RESISTANCE TRAINING AND CHRONIC DISEASE

A Summary of the Current Evidence

by Joseph T. Ciccolo, Ph.D., CSCS and Sanaz Nosrat, M.A.

Learning Objectives

- To understand that the effects of RT have been examined in persons with various chronic diseases, including cardiovascular disease, cancer, type 2 diabetes, chronic obstructive pulmonary disease, chronic kidney disease, Parkinson’s disease, multiple sclerosis, fibromyalgia, and HIV/AIDS.
- To recognize that RT can be used as a tool to manage the wide array of debilitating symptoms experienced by various populations with chronic disease.
- To review the guidelines for developing an RT program for a select number of chronic disease populations.
- To gain the knowledge needed to further explore the research examining the effects of RT on chronic disease.

Key words: Resistance Training, Chronic Disease, Muscular Strength, Physical Function, Quality of Life

It is currently estimated that half of all American adults have at least one chronic disease, which may include heart disease, cancer, type 2 diabetes, or chronic obstructive pulmonary disease (COPD) (31). The resulting effect of this level of illness is astounding. In 2010, 86% of all health care spending was for those with one or more chronic medical conditions, and seven of the top 10 causes of death were chronic diseases (31). As such, efforts to limit the progression and reduce the intensity of the symptoms experienced with chronic disease are desperately needed. Regular exercise, of course, is a powerful behavior that can impact positively many of the most common diseases experienced. Historically, aerobic exercise (and walking, in particular) has been the most widely promoted form of physical activity; however, in 2008, the U.S. Department of Health and Human Services released the first formal recommendation for Americans to participate in at least 2 d/wk of resistance training (RT) as part of the national physical activity guidelines. Since then, there has been a small bump in the participation rates of RT (Figure 1), but the numbers remain low. Although there is no doubt that the continued promotion of RT for apparently healthy adults is needed, efforts to encourage RT among those with a current chronic disease also are critically important. Thus, the purpose of this article is to promote the participation in RT by those with a chronic disease by (1) providing a brief summary of its positive effects on various chronic diseases and their associated symptoms and (2) providing practical information and a guideline for developing an RT program for a select number of chronic disease populations.

RESEARCH ON RESISTANCE TRAINING AND CHRONIC DISEASE

A wealth of research describing the effects of RT on the symptoms and management of various chronic diseases now exists. Studies show that regular RT can slow the progression...
of a disease and reduce the impact and severity of the symptoms experienced. For example, RT can increase muscle strength, functional capacity, and quality of life in patients with cardiovascular disease (33,34). RT also can reduce dyspnea, fatigue, and enhance the ability to perform activities of daily living for individuals with COPD (15,20). Other research shows that RT may be uniquely suited for individuals with type 2 diabetes, Parkinson's disease, and fibromyalgia. For instance, RT may change the course of type 2 diabetes because it can increase muscle mass and potentially alter insulin sensitivity via increased muscle glucose storage (16). RT also can reduce the deterioration of muscle strength and improve balance and walking performance for persons struggling with the negative effects of Parkinson's disease (8). Finally, RT can combat many of the muscle-related symptoms of fibromyalgia such as muscular weakness, muscle pain, and generalized fatigue (22).

Thus, the evidence to date suggests that RT can be quite helpful for those experiencing a chronic illness. More research will be needed, however, because studies must continue to test how to better prescribe and use RT to manage the symptoms of various disease states. Future studies also should determine how to increase adherence to an RT program and how this might be used to prevent certain diseases. For more information on the effects of RT for a number of different chronic diseases, see the list of systematic reviews and meta-analyses in Table.

### GUIDELINES FOR SELECT CHRONIC DISEASES

In the following sections, an overview of a select few chronic diseases is provided, including some training recommendations and special considerations when designing an RT program for these populations. The recommendations are based on the current research that has tested the effects of different RT variables on markers of physical and mental health. Importantly, an effective RT program for an individual experiencing a chronic disease is complex and requires significant planning and a sound strategy that should be safe and matched to the exerciser's goals. The factors of age, sex, symptoms experienced, and history of participating in RT must be considered. Moreover, it is critical for an individually tailored program to be constructed to effectively stimulate the physiological and psychological changes necessary to achieve the desired outcome. Practitioners should always adhere to the key RT principles of progressive overload, specificity, and variation when designing a program. Finally, the intensity of different exercises within an RT program can be prescribed using a percentage of the client's one-repetition maximum (1 RM); however, it may be necessary to estimate a 1 RM from a 5 RM or 10 RM test when a client has a condition or limitation that would make a 1 RM unsafe or excessively uncomfortable (e.g., during a symptom flare-up).

### CANCER

Cancer is the second leading cause of death in the United States (1). Prostate, breast, and colon cancer are among the most common nondermatological cancers (1), and the treatments (e.g., surgery, chemotherapy, radiotherapy) for each are accompanied by debilitating adverse effects such as chronic fatigue, body fat gain, physical impairments, bone loss, and a lower quality of life (7). Fortunately, regular RT is known to reduce or prevent many of these and other adverse effects, although the positive impact is not uniform across all types of cancer (10,14). For more information on the specific effects of RT in cancer survivors, see the systematic review by Hanson et al. (16).
Training Recommendations

In general, it is currently recommended that exercise professionals aim to implement a progressive full-body program with 2 to 3 sets per body part at 50% to 85% of 1 RM, two to four times per week (14). Practitioners should be cautious with how they progress their clients and carefully consider the type of cancer, whether surgery was part of the treatment, and the length of time the client has been in recovery. For example, although a full-body program is recommended for all, the progression to this will be different for breast cancer survivors (i.e., with potential upper body limitations) compared with prostate or colon cancer survivors. For further reading, see the online case study, Supplemental Digital Content 1, http://links.lww.com/FIT/A35, which includes an example resistance training routine for a cancer survivor.

Special Considerations

Although RT poses no major risk for an adverse event in this population, there are several circumstances that need to be taken into consideration. First, infection risk increases among patients receiving chemotherapy. Closely monitor the clients for signs of infection and take extra precautions in fitness facilities to prevent infection (e.g., clean the equipment before use) (6). Second, patients with bone metastases or with osteoporosis may need an alternative program (e.g., more seated exercises) to avoid the risk of falls, which might lead to bone fracture (6).

Third, patients with neuropathy might feel off-balance and have problems with coordination. A program with fewer unilateral movements or one modified to decrease the risk of falls and injury is recommended (6). Lastly, it is important to take the time to understand fully each client's full treatment and medication regimen and adverse effects. Consultation with the client's health care provider may be necessary. Moreover, if the individual has comorbid cardiovascular, pulmonary, and/or neurological conditions, additional modifications to the program will be needed (28).

CHRONIC KIDNEY DISEASE

Chronic kidney disease (CKD) is a condition characterized by a gradual loss of kidney function through time, which may be caused by high blood pressure, type 1 or 2 diabetes, or other conditions (21). It is estimated that 26 million American adults have CKD and millions of others are at increased risk (21). Patients with CKD who are on hemodialysis typically experience muscle wasting and weakness, reduced physical activity, problems with performing activities of daily living, and poor mental health (4). RT seems to be an ideal match for this population because it has been shown to significantly reduce muscle weakness as well as increase muscle mass and strength, walking ability, and improve quality of life (2). For more detailed information and a review of the studies on RT and CKD, see Bessa et al. (4).

<table>
<thead>
<tr>
<th>Author/Year</th>
<th>Topic</th>
<th>Type</th>
<th>Major Finding/Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Williams et al., 2007 (33)</td>
<td>Cardiovascular disease</td>
<td>Review</td>
<td>RT can significantly alter the cardiovascular system and modify cardiovascular disease risk.</td>
</tr>
<tr>
<td>Hanson et al., 2016 (14)</td>
<td>Cancer</td>
<td>Systematic review</td>
<td>Effects of RT are not uniform across all types of cancer, with the exception of muscular strength. Other improvements may include physical function, body composition, psychosocial functioning, and quality of life.</td>
</tr>
<tr>
<td>Liao et al., 2015 (20)</td>
<td>COPD</td>
<td>Systematic review and meta-analysis</td>
<td>RT can improve muscular strength, dyspnea, and lung function (i.e., FEV1).</td>
</tr>
<tr>
<td>Ishiguro et al., 2016 (16)</td>
<td>Type 2 diabetes</td>
<td>Systematic review and meta-analysis</td>
<td>RT is most likely beneficial in the early stages of type 2 diabetes. There are more benefits for less obese individuals.</td>
</tr>
<tr>
<td>Bessa et al., 2015 (4)</td>
<td>Chronic kidney disease</td>
<td>Review</td>
<td>RT can increase physical capacity, muscular strength, body composition, and quality of life.</td>
</tr>
<tr>
<td>Chung et al., 2016 (8)</td>
<td>Parkinson’s disease</td>
<td>Systematic review and meta-analysis</td>
<td>RT produces increases in muscular strength, balance, and motor symptoms in people with early to moderate Parkinson’s disease.</td>
</tr>
<tr>
<td>Kjølhede et al., 2012 (18)</td>
<td>Multiple sclerosis</td>
<td>Systematic review</td>
<td>RT can increase muscular strength, with smaller but positive effects on functional capacity, balance, fatigue, and quality of life.</td>
</tr>
<tr>
<td>Nelson, 2015 (22)</td>
<td>Fibromyalgia</td>
<td>Review</td>
<td>RT can increase muscular strength and reduce muscle pain.</td>
</tr>
<tr>
<td>Gomes Neto et al., 2013 (11)</td>
<td>HIV/AIDS</td>
<td>Systematic review and meta-analysis</td>
<td>Combined aerobic and RT can improve peak VO2, muscle strength, physical function, and quality of life.</td>
</tr>
</tbody>
</table>
Training Recommendations

It is common for health care providers to recommend that individuals with CKD alter their diet, participate in regular exercise, and reduce their body fat/weight. Thus, an RT program is just one important part of a more comprehensive exercise routine. A full-body RT program should be started with two sessions per week. The program can begin with 1 to 3 sets per exercise, 10 to 20 repetitions, at an intensity of 40% to 60% of 1 RM and progress up to 80% of 1 RM. Blood sugar and blood pressure should be monitored before and after exercise for safety; be sure not to take blood pressure on the arm with a fistula. Research shows that favorable results can occur in as few as 6 weeks (4).

Special Considerations

When working with clients with CKD, certain exercise recommendations should be followed. First, always initiate the RT program at low intensity and progress appropriately in accordance with the client's tolerance (25). Second, it is important to continually monitor the client's symptoms and make sure RT sessions are not undertaken during acute illness. Individuals with CKD may experience bone pain, drowsiness, muscle cramps, shortness of breath, sleep problems, and they may bruise easily. Such symptoms should be monitored regularly, especially to ensure that none are exacerbated in response to exercise. Third, RT done during dialysis (i.e., intradialytic RT) may be a convenient way to begin RT with this population and should be explored; proper supervision will be needed (e.g., dialysis nurse), however. Fourth and finally, patients with renal osteodystrophy have a higher risk of fracture and tendon rupture; therefore, high-impact exercises should be avoided with these patients (25).

MULTIPLE SCLEROSIS

Multiple Sclerosis (MS) is a chronic autoimmune disease that results in the demyelination of the axons in the brain, brain stem, and spinal cord. In the northern parts of North America and Europe, where the disease is most common, the prevalence is approximately one to two per 1,000 persons of the population (12). Patients with MS experience a variety of symptoms that can be attributed to the disease itself as well as inactive lifestyle. These may include a loss of function and feeling in the limbs, a loss of balance/coordination, reduced muscular strength (especially in the lower body), fatigue, and/or depression symptoms (17,27). Because some individuals with MS have lower-body balance impairments and gait problems, aerobic exercise focused on walking or running can be overly challenging. RT, on the other hand, may be a more practical option because it is known to be valuable for and well tolerated by those with MS. Specifically, a wealth of studies have consistently shown RT to induce improvements in muscular strength, muscle size, functional capacity, fatigue, and mental health in patients with MS (18,19,26). For more information and a systematic review of the studies conducted, see Kjølhede et al. (18).

Training Recommendations

Several types of RT equipment are appropriate for use when designing a program, such as elastic bands, free weights, machine weights, and pulley systems. The program should be individualized based on the client's disability level. For example, free weights and machines may be more suitable for high-functioning individuals with MS, whereas resistance bands may be better for low-functioning individuals with MS. In general, it is recommended that exercise professionals implement a full-body routine initiating with 3 sets per exercise of 8 to 15 repetitions at 65% of 1 RM, 2 to 3 times per week. The intensity can be progressed gradually up to 3 sets of 80% of 1 RM. Significant improvements in muscular strength can occur in as few as 8 to 12 weeks (9,19).

Special Considerations

A few guidelines are recommended for working with clients with MS. First, caution is recommended when beginning an RT program because those with MS typically have low muscular strength. To decrease the risk of injury with clients who have significant imbalances in bilateral strength, exercises should be done with or on stable equipment, such as with machines or in a seated position. Second, special supervision is required when working with individuals with proprioceptive deficits or poor coordination (32). Again, stable exercises are recommended, as are slow and controlled movements. Third, the rate of progression of an RT program for those with MS should be done with
caution to prevent overuse injuries or excessive fatigue. It is recommended that the resistance is increased by 2% to 5% when 15 repetitions are completed with no major fatigue in consecutive training sessions (32). If the individual experiences an exacerbation of his or her symptoms, he or she should be encouraged to reduce or abstain from exercise until his or her symptoms improve. Lastly, a frequent concern for exercise with individuals with MS is triggering the Uhtoff phenomenon (i.e., triggering of MS symptoms because of overheating). Because many individuals with MS might demonstrate an impairment in thermoregulatory reflexes (e.g., sweating and vasodilation), it is recommended that exercise professionals pay special attention to room temperature and consider using cooling devices (27). Exercise sessions should be scheduled to avoid the hotter times of the day (i.e., mornings when it is cooler and body temperature is typically lower) (32).

**HUMAN IMMUNODEFICIENCY VIRUS/ACQUIRED IMMUNE DEFICIENCY SYNDROME**

Human Immunodeficiency Virus (HIV) is a virus that progressively destroys the T lymphocyte cells (T cells) by using the CD4+ glycoprotein on the surface of the cell to gain entry into the cell. The HIV disease can progress into Acquired Immune Deficiency Syndrome (AIDS), which is the final stage of infection where the immune system is severely compromised (measured by CD4+ cell count) or the individual becomes ill with opportunistic infections.

It is currently estimated that there are more than 1.2 million adults living with HIV in the United States, with nearly 50,000 becoming newly infected each year (5). With the advancement in HIV medication, the HIV disease is now considered a chronic condition with many negative adverse effects. These may include muscle wasting, insulin resistance, high cholesterol, central adiposity, low bone density, depression, and anxiety. Several studies have examined the benefits of RT with people living with HIV (PLWH), and results show positive and significant effects on each of the aforementioned symptoms (11,29). It should be noted that RT does not have any adverse effects on the individual’s immune system or HIV viral load (24). For more information on RT and HIV, see the systematic review and meta-analysis by Gomes Neto et al. (11).

**Training Recommendations**

RT programs for this population should start with 2 to 3 sets of 8 to 12 repetitions per exercise and body part. Intensity can be 50% to 60% of 1 RM and progress up to 80% based on the individual’s increasing fitness level (24,30). Sessions should occur two to three times per week and can increase in frequency as needed. There is considerable variation among those with HIV/AIDS, with some being able to progress rapidly in their program without any exacerbation of their HIV/AIDS symptoms or medication side effects, whereas others will experience more severe illness symptoms that will interrupt and slow their progression.

**Special Considerations**

Fitness professionals need to continually monitor the general health of clients who live with HIV/AIDS. One of the most prevalent symptoms is fatigue (3), thus, the exercise provider should modify the program when intense fatigue is present during or after exercise. This is specifically important for individuals in a more advanced state of the disease or those who are diagnosed with AIDS (23). PLWH also might have peripheral neuropathy, which may cause problems with balance and coordination. In these cases, modification to the exercise program might be needed to reduce the risk of injuries and falls (23). PLWH also might have comorbid conditions such as type 2 diabetes or cardiovascular disease; therefore, it is important to follow the special recommendations for other chronic diseases when applicable (23). Lastly, it is important to postpone the exercise sessions in case of diarrhea, vomiting, fever, or severe muscle weakness until these symptoms are resolved (13).

**SUMMARY**

This article provides just a brief overview of the current evidence supporting the use of RT as a method to manage and treat the symptoms of several of the most common chronic diseases. Studies repeatedly show that RT can produce meaningful increases in muscle mass, strength, physical function, and quality of life. This occurs across different disease states and provides significant relief for individuals experiencing the debilitating symptoms of their disease. Overall, much more research is needed, and larger, more diverse trials must be conducted. Given the numerous benefits that have already been uncovered, however, and the fact that almost 80% of the population fail to meet the nationally recommended guidelines, it is now time to act. The fitness community, clinicians, and researchers should continue to promote new efforts to find ways to get both apparently healthy and known disease populations engaged in RT.

Disclosure: The authors declare no conflict of interest and do not have any financial disclosures.

Joseph T. Ciccolo, Ph.D., CSCS, is an assistant professor of Movement Sciences in the Department of Biobehavioral Sciences at Teachers College, Columbia University. His primary research interest is on the use of resistance training as a method to prevent and treat chronic disease, with a specific focus on substance use disorder and mental health.

Sanaz Nosrat, M.A., is a doctoral research fellow in the Department of Biobehavioral Sciences at Teachers College, Columbia University. Her research examines the effects of resistance exercise on mental health in people living with HIV.

BRIDGING THE GAP

The numerous health benefits gained from regularly participating in RT are now well known. These benefits may be particularly important for individuals with a chronic disease because reduced muscular strength and decreased physical function are some of the most prevalent disease effects. Current evidence suggests that RT can and should be recommended for those with a chronic disease because it has been shown to be a safe and effective way to alter the disease trajectory and reduce the negative impact of different disease states.