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ORIGINAL

Assessing the Benefits of Structured Exercise on Muscle Strength and Endurance in Lung Cancer Patients

Evaluación de los beneficios del ejercicio estructurado sobre la fuerza y la resistencia muscular en pacientes con cáncer de pulmón

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ABSTRACT

Lung cancer (LC) patients often face reduced muscular strength and endurance due to the disease itself and the side effects of its treatments. This study aimed to assess the impact of a 12-week structured exercise program on muscular strength, endurance, and quality of life (QoL) in LC patients undergoing therapy48 patients in all were randomized to either the exercise group (n = 25) or the control group (n = 23). The control group did not receive any exercise intervention, whereas the exercise group participated in a planned physical activity program. Key measurements included muscle strength (grip strength and leg press), endurance (6-minute walk test), and QoL, which was assessed across various parameters such as physical health, mental well-being, social interaction, daily functioning, sleep quality, and pain/discomfort levels. Results showed that the exercise group exhibited significantly better muscle strength and endurance compared to the control group, with grip strength (89 %), leg press performance (94 %), and 6-minute walk scores (86 %) outperforming the control group (87 %, 92 %, 83 %). Additionally, the exercise group scored higher on QoL measures, including physical health (75 % vs. 70 %), mental well-being (74 % vs. 67 %), social interaction (67 % vs. 65 %), daily functioning (68 % vs. 63 %), and sleep quality (70 % vs. 64 %). The exercise group also reported lower pain and discomfort (35 % vs. 41 %). These findings suggest that structured exercise programs can significantly enhance muscle strength, endurance, as well as overall QoL in LC patients, underscoring the importance of integrating exercise into cancer care to improve patient outcomes and well-being.

Keywords: Quality of Life; Lung Cancer; Exercise and Muscle Strength; Structured Exercise Program Muscular Strength; Endurance.

RESUMEN

Los pacientes con cáncer de pulmón (CP) a menudo se enfrentan a una reducción de la fuerza y la resistencia muscular debido a la propia enfermedad y a los efectos secundarios de sus tratamientos. Este estudio tenía como objetivo evaluar el impacto de un programa de ejercicio estructurado de 12 semanas sobre la fuerza muscular, la resistencia y la calidad de vida (CdV) en pacientes con CP sometidos a tratamiento48 pacientes

en total fueron asignados aleatoriamente al grupo de ejercicio (n = 25) o al grupo de control (n = 23). El grupo de control no recibió ninguna intervención de ejercicio, mientras que el grupo de ejercicio participó en un programa planificado de actividad física. Las mediciones clave incluyeron la fuerza muscular (fuerza de agarre y prensa de piernas), la resistencia (prueba de caminata de 6 minutos) y la calidad de vida, que se evaluó a través de diversos parámetros como la salud física, el bienestar mental, la interacción social, el funcionamiento diario, la calidad del sueño y los niveles de dolor/malestar. Los resultados mostraron que el grupo de ejercicio exhibió una fuerza y resistencia muscular significativamente mejor en comparación con el grupo de control, con fuerza de agarre (89 %), rendimiento en prensa de piernas (94 %) y puntuaciones en la prueba de caminar 6 minutos (86 %) superando al grupo de control (87 %, 92 %, 83 %). Además, el grupo de ejercicio obtuvo puntuaciones más altas en las medidas de calidad de vida, incluida la salud física (75% frente a 70%), el bienestar mental (74% frente a 67%), la interacción social (67% frente a 65%), el funcionamiento diario (68% frente a 63%) y la calidad del sueño (70% frente a 64%). El grupo de ejercicio también informó de un menor dolor y malestar (35 % frente a 41 %). Estos resultados sugieren que los programas de ejercicio estructurado pueden mejorar significativamente la fuerza muscular, la resistencia, así como la calidad de vida general en pacientes con LC, lo que subraya la importancia de integrar el ejercicio en la atención oncológica para mejorar los resultados y el bienestar de los pacientes.

Palabras clave: Calidad de Vida; Cáncer de Pulmón; Ejercicio y Fuerza Muscular; Programa de Ejercicio Estructurado Fuerza Muscular; Resistencia.

INTRODUCTION

Muscular strength is a measure of muscular function, which is critical for health and has been found to be a strong predictor of numerous illnesses and all-cause death. As a result, muscle strength should be recognized as a possible risk factor.[1] Skeletal muscles, the body's main protein replacement, account for roughly 40 % of total body weight and are vital for exercise and energy consumption. Skeletal muscles control physical activities such as movement, gestural aid, and daily life. Skeletal muscle structure and morphology research be affected by a wide range of pathological situations. Muscular atrophy refers to the decrease in muscular mass and strength.[2]

Age is taken into consideration when making clinical decisions in oncology. Because of their numerous co-morbidities, deteriorating organ function, cognitive decline, lack of social support, and clinicians' desire to prevent drug side effects, older patients typically receive less intensive care. Some patients who could otherwise be "fit" may be at a disadvantage if their age is taken into account alone.[3] Exercise is an excellent way to slow or possibly stop the development of frailty and improve its components. The loss of muscular strength and endurance is a key sign of frailty. Muscle strength declines owing to a deterioration in muscle quality. Simultaneously, the aged endure dysfunction and many diseases due to the aging process, which is often associated with inflammation.[4]

Voluntary exercise consists of intentionally created motions, such as walking, cycling, jogging, and resistance training. Voluntary exercise is supposed to induce the muscle to reply in the similar manner that usually growing muscle does, however, there is limited evidence to support research claim. Exercise is not a one-size-fits-all activity, it research differ in duration, intensity, and the specific type of muscle length variation and velocity required throughout the exercise.[5] After cardiovascular disease, cancer is presently the second most common reason of disability and death. Numerous debilitating symptoms, many of which start before the disease is diagnosed and persist during therapy, are experienced by LC patients. These symptoms have a negative impact on their functional status and QoL.[6]

The primary cause of cancer-related mortality worldwide is LC. The foundation of LC screening is the idea that early diagnosis lowers mortality. Furthermore, clinical trials have shown decreased mortality from LC in individuals screened with low-dose computed tomography (CT), as well as greater early diagnosis of LC and decreased disease progression.[7] Research on cancer survivors with adult onset cancers consistently shows that exercise improves tiredness and quality of life while also increasing cardio respiratory fitness. However, due to the fact that controlled trials (RCTs) have primarily assessed patients with prostate and breast cancer; it is unclear if these results apply to AYA or to the most common tumor types in this age range, which frequently require more intense treatment.[8] Patients with LC frequently have decreased muscular strength and endurance as a result of the disease's side effects and the therapies it receives. One possible remedy to halt these decreases is the implementation of structured exercise regimens.

An extensive analysis of twelve randomized controlled trials comparing the effects of exercise training and standard care on postoperative health-related QoL (HR QoL) and tiredness following LC and CRC surgery was carried out.[9] There were 777 patients in the researched. Findings indicated that, among LC patients undergoing surgery, exercise training resulted in a little decrease in tiredness and a considerable increase in

physical HR QoL; no effects were observed in other HR QoL dimensions. HR QoL and tiredness in CRC patients were unaffected by exercise training. The effect of a 10-week exercise interference on fatigue, QOL, and cardiorespiratory fitness in adolescents and young adults (AYA) who have lately ended cancer treatment was observed.[10] Research was split into two groups such as the control group, which received standard medical attention and the exercise group, which received increasing resistance and aerobic training. The groups' QOL and tiredness scores did not significantly vary, according to the results.

To senior NSCLC patients receiving adjuvant or palliative therapy had were physical and cognitive performance assessed after completing a 10-week multicomponent exercise program.[11] An intervention group (n = 19) that participated in organized exercise was compared to a control group (n = 7) that received standard care in a non-randomized experiment with 21 individuals. Significant gains were seen in quality of life (p = 0,006), cognitive function (p = 0,021), and physical performance (SPPB, GVT, TUG, and muscular strength). Despite many limitations, such as a limited sample size, non-randomized

Design, and brief duration, the results show that exercise was beneficial for the population. The efficacy of a 12-week multimodal exercise intervention in advanced cancer patients who were older was assessed in the trial.[12] The purpose of the research was to compile systematic evaluations of exercise therapies for individuals with surgically treated lung cancer. Seven systematic reviews (2013–2019) were found through a literature search conducted in accordance with PRISMA guidelines. While low/very-low quality data indicated advantages for quality of life and dyspnea, high/moderate quality research demonstrated that postoperative exercise increases muscular strength and exercise ability. Exercise before surgery can improve lung function and lower risks. Variable review quality and contradictory results were among the limitations. The best kinds and quantities of exercise for clinical practice require more investigation.[13]

The function of exercise in preparing for both surgical and nonsurgical cancer treatments was covered. It gives examples of prehabilitation exercise regimens, recommendations for prescribing exercises, and proof of the benefits of exercise. Prehabilitation has been more prevalent in cancer care over the last 20 years, and it uses a variety of multimodal techniques such as respiratory training, customized treatment plans, screening, and behavior modification techniques. For efficient gains in strength and fitness, supervised resistance and aerobic training are advised. In women receiving chemotherapy for early-stage breast cancer,[14] assessed the impacts of a managed exercise training program (SETP) on functional ability and HR QoL. The usual care (UC) with SETP or the UC alone was randomly allocated to ninety-three women. As a portion of the SETP, patients experienced chemotherapy and three weekly sessions of resistance and aerobic training.

An assessment was conducted on the impacts of postoperative exercise on patients with LC.[15] Seven databases were examined and randomized controlled trials estimated the influence of exercise on both psychological and physical health. According to the findings, the exercise was LC's best course of action. In addition to their dietary and exercise choices, the coping strategies, methods, and preferences of patients with low muscle mass or muscle loss after treatment were investigated.[16] Eighteen adult patients were treated with chemotherapy and radiation for either small cell lung cancer (SCLC) or non-small cell lung cancer (NSCLC). Three themes emerged: self-management, the effects of disease, and outside factors. According to the patients, there was a significant impact on their everyday eating, activity, and functioning. Support from friends and family, professional medical advice, and early advice on food and exercise were all greatly valued.

The looked at how patients with colorectal cancer who had oxaliplatin-induced peripheral neuropathy (OXAIPN) responded to an educational program and at-home elastic band exercise.[17] 42 patients got an intervention over a period of 4,5 months using a pretest-posttest, quasi-experimental method. The findings indicated modest QoL advantages along with notable gains in muscular strength and endurance (P <.001). A non-randomized design, a limited sample size, and variable QoL outcomes are some of the limitations. To verify efficacy, more research is required. A 12-week exercise regimen for LC patients who had undergone lobectomies was tested for safety and effectiveness in.[18] Participants were separated into two groups, those who had undergone lobectomies and those who had any other malignancy. The took part in 12-week supervised exercise regimens that focused on their QoL, physical strength, and cardiorespiratory function. The All-other cancer (AOC) group showed significant improvements in VO2peak, physical strength, weariness, and QoL, but only in depression. The goal of research is to assess how a 12-week regimented exercise program affects the endurance and strength of the muscles in patients with LC who are receiving therapy. The goal is to determine if exercise research enhance research population's physical capabilities and QoL.

The organization of the research follows this structure: In the next section, the research approach is provided after the literature review. In the following section, the results of the study are provided and then discussed. The study concludes with a summary of its conclusions.

METHOD

Participants

A total of 88 were collected, then the exclusion criteria (n=40) were eliminated and in inclusion criteria

(n=48) was selected. Next, LC patients were arbitrarily allocated to an exercise group (n=25) and control group (n=23). Data collection included measures of muscle strength (grip strength and leg press), endurance (6-minute walk test), and QoL assessed through various parameters, including overall physical health, mental well-being, social interactions, daily functioning, sleep quality, and levels of pain or discomfort. Table 1 and figure 1 depict the Demographic Characteristics of the selected patients.

Table 1. Demographic Characteristics

Characteristic	Exercise Group (n=25)	Control Group (n=23)
Age (years)	66	64
Gender		
Male	12 (48 %)	11 (48 %)
Female	13 (52 %)	12 (52 %)
Body Mass Index (BMI)		
Mean ± SD	26,5 ± 4,1	25,8 ± 3,6
Smoking Status		
Current Smokers	5 (20 %)	4 (17 %)
Former Smokers	10 (40 %)	9 (39 %)
Never Smokers	10 (40 %)	10 (44 %)
Stage of Lung Cancer		
Stage I	5 (20 %)	4 (17 %)
Stage II	10 (40 %)	9 (39 %)
Stage III	10 (40 %)	10 (44 %)
Comorbidities		
Hypertension	8 (32 %)	7 (30 %)
Diabetes Mellitus	4 (16 %)	3 (13 %)
Cardiovascular Disease	3 (12 %)	4 (17 %)

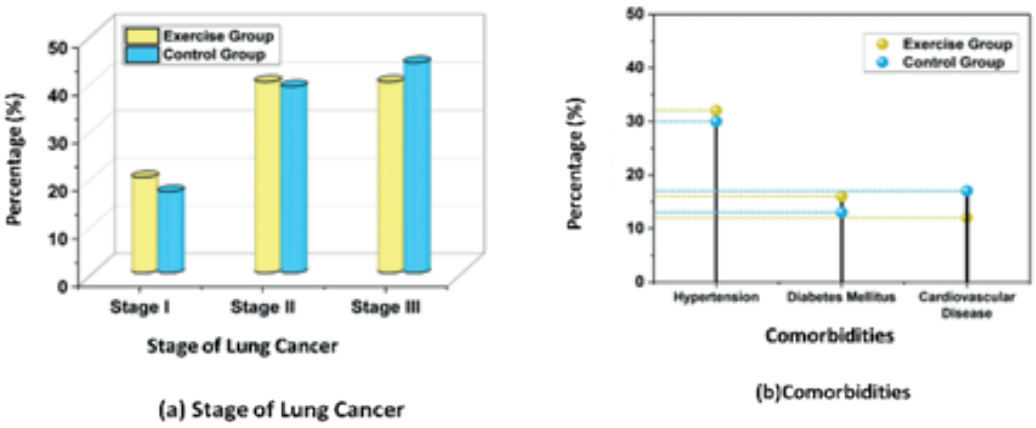

Figure 1. Demographic Characteristics

Selection process

The selected participants (n=48) were included and excluded based on the inclusion and exclusion criteria. Research uses the baseline observation carried forward (BOCF) to preserve cautious estimates of treatment effects. The exclusion and inclusion criteria as represented in figure 2.

Randomization process

A computer created randomization sequence was used to divide individuals into two groups and guarantee that the features of exercise and control groups were distributed equally. Research approach reduced selection bias and preserved the research's integrity. To guarantee that neither the participants nor the researchers had any control over group assignments, randomization was carried out following the acquisition of informed permission and before the start of the intervention. The goal of research approach was to present a solid and trustworthy indication of the program's effectiveness in exercising.

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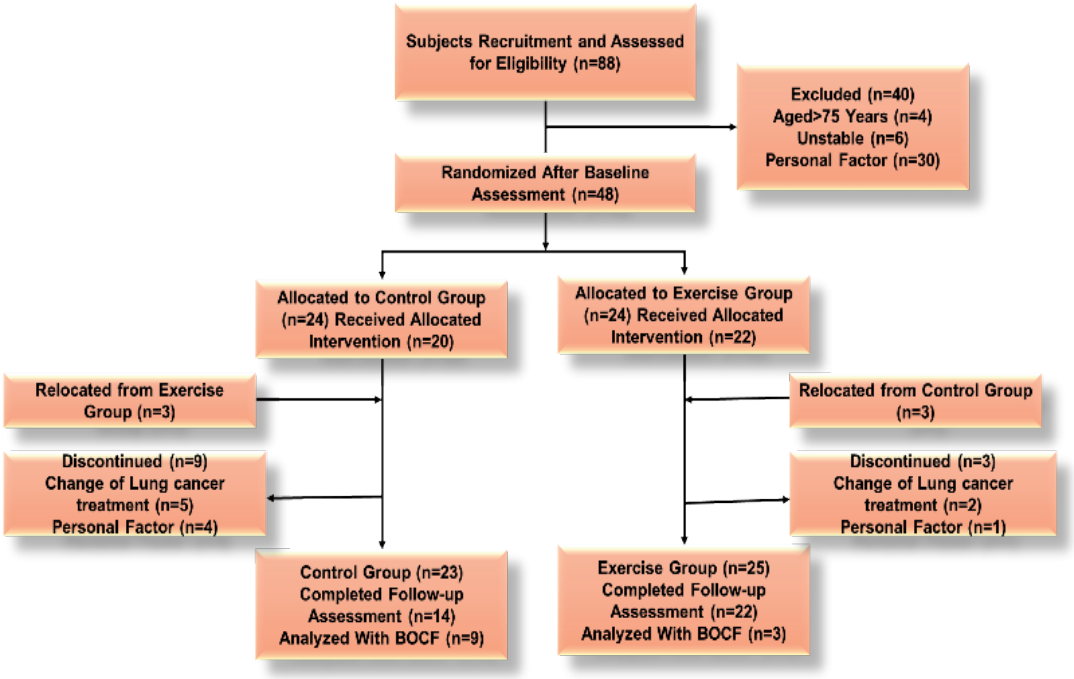

Figure 2. Schematic flowchart

Structured exercise program

Each member of the exercise group received a modified 12-week high strength aerobic interval training therapy based on their physical abilities with the structured exercise program. Numerous aerobic activities aimed at improving cardiovascular fitness and general physical ability were the focus of supervised sessions in the program. Warm-up, high strength activity, and rest intervals interchanged during each session, which ended with a cool-down.

Outcome measures

The QoL, endurance and muscular strength tests were the key outcome measures. A complete assessment of physical capability was made possible by measuring endurance with the 6-minute walk test and assessing muscle strength with the leg press and grip strength tests. A variation of factors such as general physical health, social interactions, mental health, everyday functioning, sleep quality, and pain or discomfort levels, were taken into consideration while assessing QoL. The goal of choosing these metrics was to completely indicate the variety of advantages that the exercise intervention had on the participants' general well-being and safety.

Statistical analysis

The pre-and post-intervention outcomes within and between the two groups were associated using statistical analysis. To assess how a structured exercise program affected LC patients' muscular strength and endurance, statistical analysis using ANOVA and paired t-tests was employed. The researched employed paired t-tests to observe changes in muscular strength and endurance among the groups, assessing if the planned workout schedule produced notable upgrades. An analysis of alterations in QoL metrics between the exercise and control groups was also conducted using ANOVA. Research approach enabled a systematic evaluation of the exercise program's effectiveness by enabling the comparison of pre-and post-intervention measurements both within groups and between the exercise and control groups.

RESULT

Outcomes of the Measures

The outcome of the measures for muscle strength including the grip strength and leg press, and for endurance (6-minute walk test) was evaluated based on the Control Group and Exercise Group.

Outcomes of the measurement using the Paired t-test

To evaluate the outcome of the measures using the paired t-test, it contains parameters like *t-statistic* which compares the means of two groups based on the variability in their data, whereas the *p-Value* reflects the likelihood of observing the data, with lower values indicating more statistical significant and Cohen's d is a measure of the effect size that expresses the standardized variance between the two means. Table 2 represents the outcomes of these measures using a paired T-test.

Table 2. Represents that the training group had a substantial.

Metric	Control Group (n=23)	Exercise Group (n=25)	t-Statistic	p-Value	Cohen's d
Grip Strength (kg)	30,5 ± 3,0	34,7 ± 2,8	6,28	<0,001	1,25
Leg Press (kg)	93,1 ± 7,9	108,4 ± 8,1	5,75	<0,005	1,12
6-Minute Walk (meters)	460,2 ± 44,6	512,7 ± 48,8	5,91	<0,005	1,14

Increase in grip strength at 34,7 ± 2,8 kg, whereas the control group showed negligible change. Research resulted in a t-statistic of 6,28 and a *p-value* of <0,001, suggesting a high effect size. The exercise group saw a substantial rise in Leg Press values as 108,4 ± 8,1 kg compared to the control group's shift from as 93,1 ± 7,9 kg, with a t-statistic of 5,75 and a *p-value* of <0,005. The exercise group improved significantly on the 6-Minute Walk test, improving to 512,7 ± 48,8 meters. The control group's scores decreased to 460,2 ± 44,6 meters, with a *t-statistic* of 5,91 and a *p-value* of <0,005. These findings highlight the valuable effects of organized exercise on improving muscular strength and endurance in LC patients.

Outcomes of the measurement using ANOVA

To evaluate the outcome of the measures using the paired t-test contains parameters like Sum of Squares *(SS)* which quantifies total variability, *df* (degrees of freedom) represents the number of independent values, Mean Square *(MS)* is the average variability (divided by *df), F-Statistic* tests the ratio of alteration described by the model versus the error, and *p-Value* determines the statistical significant of the results, which guides interpretations of exercise intervention effectiveness. Table 3 represents the outcomes of these measures using ANOVA.

Table 3. Comparison of Outcomes measures using ANOVA.

Source	Groups	SS	df	MS	F-Statistic	p-Value
Grip Strength (kg)	Exercise Group	120,45	1	120,45	15,67	<0,001
	Control Group	45,75	1	45,75		
Leg Press (kg)	Exercise Group	160,32	1	160,32	21,89	<0,001
	Control Group	69,83	1	69,83		
6-Minute Walk (meters)	Exercise Group	100,20	1	100,20	12,09	<0,005
	Control Group	30,75	1	30,75		

Table 3 represents that the structured exercise intervention had a substantial effect on grip strength, with the exercise group achieving an *SS* of 120,45 and *MS* of 120,45, yielding an *F-statistic* of 15,67 and a *p-Value* f <0,001. The control group had an *SS* of 45,75. Similarly, for Leg Press, the training group showed an *SS* of 160,32 and an *MS* of 160,32, resulting in an *F-statistic* of 21,89 with a *p-Value* of <0,001, demonstrating a substantial gain in leg strength through the exercise program. The *SS* for the control group was 69,83. The control group had an SS of 30,75, the exercise group had an *SS* of 100,20, an of 100,20, and an *F-statistic* of 12,09 with a *p-Value* of less than 0,005, suggesting a positive impact on endurance. Overall, the outcomes of research determine the advantages of structured exercise for improving LC patients' muscle strength and endurance.

Assessment of the QOL

For the Assessment of the QoL, there were several parameters, including mental well-being, social interactions, sleep quality, overall physical health, daily functioning, and levels of pain or discomfort. A high score indicated a higher QoL, with the exception of symptom scales, where high values indicated more severe symptomatic difficulties.

Assessment of the QoL using a paired t-test

To evaluate the QoL parameters such as overall physical health, mental well-being, social interactions, daily functioning, sleep quality, and levels of pain or discomfort using the paired t-test, it contains the parameters like *t-statistic* which compares the means of two groups based on the variability in their data, whereas the *p-Value* reflects the likelihood of witnessing the data, or something more extreme, under the null hypothesis, with lower values indicating more statistical significant and *Cohen's d* is a measure of the effect size that expresses the identical variance between the two means. Table 4 represents the QoL Assessment using a Paired t-test.

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Table 4. QoL Assessment using Paired t-test.

QoL Parameter	Pre-Intervention		Post-Intervention		t-statistic	p-Value	Cohen's d
	Control Group (n=23)	Exercise Group (n=25)	Control Group (n=23)	Exercise Group (n=25)			
Overall Physical Health	69,3 ± 9,2	68,1 ± 8,9	70,1 ± 9,4	75,4 ± 8,3	5,42	<0,001	1,05
Mental Well-being	66,4 ± 9,5	65,8 ± 9,1	67,2 ± 9,6	73,5 ± 8,5	4,98	<0,005	1,02
Social Interactions	57,8 ± 7,5	58,5 ± 7,0	58,0 ± 7,2	67,2 ± 6,5	5,22	<0,001	1,04
Daily Functioning	60,5 ± 8,8	60,2 ± 8,2	61,0 ± 8,4	68,4 ± 7,9	4,75	<0,005	0,99
Sleep Quality	63,4 ± 7,5	62,5 ± 7,3	64,8 ± 7,7	70,3 ± 6,8	5,01	<0,005	1,03
Pain/Discomfort Levels	41,8 ± 6,3	42,2 ± 6,1	40,2 ± 6,4	35,4 ± 5,6	-4,95	<0,005	1,01

Table 4 indicates that there were notable increases in the physical health of the exercise group overall, with scores rising from 68,1 ± 8,9 to 75,4 ± 8,3. ratings for mental well-being also improved, rising from 65,8 ± 9,1 to 73,5 ± 8,5, while ratings for social contacts rose from 58,5 ± 7,0 to 67,2 ± 6,5. Sleep quality improved from 62,5 ± 7,3 to 70,3 ± 6,8 and daily functioning increased from 60,2 ± 8,2 to 68,4 ± 7,9. However, compared to the control group, the pain or discomfort levels in the exercise group considerably dropped from 42,2 ± 6,1 to 35,4 ± 5,6, suggesting that the organized exercise program had a favorable impact on multiple QoL parameters.

Assessment of the QoL using ANOVA

Table 5. QoL Assessment using ANOVA

QoL Parameters	SS	df	MS	F-Statistic	p-Value
Overall Physical Health					
Exercise Group	120,25	1	120,25	10,32	<0,001
Control Group	12,24	1	12,24		
Mental Well-being					
Exercise Group	140,50	1	140,50	11,36	<0,001
Control Group	5,23	1	5,23		
Social Interactions					
Exercise Group	85,00	1	85,00	7,02	<0,005
Control Group	0,76	1	0,76		
Daily Functioning					
Exercise Group	92,35	1	92,35	7,85	<0,005
Control Group	4,00	1	4,00		
Sleep Quality					
Exercise Group	73,50	1	73,50	6,55	<0,01
Control Group	2,31	1	2,31		
Pain or Discomfort					
Exercise Group	110,00	1	110,00	9,21	<0,005
Control Group	2,94	1	2,94		

To evaluate the QoL parameters such as overall physical health, mental well-being, social interactions, daily functioning, sleep quality, and levels of pain or discomfort using the paired t-test, it contains parameters like *SS* which quantifies total variability, *df* represents the number of independent values, is the average variability (*SS* divided by *df*), *F-Statistic* tests the ratio of variance explained by the model versus the error, and *p-Value* determines the statistical significant of the results, which guides interpretations of exercise intervention effectiveness. Table 5 represents the outcomes of these measures using ANOVA.

Table 5 reveals a substantial increase in overall physical health for the exercise group, with an *SS* of 120,25 and an *F-Statistic* of 10,32 *p-Values*). Similarly, the organized exercise intervention had a substantial effect on mental health, social interactions, everyday functioning, sleep quality, and pain or discomfort, with *F-Statistic* ranging from 6,55 to 11,36 and *p-values* consistently below 0,01. In comparison, the control group shows negligible fluctuation across the parameters, implying that organized exercise considerably improves QoL

measures in the training group when equated to the control group.

Final outcomes of the assessment

The final outcomes of the measures of muscle strength and endurance in LC patients demonstrated as shown in table 6 and figure 2.

Table 6. Outcomes of Muscle Strength and Endurance

Factors	Control Group (n=23)	Exercise Group (n=25)
Grip Strength	87 %	89 %
Leg Press	92 %	94 %
6-Minute Walk	83 %	86 %

Table 6 shows that the exercise group outperformed the control group, with the rehabilitation sample's grip strength being 89 % compared to the comparison group's 87 %. Research proposes that the structured exercise program significantly increased muscular strength. Comparably, the training group performed better on the leg press (94 %), compared to the control group's 92 %, indicating that the exercise regimen's participants had stronger lower bodies. Furthermore, the training group outperformed the control group in the 6-minute walk test, scoring 86 % as opposed to 83 %, indicating notable gains in endurance. Figure 3 represents the Final outcomes of Muscle strength and Endurances.

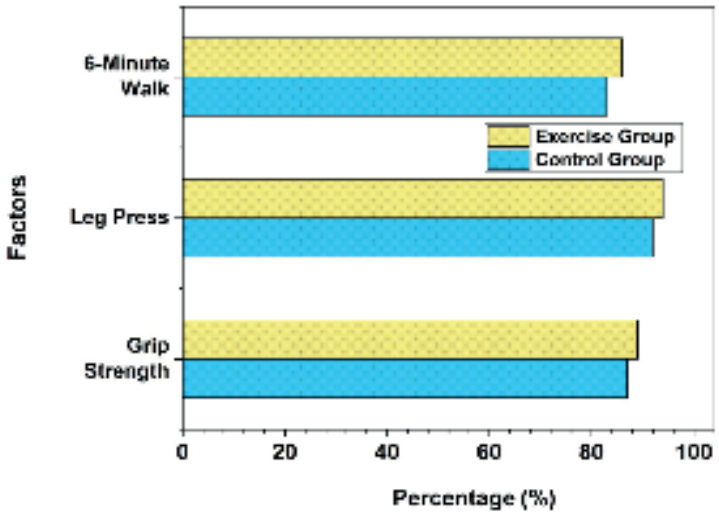

Figure 3. Final outcomes of Muscle strength and Endurances

The final outcomes of the assessment of the QoL in LC patients demonstrated that compared to the control group, the exercise group performed better. That compared to the control group, the exercise group performed better. Table 7 and figure 4 represent the overall Outcomes of QoL assessment.

Table 7. Overall Outcomes of QoL Assessment

QoL Parameter	Control Group (n=23)	Exercise Group (n=25)
Overall Physical Health	70 %	75 %
Mental Well-being	67 %	74 %
Social Interactions	65 %	67 %
Daily Functioning	63 %	68 %
Sleep Quality	64 %	70 %
Pain/Discomfort Levels	41 %	35 %

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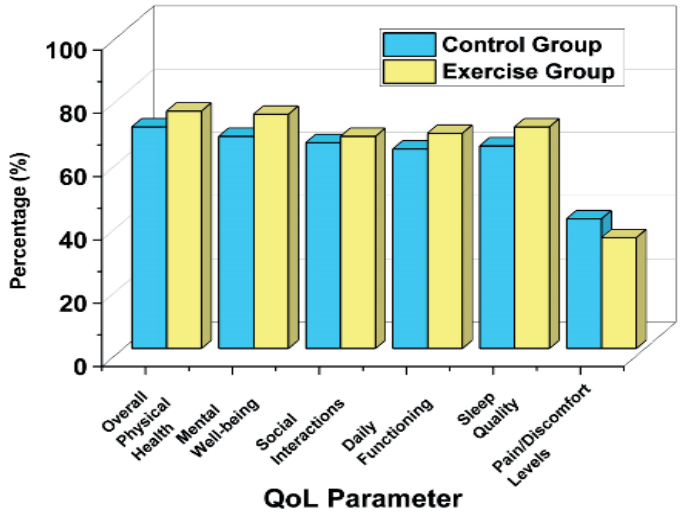

Figure 4. Final outcomes of QoL assessment

Table 7 shows that compared to the control group, which scored 70 %, 67 %, and 65 %, respectively, the exercise group showed noteworthy increases on all QoL measures, scoring 75 % in overall physical health, 74 % in mental well-being, and 67 % in social interactions. Furthermore, with a daily functional score of 68 % as opposed to 63 %, Compared to the control category, the participant group performed better. The exercise group scored 70 % on sleep quality questionnaires, compared to 64 % for the control group. Significantly, equated to a higher 41 % in the control group, pain and discomfort levels dropped to 35 % in the exercising group, highlighting the importance of the structured exercise program in improving LC patients' quality of life results.

DISCUSSION

The results of the physical performance measures and QoL evaluations show how beneficial organized exercise is for patients with LC. As demonstrated by paired t-test results with t-statistics of 6,28, 5,75, and 5,91, respectively, all with p-values less than 0,005, indicating high statistically significant, and Cohen's d of 1,25, 1,12, and 1,14. Research exercise group showed significant improvements in grip strength, leg press, and endurance. The QoL parameters that were evaluated using paired t-tests also demonstrated noteworthy improvements in terms of physical health ($t = 5,42$, $p < 0,001$, $d = 1,05$), mental health ($t = 4,98$, $p < 0,005$, $d = 1,02$), sleep quality ($t = 5,01$, $p < 0,005$, $d = 1,03$), and pain/discomfort ($t = -4,95$, $p < 0,005$, $d = 1,01$). These results were further supported by an ANOVA, which showed significant effects on mental health ($F = 11,36$,), overall physical health ($F = 10,32$, $p < 0,001$), and QoL measures, indicating that the structured exercise program is beneficial in improving different aspects of health and well-being among LC patients. Evaluating the effects of Structured exercise on LC patients' muscular strength and endurance improves their QoL by addressing their physical and psychological well-being in addition to offering important insights into successful rehabilitation techniques. Research technique highlights the value of structured exercise programs in improving overall health outcomes for those dealing with the problems of cancer treatment.

CONCLUSION

Research found that a structured 12-week exercise program significantly increases the muscle strength and endurance of LC patients, improving their physical capacity and QoL. With a 6-minute walk score of 86 %, leg press performance of 94 %, and grip strength of 89 %, respectively, the exercise group outperformed the control group in terms of muscle strength and endurance, whereas the control group scored 87 %, 92 %, and 83 %. In addition, the exercise group performed better than the control group in terms of QoL, giving the experimental group scores of 75 % for overall physical health, 74 % for mental well-being, 67 % for social interaction, 68 % for daily functioning, and 70 % for sleep quality, compared to 70 %, 67 %, 65 %, 63 %, and 64 % for the control group. Significantly decreased to 35 %, as opposed to 41 % in the control group, highlighting the significant benefits of the structured exercise program. The research's small sample size and brief intervention time can have restricted the applicability of the findings to broader LC populations. Future research must look at the long-term effects of structured exercise programs, consider a range of patient demographics, and assess the impact on other HR QoL outcomes.

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CONFLICT OF INTEREST

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