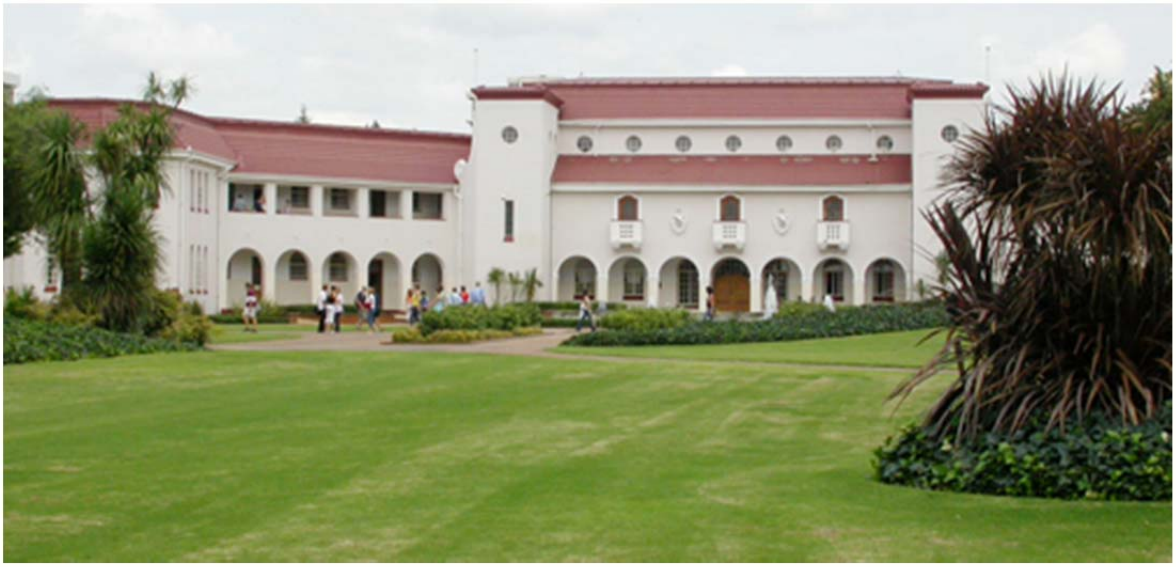
The effects of a combined resisted jump training and rugby-conditioning program on selected physical, motor ability and anthropometric components of rugby players



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NORTH-WEST UNIVERSITY
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WHATEVER YOU DO, DO ALL TO THE

GLORY OF GOD

1 CORINTHIANS 10:31

DECLARATION

The co-author of the two articles, which form part of this dissertation, Dr. Ben Coetzee (Supervisor), hereby gives permission to the candidate, Mr. Cobus Oosthuizen to include the two articles as part of a Master's dissertation. The contrubution (advisory and supportive) of the co-author was kept within reasonable limits, thereby enabling the candidate to submit this dissertation for examination purposes. This dissertation, therefore, serves as partial fulfillment of the requirements for the degree Master of Arts degree in Sport Science within the Physical Activity, Sport and Recreation Focus Area at the Potchefstroom Campus of the North-West University.

Dr. Ben Coetzee

Supervisor and co-author

SUMMARY

Plyometrics is primarily used by coaches and sport scientists to improve explosive power among athletes who participate in dynamic, high intensity type of sports. One of the plyometric-related training methods that has received attention in recent years, is loaded or resistance (resistive) jump training. Limited research does, however, exist with regard to the benefits and use of this training method as well as in conjunction with other training methods, especially among team sport participants. It is against this background that the research objectives of this study were firstly, 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. The second objective was to examine 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.

Thirty rugby players (age: 19.60 ± 0.79 years) from the first and second u/19 and u/21 rugby teams of a university in South Africa were randomly selected to participate in the first part of study. For the second part of the study thirty senior rugby players (1st and 2nd senior teams) (age: 21.78 ± 1.86 years) of the Rugby Institute at a university in South Africa were randomly selected to participate in the study. For both studies the thirty players were in turn randomly divided into two groups of fifteen players each. One group formed the experimental and the other group the control group. The first objective was tested by subjecting the players to a 4-week combined sport-specific and resisted plyometric training program (experimental group) or a combined sport-specific and normal plyometric training program to investigate the adaptations of body composition, lower body flexibility, explosive leg power, speed, agility and leg strength. After a 10-week period ("wash-out period") during which subjects continued with their normal rugby-conditioning program, the same testing procedures as before, were executed by following a crossover design. In order to test the second objective of the study players' body weight and height were firstly measured after which they were subjected to a thorough warm-up, followed by the execution of the flexibility;Vertical Jump Test (VJT); 5-, 10- and 20 m speed tests; the Illinois Agility Run Test (IART) and the 6RM (repetition maximum) Smith Machine Squat Test (6RM-SMST). The experimental group was subject to the resisted jump training session on the Vertimax whereas the control group executed the same exercises on the floor. Directly after the training session each of

the players again completed the test battery. After the first week, a crossover design was implemented.

Although the overall study (independent *t*-test and main effect ANOVA) results of the first study suggested 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 ($p < 0.05$) 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, this group experienced a significantly higher reduction in relaxed upper-arm girth due to the conditioning program than the control group. The main effect ANOVA results of the acute study showed that no significant differences were obtained for any of the measured components between an acute resisted and normal jump training session.

To conclude, the study revealed that a 4-week combined rugby-conditioning and resisted jump training program (experimental group) did not benefit university-level rugby players significantly more with regard to selected physical, motor ability and anthropometric components than a combined rugby-conditioning and normal jump training program (control group). Furthermore, despite the fact that the acute resisted and normal jump training exercises met all the requirements to produce post-activation potentiation, the study results showed that these exercise sessions did not lead to any significant acute changes in the physical and motor ability components of university-level rugby players.

Keywords: plyometrics, explosive power, resisted jump training, rugby union

OPSOMMING

Pliometrie word hoofsaaklik deur afrigters en Sportwetenskaplikes gebruik om eksplosiewe krag by atlete wat aan dinamiese, hoë-intensiteit tipe sportsoorte deelneem, te verbeter. Een van die pliometrie-verbandhoudende metodes wat aandag oor die afgelope jare ontvang het, is beladings- of weerstands-sprongoefeninge. Beperkte navorsing wat die voordele en gebruik van hierdie inoefeningsmetode sowel as in samehang met ander inoefeningsmetodes, veral onder spansportsoortdeelnemers ondersoek het, bestaan egter. Dit is teen hierdie agtergrond dat die navorsingsdoelwitte van hierdie studie was om eerstens die effekte van ŉ 4-week gekombineerde rugby-kondisionerings- en weerstands-sprong-inoefeningsprogram vergeleke met ŉ gekombineerde rugby-kondisionerings- en normale sprong-inoefeningsprogram op geselekteerde fisieke, motoriese en antropometriese komponente van universiteitsvlak rugbyspelers te ondersoek. Die tweede doelwit was om die akute effekte van ŉ weerstands- vergeleke met ŉ normale sprong-inoefeningsessie op geselekteerde fisieke en motoriese komponente van universiteitsvlak rugbyspelers te ondersoek.

Dertig rugbyspelers (ouderdom: 19.60 ± 0.79 jaar) van die eerste en tweede o/19 en o/21 rugbyspanne van ŉ universiteit in Suid-Afrika is ewekansig gekies om deel te neem in die eerste deel van studie. Vir die tweede deel van die studie, is dertig senior rugbyspelers (1ste en 2de senior spanne) (ouderdom: 21.78 ± 1.86 jaar) van die Rugby-instituut aan ŉ universiteit in Suid-Afrika ewekansig gekies om deel te neem aan die studie. Vir beide studies is die dertig spelers op hul beurt ewekansig in twee groepe van vyftien spelers elk, verdeel. Een groep het die eksperimentele en die ander groep die kontrolegroep gevorm. Die eerste doelwit is getoets deur die spelers te onderwerp aan ŉ 4-week gekombineerde sport-spesifieke en weerstands-pliometrie-inoefeningsprogram (eksperimentele groep) of ŉ gekombineerde sport-spesifieke en normale pliometrie-inoefeningsprogram om daardeur die aanpassings van liggaamsamestelling, onderste ledemaat-soepelheid, eksplosiewe beenkrag, spoed, ratsheid en beenkrag te ondersoek. Na ŉ 10-week tydperk (“uitwasperiode”) waartydens die deelnemers voort gegaan het met hul normale rugbykondisioneringsprogram is dieselfde toetsprosedures as voorheen, herhaal deur ŉ oorkruis-ontwerp te volg. Ten einde die tweede doelwit van die studie te toets, is spelers se liggaammassa en -lengte eerstens gemeet waarna hulle onderwerp is aan ŉ deeglike opwarming, gevolg deur die uitvoering van die soepelheids-, vertikale sprongtoets (VST); 5-, 10- en 20 m-spoedtoetse; die Illinois Agility Run Toets (IART) en die 6RM (repetisie-maksimum) Smith-masjien-squattoets

(6RM-SMST). Die eksperimentele groep is onderwerp aan ŉ weerstand- sprong-inoefeningsessie op die Vertimax terwyl die kontrolegroep dieselfde oefeninge op die vloer uitgevoer het. Direk na afloop van die oefeninge het elk van die spelers weer die toetsbattery voltooi. Na die eerste week van toetsing, is ŉ oorkruisontwerp geïmplementeer.

Hoewel die algehele studie- (onafhanklike *t*-toets en die belangrikste effek ANOVA) resultate van die eerste studie getoon het dat die eksperimentele groep meer positiewe veranderinge, veral met betrekking tot die liggaamsvet, skeletale massa en somatotipe-verwante antropometriese en soepelheidsverwante metings getoon het, het slegs die ontspanne bo-armomtrek-, ektomorfie-, linker-Aktiewe-reguit-been-opligtoets- en die linker-Gewysigde Thomas Quadriceps-toets-waardes betekenisvolle verskille ($p < 0.05$) getoon met ŉ vergelyking tussen die twee groepe spelers. Alhoewel die eksperimentele groep aansienlik beter gemiddelde tellings in die meerderheid van die laasgenoemde komponente getoon het, het dié groep ŉ betekenisvolle hoër vermindering in ontspanne bo-armomtrek as gevolg van die kondisioneringsprogram as die kontrolegroep getoon. Die resultate van die primêre effekte ANOVA van die akute studie het getoon dat geen betekenisvolle verskille gevind is vir enige van die komponente wat gemeet is tussen die akute weerstands- en normale sprong-inoefeningsessie nie.

Om af te sluit, die studie het getoon dat ŉ 4-week gekombineerde rugby-kondisionerings- en weerstands-pliometrie-inoefeningsprogram (eksperimentele groep) nie die universiteitsvlak rugbyspelers betekenisvol meer met betrekking tot die geselekteerde fisieke, motoriese en antropometriese komponente bevoordeel het as ŉ rugby-kondisionerings- en normale pliometrie-inoefeningsprogram (kontrole-groep). Verder, ten spyte van die feit dat die akute weerstands- en normale sprong-oefeninge aan al die vereistes vir die verkryging van post-aktivering potensiëring voldoen het, het die studieresultate getoon dat hierdie oefeningsessies nie gelei het tot enige betekenisvolle akute veranderinge in die fisieke en motoriese komponente van universiteits-vlak rugbyspelers nie.

Sleutelterme: pliometrie, explosiewe krag, weerstands-sprongoefening, rugby unie

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LIST OF ABBREVIATIONS

APT	AQUATIC PLYOMETRIC TRAINING
ASLRT	ACTIVE STRAIGHT LEG RAISE TEST
BMI	BODY MASS INDEX
BS	BACK SQUAT
CD	COMBINATION OF GROUP 1 & 2
CG	CONTROL GROUP
CMDJ	COUNTERMOVEMENT DROP JUMP
CMJ	COUNTERMOVEMENT JUMP
CPK	CREATINE PHOSPHATE KINASE
DBP	DIASTOLIC BLOOD PRESSURE
DJ	DEPTH JUMP TRAINING
EG	EXPERIMENTAL GROUP
EMG	ELECTROMYOGRAPHY
EMS	ELECTROMYOSTIMULATION
$G \cdot MM^{-2}$	GRAM MILLIMETER^2
GRF	GROUND REACTION FORCE
HD	HORIZONTAL DEPTH JUMP TRAINING
IART	ILLINOIS AGILITY RUN TEST
IL-1b	INTERLEUKIN 1B
IL-6	INTERLEUKIN 6
ISAK	INTERNATIONAL SOCIETY FOR THE ADVANCEMENT OF KINANTHROPOMETRY
JH	JUMP HEIGHT
KG	KILOGRAM
LCMJ	LOADED COUNTERMOVEMENT JUMP
LPS	LOADED PARALLEL SQUATS
LPT	LAND PLYOMETRIC TRAINING
M	SQUARE ROOT OF THE BODY STATURE
MHC	MYOSIN HEAVY CHAIN
MTQT	MODIFIED THOMAS QUADRICEPS TEST
PLYO	PLYOMETRIC EXERCISE GROUP

PT	PLYOMETRIC TRAINING
PSLRT	PASSIVE STRAIGHT LEG RAISE TEST
RAST	RUNNING-BASED ANAEROBIC SPRINT TEST
RM	REPETITION MAXIMUM
ROM	RANGE OF MOTION
RPP	RATE PRESSURE PRODUCT
SBP	SYSTOLIC BLOOD PRESSURE
SJ	SQUAT JUMP
SMST	SMITH MACHINE SQUAT TEST
SQUAT	HEAVY WEIGHT EXERCISE
SSC	STRETCH SHORTENING CYCLE
ST	SPRINT TRAINING
STG	STRENGHT TRAINING GROUP
SUM6SF	SUM OF THE SIX SKINFOLDS
TCG	TRAINING CONTROL GROUP
TEM	TECHNICAL ERROR OF MEASUREMENT
VD	VERTICAL DEPTH JUMP TRAINING
VJT	VERTICAL JUMP TEST
$VO2_{MAX}$	MAXIMAL OXYGEN UPTAKE
VTG	VERTIMAX TRAINING GROUP
W	PEAK POWER
$W.kg^{-1}$	PEAK POWER RELATIVE TO BODY MASS
$\overline{x}$	TOTAL AVERAGE SCORE FOR EACH EXERCISE VARIABLE