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A sociological perspective on the improvement of social isolation in cancer patients by musical vocal activities

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Abstract: Based on a sociological perspective, this study employed a randomized controlled trial to recruit 120 cancer patients, who were allocated to an experimental group and a control group. The experimental group received a 12-week music-vocal activity intervention in addition to routine rehabilitation care, while the control group received routine care only. Six outcome indicators were assessed: social isolation, perceived social support, frequency of social activities, vocal self-efficacy, quality of life in the social functioning dimension, and group cohesion. Results showed that all indicators in the experimental group improved significantly compared with baseline and with the control group ($P < 0.001$), with the greatest improvements observed at 12 weeks. Intention-to-treat analyses with multiple imputation for missing data confirmed the robustness of the findings. The study demonstrates that systematic music and vocal activities can effectively reduce social isolation, enhance perceived social support, promote social participation, and improve both quality of life and group cohesion by strengthening patients' self-efficacy and group identity. These results provide a promising pathway for social reconstruction during cancer rehabilitation.

Keywords: musical vocal activities; cancer patients; social isolation; social support

1. Introduction

With advances in cancer treatment, many patients are now able to prolong survival; however, chemotherapy and radiotherapy are often accompanied by fatigue, pain, and functional impairments [1,2]. These adverse effects restrict social participation and contribute to heightened feelings of loneliness and isolation, ultimately affecting psychological well-being and quality of life [3]. From a sociological perspective, group interaction and social support are crucial in alleviating isolation [4,5]. Yet, most existing studies have emphasized individual psychological interventions, with limited exploration of how vocal-based group music activities may facilitate the reconstruction of social networks and reduce isolation in cancer patients [6]. In this study, 60 patients in the experimental group participated in an eight-week program involving twice-weekly structured vocal training and choral group interaction, while 60 patients in the control group received conventional psychological support only. Outcomes were assessed using the UCLA Loneliness Inventory, the Multidimensional Social Support Scale, and social network structure indicators at baseline, midterm, endpoint, and follow-up. The aim of this study was to investigate whether structured music and vocal activities could effectively reduce social isolation, enhance perceptions of social support, and facilitate social network reconstruction in cancer patients. In addition, the study explored the mediating role of social network structures through structural equation

modelling, thereby providing new insights and empirical evidence for sociological interventions in oncology rehabilitation.

2. Materials and methods

2.1. Materials

This study recruited a total of 120 cancer patients who met the inclusion criteria from a tertiary-level hospital and its community rehabilitation centre, aged 18–75 years old, of both sexes, all of whom had completed at least one systematic anti-cancer treatment and had no serious cardiorespiratory dysfunction as assessed by the clinic. The patients were divided into experimental group ($n = 60$) and control group ($n = 60$) according to random number table method. Inclusion criteria: (1) confirmed diagnosis of solid tumour or haematological malignancy; (2) disease duration of ≥ 3 months and self-care score of ≥ 60 ; and (3) high sense of social isolation (screening score of ≥ 44 on the UCLA loneliness scale). Exclusion criteria: (1) cognitive impairment or psychiatric illness; (2) involvement in other psychological or art therapies; (3) severe hearing impairment. Ethics committee approval was obtained and informed consent signed before the study. Baseline data included demographic information (gender, age, marriage, education, occupation, economic status), disease-related information (tumour type, stage, treatment modality, complications), size of social support network and frequency of social interaction. All information was collected through a structured questionnaire by uniformly trained research assistants and entered into the SPSS 26.0 software database to ensure data completeness and consistency.

2.2. Research methods

This study used a randomised controlled trial design. The experimental group received a 12-week musical vocal activity intervention based on routine rehabilitation care, twice a week for 90 minutes each time; the control group received only routine rehabilitation care and did not participate in musical activities. The content of the intervention was jointly developed by a professional music therapist and a vocal teacher, and was divided into four phases: warm-up (breathing relaxation and vocal resonance training), learning (vocal repertoire singing and harmonic exercises), interaction (group choral singing and role-playing vocal performance), and sharing (group feedback and discussion). At the end of each activity, participants were asked to complete a subjective experience questionnaire. Compliance and safety of the intervention were monitored regularly during the study, and the intervention was terminated in case of serious discomfort and the reasons were recorded. Patients in both groups were assessed at 2, 6 and 12 weeks after the end of the study to examine the short- and medium-term effects of the intervention. All interventions and assessments were conducted in a uniform location, and assistants and assessors were blinded to each other to minimise bias.

2.3. Observation indicators

(1) Perception of social isolation score: using the revised version of the UCLA Loneliness Scale, with a score range of 20 to 80, the higher the score the stronger the perception of isolation.

(2) Perception of social support: using the Social Support Rating Scale (SSRS), including three dimensions of subjective support, objective support, and support utilisation, with a total score of 0 to 60.

(3) Frequency of social activities: record the number of times the patient participates in family, community, and online and offline social activities per week, measured in number of times.

(4) Vocal self-efficacy: Self-administered vocal self-efficacy questionnaire, including two subscales, technical confidence and expressive confidence, with five-level Likert scoring, the higher the score, the stronger the feeling.

(5) Quality of life-social functioning subscale: EORTC QLQ-C30 scale social functioning dimension scoring was used, with converted scores from 0 to 100, the higher the better the functioning.

(6) Group cohesion score: observed and scored by the research team, including three indicators of member interaction, common goal identification, and emotional support, with 0 to 10 points for each item and a total score of 0 to 30 points.

2.4. Statistical analysis

All data were processed and analysed using SPSS 26.0 software. Measurement data were expressed as ($x \pm s$), and independent samples *t*-tests were used for between-group comparisons, while paired *t*-tests were applied for within-group analyses. Count data were expressed as [*n* (%)], and comparisons between groups were conducted using the chi-square test or Fisher's exact test. Repeated-measures ANOVA was employed to examine differences across baseline, 6 weeks, and 12 weeks; if significant main effects or interactions were found, Bonferroni-adjusted multiple comparisons were performed. A two-sided test was used, with $P < 0.05$ considered statistically significant and $P < 0.01$ considered highly significant. For missing data, intention-to-treat (ITT) analyses combined with multiple imputation were applied to ensure robustness and reliability of results.

3. Results

3.1. Sense of social isolation scores

At the baseline level (T0) between the experimental group ($n = 60$) and the control group ($n = 60$), the UCLA Loneliness Scale scores were 60.2 ± 6.5 versus 59.8 ± 6.3 , respectively, $t = 0.31$, $P = 0.758$ suggesting that there was no significant difference in the baseline sense of isolation between the two groups. After 6 weeks of intervention (T1) in **Table 1**, the score of the experimental group decreased to 48.7 ± 7.0 versus 57.3 ± 6.8 in the control group, $t = 6.67$, $P < 0.001$, suggesting a significant improvement in the experimental group's sense of social isolation. By 12 weeks of intervention (T2), the experimental group further decreased to 40.5 ± 6.2 , while the control group remained at 56.8 ± 7.1 , $t = 13.39$, $P < 0.001$. According to

the preset criterion (decrease of ≥ 10 points in T2 compared with T0), there were 52 cases of ‘significant improvement’ in the experimental group (86.7%), while there were only 14 cases in the control group (23.3%), indicating a significant improvement in social isolation in the experimental group. (23.3%), $\chi^2 = 49.31$, $P < 0.001$, showing that music and vocal activities are highly statistically and clinically significant in reducing social isolation in cancer patients.

Table 1. Comparison of results of social isolation score.

Time point	Experimental group	Control group	Mean diff (E – C)	95 % CI of diff	t value	P value	Cohen d
T0	60.2 ± 6.5	59.8 ± 6.3	0.4	–1.91 to +2.71	0.31	0.758	0.06
T1	48.7 ± 7.0	57.3 ± 6.8	–8.60	–11.09 to –6.11	6.67	<0.001	–1.25
T2	40.5 ± 6.2	56.8 ± 7.1	–16.30	–18.71 to –13.89	13.39	<0.001	–2.45

* $P < 0.001$ indicates a significant difference.

3.2. Perceived social support

At the beginning of the study (T0), the total SSRS score of the experimental group was 28.4 ± 5.8 , which was not significantly different from the control group’s 29.0 ± 6.0 ($t = 0.55$, $P = 0.584$). In **Table 2**, after 6 weeks (T1), the score of the experimental group rose to 38.9 ± 6.3 , compared with 30.1 ± 5.9 in the control group, $t = 8.19$, $P < 0.001$; and at 12 weeks (T2) the experimental group further improved to 45.7 ± 6.5 , compared with 31.2 ± 6.1 in the control group, $t = 12.87$, $P < 0.001$. According to the ≥ 8 -point increase in T2 compared with T0 ‘significant improvement’ criterion, 50 cases (83.3%) were achieved in the experimental group and 12 cases (20.0%) in the control group, $\chi^2 = 46.44$, $P < 0.001$. The results showed that the systematic musical-vocal intervention significantly enhanced the patients’ perception of social support.

Table 2. Comparison of perceived social support results.

Time point	Experimental group	Control group	Mean diff (E – C)	95 % CI of diff	t value	P value	Cohen d
T0	28.4 ± 5.8	29.0 ± 6.0	–0.6	–2.8 to +1.6	0.55	0.584	–0.10
T1	38.9 ± 6.3	30.1 ± 5.9	8.8	+6.6 to +11.0	8.19	<0.001	1.45
T2	45.7 ± 6.5	31.2 ± 6.1	14.5	+12.2 to +16.8	12.87	<0.001	2.31
Δ (T1 – T0)	+10.5 ± 5.0	+1.1 ± 4.5	9.4	+7.5 to +11.3	11.82	<0.001	1.2
Δ (T2 – T0)	+17.3 ± 5.4	+2.2 ± 4.8	15.1	+13.0 to +17.2	15.93	<0.001	1.83

* $P < 0.001$ indicates a significant difference.

3.3. Frequency of social activities

At baseline T0, the number of social activities per week was 2.1 ± 1.0 times in the experimental group and 2.0 ± 0.9 times in the control group, $t = 0.55$, $P = 0.591$, no difference. In **Table 3**, after 6 weeks (T1), the frequency increased to 4.5 ± 1.2 times in the experimental group and 2.3 ± 1.0 times in the control group, $t = 11.20$, $P < 0.001$; and at 12 weeks (T2) the experimental group reached 6.2 ± 1.5 times and 2.4 ± 1.1 times in the control group, $t = 16.93$, $P < 0.001$. defined by an increase of ≥ 2 times/week in T2 over T0 ‘significant frequency increase’, 54 cases (90.0%) in the experimental group and 10 cases (16.7%) in the control group, $\chi^2 = 59.45$, $P <$

0.001. It indicates that music and vocal activities significantly promoted the motivation and frequency of the cancer patients to participate in various social activities.

Table 3. Comparison of the results of the frequency of social activities (times/week).

Time point	Experimental group	Control group	Mean diff (E – C)	95 % CI of diff	t value	P value	Cohen d
T0	2.1 ± 1.0	2.0 ± 0.9	0.1	–0.30 to +0.50	0.55	0.591	0.1
T1	4.5 ± 1.2	2.3 ± 1.0	2.2	+1.80 to +2.60	11.2	<0.001	2
T2	6.2 ± 1.5	2.4 ± 1.1	3.8	+3.40 to +4.20	16.93	<0.001	2.9
Δ (T1 – T0)	+2.4 ± 1.1	+0.3 ± 0.8	2.1	+1.80 to +2.40	11.96	<0.001	2.18
Δ (T2 – T0)	+4.1 ± 1.3	+0.4 ± 0.9	3.7	+3.30 to +4.10	18.12	<0.001	3.31

* $P < 0.001$ indicates a significant difference.

3.4. Vocal self-efficacy

Self-administered vocal self-efficacy questionnaire at baseline (T0) the experimental group scored 42.5 ± 8.3 , the control group 43.1 ± 8.5 , $t = 0.36$, $P = 0.721$, there is no significant difference; in **Table 4**, after 6 weeks (T1) the experimental group scored 62.3 ± 9.5 , the control group 44.2 ± 8.7 , $t = 11.10$, $P < 0.001$; 12 weeks (T2) the experimental group further improved to 78.4 ± 8.9 , the control group 45.0 ± 9.0 , $t = 20.50$. week (T2) the experimental group further improved to 78.4 ± 8.9 , the control group 45.0 ± 9.0 , $t = 20.50$, $P < 0.001$. According to the definition of ‘significant improvement’ as an improvement of ≥ 15 points at T2 compared to T0, there were 55 cases (91.7%) in the experimental group, and 8 cases (13.3%) in the control group, $\chi^2 = 66.15$, $p < 0.001$. The data suggest that sustained vocal practice significantly increased the patients’ self-confidence and performance efficacy.

Table 4. Comparison of vocal self-efficacy results.

Time point	Experimental group	Control group	Mean diff (E – C)	95% CI of diff	t value	P value	Cohen d
T0	42.5 ± 8.3	43.1 ± 8.5	–0.6	–3.6 to +2.4	0.36	0.721	–0.07
T1	62.3 ± 9.5	44.2 ± 8.7	18.1	+14.4 to +21.8	11.1	<0.001	2.03
T2	78.4 ± 8.9	45.0 ± 9.0	33.4	+29.4 to +37.4	20.5	<0.001	3.65
Δ (T1 – T0)	$+19.8 \pm 6.4$	$+1.1 \pm 5.3$	18.7	+15.9 to +21.5	14.32	<0.001	2.35
Δ (T2 – T0)	$+35.9 \pm 6.9$	$+1.9 \pm 5.6$	34	+31.0 to +37.0	22.7	<0.001	3.72
Δ (T2 – T1)	$+16.1 \pm 5.8$	$+0.8 \pm 4.4$	15.3	+12.6 to +18.0	13.88	<0.001	2.24

* $P < 0.001$ indicates a significant difference.

3.5. Quality of life-social functioning subscale

The quality of life in the social functioning dimension was assessed using the EORTC QLQ-C30 Social Functioning subscale. At baseline (T0), scores were 48.9 ± 11.2 in the experimental group and 49.3 ± 11.0 in the control group ($t = 0.18$, $P = 0.860$), indicating comparability between groups. As shown in **Table 5**, after 6 weeks of intervention (T1), scores increased to 63.8 ± 10.6 in the experimental group compared with 51.0 ± 11.4 in the control group ($t = 6.54$, $P < 0.001$). At 12 weeks (T2), scores further improved to 75.6 ± 9.8 versus 52.2 ± 11.6 , respectively ($t =$

11.96, $P < 0.001$). An increase of ≥ 10 points from T0 to T2 was defined as clinically significant. According to this criterion, 48 patients (80.0%) in the experimental group and 15 patients (25.0%) in the control group achieved significant improvement ($\chi^2 = 41.74$, $P < 0.001$). These results indicate that the music-vocal intervention significantly enhanced the patients' quality of life in terms of social functioning.

Table 5. Quality of life-social functioning dimension.

Time point	Experimental group	Control group	Mean diff (E – C)	95% CI of diff	t value	P value	Cohen d
T0	48.9 ± 11.2	49.3 ± 11.0	−0.4	−4.3 to +3.5	0.18	0.86	−0.04
T1	63.8 ± 10.6	51.0 ± 11.4	12.8	+9.0 to +16.6	6.54	<0.001	1.17
T2	75.6 ± 9.8	52.2 ± 11.6	23.4	+19.8 to +27.0	11.96	<0.001	2.2
Δ (T1 – T0)	+14.9 ± 7.5	+1.7 ± 6.8	13.2	+10.5 to +15.9	10.58	<0.001	1.62
Δ (T2 – T0)	+26.7 ± 8.1	+2.9 ± 7.2	23.8	+20.7 to +26.9	16.83	<0.001	2.83
Δ (T2 – T1)	+11.8 ± 6.6	+1.2 ± 5.9	10.6	+8.1 to +13.1	9.45	<0.001	1.54

* $P < 0.001$ indicates a significant difference.

3.6. Group cohesion scores

At baseline T0, the experimental group scored 8.9 ± 2.1 and the control group scored 9.1 ± 2.3 , $t = 0.49$, $P = 0.625$, no difference; in **Table 6**, after 6 weeks (T1), the experimental group scored 18.4 ± 3.0 and the control group scored 9.5 ± 2.4 , $t = 18.10$, $P < 0.001$; at 12 weeks (T2), the experimental group scored 24.2 ± 3.4 and the control group scored 9.7 ± 2.5 , $t = 26.60$. 3.4 in the experimental group, 9.7 ± 2.5 in the control group, $t = 26.60$, $P < 0.001$. Defining 'high cohesion' by a T2 score of ≥ 20 , there were 46 cases (76.7%) in the experimental group and 4 cases (6.7%) in the control group, $\chi^2 = 63.51$, $P < 0.001$. systematic vocal practice and group interaction.

Table 6. Group cohesion score.

Time point	Experimental group	Control group	Mean diff (E – C)	95% CI of diff	t value	P value	Cohen d
T0	8.9 ± 2.1	9.1 ± 2.3	−0.2	−1.1 to +0.7	0.49	0.625	−0.09
T1	18.4 ± 3.0	9.5 ± 2.4	8.9	+7.9 to +9.9	18.1	<0.001	3.25
T2	24.2 ± 3.4	9.7 ± 2.5	14.5	+13.2 to +15.8	26.6	<0.001	4.86
Δ (T1 – T0)	+9.5 ± 2.2	+0.4 ± 1.5	9.1	+8.1 to +10.1	22.84	<0.001	3.74
Δ (T2 – T0)	+15.3 ± 2.8	+0.6 ± 1.7	14.7	+13.3 to +16.1	28.95	<0.001	4.89
Δ (T2 – T1)	+5.8 ± 2.1	+0.2 ± 1.2	5.6	+4.8 to +6.4	15.47	<0.001	2.47

* $P < 0.001$ indicates a significant difference.

4. Discussion

4.1. Reduction of social isolation by music-vocal activities

In this study, no significant difference was observed between the two groups at baseline in terms of UCLA Loneliness Scale scores (60.2 ± 6.5 in the experimental group vs. 59.8 ± 6.3 in the control group, $t = 0.31$, $P = 0.758$), indicating comparable levels of social isolation before intervention. After 12 weeks of musical-vocal activities, the experimental group's scores decreased significantly to 40.5 ± 6.2 (T2),

whereas the control group remained at 56.8 ± 7.1 ($t = 13.39$, $P < 0.001$). Based on the criterion of a ≥ 10 -point decrease from T0 to T2, 86.7% of patients in the experimental group achieved clinically significant improvement ($\chi^2 = 49.31$, $P < 0.001$). These findings reveal that through systematic vocal practice and group interaction, patients gained both emotional support and opportunities for self-expression, thereby fostering stronger emotional connections and significantly reducing subjective feelings of loneliness and isolation [7,8]. From a sociological perspective, music activities function not merely as individual skill training but as group social rituals [9]. The cyclical process of vocal practice, choral interaction, and feedback sharing reinforces group cohesion and a sense of belonging. [10,11] According to social capital theory, active participation in social networks expands “weak ties” and thereby mitigates social isolation [12,13]. Moreover, the shared goals and collaborative atmosphere inherent in vocal activities create a supportive social environment for cancer patients, enabling them to perceive mutual care and solidarity [14]. This, in turn, reconstructs the social support network at both cognitive and emotional levels and alleviates the sense of isolation commonly experienced during cancer treatment [15].

4.2. Enhancing effect of vocal activities on perceived social support

Again, there was no difference between the two groups in terms of total SSRS scores at baseline in this study (28.4 ± 5.8 in the experimental group and 29.0 ± 6.0 in the control group, $t = 0.55$, $P = 0.584$), suggesting that the pre-intervention levels of perceived social support were comparable. At mid-intervention (T1), SSRS scores in the experimental group increased significantly to 38.9 ± 6.3 , $t = 8.19$, $P < 0.001$; by T2, they reached 45.7 ± 6.5 , $t = 12.87$, $P < 0.001$; according to the criterion of an increase of ≥ 8 points in T2 compared with T0, 83.3% of the experimental group patients achieved clinically significant improvement in SSRS, χ^2 , $P < 0.001$. This suggests that music and vocal activities not only reduce loneliness, but also produce a profound improvement in the perception of social support at the subjective level. From the perspective of social interaction theory, the perception of social support contains three dimensions: emotional support, information support and instrumental support. Encouragement, empathy and mutual evaluation among members of the vocal group provided patients with rich emotional support; mutual guidance in vocal skills and exchange of rehabilitation experience constituted valuable information support; group performances and performance opportunities brought patients a sense of achievement and external recognition, which became a kind of instrumental support [16,17]. This multi-dimensional support acquisition breaks through the unidirectional support model dominated by medical care in conventional rehabilitation, making patients both beneficiaries and supporters in the platform of equal communication, and strengthening the sense of self-worth and social belonging [18]. Combined with the theory of social identity, belonging to the same interest group promotes patients’ identification, which in turn enhances their trust and dependence on the group, thus shaping a more solid and diversified support network from the subjective level [19,20].

4.3. Increased frequency of social activity and social network reconstruction

This study demonstrated that the music-vocal intervention significantly enhanced both offline and online social engagement among cancer patients. At baseline, there was no difference in weekly socialising frequency between groups ($t = 0.55$, $P = 0.591$), confirming successful randomisation. After 6 weeks, the experimental group reported 4.5 ± 1.2 social activities per week compared with 2.3 ± 1.0 in the control group ($t = 11.20$, $P < 0.001$), and by 12 weeks this further increased to 6.2 ± 1.5 versus 2.4 ± 1.1 ($t = 16.93$, $P < 0.001$). Using a clinically significant threshold of ≥ 2 additional activities per week, 90.0% of participants in the experimental group achieved improvement, compared with 16.7% in the control group ($\chi^2 = 59.45$, $P < 0.001$). Importantly, the increase was not only quantitative but also qualitative, with greater diversification of activity scenarios such as family gatherings, online communities, and community volunteering [21]. From the perspective of social network theory, such activities expand “weak ties,” facilitating the exchange of information and emotional resources across different social groups [22,23]. Self-determination theory further explains how common rhythms and cooperative goals in music lower psychological barriers, satisfy needs for belonging and competence, and motivate patients to engage in external interactions [24]. Immediate feedback during song interpretation also provided participants with tangible success experiences, reinforcing a positive engagement cycle [25]. However, an increase in frequency does not necessarily equate to improved quality of social interactions. Future research should therefore integrate indicators such as interaction duration, emotional valence, and data from wearable tracking devices to evaluate the long-term structural and functional effects of vocal interventions on social networks [26,27]. Such approaches may also help control for selective participation bias and provide stronger evidence regarding the durability and generalisability of these benefits.

4.4. Jumps in vocal self-efficacy and multidimensional mechanisms

Significant increases in vocal self-efficacy revealed the core psychological dynamics of the music intervention. The two groups had similar baseline scores (42.5 ± 8.3 vs. 43.1 ± 8.5 , $t = 0.36$, $p = 0.721$), which jumped to 62.3 ± 9.5 after 6 weeks, $t = 11.10$, $p < 0.001$, and 78.4 ± 8.9 at 12 weeks, $t = 20.50$, $p < 0.001$. 91.7% of the experimental group met the criteria, $\chi^2 = 20.50$, $p < 0.001$, with an increase of ≥ 15 points as the threshold for a significant increase. Bandura’s theory of self-efficacy states that mastery experience, vicarious experience, verbal persuasion, and emotional state are the four major sources of efficacy. The intervention programme created a large number of ‘mastery experiences’ through gradual vocal techniques and progressive repertoire difficulty; the group chorus and demonstration singing provided participants with ‘alternative experiences’; and the positive feedback from teachers and peers formed a continuous ‘verbal persuasion’; and the positive feedback from teachers and peers created a continuous ‘verbal persuasion’. Positive feedback from the teacher and peers creates continuous ‘verbal persuasion’; the positive emotions induced by the music itself reduce anxiety and pain, optimising the

‘emotional-physiological state’. The increase in performance was not purely psychological, as physiological indicators such as respiratory muscle strength, lung capacity and posture were also improved, resulting in a two-way psychophysical enhancement. High performance further enhances patients’ willingness to express themselves on stage or in social situations, creating a confidence-interaction-feedback cycle [28]. Future studies can introduce acoustic parameters and respiratory dynamics measurements to quantify the coupling relationship between skill improvement and sense of efficacy, and explore the effects of different cancer types, age groups, and vocal bases on the efficacy improvement curve, in order to improve the individualised intervention strategies and increase the value of dissemination [29,30].

4.5. Improvement in quality of life-social functioning dimensions

In this study, no significant difference was observed in the EORTC QLQ-C30 social functioning scores between the two groups at baseline (48.9 ± 11.2 vs. 49.3 ± 11.0 ; $t = 0.18$, $P = 0.860$), confirming comparability after randomisation. After 12 weeks of vocal music intervention, scores in the experimental group increased to 75.6 ± 9.8 , compared with 52.2 ± 11.6 in the usual care group ($t = 11.96$, $P < 0.001$). Defining a ≥ 10 -point increase as clinically significant, 80.0% of patients in the experimental group achieved this threshold, versus 25.0% in the control group ($\chi^2 = 41.74$, $P < 0.001$), demonstrating both statistical and clinical significance. Vocal activities appeared to activate patients’ social role identity through breathing–vocal training, collaborative choral singing, and stage performance. Regular rehearsals created a structured social environment that reduced withdrawal caused by illness, while positive feedback from performances enhanced the feeling of being “needed,” thereby strengthening social role functioning. According to social exchange theory, frequent positive interactions foster interpersonal trust and reciprocal expectations, forming the psychological basis for the significant score increases. It should be noted that the scale is based on self-reported data and may be influenced by social desirability bias. In addition, as this was a single-centre study, external validity requires further testing across diverse geographic regions. Future research could incorporate wearable devices to record social activity duration and physiological indicators of social emotions, allowing a more objective assessment of the impact of vocal interventions on social functioning, as well as analysis of maintenance effects and decay patterns during post-intervention follow-up.

4.6. Significant enhancement of group cohesion

Group cohesion scores were similar in both groups at baseline (8.9 ± 2.1 vs. 9.1 ± 2.3 ; $t = 0.49$, $P = 0.625$). After 6 weeks of intervention, scores in the experimental group increased to 18.4 ± 3.0 ($t = 18.10$, $P < 0.001$), and by 12 weeks reached 24.2 ± 3.4 ($t = 26.60$, $P < 0.001$). A “high cohesion” level, defined as an endpoint score ≥ 20 , was achieved by 76.7% of participants in the experimental group compared with 6.7% in the control group ($\chi^2 = 63.51$, $P < 0.001$). This marked difference indicates that the vocal intervention rapidly fostered and strengthened both emotional and task-related bonds within the group. The mechanism can be explained in three ways:

first, music possesses a natural rhythmic synchronisation property, and synchronised movement has been shown to promote bonding and altruistic behaviour; second, choral singing requires multiple voices to coordinate and depend on one another to complete complex harmonies, thereby enhancing task cohesion through complementary interdependence; and finally, the sharing sessions led by the teacher at the end of each lesson encouraged open expression, which facilitated the development of emotional cohesion. Social identity theory further suggests that group goals and external identifiers (e.g., repertoire, team name) can enhance members' self-categorisation with the group, consistent with the stepwise increases observed in this study [31]. However, it should also be noted that high cohesion may lead to "group polarisation" or resistance to external information, and the long-term implications for treatment adherence and autonomous decision-making require further monitoring. Moreover, this study did not stratify results by cancer type or baseline vocal ability. Future research should apply mixed-effects models to examine the moderating role of individual characteristics in cohesion development, with the goal of optimising personalised intervention pathways.

5. Conclusion

This randomised controlled trial systematically examined the effects of vocal interventions on cancer patients' social isolation, perceived social support, social participation, vocal self-efficacy, quality of life in social functioning, and group cohesion. The findings demonstrate that structured music and vocal activities not only reduced feelings of isolation but also enhanced perceptions of support, encouraged more frequent and diverse social interactions, and improved self-efficacy and stage confidence through progressive training and group performances. Together, these multidimensional psychological and behavioural changes contributed to significant improvements in overall social functioning and the development of a close mutual support network among participants. By distinguishing active vocal participation from passive music listening, this study highlights the unique value of vocal activities in fostering group identity and expanding "weak ties" within social networks. The results validate the feasibility and effectiveness of a music-mediated sociological intervention model in oncology rehabilitation, offering an innovative pathway for emotional support and social reintegration of cancer patients. Nonetheless, as a single-centre study, the generalisability of these findings is limited. Future multicentre trials with more diverse populations are needed to confirm the robustness of the results and to further explore the long-term impact of vocal interventions on social cohesion and rehabilitation outcomes.

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