ORIGINAL RESEARCH ARTICLE

Evaluating the Impact of a Structured Educational Program with Telephone Follow-up on Caregiver Burden in Multiple Sclerosis: A Quasi-Experimental Study in Iran

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Abstract

Background Caregivers of individuals with multiple sclerosis experience considerable burdens. Given that educational and supportive interventions can reduce caregiver strain, telephone-based programs offer a potentially accessible and cost-effective solution; however, structured telephone follow-up initiatives remain under-researched in the Middle East. This study aimed to investigate the effect of a face-to-face educational program with telephone follow-up on caregiver burden among family caregivers of patients with multiple sclerosis in Iran.

Methods This quasi-experimental study was conducted in Iran from 2019 to 2020. Ninety-five family caregivers of multiple sclerosis patients were recruited through convenience sampling and, to minimize contamination, allocated by attendance day after a simple random draw: odd days to the control group (n = 47) and even days to the intervention group (n = 48). The intervention group received three face-to-face educational sessions plus one month of telephone follow-up, whereas the control group received routine care. Caregiver burden was self-assessed using the Zarit Burden Interview at baseline and two months post-intervention. Data were analyzed with SPSS version 25.

Results Baseline demographic and clinical characteristics showed no statistically significant differences between the two groups (all $p > 0.05$). The intervention group demonstrated a statistically significant reduction ($p < 0.001$), whereas the control group did not show a significant change ($p = 0.257$). The post-intervention difference between the groups, assessed using an independent t-test, was statistically significant ($p < 0.001$).

Conclusion This single-center, non-blinded trial with a two-month follow-up suggests that a combined educational and telephone follow-up program may reduce caregiver burden in family caregivers of MS patients. Although the intervention is low-cost and scalable, further multi-center, blinded studies with longer follow-up are needed before recommending routine integration into multiple sclerosis care

Keywords Education, Family, Multiple Sclerosis, Caregiver Burden, Caregivers, Telephone

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1 Introduction

Multiple sclerosis (MS) is a chronic autoimmune CNS disorder causing demyelination, impaired nerve transmission, and progressive physical, cognitive, and psychological symptoms.[1] Globally, more than 2.8 million individuals are affected by MS, with prevalence rates exhibiting an upward trend in recent decades.[2] In Iran, the pooled prevalence of MS is estimated at 100 per 100,000 people, with the highest prevalence reported in Tehran province and the lowest in Khuzestan and Sistan-Baluchestan provinces.[3]

Patients diagnosed with MS often require ongoing medical care, which imposes significant burdens on family caregivers, adversely affecting their physical, communicative, social, and emotional quality of life in comparison to the general population.[4, 5] Caregiver burden encompasses the physical, psychological, social, and financial stresses experienced by individuals providing care to those with chronic illnesses.[6]

Family caregivers of MS patients encounter distinct challenges, including role adjustments, emotional exhaustion, and social isolation; yet, their needs are frequently neglected within healthcare systems.[7] Telephone-based follow-up remains well-suited to this population because it does not require smartphone ownership, digital literacy, or internet access, which may be inconsistent among Iranian caregivers, particularly older adults and those in rural areas. It also provides immediate, personalized support and has shown promise in empowering caregivers, improving coping, and reducing caregiver burden.[8, 9] Given these advantages, actively involving nurses in the delivery of structured telephone-based education and follow-up has the potential to address health-related barriers and improve outcomes for caregivers.[9, 10]

Prior studies have established the effectiveness of educational programs in mitigating caregiver burden in chronic conditions such as stroke and dementia.[11] For instance, Rakhshan et al. reported that collaborative care models significantly increased hope among caregivers of MS patients.[12] However, most interventions rely on in-person sessions, which may not provide the ongoing support, real-time problem-solving, and reinforcement caregivers need as challenges fluctuate. Telephone follow-up addresses this gap by offering continuous, accessible, and individualized support that overcomes geographical, temporal, and mobility barriers.[10] Despite these theoretical benefits, no study has examined the combined effect of structured face-to-face education and systematic telephone follow-up on caregiver burden in MS care in Iran. This quasi-experimental study, therefore, aimed to investigate the impact of such an intervention on caregiver burden among family caregivers of patients with MS in Iran.

2 Methods

Study Design and Setting

This quasi-experimental study used a pre- and post-test design. The study was conducted at the MS Association of Hamadan City, Iran, from 2019 to 2020. Because the behavioral intervention involved face-to-face education and active telephone follow-up delivered by the primary researcher, blinding of participants and the interventionist was not feasible. Data were obtained through self-report questionnaires completed independently by the caregivers; therefore, the participants themselves served as the assessors of their own burden and were unblinded. The research team members who distributed and collected the questionnaires, as well as the statistician who performed the data analysis, were also aware of group allocation. Consequently, neither the data collection process nor the statistical analysis was blinded.

Participants and Sampling

The study population comprised family caregivers of patients with MS referred to the Hamadan MS Association. Using convenience sampling, 100 eligible caregivers were recruited. Written informed consent was obtained from all participants. Confidentiality was upheld; participants retained the right to withdraw at any point, and educational materials were provided to the control group upon completion of the study. To minimize contamination due to information exchange among members of the same association, group allocation was based on attendance day. Prior to enrollment, a simple lottery determined that odd calendar days would correspond to the control group and even days to the intervention group. Accordingly, caregivers presenting on odd days were assigned to the control group (n = 50) and those on even days to the intervention group (n = 50).

Sample Size Calculation

The sample size was calculated using data from Özmen and Yurttaş, who reported a mean Zarit Burden Interview (ZBI) score of 25.44 with a standard deviation of 9.50 among caregivers of patients with MS in Turkey. Assuming a clinically meaningful between-group difference of 6.5 points (approximately 0.68 standard deviations) and setting the two-sided significance level at 0.05 with a power of 90%, the minimum required sample size per group was computed as 45 using the standard formula for an independent t-test. To allow for a potential attrition rate of approximately 10%, the target enrollment was set at 50 caregivers per group.[13]

$$n = \frac{2\left(Z_{\alpha/2} + Z_{\beta}\right)^2}{(\Delta/\sigma)^2}$$

$$n = \frac{2 \times (1.96 + 1.28)^2}{(0.68421)^2} = \frac{2 \times (3.24)^2}{0.46815} = \frac{2 \times 10.4976}{0.46815} = \frac{20.9952}{0.46815} \approx 44.85$$

$$\xrightarrow{\text{10\% attrition}} \frac{44.85}{0.90} \approx 49.83 \rightarrow 50 \text{ per group}$$

Inclusion and Exclusion Criteria

Inclusion criteria for caregivers included: age between 18 and 55 years; being the primary caregiver of a patient with an Expanded Disability Status Scale (EDSS) score ≥ 5; having a ZBI score > 21; providing direct care; having no diagnosed psychiatric illness; possessing a mobile phone; and being fluent in Persian. Caregivers were excluded if they withdrew consent, if the patient passed away, or if the patient was hospitalized during the study period.

Data Collection Instruments

Data were collected utilizing three instruments:

1. Demographic and Baseline Characteristics Form: This instrument included items pertaining to both the patient (age, gender, education level, disease duration, history of previous illness, personal ability for self-care, need for daily care) and the caregiver (age, gender, education level, household head status, health insurance coverage, and receipt of organizational/association support). Completion was self-reported by the caregiver.
2. EDSS: EDSS is a physician-administered scale that assesses disability across eight functional systems, yielding a score from 0 (normal neurological examination) to 10 (death due to MS).[14, 15] In the present study, the scale was completed by the attending physician at the association and was used to verify participant eligibility. Patients were enrolled if their EDSS score was 5 or greater. The EDSS has demonstrated acceptable psychometric properties in MS populations: inter-rater reliability is adequate for group comparison studies (intraclass correlation coefficient [ICC] = 0.78), intra-rater reproducibility ranges from 0.62 to 0.94, convergent and discriminant validity have been established, and the scale is widely accepted as a primary endpoint in clinical trials.[16, 17]
3. ZBI: This 22-item self-report tool measures caregiver burden on a 5-point Likert scale ranging from 0 (never) to 4 (nearly always), with total scores spanning from 0 to 88. Higher scores indicate a greater burden. Scores are categorized as little or no burden (0–20), mild to moderate burden (21–40), moderate to severe burden (41–60), and severe burden (61–88).[18, 19] The Persian version has demonstrated high reliability in previous studies (Cronbach's α up to 0.94).[20, 21] In the present study, internal consistency was found to be excellent (Cronbach's α = 0.93). Caregivers completed the ZBI at baseline and two months post-intervention.

Intervention Protocol

Following baseline assessment, the intervention group received a structured, multi-component program designed to ensure intervention fidelity and comprehensive caregiver education. The program consisted of two main phases:

Face-to-Face Education. Three standardized one-hour sessions were delivered over 2 weeks at the MS Association. Each session was conducted in small groups of 16–17 caregivers to facilitate interactive discussion and personalized guidance. To maintain fidelity, all sessions followed a pre-defined curriculum and a detailed facilitator guide, and were conducted by the same researcher using a consistent slide deck. Delivery methods included lectures, counseling, question-and-answer periods, and group discussion. The standardized content was as follows:

Session 1: Pathophysiology of MS, its effects on different body systems, the disease course, common symptoms (including fatigue, spasticity, and cognitive changes), and the importance of fall prevention and safe mobility.

Session 2: Medication adherence and proper administration; nutritional guidelines, including an appropriate diet for managing bladder and bowel dysfunction, constipation, chewing and swallowing difficulties, the role of vitamins and adequate hydration; and practical strategies for pressure ulcer prevention.

Session 3: The importance of tailored physical activity and safe exercise; the impact of stress on symptom exacerbation; stress management techniques (e.g., relaxation, breathing exercises, guided imagery); energy conservation strategies; and caregiver self-care, including coping with emotional burden and accessing social support.

Telephone Follow-Up. After the face-to-face sessions, the primary researcher conducted telephone follow-ups every three days for 2 weeks. Each call lasted between 10 and 15 minutes. A semi-structured telephone script was used to review the educational content systematically, reinforce key care practices (medication schedule, dietary modifications, exercise, and stress reduction), address caregivers' questions, and provide ongoing emotional support. Caregivers also had the option to call the researcher during specified hours if additional questions arose.

Intervention fidelity was assessed through multiple measures. Session content was standardized via the curriculum and slide deck, and the same researcher delivered all sessions. Telephone calls followed the semi-structured script to ensure consistent delivery. Adherence was monitored by recording attendance at each educational session and maintaining a log of completed telephone follow-up calls. All intervention components were documented in a study-specific tracking form.

Control Group. The control group received only the routine care and passive educational resources typically

available at the MS Association, without any structured face-to-face sessions, standardized curriculum, or proactive telephone follow-up.

To evaluate the sustained effect of the intervention, a follow-up assessment was conducted at two months following the completion of the telephone follow-up period. At this time point, caregiver burden was reassessed in both groups using the ZBI, which was self-reported by the caregivers.

Data Analysis

Statistical analyses were performed using SPSS version 25. Descriptive statistics (mean, standard deviation, frequency, and percentage) were computed to summarize sample characteristics. Normality of continuous variables was assessed using the Kolmogorov–Smirnov test. Between-group comparisons of quantitative data were conducted with independent-samples t-tests, while within-group changes in caregiver burden from baseline to the two-month follow-up were evaluated using paired-samples t-tests. Categorical variables were compared using the chi-square test or Fisher's exact test, as appropriate, when expected cell frequencies were below five. A two-tailed p-value < 0.05 was considered statistically significant.

This quasi-experimental study was approved by the Ethics Committee of Hamadan University of Medical Sciences (Ethics Code: REDUCTED). The trial was registered with the Iranian Registry of Clinical Trials (REDUCTED).

3 Results

A total of 180 caregivers were initially assessed for eligibility. Of these, 70 did not meet the inclusion criteria, and 10 declined to participate, resulting in 100 eligible caregivers who were enrolled and assigned to the intervention (n = 50) and control (n = 50) groups. During the study, three participants from the control group and two from the intervention group withdrew due to unwillingness to continue participation. Consequently, the final analysis included 47 caregivers in the control group and 48 in the intervention group. In addition, all demographic and clinical variables, as well as the study outcomes, were normally distributed (P > 0.05). The demographic and clinical characteristics of the patients cared for by the 95 caregivers are presented in Table 1. No statistically significant differences were observed between the two groups with respect to patients' age, gender, education level, history of previous illness, duration of illness, capacity for self-care, need for daily care, household head status, health insurance coverage, or receipt of organizational support (all p > 0.05).

Table 1 Comparison of demographic and clinical characteristics of patients in the intervention and control groups

Variable	Control group (n = 47)	Intervention group (n = 48)	P-value
Age (Mean ± SD)	33.06 ± 10.25	36.12 ± 9.80	0.140†
Gender (n, %)			0.227**
- Male	14 (29.8%)	20 (41.7%)	
- Female	33 (70.2%)	28 (58.3%)	
Education level (n, %)			0.576*
- Illiterate	2 (4.3%)	5 (10.4%)	
- Below diploma	8 (17.0%)	8 (16.7%)	
- Diploma	28 (59.6%)	30 (62.5%)	
- University	8 (17.0%)	5 (10.4%)	
History of previous illness (n, %)			0.667*
- Yes	3 (6.4%)	2 (4.2%)	
- No	44 (93.6%)	46 (95.8%)	
Duration of illness, years (Mean ± SD)	4.79 ± 1.70	5.32 ± 1.94	0.165†
Personal ability for self-care (n, %)			0.726*
- Very high	2 (4.3%)	2 (4.2%)	
- High	2 (4.3%)	2 (4.2%)	
- Moderate	21 (44.7%)	28 (58.3%)	
- Low	21 (44.7%)	15 (31.3%)	
- Very low	1 (2.1%)	1 (2.1%)	
Need for daily care (n, %)			0.819*
- Very high	18 (38.3%)	14 (29.2%)	
- High	25 (53.2%)	30 (62.5%)	
- Moderate	2 (4.3%)	1 (2.1%)	
- Low	1 (2.1%)	2 (4.2%)	
- Very low	1 (2.1%)	1 (2.1%)	
Household head (n, %)			0.660**
- Yes	9 (19.1%)	12 (25.0%)	
- No	38 (80.9%)	36 (75.0%)	
Health insurance coverage (n, %)			0.310*
- Yes	46 (97.9%)	48 (100.0%)	
- No	1 (2.1%)	0 (0.0%)	
Receiving organizational/association Support (n, %)			0.242*
- Yes	45 (95.7%)	48 (100.0%)	
- No	2 (4.3%)	0 (0.0%)	

*Fisher's exact test, ** Chi-square test, † Independent t-test

The demographic and socioeconomic characteristics of the corresponding caregivers are detailed in Table 2. Similarly, no statistically significant differences were noted between the caregivers in the control and intervention groups across all assessed variables, including age, gender, marital status, education, medical background, relationship to the patient, caregiving duration, occupation, income level, household size, living arrangements, and perceptions of the patient's condition ($p > 0.05$ for all comparisons).

Table 2 Comparison of demographic and socioeconomic characteristics of caregivers in the intervention and control

Variable	Control group (n = 47)	Intervention group (n = 48)	P-value
Age (mean ± sd)	39.74 ± 8.07	38.41 ± 9.98	0.477†
Gender (n, %)			0.182**
- Male	27 (57.4%)	21 (43.8%)	
- Female	20 (42.6%)	27 (56.2%)	
Marital status (n, %)			0.732*
- Single	5 (10.6%)	7 (14.6%)	
- Married	37 (78.7%)	33 (68.8%)	
- Divorced	2 (4.3%)	4 (8.3%)	
- Widowed	3 (6.4%)	4 (8.3%)	
Education level (n, %)			0.774*
- Illiterate	3 (6.4%)	3 (6.3%)	
- Below diploma	3 (6.4%)	6 (12.5%)	
- Diploma	28 (59.6%)	25 (52.1%)	
- University	13 (27.7%)	14 (29.2%)	
Related medical education (n, %)			0.106**
- Yes	8 (17.0%)	15 (31.3%)	
- No	39 (83.0%)	33 (68.8%)	
Family relationship to patient (n, %)			0.252*
- Father	16 (34.0%)	9 (18.8%)	
- Mother	10 (21.3%)	10 (20.8%)	
- Spouse	13 (27.7%)	16 (33.3%)	
- Sister	2 (4.3%)	5 (10.4%)	
- Brother	2 (4.3%)	0 (0.0%)	
- Child	4 (8.5%)	8 (16.7%)	
Duration of caregiving, years (Mean ± SD)	5.29 ± 1.88	5.97 ± 1.81	0.076†
Has other responsibilities (n, %)			0.616**
- Yes	7 (14.9%)	9 (18.8%)	
- No	40 (85.1%)	39 (81.3%)	
Has specific/chronic illness (n, %)			0.864**
- Yes	12 (25.5%)	13 (27.1%)	
- No	35 (74.5%)	35 (72.9%)	
Residence (n, %)			0.558**
- Urban	33 (70.2%)	31 (64.6%)	
- Rural	14 (29.8%)	17 (35.4%)	
Housing status (n, %)			0.972**
- Rented	5 (10.6%)	5 (10.4%)	
- Owned	42 (89.4%)	43 (89.6%)	
Occupation (n, %)			0.264*
- Unemployed	1 (2.1%)	3 (6.3%)	
- Farmer	3 (6.4%)	3 (6.3%)	
- Homemaker	12 (25.5%)	17 (35.4%)	
- Laborer	3 (6.4%)	3 (6.3%)	
- Employee	15 (31.9%)	9 (18.8%)	
- Self-employed	10 (21.3%)	4 (8.3%)	
- Retired	1 (2.1%)	4 (8.3%)	
- Student	2 (4.3%)	5 (10.4%)	
Has a specific source of income (n, %)			0.180**
- Yes	28 (59.6%)	22 (45.8%)	
- No	19 (40.4%)	26 (54.2%)	
Monthly household income (n, %)			0.710*
Low income	1 (2.1%)	0 (0.0%)	
Moderate income	2 (4.3%)	2 (4.2%)	
High income	44 (93.6%)	46 (95.8%)	
Household size (mean ± sd)	3.31 ± 0.86	3.00 ± 1.09	0.118†
Lives with the patient (n, %)			0.278*
- Yes	41 (87.2%)	45 (93.8%)	
- No	6 (12.8%)	3 (6.3%)	
Receives organizational/ association support (n, %)			0.998*
- Yes	46 (97.9%)	47 (97.9%)	
- No	1 (2.1%)	1 (2.1%)	
Perception of patient's personal ability (n, %)			0.224*
- Very high	1 (2.1%)	0 (0.0%)	
- High	8 (17.0%)	14 (29.2%)	
- Low	37 (78.8%)	34 (70.8%)	
- Very Low	1 (2.1%)	0 (0.0%)	
Perception of patient's need for daily care (n, %)			1.000*
- Very high	2 (4.3%)	3 (6.3%)	
- High	43 (91.5%)	44 (91.7%)	
- Low	1 (2.1%)	1 (2.1%)	
- Very low	1 (2.1%)	0 (0.0%)	

*Fisher's exact test, ** Chi-square test, † Independent t-test

The primary outcome, caregiver burden, was evaluated for both within-group and between-group differences using paired t-tests and independent t-tests, respectively, as shown in Table 3. At baseline, mean caregiver burden scores were comparable between the control group (69.36 ± 8.88) and the intervention group (70.42 ± 5.44), with no statistically significant difference ($p = 0.482$). Following the intervention, caregiver burden scores in the control group remained stable (67.45 ± 7.47, $p = 0.257$), whereas the intervention group exhibited a marked and statistically significant reduction (39.49 ± 7.30, $p < 0.001$). Consequently, post-intervention between-group analysis revealed a highly significant difference ($p < 0.001$), with participants in the intervention group demonstrating substantially lower caregiver burden scores compared with those in the control group.

Table 3 Between- and within-group comparison of caregiver burden scores before and after the intervention

Time point	Control group (n = 47) (M ± SD)	Intervention group (n = 48) (M ± SD)	Test statistic	P-value
Pre-intervention	69.36 ± 8.88	70.42 ± 5.44	0.705	0.482*
Post-intervention	67.45 ± 7.47	39.49 ± 7.30	18.257	< 0.001
Test Statistic	1.140	23.538	–	–
P-value (Paired)	0.257**	< 0.001**	–	–

*Independent t-test, **Paired t-test

4 Discussion

This study evaluated the impact of a structured education with telephone follow-up program on caregiver burden among family caregivers of patients with MS. The intervention was designed as a multi-component program comprising three face-to-face educational sessions followed by telephone follow-up over one month. Each component likely contributed to burden reduction through distinct but complementary pathways.

The findings revealed a critical gap in caregiver knowledge. Prior research in Iranian MS caregiver populations has documented that inadequate training and support constitute major factors contributing to caregiver stress, anxiety, and burden.[22] By providing structured information on MS pathophysiology, symptom management, medication adherence, nutrition, fall prevention, pressure ulcer care, physical activity, stress management, and caregiver self-care, the educational sessions likely enhanced caregivers' objective knowledge and practical caregiving skills. Improved knowledge and skill acquisition have been identified as key mediators in psychoeducational interventions for caregiver burden across various chronic conditions.[23]

Additionally, perhaps more importantly, the acquisition of practical caregiving knowledge may have enhanced caregivers' perceived self-efficacy and their confidence in their ability to manage caregiving tasks effectively. Self-efficacy has been identified as a critical mediator in the transactional stress and coping model, wherein it shapes primary appraisal of stressors and influences coping resource mobilization.[24] Among Iranian MS caregivers, a significant positive correlation between health literacy and self-efficacy has been documented, and family-centered empowerment interventions have been shown to improve both health literacy and self-efficacy in this population.[24] A self-management program for family caregivers of people with MS in Iran similarly demonstrated that reducing care burden was accompanied by increased self-efficacy.[25] In the present study, the educational curriculum explicitly addressed caregiver self-care, coping with emotional burden, and accessing social support, all of which may have contributed to enhanced perceived competence.

Third, the telephone follow-up component provided ongoing reinforcement, real-time problem-solving, and emotional support beyond what face-to-face sessions alone could offer. In Iran, caregivers, particularly those in rural areas or of older age, may face barriers related to transportation, mobility, and smartphone or internet access. Telephone-based follow-up overcomes these barriers while providing synchronous, personalized interaction. A meta-analysis of telehealth interventions for caregivers of people with dementia found that telephone-based interventions significantly reduced caregiver burden and depression, with tailored approaches showing greater effectiveness than standardized ones.[26]

Furthermore, structured telephone support programs have demonstrated effectiveness in reducing loneliness and social isolation,[27] factors that are particularly relevant to MS caregivers who frequently report emotional exhaustion and social withdrawal due to the demands of caregiving.[7] The regular telephone contacts in the present study, every three days for 2 weeks, may have mitigated feelings of isolation by providing a sustained connection to a healthcare professional who could validate caregivers' concerns and offer immediate guidance.

The synergistic combination of these components, knowledge transfer, skill building, self-efficacy enhancement, and sustained telephone-based emotional and practical support, likely explains the large effect observed. This interpretation is consistent with findings from a systematic review and network meta-analysis by Chen et al, which demonstrated that psychosocial interventions incorporating multiple active components produce significant reductions in caregiver burden, with

effect sizes varying by intervention type and context.[28] Similarly, Homayouni et al., in an experimental study of a healthy lifestyle empowerment program delivered virtually to MS caregivers in Iran, reported a reduction in caregiver burden scores at three-month follow-up ($p < 0.001$), a magnitude comparable to that observed in the present study.[29]

The present findings align with a growing body of evidence supporting the effectiveness of educational and telehealth interventions in reducing caregiver burden across various chronic disease contexts. Gök Uğur and Erci reported that home care training and caregiver education significantly decreased burden among caregivers of stroke patients.[11] Ortiz-Piña et al. demonstrated that telehealth interventions for family caregivers of older adults with multiple diseases can reduce caregiver burden and improve psychological well-being and caregiving competence in the short term.[30] In the MS-specific context, Pahlavanzadeh et al. found that a group psycho-education program significantly reduced burden among family caregivers of MS patients in Isfahan, Iran,[20] while a pilot trial of a remotely delivered psychoeducational intervention with telecoaching for MS caregivers demonstrated preliminary efficacy in improving emotional outcomes.[31]

The approximately 31-point reduction in ZBI scores observed in the intervention group represents a clinically meaningful improvement, shifting caregivers from the "severe burden" category to the "mild-to-moderate burden" category.[19] Although minimally clinically important difference (MCID) thresholds for ZBI scores in MS caregivers have not yet been firmly established, the magnitude of improvement observed in this study suggests substantial practical significance. The high baseline burden observed in the present sample may also have contributed to the large intervention effect, as caregivers experiencing severe burden may derive greater benefit from interventions targeting unmet informational and emotional needs.

Another noteworthy finding is that the intervention combined both educational and supportive elements rather than relying solely on information transfer. Contemporary caregiver intervention models increasingly emphasize that emotional support, empowerment, and sustained professional contact may be as important as factual disease education in reducing caregiver burden. The integration of these components may therefore explain the relatively strong effect size observed in the present study.

Several limitations should be considered when interpreting the findings. First, the study was conducted in a single MS association in Hamadan, Iran, which may limit the generalizability of the findings to other cultural or healthcare settings. Second, the two-month follow-up period does not permit evaluation of the long-term sustainability of the intervention effects. Third, because of the behavioral nature of the intervention, blinding of participants and researchers was not feasible, which may have increased the risk of performance, detection, and social desirability biases, although validated instruments and pre-specified analyses were used to minimize these concerns. Fourth, the inclusion criteria restricted participation to caregivers of patients with relatively severe disability (EDSS ≥ 5) and caregivers aged 18–55 years. While this approach increased the likelihood of detecting intervention effects among highly burdened caregivers, it may also have increased the risk of regression to the mean and limited applicability to older caregivers or caregivers of patients with milder disease severity.

5 Conclusion

Overall, the findings of this study provide preliminary evidence that a structured educational intervention combined with systematic telephone follow-up may be effective in reducing caregiver burden among family caregivers of patients with MS. The intervention appears to address important informational, emotional, and supportive needs through a practical and relatively low-cost approach. Nevertheless, further multi-center randomized controlled trials with longer follow-up periods, blinded outcome assessment, and broader eligibility criteria are needed to confirm the effectiveness and sustainability of this intervention before routine implementation in neurological and nursing care settings can be recommended.

Declarations

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Artificial Intelligence Disclosure
In the preparation of this manuscript, the free version of DeepSeek was utilized exclusively for translating Persian content into English.

Authors' Contributions
M.J. & M.S.: Conceptualization, methodology, investigation, data collection, writing the original draft. N.K.: Conceptualization, methodology, investigation, writing – review & editing, supervision, project administration. A.A.: Conceptualization, investigation, data collection, formal analysis, writing – review & editing. All authors have read and approved the final manuscript.

Availability of Data and Materials
The datasets generated and analyzed during the current study

are not publicly available due to privacy and ethical restrictions but are accessible from the corresponding author upon reasonable request.

Conflict of Interest
The authors declare no competing interests.

Consent for Publication
Not applicable.

Ethical Considerations
This quasi experimental study was approved by the Ethics Committee of Hamadan University of Medical Sciences (Ethics Code: IR.UMSHA.REC.1398.149). The trial was registered with the Iranian Registry of Clinical Trials (IRCT20170130032303N6). Written informed consent was obtained from all participants.

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References

1. Haki M, Al-Biati HA, Al-Tameemi ZS, Ali IS, Al-Hussaniy HA. Review of multiple sclerosis: Epidemiology, etiology, pathophysiology, and treatment. Medicine (Baltimore). 2024;103(8):e37297. doi: 10.1097/MD.0000000000037297.
2. Walton C, King R, Rechtman L, Kaye W, Leray E, Marrie RA, et al. Rising prevalence of multiple sclerosis worldwide: Insights from the Atlas of MS. Mult Scler. 2020;26(14):1816-21. doi: 10.1177/1352458520970841.
3. Mirmosayyeb O, Shaygannejad V, Bagherieh S, Hosseinabadi AM, Ghajarzadeh M. Prevalence of multiple sclerosis (MS) in Iran: a systematic review and meta-analysis. Neurol Sci. 2022;43(1):233-41. doi: 10.1007/s10072-021-05750-w.
4. Ponzio M, Tacchino A, Verri A, Battaglia MA, Brichetto G, Podda J. Profile and burden of the family caregiver: the caring experience in multiple sclerosis. An observational study. BMC Psychol. 2024;12(1):173. doi: 10.1186/s40359-024-01678-w.
5. Maguire R, Maguire P. Caregiver burden in multiple sclerosis: recent trends and future directions. Curr Neurol Neurosci Rep. 2020;20(7):18. doi: 10.1007/s11910-020-01043-5.
6. Loo YX, Yan S, Low LL. Caregiver burden and its prevalence, measurement scales, predictive factors, and impact: a review with an Asian perspective. Singapore Med J. 2022;63(10):593-603. doi: 10.11622/smedj.2021033.
7. Benini S, Pellegrini E, Descovich C, Lugaresi A. Burden and resources in caregivers of people with multiple sclerosis: A qualitative study. PLoS One. 2023;18(4):e0265297. doi: 10.1371/journal.pone.0265297.
8. Rezvaniamin M, Salar A, Pournamdar Z, Yousefian N. Effect of progressive muscle relaxation on headache-related disability in patients with multiple sclerosis: A quasi-experimental study. J Res Dev Nurs Midw. 2025;22(4):34-9. doi: 10.29252/jgbfnm.22.4.34.
9. Nasreen HE, Ahmad SABS, Tyrrell M, Zin NM, Aziz KHA, Aris MAM, et al. Telephone-based intervention improves quality of life among family caregivers of persons with dementia in Malaysia: the mediating role of caregiver burden. BMC Geriatr. 2026;26(1):307. doi: 10.1186/s12877-026-07066-w.
10. Graven LJ, Glueckauf RL, Regal RA, Merbitz NK, Lustria ML, James BA. Telehealth interventions for family caregivers of persons with chronic health conditions: a systematic review of randomized controlled trials. Int J Telemed Appl. 2021;2021(1):3518050. doi: 10.1155/2021/3518050.
11. Gok Ugur H, Erci B. The effect of home care for stroke patients and education of caregivers on the caregiver burden and quality of life. Acta Clin Croat. 2019;58(2.):321-32. doi: 10.20471/acc.2019.58.02.16.
12. Rakhshan M, Ganjalivand S, Zarshenas L, Majdinasab N. The effect of collaborative care model-based intervention on hope in caregivers and patients with multiple sclerosis: a randomized controlled clinical trial. Int J Community Based Nurs Midwifery. 2018;6(3):218.
13. Özmen S, Yurttaş A. Determination of Care Burden of Caregivers of Patients with Multiple Sclerosis in Turkey. Behav Neurol. 2018;2018. doi: 10.1155/2018/7205046.
14. Vickrey B, Hays R, Harooni R, Myers L, Ellison G. A health-related quality of life measure for multiple sclerosis. Qual Life Res. 1995;4(3):187-206. doi: 10.1007/BF02260859.
15. Kurtzke JF. Rating neurologic impairment in multiple sclerosis: an expanded disability status scale (EDSS). Neurology. 1983;33(11):1444-52. doi: 10.1212/wnl.33.11.1444.
16. Sharrack B, Hughes RA, Soudain S, Dunn G. The psychometric properties of clinical rating scales used in multiple sclerosis. Brain. 1999;122 (Pt 1):141-59. doi: 10.1093/brain/122.1.141.
17. Noseworthy JH, Vandervoort MK, Wong CJ, Ebers GC. Interrater variability with the Expanded Disability Status Scale (EDSS) and Functional Systems (FS) in a multiple sclerosis clinical trial. The Canadian Cooperation MS Study Group. Neurology. 1990;40(6):971-5. doi: 10.1212/wnl.40.6.971.
18. Zarit SH, Reever KE, Bach-Peterson J. Relatives of the impaired elderly: correlates of feelings of burden. gerontologist. 1980;20(6):649-55. doi: 10.1093/geront/20.6.649.
19. Shim V, Ng C, Drahman I. Validation of the Malay Version of Zarit Burden Interview (MZBI). Malaysian Journal of Psychiatry. 2017;26(2):3-18.
20. Pahlavanzadeh S, Dalvi-Isfahani F, Alimohammadi N, Chitsaz A. The effect of group psycho-education program on the burden of family caregivers with multiple sclerosis patients in Isfahan in 2013-2014. Iran J Nurs Midwifery Res. 2015;20(4):420-5. doi: 10.4103/1735-9066.161000.
21. Navidian A, Pahlavanzadeh S, Yazdani M. The effectiveness of family training on family caregivers of inpatients with mental disorders. Iranian journal of psychiatry and clinical psychology. 2010;16(2):99-106.
22. Masoudi R, Abedi HA, Abedi P, Mohammadianinejad SE. Iranian family caregivers' challenges and issues in caring of multiple

sclerosis patients: A descriptive explorative qualitative study. Iran J Nurs Midwifery Res. 2014;19(4):416-23.

23. Figved N, Myhr K-M, Larsen J-P, Aarsland D. Caregiver burden in multiple sclerosis: the impact of neuropsychiatric symptoms. Journal of Neurology, Neurosurgery & Psychiatry. 2007;78(10):1097-102. doi: 10.1136/jnnp.2006.104216.

24. Jafari Y, Tehrani H, Esmaily H, Shariati M, Vahedian-shahroodi M. Family-centred empowerment program for health literacy and self-efficacy in family caregivers of patients with multiple sclerosis. Scandinavian journal of caring sciences. 2020;34(4):956-63. doi: 10.1111/scs.12803.

25. Banitalebi S, Etemadifar S, Kheiri S, Masoudi R. The effect of a self-management program on care burden and self-efficacy in family caregivers of people with multiple sclerosis. J Nurs Res. 2022;30(5):e234. doi: 10.1097/jnr.0000000000000509.

26. Zhu L, Xing Y, Jia H, Xu W, Wang X, Ding Y. Effects of telehealth interventions on the caregiver burden and mental health for caregivers of people with dementia: a systematic review and meta-analysis. Aging & Mental Health. 2024;28(11):1427-39. doi: 10.1080/13607863.2024.2371480.

27. Hernández-López MJ, García-González J, Leal-Costa C, Ramos-Morcillo AJ, Díaz-García I, López-Pérez MV, et al. Reducing Loneliness and Social Isolation Through the HELPeN Telephone-Call Program: Results from a Randomized Controlled Trial in Older Adults Living in the Community. J Clin Med. 2025;15(1):93.

28. Chen Y, Yi S, Chen R, Zhang Q. The efficacy of psychosocial interventions in relieving family caregiver burden in older adults with disabilities: a systematic review and network meta-analysis. Age Ageing. 2025;54(6):afaf155. doi: 10.1093/ageing/afaf155.

29. Homayouni A, Vasli P, Estebsari F, Nasiri M. Reducing care burden and improving adherence to health-promoting behaviors among family caregivers of patients with multiple sclerosis through a healthy lifestyle empowerment program. BMC Nurs. 2022;21(1):229. doi: 10.1186/s12912-022-00961-8.

30. Ortiz-Piña M, Encarnación Martín-Franco M, Molina-García P, Prieto-Moreno R, Mora-Traverso M, Russell T, et al. Effectiveness of telehealth interventions for family caregivers of older adults with multiple diseases: A systematic review and meta-analysis. J Telemed Telecare. 2025:1357633X251357054. doi: 10.1177/1357633X251357054.

31. Douglas SL, Plow M, Packer T, Lipson AR, Lehman MJ. Effect of 2-arm intervention on emotional outcomes in informal caregivers of individuals with multiple sclerosis: a randomized pilot study trial. Int J MS Care. 2023;25(6):252. doi: 10.7224/1537-2073.2022-111.