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Quality of Life and Mental Health in Patients with Exacerbated Heart Failure: The Role of Obstructive and Central Sleep Apnea Phenotypes

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Abstract: Background: Managing acute decompensated heart failure (ADHF) is complex, particularly when combined with comorbidities like sleep apnea. Effective treatment requires personalized approaches, focusing on quality of life (QoL) and mental health outcomes. **Purpose**: This study explored the prevalence and characteristics of sleep apnea in patients with obesity and AHF exacerbations. It assessed how different sleep apnea phenotypes impact QoL and mental health, applying personalized medicine strategies. **Methods**: A prospective cohort study was conducted on 150 patients admitted for AHF exacerbation. Inclusion criteria included an Apnea–Hypopnea Index (AHI) > 5, an Epworth Sleepiness Scale (ESS) > 8, NT-proBNP > 900 pg/mL and informed consent obtained prior to participation. Optimized medical treatment was provided. QoL and mental health were evaluated using the Kansas City Cardiomyopathy Questionnaire (KCCQ) and the Beck Depression Inventory (BDI). **Results**: Among 81 patients with sleep apnea, 73% (n = 59) had obstructive sleep apnea (OSA) and 27% (n = 19) had central sleep apnea (CSA). OSA patients reported a higher QoL (61.12 ± 17.88) compared to CSA patients (37.18 ± 19.98, $p < 0.001$). CSA patients exhibited more severe depression (BDI: 26.18 ± 5.5 vs. 16.64 ± 4.1, $p < 0.001$). Significant correlations were noted between KCCQ and BDI scores ($r = -0.849$, $p < 0.001$) and central apnea events ($r = -0.485$, $p < 0.001$). **Conclusions**: Sleep apnea is common in ADHF patients, with CSA being linked to poorer QoL and greater depression. Personalized medicine offers promising strategies to enhance care and outcomes.

Keywords: obstructive sleep apnea; central sleep apnea; sleep disorders; sleep apnea phenotyps; patient-reported outcomes

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1. Introduction

Heart failure (HF) is a complex clinical condition that, due to the heart's inability to pump blood effectively, leads to symptoms such as shortness of breath, fatigue, and leg swelling, and is associated with high morbidity and mortality rates, ADHF representing a critical phase that often requires urgent hospitalization and intensive treatment [1]. ADHF can result from the progression of chronic HF or can emerge as a new onset of cardiac dysfunction. Despite advancements in the management of chronic HF, ADHF remains associated with poor outcomes, including frequent hospital readmissions and significant

mortality within a year [2]. HF is also associated with the deterioration of the quality of life and mental health of patients [3].

Sleep apnea (SA) is a common comorbidity in patients with HF, further complicating disease management. Both OSA and CSA are associated with intermittent hypoxia, sleep fragmentation, and neurohormonal imbalances that exacerbate HF and negatively impact patients' QoL and mental health [4,5]. Emerging evidence suggests that CSA is more strongly associated with a reduced QoL and higher rates of depression compared to OSA, highlighting the importance of tailored therapeutic strategies [6]. Evaluating QoL and mental health is crucial for assessing the effectiveness of HF interventions [7]. However, limited research has explored the differential impact of SA subtypes on clinical outcomes in HF patients.

In this context, the present study aims to evaluate the impact of OSA and CSA on QoL and mental health in patients hospitalized for exacerbated HF, comparing these outcomes between groups while employing contemporary approaches to personalized medicine. Additionally, this study seeks to assess specific clinical parameters and analyze how different SA phenotypes influence these outcomes, thus providing a deeper understanding of their role in the clinical management of this patient population.

2. Materials and Methods

2.1. Study Design

We undertook a single-center, prospective cohort study involving a total of 150 consecutive patients who were admitted to the cardiology department of University Hospital "Tsaritsa Yoanna—ISUL" in Sofia for the management of acute decompensated heart failure. This study spanned a period of three years, from January 2017 to December 2019. The study population included 150 consecutive patients admitted with acute decompensated heart failure. Among these, 81 patients met the inclusion criteria and were enrolled in the analysis. The primary aim was to assess the prevalence and phenotypic characteristics of sleep apnea in this population and evaluate the effects of OSA and CSA on quality of life and mental health.

Patients were included in the study if they met the following criteria: an Apnea–Hypopnea Index (AHI) > 5, an Epworth Sleepiness Scale (ESS) score > 8, N-terminal fragment of the prohormone brain-type natriuretic peptide (NT-proBNP) levels > 900 pg/mL (confirming significant heart failure severity), and having provided informed consent. The exclusion criteria included the presence of severe comorbidities with a life expectancy of less than six months, significant non-cardiac conditions that could interfere with the QoL assessment (e.g., advanced cancer or severe chronic obstructive pulmonary disease), and non-compliance or inability to complete the study assessments. All inclusion and exclusion criteria are presented in Table 1.

Table 1. Inclusion and exclusion criteria for the subjects.

Inclusion Criteria	Exclusion Criteria
Clinical manifestations of heart failure (NYHA class II/III)	NYHA class IV
Epworth Sleepiness Scale > 8	Acute respiratory failure
NT-proBNP > 900 pg/mL	Acute coronary syndrome
Apnea–Hypopnea Index > 5	Severe renal insufficiency
Signed informed consent	Severe hepatic insufficiency
-	Chronic pulmonary diseases
-	Unsigned informed consent

2.2. Sleep Apnea Screening and Diagnostic Tools

During their hospital stay, and after obtaining informed consent—approved by the Institutional Ethics Committee of the Medical University of Sofia (Protocol code 2100, 27 April 2016)—patients with an Epworth Sleepiness Scale (ESS) score >8 was screened for sleep apnea using the ApneaLink™ system (ResMed, San Diego, CA, USA) [8]. This portable device monitors airflow, chest movements, heart rate, and oxygen levels, enabling the detection of obstructive and central sleep apnea. While polysomnography (PSG) is the gold standard for diagnosing sleep apnea, ApneaLink™ provides a practical and reliable alternative for initial assessment, with studies showing a strong correlation between its AHI values and those from PSG [9]. The process of patient selection is presented in the flow chart (Figure 1).

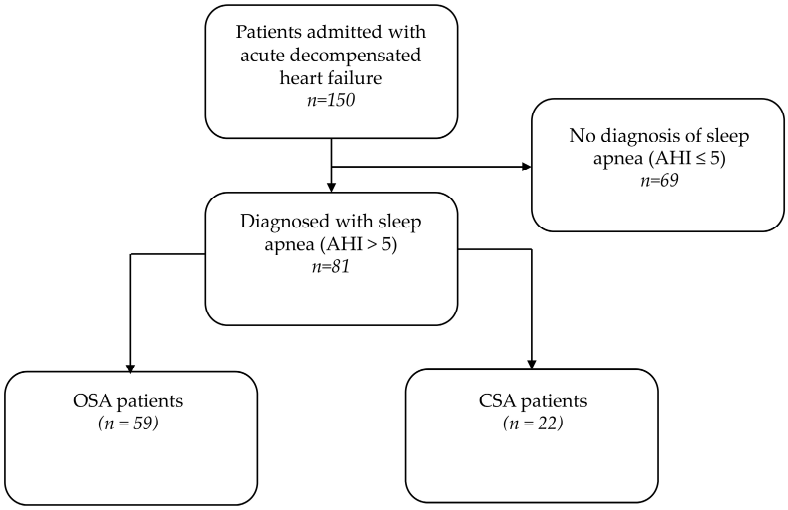

Figure 1. Flow chart of patient selection and classification. Patients admitted with acute heart failure (n = 150) were screened for sleep apnea. After diagnostic evaluation, 81 patients were diagnosed with sleep apnea (AHI > 5) and included in the study. Among them, 59 were classified with OSA and 22 with CSA. OSA—obstructive sleep apnea; CSA—central sleep apnea; AHI—Apnea–Hypopnea Index.

2.3. Assessment of Quality of Life, Mental Health, and Clinical Parameters

Quality of life (QoL) was evaluated using the Kansas City Cardiomyopathy Questionnaire (KCCQ), a tool specifically designed to measure how heart failure affects patients' daily lives. The KCCQ scores range from 0 to 100, with higher scores indicating better health and fewer limitations. Patients with scores below 25 are considered to have very poor QoL, those scoring between 25 and 49 fall into the poor to fair range, scores of 50–74 indicate a satisfactory to good QoL, and those above 75 reflect a good to excellent health status. This breakdown helps to clearly categorize the degree to which HF impacts patients' lives [10,11].

Mental health was assessed using the Beck Depression Inventory (BDI), a 21-item questionnaire widely used to gauge the severity of depressive symptoms [12]. The BDI categorizes scores as follows: 0–10 indicates normal mental health, 11–16 represents mild depression, 17–20 signals borderline clinical depression, 21–30 suggests moderate depression, and 31–40 reflects severe depression. This stratification provides a detailed view of patients' psychological well-being, emphasizing the common overlap between HF and depressive symptoms [13]. The original questionnaires, in Bulgarian, are included in the Supplementary File S1.

In addition to QoL and mental health, key clinical parameters were documented to provide a complete picture of HF severity. Left ventricular ejection fraction (LVEF), a

critical indicator of cardiac function, was measured using transthoracic echocardiography. NT-proBNP levels, a biomarker for HF, were recorded on admission and monitored during hospitalization. Heart rate and blood pressure were also measured to assess cardiovascular stability. Together, these evaluations offered a comprehensive understanding of patients' physical and mental health, helping to guide personalized care strategies aimed at improving both clinical outcomes and overall well-being.

2.4. Statistical Analysis

The statistical analysis included descriptive and inferential methods. Continuous variables were presented as mean ± standard deviation (SD) or median with interquartile range (IQR), depending on the data distribution. Categorical variables were summarized as frequencies and percentages. Group comparisons (OSA vs. CSA) were performed using independent t-tests for normally distributed variables or Mann–Whitney U tests for non-normally distributed data. Categorical variables were analyzed using Chi-square tests. Correlations between clinical parameters (e.g., LVEF, NT-proBNP) and outcomes (KCCQ and BDI scores) were assessed using Pearson's or Spearman's correlation coefficients, depending on the normality of the data. A p-value of less than 0.05 was considered statistically significant.

3. Results

3.1. Demographic and Clinical Profile of Participants

From a total of 150 screened patients with acute decompensated heart failure, 81 individuals (54%) were diagnosed with sleep apnea (SA) with an AHI > 5. These cases were categorized into two groups based on the predominance of obstructive or central apneas: OSA and CSA. Among the participants, 59 (72.8%) had OSA, and 22 (27.2%) had CSA. The mean age of patients with OSA was 67 years compared to 69 years for those with CSA, with no statistically significant difference ($p = 0.38$). Similarly, the gender distribution showed no significant difference between the two groups, with 57.6% of OSA patients and 54.5% of CSA patients being male ($p = 0.499$). The prevalence of comorbid conditions varied between the two groups. Hypertension was observed in 74.6% of OSA patients and 68.1% of CSA patients ($p = 0.565$). Ischemic heart disease (IHD) was significantly more common in CSA patients (86.3% vs. 47.5%, $p = 0.002$), while left ventricular hypertrophy (LVH), diabetes mellitus type II (DM), and atrial fibrillation (AF) were more prevalent in the OSA group. All comorbid conditions were defined in accordance with the latest clinical criteria outlined in the European Society of Cardiology guidelines.

OSA patients had significantly higher systolic arterial pressure (SAP) and diastolic arterial pressure (DAP) compared to CSA patients ($p < 0.001$ for both). However, the mean nighttime heart rate was significantly higher in the CSA group ($p < 0.001$). Body mass index (BMI) was also significantly elevated in OSA patients ($p = 0.002$), while NT-proBNP levels were markedly higher in CSA patients ($p < 0.001$). The data are presented in Table 2.

Table 2. Demographic characteristics and clinical parameters of the studied subjects.

Parameter	OSA (n = 59)	CSA (n = 22)	p-Value
Age (years)	67.08 ± 8.84	69.05 ± 9.63	0.38
Male (%)	57.6%	54.5%	0.499
Hypertension (%)	74.6%	68.1%	0.565
IHD (%)	47.5%	86.3%	0.002
LVH (%)	79.7%	50%	0.008

Table 2. *Cont.*

Parameter	OSA (*n* = 59)	CSA (*n* = 22)	*p*-Value
Diabetes Mellitus (%)	74.5%	40.9%	0.005
AF (%)	49.1%	81.8%	0.008
Systolic BP (mmHg)	132.7 ± 9.07	111.04 ± 11.1	<0.001
Diastolic BP (mmHg)	83.3 ± 7.08	71.5 ± 7.9	<0.001
Mean Heart Rate (bpm)	73.1 ± 8.2	86.9 ± 8.9	<0.001
BMI	36.8 ± 7.07	31.9 ± 3.5	0.002
NT-proBNP (pg/mL)	1623 ± 897	3500 ± 1453	<0.001

OSA—obstructive sleep apnea; CSA—central sleep apnea; BP—blood pressure; bpm—beats per minute; BMI—body mass index; NT-proBNP—N-terminal prohormone of the brain natriuretic peptide; LVH—left ventricular hypertrophy; AF—atrial fibrillation; IHD—ischemic heart disease; SD ±—standard deviation.

3.2. Mental Health and Quality of Life

All participants exhibited varying degrees of depressive symptoms, assessed using the Beck Depression Inventory. The majority were classified into mild (40.7%) and moderate depression (32.2%), while 22.2% fell into the borderline clinical depression category, and 4.9% were categorized as having severe depression. No patients were identified with either normal mental health or extreme clinical depression. Regarding quality of life, assessed via KCCQ, 11.1% of patients reported very poor QoL, while 35.8% had poor to satisfactory QoL, 24.7% had satisfactory to good QoL, and 28.4% reported good to excellent QoL. The data are presented in Table 3.

Table 3. Mental health and quality of life assessments in patients with sleep apnea included in the study.

Category	Number of Patients (*n*)	Percentage (%)
Mental Health (BDI)		
Normal Mental Health (BDI 0–10)	0	0.0
Mild Depression (BDI 11–16)	33	40.7
Borderline Clinical Depression (BDI 17–20)	18	22.2
Moderate Depression (BDI 21–30)	26	32.2
Severe Depression (BDI 31–40)	4	4.9
Extremely Severe Depression (BDI > 40)	0	0.0
Quality of Life (KCCQ)		
Very Poor to Poor QoL (KCCQ 0–24)	9	11.1
Poor to Satisfactory QoL (KCCQ 25–49)	29	35.8
Satisfactory to Good QoL (KCCQ 50–74)	20	24.7
Good to Excellent QoL (KCCQ 75–100)	23	28.4

BDI—Beck Depression Inventory; KCCQ—Kansas City Cardiomyopathy Questionnaire.

3.3. Sleep Parameters in OSA and CSA Groups

The analysis of sleep studies in patients with OSA and CSA revealed no significant differences in the AHI, oxygen saturation levels (including baseline, lowest, and mean values), or the time spent with oxygen saturation below thresholds of 90%, 85%, and 80%. However, the number of snoring episodes was significantly higher in the OSA group compared to the CSA group (1560 ± 1332 vs. 777 ± 1026, $p = 0.015$). The data are presented in Table 4.

Table 4. Sleep parameters in OSA and CSA groups.

Parameter	OSA (n = 59)	CSA (n = 22)	p-Value
AHI	42.3 ± 22.3	34.8 ± 9.8	0.129
Number of Apneas	127 ± 121	149.5 ± 89.3	0.429
Number of Hypopneas	135.1 ± 103.7	124.2 ± 108.8	0.681
Oxygen Desaturation Index	46.4 ± 21.9	37.2 ± 18.2	0.204
Mean Saturation During Sleep (%)	84.2 ± 6.3	86.1 ± 5.3	0.203
Lowest Saturation During Sleep (%)	66.4 ± 12.4	68.2 ± 13.1	0.556
Baseline Saturation at Sleep Onset (%)	90.2 ± 5.7	91.6 ± 2.1	0.284
Time Spent with Saturation < 90% (%)	81.2 ± 23.7	72.5 ± 28.8	0.171
Time Spent with Saturation < 85% (%)	53 ± 35.3	44.6 ± 35.5	0.342
Time Spent with Saturation < 80% (%)	26.7 ± 29.1	19.2 ± 22.9	0.281
Snoring Episodes (n)	1560 ± 1332	777 ± 1026	0.015

OSA—obstructive sleep apnea; CSA—central sleep apnea; AHI—Apnea–Hypopnea Index; SD ±—standard deviation.

3.4. Comparison of Quality of Life and Mental Health in OSA and CSA Groups

3.4.1. Quality of Life Assessment

Significant differences were observed in the QoL scores between the OSA and CSA groups, as assessed using the KCCQ. The mean KCCQ score was significantly higher in the OSA group, at 61.12 ± 17.88, compared to the CSA group, at 37.18 ± 19.98, ($p < 0.001$).

3.4.2. Mental Health Assessment

Mental health, evaluated using the BDI, revealed significantly worse depressive symptoms in the CSA group. The mean BDI score in the CSA group was 26.18 ± 5.5, compared to 16.64 ± 4.1 in the OSA group ($p < 0.001$). The data are presented in Figure 2.

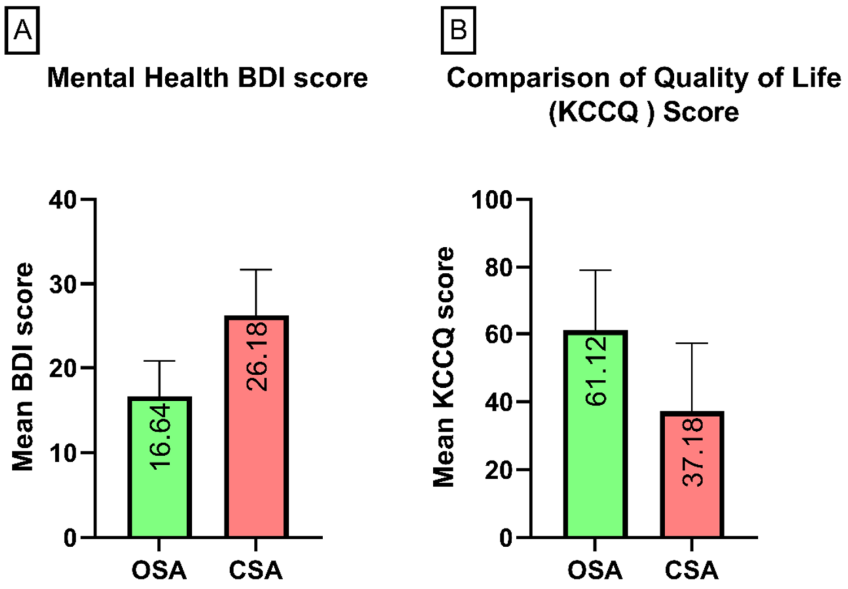

Figure 2. Comparison of mental health and quality of life between study groups. Panel (**A**) shows the BDI scores for mental health. The mean BDI score in the CSA group is 26.18 ± 5.5, compared to 16.64 ± 4.1 in the OSA group ($p < 0.001$). Panel (**B**) illustrates the KCCQ scores for quality of life. The mean KCCQ score is 61.12 ± 17.88 for the OSA group and 37.18 ± 19.98 for the CSA group ($p < 0.001$). OSA—obstructive sleep apnea; CSA—central sleep apnea; KCCQ—Kansas City Cardiomyopathy Questionnaire; BDI—Beck Depression Inventory.

3.5. Correlation Analyses of QoL and Mental Health with Clinical and Laboratory Parameters

3.5.1. Correlations Related to QoL

Significant correlations were observed between KCCQ scores, QoL assessments, and several clinical parameters, including BDI, CSA events, LVEF, mean HR, and NT-proBNP levels. The strongest correlation was found between KCCQ and BDI scores ($r = -0.849$, $p < 0.001$), indicating that lower QoL was associated with more severe depressive symptoms. Moderate negative correlations were observed between KCCQ and CSA events ($r = -0.485$, $p < 0.001$) and NT-proBNP levels ($r = -0.515$, $p < 0.001$). Additionally, KCCQ showed a significant positive correlation with LVEF ($r = 0.743$, $p < 0.001$), suggesting that better cardiac function was linked to improved QoL.

3.5.2. Correlations Related to Mental Health

Mental health, measured using the BDI, demonstrated significant correlations with KCCQ scores, CSA and OSA events, LVEF, mean HR, and NT-proBNP levels. The strongest correlation was observed between BDI and KCCQ ($r = -0.849$, $p < 0.001$), emphasizing the inverse relationship between depression severity and QoL. Positive correlations were noted between BDI and CSA events ($r = 0.626$, $p < 0.001$) and NT-proBNP levels ($r = 0.600$, $p < 0.001$), indicating that worse mental health was associated with poorer cardiac and respiratory function. The data are presented in Tables 5 and 6.

Table 5. Correlations between KCCQ scores of sleep apnea patients and their clinical parameters.

Parameter	*r*	*p*-Value
KCCQ–BDI	−0.849	<0.001
KCCQ–CSA Events	−0.485	<0.001
KCCQ–LVEF (%)	0.743	<0.001
KCCQ–Mean HR	−0.377	0.001
KCCQ–NT-proBNP	−0.515	<0.001

KCCQ—Kansas City Cardiomyopathy Questionnaire; BDI—Beck Depression Inventory; CSA—central sleep apnea; LVEF—left ventricular ejection fraction; HR—heart rate; NT-proBNP—N-terminal pro-brain natriuretic peptide; *r*—correlation coefficient.

Table 6. Correlations between BDI scores of sleep apnea patients and their clinical parameters.

Parameter	*r*	*p*-Value
BDI–KCCQ	−0.849	<0.001
BDI–CSA Events	0.626	<0.001
BDI–OSA Events	0.238	0.033
BDI–LVEF (%)	−0.782	<0.001
BDI–Mean HR	0.360	0.001
BDI–NT-proBNP	0.600	<0.001

KCCQ—Kansas City Cardiomyopathy Questionnaire; BDI—Beck Depression Inventory; CSA—central sleep apnea; LVEF—left ventricular ejection fraction; HR—heart rate; NT-proBNP—N-terminal pro-brain natriuretic peptide; *r*—correlation coefficient.

4. Discussion

Our study highlighted the substantial prevalence of sleep apnea (SA) in patients hospitalized with acute decompensated heart failure (ADHF), with 54% of the cohort meeting the diagnostic criteria (AHI > 5). Consistent with existing epidemiological data, the majority of these patients were diagnosed with obstructive sleep apnea (OSA, 73%), while 27% had central sleep apnea (CSA), in line with reported prevalence ranges of 21–80%

for OSA and 15–45% for CSA [14–16]. The greater prevalence of CSA among patients with lower left ventricular ejection fraction (LVEF) and elevated NT-proBNP emphasized the complex interplay between the degree of cardiac dysfunction and the type of sleep-disordered breathing. These observations are supported by previous reports, including those by Khayat et al., which linked fluid redistribution and Cheyne–Stokes respiration to an increased CSA incidence in patients with heart failure [17]. Furthermore, as proposed by Draganova et al., implementing targeted screening for SA in high-risk HF populations may enhance clinical outcomes and optimize disease management [18].

In our cohort, CSA patients were slightly older than those with OSA (69.05 vs. 67.08 years), although the difference was not statistically significant ($p = 0.38$). Similar age distributions have been reported in prior HF cohorts, with some attributing the higher CSA prevalence to the accumulation of comorbidities rather than chronological age alone [19,20]. While gender distribution did not differ significantly between groups, a predominance of male patients was noted in the OSA subgroup. This finding is consistent with prior evidence identifying male sex as a risk factor for both OSA and CSA in HF populations [21].

With regard to health status and quality of life (QoL), CSA patients exhibited significantly lower KCCQ scores compared to those with OSA, a finding that reflects the more severe clinical profile in this subgroup, including reduced LVEF, higher NT-proBNP, and elevated heart rate (HR). These results are consistent with prior studies demonstrating that reduced LVEF is a key determinant of diminished QoL and mental health in heart failure [22]. In our study, depressive symptoms were assessed using the Beck Depression Inventory (BDI), with 40.7% of patients reporting mild depression (11–16 points), and no patients meeting criteria for severe depression (>40 points). Several reports have underscored the contribution of CSA beyond hemodynamic burden, highlighting its association with increased sympathetic activity and disrupted sleep architecture—both of which are implicated in the development of depressive and anxiety symptoms [23,24]. This is particularly relevant in advanced HF, where autonomic imbalance is often pronounced. The significant correlation between KCCQ and BDI scores observed in our analysis reinforces the need for clinical strategies that address both the respiratory and psychological dimensions of care in this population [25]. Accordingly, mental health screening may represent a valuable adjunct to SA management in HF, aiding in the early identification of vulnerable patients and informing integrative care approaches [26]. Prior studies have further linked SA to an increased risk of depression and impaired physical functioning, corroborating our findings [27,28].

Patients with OSA demonstrated more favorable QoL and psychological outcomes to those with CSA. These differences underscored the complex pathophysiological relationship between SA phenotype and cardiac dysfunction, particularly the feedback loop that appeared to perpetuate CSA in the setting of ADHF. In support of this, Flint et al. demonstrated that patients with KCCQ scores below 60 are more likely to experience co-occurring depressive and anxiety symptoms [29]. Moreover, Mo et al. reported that post-discharge nursing care was associated with significant improvements in both QoL and mental health indices, emphasizing the value of multidisciplinary follow-up strategies [30].

Our findings also revealed important differences in comorbidities across SA subtypes. Patients with OSA had higher rates of left ventricular hypertrophy (LVH) and type 2 diabetes mellitus (DM) (79% and 74%, respectively), likely driven by a greater body mass index (BMI), higher prevalence of metabolic syndrome, and elevated blood pressure [31,32]. Conversely, CSA patients had a significantly higher prevalence of atrial fibrillation (AF) and ischemic heart disease (IHD) (81% and 86%, respectively), consistent with previous reports [33,34]. Higher NT-proBNP and HR values in this group further support the more advanced heart failure phenotype observed in CSA [35]. These findings

point to the need for individualized therapeutic approaches based on both SA phenotype and associated comorbidities.

Additionally, no significant differences were noted between the groups in terms of sleep-related parameters such as ESS scores, ODI, or time spent under specific desaturation thresholds (90%, 85%, or 80%), likely due to their similar AHI values (42.3 in OSA vs. 34.8 in CSA) [36]. However, OSA patients experienced significantly more snoring episodes, in keeping with the obstructive pathophysiology of this phenotype [37]. Differences in ODI values compared to prior studies—such as those by Khayat et al., which found a higher ODI in CSA—may be attributed to sample size limitations or shorter sleep durations during in-hospital recordings [17].

Finally, correlation analysis revealed a strong relationship between KCCQ and BDI scores, supporting the bidirectional connection between QoL and mental health in patients with SA and ADHF. Central apneas were more closely associated with diminished QoL and moderately associated with depressive symptoms, while OSA events showed weaker associations, consistent with the comparatively better clinical profile of this group. These results are in line with the international literature highlighting the adverse psychological impact of SA in cardiac populations [38,39].

Given the strong correlation between depressive symptoms and reduced quality of life in our cohort, it is relevant to briefly address pharmacological treatment considerations. Although antidepressant use was not a focus of our study, previous trials—such as the SADHART-CHF—have shown that sertraline is safe but has limited efficacy in improving depression or functional outcomes in HF patients [1]. More recent reviews suggest that SSRIs like sertraline and escitalopram may be cautiously considered, especially in selected cases, due to their neutral hemodynamic profile [2]. These findings highlight the complexity of managing depression in HF, particularly in CSA patients, and support the need for integrated, individualized therapeutic approaches [40,41].

Recent evidence supports the integration of SA screening into routine evaluation protocols for hospitalized HF patients, particularly to identify high-risk cases such as CSA. Early detection and treatment have been shown to reduce readmissions and improve symptom control within multidisciplinary care models. Precision medicine approaches further emphasize the value of incorporating markers like AHI, NT-proBNP, LVEF, and autonomic function to guide individualized therapy.

5. Limitations

This study has a few limitations that should be acknowledged. The heterogeneity between the groups, particularly the CSA group's more severe HF characteristics, such as having lower LVEF, higher NT-proBNP, and elevated HR, may have influenced the comparisons. The relatively small size of the CSA group limits the statistical power and generalizability of the results. The absence of a control group without SA restricts the ability to fully isolate the impact of SA on QoL and mental health. Additionally, sleep studies conducted during acute HF episodes in a hospital setting may not represent typical sleep patterns or AHI values. The variability in medication regimens among participants also introduces potential confounding factors. Future research should address these issues with larger, more uniform cohorts and the inclusion of control groups.

However, the strengths of our study are in how it uniquely distinguishes between OSA and CSA in AHF patients, highlighting their differential impact on QoL and mental health, providing valuable insights into phenotype-specific outcomes. Our research also establishes significant correlations between QoL, mental health (BDI scores), and clinical parameters like NT-proBNP, LVEF, and apnea events, offering a comprehensive understanding of the interplay between cardiac and respiratory comorbidities.

6. Conclusions

This study underscores the high prevalence of sleep apnea among patients hospitalized with acute decompensated heart failure and reveals the distinct clinical profiles associated with obstructive and central sleep apnea. CSA was linked to more advanced heart failure, poorer quality of life, and greater depressive symptom burden, whereas OSA patients demonstrated better functional and psychological outcomes. These findings emphasize the importance of incorporating sleep apnea phenotyping and mental health assessment into individualized heart failure management. Targeted interventions addressing both cardiopulmonary and psychological domains may improve prognosis. Further research should explore phenotype-specific strategies to optimize outcomes in this high-risk population.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/jmms12010018/s1, File S1: Original questionnaires in Bulgarian.

Author Contributions: Conceptualization, P.K., E.K. and A.G.; methodology, P.K. and G.V.; software, P.K., N.S. and R.I.; validation, P.K., E.K. and T.V.; formal analysis, T.V.; investigation, P.K., D.S. and G.V.; resources, T.V.; data curation, R.I.; writing—original draft preparation, P.K.; writing—review and editing, T.V. and E.K.; visualization, P.K., N.S. and R.I.; supervision, A.G.; project administration, P.K.; funding acquisition, P.K. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement: This study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Ethics Committee of Medical University of Sofia, protocol code 2100, from 27 April 2016.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Data cannot be shared for ethical/privacy reasons. The data underlying this article cannot be shared publicly due to ethical reasons. The data contain sensitive information and are associated with questionnaires completed by patients. The data will be shared upon reasonable request to the corresponding author, after any sensitive information has been removed.

Conflicts of Interest: All other authors have declared no conflicts of interest.

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