EFFECTS OF PROGRESSIVE LOADS WORKOUTS ON THE DEVELOPMENT OF MUSCLE STRENGHT AND BODY COMPOSITION FOR WOMEN

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Abstract: Special literature shows that High Intensity Interval training (HIIT) has the capacity to develop muscle mass, muscle strength and sports performance. The general recommendation of moderate to high intensity programs using short rest periods was based on empirical evidence suggesting that this training paradigm is commonly used by bodybuilders in the hypertrophy phases of periodic workout for athletes and on studies that have reported higher increases in muscle mass as training volume, meaning the number of the performed sets. If we apply a progressive load training program aiming at improving muscle strength, muscle mass, and body composition changes, we will probably get improvements of these parameters. Thus, this type of protocol could be an effective solution in combating obesity and associated pathologies, which have a weight and an altered body composition complemented by a sedentary life. The exercise program covers a volume and an intensity helping to keep muscle mass, increase in strength and change body composition in the shortest time spent in the fitness gym.

Introduction

Progressive load strength programs have the potential to develop muscle mass, muscle strength and sport performance [3]. Previous studies have shown that progressive workout improves jumps in height, sprint, strength and muscle strength, all of these factors being correlated with improving muscle performance [5].

As the intensity of progressive exercise increases, the activation of fast muscle fibers increases and the focus is more on the mechanical stress [8]. In contrast, large volumes, meaning a greater number of repetitions using short rest periods, generate a higher metabolic stress [18]. A minimum intensity threshold is required to maximize the stimulation of muscle activation for those metabolic stress programs [18]. Thus, the metabolic stress is concerned with increasing the exercise

volume, the load volume and reducing the rest interval between sets [11, 18].

The general recommendation of high intensity programs using short rest periods was based on empirical evidence suggesting that this training paradigm is commonly used by bodybuilders [5] in the hypertrophy phases of periodic workout for athletes and on studies reporting higher increases in muscle mass as exercise volume, ie the number of the performed sets [10, 12].

A high volume of workout is associated with an increased exercise hormone response, which they thought to provide an enhanced stimulus for muscle mass growth [11, 13, 20]. However, these studies extrapolated acute endocrine response to a single exercise with progressive load in changes of the skeletal muscle mass over time. Although it has been shown that anabolic hormones (testosterone), exogenously administered, cause linear growth of the accumulation of weak tissue [1], they have not demonstrated a consistent relationship between the increasing endogenous anabolic hormone response during progressive exercise and increasing muscle mass. In addition, investigations that compared the acute anabolic hormone response to different progressive exercise protocols (traditional hypertrophy, resistance, or power models) could not demonstrate that greater metabolic stress was more beneficial to stimulate testosterone-enhanced responses [7, 14].

A major limitation of research lies in the fact that most studies have examined the adaptations in performance and muscle strength for non-trained or moderately trained people. Differentiating the effectiveness of the program is difficult for non-trained people, because trained individuals respond favorably to a multitude of training stimuli. As the "adaptation window" decreases during long-term resistance training, more scientific advice is needed to adequately address the design of programs for trained people that target muscle strength and muscle growth [18].

These investigations have shown that high intensity training is more beneficial for improving muscle strength, but similar to high volume training protocols for increasing muscle mass [2, 19]. However, some methodological limitations (eg program design and hypertrophy assessment) raise questions about the effectiveness of each type of program in increasing muscle strength and muscle mass. In addition, endocrine response to training remains unclear. Therefore, the purpose of this study was to compare a moderate, high-intensity intensity program

using short rest periods to a high-intensity volume program using the same rest periods for non-trained people by progressively increasing the exercises difficulty through load. Muscle strength, muscle mass and body composition responses were measured before and after the 26-week follow-up period.

Material-method

If we apply a progressive load training program that aims at improving muscle strength, muscle mass, and body composition changes, we will probably get improvements of these parameters.

The purpose of this research is to verify the hypothesis that progressive stretching training or high intensity interval training (HIIT) using strength-specific exercises could lead to the development of muscle mass, muscle strength, reducing body fat and the improvement in body mass index.

The program addresses to people willing to apply these training methods and gain an improvement of the parameters mentioned above, within a time frame.

We have the complementarity of a program with circuit execises and strength exercises. That is why we have proceeded to progressive loading in the case of complex exercises of squats, front strap straightening and push-ups.

Therefore we initiated a program evaluating whether there are muscle mass growth, muscle strength growth and body mass index improvement for women with beginner level in progressive exercise.

The program ran for 26 weeks starting in September 2017 and ended in February 2018. During the first 6 weeks subjects were weekly monitored and after this time the measurements were recorded every 4 weeks.

Subjects took note of the protocol and the possible risks they undergo during the training and the completion of a medical questionnaire aiming at obtaining data exposing the medical history of each subject, thus excluding potential subjects with pathologies that could not be subjected to such an effort. The participation agreement was individually signed.

The training sessions took place at the Sun Gym Suceava gym, each participant following 3 training sessions per week, with the same organization content, having as structure: 4 circuits of 10 workstations with 7 exercises variables and 3 exercises with measured parameters: squats, push-up, front strap straightening (classic).

10 female subjects aged between 18 and 41 participated in this research, women previously sedentary or with physical activity at recreational level. Normoponderal in terms of body mass index (BMI ≤ 24.9).

The training sessions were held on Mondays, Wednesdays and Fridays of each week at 18:00.

The training sessions were as follows: 40 seconds in exercise / exercise followed by 20 seconds rest between exercises; 4 minutes of rest between circuits. The progressive load exercises ended at a distance of 1-2 positions compared to the next monitored exercise. The monitoring was done during the 40 seconds, recording the number of repetitions obtained for that exercise.

A training session meant a circuit consisting of 10 workstations four times, at each station the duration of the workout was of 40 seconds and the break of 20 seconds.

The body composition was determined with Tanita SC330. The device uses bioelectric impedance (BIA) method, used to estimate total body water (TBW), the body mass without fat and the body fat. Three follow-ups were: before the exercise program, during and after the exercise program. The subjects received a nutritional counseling session where they were trained with general notions about macro and micronutrients. The distribution of macronutrients in the daily diet was approximately the following: 45% carbohydrates, 40% protein, 15% lipids.

Results and discussions

Each subject recorded major progression during the three applied tests, which leads to the conclusion that the increase in strength occurred in all cases regardless of body composition, previous fitness level, and the adaptability to the program. The initial evaluation took place during the first training session and the final evaluation during the last training session. Throughout this program there was one subject that left the program for personal reasons and professional context. The average of the group of the subjects considerably increased from the first training session, the same thing transposing in the ease with which the subjects were able to perform all types of exercises. Improvements were recorded for each studied parameter and they will be displayed on tables and graphs to follow the group evolution (table 1).

Table 1. The individual evolution values of the subjects in the three monitored movements

Subjects	Squats		Straightening with dumbbell		Push-up	
	Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test
A.L.	20	34	14	23	17	30
O.C	16	29	17	26	16	33
A.D	18	35	15	29	18	31
D.L	19	31	16	28	24	37
S.A	18	31	18	29	13	31
A.B	16	32	10	25	19	34
G.R	17	-	15	-	12	-
S.D	22	40	22	35	15	30
N.L	10	23	13	26	17	39
B.M	22	38	16	30	29	38

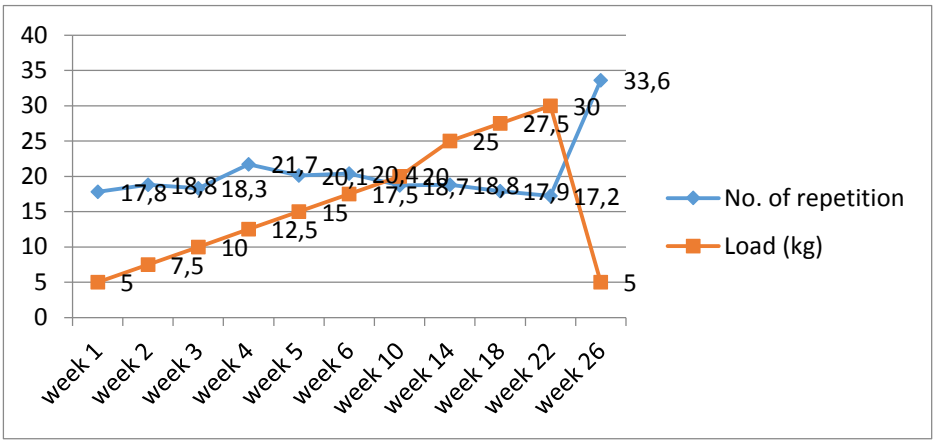
Table 2 shows the average values with the progress of the group of subjects from the initial phase of the measurements to the final phase of the exercise program.

Table 2. The average evolution values of the subjects during the three monitores movements

Period	Squats (no. of repetions)	Straightening with dumbbell (no. of repetions)	Push-up (no. of repetions)
Week 1	17,8 rep	15,6rep	17rep
Week 2	18,8 rep	16,2rep	19,5rep
Week 3	18,3rep	16,9rep	21,8rep
Week 4	21,7 rep	17,2rep	17,2rep
Week 5	20,1rep	17,8rep	19,2rep
Week 6	20,4rep	17,9rep	10,9 rep
Week 10	18,7rep	17,6 rep	12,8rep
Week 14	18,8rep	18,6rep	13,2rep
Week 18	17,9rep	17rep	14,4rep
Week 22	17,2rep	16,6rep	15,6rep
Week 26	33,6rep	27,8rep	33,6rep

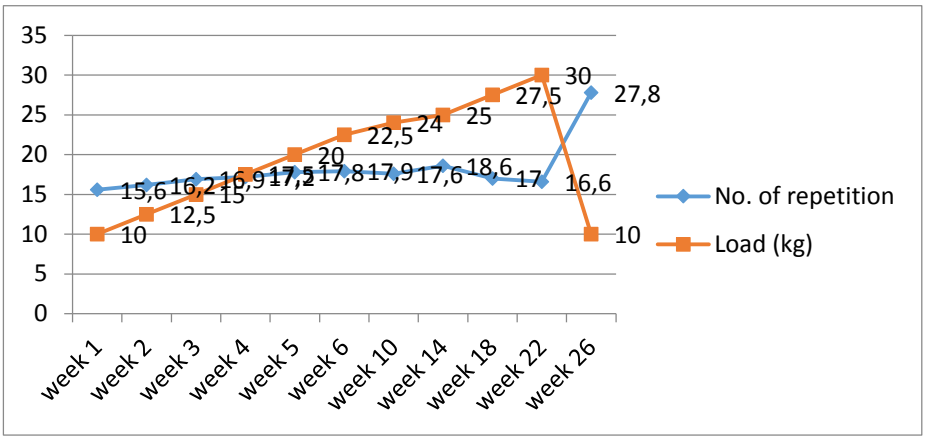
Figure 1 shows the group evolution per week at dumbbell squats on a number of repetitions. It should be noted that the load is progressive and at the final measurement we recorded the number of repetitions using the initial load.

Figure 1. The average value of the group registered in the exercise progression of the dumbdell squat



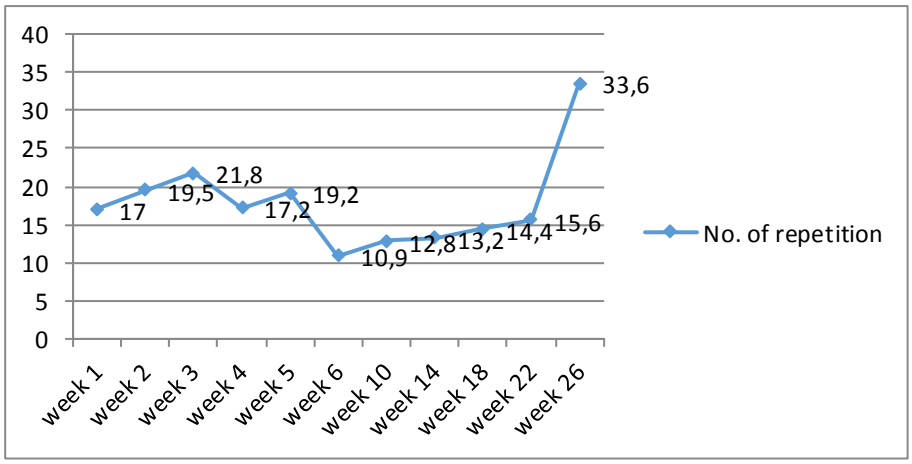
In figure 2 we graphically plotted the average group evolution of subjects with straightening with the dumbbell on a number of repetitions. We used the same method of loading the exercise, namely the progressive exercise.

Figure 2. Group average values recorded in the progression of the straightening exercise



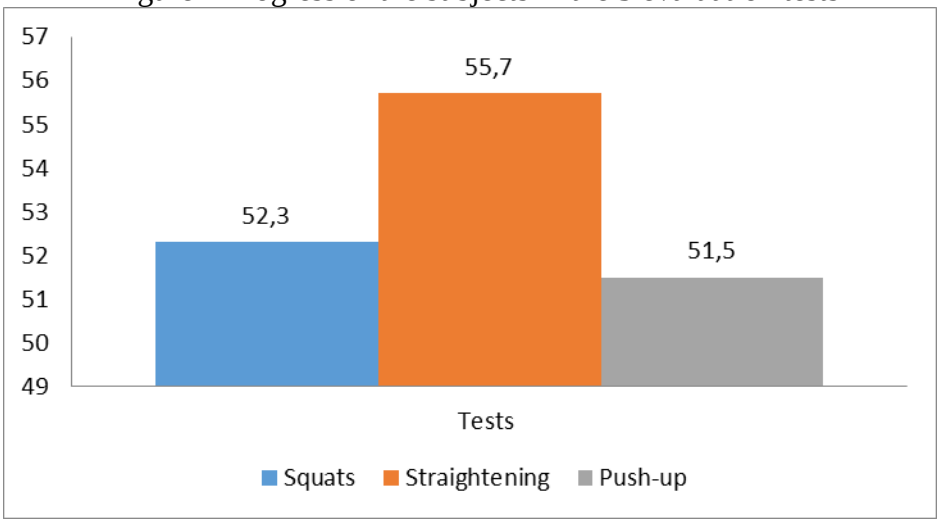
In Figure 3, we plotted the average group evolution of the subjects in the push-up exercise.

Figure 3. Group average values recorded in the progression of the push-up exercise



At dummbbell squats the progress was 55.6% between the initial and final testing. In the case of straightening, the progress was 62.4%, and for push-up the progress was 51.5%. Figure 4 illustrates progress data in each monitored exercise during the program applied to the involved subjects.

Figure 4 Progress of the subjects in the 3 evaluation tests



We initiated a program in which a group of individuals (normoponderal) with physical activity at recreational level who followed a program of strength training with a hyperprotective diet (> 2g / kg body). We included exercises that had the capacity to promote rapid increases in strength and fitness as well as to cause poor mass retention. We monitored three of these within 26 weeks and tracked the subjects' evolution on muscular force parameters, the difficulty of exercises being progressive.

The results of the program confirm the hypothesis that strength-specific exercises with progressive loading circuit exercises maz determine favorable changes of the following parameters: muscle strength, muscle mass and body composition.

The results of this program are in line with other studies that examined the impact of strength-specific exercises and hyperprotective diets on poor weight retention [4, 9, 15, 16, 17]. Pasiakos et al. [16] associated a low-to-moderate exercise program (static bike and 40-60% VO2max treadmill) and 3 low intensity strength training sessions (3 sets of 15 repetitions); 21 days reported a loss of 1.2 kg of mild weight at a protein intake of 2.4 g / kg body [16], slightly higher than that reported by us. We can speculate that the structure of the training program used in our study (volume, intensity and frequency) and the duration of the intervention (1-7 months versus 21 days) led to a better retention of the weak body mass.

The structure of the training program used in our study (strength training, progressive load, high intensity circuit) had a significant role in stimulating muscle strength. Data from special literature suggest that strength training determines a significant increase in muscle strength and muscle mass. Thus, weight-training with progressive load in circuit followed by the subjects of this program has probably led to an increase in strength and muscle mass [6]. Program data suggest that a significant increase in muscle strength could be achieved by performing to specific strength and progressive exercise in circuit.

The results show that each subject following such a progressive load-specific training program experienced progression in muscle strength, muscle mass and body composition.

The results also show that women with a higher BMI had a higher muscle strength increase than those with a lower BMI.

The study has some limitations that can be improved in the future or through other studies. One of the major limitations of the protocol is

that the participants transmitted their capability to perform the monitored exercises and the participants' food intake could not be strictly controlled.

Another factor that could not be controlled and has the ability to influence the final results was the physical activity of each individual, outside the training sessions. Those with sedentary lifestyles may have a significantly lower muscle mass compared to the physically active individuals.

Conclusions

This study confirms the purpose and working hypothesis so in the case of some women, a program of strength-specific exercises with progressive load performed in a high-intensity circuit associated with a hyperprotective diet (> 2g / kg body), during a 26-week period, results in significant increase in strength, slight loss of muscle mass and body composition changes. Increase in strength is significant within 26 weeks; respectively 55.6% in squats, 62.4% in straightening and 51.5% in push-up.

The protocol used in this work can bring major increases in muscle strength for women, and the hyperprotective diet reduces the loss of muscle mass that occurs in a body remodeling program.

A positive change in body composition and strength parameters could noticed in the collected data. Loss of muscle mass has been diminished due to progressive exercise supplemented by a hyperprotective diet, as well as a significant decrease in the percentage of body fat in some cases.

Thus, this type of protocol could be an effective solution in combating obesity and associated pathologies, which have a weight and an altered body composition complemented by a sedentary life. The exercise program covers a volume and intensity helping to keep muscle mass, increase in strength and change body composition in the shortest time spent in the fitness gym.

References

[1] Amenda Ramirez, Len Kravitz, Resistance Training Improves Mental Health.

[2] Bhasin S, Woodhouse L, Casaburi R, Singh AB, Bhasin D, Berman N, Chen X, Yarasheski KE, Magliano L, Dzekov C, Dzekov J, Bross R, Phillips J, Sinha-Hikim I, Shen R, Storer TW. Testosterone dose-response relationships in healthy young men. Am J Physiol Endocrinol Metab. 2001 Dec; 281(6):E1172-81

[3] Brandenburg JE. Docherty D. The effects of accentuated eccentric loading on strength, muscle hypertrophy, and neural adaptations in trained individuals. J. Strength Cond. Res. 2002;16:25–32.

[4] Delecluse C. Influence of strength training on sprint running performance. Current findings and implications for training. Sports Med. 1997 Sep;24(3):147-56.

[5] Epuran M. Metodica cercetarii activitatilor corporale ,ed a2-a, Bucuresti 2005

[6] Garthe I, Raastad T, Refsnes PE, Koivisto A, Sundgot-Borgen J. Effect of two different weight-loss rates on body composition and strength and power-related performance in elite athletes. Int J Sport Nutr Exerc Metab 2011; 21:97–104.

[7] Hackett DA, Johnson NA, Chow CMJ. Training practices and ergogenic aids used by male bodybuilders. Strength Cond Res. 2013 Jun; 27(6):1609-17.

[8] Hameed M, et al. The effect of recombinant human growth hormone and resistance training on IGF-I mRNA expression in the muscles of elderly men. J Physiol 555: 231–240, 2004.

[9] Hasani-Ranjbar S, Soleymani Far E, Heshmat R, Rajabi H, Kosari H. Time course responses of serum GH, insulin, IGF-1, IGFBP1, and IGFBP3 concentrations after heavy resistance exercise in trained and untrained men. Endocrine. 2012 Feb; 41(1):144-51

[10] Henneman E, Somjen G, Carpenter DOJ. Functional significance of cell size in spinal motoneurons. Neurophysiol. 1965 May; 28():560-80.

[11] Kraemer WJ, Marchitelli L, Gordon SE, Harman E, Dziados JE, Mello R, Frykman P, McCurry D, Fleck SJJ. Hormonal and growth factor responses to heavy resistance exercise protocols. Appl Physiol (1985). 1990 Oct; 69(4):1442-50.

[12] Josse AR, Atkinson SA, Tarnopolsky MA, Phillips SM. Increased con-sumption of dairy foods and protein during diet- and exercise-induced weight loss promotes fat mass loss and lean mass gain in overweight and obese premenopausal women. J Nutr 2011; 141:1626–34.

[13] Kraemer WJ, Ratamess N, Fry AC, Triplett-McBride T, Koziris LP, Bauer JA, Lynch JM, Fleck SJ. Influence of resistance training volume and periodization on physiological and performance adaptations in collegiate women tennis players. Am J Sports Med. 2000 Sep-Oct; 28(5):626-33.

[14] Kraemer WJ, Ratamess NA. Hormonal responses and adaptations to resistance exercise and training. Sports Med. 2005; 35(4):339-61.

[15] Kraemer WJ. A series of studies-the physiological basis for strength training in American football: fact over philosophy. J. Strength Cond. Res. 1997;11:131–142

[16] Maddalozzo, G.F., and Snow, C.M. 2000. High intensity resistance training: Effects on bone in older men and women. Calcified Tissue International, 66, 399-404.

[17] McBride, Blow, Kirby, Haines, Dayne, & Triplett. Relationship between maximal squat strength and five, ten, and forty yard sprint times. J Strength Cond Res. 2009 Sep;23(6):1633-6. doi: 10.1519/JSC.0b013e3181b2b8aa.

[18] McCaulley GO, McBride JM, Cormie P, Hudson MB, Nuzzo JL, Quindry JC, Travis Triplett N. Acute hormonal and neuromuscular responses to hypertrophy, strength and power type resistance exercise. Eur J Appl Physiol. 2009 Mar; 105(5):695-704.

[19] McCaulley GO, McBride JM, Cormie P, Hudson MB, Nuzzo JL, Quindry JC, Travis Triplett N Acute hormonal and neuromuscular responses to hypertrophy, strength and power type resistance exercise. Eur J Appl Physiol. 2009 Mar; 105(5):695-704

[20] Mettler S, Mitchell N, Tipton KD. Increased protein intake reduces lean body mass loss during weight loss in athletes. Med Sci Sports Exerc 2010; 42:326–37.

[21] Pasiakos SM, Cao JJ, Margolis LM, Sauter ER,Whigham LD, McClung JP, Rood JC, Carbone JW, Combs GF Jr., Young AJ. Effects of high-protein diets on fat-free mass and muscle protein synthesis following weight loss: a randomized controlled trial. FASEB J, 2013; 27:3837–47.

[22] Pikosky MA, Smith TJ, Grediagin A, Castaneda-Sceppa C, Byerley L, Glickman EL, Young AJ. Increased protein maintains nitrogen balance during exercise-induced energy deficit. Med Sci Sports Exerc 2008; 40:505–12.

[23] Ratamess NA, Alvar BA, Evetoch TK, Housh TJ, Kibler WB, Kraemer WJ, et al. American college of sports medicine position stand. Progression models in resistance training for healthy adults. Med. Sci. Sports Exerc. 2009;41:687.

[24] Schoenfeld BJ, Ratamess NA, Peterson MD, Contreras B, Sonmez GT. Alvar BA. Effects of different volume-equated resistance

training loading strategies on muscular adaptations in well-trained men. J. Strength Cond Res. 2014;28:2909–2918.

[25]West DW, Phillips SM. Associations of exercise-induced hormone profiles and gains in strength and hypertrophy in a large cohort after weight training. Eur J Appl Physiol. 2012 Jul; 112(7):2693-702

EFECTELE ANTRENAMENTELOR CU INCARCARE PROGRESIVA ASUPRA DEZVOLTARII FORTEI MUSCULARE SI A COMPOZITIEI CORPORALE LA FEMEI

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Cuvinte cheie: forţă, antrenament HIIT, femei, compoziţie corporală

Rezumat: Literatura de specialitate arată că exercițiile de forță cu încarcare progresivă (HIIT) au calitatea de a dezvolta masa musculară, forța musculară și performanța sportivă. Recomandarea generală a programelor de intensitate moderată până la ridicată, care utilizează intervale scurte de odihnă, s-a bazat pe dovezi empirice care sugerează că această paradigmă de formare este folosită în mod obișnuit de culturisti în fazele de hipertrofie a antrenamentului periodic pentru sportivi și pe studii care au raportat creșteri mai mari ale masei musculare ca volum de antrenament, adică numărul de seturi efectuate. Dacă vom aplica un program de antrenament cu încarcare progresivă ce urmarește îmbunătățirea parametrilor de forță musculară, masă musculară și schimbarea compoziției corporale, probabil vom obține îmbunătățiri ai acestor parametrii. Astfel acest tip de protocol poate fi o soluție eficientă în combaterea obezității și a patologiilor asociate, ce au în spate o greutate și o compoziție corporală alterată, completată de o viață sedentară. Programul de exerciții reușeste sa acopere un volum și o intensitate ce favorizează pastrarea masei musculare, creșterea în forță și modificarea compoziției corporale într-un timp cât mai scurt petrecut în sala de fitness.