Original Article

Effects of Aquatic Exercise on Dimensions of Quality of Life and Blood Indicators in Patients with Beta-Thalassemia Major

Abstract

Background: Thalassemia is considered as a group of genetic blood disorders, characterized by anemia. The present research aimed at evaluating the effects of aquatic exercise on quality of life and blood indices in patients with beta-thalassemia major. **Methods:** A clinical trial study involving 40 patients with thalassemia major, divided into two groups: experimental and control. The tools used to collect the data included demographic information questionnaire, blood indicators questionnaire, and SF-36 quality of life questionnaire. The experimental group performed exercise in water three times per week for 8 weeks in the pool after obtaining the consent. In this research, the quality of life questionnaire was filled out 24 h before the intervention, 24 h after the last session of the exercise program, and 2 months after the end of the exercise program. **Results:** The current research revealed that exercise in water affected the quality of life, hemoglobin, hematocrit, iron and ferritin of serum such that the mean score of quality of life and blood indicators in the study showed a significant difference in the experimental group. **Conclusions:** The use of a regular exercise program combined with drug therapy and blood transfusion can be useful in the treatment of beta-thalassemia patients.

Keywords: *Aquatic exercise, beta-thalassemia, quality of life*

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Introduction

Thalassemia is considered as a hereditary hemoglobinopathy and hemolytic anemia.[1,2] It is transmitted from one generation to another.[3] Genetic defect on chromosome 11 in β-thalassemia results in complete or partial loss of beta chain synthesis.[4] Although this disease has a global prevalence,[5,6] it is seen more in the Mediterranean Sea, the Middle East, Asia, and South-East Asia.[6-9] Iran is one of the countries, where thalassemia has a high prevalence;[10,11] however, it was limited to certain regions of Iran.[12] Nevertheless, its prevalence has unfortunately been increased due to population growth, non-prevention of the disease, and improper implementation of family planning.[11] Its prevalence is estimated to be about 15000. The prevalence of beta gene carriers is also estimated to be about 4% in Iran.[8,11,12]

The major problems of these patients include a decline in academic performance, limited social communication, feeling misery owing to dependence on others to receive care, psychosocial problems[1,13] such as unpleasantness, sadness, and distress caused by health problems, concern related to premature death, social isolation and depression, physical problems, prolonged and frequent diet therapy, hospitalization and absenteeism from the workplace or school, and the economic problems caused by the cost of hospitalization and the use of iron removal treatments.[14,15] Physical and psychological problems in this group of patients result in hopelessness and reduced social functioning and social relationships, and finally, reduced quality of life.[16] Improving the quality of life of the patients is considered an important motivation in this regard since developments in new treatments and clinical planning have nowadays increased the life span of patients.[14-16] Exercise, especially aerobic activities, improves the quality of life, family self-esteem, social communication, and the sense of well-being.[17] Group activities such as exercise can enhance the ability of patients to perform daily activities without dependency on others.[18] It also has a positive impact on the quality of life dimensions including role-playing,

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cognitive and physical preparedness, reduced physical pain, vitality and well-being, emotional performance, mental health, cognitive functions, and flexibility of chronic patients.[19,20] The results of a study conducted by Kargarfard *et al*. revealed that the quality of life dimensions was significantly increased in the experimental group after 8 weeks of exercise in water, compared to that of the control group.[21] In addition, the results of a study by Ortega *et al*. show that an increased IL-6 was found to be associated with a decrease in a spontaneous release of TNFα after a 4-month exercise program. At the completion of the program (8 months), monocytes in the FM patients decreased spontaneous production of pro/anti-inflammatory cytokines along with the spontaneous release of IL-1β and IL-6 to HW; however, the production of TNFα was low and that of IL-10 was high. The production of TNFα, IL-1β, IL-6, and IL-10 induced by lipopolysaccharide, was reduced at the completion of the exercise program; however, IL-10 was still higher than HW. The anti-inflammatory effect of the exercise program was also approved by a decreased concentration of circulating CRP. The exercise enhanced the health-related QOL in patients with FM.[22]

The results of another study indicated the positive effect of exercise in the water on the quality of life of the patients.[19] Kargarfard *et al*. showed that exercise in the water had a significant effect on domains of autonomy and communication with others but it showed no significant effect on environmental domination, individual growth, and self- acceptance.[23] However, the general investigation of psychological well-being revealed a significant difference between the posttest scores of the psychological well-being of the subjects.[23] The results of a study conducted by Arian *et al*. indicated that the planned program of walking had a positive impact on the quality of life of the patients suffering from thalassemia major.[24] Thalassemia adolescents suffer from more depressive symptoms and lower quality of life compared to patients with short-term injuries.[13] Thus, improvement of the psychological state of adolescents can reduce depression and improve the prognosis of these patients. Proper nursing care can enhance the quality of life.[3,14,24] No proper exercise program has been designed yet for thalassemia patients. Besides, a limited number of studies has been conducted on the effect of exercise on the quality of life in the patients with thalassemia in Iran, especially in Chaharmahal and Bakhtiari province in southern Iran, where thalassemia has high prevalence, despite the recommendation of physicians and physiotherapists on the positive effect of exercise, especially exercise in water, on treatment and prevention of diseases. Moreover, no research has been carried out yet on the effect of exercise in the water on these patients. Hence, the aim of our study was to investigate the impacts of aquatic exercise training on quality of life and blood indices in patients with beta-thalassemia major in southern Iran in 2016.

Methods

This research is considered a clinical trial study. With ethical code IRCT2017021013768N12 IR.SKUMS.REC.1395.119, it was conducted in Shahrekord in summer of 2016. The research population included the beta-thalassemia major patients admitted to Hajar Hospital in Shahrekord for treatment and transfusion. A total of 40 patients with beta-thalassemia major were enrolled in this research.

Inclusion criteria

Age over 12 years, with major thalassemia, examination by the treating physician, confirmation of participation in the study, no smoking addiction, ability to understand education, having the desire and motivation to participate in the exercise program, participate in the research, ability to exercise, lack of physical illness or history of any particular illness that may be compromised by performing a health exercise (such as cardiovascular, respiratory, mental, skin, osteoarthritis, etc.), lack of regular participation in or out of the program, and ability to attend training sessions regularly were considered as the inclusion criteria of the study.

Exclusion criteria

Deteriorating health status and unwillingness to cooperate constitutes the exclusion criteria of the study.

After obtaining the written consent from the patients, the ones who met the inclusion criteria of the research were selected by using a convenient sampling method. They were homogenous in terms of marital status, level of education, age, and job. Later, the patients were randomly divided into two groups of experimental and control (each contained 20 patients). Sysmex device was used to measure the level of hemoglobin and hematocrit. The hematocrit level was also calculated by the computational method. Cobase device (made in Japan) was used to measure the ferritin. Luminescence and calorimetry quantitative measurement method was used to measure electrochemical ferritin concentration. BT3500 biochemistry device (made in Italy) was used to measure iron and TIBC. The photometric method was used for quantitative measurement of iron and TIBC concentration. The colorimetric kit was also used to measure iron. The questionnaire used in this research consisted of two sections. The first section included general information such as age, gender, marital status, education level, job, hemoglobin, hematocrit, iron, serum ferritin, and TIBC. The second section included the SF-36 questionnaire based on physical function, physical pain, and functional limitation caused by physical problems, general health and mental health, feeling vitality, limited function due to emotional issues, and social functioning. It scored from 0 to 100.[25] Montazeri *et al*. and Eshaghi *et al*. measured the validity and reliability of this questionnaire. The reliability coefficient of the questionnaire was found to be 0.7 using

Cronbach's alpha method.[26,27] The research patients filled out the questionnaire before and after the study under the supervision of the researcher. After coordinating with the subjects in one 60-min session, the researcher and the sports expert provided the exercises by displaying them for the experimental group. Then, the experimental group performed the exercises for 8 weeks and the patients continued their treatment routinely during the intervention. The control group did not participate in any exercise and they received their routine treatment while the patients of the experimental group performed the exercises in water for 2 months, three sessions of 60 min each per week at a temperature of 28 to 30°C. In the semi-deep part of the small pool of a day care facility under fitness instructor and supervised by the researchers. Moreover, the participants received medical permission from their physician to exercise.

Aquatic exercise training

The way of exercising on water and the water properties were explained to the subject's on the first day of the program that lasted 20 min. After learning the skill of controlling the body in water and walking in water, the subjects started the exercise. The rest of the sessions lasted for an hour in three sections. Warming up: This stage lasted 10 to 15 min. In this stage, the subjects prepared themselves for the main exercise program by walking in the pool. The main stage involved performing the aerobic and resistance exercises for 35 to 40 min. The exercises were repeated three times every 10–15 min. Cooling down: At the end of each exercise session, the subjects performed activities to return to the initial state including walking and simple movements with low intensity and stretching movements. This stage lasted 5–10 min.[28] These exercises continued up to the patients' tiredness, and if the patients were tired sooner than the specified time during one session, they would not continue to exercise that day. The intensity of the water exercise commensurate with the patients' strength. Furthermore, the researchers controlled the intensity of training by measuring the symptoms of weakness, body temperature, respiratory rate, and blood pressure daily before and after the exercise. Thus, 24 h after the end of the eighth week[29,30] and 2 months after the end of the intervention, the quality of life questionnaire was refilled out in both groups. SPSS16 software was used to analyze the results. Further, descriptive statistics (including mean, standard deviation, frequency, and percentage) and statistical analysis (including independent *t*-test, paired *t*-test, Fisher's exact test, and repeated measures of ANOVA test) were used. *P* value at 0.05 was considered significant.

Results

The study results revealed that the majority of the sample in both groups were females, being single with a high school diploma and unemployed. Both groups were similar in demographic characteristics ($P > 0.05$) [Table 1]. Paired *t*-test for blood indices showed that the mean level of hemoglobin, hematocrit, iron, and ferritin in the control group before and after the study were not significantly different [Table 2].

However, paired *t*-test revealed that the mean level of hemoglobin in the experimental group from 8.57 ± 1.24 to 9.46 ± 1.24 was significantly increased ($P < 0.05$). For other blood parameters: increased hematocrit, decreased iron and ferritin were not significantly different before and after the intervention [Table 3]. The results showed that the mean score of iron and ferritin were reduced after the intervention in the experimental group while the mean score of iron was decreased in the control group. However, this difference was not statistically significant in the experimental and control groups ($P > 0.05$) [Table 4]. The mean score of quality of life and eight scales and statistical results of repeated measures of ANOVA between groups at each time interventions are given in Figure 1 and Table 5. Increase in mean score quality of life and eight scales at each time between groups were not significant ($P > 0.05$) [Figure 1 and Table 5].

Discussion

The results of the study revealed that exercise in water caused an increase in hemoglobin and hematocrit in

Table 1: Comparison of demographic data of participants in experimental and control groups

Group Demographic data	Experimental	Control	*P*
Gender *n* (%)			
Male	9 (45)	8 (40)	>0.05
Female	11 (55)	12 (60)	
Marital Status			
Single	17 (85)	14 (70)	0.451
Married	3 (15)	6 (30)	
Education *n* (%)			
Illiterate	1 (5)	3 (15)	0.429
Under high school	3 (15)	6 (30)	
High school completion	9 (45)	7 (35)	
Academic	7 (35)	4 (20)	
Job *n* (%)			
Unemployed	13 (65)	14 (70)	>0.05
Housewife	3 (15)	3 (15)	
Employee	2 (10)	2 (10)	
Other	2 (10)	1 (5)	

Table 2: Comparison of mean of blood indices in the control group

Blood Indices	Means (SD)		*P*
	Before	After	
Hemoglobin	8.56 (1.12)	8.68 (0.83)	0.602
Hematocrit	26.65 (3.57)	27.04 (2.93)	0.585
Iron	154.24 (49.97)	180.70 (47.19)	0.071
Ferritin	1422.85 (1165.49)	1466.45 (1271.13)	0.702

the experimental group but it reduced iron and ferritin compared to before the intervention. The results of the research conducted by Hiedari showed a slight increase in hemoglobin and hematocrit of female athletes and nonathletes after 5 weeks of aerobic exercise with a 60–80% HR_{max}.[31] The results of the research conducted by Engy showed that exercise improves hemoglobin and reduces fatigue. The results of the study conducted by Durbin *et al*. showed that 7 weeks of aerobic exercise increased the level of HCT, Hb, RBC, and VO2 peaks. In addition, Kratz *et al*. showed that exercise increased the level RBCs, Hb, and HCT.[32] The results of another study showed that the body mass index, waist circumference, mean arterial pressure, and diastolic blood pressure significantly decreased after aerobic and resistance exercise but the HDL, fasting plasma glucose, cholesterol, or systolic blood pressure did not change significantly in the exercise groups.[33,34]

In addition, the results of a study performed by Salianeh *et al*. showed that RBC count increased in both groups. These changes were higher in the periodic exercise.[35] Hefernan did not show a significant change in the levels of hemoglobin and hematocrit in inactive men.[36] The results of a study performed by Ramezanpour *et al*. showed that exercise increased the iron, ferritin, and transferrin of serum.[37] In contrast to the results of this research, the results of the research conducted by Hoseinpour Motlagh *et al*. showed that 8 weeks of resistance exercise increased muscle strength and reduced the number of red blood cells and hematocrit but it did not show any effect on concentration of fibrinogen, number of platelets, and the number of white blood cells. Resistance exercises need to be performed for longer periods of time to increase the effectiveness of resistance exercises on the concentration of fibrinogen and other blood cells.[38] Eastwood *et al*. showed that exercises did not affect hemoglobin.[39] In addition, the results a study on the dimensions of physical function, role-playing with regard to physical state, and role-playing with regard to psychological state showed that the mean scores of the physical performance were significantly different in two groups at the studied times ($P < 0.05$). The current research results revealed that exercise in water increased the quality of life in the experimental group so that the mean score of quality of life in the studied time period showed a significant reduction. These results are in-line with other

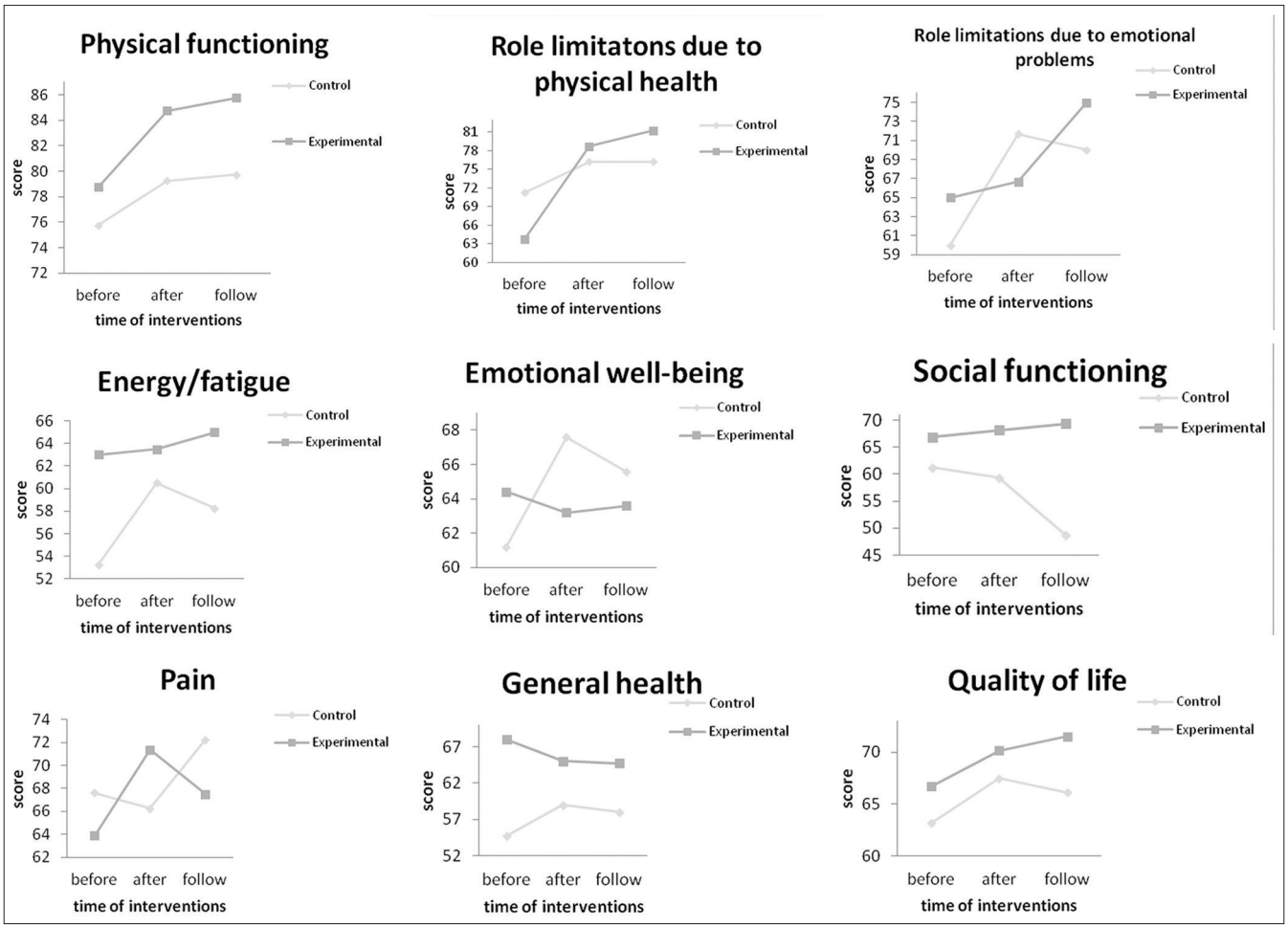

Figure 1: Mean scores in quality of life and 8 scales at the time of interventions (before, after, and follow) between groups (control and experimental). Changes in scores in quality of life and 8 scales at each time interventions between groups are not significant ($P > 0.05$)

studies.[40-42] The results of other research showed that exercises improved the quality of life.[16,24,40] Moreover, the results of the study revealed that the mean total score of quality of life in the experimental group was increased after the intervention. Thus, the mean score of the total quality of life after the intervention was significantly different from that before the intervention. The results of the research carried out by Arian *et al*. revealed that the planned walking program has an impact on the quality of life of the patients suffering from thalassemia major. The planned walking program is recommended for thalassemia patients to improve the quality of life of them.[24] An exercise program can improve the quality of life by increasing exercise capacity.[24,40] Evidence has shown that exercise and fitness improve the human body. In children and adolescents, the effects of regular exercise with physical activity can lay a positive foundation on a healthy future life. Aerobic training has been particularly shown to improve cardiovascular fitness. Other positive effects are a decrease in fat mass and an increase in insulin sensitivity. This physiological condition is essential in preventing various diseases such as diabetes, metabolic syndrome and more generally major cardiovascular diseases.[43] Sports rehabilitation is effective in the mental health of the patients and in increasing the self-confidence, well-being, feeling intimacy and happiness, and reducing depression and anxiety. In general, it improves the quality of life of patients.[44] Exercise can reduce the risk factors in chronic diseases and improve the health as well as behavioral intervention, it can play a key role in improving the mental state and improving the quality of life of patients.[45] The research results suggest that thalassemia affects the quality of life hence, the majority of thalassemia patients have a lower quality of life. It also negatively influences the physical, psychological, social, economic state, and the mental image of the patients. It seems that a planned and vibrant program in the environment might improve the quality of life of patients during the exercise in water. Moreover, patients' more communication with other people improves their social functioning. Learning exercise in water and the ability to float in the deep parts of the pool enhances the self-esteem of patients. Increasing endurance, improving performance and the ability to perform more activities, and reducing fatigue may be effective in improving the quality of life of the subjects. Improving the respiratory status of patients and their quality of life can be effective. Performing group-based exercises in water create a sense of sympathy with symptoms of the disease and self-confidence among the patients.[46] Lack of observed significant increase in the mean score of quality of life in this research might be attributed to a low number of samples and the social and economic status of subjects and individual differences in spiritual beliefs, and the low number of exercise sessions. However, no significant difference was found between the mean scores of fatigue, vitality and feeling recovery, social functioning, physical pain, and general health at

Table 3: Comparison of mean of blood indices in the experimental group

Blood Indices	Means (SD)		*P*
	Before	After	
Hemoglobin	8.57 (1.24)	9.46 (1.24)	0.036*
Hematocrit	27.43 (3.68)	29.04 (4.63)	0.119
Iron	181.15 (171.28)	139.36 (48.07)	0.071
Ferritin	1403.80 (1771.76)	1276.55 (1636.01)	0.350

*$P<0.05$

Table 4: Comparison of mean differences before and after of blood indices between experimental and control groups

Blood Indices	Means (SD)		*P*
	Control	Experimental	
Hemoglobin	-0.12 (1.01)	-0.89 (1.76)	0.102
Hematocrit	-0.40 (3.18)	-1.61 (4.39)	0.325
Iron	-26.47 (61.86)	41.79 (181.50)	0.120
Ferritin	-43.60 (502.65)	1276.55 (593.89)	0.332

Table 5: Repeated measures ANOVA results: Effects of Group (control and experimental), Time (before, after, follow of interventions), and their interaction Group*Time

Scale	Group			Time			Group*Time		
	F	df	*P*	*F*	df	*P*	*F*	df	*P*
Physical functioning	0.754	1,38	0.391	6.358	2,76	0.009[a]	0.462	2.76	0.558
Role limitations due to physical health	0.000	1,38	>0.05	6.083	2,76	0.013[a]	1.750	2.76	0.193
Role limitations due to emotional problems	0.028	1,38	0.869	4.771	2,76	0.020[b]	1.354	2.76	0.226
Energy/fatigue	1.046	1,38	0.313	1.696	2,76	0.200	1.061	2.76	0.329
Emotional well-being	0.041	1,38	0.840	0.741	2,76	0.457	1.576	2.76	0.217
Social functioning	3.566	1,38	0.067	1.396	2,76	0.254	2.787	2.76	0.080
Pain	0.040	1,38	0.842	1.073	2,76	0.337	1.727	2.76	0.191
General health	2.125	1,38	0.153	0.069	2,76	0.887	2.093	2.76	0.144
Quality of life	0.752	1,38	0.391	6.127	2,76	0.010[a]	0.589	2.76	0.506

Post hoc tests were done by Tukey. [a]There is a significant increase in mean scores after and follow with before interventions ($P<0.05$). [b]There is a significant increase in mean scores follow with before interventions ($P<0.05$). Also in other results show that it is not a significant difference ($P>0.05$)

studied time periods. In contrast to the results of our research, another study showed that exercises reduced the fatigue and improved the quality of life dimensions so that the patients who performed exercise showed a lower level of pain and fatigue, better job performance, and they were generally happy people.[45]

Conclusions

A regular aquatic exercise program helps patients maintain or increase the level of performance.

The results of the present research suggest that providing an exercise program, especially aerobic exercises, in the patients with thalassemia major, along with the main treatment of disease, blood transfusion, psychiatric counselling and life skills training can improve the social relations, prevent social isolation and depression, and improve the quality of life and blood.

Study limitation

Individual differences in diet and blood transfusion time can affect the actual amount of blood factors, especially ferritin, haemoglobin, and iron. Also, differences in spiritual beliefs, cultural values and attitudes toward illness can affect patients' performance.

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Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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