

CHAPTER 5



5

SUMMARY, CONCLUSIONS, LIMITATIONS AND RECOMMENDATIONS

1. SUMMARY

2. CONCLUSIONS

3. LIMITATIONS AND RECOMMENDATIONS

1. SUMMARY

The purpose of this study was firstly to determine the effects of a 4-week combined rugby-conditioning and resisted jump training program compared to a combined rugby-conditioning and normal jump training program, on selected physical, motor ability and anthropometric components of university-level rugby players. Secondly, to determine the significant acute effects of a resisted compared to a normal jump training session on selected physical and motor ability components of university-level rugby players. Chapter 1 provided a brief summary of the problem that underlies the research questions of the study and the research questions itself, the objectives and hypotheses of the study as well as the structure of the dissertation.

Chapter 2 consisted of a literature review titled “Effects of different plyometric training programs on the physical, motor ability and anthropometric components of subjects.” The purposes of this review were firstly to review critically all available and relevant research of the last 14 years (2000-2013) with regard to plyometric related program, the type of program that were used as well as the effects of these program on the physical, motor ability and anthropometric components of study subjects. Secondly, the researchers made an attempt to provide detailed guidelines to prospective researchers and practitioners in the field of Sport Science for the use of different types of plyometric training methods and program. Fifty articles which investigated the effects of plyometric training program alone (29 articles) or combined plyometric training program (21 articles) were identified.

With regard to the possible benefits of plyometric training programs/exercises alone, the literature seems to support the use of this training modality when the aim is to improve significantly ($p < 0.05$) the following physical and motor ability components: joints' range of motion; speed; agility; upper and lower body explosive power and strength; anaerobic peak power and cardiovascular endurance. Plyometric exercises or programs' benefits can even be extended to include significant changes ($p < 0.05$) in muscle, peripheral, haematological and central factors, such as: increased thigh muscle volume; increased rate of muscle fibre twitch torque development and rate of muscle relaxation; increased average electromyographic activity, tendon elongation and elastic energy storage during squat jump execution; a decrease in altered neuromotor control; increased creatine kinase, lactate dehydrogenase and lactate activity as well as increased free testosterone concentrations; increased heart rates and the rate pressure product during plyometric exercises as well as increased systolic and diastolic blood pressure during and after plyometric exercises.

The plyometric training programs/exercises alone which were more successful in obtaining significant results with regard to the different physical and motor ability components were followed for 3 days up to 7 weeks and consisted of 2 plyometric sessions a week. During these sessions 3 to 6 sets of 7 to 16 repetitions were performed with 90 sec to 3 min rest between sets and 1- and 3 min rest between 2 to 11 plyometric exercises per session. Foot contacts per session varied between 79 to 137 repetitions and the known exercise intensities ranged between 60 and 105% of the 1RM.

The results of the literature review further revealed that combined plyometric training programs were more effective in causing significant ($p < 0.05$) positive pre-post training changes in the following variables compared to combined non-plyometric or non-combined program: lower and upper body explosive power and strength; anaerobic power and work; speed; agility; CMJ flight time, mean and peak ground reaction forces; maximum angular velocity of the knee; vertical velocity at take-off; golf driving distance and club head speed; running economy and kicking performance. Significant increases ($p < 0.05$) for the following anthropometric measurements and muscle related variables were also reported when the effects of a combined plyometric training program were compared to that of a combined non-plyometric program: lower limb lean mass; femur and wrist breadth as well as skeletal mass; the amount of myosin-heavy chain (MHC) type IIa muscle fibres; muscle-activation patterns and the electromyographic dependant variables. The combined plyometric training programs which were more successful in obtaining significant

results with regard to the different physical and motor ability components were followed for 1 day up to 7 weeks and consisted of 3 plyometric sessions that were performed per week. The plyometric sessions consisted of 4 to 9 exercises of which 6 to 12 repetitions were performed for 2 to 7 sets. Rest periods of between 2- and 5 min were used between sets and 30 sec to 5 min between exercises. The exercise volume ranged between 65 and 150 foot contacts per session whereas exercise intensity was set at between 30 and 105% of the 1RM.

Chapter 3 consisted of the first article titled “The effects of a combined resisted jump training and rugby-conditioning program on selected physical, motor ability and anthropometric components of rugby players”. The purpose of this investigation was to examine the effects of a 4-week combined rugby-conditioning and resisted jump training program compared to a combined rugby-conditioning and normal jump training program on selected physical, motor ability and anthropometric components of university-level rugby players. Although the overall study results suggest that the experimental group experienced more positive changes, especially with regard to the body fat, skeletal mass and somatotype-related anthropometric and flexibility-related measurements, only relaxed upper-arm girth, ectomorphy, left Active-straight-leg-raise-test and the left Modified Thomas Quadriceps Test values showed significant differences when the two groups of players were compared. Although the experimental group demonstrated significantly better average scores in the majority of the last-mentioned components, the experimental group experienced a significantly higher reduction in relaxed upper-arm girth due to the conditioning program than the control group. Therefore the study did not succeed in showing that a four-week combined rugby-conditioning and resisted training program will lead to significantly better changes in leg explosive power, speed, agility, lower body flexibility and muscle strength as well as body size, lean body, muscle, fat and skeletal mass as well as the somatotype of university-level rugby players than a combined rugby-conditioning and normal training program.

The second article, titled “Acute effects of a resisted compared to a normal jump training session on selected physical and motor ability components of university-level rugby players” was presented in Chapter 4. The purpose of this study was to determine the acute effects of a resisted compared to a normal jump training session on selected physical and motor ability components of university-level rugby players. Although the researchers expected an acute resisted jump training session to lead to significantly bigger changes in leg explosive power, speed, agility, lower body flexibility and muscle strength, among university-level rugby players than a normal jump training session, no significant differences were obtained for any of the measured components. What these

results suggest, is that resisted jump training exercises do not provide additional stimuli to the neurological and peripheral structures of the body than normal jump training exercises. Some of the results may even suggest that this technique may have an acute detrimental effect (although not significantly so) on VJT peak power compared to normal jump training.

The article presented in Chapter 3, were compiled in accordance with the guidelines of The Journal of Strength and Conditioning Research and the article presented in Chapter 4, was compiled in accordance with the guidelines of The European Journal of Sport Science to which it will be submitted for possible publication. Each consisted of an introduction and the experimental approach of the specific studies. The research methods (subjects, procedures and data analyses) were also described together with the results and discussion of each of the studies followed by conclusions or practical applications.

2. CONCLUSIONS

Hypothesis 1: A 4-week combined rugby-conditioning and resisted jump training program will lead to significantly better changes in leg explosive power, speed, agility, lower body flexibility and muscle strength as well as body size, lean body, muscle, fat and skeletal mass as well as the somatotype of university-level rugby players compared to a combined rugby-conditioning and normal jump training program.

Hypothesis 1 is rejected due to the conclusion that only ectomorphy, left Active-straight-leg-raise-test and the left Modified Thomas Quadriceps Test values showed significant bigger change due to the combined rugby conditioning and resisted jump training program, compared to a combined rugby-conditioning and normal jump training program.

Hypothesis 2: An acute resisted jump training session will lead to significantly bigger changes in leg explosive power, speed, agility, lower-body flexibility and muscle strength, among university-level rugby players than a normal jump training session.

Hypothesis 2 is also rejected due to the conclusion that none of the components displayed a significantly bigger change due to the acute effects of a resisted compared to a normal jump training session.

3. LIMITATIONS AND RECOMMENDATIONS

Although these results cast a shadow of doubt on the contention that the use of resisted jump training will be more beneficial than the use of normal jump training when used as an acute post-activation potentiation technique or combined with a more long-term rugby-specific program, the following shortcomings must be considered when interpreting the results of this study:

- The lack of significant differences between the two combined programs may be related to the rather short training period (4 weeks) the players were subjected to. Although the 4-week training period was deemed to be sufficient by researchers in causing significant improvements in a variety of physical and motor ability components of team sport participants, some studies on rugby players seem to suggest that a 4-week combined rugby-conditioning and plyometric training program may only lead to neural adaptations and not to morphological changes. Therefore, it can be recommended that longer training periods be used in future studies of this nature, especially where changes in the anthropometric profile of rugby players is the focus.
- Another factor to consider when interpreting the results is that the players in this study were all used to plyometric training and their muscles were, therefore, already accustomed to land-based plyometric type of explosive exercises before the start of the intervention period. All the players had been subjected to a general rugby-conditioning program for six months prior to the intervention period. Despite the fact that they were not used to resisted jump training type of program, their neuromuscular systems would probably not be as sensitive and reactive to combined sport-specific plyometric conditioning programs as those of players that were untrained and not accustomed to this type of training. It is therefore important to consider players' experience in plyometric type of programs and training when planning a study of this nature.
- The non-significant results with regard to the measured components of the combined plyometric program related study can also possibly be attributed to the high fall-out of players during the course of the study. The groups of players that were tested were smaller than originally planned and could have caused outliers to have influenced the mean values of the respective test scores and anthropometric measurements more than would have been the case with larger group sizes. However, the use of a two-way randomized, pre- and post-test, crossover experimental design in this study, ensured that all players were subjected to the same number and type of training sessions for the same periods of time. The implementation of this

study design reduces the influence of confounding covariates because every player served as his own control which meant that smaller group sizes could be used.

- Furthermore, combined rugby-conditioning and resisted jump training programs will probably benefit players more with regard to their physical, motor ability and anthropometric profile if it were compiled according to each player's initial strength levels. The cords of the Vertimax resistance training apparatus can then be set according to a certain percentage of the player's strength levels in order to individualize the training load. It will probably also be advisable to determine at which load each player is able to perform the jump training exercises in such a way that the transition time from eccentric to concentric muscle contractions (amortisation phase) is kept short. The same applies to the fact that similar post-activation potentiation exercise protocols and resistance levels were used for all the subjects in this study. A study in which the protocols are individualized according to each individual's strength and explosive power scores will offer a possible solution to the problem of individuality. Furthermore, it would also be advisable to set up and test each player's post-activation potentiation protocol before the start of the study in order to determine the most ideal exercise load, volume and duration.
- In view of the non-significant effects of the plyometric exercises (acute study) and the short period of rest players received between the execution of the plyometric exercises and the test battery, it is possible that fatigue may have played a role in influencing the results. Therefore, players may have experienced peripheral fatigue immediately after the preload stimulus which would inhibit the potentiation effect obtained. A better approach to studies of this nature will be to determine each player's most ideal recovery time before the start of the study and then use these individualized recovery times in the study protocol.

The study results, therefore, suggest that further research be done to verify the use and effectiveness of combined sport-specific and resisted training programs compared to sport-specific programs that do not make use of a resisted jump training apparatus (VertiMax). Researchers in the field of sport science also need to develop post-activation potentiation exercise sessions that can be incorporated into athletes' training program and competition warm-ups. Furthermore, it can also be advised that future studies need to investigate the exact neural and musculoskeletal mechanisms that underlie the possible physiological benefits to be derived from resisted jump training programs.