Resistance Training for Metabolic Syndrome: Part II

Paul Sorace, MS, RCEP, FACSM, CSCS*D,1 Peter Ronai, MS, FACSM, RCEP, CSCS*D, CSPS,2 and James R. Churilla, PhD, MPH, FACSM, RCEP, CSCS3
1Hackensack University Medical Center, Hackensack, New Jersey; 2Sacred Heart University, Fairfield, Connecticut; and 3University of North Florida, Jacksonville, Florida

ABSTRACT

THE SPECIAL POPULATIONS COLUMN PROVIDES A BRIEF OVERVIEW OF METABOLIC SYNDROME (MetS) AND THE POTENTIAL BENEFITS RESISTANCE TRAINING (RT) CAN HAVE ON PREVENTING AND MANAGING MetS. THIS COLUMN WILL PROVIDE SCIENTIFICALLY SUPPORTED RT RECOMMENDATIONS FOR THE PREVENTION AND MANAGEMENT OF MetS.

RESISTANCE TRAINING RECOMMENDATIONS FOR METABOLIC SYNDROME

The Special Populations column provides a brief overview of Metabolic Syndrome (MetS) and the potential benefits resistance training (RT) can have on preventing and managing MetS. Current recommendations for RT and MetS are consistent with the recommendations for healthy adults (2). Because there is no consensus on specific RT recommendations for MetS at the present time, recommendations are general and may need modifying, based on the person’s abilities, health condition, time constraints, etc. The Table summarizes general recommended RT variables for MetS.

The mode of resistance exercise selected is typically determined by availability, preference, skill level, and any special needs of the individual. It is the authors’ experience that free weights, weight machines, elastic tubes, or bands and calisthenics are commonly used modes of training. The use of periodization (linear and nonlinear) should be considered for long-term progression and the avoidance of training boredom. As is the case with many special populations, obtaining medical clearance and any special precautions is necessary when working with individuals with MetS. Persons with MetS are at increased risk for coronary artery disease (CAD), may have subclinical CAD, and may be taking a number of medications, which may affect RT performance and physiological responses (2). Thus, fitness professionals should be cognizant of these factors and be able to recognize when to intervene or alter a training program.

RESISTANCE TRAINING MODIFICATIONS FOR COMPONENTS OF THE METABOLIC SYNDROME

Prehypertension and Hypertension

Of all the components of MetS, prehypertension and hypertension are conditions the exercise professional should be most concerned with regarding RT safety. This is because of the potential of abnormally high blood pressure responses during RT. For example, extremely high blood pressures have been observed (480 mm Hg systolic and 350 mm Hg diastolic) in individuals performing a leg press to maximal fatigue (9). Factors that affect the blood pressure response during RT include load, repetitions, repetition speed, rest periods, number of sets, and total volume of muscle...
used (11). As a result, the exercise professional should consider the following RT modifications when working with a client who has prehypertension or hypertension:
- **Monitor blood pressure before and after each session; occasional exercise pressures should be measured as well.**
- **Know the blood pressure limits: absolute contraindication—180/110 mm Hg at rest; relative contraindication—160/100 mm Hg at rest (check with physician); maintain exercise blood pressure <220/105 mm Hg (2,13).**
- **Ensure that the person is being compliant with their blood pressure medication.**
- **Start with light or conservative initial loads (30–40% IRM upper body and 50–60% IRM lower body), maintaining intensity between 11–13 on the Borg category scale (1,13).**
- **Consider 8–10 repetitions per set; use fast but controlled repetition speeds (e.g., 1-second concentric and 1-second eccentric) (8).**
- **Use rest periods of at least 1 minute or longer; although shorter rest periods may be used in certain situations (as indicated in the Table), 60–90 seconds or more will typically allow blood pressure to return to baseline or near baseline levels (8).**
- **If necessary to maintain a controlled exercise blood pressure, use 1 limb exercises, especially with large muscle mass exercises (e.g., leg press). Single limb exercises decrease the total volume of muscle mass used and elicit less of a hemodynamic response.**

### Table

<table>
<thead>
<tr>
<th>Frequency: 2–3 d/wk; a greater frequency will be required for split routines (e.g., upper body/lower body).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intensity: 60–80% one-repetition maximum (1RM); older or very deconditioned persons should use lower resistance (60–70% 1RM).</td>
</tr>
<tr>
<td>Repetitions (Reps): 8–12 reps per set; 10–15 reps per set for older or very deconditioned persons.</td>
</tr>
<tr>
<td>Sets: 2–4 sets per muscle group (e.g., 2 sets of pulldowns and 2 sets of a seated row machine for the back musculature).</td>
</tr>
<tr>
<td>Exercises: 8–10 exercises, emphasizing multijoint movements for the major muscle groups (chest, shoulders, back, hips, legs, arms, and abdomen).</td>
</tr>
<tr>
<td>Rest periods: 60–90 seconds; this time frame may vary depending on the exercise performed, training goal, and health status.</td>
</tr>
<tr>
<td>Technique: maintain a regular breathing pattern (exhale during the lifting phase), use controlled movements, and a full range of motion.</td>
</tr>
<tr>
<td>Progression: overload the muscles by increasing resistance, performing more reps (within the desired rep range), or training muscle groups more frequently.</td>
</tr>
</tbody>
</table>

**Impaired Fasting Glucose and Type 2 Diabetes**

Although RT has been shown to improve glycemic control, strength, and physical function in persons with type 2 diabetes (T2D) and impaired fasting glucose (IFG) (3,4,6,10), there are certain conditions that can preclude a client’s participation in a RT program. Resistance training is generally contraindicated for persons with diabetes who have ulcerations and wound infections (in persons with peripheral neuropathy) and retinal detachment (in persons with retinopathy) (2–4,6,10). Clients with T2D and IFG can participate in RT if they are asymptomatic (see signs/symptoms of hypoglycemia below) and are well hydrated (2–4). In addition, they should use caution if their blood glucose levels exceed 300 mg/dL without ketones (2,4). The risk of hypoglycemia increases in individuals with preexercise glucose levels of <100 mg/dL and they should be advised to ingest a carbohydrate snack (20–30 g) before exercising (2).

Hypoglycemia can be prevented by encouraging clients to monitor blood glucose before exercise, every 30 minutes during and after exercise (2). It is very important that individuals with T2D refrain from exercising too late in the evening; this to reduce the risk of hypoglycemia while sleeping. Common signs of hypoglycemia include shakiness, weakness, abnormal sweating, nervousness and anxiety, tingling of the mouth and fingers and hunger, headache, visual disturbance(s), mental dullness, confusion, amnesia and in severe cases, seizures, and coma (2). Clients should be encouraged to have high glycemic index foods and snacks such as fruit juice available when exercising to help avoid and/or reverse exercise-induced hypoglycemia (3).

Resistance training guidelines for people with T2D and IFG resemble those appearing in the Table with a few exceptions. Exercise professionals should consider the following:
- **Assigning an initial training intensity of 50% 1RM (4).**
- **Assigning heavier (70–85% of IRM) intensity loads in trained individuals to optimize insulin action and glucose control (4,10).**
- **Combining RT and endurance training within the exercise program to optimize glucose tolerance and control (2,4,10).**
- **Using both machines, free weights, resistance exercise bands, and calisthenic exercises as part of a RT program (2,4,7,10).**
- **Monitoring blood pressure before, during, and after exercise and avoiding breath holding in persons with comorbid hypertension (2).**

**Abdominal Obesity**

The authors would like to point out that the following RT modifications
relate to overweight and obesity in general, not just abdominal obesity. When working with overweight and obese clients, it is important to remember that they may not fit into some selectorized machines properly or comfortably. As a result, choose large-framed weight machines or free weights to allow for proper body alignment, proper exercise technique, and client comfort. It is the authors’ experience that obese individuals often have strong lower-body musculature, possibly from supporting extra body mass. However, their upper-body strength may be poor if they are inactive. In this situation, considering start with basic strengthening exercises involving elastic tubes or bands, wall push-ups, and light dumbbells. Lower-body RT should not be neglected, especially because lower-body RT has a greater metabolic demand. Orthopedic issues such as osteoarthritis are common with obese persons and arthritic weight bearing joints may require some RT modifications (e.g., reduced range of motion). Finally, the exercise professional should always consider safety and proper exercise technique first and foremost. For example, if the person has poor balance, lie or she should be closely monitored and gradually progressed to exercises requiring greater levels of self-stabilization and balance.

Dyslipidemia

Persons with dyslipidemia should be thoroughly screened for cardiovascular disease(s) and medically cleared before engaging in a RT program (2,5). RT does not seem to substantially contribute to caloric expenditure levels considered necessary for improving blood lipid and lipoprotein levels (2,5). RT should be an adjunct to aerobic training (2,5) because it can improve overall physical function (7). The Table illustrates guidelines medically cleared persons with dyslipidemia can follow (2,5,7). Individuals taking lipid-lowering medications like 3-hydroxy-3-methylglutaryl-CoA reductase inhibitors (Statins) and fibric acid can experience “myopathy” (muscle weakness and soreness) (2,5,12). In some cases, myopathy has been associated with eccentric muscle contraction-induced damage in persons taking statins (12). Exercise professionals should refer clients experiencing unusual muscle soreness (prolonged, strong, even severe muscle pain) while taking these medications to their physician immediately (2).

SUMMARY

Exercise and regular physical activity are critical for managing and reducing the likelihood of developing MetS. Although cardiorespiratory activities should remain the emphasis, RT has an important role as well. More research is needed to determine the specific effects RT may have on MetS and to determine if there is a dose–response relationship between RT and MetS. However, current data indicate that regular RT has beneficial effects on MetS and should be a part of the lifestyle intervention for the management and potential prevention of MetS.

Conflicts of Interest and Source of Funding: The authors report no conflicts of interest and no source of funding.

Paul Sorace is a clinical exercise physiologist for The Cardiac Prevention and Rehabilitation Program at Hackensack University Medical Center.

Peter Ronai is a clinical associate professor in the Exercise Science Department at Sacred Heart University.

James R. Churilla is an Assistant Professor of clinical exercise physiology and physical activity and the Graduate Program Director for the Exercise Science and Chronic Disease program in the Brooks College of Health at the University of North Florida in Jacksonville, Florida.

REFERENCES


**ADDITIONAL RESOURCES**


The NSCA’s Education Recognition Program (ERP) highlights institutions that teach an exceptional curriculum with regard to personal training, strength and conditioning, and graduate studies. Not only is your school counted among the best, but your students reap the greatest reward—an outstanding education. ERP schools receive:

- $25 discount for students on certification exam registrations
- $25 to your academic department per student exam registration
- Certificate of distinction for display
- Recognition and link on the NSCA.com website
- Acknowledgement in the NSCA Bulletin, received by all NSCA members
- ERP logo usage to promote on your program documents
- Career postings for your school through the NSCA’s Career Resources
- **NEW** Host an Exam Prep Symposium with discounts for students

Visit [NSCA.com/ERP](http://NSCA.com/ERP) to apply now and move to the head of the class.