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Improving muscle size with Weider's principle of progressive overload in non-performance athletes

Vlad Adrian GEANTĂ¹ Viorel Petru ARDELEAN²

Abstract

Introduction: The concept of progressive overload is one of the most well known and well understood principles in strength training around athletes. To gain muscle mass, this principle consists of progress in weight, number of repetitions, frequency and sets. **Aim:** Although it is a widely used principle, through our study, we wanted to ascertain if, after training sessions applying Weider's principle of progressive loading (PPO), we can highlight significant increases in some muscle groups (chest M_c and back M_b), in non-performance subjects. **Materials and methods:** One sample (N= 8 subjects, 8 men, with a mean age of 20.4 ± 0.74 years), trained for 12 weeks with a frequency of 4 workouts per week, in a sports center from Arad county. Muscle perimeters were measured using a metric band. Subjects underwent bodybuilding-specific training with a predominant focus on PPO. Measurements of the pectoral muscle (M_c) and back muscle (M_b) were carried out in two stages: an initial test (C_i, B_i) and a final test (C_f, B_f), to see at the end of the experiment, if there are improvements. **Results:** After 12 weeks of training, the final results indicate an increase of the average of both chest and back muscles (C_i 102.6, C_f 107.4 and B_i 109.6, B_f 113.8). Although the values of the T-test, at both groups, are identical, it seems that the PPO effective size (ω^2) is larger in the back (14%) compared to the chest (12%). **Conclusion:** Within the limits of our experiment, we consider that by only using the PPO, significant improvements can be obtained on the targeted muscle groups.

Key words: strength training, muscle hypertrophy, human performance, training stimulus

Rezumat

Introducere : Conceptul de încărcare progresivă este unul dintre cele mai cunoscute principii ale antrenamentului de forță în jurul sportivilor. Acest principiu constă în: progresul în greutate, numărul de repetări, frecvență și seturi. **Scop :** Deși este un principiu foarte utilizat, prin studiul nostru, am dorit să constatăm, dacă în urma sesiunilor de antrenament, aplicând principiul încărcării progresive (PPO) al lui Weider, putem evidenția creșterea semnificativă pe unele grupe musculare (pectorali M_c și dorsali M_b), la subiecții non performeri. **Material și metode :** Un eșantion (N=8 subiecți, 8 bărbați, cu vârsta medie 20.4 ± 0.74 ani), s-au antrenat pe o perioadă de 12 săptămâni cu o frecvență de 4 antrenamente pe săptămână, într-o sală de forță din Arad. Perimetrele musculare, s-au măsurat, folosind o bandă metrică. Subiecții au fost supuși unor antrenamente specifice bodybuildingului cu accent preponderent pe PPO. Măsurătorile perimetrelor musculare pectorale (M_c) și dorsale (M_b) ale subiecților, au fost măsurate în două etape : o testare inițială (C_i, B_i) și una finală (C_f, B_f), pentru a constata la finalul experimentului, dacă există îmbunătățiri. **Rezultate :** După 12 săptămâni de antrenament, rezultatele finale ne indică o creștere a mediei, atât a musculaturii pectoralilor cât și a musculaturii dorsale (C_i 102.6, C_f 107.4 respectiv B_i 109.6, B_f 113.8). Atât T-test M_c cât și T-test M_b au valoarea 1.89 și sunt semnificative pentru $p \leq 0.05$. Deși valorile la Testul T, la ambele grupe sunt identice, se pare că PPO, este mai eficientă, datorită faptului, că mărimea efectului (ω^2) este mai mare la dorsali (14%) față de pectorali (12%). **Concluzii :** În limitele experimentului nostru, considerăm faptul că, utilizând doar PPO, se pot obține îmbunătățiri semnificative asupra grupelor musculare vizate.

Cuvinte cheie: antrenament de forță, hipertrofie musculară, performanță umană, stimul de antrenament.

¹ PhD Student, University of Pitesti, Faculty of Science, Physical Education and Informatics, Romania, vladu.geanta@gmail.com

² Lecturer PhD, "Aurel Vlaicu" University of Arad, Faculty of Physical Education and Sport, Romania.

Introduction

Athletes use training to achieve specific goals, because it is a process that prepares the individual for the highest possible level of efficiency. The human body, as a unit and biological entity, can easily adapt to any stress that is applied to it. Training, is the way that we tell our body to build muscle. Through training we improve well-being. Weight training is a great way to combat the virus called sedentary lifestyle. This lifestyle should make its presence felt in most people around us due to the development of technology. It would be advisable for young people to be involved in daily physical activities, to increase their fitness and health. Weight training has the advantage of maintaining the functions of the body, while also shaping it. Through specific bodybuilding training, the human body transmits stimuli to the muscles, which make them react specifically, making them grow, as an example, in the case of our study.

The principles of the bodybuilding training of the American professor Joe Weider, among which we find the one from our study, are very well structured and have an analytical approach on the human body [1].

One major component in all training programs is the principle of progressive overload (PPO)[2]. Progressive Overload is an important principle in strength training [3]. Through the use of progressive overload, an athlete builds upon their work capacity, strength, and conditioning level in a systematic and logical way [4]. This principle of training is used by weightlifters and those participating in a team sport. The overload training principle (also called the progressive overload principle) forces athletes out of their comfort zones to gradually increase training difficulty to see measured results [5]. The human body will not change unless it is forced to [6]. This principle simply refers to progressive training in some capacity [7]. Increasing the load, the number of reps, or increasing the number of sets performed for a given exercise are some ways to achieve this [7]. Overloading is necessary to make gains in fitness and athletic performance [8].

It is essential before we use this principle in your training, or when we want to train in

another sport branch and use weights, because it is essential to have the correct technique for those exercises we want to perform. In the PPO training, both muscle memory and the correct execution technique play an important role to perform any exercise flawlessly, without the risk of injury. The PPO suggests the gradual use of higher requirements than the normal ones that the muscles exert. In order for progressive loading to be possible, it is necessary to adapt the body to the new effort provided by constant training because, without the adaptation phase, our body cannot continue to use a task that is superior to its possibilities.

Adaptations represent improvements in muscle size, strength, or endurance. The technique of PPO pushes the body past its limits, further breaking it down to force adaptations that lead to performance gains [5].

In non-performance athletes, the PPO training can bring visible gains in muscle size, but as its level of conditioning improves, increased training intensity is needed to continue to achieve positive results. If an athlete continues to lift the same weight, with the same number of repetitions, sets, weekly, the body will adapt to this type of training, and the plateau effect will occur. The proper structuring of the training load is directly related to the improvement of the athlete's performance [9], this also being possible in non-performance athletes. The load can be seen as a combination of the intensity, duration and frequency of training [10]. In the literature, the load is determined by the degree of specificity of the training and by developing the athlete's efficiency [11]. The application of an adequate load results in a set of physiological reactions that allow the athlete to adapt to the training stimulus, which increases his level of fitness and tolerance to training and the ability to perform[10][12]. Properly structured training loads will increase gradually and will increase the execution capacity [10]. To improve muscle size, we should need to create a training stimulus that elicits the three mechanisms for muscle growth (i.e. hypertrophy): mechanical tension, muscle damage, and metabolic stress [13]. Mechanical tension is exerted on the muscles from movement and external load to educate, produce or control force, and this, can be

created either by lifting heavy loads for lower volumes (i.e. lower numbers of repetitions), or by lifting medium loads for higher volumes (i.e. higher numbers of repetitions) [14]. Therefore, we can create a stimulus for muscle growth. Muscle damage refers to muscle tissue micro-tears that occur when working muscles, which tear and struggle to resist the weight while the muscle fiber is lengthening eccentrically [14]. Metabolic stress represents increasing time under tension and gives athletes an incredible pump, or muscle-cell swelling [14]. With all of the above, the idea of starting a study that evaluates the PPO training efficiency applied on non-performance athletes, has become the aim of this paper.

Methods

Subjects and experimental design

The study was started in order to obtain a conclusion regarding the fact that if, using Weider's PPO, non-performance subjects can have significant increases of the selected body perimeters, chest muscles (M_c), and back muscles (M_b), although in their training routine the other muscle groups were not neglected. Each subject was tested before and after the research period of the training program, by measuring the perimeter of the muscles. To be accepted in this study, participants should be at least 18 years of age, have not participated in any bodybuilding training program over the past three months and be free of health problems [15]. The subjects also signed an agreement to participate in the study. To be included in the analysis, the participants had to attend at least 80%-90% of the training sessions [16]. For the current investigation, the workout training logs for each subject were analyzed with the amount of intensity, volume, and training frequency of each participant. A total of 8 subjects ($N=8$ males, age = 20.4 ± 0.74 years) were included in this study. The experiment occurred in a sport center in Arad County, having the necessary conditions for the study to occur. The period in which the research was performed was November-March 2019.

Material and methods

Measurements of the chest muscles (M_c) and back muscles (M_b) were carried out in two

stages: an initial test (T_i) and a final test (T_f), to see, at the end of the experiment, if there are improvements. We used a metric band. The technique involves placing a flexible measure tape (metric band), made of cloth, over an area of the body and measuring its girth [17]. Measurements are commonly taken at the midpoint of the body area, but any site along the muscle can be assessed [17].

The reliability of circumference assessments is acceptable and is better than the one reported with skinfold testing [18]. The measurements were expressed in cm. Through this measurement method, we will be able to estimate, from an anthropometric perspective, how much the subjects have increased the perimeter of their muscles. A statistical analysis was performed using SPSS (v.20.0). We calculated the mean, standard deviation, t-test dependent, and omega square ω^2 , for $p \leq 0.05$.

Exercise training program

Throughout the 12-week intervention, subjects met twice per week in the first one, for their body to get used to the effort, and after, the training routine increased from twice to four times per week (for approximately 45-60 min/session). Each training session was preceded by general warm-up, and a specific workout with moderate weights. Training routines were monitored by the researcher and fitness staff responsible for training implementation. Throughout the research, we tried to apply the PPO training, by alternating, either by adding weights, repetitions or sets. The specific progression of weekly training (i.e.: barbell bench press) included weeks 1-4: three sets of 10 repetitions, weeks 5-9: four sets of 12 repetitions, weeks 10-12: five sets of 10-12 repetitions [19]. For every workout, the load increases occurred gradually (0.5-1-2 kg) if a subject managed to complete two or more repetitions above his repetition goal assigned for each routine exercise, in the last set, for two consecutive workouts, respectively (the "2-for-2 rule") [20]. There is also a study that compared basic and isolation exercises, which generated interesting results [21].

Results

Table I. The values of the subjects' measurements for the two muscle groups, both at the initial test (C_i , B_i) and at the final test (C_f , B_f).

ID	C_i (cm)	C_f (cm)	B_i (cm)	B_f (cm)
G.A	104	107	110	114.8
V.F	100	104	107	113
S.O	103.5	108	112	116
G.D	100.5	106.4	106	110
C.C	104	113	117	120.8
D.S	104.5	109	112	116
P.O	103	107	106	110
C.L	101	105	106.5	109.7
M	102.6	107.4	109.6	113.8
SD	1.67	2.57	3.69	3.64

Legend: C = chest, C_i = initial, C_f = final
 B = back, B_i = initial, B_f = final

Obviously, the interest of the study refers not only to muscular hypertrophy, but to whether this development can be attributed to the method used. At the end of the experiment, an improvement of the perimeters can be observed (Fig. 1, and Fig. 2).

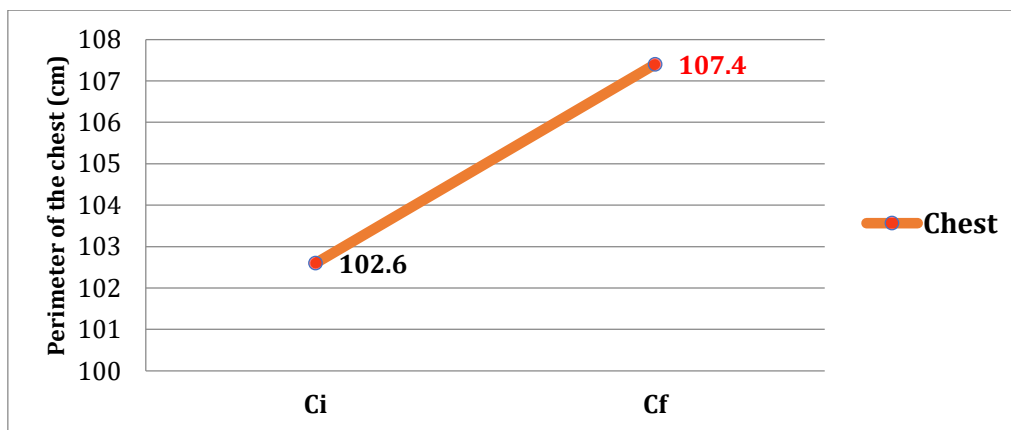


Figure 1. Graphical representation of the initial (C_i) and final (C_f) testing for the Chest group.

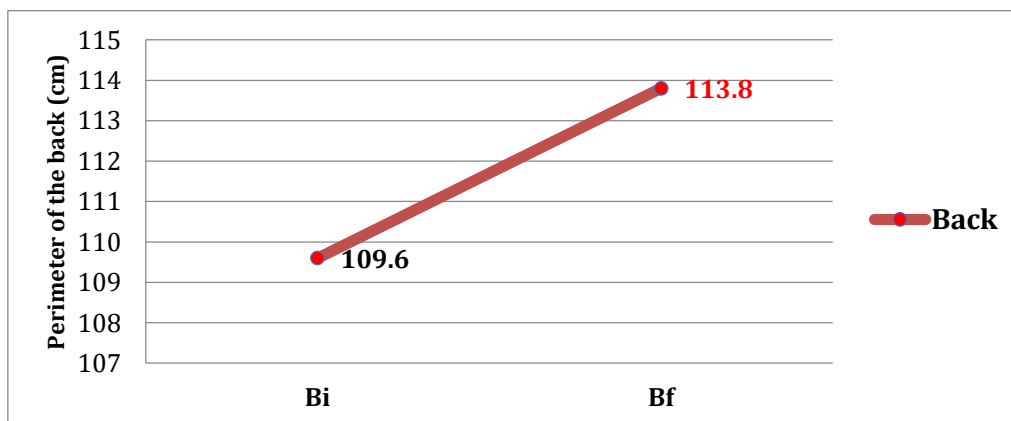


Figure 2. Graphical representation of the initial (B_i) and final (B_f) testing for the Back group.

The association between the improvement of the targeted perimeters and the working method (PPO), is highlighted by the dependent T-test, obtaining the following values ($T=1.89$). The relatively small values of omega squared (ω^2), both for the chest and for the back ($\omega^2_c = 12\%$, $\omega^2_b = 14\%$), are not suggestive if only one method is used (in our case PPO); increases are not significant. It is recommended to use several methods. Using only the PPO, without food supplements, it is assumed that this increase is natural.

Discussions

Weight training has become a popular sport among the young population, because most teenagers want a beautifully shaped body. Muscle hypertrophy occurs when skeletal muscles are subjected to an overload stimulus because it causes perturbations in myofibers and the related extracellular matrix [22]. Through this method of training (PPO), we also tried avoiding the plateau effects in our subjects. The way an individual trains is essential for his performance. The larger the muscle, the larger the strength capacity [23]. Once subjects fall into a comfort zone and the workouts are no longer challenging, the plateau effects will occur [6]. Our goal was to demonstrate a hypertrophic effect with this method of training in non-athlete subjects. At the final measurements, there were increases in all muscle groups. Through the usual use of physical exercises, we noticed in subjects an increase in the mental state through good mood, but also in the physical condition through increases in muscle mass. Also, from the results obtained, the message behind our study is to incite the young population to physical activity of all kinds, to avoid a sedentary lifestyle, showing that through regular exercise, good results can be obtained.

Conclusions

In our study, because the subjects were relatively young, and they also practiced in this sport as a leisure activity, they had muscle memory, which helped them grow faster in the muscle perimeters targeted for measurement. The limit of the study was not only the use of the principle, but also the intake of nutrients and other factors that the literature puts in relation to the increase in muscle

mass, including anabolic substances. Certainly, our study could have been much more developed if we had access to laboratory equipment, for much more detailed monitoring of the muscles. Subjects will evolve in terms of training level, and they will need new training plans, based on new training principles specific to bodybuilding, which can have much more visible results. It is recommended to use several methods to see which method has the best efficiency.

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References

1. Ardelean V.P. (2009). *Oportunitatea folosirii metodelor specifice sistemului Weider din culturism in procesul pregatirii fizice din alte ramuri sportive*, Physical Education in Romania Present and Innovation, Oradea, 43-50.
2. Pearson D., Faigenbaum A., Conley M., & Kraemer W. (2000). *The National Strength and Conditioning Association's Basic Guidelines for the Resistance Training of Athletes*. *Strength and Conditioning Journal*, 22, 14.
3. Seana S. (2021). *The Principle of Progressive Overload*. *Freeletics*. Retrieved May 15, 2021, from <https://www.freeletics.com/en/blog/posts/the-principle-of-progressive-overload/>
4. Kavanaugh A. (2000). *The Role of Progressive Overload in Sports Conditioning*, NSCA's Performance Training Journal, 6 (1), 15-17.
5. Martins N. (2019). *Overload Principle: Training with Purpose*, H.V.M.N. Retrieved May 15, 2021, from <https://hvmn.com/blogs/blog/training-overload-principle-training-with-purpose>
6. Goulet C. (2020). *The Progressive Overload Principle: Train For Continued Growth*, Retrieved May 15, 2021, from <https://www.bodybuilding.com/content/progressive-overload-the-concept-you-must-know-to-grow.html>
7. Indrayan D. (2020). *Progressive Overload: Why Is It Necessary for Building Muscle?* Medium, Retrieved May 14, 2021, from <https://medium.com/superhuman-by-science/progressive-overload-why-is-it-necessary-for-building-muscle-5d85a135c3e4>
8. ISSA. (n.d.) *Understanding and Using the Overload Principle*, ISSA Online. Retrieved May 14, 2021, from <https://www.issaonline.com/blog/index.cfm/2019/undersanding-and-using-the-overload-principle>
9. Bomba T., Haff G. (2014). *Periodization: Theory and methodology of Training*, 5th ed. Ad Point Promo., 31.

10. Smith D.J. (2003). *A framework for understanding the training process leading to elite performance*, Sports Medicine, 33, 1101-1126.
11. Siff M.C., Verkhoshansky Y.U. (1999). *Supertraining*, Denver, CO: Supertraining International, 319-336.
12. Zatsiorsky V.M., Kraemer W.J. (2006). *Science and Practice of Strength Training*, 2nd ed. Champaign, IL: Human Kinetics, 4-6.
13. Harman E. (2000). *The biomechanics of resistance exercise*. In: Baechle ER, and Earle RW(eds.), *NSCA's Essentials of Strength Training and Conditioning*, 3rd ed. Champaign, IL: Human Kinetics, 25-55.
14. Tumminello N. (2016). *Building muscle and performance*, Champaign IL: Human Kinetics, 13.
15. Gentil P., Soares S., & Bottaro M. (2015). *Single vs. Multi-Joint Resistance Exercises: Effects on Muscle Strength and Hypertrophy*, Asian journal of sports medicine, 6(2), e24057.
16. Gentil P., & Bottaro M. (2013). *Effects of training attendance on muscle strength of young men after 11 weeks of resistance training*, Asian journal of sports medicine, 4(2), 101-106.
17. Schoenfeld B. (2021). *Science and Development of Muscle Hypertrophy*, 2nd ed. Champaign, IL: Human Kinetics, 69-70.
18. Atherton P. J., Phillips B. E., & Wilkinson D. J. (2015). *Exercise and Regulation of Protein Metabolism*, Progress in molecular biology and translational science, 135, 75-98.
19. Peterson M.D., Pistilli E., Haff G.G., Hoffman E.P., & Gordon P. M. (2011). *Progression of volume load and muscular adaptation during resistance exercise*, European journal of applied physiology, 111(6), 1063-1071.
20. Baechle T., Earle R. (2008). *Essentials of strength training and conditioning*, Human Kinetics, Champaign, 381-412.
21. Geanta V. A., & Herlo J. N. (2020). *Comparative Study on Multi-Joint and Single-Joint Exercises in Bodybuilding Economics*, Arena-Journal of Physical Activities, 9, 81-92.
22. Schoenfeld B.J. (2010). *The mechanisms of muscle hypertrophy and their application to resistance training*. *Journal of strength and conditioning research*, 24(10), 2857-2872.
23. Coleman S.(2020). *How To Progressive Overload for Strength and Hypertrophy*, SET FOR SET, Retrieved November 22, 2021, from <https://www.setforset.com/blogs/news/how-to-progressive-overload>