Cardiovascular and Quality of Life Outcomes of a 3-Month Physical Exercise Program in Two Brazilian Communities

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Research article

Keywords: quality of life, aging, physical exercise, cardiovascular risk factors

Posted Date: May 15th, 2020

DOI: https://doi.org/10.21203/rs.3.rs-27447/v1

Abstract

Background

A decline in physical activity levels in older people is related with worsening of quality of life and a lower cardiorespiratory fitness level, which are associated with cardiovascular disease events and mortality from all causes. Evidence supports the potential impact of community-based physical exercise programs (CEXE) on cardiovascular health and quality of life. The aim of this study was to investigate health-related quality of life (HRQoL) and cardiovascular risk factors of a CEXE in two communities in Brazil.

Methods

Adults with an average age of 70.2 ± 5.4 years were recruited to take part in an individually designed group based CEXE program 2–3 times/ week (aerobic exercise, circuit resistance training and stretching exercises for 1 h each time). Once a week were held competitions to develop the socialization and the ability to collaborate among group members. A CEXE group was compared with a sedentary group. Cardiovascular outcomes were blood pressure (BP), triglycerides, body mass index, waist circumference, high-density-lipoprotein cholesterol (HDL-C), low-density-lipoprotein cholesterol (LDL-C), total cholesterol, and glycaemia. HRQoL was evaluated with the Short Form-36 (SF-36).

Results

Of the investigated cardiovascular outcome measures, significantly decreased by the CEXE program were systolic BP (5.7 [95%CI 0.2 to 11.3], $p < 0.05$), and the triglyceride-HDL-C ratio (0.8 [95%CI 0.05 to 1.5], $p < 0.05$), while HDL-C was significantly increased (4.4 [95%CI 0.02 to 8.8], $p < 0.05$). A significant improvement in the SF-36 subscales occurred in CEXE but not in the control group: physical functioning score (increase of 24.2 [95%CI 11.8 to 36.5] vs. -9.2 [95%CI -21.5 to 3.2], $p < 0.001$), physical role functioning score (increase of 35.4 [95%CI 12.8 to 58.0] vs. 16.7 [95%CI -6.0 to 39.3], $p < 0.01$) and general health score (increase of 23.7 [95%CI 36.9 to 10.4] vs. 2.4 [95%CI -10.9 to 15.7], $p < 0.001$).

Conclusion

This study shows that a 12-week physical exercise program may significantly improve cardiovascular risk and health-related quality of life measures in older people. An important socio-cultural transferable strategy of our physical exercise program was to develop social activities during and outside the CEXE program.

[#] These authors contributed equally to this study

Introduction

Worldwide, increases in both longevity and the number of older adults has been observed over the past years. The increase of life expectancy raises demands on public health due to a greater number of

functionally limited older adults that endure a decline in the quality of life and a growing burden of cardiovascular diseases (Barquera et al., 2015). Physical inactivity is among the top 10 risk factors for global disease burden reaching a pandemic status (Lim et al., 2012; Manson, Skerrett, Greenland, & VanItallie, 2004). This situation is aggravating with age, increasing from 45% of physically inactive people aged 60 to 75% at age of 75 (Franco et al., 2015). A decline in functional fitness in older women is related with worsening of quality of life (Serra et al., 2015) and a lower cardiorespiratory fitness level, which are associated with cardiovascular disease events and mortality from all causes (de Oliveira Brito, Maranhao Neto, Moraes, Emerick, & Deslandes, 2014). Not only in Brazil but also in Latin America and worldwide there is an escalating prevalence of cardiovascular diseases associated with older adults' physical inactivity, especially in women (Denys, Cankurtaran, Janssens, & Petrovic, 2009; Márquez-Sandoval et al., 2011).

A large amount of evidence from high quality studies supports the improved health in older adults through physical activity (Falck, Davis, Best, Crockett, & Liu-Ambrose, 2019). A Position Stand of the American College of Sports Medicine summarizes the benefits of both long-term exercise and physical activity and shorter-duration exercise programs on health and functional capacity for older adults (American College of Sports Medicine et al., 2009). However, the development and implantation of physical activity programs in older adults represents an actual challenge for health professionals. Moreover, adherence to physical activity guidelines in older adults is low and few attain current physical activity guidelines (Du et al., 2019).

According to the Position Stand of the American College of Sports Medicine, the effect of exercise on physical performance belongs to category C/D, meaning that it is poorly understood and does not seem to be linear and more information is needed to understand the precise nature of the relationship between exercise and functional performance. Moreover, the effects of physical activity on quality of life in older adults belongs to evidence category D, meaning that although physical activity seems to be positively associated with some aspects of QOL, the precise nature of their relationship is poorly understood (American College of Sports Medicine et al., 2009).

The aim of this study was to investigate the effectiveness of a short-term (12-week) community-based physical exercise program on cardiovascular health and quality of life in older adults.

Methods

Study setup and outcome measures

The target population for the community-based physical exercise program (EXE) was community-dwelling older people that were insufficiently active with sedentary lifestyle. This was a prospective, longitudinal and controlled study with parallel assignment. All medical evaluations were performed with the informed consent of the patient. The Institutional Ethical Committee of Anhembi Morumbi University

and Brasil University approved this study (CAAE: 11818919.8.0000.5492, and 24558913.7.0000.5494, respectively). Follow-up data were obtained by retrospective anonymized chart review and analyzed.

Primary outcome measures were health-related quality of life (HRQoL) and secondary outcomes were changes in cardiovascular risk factors. Time frame for outcome measures was baseline and post 12 weeks of exercise intervention program. Outcome assessors were masked to group allocation.

The following cardiovascular risk measures were investigated: arterial blood pressure, body mass index (BMI), waist circumference, triglycerides, HDL-C, and fasting glycaemia. Blood pressure was measured in the non-dominant arm with the individual seated and resting for at least 5 minutes. Body weight was obtained on an electronic scale with the individual wearing only light clothing and with an empty bladder. Height was obtained using a wall stadiometer with the individual barefooted and calculated the body mass index (BMI = weight / height^2). The waist circumference was measured at a level midway between the lowest rib and the iliac crest. The biochemical exams were obtained from clinical laboratory.

Quality of life was evaluated using SF-36 validated in Brazil and adapted to the socioeconomic and cultural conditions of the population (Pereira et al., 2007). The SF-36 consisted of 36 questions yielding to an 8-scale profile of functional health and well-being scores: general health perceptions, physical functioning, physical role functioning, vitality, social functioning, emotional role functioning, mental health, and bodily pain.

Participants To The Study – Inclusion And Exclusion Criteria

Older adults aged more than 60 years from two municipalities participated to the study: one group was at the municipality of Ourinhos – Sao Paulo and registered with UNIMED; the second group was at Guaratinga – Bahia and registered at the Municipal Department of Health. Inclusion criteria were: women and men aged over 60 years, willing and be able to engage in moderate forms of physical activity, voluntary participation, insufficiently active defined as a person who does not meet the physical activity recommendations of World Health Organization: 30 minutes per day of moderate physical activity (including active leisure and travel), 5 days a week; or 30 minutes per day of vigorous physical activity, 3 days a week. Exclusion criteria were: serious disease that limits physical activity (cardiovascular or respiratory disease, major neuromuscular disease, cancer, or recent major surgery), psychological disease, prescription of neuroleptic medication.

Physical Exercise Intervention Program

The community-based physical exercise program (EXE) adhere to the Position Stand of the American College of Sports Medicine, as it included combined aerobic exercise, muscle strengthening exercises, and flexibility exercises (American College of Sports Medicine et al., 2009). A progressive and structured, exercise training 2–3 times a week, 50–60 min a session at intensity of 1 to 3 in rate of perceived

exertion (RPE) for 12 weeks. The sessions comprised a combination of aerobic, strength, balance and flexibility exercises under the guidance of a physical therapist and a physical education teacher. In order to maintain the adherence of the participants to our physical activity program, we aimed at “(1) raising awareness of the benefits and minimize the perceived risks of physical activity and (2) improving the environmental and financial access to physical activity opportunities”, as recommended by Franco et al. (Franco et al., 2015). An important positive feature of our physical exercise program was the opportunity of the participants to socially interact and enjoy group exercise, as depicted also by McPhate et al. (McPhate et al., 2016).

The training session began with general warm up (articular and cardiorespiratory) using mats and flexibility exercises for 10 minutes. The second step was composed by aerobic exercise for 20 minutes through group walk around the sports court of the gymnasium, with intensity from mild to moderate, respecting the limit of each participant. The next step was composed of muscle strengthening of the lower and upper extremities lasting 20 minutes of alternating exercises and the use of canes, dumbbells, ankle weights and elastic bands. The closure of the activity was based on stretching the major muscle groups for 10 minutes, keeping 30 seconds for each muscle group with two replications. Once a week were held competitions to develop the socialization and the ability to collaborate among group members. These competitions were in the form of circuit of static and dynamic exercises with similar motions necessary to carry out basic daily activities; perception of games and body awareness. The participants in the control arm, nonintervention group received usual advice on healthy habits.

Statistical Analysis

The D'Agostino & Pearson omnibus and Kolmogorov-Smirnov (with the Dallal-Wilkinson-Lillie for corrected P value) tests were used to determine the normality of the data. Mixed-effects analysis followed by Fisher’s LSD multiple comparison test were employed to study the significance of physical exercise intervention program in the active group in comparison to the control group (GraphPad Prism version 8.2.1 for Mac OS X, GraphPad Software, La Jolla California USA, www.graphpad.com). Data are presented as mean and standard error of the mean. Differences were considered significant when the probability of a Type I error was lower than 5% ($p < 0.05$).

Results

Eighty-five (85) study participants completed the study: 42 participants were in the EXE group, while the control (sedentary) group comprised of 43 participants who dropped out or had low adherence to of the exercise program and voluntaries who did not will to engage in the EXE program. The recruited cohort comprised of women (60%) and men with mean age of 69.9 ± 0.9 years (EXE group) and 70.2 ± 0.8 years (control group).

Of the investigated cardiovascular outcome measures, significantly decreased by the EXE program were systolic BP (5.7 [95%CI 0.2 to 11.3], $p < 0.05$) (Fig. 1), and the triglyceride-HDL-C ratio (0.8 [95%CI 0.05 to

1.5], $p < 0.05$), while HDL-C was significantly increased (4.4 [95%CI 0.02 to 8.8], $p < 0.05$) (Fig. 2). No significant effects of the EXE program were observed for diastolic BP, BMI, waist circumference, total cholesterol, LDL-C, triglycerides, or fasting glucose (Table 1).

Table 1
Cardiovascular risk and health-related quality of life (HRQoL) measures.

* Significant differences of outcome measures by mixed-effects analysis are presented in figures.

Outcome Measures	Sedentary Group		Physical Exercise Group	
	Before	After	Before	After
Age (years)	70.2 ± 0.8		69.9 ± 0.9	
BMI (kg/m^2)	29.7 ± 0.8	29.7 ± 0.7	28.1 ± 0.6	28.3 ± 0.6
Waist circumference (cm)	100.7 ± 1.9	100.5 ± 1.8	93.5 ± 1.7	93.1 ± 1.6
Blood pressure systolic * / diastolic (mm Hg)	127.9 ± 1.6 / 79.5 ± 1.2	128.6 ± 2.2 / 80.9 ± 1.2	127.4 ± 1.8 / 79.0 ± 1.2	121.6 ± 1.4 / 77.9 ± 1.3
Total cholesterol (mg/dL)	196.1 ± 7.9	196.1 ± 7.9	191.6 ± 6.8	193.8 ± 6.7
Triglycerides (mg/dL) *	149.3 ± 11.5	151.8 ± 7.5	154.7 ± 4.4	134.8 ± 5.5
HDL-C (mg/dL) *	43.2 ± 1.3	42.4 ± 1.6	43.7 ± 1.0	48.1 ± 1.4
LDL-C (mg/dL)	111.7 ± 6.8	123.4 ± 7.6	122.9 ± 7.6	123.3 ± 6.6
Triglyceride:HDL-C ratio*	3.8 ± 0.4	3.8 ± 0.2	3.6 ± 0.1	2.8 ± 0.1
Fasting glucose	101.7 ± 3.4	114.3 ± 7.4	100.1 ± 3.4	105.3 ± 3.2
Health-related quality of life (HRQoL) scores				
General health	62.6 ± 5.7	65.0 ± 6.5	49.4 ± 6.5	73.1 ± 3.1
Vitality	52.9 ± 6.6	56.7 ± 9.2	59.6 ± 5.9	64.6 ± 4.5
Physical function	52.9 ± 9.4	43.7 ± 8.0	50.8 ± 7.0	75.0 ± 4.7
Role physical	22.9 ± 11.3	39.6 ± 10.9	37.5 ± 11.7	72.9 ± 8.4
Social function	65.6 ± 7.2	64.6 ± 9.7	83.3 ± 6.7	81.7 ± 4.5
Emotional role	52.8 ± 14.5	44.4 ± 12.5	55.6 ± 13.2	75.0 ± 8.3
Mental health	63.3 ± 4.1	66.0 ± 8.2	70.7 ± 6.9	81.7 ± 4.0
Bodily pain	44.6 ± 7.7	55.7 ± 6.6	61.9 ± 7.5	70.6 ± 3.9

Significant improvements were observed in the following health-related quality of life measures in exercise but not control group:

- physical functioning score (increase of 24.2 [95%CI 11.8 to 36.5] vs. -9.2 [95%CI -21.5 to 3.2], p< 0.001) (Figure 3.A),
- physical role functioning score (increase of 35.4 [95%CI 12.8 to 58.0] vs. 16.7 [95%CI -6.0 to 39.3], p< 0.01) (Figure 3.B) and
- general health score (increase of 23.7 [95%CI 36.9 to 10.4] vs. 2.4 [95%CI -10.9 to 15.7], p< 0.001) (Figure 3.C).

No differences were observed between the study groups and by the intervention in the following health-related quality of life measures: vitality, social function, emotional role (Table 1).

Discussion

The main outcome of this study is that a 12-week community-based physical exercise program may significantly improve some cardiovascular risk factors and health-related quality of life (HRQoL) measures, including systolic BP, HLD-C, triglyceride-HDL-C ratio, physical capacity, physical function and general health scores.

Combined training protocols with aerobic and resistance training are recommended as non-pharmacological treatments to prevent hypertension and seem to be the most suitable for elders, deconditioned individuals and hypertensives (Herrod et al., 2018). Physical exercise can improve significantly cardiorespiratory fitness and some cardiometabolic biomarkers in adults without cardiovascular disease. Moreover, exercise improves cardiovascular risk factors such as hypertension, dyslipidemia and type II diabetes (Volpe et al., 2018). For instance, exercise lowers blood pressure, LDL-C, triglycerides, improves glucose-insulin homeostasis and raises HDL-C (Seron, Lanas, Pardo Hernandez, & Bonfill Cosp, 2014). In our study, systolic BP was significantly decreased. Higher triglyceride:HDL-C ratio and lower HDL-C are correlated with the risk of cardiovascular disease (Farrell et al., 2017). Several studies have found that physical exercise may play an important role in the maintenance of HDL-C concentrations in older people (Ihalainen et al., 2019). A 1% decrease in HDL-C has been associated with a 2–3% increase in cardiovascular disease risk (Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults, 2001). Based on our findings, it would appear plausible to suggest that participation in a physical exercise program of at least 12 weeks would be appropriate for decreasing cardiovascular disease risk as suggested by decreased systolic BP, triglyceride:HDL-C ratio and increase of HDL-C. Since the effects on triglyceride:HDL-C ratio and HDL-C occurred without concurrent changes in weight or diet, this may indicate that the physical exercise program alone can modify lipoprotein profile in older people.

The other cardiovascular risk factors investigated, including triglycerides, BMI, waist circumference were not influenced by the exercise program suggesting that a training period longer than 12 weeks is necessary to observe improvements in these measures [23]. This is in line with evidence category A

indicating that three or more months of moderate-intensity exercise elicits cardiovascular adaptations in healthy older adults [10]. Also, combined therapeutic or preventive strategy involving dietary, lifestyle modifications and pharmaceutical should be considered.

Sedentary behaviors are independently associated with physical, functional, mental and cognitive health among older adults in retirement communities (Wilson et al., 2019). Our physical training program led to an improvement of physical capacity, physical function and general health. Our program provides further support for the efficacy of a combined physical activity program on health-related quality of life measures in elderly women. Specifically, the physical and general health domains were significantly improved with our program. These physical domains appear to be strong and independent predictors of long term cardiovascular events (Bousquet et al., 2019). Moreover, health-related quality of life measures are associated with the investigated obesity-related cardiovascular risk factors including body mass index and waist circumference (Hyun et al., 2019). Health-related quality of life measures may be considered as cardiovascular risk factors, besides the Framingham five modifiable major risk factors – smoking, hypertension, diabetes, high cholesterol, and obesity – and two non-modifiable risk factors – age and sex (Ose et al., 2013).

An essential component for the implementation with success of our physical exercise intervention program was understanding the factors influencing the participants' physical activity behavior. Six such factors that influence physical activity behavior are identified by Franco et al.: social influences, physical limitations, competing priorities, access difficulties, personal benefits of physical activity, and motivation and beliefs (Franco et al., 2015). The GrOup-based physical Activity for oLder adults (GOAL) trial of Beauchamp et al. suggests that community exercise programs should attempt to engage in age-targeting but not necessarily gender-targeting among older adults (Beauchamp et al., 2018). Our physical exercise community program aimed at resolving these factors.

In summary, we conclude that a 3-month physical exercise intervention program was effective in decreasing cardiovascular risk and improving health-related quality of life measures in older people of two communities in Brazil.

Declarations

Competing interests

The authors declare that they have no competing interests.

Funding

This research was supported by the Center of Innovation, Technology and Education (CITE) and by Khalifa University of Science and Technology under Award No. FSU-2020-33 to OCB. MPL was supported

by a fellowship from the Anhembi Morumbi University – Laureate Universities; OCB was supported by the National Council for Scientific and Technological Development (CNPq, 307760/2018-9).

Authors' contributions

Study conception and design: MPL, SCJr, LAC and OCB. Performed the study: MPL, SCJr. Assays and data analysis: LAC, OCB, RM, GR, MPL, SCJr. Interpretation of the data, writing of the manuscript: OCB and LAC. Critical revision of the manuscript regarding the important intellectual content RM, GR, MPL, SCJr.

Acknowledgments:

The authors specially thank Laércio O. Silva, BPhysed, Audirene B. de O. Figueredo, BPhysio from the Guaratinga Municipal Department of Health, Guaratinga, Brazil and Cecilia Sá Rodrigues Alves, RN from Unimed Ourinhos, Núcleo Viver Bem - Preventive Medicine and Home Care Unit, Ourinhos, Brazil for contributing to the implementation of the community-based physical exercise programs.

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Figures

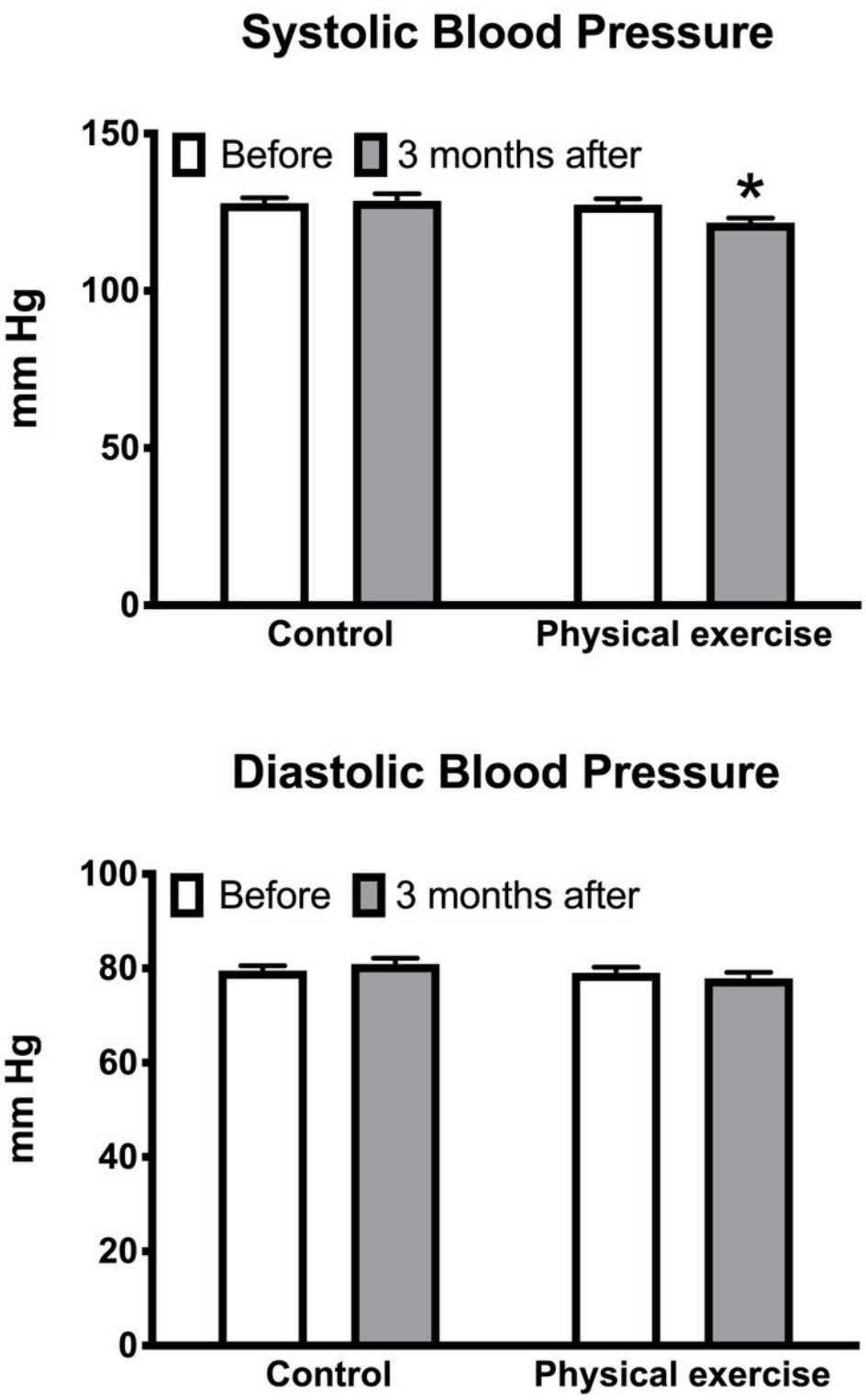

Figure 1

Effects of the physical exercise program on systolic and diastolic blood pressure. Data are mean with standard error; *, $p < 0.05$.

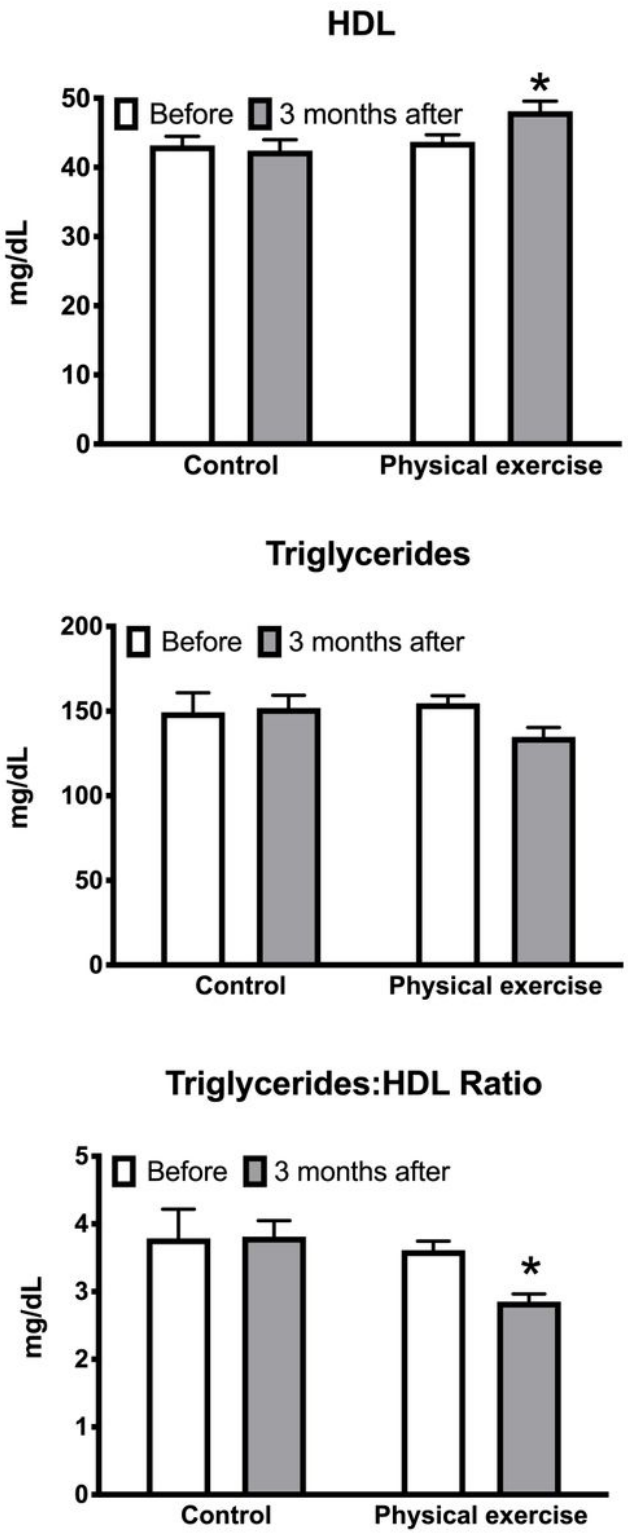

Figure 2

Effects of the physical exercise program on HDL-C, triglycerides and triglyceride:HDL-C ratio. Data are mean with standard error; *, $p < 0.05$.

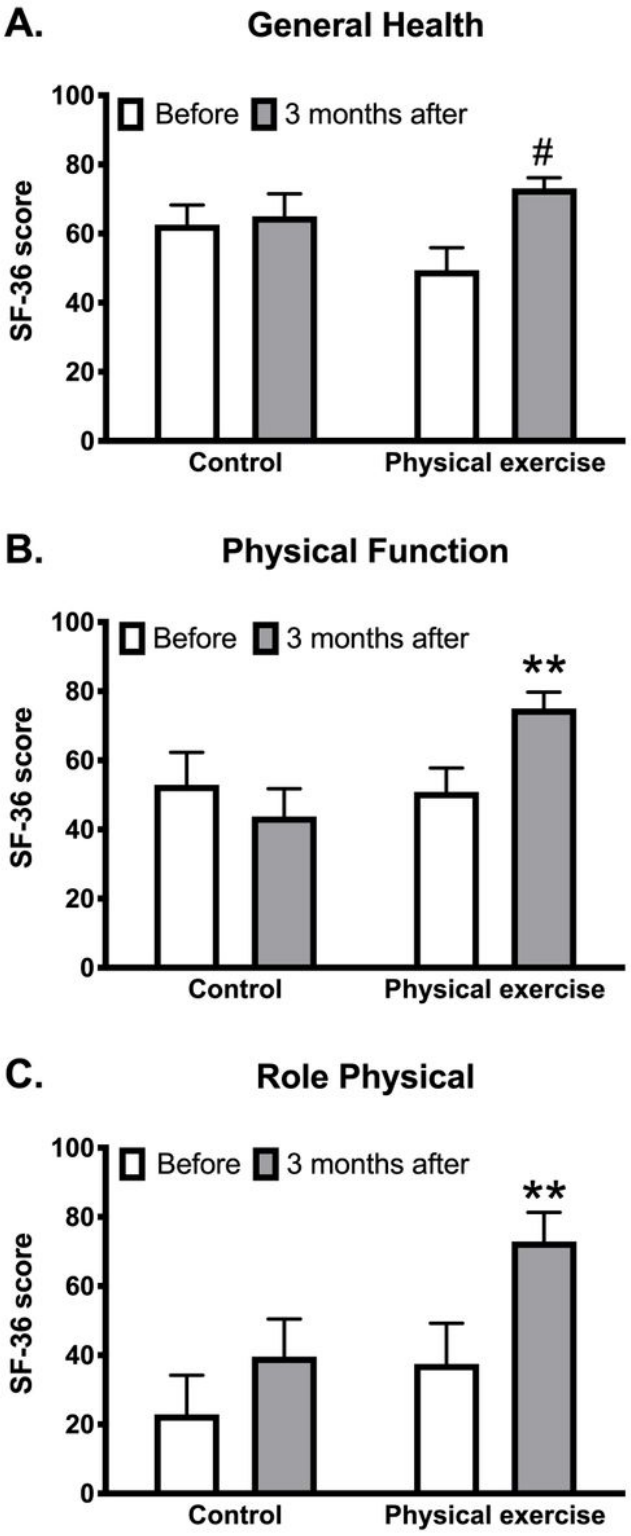

Figure 3

Effects of the physical exercise program on the health-related quality of life (HRQoL) measures: general health score (A), physical function score (B), physical role score (C). Data are mean with standard error; **, $p < 0.01$; #, $p < 0.001$.