

Determination of the effect of isotonic exercises on the quality of life of patients after a stroke

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ABSTRACT

Purpose. This study aimed to evaluate the effect of isotonic exercises on the quality of life of stroke patients in Shahrekord, Iran, in 2023.

Methods. A semi-experimental design was employed, involving 30 stroke patients assigned to control and case groups through simple random sampling. The case group underwent isotonic exercise training three times a week for 8 weeks, while the control group received no intervention. Quality of life was measured using the SF-36 questionnaire before and after the intervention, and data were analysed using SPSS software.

Results. Demographic variables were homogeneous across both groups, with no significant differences ($p > 0.05$). The case group showed significant improvement in physical performance ($p = 0.001$). The control group showed significant differences in role limitations due to physical health ($p = 0.031$) and emotional problems ($p = 0.016$). Pain subscale improvements were noted in both groups, with significant differences in the case group ($p = 0.012$) and the control group ($p = 0.002$).

Conclusions: Isotonic exercises positively affected multiple dimensions of quality of life, indicating their potential to enhance the overall well-being of stroke patients.

Key words: stroke, exercise therapy, quality of life, isotonic contraction, rehabilitation

Introduction

Stroke is a sudden neurological defect caused by haemorrhagic lesions in the brain that occur over a period of more than 24 hours, resulting in changes in the physical and functional perception of a part of the body [1].

The risk of stroke doubles every 10 years after the age of 55, and despite preventive measures, the probability of experiencing a recurrent stroke within two years is 20% [2]. According to statistics of the World Health Organization, the incidence of stroke worldwide ranges from 2.7 to 4.7 cases per thousand people, with nearly one million cases occurring annually in

European countries [2]. A study conducted in China predicts that stroke will have become the second leading cause of death globally by 2030, with a sharp increase expected in underdeveloped countries with low economic resources [3]. In Iran, between 139 and 149 individuals out of every 100,000 experience a stroke each year, with more than 15 to 30 percent becoming disabled as a result [2]. Stroke can have profound and unpredictable effects on patients' lives, including physical complications, feelings of worthlessness, speech and communication impairments, depression, personality changes, social isolation, and dependence on others for activities of daily living [4]. Finally, stroke impacts patients' life satisfaction and quality of life [5].

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Quality of life is a multi-dimensional concept encompassing various physical, mental, social and personal dimensions. In recent years, measuring and improving quality of life has been established as one of the primary goals of treatment. By assessing the quality of life, healthcare providers can evaluate patients' responses to their illness and determine the negative effects of disease or treatment on their overall well-being [5].

Studies have shown that stroke patients generally do not enjoy a good quality of life [3], with those experiencing mild stroke reporting low levels of quality of life [5]. Similar findings have been reported in Iran, including in Rafsanjan [6].

Due to the fact that stroke patients often rely on others for their daily tasks [5], the examination of quality of life of these patients has drawn considerable attention to post-stroke treatment [7]. Impaired physical function is the most common complication following a stroke; studies show that between 19% and 75% of stroke survivors experience some degree of physical impairment [8].

Various exercises available for the rehabilitation of stroke patients are performed at each stage of treatment based on individual needs. Notably, these exercises do not require special equipment compared to other forms of exercise and are relatively cost-effective. Additionally, they are non-invasive, making them suitable for implementation if satisfactory results are achieved.

Since most research emphasises the impact of exercise training on improving stroke patients' performance, this study aims to investigate the effect of isotonic exercises on the quality of life among stroke patients.

Isotonic exercises were chosen based on their known benefits in enhancing muscular strength and functional mobility without requiring complex equipment, making them suitable for stroke rehabilitation. Prior literature indicates their effectiveness in improving cardiovascular endurance and muscle performance.

Material and methods

In this study, 30 patients with stroke who met the eligibility criteria for participation were selected through convenience sampling from among the patients referred to Kashani Hospital in Shahrekord, southwest Iran, in 2023. They were then randomly divided into case and control groups. After attending an orientation meeting and being fully informed about the research conditions, these individuals voluntarily expressed their willingness to participate in the study. The primary inclusion criteria for the study were: having

either a haemorrhagic or ischemic stroke, a desire, and motivation to participate, the ability to comprehend the training, and the capacity to change direction during exercises. The control group received standard care, which did not include any additional structured physical activity or individual rehabilitation sessions beyond routine hospital follow-ups.

Exclusion criteria included: suffering from other neuromuscular diseases, spinal cord injuries, concussions, reduced levels of consciousness, intellectual disabilities, cognitive and visual impairments, substance abuse (including alcohol and drugs), a history of multiple strokes, and mental illnesses.

Demographic information included: sex, age, marital status (single, married, or other), level of education (sub-diploma, post-diploma, bachelor's degree, master's degree, or doctorate), occupation, number of children, and housing status. The SF-36 questionnaire was used to assess and evaluate the patients' quality of life. This scale is widely utilised in medical research and has been validated for measuring quality of life in stroke patients, demonstrating good reliability and validity [6].

The SF-36 questionnaire consists of eight scales that focus on a person's performance across eight different dimensions. Each scale is derived from a combination of 2 to 10 questions. Overall, two summary measures are obtained under the headings of physical health (which includes physical activity, physical limitations, physical pain, and general health) and mental health (which includes vitality, mental health issues, social functioning, and emotional well-being). Each dimension of the questionnaire assesses different aspects based on a range of responses; questions may have binary options (yes/no) or six options: always, most of the time, sometimes, occasionally, or never. Scores for each subscale range from zero to 100, where zero represents the lowest possible score and 100 represents the highest possible score on that scale; higher scores indicate better quality of life [6]. According to reports from 2005, the Persian version of this questionnaire was translated and validated by Montazeri *et al.* [9], with an overall Cronbach's alpha estimated at 0.95 [6].

After the initial evaluation, participants in the case group engaged in three sessions of isotonic exercises each week for eight weeks, while participants in the control group did not receive any intervention. Stroke rehabilitation exercises are diverse and are tailored to each stage of treatment based on individual patient needs. These exercises include stretching exercises, strength training exercises, mobility exercises, limb movement exercises within a range of motion, walking

exercises, and balance training for stroke patients. Initially, an occupational therapist and physiotherapist assessed each stroke patient and provided rehabilitation exercises and treatment modalities based on their specific levels and needs. The exercises implemented – stretching, resistance with elastic bands, and body-weight movements – are all characterised by controlled muscle lengthening and shortening under constant load, consistent with isotonic exercise principles.

The exercise program in this study consisted of light exercises emphasising hand and leg movements as well as aerobic activities such as yoga. The program was divided into three phases: warm-up, exercise, and cool-down. The warm-up phase lasted 5–10 min and involved stretching and light movements. The training phase lasted 20–30 min during which hand exercises, leg exercises, and aerobic activities for stroke rehabilitation were performed. Each movement lasted 40 s with a 20-second rest period between movements. Each exercise was repeated 10–15 times. Following the exercise phase was a cool-down phase lasting 5–10 min (Table 1).

At the end of the eight-week intervention, the participants completed the quality-of-life questionnaire again to compare their scores before and after the exercise program. After data collection was complete, data were analysed using SPSS software along with Kolmogorov–Smirnov tests, *t*-tests, Wilcoxon tests, and analysis of covariance. A significance level of < 0.05 was set for all statistical tests.

Results

The research findings indicated that 46.7% of the participants in the control group and 3.53% of those in the case group were over 50 years old. Additionally, 73.3% of the participants in the case group were male, while 46.7% of the participants in the control group were either single or married. Furthermore, 33.3% of the participants in the case group had a bachelor's degree, and 33.3% of the participants in this group were employed.

The results of the chi-square statistical test revealed that the demographic variables – including gender, education, marital status, employment status, number of children, age, and housing status – were homogeneous between the two groups (case and control), with no significant differences observed ($p > 0.05$).

The findings showed a significant increase in the case group in the average scores on several subscales – specifically physical performance, role limitations due to physical health status, role limitations due to emotional problems, energy, and vitality – when comparing post-test scores to pre-test scores. In contrast, this increase was not significant for the control group regarding role limitations due to physical health status, role limitations due to emotional problems, and energy and vitality (Table 2).

Paired *t*-tests and Wilcoxon tests demonstrated statistically significant differences in the case group in scores for role limitations due to physical health status, role limitations due to emotional problems, energy and vitality, emotional health, and general health before

Table 1. Sports exercises for stroke patients in 24 training sessions

Hand exercise for stroke	1 – hand strength exercises 2 – bending the wrist 3 – grasping a physiotherapy ball with your fingertips 4 – bending the fingers 5 – help turn the thumb 6 – lateral pressure of the fingers 7 – rolling and holding 8 – hand stretching exercises with (extension) opening and (flexion) bending 9 – palm rotation 10 – bending and opening the wrist up and down and left and right 11 – strengthening the fingers
Leg exercise for stroke	1 – ankle exercise 2 – knee stretching exercises 3 – parade sitting on a chair 4 – turning the trunk while sitting 5 – bringing the knees closer to the chest while lying down 6 – hitting the toes on the floor
Aerobic exercise for stroke	yoga

Table 2. The mean and standard deviation of the quality-of-life parameters

Variable	Control group		Case group	
	pre-test (mean $\pm$ SD)	post-test (mean $\pm$ SD)	pre-test (mean $\pm$ SD)	post-test (mean $\pm$ SD)
Physical performance	1.00 $\pm$ 0.00	1.10 $\pm$ 0.26	1.00 $\pm$ 0.00	1.81 $\pm$ 0.49
Health status	1.25 $\pm$ 0.32	1.03 $\pm$ 0.08	1.15 $\pm$ 0.31	1.25 $\pm$ 0.23
Role playing limitations of emotional problems	1.28 $\pm$ 0.33	1.02 $\pm$ 0.08	1.22 $\pm$ 0.37	1.31 $\pm$ 0.32
Energy and vitality	3.35 $\pm$ 0.38	3.00 $\pm$ 1.27	3.25 $\pm$ 0.71	3.30 $\pm$ 0.41
Emotional health	3.18 $\pm$ 0.64	2.82 $\pm$ 1.36	3.05 $\pm$ 0.51	3.01 $\pm$ 0.35
Social performance	3.53 $\pm$ 1.02	4.36 $\pm$ 1.18	4.36 $\pm$ 1.27	3.30 $\pm$ 1.11
Pain	2.66 $\pm$ 0.67	4.13 $\pm$ 0.91	3.33 $\pm$ 1.04	2.36 $\pm$ 0.44
General health	2.61 $\pm$ 0.49	2.11 $\pm$ 0.39	2.33 $\pm$ 0.26	2.25 $\pm$ 0.43

Table 3. Quality-of-life scores of stroke patients before and after isotonic exercises in the case and control groups

Variable	Case group	Control group
Physical performance	0.001 [#]	0.066 [#]
Limitations due to physical health status	0.304 [#]	0.031 [#]
Role playing limitations of emotional problems	0.467 [#]	0.016 [#]
Energy and vitality	0.817 [*]	0.280 [*]
Emotional health	0.735 [*]	0.231 [*]
Social performance	0.025 [*]	0.005 [*]
Pain	0.012 [#]	0.002 [#]
General health	0.565 [*]	0.023 [*]

* paired *t*-test, [#] Wilcoxon test

and after the intervention. Conversely, in the control group, no statistically significant differences were found in scores for physical performance, energy and vitality, or emotional health before and after the intervention (Table 3).

When comparing the average results of both case and control groups after eight weeks of isotonic exercises, a significant difference was observed in physical performance, role limitations due to physical health status, role limitations due to emotional problems, social performance, and pain ($p \leq 0.05$). Additionally, eta squared analysis indicated that exercise had a very strong effect on physical performance (0.450) and pain (0.578), while demonstrating a weak effect on general health (0.002) compared to other variables (Table 4). Paired sample *t*-tests were conducted to assess within-group differences between pre- and post-intervention scores. Independent sample *t*-tests compared differences between groups. Statistical significance was set at $p < 0.05$.

Discussion

The findings of this research indicated that performing isotonic exercises improves the quality of life of

Table 4. The results of covariance analysis to compare research variables in two control and case groups

Variable	Group	Mean in the post-test	F-value	p-value	Eta squared
Physical performance	case	1.81	22.048	< 0.001	0.450
	control	1.10			
Role playing limitations due to physical health status	case	1.25	10.591	0.003	0.282
	control	1.03			
Role playing limitations of emotional problems	case	1.31	11.010	0.003	0.290
	control	1.02			
Energy and vitality	case	3.30	0.864	0.361	0.031
	control	3.00			
Emotional health	case	3.01	0.931	0.343	0.033
	control	2.82			
Social performance	case	3.30	0.933	0.005	0.257
	control	4.36			
Pain	case	2.36	38.31	< 0.001	0.587
	control	4.13			
General health	case	2.25	0.067	0.798	0.002
	control	2.11			

stroke patients. Specifically, the results showed that isotonic exercises enhance both physical and social performance. Regular isotonic exercises appear to reduce role limitations caused by physical health issues. Furthermore, patients who received the intervention experienced fewer role-playing restrictions due to emotional problems compared to those who did not. Additionally, the results demonstrated that patients who participated in the intervention reported less pain than others. Overall, these observations suggest that engaging in physical activities has a positive effect on pain levels.

Concerning the physical performance of the participants, a significant difference in physical performance was observed after eight weeks of isotonic exercises, which contrasts with the findings of Babaeipour *et al.* [6]. However, Badri *et al.* [10] noted significant improvement in physical performance after 12 weeks of combined aerobic-resistance training with two different volumes. Similarly, Naderi *et al.* [11] found that participants' physical performance improved by 10% after a 12-week exercise programme, which was a statistically significant increase. The findings of the present study regarding physical performance align with those of Sedaghati *et al.* [12].

Similar to the findings of Yaghoubi *et al.* [13] and Babaeipour *et al.* [6], the present study demonstrated a significant difference in the mean scores for role limitations due to physical health between the case and control groups. Also, Naderi *et al.* [11] observed improvement of physical health after 12 weeks of aerobic-resistance exercises in hyperkyphosis patients. Moreover, the present study results concerning improvement of the physical health of patients after the implementation of sports exercises were in agreement with the findings of Zarneshan and Abdi [14].

In this study, consistent with the findings of Yaghoubi *et al.* [13], a significant difference was determined regarding role limitations caused by emotional problems between the case and control groups, as evidenced by the mean scores. Also, in the study of Naderi *et al.* [11], the results showed that aerobic and resistance exercises can alleviate role limitations due to emotional problems in stroke patients. Sedaghati *et al.* [12] in a prospective cohort study also stated that sports training could improve the limitations of role playing caused by emotional problems.

Consistent with the findings of Yaghoubi *et al.* [13] and Babaeipour *et al.* [6], the present study results showed a significant difference in the social performance of the participants when comparing the mean

scores of the case and control groups. Noteworthy, Sedaghati *et al.* [12] observed improvement of social performance after aqua gymnastic exercises. Furthermore, Hasanpour-Dehkordi and Rastar [15] found that the characteristics of the intervention group participants indicated improvement in social performance following progressive muscle relaxation. However, Naderi *et al.* [11] reported different findings. In their research, no significant difference was observed in social performance when comparing the mean scores of the intervention and control groups.

In this study, contrary to the findings of Babaeipour *et al.* [6], no significant relationship between exercise and quality of life (energy, vitality, and general health) was observed. Likewise, Sedaghati *et al.* [12] and Naderi *et al.* [11] found no significant difference in the components of energy and vitality and general health having compared the mean results of the intervention and control groups.

Babaeipour *et al.* [6], consistent with our findings, showed a significant difference in relation to the pain component when comparing the mean scores of the case and control groups. The results of the present study in relation to the pain component were consistent with the findings of Sedaghati *et al.* [12]. It is worth mentioning that Hasanpour-Dehkordi and Rastar [15] observed some alleviation of physical pain after the intervention. Furthermore, Haghighi *et al.* [16] showed that social performance improved significantly after performing balance exercises accompanied by exercises based on vestibular system stimulation.

Limitations

This study has several limitations. First, the relatively small sample size may have affected the generalisability of results. Second, the absence of a placebo intervention in the control group may have introduced bias. Finally, only short-term effects were evaluated; long-term outcomes remain uncertain.

Conclusions

The results suggest that isotonic exercises significantly improve physical functioning, social participation, and psychological well-being of stroke patients. These variables are key contributors to quality of life, underscoring the importance of incorporating such exercises into rehabilitation programs.

Detailed description of the use of AI

We would like to disclose transparently that we used an artificial intelligence-based writing assistant solely for minor language editing and grammatical editing, clarity and sentence structure in the manuscript.

Data statement

The data used in this study are available from the corresponding author upon reasonable request.

Ethical approval

The research related to human use complied with all the relevant national regulations and institutional policies, followed the tenets of the Declaration of Helsinki, and was approved by the Shahrekord University of Medical Sciences (approval No.: IR.SKUMS.REC.1394.158).

Informed consent

Informed consent was obtained from all individuals included in this study.

Conflict of interest

The authors state no conflict of interest.

Disclosure statement

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