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# Effects of a Web-based Health Education Program on Quality of Life and Symptom Distress of Initially Diagnosed Advanced Non-Small Cell Lung Cancer Patients: A Randomized Controlled Trial

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**Abstract** Advanced non-small cell lung cancer (NSCLC) patients treated with chemotherapy experience functional decline and decreased quality of life. The purpose of this study was to evaluate the effects of a web-based health education program on global quality of life, quality of life-related functional dimensions, and symptom distress of initially diagnosed advanced non-small cell lung cancer patients. This study used a randomized, pre- and post-repeated measures design. A total of 55 participants were randomly assigned to an experimental group ($n = 27$) and a control group ($n = 28$). The experimental group participated in a web-based health education program, and the control group received usual care. Patients were assessed at 4 time points: baseline assessment (T0), and then 1, 2, and 3 months (T1, T2, and T3) after participating in the web-based health education program or receiving usual care. Patients in the experimental group had significantly greater global quality of life and emotional function, and significantly less top ten significant symptom distresses compared to those in the control group. There were no differences between the groups and within groups with respect to physical function, role function, cognitive function, and social function. The web-based health education can improve global quality of life, emotional function, and top ten significant symptom distresses in patients receiving chemotherapy during the first 3 months after initial diagnosis of advanced NSCLC. Web-based health education can improve quality of life and lessen distress of initially diagnosed NSCLC patients treated with chemotherapy.

**Keywords** Non-small cell lung cancer · Web-based health education · Symptom distress, quality of life

## Introduction

Lung cancer is the most common cancer, and the first leading cause of cancer death worldwide with 1.8 million people diagnosed each year, and 1.59 million deaths [1]. In Taiwan, lung cancer has become the most common malignancy [2]. Non-small cell lung cancer (NSCLC) accounts approximately 80–85% of all lung cancers; more than half of patients are diagnosed at an advanced stage, and chemotherapy, targeted therapy, and radiation therapy are the major treatment modalities [3, 4]. Cancer treatments cause symptom distress [5, 6], and functional impairment [7], which may negatively impact daily function and quality of life [5–7].

Symptom distress was defined as "the degree of discomfort from the specific symptom as reported by the patient" [8]. A high proportion of advanced NSCLC who receive treatment report symptom distress including fatigue (100%), loss of appetite (97%), shortness of breath (95%), cough (93%), pain (92%), and blood in the sputum (63%) [9]. Symptom distress may last to 4 to 6 months after diagnosis [10] and result in decreased quality of life [11].

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Quality of life refers to the degree to which the experience of an individual's life is satisfying, and specified verifiable conditions, activities, and activity consequences of an individual's life [12]. Global quality of life may reflect attributes of the whole of life that matter to the individual [13]. Therefore, quality of life involves bio-psycho-social components that represent the degree of physical, mental, and social function or health of the individual. Performance status is related to the general well-being of an individual and the activities of daily life [14]. Studies have indicated that the physical performance status of advanced lung cancer patients affects their physical and emotional function, and quality of life [15]. Silvoniemi et al. [16] reported that the mean global quality of life score of NSCLC patients scheduled for chemotherapy was 56.9, and physical, cognitive, and emotional functioning, insomnia, diarrhea, and dyspnea had a significant influence on the global quality of life score.

Web-based intervention refers to a primarily self-guided intervention program that is executed by means of a prescriptive online program operated through a website, and used by consumers seeking health- and mental-health-related assistance. The intervention program itself attempts to create a positive change and/or improve and enhance knowledge, awareness, and understanding via accurate health-related information and the use of interactive web-based components [17]. A study of cancer survivors after chemotherapy by Bray et al. [18] revealed that a 15-week web-based cognitive rehabilitation program resulted in a significant improvement in cognitive function [14]. Bowen et al. [19] found that breast cancer patients who participated in a year-long web-based intervention had a higher level of breast health knowledge and a lower level of cancer worry. A recent review also indicated that the needs of breast cancer survivors can be provided by web-based survivorship interventions [20]. Patients who were initially diagnosed with advanced-stage cancer and were awaiting or receiving active anti-cancer treatment may suffer from symptom distress [5–7]. Computer-assisted learning and computer-based education can promote individuals to interact with e-learning systems [21, 22]. Based on the aforementioned studies, we hypothesized that a web-based intervention can effectively enhance symptom management strategies, provide palliation of symptoms, and improve functional dimensions and quality of life. The purpose of this study was to evaluate the effects of a web-based health education program on global quality of life, quality of life-related function, and symptom distress in patients diagnosed with advanced NSCLC.

## Methods

This study was a randomized controlled trial, using a pre- and post-repeated measures design. The study was conducted between November 2011 and October 2014. Participants in the study were randomly assigned to the experimental group or control group using computer-generated random numbers. The experimental group participated in a web-based health education program based on NSCLC disease education, while the control group received usual care.

### Participant Sample and Setting

The study was approved by the Ethical Review Board of the study institute. A convenience sample of NSCLC patients was selected from a chest medicine ward and an outpatient department of a medical center in northern Taiwan. The inclusion criteria were the following: (1) ≥ 20 years old; (2) initially diagnosed with stages IIIa, IIIb, or IV NSCL; (3) informed of the treatment plan by the attending physicians and awaiting chemotherapy; (4) able to use a mobile phone; and (5) agreed to participate in the study after explanation of its purposes and procedures. The exclusion criteria were the following: (1) NSCL recurrence; (2) treatment plan included targeted therapy, palliative therapy, radiation therapy (RT), and RT combined with concurrent chemotherapy (CCRT); (3) any unstable systemic disease (heart disease, cognitive dysfunction, active infection, or other underlying disease); and (4) any condition likely to cause discomfort during the research interview. Potential subjects were recruited from physician referrals. All patients provided written informed consent for participation in the study before any data was collected.

### Intervention Program and Process

The theoretical framework of the program is based on Symptom Management Theory (SMT) [23, 24], and e-learning theory [21, 22], in which patients learn symptom management strategies using electronic educational technology. The goal is to teach patients to express their symptom experience and larger contextual factors influencing symptom management, and to create a care environment that minimizes symptoms. Employing this framework, we assumed that initially diagnosed advanced NSCLC patients experienced symptom perceptions and can learn symptom management strategies through web-based learning in order to manage symptoms and their response to symptoms. The web-based health education was developed based on a literature review [25–28] and clinical experience. The web-based intervention provided a self-taught program in Chinese and consisted of six parts: (1) personal assessment including symptoms, performance status, and vital signs; (2) explanations of laboratory data; (3) information regarding lung cancer including the anatomy and physiology of the lungs, examinations, cancer staging, treatment protocols, and palliative care; (4) symptom management including chemotherapy- or radiation-induced symptom distress, e.g., nausea, vomiting, fever, infection, skin toxicity, oral mucositis, and gastrointestinal (GI) disturbances; (5) supportive care consisting of emotional support, available social resources, and stories of patients with lung cancer; and (6) "Questions and answers" that patients ask open questions and researchers provided answer or discussion.

The program was reviewed by five lung cancer or informatics experts (two chest medicine physicians, two doctoral-level nurse researchers, and an information engineer) for content validity to ensure feasible and acceptable. It was further pilot-tested in two initially diagnosed advanced-stage lung cancer patients. The user interface was modified slightly based on the opinions of the two pilot patients. Participants reported no difficulties in using the web-based health education program and completed the program in 15 to 20 min. The "questions and answers" component was provided by the research nurse (principal investigator) based on the individual needs of the participants. After practice, the research nurse completed a repeat demonstration to verify skills. The question and answer component was monitored at all times by a physician (co-principal investigator) from the Department of Chest Medicine of the study hospital with expertise in the treatment of lung cancer with chemotherapy who has practiced medical oncology independently for more than 10 years. The physician also revised the contents of the web-based health education program biweekly based literature updates.

The experimental group participated in the web-based education program biweekly for a period of 3 months, and the program was led by a trained research nurse. Participants accessed the program via a website with log-in using a mobile phone number. Participants received text messages when new laboratory results were received or materials of the program were updated. The trained nurse and principal investigator provided answers or discussion to patient questions within 24 h.

The control group received usual care, including information regarding the side-effects of chemotherapy and symptom management for individual needs. The information was provided by the patient's primary care nurse.

## Data Collection

The data collection time points of this study were based on the time frame of the chemotherapy protocol. Based on treatment guidelines for advanced NSCLC, patients received chemotherapy within 3 to 4 months of diagnosis. Cisplatin-based regimens, plus vinorelbine/etoposide/vinblastine/gemcitabine/docetaxel were administered every 21–29 days for a total of 4 cycles [29].

Baseline data were obtained before random assignment using computer-generated random odd and even numbers (even, control; odd, experimental). Patients were assessed at 4 time points: baseline assessment (T0) was conducted before chemotherapy, and at 1 (T1), 2 (T2), and 3 (T3) months after beginning chemotherapy. T0 was defined as the time when patients were initially diagnosed with NSCLC, received an explanation of their treatment plan from their attending physician, and had not begun chemotherapy. T1, T2, and T3 were defined as outpatient visits to the chest medicine clinic at 1, 2, and 3 months after beginning chemotherapy. All subjects were interviewed before they received treatment, or visited the physician.

## Outcome Measures

### Demographic and Clinical Characteristics

Demographic data collected included patient sex, age, occupation, marital status, educational level, and religion. Disease and treatment characteristics included cancer stage, histological diagnosis, and medical treatments.

### Eastern Cooperative Oncology Group Performance Status Scale

Performance status was assessed by the Eastern Cooperative Oncology Group Performance Status Scale (ECOG-PS) [14, 30]. The ECOG-PS is scored from 0 to 5, with 0 indicating normal function and 5 indicating severely impaired function. The ECOG-PS has been widely used in cancer-related studies [31, 32].

### Symptom Distress Scale

The symptom distress scale (SDS) was used to measure symptom distress [8]. The SDS consists of 22 items, and responses are scored on a scale of 1 to 5, with higher scores indicating higher symptom distress perceived by the patient. In Taiwan, the Chinese version has been shown to be reliable in clinical cancer studies [33, 34]. The Cronbach's alpha was 0.94 in this study.

### European Organization for Research and Treatment of Cancer Quality of Life Questionnaire Core 30

The European Organization for Research and Treatment of Cancer Quality of Life Questionnaire Core 30 (EORTC C30), version 3.0, was used to measure health-related quality of life and functional dimensions [35, 36]. In this study, a global quality of life scale and five quality of life-related functional subscales (physical, role, emotional, cognitive, and social) were used. Scores for the global quality of life scale and each quality of life-related functional subscale were summed.

A standardized method was used to convert the summed scores into a 0–100 range for each domain and for total scores, with higher scores indicate higher overall quality of live or higher functioning [36]. Satisfactory psychometric properties have been shown for the EORTC C30 in a cancer-related study in Taiwan [37]. In this study, the Cronbach's alpha was 0.70 to 0.80 for the global quality of life scale and for the functional subscales.

## Statistical Methods

Data were analyzed using SPSS software (Armonk, NY, USA), version 21.0, for Windows. Descriptive statistics were used to summarize patient demographic and clinical characteristics. Chi-square test, Fisher's exact test, and independent *t* test were used to test the homogeneity between the groups at baseline, as well as differences in global quality of life, each functional subscale, and symptom distress. The 10 top-ranked causes of symptom distress perceived by patients at each time points were selected as "the top 10 significant symptom distresses," and were measured by the SDS [8]. Repeated-measures ANOVA with least significance difference (LSD) and Bonferroni adjustment were used to examine differences in the global quality of life, physical function, role function, emotional function, cognitive function, social function, and top ten significant symptom distresses within groups across different time points. The effects of the web-based health education program on global quality of life, physical function, role function, emotional function, cognitive function, social function, and top ten significant symptom distresses were analyzed using mixed-model repeated measure ANOVA, including variance-covariance between-group factors ($F_b$), within-group factors ($F_w$), and the interaction factor ($F_{in}$), both between groups and over time [38]. Two-tailed *t* tests were used for comparisons, and a value of $P = .05$ represented statistical significance. The power of this study was estimated based on quality of life. Based on a previous similar study [37], the sample size was estimated based on the minimum requirement for comparing the means of two groups with a medium effect size [39]. Therefore; at least 26 participants were required for each group.

## Results

### Patient Characteristics

Of 60 eligible patients recruited, 3 declined to participate because of no interest, and 2 failed to complete all of the surveys forms. As a result, 55 patients who completed all assessments were included in the analysis, with 27 in the experimental group and 28 in the control group. The response rate was 91.67%. Patients in the experimental group and control group were on average 61.00 (SE = 2.04) and 58.68 (SE = 1.77) years old, respectively. Half of the patients in the experimental group were female (51.9%), and the majority of patients in the control group were male (67.9%). The majority of participants in both groups were unemployed (74.1 vs. 60.7%), were married (77.8 vs. 89.3%), had graduated from elementary school (40.7 vs. 32.1%) or senior high school (25.9 vs. 25.0%), and held Buddhism/Taoism religious beliefs (70.4 vs. 64.3%). In both groups, the most common diagnosis and cancer stage was NSCLC stage IV (77.8 vs. 82.1%), with adenocarcinoma histology (96.3 vs. 78.6%). All patients in both groups received chemotherapy. Patient characteristics are summarized in Table 1.

### Comparison of Baseline Outcome Measures

At baseline, there were no statistically significant differences in the mean global quality of life score, quality of life-related functional dimension scores, and symptom distress score between the two groups (Table 2).

### Changes in Global Quality of Life, Function, and Top Ten Significant Symptom Distresses Within Groups

In the experimental group, global quality of life increased from T1 (1 month after beginning chemotherapy) to T3 (3 months after beginning chemotherapy), and that at T3 (3 months after beginning chemotherapy) was greater than at T0 (before chemotherapy), and statistically significant differences over time were noted. Global quality of life in the control group decreased from T0 (before chemotherapy) to T3 (3 months after beginning chemotherapy), but no statistically significant differences were found. Emotional function in the experimental group increased from T1 (1 month after beginning chemotherapy) to T3 (3 months after beginning chemotherapy), and that at T3 was greater than T0 (before chemotherapy), and the differences were statistically different. In the control group, emotional function decreased from T0 (before chemotherapy) to T3 (3 months after beginning chemotherapy); however, the decrease was not statistically significant. Top ten significant symptom distresses in the experimental group decreased from T0 (before chemotherapy) to T1 (1 month after beginning chemotherapy), and decreased over time with T3 (3 month after beginning chemotherapy) being significantly less than T0 (before chemotherapy). Top ten significant symptom distresses in the control group increased from T0 (before chemotherapy) to T3 (3 months after beginning chemotherapy); however, the difference was not statistically significant (Table 3).

**Table 1** Subject characteristics by group ($n = 55$)

| Characteristics | EG ($n = 27$) $N$ (%)/mean (SE) | CG ($n = 28$) $N$ (%)/mean (SE) | $X^2/t$ | $p$ |
|---|---|---|---|---|
| Age | 61.00 (2.04) | 58.68 (1.77) | −0.860 | 0.393 |
| Gender | | | 2.195 | 0.139 |
| Male | 13 (48.1) | 19 (67.9) | | |
| Female | 14 (51.9) | 9 (32.1) | | |
| Occupation | | | 1.642 | 0.200 |
| Unemployed | 20 (74.1) | 17 (60.7) | | |
| Employed | 6 (25.9) | 11 (39.3) | | |
| Marital status | | | 0.775 | .379 |
| Unmarried | 5 (22.2) | 3 (10.7) | | |
| Married | 21 (77.8) | 25 (89.3) | | |
| Education level | | | 7.384 | 0.194[a] |
| None | 2 (7.4) | 3 (10.7) | | |
| Elementary | 11 (40.7) | 9 (32.1) | | |
| Junior high | 2 (7.4) | 6 (21.4) | | |
| Senior high | 7 (25.9) | 7 (25.0) | | |
| College and above | 5 (18.5) | 3 (10.7) | | |
| Religion | | | 4.126 | 0.127[a] |
| None | 5 (18.5) | 10 (35.7) | | |
| Buddhism/Taoism | 19 (70.4) | 18 (64.3) | | |
| Christianity/Catholicism | 3 (11.1) | 0 (0) | | |
| Cancer stage | | | 3.073 | 0.215[a] |
| NSCLC stage IIIA | 0 (0) | 1 (3.6) | | |
| NSCLC stage IIIB | 6 (22.2) | 2 (7.1) | | |
| NSCLC stage IV | 21 (77.8) | 23 (82.1) | | |
| Histology | | | | |
| Adenocarcinoma | 26 (96.3) | 22 (78.6) | | |
| Squamous cell carcinoma | 1 (3.7) | 4 (14.3) | | |
| Other | 0 (0) | 2 (7.1) | | |
| Medical treatment | | | | |
| Chemotherapy only | 27 (100) | 28 (100) | | |
| Performance status | | | 4.524 | 0.172[a] |
| Grade 0 | 11 (40.7) | 15 (53.6) | | |
| Grade 1 | 16 (59.3) | 11 (39.3) | | |
| Grade 2 | 0 (0) | 2 (7.1) | | |

*EG* experimental group, *CG* control group

[a] Fisher's exact test

### Effects of the Web-Based Health Education Program on the Outcome Variables

Global quality of life ($F_b = 4.512$, $p < 0.05$), emotional function ($F_b = 11.270$, $p < 0.01$), and top ten significant symptom distresses ($F_b = 8.889$, $p < 0.01$) in the experimental group improved significantly from pre-test to post-test. After 3 months, the experimental group had a significantly larger group × time interaction for global quality of life ($F_{in} = 6.462$, $p < 0.05$) and emotional function ($F_{in} = 3.086$, $p < 0.05$) than the control group (Table 4).

## Discussion

The results of this study showed that advanced NSCLC patients who participated in a web-based health education program had better global quality of life post-intervention, a finding not seen in the control group. This result is similar to that of a study that indicated web-based survivorship interventions met care needs of breast cancer survivors [16]. These findings suggest that a web-based intervention provides effective supportive care for patients initially diagnosed with NSCLC and subsequently received

**Table 2** Comparison of group outcomes at baseline ($n = 55$)

| Variable | EG ($n = 27$) | | CG ($n = 28$) | | $t$ | $p$ |
|---|---|---|---|---|---|---|
| | Mean | SE | Mean | SE | | |
| Global quality of life (EORTC QLQ-C30) | 50.00 | 3.76 | 55.61 | 4.32 | 0.976 | 0.334 |
| Functioning scales (EORTC QLQ-C30) | | | | | | |
| Physical | 90.59 | 2.71 | 80.46 | 4.87 | −1.800 | 0.077 |
| Role | 74.81 | 5.21 | 73.89 | 5.44 | −0.203 | 0.840 |
| Emotional | 78.93 | 2.84 | 75.89 | 2.84 | −0.756 | 0.453 |
| Cognitive | 91.93 | 2.57 | 85.75 | 3.04 | −1.546 | 0.128 |
| Social | 76.48 | 4.28 | 69.14 | 3.97 | −1.258 | 0.214 |
| Symptom distress (SDS) | 1.27 | 0.65 | 1.41 | 0.09 | 1.206 | 0.233 |
| Top ten significant symptom distress (SDS) | 1.45 | 0.08 | 1.41 | 0.09 | 0.800 | 0.427 |

*Baseline* before the web-based health education program, *EG* experimental group, *CG* control group, *EORTC QLQ-C30* European Organization for Research and Treatment of Cancer Quality of Life Questionnaire Core Module, *SDS* symptom distress scale

chemotherapy, and that the information improved daily quality of life.

The web-based health education program effectively reduced top ten significant symptom distresses of initially diagnosed advanced-stage NSCLC patients but did not improve physical function. Our study participants received chemotherapy, which may cause side effects leading to a decline of physical function during and post treatment. The experimental group had improved physical function as compared to the control group, but the difference did not reach statistical significance. This finding may be because the intervention program focused on knowledge regarding physical activity and did not include an element of practice or exercise. The results may have been different if these elements had been included in the program.

Role function dropped gently in both groups from pre-test to post-test, although the decreases were not statistically significant. These results may indicate that most of

**Table 3** Changes in global quality of life, function, and top ten significant symptom within groups over 4 times ($n = 55$)

| Variable | | T0<br>M (SE) | T1<br>M (SE) | T2<br>M (SE) | T3<br>M (SE) | $F$ | $p$ | Post-hoc, pair-wise comparison |
|---|---|---|---|---|---|---|---|---|
| Global quality of life (EORTC QLQ-C30) | EG | 50.00 (3.76) | 46.93 (3.76) | 54.93 (3.61) | 60.07 (4.04) | 6.170 | < 0.05 | T4 > T2, T1, T0 |
| | CG | 55.61 (4.32) | 45.82 (3.76) | 45.18 (4.05) | 43.32 (3.75) | 1.174 | 0.288 | |
| Physical | EG | 90.59 (2.71) | 87.65 (2.89) | 84.23 (5.22) | 84.78 (5.23) | 0.888 | 0.429 | |
| | CG | 80.46 (4.87) | 81.44 (4.99) | 69.94 (8.49) | 71.13 (9.76) | 2.206 | 0.121 | |
| Role | EG | 74.81 (5.21) | 68.73 (4.18) | 70.55 (6.84) | 70.39 (6.95) | 1.297 | 0.288 | |
| | CG | 73.29 (5.44) | 62.41 (6.15) | 61.17 (8.94) | 60.07 (9.18) | 0.169 | 0.877 | |
| Emotional | EG | 78.93 (2.84) | 83.00 (2.12) | 85.44 (2.55) | 90.33 (1.94) | 4.297 | < 0.05 | T3 > T2, T1, T0 |
| | CG | 75.89 (2.84) | 78.79 (2.59) | 75.00 (3.24) | 73.21 (3.65) | .613 | 0.593 | |
| Cognitive | EG | 91.93 (2.57) | 94.19 (2.06) | 91.73 (3.03) | 91.67 (3.07) | 1.292 | 0.289 | |
| | CG | 85.75 (3.04) | 95.04 (1.95) | 85.22 (5.17) | 76.73 (8.87) | 0.621 | 0.559 | |
| Social | EG | 76.48 (4.28) | 73.00 (4.43) | 71.14 (6.21) | 71.11 (6.57) | 0.651 | 0.542 | |
| | CG | 69.14 (3.97) | 63.56 (6.47) | 56.33 (8.32) | 70.00 (6.32) | 0.278 | 0.774 | |
| Top ten significant symptom distress (SDS) | EG | 1.45 (0.08) | 1.58 (0.08) | 1.44 (0.10) | 1.26 (0.06) | 3.220 | < 0.05 | T1 > T0, T2, > T3 |
| | CG | 1.41 (0.09) | 1.42 (0.07) | 1.54 (0.10) | 1.73 (0.27) | 0.684 | 0.530 | |

Patients were followed from initially diagnosed with NSCLC and received an explanation of their treatment plan before intervention through the first 3 months after intervention. Reference group was T0. Significant at the $P < 0.05$ level (two-tailed)

*T0* baseline, *T1* 1 month after a web-based health education program, *T2* 2 months after a web-based health education program, *T3* 3 months after a web-based health education program, *EORTC QLQ-C30* European Organization for Research and Treatment of Cancer Quality of Life Questionnaire Core 30, *SDS* symptom distress scale participants in the study who were middle-aged and male undertake multiple roles, including work and family responsibilities. Therefore, the web-based health education program is not effective for supporting role function. Healthcare providers should therefore enhance social support and family function to promote positive role function adjustment.

Cognitive functioning was not statistically different between the two groups. This result is inconsistent with a prior study, which found that a 30-min telephone intervention combined with a 15-week web-based cognitive rehabilitation program can improve the cognitive function of cancer patients after chemotherapy [18]. Cognitive declined is experienced by many cancer patients who undergo chemotherapy. Continuing assessment of cognitive problems and guidance to minimize the effects of the cognitive decline (e.g., lists, sticky notes, and calendars) should be a priority for patients receiving chemotherapy.

The current study also showed that initially diagnosed advanced-stage NSCLC patients who participated in the web-based health education program had improved emotional function post-intervention, a finding not seen in the control group. This finding is consistent with that of a prior study, indicating that web-based intervention can improve health knowledge and decrease worries about cancer [19]. Advanced-stage NSCLC patients who received supportive care were able to obtain more emotional support and available social resources at their initial diagnosis, which increased their ability to cope with problems and establish a social network. Moreover, religious belief was an important factor influencing adjustment of emotional function at the initial diagnosis and during active treatment [40]. Nearly one-fifth of patients in the experimental group and one-third of patients in the control group did not have religious beliefs. Religious beliefs can heal the mind and spirit. Additional studies are needed to examine the interactions between religious beliefs and emotional function.

In our study, the web-based health education program tried to create a "question and answer" web application interface that can access directly contacts from a research nurse and

**Table 4** Mixed model: repeated measures of global quality of life, function, and symptom distress by group ($n = 55$)

| Variable | Pre-test[a] mean (SE) | Post-test[b] mean (SE) | Between-groups, $F_b$ ($p$) | Within-times, $F_w$ ($p$) | Interaction, $F_{in}$ ($p$) |
|---|---|---|---|---|---|
| Global quality of life (EORTC QLQ-C30) | | | 4.512 (< 0.05*) | 2.359 (0.086) | 6.462 (< 0.05*) |
| EG | 50.00 (3.76) | 60.07 (4.04) | | | |
| CG | 55.61 (4.32) | 43.32 (3.75) | | | |
| Physical | | | 1.249 (0.273) | 2.817 (0.054) | 0.964 (0.403) |
| EG | 90.59 (2.71) | 84.78 (5.32) | | | |
| CG | 80.46 (4.87) | 71.13 (9.76) | | | |
| Role | | | 0.061 (0.807) | 0.504 (0.650) | 0.709 (0.527) |
| EG | 74.81 (5.21) | 70.39 (6.95) | | | |
| CG | 73.29 (05.44) | 60.07 (9.18) | | | |
| Emotional | | | 11.270 (< 0.01**) | 1.364 (.258) | 3.086 (< 0.05*) |
| EG | 78.93 (2.84) | 88.22 (2.49) | | | |
| CG | 75.89 (2.84) | 73.21 (3.65) | | | |
| Cognitive | | | 2.572 (0.207) | 2.421 (0.131) | 0.458 (0.504) |
| EG | 91.93 (2.57) | 91.67 (3.07) | | | |
| CG | 85.75 (3.04) | 76.73 (8.87) | | | |
| Social | | | 0.296 (0.591) | 0.271 (0.800) | 0.600 (0.580) |
| EG | 76.48 (4.28) | 71.11 (6.57) | | | |
| CG | 69.14 (3.97) | 70.00 (6.32) | | | |
| Top ten significant symptom distress (SDS) | | | 8.889 (< 0.01**) | 1.338 (0.265) | 1.666 (0.187) |
| EG | 1.45 (0.08) | 1.26 (0.06) | | | |
| CG | 1.41 (0.09) | 1.73 (0.27) | | | |

$F_b$ the $F$ value between group comparison, $F_w$ the $F$ value within pre- and post-test, $F_{in}$ the $F$ value of the interaction of between groups and within pre- and post-test, *EORTC QLQ-C30* European Organization for Research and Treatment of Cancer Quality of Life Questionnaire Core 30, *EG* experimental group, *CG* control group, *SDS* symptom distress scale

*$p < 0.05$, **$p < 0.01$

[a] Measured before the web-based health education program

[b] Measured at 3 months after receiving the web-based health education program

principal investigator. While the web-based health education program focused on self-learning, support groups can help patients more effectively deal with their treatments and care. Development of social network sites is recommended.

There are several limitations to the current study. The ability of patients to learn using an electronically based platform was not considered. Studies are needed to compare how individual differences affect assimilation of information from electronic-based and conventional training methods. This research was restricted to patients treated with chemotherapy, and the results may not be generalizable to all advanced-stage NSCLC patients receiving other treatments. Future research should involve patients receiving different treatment modalities. This web-based health education program lack of user instructions and recorded browser history; which may limit the generalizability of the findings. Development of user instructions and recording of a login record should be considered for future studies. The pilot randomized controlled trial involved small sample size, and this may have affected the results. The next step for future research should include a larger sample size to validate the intervention.

## Conclusion

The web-based health education program described can improve global quality of life, emotional function, and reduce top ten significant symptom distresses during the first 3 months after diagnosis and treatment of advanced-stage NSCLC patients. Web-based health education can enhance self-learning to cope with cancer, treatment, and side effects.

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### Compliance with Ethical Standard

**Conflicts of Interest** The authors declare that they have no conflict of interest.

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