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Association between caregiver burden and quality of life among family caregivers of patients with heart failure: a cross-sectional study

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Abstract

Background

Heart failure is a common and growing public health problem and a leading cause of recurrent hospital admission among adults aged 65 years and older. Family members are central to the provision of long-term care, but caregiving may impose a substantial burden and affect caregivers' quality of life. This study aimed to determine caregivers' quality of life and examine its association with caregiver burden among family caregivers of patients with heart failure.

Methods

This descriptive cross-sectional study was conducted in Zanjan, Iran. The study population comprised family caregivers of patients with New York Heart Association functional class III or IV heart failure who were admitted to Ayatollah Mousavi Teaching Hospital. A convenience sample of 176 caregivers completed a demographic questionnaire, the Novak and Guest Caregiver Burden Inventory, and the World Health Organization Quality of Life–BREF questionnaire. Data were analysed using descriptive statistics, independent-samples t tests, one-way analysis of variance, and multiple linear regression.

Results

The mean caregiver quality-of-life score was 63.3 ± 19.8, and the mean caregiver burden score was 46.34 ± 10.16. The multiple linear regression model was statistically significant ($R = 0.475$, $R^2 = 0.226$, $F = 8.007$, $p < 0.001$). Caregiver burden was the only significant independent predictor of quality of life ($B = -0.652$, $\beta = -0.335$, $p < 0.001$); after adjustment for the other variables, each one-point increase in caregiver burden was associated with a 0.652-point decrease in quality of life.

Conclusions

Caregiver burden was independently and inversely associated with quality of life among family caregivers of patients with heart failure. Early identification of caregivers at risk and the provision of effective supportive, educational, and psychological interventions may help reduce caregiver burden and preserve caregivers' quality of life.

Background

Heart failure (HF) is a major public health problem, affecting more than 5.8 million people in the United States, and its prevalence continues to increase [1]. Worldwide, approximately 26 million people are living with HF, imposing a substantial global economic burden of nearly US$31 billion annually on healthcare systems [2]. In Iran, cardiovascular diseases are the leading cause of death and one of the

most important challenges facing the healthcare system, accounting for more than one-third of all deaths (39%). The prevalence of HF in Iran exceeds 8%, which is higher than that reported in other countries in the region and worldwide [3]. Despite advances in reducing HF-related mortality, recurrent hospital admissions remain common and continue to increase [4].

Heart failure is associated with progressive deterioration in patients' physical and functional status, punctuated by unpredictable and potentially life-threatening episodes that may require repeated hospitalisation. Patients with HF experience symptoms such as dyspnoea, chest pain, weakness, sleep disturbance, and depression, all of which may restrict their physical and social activities [5]. The condition requires lifelong home-based management, including appropriate exercise, lifestyle modification such as dietary changes, symptom monitoring, regular medical follow-up, and adherence to prescribed medications, and patients often require support to undertake these activities [6, 7]. Consequently, HF-related limitations may increase patients' dependence on others [8].

The importance of family caregivers has long been recognised in palliative care [9]. Family caregivers are essential partners in the home care of patients with HF. They support dietary and medication adherence and assist with the early recognition of symptoms [10]. Their support may extend across all aspects of patients' lives, ranging from assistance with basic activities of daily living to emotional, financial, and social support [11]. Because of impaired physical and cognitive health, patients with HF often depend on family members for daily activities and management of their treatment [12].

Although family caregivers provide substantial support to patients, their own health may be adversely affected by the caregiving role [13]. Caregiver burden is not limited to physical demands; it also encompasses psychological, emotional, and financial strain [14]. Caring for a person with HF may affect caregivers' social lives and employment and may impose an economic burden [15]. Among HF caregivers, greater caregiving demands have been associated with higher psychosocial distress, poorer well-being, and worse functional and health status [16–18]. Increased caregiver burden has also been associated with poorer quality of care and, consequently, poorer patient health outcomes [19]. Approximately one-third of HF caregivers are affected by caregiver burden [20]. The workload, depressive symptoms, anxiety, and stress associated with caregiving may further compromise caregivers' health and quality of life [21].

Caregiver burden may be influenced by the availability of family and social support; caregivers with broader social support networks may experience less burden [22]. Healthcare professionals should attend to both patients with HF and their family caregivers because caregivers play a major role in disease management and may influence patient outcomes [23]. Although HF is common and is associated with adverse consequences for patients and multiple challenges for family caregivers, relatively few studies have examined caregiver burden, psychosocial well-being, and quality of life specifically among family caregivers of patients with HF. Caregivers' quality of life is related to multiple factors, indicating a need for further investigation. Although caregiver burden has been extensively studied in other chronic conditions, evidence specific to HF and its associated factors remains limited.

Therefore, this study aimed to determine the association between caregiver burden and quality of life among family caregivers of patients with HF.

Methods

Study design and setting

This descriptive cross-sectional study was conducted in November 2024, to April 2025. The study population comprised all informal caregivers of patients with New York Heart Association (NYHA) functional class III or IV heart failure who attended Ayatollah Mousavi Teaching Hospital in Zanjan, Iran.

Participants and sampling

Eligible caregivers were recruited using convenience sampling. The minimum sample size was calculated based on the smallest correlation coefficient reported between caregiver burden and quality of life in a previous study ($|r| = 0.22$) [24], assuming a two-sided significance level of 0.05 and a statistical power of 80%. After adding 10% to allow for potential non-response or incomplete questionnaires, the required sample size was determined to be 176 participants.

Patients were eligible if they had NYHA class III or IV heart failure confirmed by a cardiologist and had attended Ayatollah Mousavi Teaching Hospital. Caregivers were eligible if they were the patient's primary caregiver, agreed to participate, reported no cognitive disorder, reported no severe physical or mental illness, and had experienced no major life crisis during the preceding six months. Caregivers were excluded if they withdrew from the study or declined to complete the questionnaires.

Data collection and ethical procedures

After permission was obtained from the relevant hospital authorities, the researcher attended the hospital wards and approached caregivers who met the eligibility criteria. The study procedures were explained, and the questionnaires were completed by the participants. The researcher remained available during questionnaire completion to answer questions and ensure that no items were left unanswered.

Measures

Three data collection instruments were used: a demographic information form, the Caregiver Burden Inventory (CBI), and the World Health Organization Quality of Life–BREF (WHOQOL-BREF). The demographic information form was developed by the research team specifically for the present study. The CBI and WHOQOL-BREF were previously published instruments and were not developed for this study.

Demographic information form

Patient characteristics included in the present analyses were age, sex, employment status, marital status, number of children, educational level, and daily working hours. Caregiver characteristics included in the present analyses were age, sex, employment status, educational level, marital status, number of children, relationship to the patient, daily working hours, duration of caregiving in years, and daily caregiving time. The English-language version of the complete demographic information form is provided as Supplementary File 1.

World Health Organization Quality of Life–BREF

The WHOQOL-BREF is a 26-item questionnaire that assesses an individual's overall and general quality of life. It was developed in 1996 by a group of World Health Organization experts through adaptation of the items in the 100-item version [25]. The questionnaire includes four domains and an overall score. The domains are physical health (e.g., energy and fatigue, sleep and rest), psychological health (e.g., negative and positive feelings, memory, and concentration), social relationships (e.g., personal relationships and social support), and environment (e.g., financial resources and access to and quality of health and social care). Responses are rated on a five-point Likert scale ranging from 1 (very low) to 5 (very high). The questionnaire has no cut-off score, and higher scores indicate better quality of life. For ease of interpretation, raw scores were transformed to standardized scores ranging from 0 to 100. The Persian version was validated by Nejat et al.; Cronbach's alpha was greater than 0.70 for all domains, and acceptable validity was reported for each domain [26].

Caregiver Burden Inventory

The Caregiver Burden Inventory (CBI), developed by Novak and Guest in 1989 [27], contains 24 items. It comprises five domains: time-dependence burden, which reflects the amount of time devoted to the patient's daily care; developmental burden, which reflects the burden arising from caregiving during different stages of the caregiver's life; physical burden, which reflects physical strain and exhaustion associated with caregiving; social burden, which reflects the effects of caregiving on the caregiver's social life; and emotional burden, which reflects the effects of caregiving on the caregiver's emotions and feelings. The validity and reliability of the Persian version were confirmed by Abbasi et al. [28], who reported a Cronbach's alpha coefficient of 0.90 for the total scale. Responses are rated on a five-point Likert scale ranging from 1 (very low) to 5 (very high), producing a total score ranging from 24 to 120. Scores of 24–47, 48–71, 72–95, and 96–120 indicate mild, moderate, severe, and very severe caregiver burden, respectively [29].

Statistical analysis

Data were analysed using IBM SPSS Statistics, version 27. Caregiver and patient characteristics were summarized ed using descriptive statistics, including means and standard deviations for continuous

variables and frequencies and percentages for categorical variables. The Kolmogorov–Smirnov test was used to assess the normality of data distributions. Independent-samples t tests and one-way analysis of variance (ANOVA) were used to compare mean scores between groups, and multiple linear regression was used to examine associations between variables. When an overall group difference was statistically significant, least significant difference (LSD) post hoc tests were used for pairwise comparisons. A p value of less than 0.05 was considered statistically significant.

For statistical analysis, selected caregiver characteristics were recoded into broader categories. Age was categorised as < 35, 35–49, and ≥ 50 years; educational level as illiterate, high school diploma or lower, and university education; employment status as employed (employee or self-employed) and not employed (all other occupational categories); number of children as none, 1–2, and ≥ 3; daily working hours as 0, < 8, and ≥ 8 hours; relationship to the patient as spouse, child, and sibling/non-relative; duration of caregiving as 1 year, 2 years, and ≥ 3 years; and daily caregiving time as 1 hour, 2 hours, and ≥ 3 hours.

For caregiver demographic variables, four values were missing for age and number of children, one for employment status, three for relationship to the patient and duration of caregiving in years, and five for daily caregiving time. For patient demographic variables, five values were missing for age and employment status, one for marital status and educational level, and three for daily working hours. Analyses were performed using the available data.

Results

Participant characteristics

Of the patients, 39.2% were men and 60.8% were women. Most patients (77.7%) were aged 50 years or older, 86.5% were unemployed and had insufficient income, and 48.0% were illiterate. In addition, 61.9% took more than five medications per day, and 55.1% had a moderate level of treatment adherence. The mean patient age was 60.5 ± 17.4 years.

Among caregivers, 52.8% were women, and approximately half (50.2%) were the patients' children. Caregivers worked for a mean of 5.3 ± 3.8 hours per day. Nearly half (49.4%) had a university education, and 55.7% lived with the patient. The mean duration of caregiving was 5.5 ± 5.2 years, and the mean daily caregiving time was 6.2 ± 6.5 hours. The mean caregiver age was 43.0 ± 11.7 years; the youngest caregiver was 19 years old and the oldest was 70 years old (Table 1).

Table 1
Demographic characteristics of caregivers and patients with heart failure

Variable	Category	Caregivers, n (%)	Patients, n (%)
Sex	Male	83 (47.2)	69 (39.2)
	Female	93 (52.8)	107 (60.8)
Age (years)	< 35	47 (27.3)	16 (9.4)
	35–49	68 (39.6)	22 (12.9)
	≥ 50	57 (33.1)	133 (77.7)
Marital status	Single	47 (26.7)	30 (17.1)
	Married	129 (73.3)	145 (82.9)
Educational level	Illiterate	17 (9.7)	84 (48.0)
	High school diploma or lower	72 (40.9)	67 (38.3)
	University education	87 (49.4)	24 (13.7)
Relationship to patient	Spouse	41 (23.7)	—
	Child	87 (50.2)	—
	Sibling/non- relative	45 (26.1)	—
Number of children	None	57 (33.1)	32 (18.2)
	1–2	57 (33.1)	28 (15.9)
	≥ 3	58 (33.8)	116 (65.9)
Employment status	Not employed	71 (40.5)	148 (86.5)
	Employed	104 (59.5)	23 (13.5)
Daily working hours	0	54 (30.7)	144 (83.2)
	< 8	48 (27.3)	13 (7.5)
	≥ 8	74 (42.0)	16 (9.3)

Values are presented as n (%). An em dash indicates that the item was not applicable.

Caregiver burden and quality of life

The mean total caregiver burden score was 46.34 ± 10.16, indicating a mild level of burden. The mean scores for time-dependence, developmental, physical, social, and emotional burden were 46.23 ± 4.00, 46.4 ± 23.0, 43.0 ± 24.8, 38.3 ± 23.2, and 32.8 ± 22.0, respectively.

The mean caregiver quality-of-life score was 63.3 ± 19.8. Mean domain scores were 40.19 ± 8.7 for physical health, 45.9 ± 12.1 for psychological health, 37.3 ± 20.2 for social relationships, 39.4 ± 12.4 for environment, and 44.5 ± 20.7 for general health.

Associations with caregiver demographic characteristics

Independent-samples t tests were used for variables with two groups, and one-way ANOVA was used for variables with three or more groups. Statistically significant differences in caregiver burden were observed according to caregiver age, educational level, number of children, relationship to the patient, employment status, daily working hours, and duration of caregiving in years (all $p < 0.05$). LSD post hoc comparisons showed significant differences among all three educational groups, with the highest caregiver burden among caregivers with a university education. Caregivers younger than 35 years differed significantly from both older age groups and had the highest burden, whereas the 35–49-year and ≥ 50-year groups did not differ significantly. Caregivers with one or two children differed significantly from both other groups and had the highest burden; no significant difference was found between caregivers without children and those with three or more children.

Spouses differed significantly from children and had the highest caregiver burden, whereas caregivers who were siblings or non relatives did not differ significantly from either group. Caregivers who were not employed differed significantly from those who worked eight hours or more per day, with the highest burden in the latter group; no other pairwise differences were significant. Caregivers in the first year of caregiving differed significantly from those who had provided care for three years or longer and had the highest burden, whereas no other differences were observed. Caregiver burden was not significantly associated with daily caregiving time, sex, or marital status (all $p > 0.05$).

Quality of life differed significantly according to age, educational level, number of children, employment status, daily working hours, and duration of caregiving in years and hours per day (all $p < 0.05$). LSD post hoc tests showed no significant difference between illiterate caregivers and those with a high school education or lower, whereas caregivers with a university education differed significantly from both groups and had lower quality-of-life scores. Caregivers younger than 35 years did not differ significantly from those aged 35–49 years; however, caregivers aged 50 years or older differed significantly from both younger groups and had the highest quality-of-life scores.

Caregivers without children did not differ significantly from those with one or two children; however, caregivers with three or more children differed significantly from both groups and had higher quality-of-life scores. Caregivers who worked eight hours or more per day differed significantly from those who were not employed and had the lowest quality-of-life scores, whereas no other differences were significant. Caregivers who had provided care for two years did not differ significantly from those with three or more years of caregiving, whereas caregivers in the first year differed significantly from both groups and had the lowest quality-of-life scores. Similarly, caregivers who provided two hours of care per day did not differ significantly from those who provided three hours or more, whereas those who provided one hour of daily care differed significantly from both groups and had the lowest quality-of-life

scores. Quality of life did not differ significantly according to relationship to the patient, sex, or marital status (all $p > 0.05$) (Table 2).

Table 2
Comparison of mean caregiver burden and quality-of-life scores by caregiver demographic characteristics

Variable	Group	Caregiver burden, mean ± SD	Caregiver burden: test statistic; p value	Quality of life, mean ± SD	Quality of life: test statistic; p value
Age (years)	< 35	49.81 ± 10.45	F = 4.95; p = 0.008	55.83 ± 19.22	F = 7.72; p = 0.001
	35–49	45.98 ± 10.11		62.85 ± 21.49	
	≥ 50	43.70 ± 9.16		70.58 ± 15.74	
Sex	Female	45.11 ± 10.30	t = 1.71; p = 0.089	65.23 ± 20.60	t = − 1.40; p = 0.162
	Male	47.72 ± 9.80		61.06 ± 18.73	
Marital status	Single	45.80 ± 9.99	t = − 0.42; p = 0.670	64.28 ± 19.57	t = 0.413; p = 0.680
	Married	46.54 ± 10.25		62.89 ± 19.94	
Educational level	Illiterate	39.00 ± 8.79	F = 11.49; p = 0.001	72.24 ± 24.04	F = 4.30; p = 0.015
	High school diploma or lower	44.24 ± 7.94		65.93 ± 18.62	
	University education	49.52 ± 10.90		59.30 ± 19.12	
Number of children	None	47.04 ± 10.51	F = 6.413; p = 0.002	60.72 ± 20.36	F = 3.180; p = 0.044
	1–2	49.42 ± 10.94		60.67 ± 19.26	
	≥ 3	42.88 ± 8.10		68.48 ± 17.77	
Relationship to patient	Spouse	49.56 ± 10.01	F = 4.700; p = 0.010	63.95 ± 18.35	F = 2.066; p = 0.130
	Child	44.01 ± 9.44		65.33 ± 20.53	
	Sibling/other relative	46.91 ± 10.24		58.24 ± 17.19	

Variable	Group	Caregiver burden, mean ± SD	Caregiver burden: test statistic; p value	Quality of life, mean ± SD	Quality of life: test statistic; p value
Employment status	Not employed	43.85 ± 10.75	t = − 2.51; p = 0.013	68.65 ± 19.42	t = 2.94; p = 0.004
	Employed	47.85 ± 9.45		59.68 ± 19.37	
Daily working hours	0	43.04 ± 9.58	F = 5.69; p = 0.004	69.04 ± 19.56	F = 5.27; p = 0.006
	< 8	45.90 ± 10.08		64.94 ± 19.17	
	≥ 8	49.01 ± 10.00		58.01 ± 19.27	
Duration of caregiving (years)	1	51.03 ± 10.31	F = 5.03; p = 0.008	52.77 ± 16.54	F = 5.77; p = 0.004
	2	46.08 ± 8.37		64.83 ± 14.94	
	≥ 3	44.78 ± 9.88		65.55 ± 20.00	
Daily caregiving time (hours)	1	48.11 ± 11.69	F = 0.43; p = 0.651	46.16 ± 15.64	F = 10.88; p = 0.001
	2	45.53 ± 7.05		60.38 ± 18.93	
	≥ 3	46.11 ± 10.35		66.82 ± 18.58	

SD, standard deviation; t, independent-samples t test; F, one-way analysis of variance.

Table 3
Multiple linear regression analysis of caregiver quality of life

Variable	Unstandardised coefficient (B)	95% CI, lower	95% CI, upper	Standard error	Standardised coefficient (β)	p value
Caregiver burden score	−0.652	−0.940	−0.364	0.146	−0.335	< 0.001
Sex (male vs female)	3.166	−2.288	8.620	2.762	0.080	0.253
Age	0.318	−0.013	0.649	0.159	0.188	0.059
Marital status (married vs single)	−7.906	−16.225	0.413	4.213	−0.177	0.062
Number of children	1.165	−1.613	3.943	1.407	0.101	0.409
Educational level	−0.554	−3.659	2.552	1.573	−0.028	0.725

Model statistics: N = 176; R = 0.475; R^2 = 0.226; F = 8.007; p < 0.001. CI, confidence interval.

Multiple linear regression analysis

The multiple linear regression model examining caregiver quality of life in relation to caregiver burden, sex, age, marital status, number of children, and educational level was statistically significant (R = 0.475, R^2 = 0.226, F = 8.007, p < 0.001). The model explained 22.6% of the variance in quality of life. Among the variables entered into the model, only caregiver burden was a significant independent predictor of quality of life (B = − 0.652, β = −0.335, p < 0.001). Thus, after adjustment for the other variables, each one-point increase in caregiver burden was associated with a 0.652-point decrease in quality of life. Sex, age, marital status, number of children, and educational level were not statistically significant predictors in the adjusted model (all p > 0.05) (Table 3).

Discussion

This descriptive cross-sectional study included 176 family caregivers of patients with heart failure. The mean caregiver burden score was 46.34 ± 10.16 out of 120, indicating mild caregiver burden. The mean quality-of-life score was 63.3 ± 19.8 out of 100, indicating relatively favourable quality of life in the study population.

The findings showed that, on average, family caregivers of patients with HF experienced mild caregiver burden and had relatively favourable quality of life. The comparatively low level of burden may be related to caregivers' gradual adaptation to the caregiving role, support from other family members, access to healthcare services, and experience in managing patients' needs. Patients' clinical status, level of dependence in activities of daily living, and duration of caregiving may also have influenced the intensity

of perceived burden. Similarly, the relatively favourable quality of life may reflect access to supportive resources, appropriate coping strategies, and an ability to maintain personal, family, and social activities alongside caregiving responsibilities. Nevertheless, a mild mean burden score does not indicate an absence of burden among all participants. The dispersion of scores suggests that caregivers' experiences were heterogeneous and that some caregivers may have experienced moderate or severe burden.

In the present study, caregivers' quality of life tended to increase with age, and the lowest mean quality-of-life score was observed among caregivers younger than 35 years. In contrast, Kim et al. [23] reported that quality of life decreased with increasing age, and Ağaslan and Kumaş [30] reported higher quality of life among younger caregivers. This inconsistency may reflect differences in the characteristics of the study populations, particularly caregivers' relationships to patients. In the study by Kim et al., caregivers had a mean age of 57 years and were predominantly patients' spouses. Older spouses may themselves experience physical limitations, chronic illness, and reduced functional capacity; therefore, increasing age may negatively affect their quality of life. By contrast, caregivers in the present study had a mean age of 43 years and were predominantly patients' children. These caregivers may have better physical health and functional capacity and, with increasing age, greater economic stability, experience, and coping skills, which may explain the observed increase in quality of life among older caregivers. Another possible explanation is that younger caregivers often combine caregiving with multiple responsibilities, including employment, education, family formation, and childcare. These overlapping roles may reduce the time available for rest, social activities, self-care, and a balance between personal life and caregiving, thereby reducing quality of life. Older caregivers, in contrast, may have more stable occupational and family circumstances, greater experience of chronic illness, and better adaptation to the caregiving role, enabling them to manage caregiving-related pressures more effectively.

In the present study, employed caregivers and those with a university education had lower quality-of-life scores. In contrast, Cengiz et al. [13] reported lower quality of life among caregivers who were unemployed and had lower educational levels, and Ağaslan and Kumaş [30] similarly reported lower quality of life among unemployed individuals. This inconsistency may be related to differences in the occupational composition of the study samples. In the study by Cengiz et al., 67.5% of caregivers were unemployed, compared with 40.5% in the present study. Employment in the present population may therefore have represented an additional source of obligations, time constraints, stress, and role conflict rather than a protective resource. Because the proportions of university-educated caregivers were similar in the two studies, the association with education may have been influenced by employment status. University-educated caregivers in the present study may have been more likely to be employed and to hold simultaneous social and family responsibilities, contributing to poorer quality of life. Combining employment with caregiving can produce role conflict, time pressure, and physical and psychological fatigue. Employed caregivers must fulfil both professional duties and patient-care responsibilities; this overlap may limit opportunities for rest, social participation, and self-care, ultimately affecting quality of life. This burden may be particularly pronounced in HF, where patients require continuous care, frequent healthcare visits, and daily monitoring. However, employment and educational

level were not identified as independent predictors of quality of life in the multivariable regression analysis. Thus, although differences were observed in the initial analyses, caregiver burden remained the most important factor associated with quality of life after adjustment for other variables.

The lowest quality-of-life score was observed among caregivers who provided only one hour of direct care per day, whereas Ağaslan and Kumaş [30] reported that longer daily caregiving time was associated with poorer quality of life. This discrepancy suggests that the number of hours devoted to direct care may not, by itself, adequately reflect caregiving-related strain. Caregivers' quality of life may also be influenced by concurrent employment, family responsibilities, psychological pressure, the severity of patients' needs, and the availability of social support. Caregivers who provide less direct care may have multiple competing commitments and severe time constraints, which may contribute to poorer quality of life. The present findings suggest that caregivers' quality of life and burden may be influenced more strongly by the simultaneous demands of occupational, family, and caregiving roles than by the duration of direct care alone.

The highest mean caregiver burden was observed during the first year of caregiving. By contrast, Bozkurt Zincir et al. [20] reported greater caregiver burden among individuals who had provided care for more than 36 months. This difference may reflect variations in population characteristics and in caregivers' adaptation to the caregiving role. During the early stages of caregiving, caregivers may need to learn new skills, adapt to the diagnosis, manage changes in family roles, and cope with uncertainty about the future, all of which may increase perceived burden. Over time, some caregivers may gain experience, develop coping strategies, and adapt more effectively to the role, thereby reducing their burden. In other populations, however, prolonged caregiving may lead to caregiver exhaustion and increasing burden. Differences in burden measurement instruments and sample characteristics may also have contributed to the inconsistent findings. Although the present results indicate greater burden at the beginning of the caregiving period, they do not support a definitive linear pattern of increasing or decreasing burden over time. Moreover, the absence of a significant difference between caregivers in the second year and the other groups suggests that burden is probably influenced by multiple factors, including illness severity, patient functional status, family support, caregiver mental health, and coping skills, rather than by caregiving duration alone.

Mean caregiver burden increased with educational level, and caregivers with a university education experienced the highest burden. This finding is consistent with that of Özönder Ünal and Ordu [31]. One possible explanation is that caregivers with higher education may have greater awareness of the nature of HF, its complications, the possibility of repeated hospitalisation, and its long-term consequences. Such awareness may increase their sense of responsibility, worry, and sensitivity to the patient's condition, resulting in greater perceived burden. In addition, individuals with higher education are often employed in specialised or full-time positions, and the combination of occupational and caregiving responsibilities may create greater role conflict, time constraints, and psychological pressure. These circumstances may not only increase caregiver burden but also reduce opportunities for self-care, rest, social activities, and maintenance of mental health, thereby affecting quality of life.

The greatest caregiver burden in the present study was observed among caregivers younger than 35 years and among employed caregivers. Özönder Ünal and Ordu [31] similarly reported that younger caregivers experienced greater burden. In contrast, Durante et al. [32] found that older caregivers experienced greater burden, and Ağaslan and Kumaş [30] reported the highest burden among caregivers aged 40–59 years. In the present study, caregivers younger than 35 years had significantly greater burden than both older groups, whereas no significant difference was observed between caregivers aged 35–49 years and those aged 50 years or older. This pattern may indicate that, in the present population, caregiving strain among younger caregivers was driven largely by the simultaneous demands of occupational, family, and caregiving roles. Older caregivers may have greater stability in their family and occupational circumstances, more experience in managing life challenges and chronic illness, and more effective coping strategies. These factors may explain why caregiver burden remained at a relatively similar level across the age groups older than 35 years.

No significant association was observed between daily caregiving hours and caregiver burden in the present study, whereas Ağaslan and Kumaş [30] reported that longer caregiving hours were associated with greater burden. This inconsistency may be attributable to differences in study populations and socioeconomic circumstances. It also suggests that longer daily caregiving time does not necessarily result in greater burden. The way in which caregiving responsibilities are experienced, the level of social support, coping skills, and the severity of the patient's needs may play important roles in shaping caregiver burden.

Caregiver sex was not significantly associated with caregiver burden in the present study. In contrast, Durante et al. [32] reported greater burden among female caregivers, and Araújo et al. [33] found that women experienced greater pressure because they were simultaneously responsible for multiple other duties. This inconsistency may reflect differences in population characteristics, family structure, cultural context, and the division of caregiving responsibilities. In the study by Durante et al., greater burden among women may also have been associated with traditional female caregiving roles, reduced physical capacity at older ages, longer caregiving duration, and lower social support.

Caregiver burden differed according to the caregiver's relationship to the patient, and the highest mean burden was observed among spouses. However, the statistically significant pairwise difference was limited to spouses versus children; caregivers who were siblings or other relatives did not differ significantly from either group. This finding is consistent with that of Özönder Ünal and Ordu [31], who reported that caring for a spouse was associated with greater burden. Spouses generally assume the principal responsibility for direct care, treatment follow-up, management of daily affairs, and emotional support. In addition, emotional attachment and cohabitation mean that the consequences of illness directly affect multiple aspects of the spouse's life, including physical and mental health, family relationships, and financial circumstances, thereby increasing perceived burden. Children and other relatives, in contrast, may share responsibilities with other family members or spend less time with the patient and may consequently experience less burden.

Caregiver burden differed significantly according to the number of children. Caregivers with one or two children experienced the greatest burden and differed significantly from the other groups, whereas no significant difference was found between caregivers without children and those with three or more children. This finding suggests that the relationship between number of children and caregiver burden is not necessarily linear. Caregivers with one or two children may combine patient care with parenting responsibilities, and the overlap of these roles may increase perceived burden. However, because the factors underlying this association were not directly examined in the present study, the finding should be interpreted cautiously. The literature review also indicated that caregivers' number of children has rarely been examined as a variable related to burden or quality of life; therefore, insufficient evidence was available for direct comparison with previous studies.

Among the variables entered into the regression model, caregiver burden was the only independent predictor of quality of life. The absence of statistically significant demographic predictors does not establish that these characteristics are unimportant; rather, it indicates that they did not independently predict quality of life in this sample after simultaneous adjustment for the other factors. Higher caregiver burden was associated with lower quality of life after adjustment for the remaining variables. This finding is consistent with previous research. Heravi-Karimooi et al. [34] reported that family caregivers of older adults with gastrointestinal cancers experienced substantial caregiver burden, which may be associated with poorer quality of life and impaired physical and mental health. Cengiz et al. [13] also reported a strong inverse correlation between caregiver burden and quality of life, indicating that quality of life declined as burden increased. Similarly, Jafari et al. [14] showed that caregivers of patients undergoing hemodialysis experienced considerable burden and that caregiver burden was significantly and inversely associated with quality of life. The consistency of these findings across different caregiver populations suggests that increasing caregiving responsibilities, the time and energy required for patient care, restriction of personal and social activities, and continuous exposure to patients' physical and psychological needs may deplete caregivers' physical and psychological resources and reduce their quality of life. Regular assessment of caregiver burden, identification of caregivers at risk, and supportive, educational, psychological, and social interventions may therefore play an important role in maintaining and improving family caregivers' quality of life.

Conclusions

This study showed that caregiver burden was the only independent predictor of quality of life among family caregivers of patients with heart failure. Although several demographic characteristics were associated with caregiver burden or quality of life in the unadjusted analyses, higher caregiver burden remained associated with poorer quality of life after adjustment for other individual factors. Younger and employed caregivers and those managing caregiving alongside family responsibilities may be particularly vulnerable because of overlapping roles and competing demands.

These findings highlight the importance of recognizing family caregivers as an essential component of heart failure care. Despite the mild mean caregiver burden and relatively favorable quality of life

observed in this study, the chronic and progressive nature of heart failure may expose caregivers to increasing physical and psychological strain over time. Early identification of caregivers at risk, regular assessment of caregiver burden, and access to supportive, educational, counselling, and psychological interventions may help preserve caregivers' quality of life and enable them to provide more effective and sustainable care.

A strength of this study was the simultaneous assessment of caregiver burden and quality of life in a relatively large sample of 176 family caregivers using validated questionnaires. In addition, multiple linear regression allowed the independent association between caregiver burden and quality of life to be examined after controlling for several individual and demographic factors. However, convenience sampling and recruitment from a single hospital may limit the generalizability of the findings. Furthermore, the cross-sectional design does not allow causal relationships or changes over time to be determined. The use of self-report questionnaires may also have introduced recall or social desirability bias

Declarations

Ethics approval and consent to participate

The study was approved by the Ethics Committee of Zanjan University of Medical Sciences (IR.ZUMS.REC.1403.257). All procedures were performed in accordance with relevant ethical guidelines and regulations and the principles of the Declaration of Helsinki. Family caregivers of patients with heart failure participated after providing written informed consent. Participants were informed about the study objectives, confidentiality of identifying information, their right to withdraw from the study, and all other relevant ethical requirements.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

AA contributed to conceptualization, methodology, supervision, and critical revision of the manuscript. EH contributed to investigation, data collection, literature review, project administration, and preparation of the original draft. AV served as a study advisor and contributed to methodology, supervision, interpretation of the findings, and critical revision of the manuscript. RF contributed to statistical methodology, formal analysis, interpretation of the results, and critical revision of the manuscript. All authors read and approved the final manuscript.

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Use of generative artificial intelligence

A large language model was used solely to assist with translation of the manuscript from Persian into English and with linguistic editing. The authors reviewed the translated manuscript and remain fully responsible for the scientific content, data, analyses, interpretations, and references.

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