correlation testing, group comparisons, and regression models. Results. Among the participants, 32.04% exhibited clinical depression, and 26.21% had clinical anxiety. A statistically significant correlation was observed between HF severity and both anxiety (p=0.007) and depression (p=0.009) scores. Regarding healthcare visits, 60.19% of patients had between 4 and 8 family physician visits per year, while 25.24% had more than 8 visits. The qualitative aspects of anxiety included a heightened feeling that something bad is about to happen (14.56%), emotional tension that leads to psycho-emotional agitation (11.65%), restlessness and a constant desire for movement (15.53%). Frequently, these symptoms culminated in sudden panic attacks (10.68%). Patients who develop depression exhibit a maximum intensity of lack of energy (31.07%), followed by loss of interest in previously enjoyable activities and personal appearance (11.65%) and the inability to find joy in typically enjoyable situations. Conclusions. The symptoms of psycho-emotional disorders can often be identified during routine evaluations by family physician, who play a pivotal role in identifying these comorbidities early. Family physicians should incorporate validated tools like HADS into HF follow-up visits to screen for both clinical and subclinical symptoms. A multidisciplinary, collaborative approach is essential for improving both clinical outcomes and quality of life.

Keywords: Heart Failure. General Practitioner. Anxiety. Depression. Multidisciplinary Approach.

otimizar as estratégias de manejo. Métodos: Este estudo observacional foi conduzido ao longo de um período de três meses em cinco contextos familiares. Um total de 103 pacientes diagnosticados com IC foram incluídos com base em critérios específicos de inclusão e exclusão. A coleta de dados envolveu três questionários que avaliaram características demográficas, clínicas e psicoemocionais. A Escala Hospitalar de Ansiedade e Depressão (HADS) foi utilizada para quantificar a ansiedade e a depressão. As análises estatísticas incluíram testes de correlação, comparações entre grupos e modelos de regressão. Resultados: Entre os participantes, 32,04% apresentaram depressão clínica e 26,21% apresentaram ansiedade clínica. Observou-se uma correlação estatisticamente significativa entre a gravidade da insuficiência cardíaca e os escores de ansiedade (p=0,007) e depressão (p=0,009). Em relação às consultas médicas, 60,19% dos pacientes tiveram entre 4 e 8 consultas com o médico de família por ano, enquanto 25,24% tiveram mais de 8 consultas. Os aspectos qualitativos da ansiedade incluíram uma sensação intensa de que algo ruim está prestes a acontecer (14,56%), tensão emocional que leva à agitação psicoemocional (11,65%), inquietação e um desejo constante de movimento (15,53%). Frequentemente, esses sintomas culminaram em crises de pânico súbitas (10,68%). Os pacientes que desenvolveram depressão apresentaram como sintoma principal a falta de energia (31,07%), seguida pela perda de interesse em atividades anteriormente prazerosas e na aparência pessoal (11,65%) e pela incapacidade de encontrar alegria em situações normalmente agradáveis. Conclusões: Os sintomas de transtornos psicoemocionais podem ser frequentemente identificados durante avaliações de rotina realizadas pelo médico de família, que desempenha um papel fundamental na identificação precoce dessas comorbidades. Os médicos de família devem incorporar ferramentas validadas, como a HADS, nas consultas de acompanhamento de insuficiência cardíaca para rastrear sintomas clínicos e subclínicos. Uma abordagem multidisciplinar e colaborativa é essencial para melhorar tanto os resultados clínicos quanto a qualidade de vida.

Palavras-chave: *Insuficiência Cardíaca. Médico de Família2. Ansiedade3. Depressão. Abordagem Multidisciplinar5.*

1 INTRODUCTION

Heart failure (HF) is a complex clinical syndrome that, from a hemodynamic point of view, is characterized by the inability of the heart to maintain sufficient blood flow to meet the body's needs. Patients usually experience fatigue, dyspnea, reduced exercise tolerance, and systemic or pulmonary congestion. The leading cause of HF is ischemic heart disease, which is also the leading cause of death worldwide [1]. HF was first described as a true epidemic about 25 years ago and is associated with significant morbidity and mortality, reduced functional capacity, poor quality of life, and high healthcare costs [2]. According to the Global Health Data Exchange registry, the worldwide prevalence of HF is 64.34 million cases [1,2]. In an attempt to provide an overview of the global burden of HF, it has been found that even in the presence of promising therapeutic progress, the total number of HF patients continues to increase, a phenomenon attributed to effective medication, which prolongs the survival of these patients [2]. Palliative care has become an integral component of advanced HF management, emphasizing a holistic, multidisciplinary approach [3].

Despite improved therapies for HF, the prognosis remains poor, with one-third of patients not surviving more than one year from diagnosis. In addition, it has been observed that the typology of HF cases is changing, with a higher proportion having a non-ischemic etiology, preserved ejection fraction, and a higher prevalence of non-vascular comorbidities [4]. Relative to the current pattern of disease presentation, a successful model of care for patients with HF may require a multidisciplinary team of clinicians implementing patient-centered rather than specialty-specific solutions, necessitating a concomitant focus on the impact of the pathologies that may be present in such a vulnerable patient [3].

Among the comorbidities associated with HF, psycho-emotional disorders are frequently secondary. The prevalence of depression in patients with HF is between 20 and 30% [5,6], and it has often been shown that their association can have a dramatic potential on the prognosis of patients [5]. Depression is an independent risk factor for cardiac decompensation, even altering left ventricular function [7,8]. The psycho-emotional disturbances that may be observed in these patients are persistent feelings of sadness, hopelessness, self-devaluation, anxiety, irritability or restlessness, loss of interest in hobbies and activities, fatigue or slowness of movement, sleeping or concentrating

difficulty, pain without clear physical cause, changes in appetite or weight, and even thoughts about death or suicide [9].

On the one hand, anxiety leads to cardiac decompensation and acute cardiac events. It influences adherence to treatment and the patient's quality of life [10], and on the other hand, cardiac pathology can be a trigger for anxiety [10,11]. The need for screening of psycho-emotional pathologies for correct diagnoses and optimization of HF treatment becomes obvious [11,12]. The psycho-emotional disturbances that occur in the patient with HF affect the patient's primary caregiver, who, in turn, experiences anxiety due to the worsening clinical condition of the patient and its exacerbation related to uncertainty about the course of the disease [13].

The research aims to identify the presence of anxiety and depression in patients with heart failure and to analyze the correlations between the three pathological conditions.

2 MATERIALS AND METHODS

The observational study was conducted over a period of three months (January to March 2024) in five family medicine practices, enrolling patients with HF who visited their family physician for consultation. Inclusion criteria were: patients diagnosed with HF by cardiologist based on clinical criteria, echocardiographic findings and pro-BNP levels, patients over 18 years of age, patients without known psychiatric disease and patients who provided informed consent to participate in the study. Exclusion criteria included: absence of confirmed HF diagnosis, age under 18, cognitive impairment, previous diagnosis of depression or anxiety, alcohol or substance abuse or refusal to consent. Three questionnaires were used: a demographic questionnaire, the second assessed the clinical characteristics of the disease, and the third measured the level of anxiety and depression of each patient. Demographic data included age, gender, living environment, education level and marital status.

The clinical questionnaire collected data regarding HF severity on the NYHA classification, the duration since diagnosis, number of family physician consultations and cardiology consultations for HF over the past year, number of psychiatric consultations, hospitalizations for HF, and the classes of drugs used in treatment. This information was

obtained from the medical records in the family physician's offices for each patient participating in the study.

The Hospital Anxiety and Depression Scale developed by Zigmond and Snaith was used to assess anxiety and depression. It consists of 7 items for the assessment of anxiety and another 7 for depression. Each statement is quantified from 0 - 3 points so that for both depression and anxiety, the score can be between 0-21 points. A score between 0-7 points signifies the absence of anxiety/depression, and a score greater than or equal to 11 points represents the presence of clinical symptoms of anxiety/depression. Subclinical anxiety/depression is present with a score between 8-10 points [14].

2.1 Statistical analysis

Data distribution was analyzed using Kolmogorov-Smirnov and Shapiro-Wilk tests. The survey's internal consistency was evaluated using the Cronbach Alpha factor for depression and anxiety scales individually and combined. Spearman’s correlation coefficients were used to assess linear relationships. Group comparisons were made using Mann-Whitney U testing or Kruskal-Wallis H, followed by Dunn-Bonferroni tests, adjusting for complicity. Analysis for independence was performed by calculating the Chi-square test. All statistical analyses and graphical representations were conducted using IBM SPSS Statistics v.26.0.0.

3 RESULTS

The study group included 103 participants selected according to the inclusion criteria. The socio-demographic characteristics in Table 1 show that more than half of the subjects (58.25%) were males. Most patients (80.58%) were from urban areas, which can be attributed to the fact that the participating family physicians have their practices in the city. Two-thirds of the study participants were married, and the rest lived alone due to losing a life partner (36.89 %). Only 18.45% were employed and most were retired. Only 9.71% were retired on disability due to heart disease. The mean age of the participants was 71.17 ± 11.62, most of them being over 60 years old (79.62%). Most of the patients had grammar school education (70.87%).

Table 1

Socio-demographic characteristics of the patients with HF included in the study

Variable	Characteristic	Number N (%)
Living environment	Urban Rural	83 (80.58%) 20 (19.42%)
Gender	Male Female	60 (58.25%) 43 (41.75%)
Marital status	Married Single (divorced, widowed)	65 (63.11%) 38 (36.89 %)
Living Resources	Employed Age retirement Disability retirement Unemployed	19 (18.45%) 73 (70.87%) 10 (9.71%) 1 (0.97%)
Education	Primary school Grammar school Higher education	12 (11.65%) 73 (70.7%) 18 (17.48%)
Mean age	Mean ± SD	71.17 ± 11.62
Age distribution	Under 60 years Over 60years	21(20.38%) 82 (79.62%)
Severity of HF	NYHA class II NYHA class III NYHA class IV	64 (62.14%) 35 (33.98%) 4 (3.88%)
Time since HF diagnosis	Less than 3 years Over 3 years	22 (21.36%) 81 (78.64%)
The number of specialist consultations for HF (cardiology in the past year)	< 3 > 3	78 (75.73%) 25 (24.27%)
The number of visits to the family physician for HF in the past year.	< 4 4-8 > 8	15 (14.57%) 62 (60.19%) 26 (25.24%)
The number of psychiatric consultations in the past year	None < 3 > 3	95 (92.23%) 6 (5.83%) 2 (1.94%)
The number of hospital admissions for HF in the past year	None < 3 > 3	55 (53.40%) 34 (33.01%) 14 (13.59%)
Depression score (HADS)	Normal (< 7 pts) Borderline (7-10 pts) Clinic disease (>10 pts)	60 (58.25%) 10 (9.71%) 33 (32.04%)
Anxiety score (HADS)	Normal (< 7 pts) Borderline (7-10 pts) Clinic disease (>10 pts)	59 (57.28%) 17 (16.50%) 27 (26.21%)

The analysis of the clinical characteristics of the group focused on aspects related to the stage of the disease, the medication used in the treatment, and the assessment of depression and anxiety. Additionally, the number of visits made by the patient in the past year to the family physician and other specialists (cardiologist, internist, psychiatrist) for symptoms related to heart failure was also documented. Most patients (75.73%) in the study group had less than three consultations for HF with their specialist in the last year. Consultations with family physicians were much more frequent. Nearly two-thirds of the

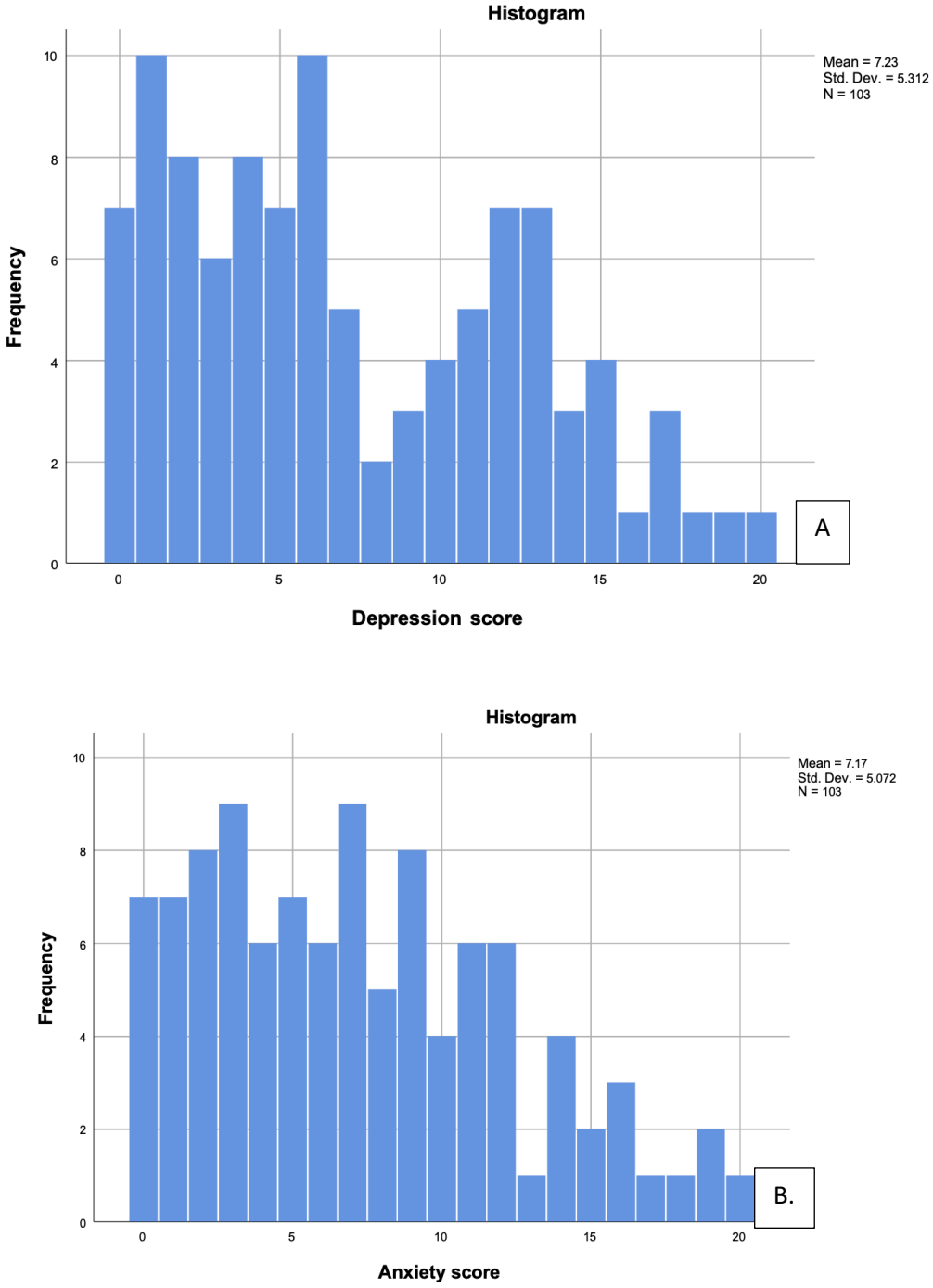
patients (60.19%) had between 4 to 8 visits in the last year, and a quarter of the subjects (25.24%) had more than eight visits. More than half of these patients (53.40%) did not need hospitalization in the last year. The percentage of those who needed more than three hospital admissions in the previous year for HF was low, only 13.59%. This finding highlights the importance of the family doctor in the role of coordinator in the management of patients with heart failure, especially in identifying emotional issues that require referral to psychiatric/psychological services.

Most patients in the study group were classified as having NYHA class II HF (62.14%), followed by NYHA class III (33.98%). Only four patients (3.88%) had NYHA class IV HF. The distribution of patients indicates that most males (71.67%) had NYHA class II HF. In contrast, the female patient group shows a relatively equal distribution, with 48.84% having NYHA class II HF and 41.86% having NYHA class III HF. Almost a quarter of the patients were less than 3 years since diagnosis, and the majority (78.64%) were confirmed with the diagnosis of HF more than 3 years ago.

Clinical signs of depression occurred in 32.04% of patients, and anxiety in 26.21%. People who did not develop psycho-emotional disorders represent a little over half of the studied group (58.25% in the case of depression and 57.28% in the case of anxiety). The mean depression and anxiety scores were similar (7.23+/-5.312, respectively, 7.17+/-5.072). Some of the patients had borderline depression and anxiety scores (9.71% and 16.5%, respectively), often progressing to clinical forms of depression and anxiety. (Figure 1).

Figure 1

Distribution of patients based on depression score (A) and anxiety score (B)

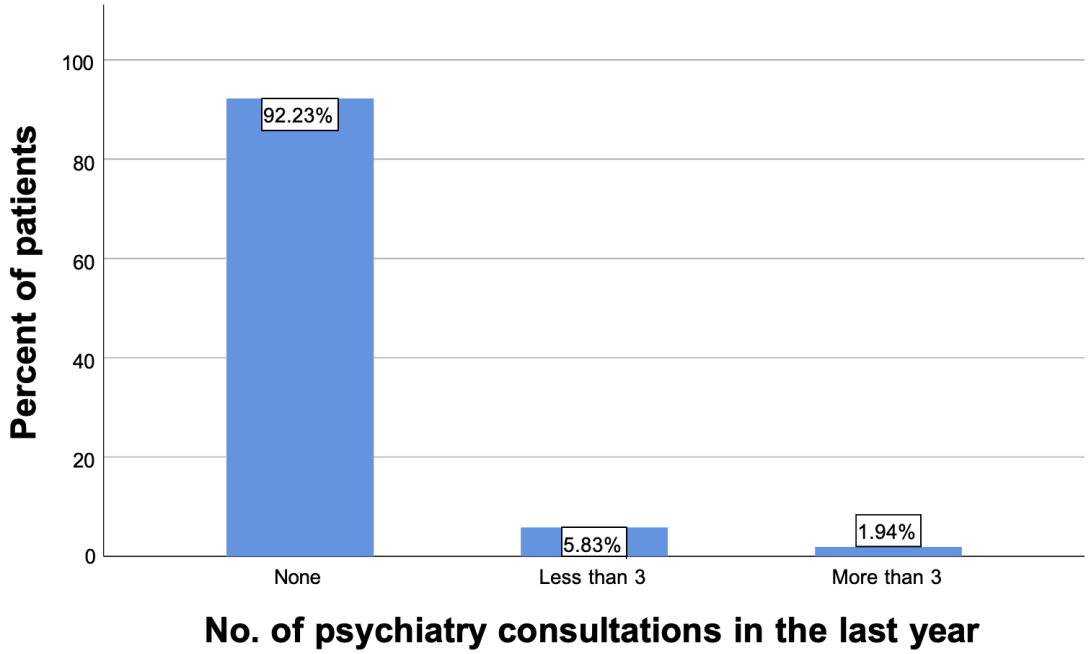


Source: Authors

Despite the evidence, most subjects (92.23%) did not undergo specialized psychiatric evaluation in the past year (Figure 2).

Figure 2

Distribution of patients with heart failure who have the psychiatric consultations



Source: Authors

The correlations between the three pathological entities were analyzed, and the results are summarized in Table 2. A statistically significant correlation was found between the degree of HF, anxiety, and depression scores ($p = 0.007$ and $p = 0.009$, respectively), although they were weakly positive (rho = 0.264 for anxiety, and rho = 0.255 for depression). As HF progresses, the burden of symptoms increases, leading to greater psycho-emotional instability. The number of visits to the family physician for HF-related issues showed a statistically significant correlation with the mean depression score ($p = 0.003$), and the mean anxiety score ($p = 0.001$) and with the degree of HF ($p<0.0001$), with a moderate positive correlation (rho = 0.507).

Table 2

Correlations between heart failure, anxiety, and depression

Variable	**Spearman test**	**Depression score**	**Anxiety score**	**Heart Failure**
Heart Failure Level	Correlation coeff p-value	0.255 **0.009**	0.264 **0.007**	1.00
No. of cardiology consultations in the past year	Correlation coeff p-value	- 0.138 0.165	- 0.058 0.561	-0.19 **0.045**
No. of GP consultations in the past year	Correlation coeff p-value	0.291 **0.003**	0.391 **0.001**	0.507 **<0.0001**
No psychiatry consultations in the last year	Correlation coeff p-value	0.047 0.638	0.142 0.151	0.205 0.38
Depression score	Correlation coeff p-value	1.00	0.612 **<0.0001**	0.255 **0.009**
Anxiety score	Correlation coeff p-value	0.612 **<0.0001**	1.00	0.264 **0.007**

Source: Authors

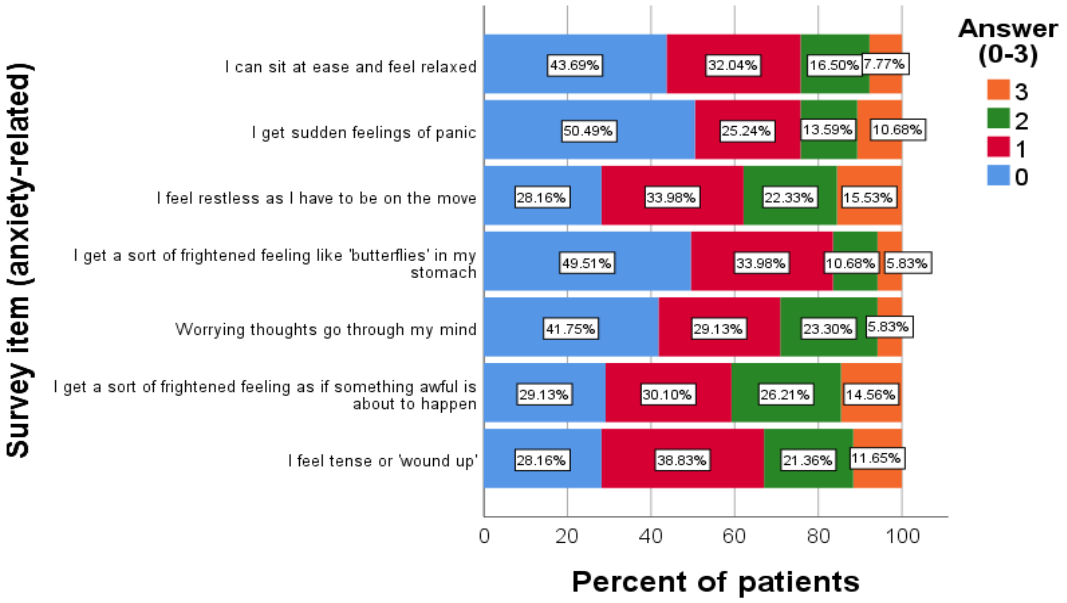
The number of annual cardiologist visits by HF patients showed a weak correlation with severity of HF (p = 0.045) but did not correlate with anxiety or depression scores. Patients tend to visit their family physician more frequently for symptoms they perceive as cardiac-related, which often reveal the presence of associated psycho-emotional disorders.

The number of hospitalizations showed a significant correlation with anxiety (p = 0.008), with clinical anxiety disorders often being the reason for referrals to the emergency department. However, referrals for psychiatric consultations in patients with HF are very rare despite the high frequency of associated psycho-emotional symptoms.

The qualitative aspects of anxiety show that patients with heart failure experience a heightened feeling that something bad was about to happen (14.56%), accompanied by emotional tension (11.65%) that leads to psycho-emotional agitation, restlessness, and a constant desire for movement (15.53%). Symptoms often culminated in sudden panic attacks (10.68%) that occur suddenly. (Figure 3)

Figure 3

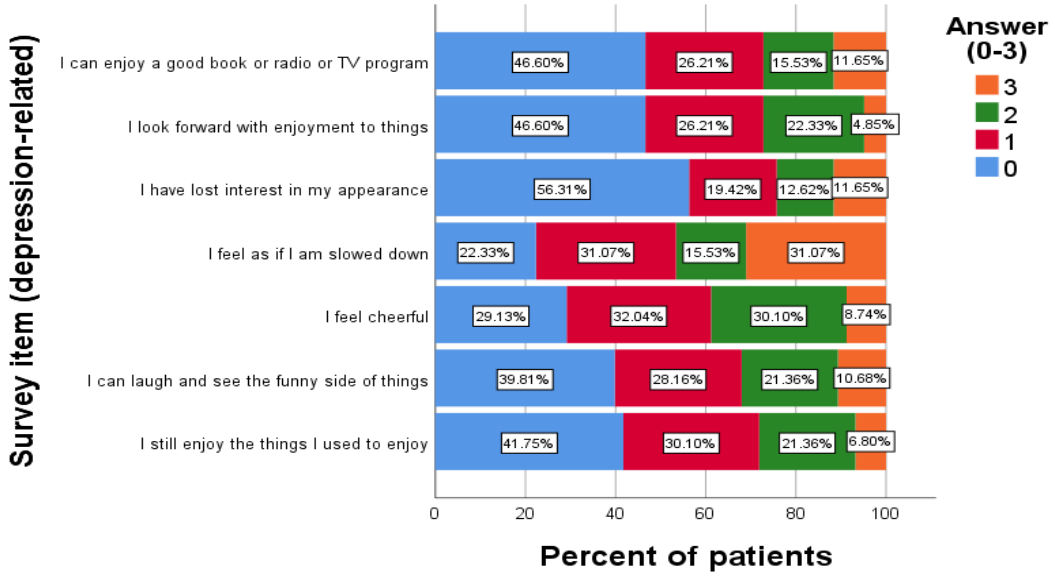
Percentage distribution of the items of anxiety experienced by patients with heart failure



Patients who developed depression most frequently exhibited a lack of energy (31.07%), followed by loss of interest in recreational activities that previously brought them joy and decline in interest in personal appearance (11.65%). Patients cannot enjoy or see the fun side of situations (10.68%). (Figure 4)

Figure 4

Percentage distribution of the items of depression experienced by patients with heart failure.



These symptoms may prompt family physicians to initiate a psycho emotional evaluation and, more importantly, the refer patients to a psychiatrist when a necessary.

4 DISCUSSION

The connection between heart failure and psycho-emotional disorders has been established in numerous research studies, with anxiety and depression being the most frequently associated conditions.

This study revealed that in Romania, depression occurs in 32.04% of patients with heart failure, which is slightly higher than findings in other research where the prevalence ranges from 21.5% to 30% [6,15,16]. This suggests that Romanian HF patients may be particularly vulnerable to emotional distress. Depression is considered an independent, decisive risk factor for the development of heart failure (HF), even in individuals without prior heart conditions, the risk being estimated at 46% compared to healthy individuals [16]. Through mechanisms that are not yet fully understood, depression contributes to cardiovascular decompensation, recurrent cardiac events, increased hospitalizations, a poorer prognosis for HF patients, and higher mortality rates due to HF [5,17]. Common pathogenic mechanisms shared by both HF and depression include platelet activation and elevated inflammatory markers [18].

The most frequently reported symptoms among patients include lack of energy (31.07%), diminished interest in previously pleasurable activities, neglect of personal appearance (11.65%), varying degrees of sadness (8.74%) and an inability to enjoy even positive social situations (10.68%). The symptoms overlap significantly with HF symptoms, making clinical recognition more difficult. More than a quarter of the HF patients in the study group experienced various degrees of anxiety, almost double the percentage reported in previous studies (13%) [19]. Anxiety contributes to acute cardiovascular events through mechanisms that are still not fully understood. Over two-thirds of patients reported various concerns about the unpredictability of their condition, *leading to increased emotional tension (11.65%), agitation, restlessness, a state of constant movement (15.53%), with the emergence of the feeling that something bad is going to happen (14.56%).*

Importantly,10-15% of patients have borderline anxiety and depression scores, highlighting the need for systematic screening. Early interventions, such as psychological

counseling and clear communication regarding the disease, treatment, and prognosis, can help prevent the progression to clinically significant anxiety and depression [19].

Certain individual characteristics are correlated with a higher risk of experiencing heart failure with anxiety and depression. Identifying at risk patients can guide family doctors towards early evaluation of psycho-emotional disorders and refer for appropriate psychiatric care. The risk factors associated with both anxiety and depression are older age and female gender. In addition, for depression, low education level and the marital status of the patient, especially the loss of a life partner, are also added [20]. Regarding the patient's education level, a statistically significant but weak negative correlation was found (rho = -0.236; p = 0.016) with the average depression. This suggests that a lower level of understanding of the disease and treatment may contribute to higher levels of depression. The patient's age represents an essential and non-modifiable risk for both cardiovascular diseases and psychiatric pathology. As both age and disease severity increase, greater attention must be given to associated psycho-emotional issues, which may further worsen the patient’s prognosis [21]. Women with heart failure (HF) are significantly more predisposed to anxiety and depression (p=0.002 and p=0.003, respectively) [20]. Single individuals who have lost a life partner show a statistically significant depression score (p=0.005), due to heart failure-specific symptoms that overlap with an emotional background already affected by previous events [20]. A concerning finding is the high number of patients (92.23%) who had no psychiatric consultation in the previous year, despite presenting with clear psycho-emotional symptoms. This likely reflects both under-recognition by physicians and patient hesitation to seek mental health care, possibly due to stigma or lack of access. As a result, family physicians must play a proactive role in screening and initiating referrals.

It emphasizes the importance of holistic assessment by family physicians to detect early signs of cardiovascular decompensation. This proactive approach allows timely referrals to cardiologists for specialized investigations and treatment adjustments. Most of the time, the clinical symptoms of anxiety and depression such as: fatigue, lack of energy, emotional tension, somatic pain, dizziness, overlap with those of heart failure: exertional dyspnea, nocturnal dyspnea, tachycardia, palpitations, nocturnal cough, and reduced exercise capacity. [22,23]

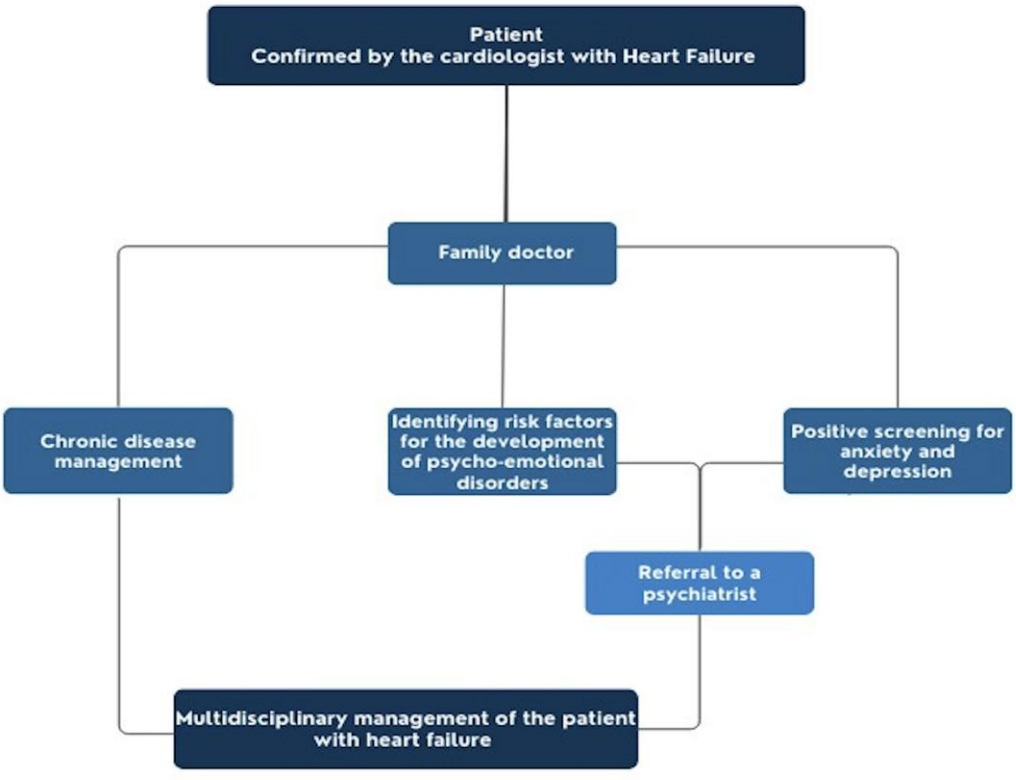
It has been statistically observed that heart failure patients more frequently seek consultations with family doctors rather than with cardiology specialists. This is

explained by the family doctor's expertise in differentiating diagnoses and referring only decompensated cases to specialists. The family doctor consultation will have two components: identifying the clinical signs specific to heart failure and assessing the risk factors for the occurrence of associated psycho-emotional disorders. Nevertheless, only 7.7% of HF (heart failure) patients end up being evaluated by a psychiatrist.

This highlights the critical role family doctors play in identifying psycho-emotional comorbidities linked to cardiovascular issues. Their efforts are pivotal in providing proper guidance, conducting assessments, and collaborating with psychiatrists to create effective therapeutic plans. This is a useful algorithm to monitoring the patients with heart failure. (Figure 5)

Figure 5

Algorithm for management patients with heart failure



In addition, both anxiety and depression lead to undesirable changes in the behavior of patients with HF: reduced adherence to lifestyle changes, adopting a sedentary lifestyle, abandonment of recommended diet and exercise diet and exercise

routines, emotional detachment, relapse into smoking, withdrawal from social activities and social isolation [19,24].

There is a need for multidisciplinary management of HF patients, with the family physician and the cardiologist/internist playing key roles in this collaborative approach. The complexity of the treatment plan depends on all the associated comorbidities and often represents a burden for the patient and the family [25,26]. The family physician is typically the first point of contact when the patient experiences symptoms related to cardiovascular issues. The patient is then referred to the specialist cardiologist or internist for either a scheduled check-up, clinical evaluation, and therapeutic management or urgent care in response to the onset of symptoms and clinical signs of cardiovascular decompensation.

European guidelines emphasize the importance of early use of screening tools for psycho-emotional disorders as part of effective HF management [27,28,29]. A practical and easy to use tool for clinical practice is the Hospital Anxiety and Depression Scale (HADS). The multidisciplinary team should include a psychiatrist, who, alongside the cardiologist, internist, and family physician, ensures quality management of HF. The family physician plays a central role as the care coordinator, providing the initial consultation and recommending the appropriate approach for managing the patient.

5 CONCLUSIONS

Anxiety and depression are common comorbidities associated with HF, and they can negatively impact the progression of the disease.

This study confirms that a substantial proportion of HF patients suffer from clinical or subclinical levels of anxiety and depression, with many of these conditions remaining undiagnosed and untreated. Symptoms often overlap with HF-related somatic complaints, which can complicate clinical assessment.

The family physician plays a crucial role in the objective identification of anxiety and depression, with the HF follow-up consultation providing an ideal opportunity to assess the psycho-emotional disturbances in cardiac patients. The use of validated screening tools for anxiety and depression facilitates the identification of both clinical and subclinical forms of these conditions, enabling the early detection of psycho-emotional disturbances in HF patients.

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INSTITUTIONAL REVIEW BOARD STATEMENT

The study was conducted in accordance with the Declaration of Helsinki, and approved by the Ethics Committee of Municipal Hospital "Dr Cornel Igna", Campia Turzii, Romania no. 1201/20.12.2023.

INFORMED CONSENT STATEMENT

Informed consent was obtained from all subjects involved in the study. Written informed consent has been obtained from the patient(s) to publish this paper.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

ABBREVIATIONS

The following abbreviations are used in this manuscript:

HF: Heart Failure.

HADS: The Hospital Anxiety and Depression Scale.

NYHA: New York Heart Association.

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Authors' Contribution

"Conceptualization, RSP and AP; methodology, RSP and ACM software, ACM; validation, AP; investigation, CPU and ȘU; writing—original draft RSP and CPU; writing—review and editing, AP; supervision, AP. All authors have read and agreed to the published version of the manuscript. Authorship must be limited to those who have contributed substantially to the work reported.

Data availability

All datasets relevant to this study's findings are fully available within the article.

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