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Making Sense of the Exercise Prescription
By Jon Wallace, Ph.D., FACSM

To continue to provide ACSM certified professionals with important and timely information, ACSM’s Certified News has undergone some changes starting in 2010.

We would like to highlight these changes which include:

• More pages: Each issue of Certified News will now have 16 pages.

• Color-glossy pages. To make the publication more visually appealing, Certified News has a new look, which includes color headshots of all authors. Speaking of authors, ACSM certified professionals are encouraged to submit articles to Certified News. Author guidelines can be obtained by emailing ACSM at trush@acsm.org.

• Features, Wellness, and Columns: Each issue of Certified News will have one health & fitness feature article, one clinical feature article, two wellness articles, a health & fitness column and a clinical column. Wayne Westcott, Ph.D., is the inaugural health & fitness columnist. We are very excited to have Dr. Westcott fill this role! We are also very excited to announce that our inaugural clinical columnist will be Jonathan K. Ehrman, Ph.D. We look forward to kicking off our clinical column by the third issue of 2010. Each issue of Certified News will continue to provide 4 CECs.

• Editorial Board: An editorial review board was added to Certified News in 2009 to further increase the quality of all articles published in Certified News. We feel these changes will enhance the publication and offer relevant and timely topics for any and all ACSM certified professionals. We look forward to continuing providing you with evidence-based information and continuing education.

A HEALTHY SET OF CHANGES FOR YOU

James R. Churilla, Ph.D., M.P.H.
Paul Sorace, M.S.
Co-Editors

We feel these changes will enhance the publication and offer relevant and timely topics for any and all ACSM certified professionals. We look forward to continuing providing you with evidence-based information and continuing education.
It causes a deterioration of a person’s physiological functions, increases the risk of loss of independence and even death. Frailty can be challenging to diagnose, although it has been defined (see Table 1). There are a number of contributing factors for frailty. Older adults are often at risk for becoming frail due to aging, physical disuse and chronic diseases. Obesity is also a potential contributing factor to frailty. Table 2 lists some of the common diseases and disabilities that can lead to frailty.

**Exercise Effects on Frailty**

Regular exercise can have a number of benefits in older, frail persons. These include:
- Improved muscular strength and endurance
- Increased aerobic capacity
- Enhanced joint flexibility
- Improved balance and coordination
- Improved psychological well-being
- Weight loss (if needed)
- Management of chronic diseases/disabilities

These potential benefits can result in enhanced functional abilities, maintained or increased independent living and possibly reversing the condition of frailty. Weight loss and regular exercise/physical activity have been shown to reduce the effects of frailty in obese older adults. Exercise can slow the process of frailty and may even prevent it from developing.

**Exercise Recommendations**

Due to a variety of health conditions that may be present in this population, obtaining medical clearance prior to initiating an exercise program is prudent. Exercise testing should be performed whenever possible to determine what the person’s abilities are prior to beginning an exercise program. Additionally, baseline testing will provide the necessary information for developing an exercise prescription. Some of the exercise tests that can be done include a 6-minute walk to estimate cardiorespiratory fitness, a handgrip dynamometer to measure upper body strength and a sit and reach test to measure flexibility. Resting heart rate, resting blood pressure and body composition also should be measured. If a medical condition such as hypertension or diabetes is present, monitoring blood pressure or blood glucose levels pre- and post-exercise should be performed.

Increasing the functional abilities of the individual should be kept in mind when developing the exercise program. Depending on the individual, different modes of exercise should be considered. Walking is the most common aerobic activity in older adults. Large muscle groups and weight bearing aerobic exercises should be emphasized whenever possible. Non-weight bearing aerobic activities (e.g., cycling, swimming) should be used when weight bearing exercises are too strenuous. Aerobic training should be performed 3 to 5 or more days per week. However, this may not always be possible and a lesser frequency might be all the individual can tolerate during the early stages of an exercise program. The certified personal trainer or health/fitness specialist should encourage increased daily physical activity (e.g., climbing stairs, short walks) to improve aerobic conditioning and functional abilities.

Flexibility training (e.g., static stretching) for frail persons is important to increase joint range of motion, which can increase ease of movement with daily activities. Yoga is a form of exercise that is suitable for many frail persons. DiBenedetto and colleagues’ suggest that yoga can improve hip extension, stride length and pelvic tilt in the eld-
The resistance training program should start at a low level—free weight, machines, and an emphasis on lower body strength. Gradual progression to heavier weights (accompanied by increases in strength) occurs at all ages as a result of regular resistance training. Gradual progression to heavier weights (i.e., more resistance) in the properly risk-stratified individual is just as important in older populations as it is in their younger counterparts. Functional training can improve body awareness and balance, increase neuromuscular coordination, flexibility, ambulation and lower body strength. This is important for frail individuals, particularly in reducing the risk of falls. Examples include a chair sit and stand, one-foot stand, balance board walking and activity-specific exercises (e.g., carrying objects). Other activities such as obstacle courses can enhance reaction time and coordination. Tai Chi, a form of martial arts that enhances balance and body awareness through slow, graceful and precise body movements, has been shown to reduce the risk of falling by approximately 47.5% in frail older adults. Like yoga, Tai Chi is an activity that many frail individuals can perform at their own pace.

Some general exercise recommendations include:
• Properly supervised aerobic exercise 3 to 5 or more days per week; exercise heart rate should not be the focus; use a 5 to 8 on a 1 to 10 rating of perceived exertion scale to measure moderate to vigorous exertion; accumulate 20 to 60 minutes; large muscle group activities (e.g., walking, cycling, swimming).
• Flexibility training 3 to 7 days per week; static stretching to a point of mild tension; all major muscle groups; 15 to 60 seconds in duration.
• Properly supervised resistance training 2 to 3 days per week (nonconsecutive days); use modes (e.g., free weight, machines, elastic bands) that are suitable for the individual; 8 to 10 exercises for the major muscle groups; 1 to 3 sets per exercise; 10 to 15 repetitions.
• Other activities such as yoga, Tai Chi and functional exercises can be performed on a daily or near-daily frequency, based on the abilities of the individual.

Note: Recommendations may need to be modified depending on the individual. These recommendations are based on references.1,2

**Summary**
Frailty is a medical condition that is linked to chronic health problems, disability, reduced functional capacity and loss of independence. Many of the effects of frailty can be improved by participation in a comprehensive exercise program. The certified health and fitness professional must consider the overall health and functional abilities of the individual when designing an exercise program. The benefits of exercise can contribute to a healthier and more independent lifestyle for frail persons.

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**Table 2. Chronic Diseases and Disabilities that Contribute to Frailty**

<table>
<thead>
<tr>
<th>Condition</th>
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<tbody>
<tr>
<td>Hypertension</td>
</tr>
<tr>
<td>Coronary Artery Disease</td>
</tr>
<tr>
<td>Peripheral Artery Disease</td>
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<tr>
<td>Asthma, Chronic Obstructive Pulmonary Disease (COPD)</td>
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<tr>
<td>Arthritis</td>
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<tr>
<td>Osteoporosis</td>
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<tr>
<td>Diabetes</td>
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<tr>
<td>Cancer</td>
</tr>
<tr>
<td>Anemia</td>
</tr>
<tr>
<td>Parkinson’s Disease</td>
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<tr>
<td>Alzheimer’s Disease</td>
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</tbody>
</table>

Adapted from reference 2.

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**About the Author**

Paul Sorace, M.S., RCEP, CSCS*D, is a clinical exercise physiologist for The Cardiac Prevention and Rehabilitation Program at Hackensack University Medical Center in Hackensack, NJ. Paul also is a member of the ACSM Publications Subcommittee and ACSM’s Health & Fitness Summit & Expoission Program Committee. He is co-editor for ACSM’s Certified News and an editorial board member for ACSM’s Health & Fitness Journal.

**References**


In most sports, an athlete must be able to accelerate, decelerate and change directions rapidly with good body control in order to perform well and reduce their risk of injury. For this reason, agility drills are commonly utilized by athletes to enhance their on-field performance. However, these same types of drills can easily be incorporated into training programs for the general fitness population in order to improve performance in recreational and daily activities and help them respond faster in emergency situations. In this article, a few suggestions for implementing these drills into a comprehensive training program for the non-athlete will be discussed.

**Safety**

Prior to beginning any agility training, it is important to make certain the client can safely participate in this type of activity. Clients with orthopedic limitations that affect their ability to balance either statically or dynamically, and those that lack the strength or ability to maintain proper position should refrain from this type of training until they have adequately developed their performance levels. Table 1 lists individual characteristics that would preclude participation in agility training. It also is recommended that before these individuals participate in agility training for the first time, they have at least 2 to 3 months of consistent resistance training experience.

**Drill Selection**

When selecting drills, an emphasis should be placed on improving fundamental movement skills. These skills include locomotor, non-locomotor, manipulative, and movement/body awareness skills (Table 2). These movements are required in all activities in varying amounts, and should be performed at a wide array of speeds, amplitudes, and forces based on the specific population. For instance, the same movements being produced by an athlete in a game or practice situation versus a non-athlete playing with their children or crossing a busy street may require similar intensity and mobility demands. While certain skills are necessary, balance, explosiveness and speed (in both situations), the degree of skill and the magnitude of movement may be different for these movement abilities. Thus, when used as in conjunction with a comprehensive resistance training program this form of training may better prepare individuals for the demands of their daily lives, allowing them to perform activities with greater skill and efficiency. Furthermore, training drills that help individuals develop generalized motor programs aid in the development of greater proprioceptive capabilities. This provides the client with a reference point to evaluate their own movement behaviors in the future and a greater capacity to detect errors in performance and correct them via augmented musculoskeletal feedback.

In general terms, agility drills can be classified as closed or opened. Closed drills are preprogrammed drills, performed in a predictable and unchanging environment. Initially, closed drills, with minimal force production requirements, such as most agility ladder drills or cone drills, should be performed, progressing to more complex drills later, such as those that are non-programmed, or open. An individual attempting to mirror the actions of another individual or drills that require a person to respond to an auditory cue before selecting a specific movement pattern. The focus of closed drills is primarily on proper movement mechanics, proper body position and simple changes of direction. Clients should be encouraged to perform drills only at speeds that allow proper execution of the targeted movements. Once the technique has been mastered, the client may then increase their speed of movement.
### Table 2: Fundamental Movement Skills

<table>
<thead>
<tr>
<th>Locomotor</th>
<th>Non-Locomotor</th>
<th>Manipulative</th>
<th>Movement Awareness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walking</td>
<td>Twisting</td>
<td>Throwing</td>
<td>Spatial</td>
</tr>
<tr>
<td>Running</td>
<td>Turning</td>
<td>Catching</td>
<td>Awareness</td>
</tr>
<tr>
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<td>Balancing</td>
<td>Kicking</td>
<td>Kinesthetic</td>
</tr>
<tr>
<td>Hopping</td>
<td>Jumping</td>
<td>Punting</td>
<td>Awareness</td>
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<tr>
<td>Sliding</td>
<td>Landing</td>
<td>Dribbling</td>
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<tr>
<td>Chasing</td>
<td>Stretching</td>
<td>Striking</td>
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<td>Fleeing</td>
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<tr>
<td>Dodging</td>
<td>Pulling</td>
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<tr>
<td>Galloping</td>
<td>Rolling</td>
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</table>

Following technique mastery, the exercise professional may now consider the implementation of open drills to the client’s agility program. This can be easily done by adding some form of sensory stimuli (visual, auditory or kinesthetic) to a traditional closed training drill. For instance, tossing a client a ball to catch or requiring them to perform various biomotor skills based on the trainer’s command. These advanced drill progressions require the client to adapt their newly learned skills based on a novel situation, similar to real life, rather than simply performing a preprogrammed pattern or drill.

Additionally, the client will develop certain perceptual and decision making skills that cannot be learned as effectively during closed training drills. Table 3 shows some examples of closed, semi-programmed, and open agility drills.

### Modifications

When integrating agilities into a client training program it is important to modify each specific drill based on the clients’ current skills and abilities. As previously stated, most non-athletes will not be required to make high intensity cutting movements with large amplitudes of movements at maximal speeds. Therefore, when designing an agility-training program for the general fitness client, maximum effort and speed of movement is not necessarily the focus of training. Rather it should be performing the appropriate movement patterns through the desired ranges of motion in a safe and effective manner. Since these individuals may not be athletes, agility training programs should be modified by starting and progressing more slowly. Furthermore, adjusting the mobility and flexibility demands of a drill also allows clients to work at their own level versus trying to accomplish the movement patterns expected of elite athletes.

### Conclusion

Agility training can provide fun and variety to a traditional training program aimed at improving health and fitness. Enhanced agility also may help improve performance in basic activities of daily living, and even assist in the prevention of some types of injuries, especially falls. However, it is important to remember that for individuals in the general fitness population appropriate modifications to accommodate their current levels of health and skill related fitness must be made to promote safety. It is recommended that agility drills be progressed slowly with an emphasis on technique mastery; before progressing the speed of movements and adding complex variations, such as open, or non-programmed agility training.

### About the Author

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### References

It is not uncommon for patients to begin phase II cardiac rehabilitation without a recent exercise test. According to a survey by Andreuzzi et al., 60% of programs do not require an exercise test prior to program entry. However, there are few evidence-based recommendations for establishing a target heart rate (HR) in patients with heart disease in the absence of an exercise test. ACSM’s Guidelines for Exercise Testing and Prescription, 8th edition 1 improves on prior editions by providing some guidance for these situations (see Table 9.1, p. 214). These guidelines will be refined as more evidence-based data become available. This article will discuss challenges faced by the exercise physiologist when prescribing exercise without an exercise test.

PRE-PROGRAM EXERCISE TEST

Although the American College of Cardiology and the American Heart Association recommend a pre-program, symptom-limited exercise test in all patients in which cardiac rehabilitation is indicated, 9 the necessity has been questioned. McConnell et al. 12 concluded that patients completing 12 weeks of cardiac rehabilitation can be safely progressed and demonstrate similar improvements in caloric expenditure, independent of whether they have a pre-program exercise test. It should be kept in mind, however, that an exercise test provides more than just data for an exercise prescription. Following a cardiac event or procedure, an exercise test also provides information on residual ischemia, risk stratification, and functional capacity. 11 If implemented before and after an exercise training program, changes in functional capacity can be quantified which can be useful for program outcomes and patient motivation.

REST PLUS 20

When an exercise test is not available, clinicians will typically set a target HR based on the patient’s resting HR plus 20 beats per minute (bpm; “rest plus 20”), or they will guide exercise based solely on ratings of perceived exertion (RPE). Establishing a target HR using rest plus 20 was originally intended to be a temporary recommendation following hospital discharge until the patient had a symptom-limited exercise test in conjunction with an outpatient cardiac rehabilitation program. In some programs it is viewed as a safe and conservative initial training intensity in the absence of an exercise test. Practical experience, however, suggests that some patients may not undergo an exercise test...
while in cardiac rehabilitation. Some of these patients will have had a pharmacologic stress test that was ordered by a physician for clinical purposes. The absence of exercise test data presents a challenge when defining the exercise intensity for an individual patient.

Joo et al.1 reported that, on average, rest plus 20 corresponded to 42% of VO2 reserve among patients entering a phase II cardiac rehabilitation program. Brawner et al.1 reported the relative percent HR reserve associated with rest plus 20 in patients with ischemic heart disease (Table 1). Although rest plus 20 appears to be a “good fit” for some, it may result in suboptimal training intensity in many.

In the HF-ACTION trial (Heart Failure: A Controlled Trial Investigating Outcomes of Exercise Trainina), we learned that various rest plus 20 procedures were being used across exercise centers. It was not uncommon for centers to recalculate this each day. Neither ACSM nor the American Association for Cardiovascular and Pulmonary Rehabilitation (AACVPR) provide specific procedures on the calculation and use of rest plus 20.

In light of this, the following is presented as a framework to establish program procedures for the use of rest plus 20 when an entry exercise test is not available. First, identify a baseline resting HR in an upright position (seated or standing) after two minutes of quiet rest on three separate days. In addition to its use in establishing a target HR, it also will provide a useful baseline resting HR to help identify patients during subsequent exercise sessions who may not have taken, or had a change in, their beta blockade. Patients are then provided a “target HR range” based on their resting HR plus 15 to 25 bpm. This provides patients a 10 beat range that they can use consistently.

**RATINGS OF PERCEIVED EXERTION**

Per ACSM’s recommendations, a target HR range based on rest plus 20 can be gradually titrated to higher intensities based on RPE, signs, and symptoms.3 Although RPE scales are frequently cited as valid tools to guide exercise intensity, specifics on how to implement them are rarely outlined. In addition, discordance exists between RPE and target HR during exercise in many patients.3 However, in healthy adults, the validity of RPE has been shown to improve when feedback on their intensity (e.g., too high or too low) is provided during three initial training sessions.4 Caution should be used when depending solely on RPE.

Another perceived exertion-related tool that may be useful is the talk test. This is the highest exercise intensity at which the person feels they can talk comfortably. The talk test has been shown to be a good estimate of the exercise intensity associated with the ventilatory-derived anaerobic threshold7 and the ischemic threshold.7 When patients with heart disease were asked to exercise on a track at the fastest pace that still allowed them to talk comfortably, 59% chose a pace that was within 50-85% of HR reserve; 14% chose a pace above this range and 27% were below.7 Similar to RPE, the talk test results in inter-individual variability; however, if a patient feels they cannot talk comfortably, they are likely exercising too hard.

**A CASE STUDY**

The following case study illustrates the challenges of depending solely on RPE. A 55-year-old male with heart failure was referred to cardiac rehabilitation. Based on an exercise test, his peak HR was 115 bpm and the target HR range based on 60-70% HR reserve was set at 89 to 102 bpm. During the first few exercise sessions he exercised at a HR of 105 bpm and a RPE of 10 (Borg 6 to 20 scale). Because of the low RPE, the exercise staff decided to forgo using HR and guide exercise solely by RPE. He then began to exercise at a HR of 115 bpm and a RPE of 14. Following these exercise bouts he reported extreme fatigue and subsequently missed several visits. When he returned to exercise he was instructed to keep his HR within his previously defined target range and he tolerated exercise much better without complaints of excessive post-exercise fatigue. This individual did not interpret his RPE well. Optimal exercise staff would have looked for reasons the target HR range and RPE were discordant (e.g., patient not taking medications, change in beta blockade). If none were identified, then the importance of the prescribed target HR range should have been emphasized and the patient educated on the RPE that corresponds with this range. Alternative subjective methods, such as the talk test, also may have been useful.

**EXERCISE TESTS VS. PHARMACOLOGICAL TESTS**

It is not uncommon for patients in phase II or maintenance-type cardiac rehabilitation programs to undergo pharmacological stress tests (e.g., dobutamine, adenosine) instead of a symptom-limited exercise test. A common question that arises is, can information from these tests be used to develop an exercise prescription? ACSM provides options for this situation; however, this information does not address all possible circumstances.

A symptom-limited exercise test assesses ischemia by increasing myocardial oxygen demand through increases in HR and myocardial contractility. Ischemia occurs when myocardial blood supply cannot match the myocardial demand for oxygen. An exercise test also is used to assess functional capacity (e.g., peak VO2, peak watts). Functional capacity is the focus of the exercise intensity prescription with a typical goal of 50-85% of functional capacity (i.e., VO2 reserve). Because of the linear relationship between HR and VO2 (or watts), HR serves as a useful surrogate or estimate of a target work rate.

On the other hand, dobutamine stress tests assess ischemia without exercise by increasing myocardial oxygen demand through medication-induced increases in HR and myocardial contractility. However, they do not assess functional capacity. No studies have shown a useful relationship between HR responses observed during dobutamine and exercise tests. For these reasons the usefulness of this information is limited. If a dobutamine test is positive for ischemia, the rate-pressure product (HR x systolic blood pressure) at the ischemic threshold could be used to...

Cardiac Rehabilitation (continued on page 12)
In a recent study, more than 2,000 older adults aged 60 to 86 were evaluated to determine who was more likely to be alive at the conclusion of the study. In the group that achieved greater longevity, one factor was significantly more important than any other: Are you curious as to what that factor was? Knowing about this factor also may help you enjoy a long life.

In his new book, *Curious?* Todd Kashdan, professor of psychology at George Mason University, reveals that the all-important ingredient to longevity in this study was curiosity. He points out: “Those who were more curious at the beginning of the study were more likely to be alive at the end of the study, even after taking into account age, whether they smoked, the presence of cancer or cardiovascular disease, and all the rest of the usual markers.” While he acknowledges that declining curiosity may be a sign of declining health and neurological illness, Kashdan believes that “there are promising signs that enhancing curiosity reduces the risk for these diseases and even the potential to reverse some of the natural degeneration that occurs.”

According to Kashdan, curiosity has a powerful effect on well-being and thriving. It is incumbent upon coaches to understand precisely what it is, its benefits for psychological and physical health, and how to best facilitate curiosity in our clients.

**What is Curiosity?**

Curiosity has received more than a century of psychological study and many definitions have been offered over the years. What all definitions have in common, however, is that curiosity is (1) a motivational state; (2) approach-oriented and; (3) associated with exploration. A good working definition of curiosity, offered by Kasdan, is: “The recognition, pursuit, and intense desire to explore novel, challenging, and uncertain events.”

**We are Wired to Be Curious**

Psychologists who subscribe to the intrinsic motivation tradition believe that interest or curiosity arises from the operation of evidence-based primal needs, such as competence, autonomy, and relatedness. Scientists also have focused on physiological explanations by studying curiosity patterns in the brain. They have discovered that the chemical dopamine is released from the striatum in the brain at a greater rate when a person pushes beyond the boundaries of the known, facing challenges, novelty, and uncertainty. There is also a greater release of dopamine when there is personal importance or meaning in the novel situation. This surge of dopamine prepares us to capitalize on these experiences by focusing our attention on the present, mobilizing our energy resources, and initiating approach movements.

**What purpose does curiosity serve?**

Curiosity motivates us to be receptive to the happenings of the present moment, to be immersed in, explore, and investigate our surroundings. In the process, curiosity stretches our knowledge and skills, enabling us to meet new people and learn new things. In the long term, curiosity builds competence.

**Curiosity leads to well-being**

In cross-sectional studies, researchers who measured levels of curiosity consistently report a greater level of psychological well-being. Regarding physical health, as was previously mentioned, older adults with greater curiosity have been found to live longer over a 5-year period.

Kashdan admits that the mechanisms linking curiosity to physical health, illness, and mortality are not yet fully understood. He offers several intriguing explanations for why highly curious people may live longer, such as “the process of neurogenesis stemming from continued novel and intellectual pursuits, a non-defensive willingness to try unfamiliar yet science-based health strategies, or the psychological benefits of evaluating stressors as challenges being guided by exploration as opposed to avoidance.” He suggests that “an examination of cognitive, behavioral, social, and biological levels of analysis will lead to promising avenues of when and how curiosity leads to desirable outcomes.”

**In Coaching**

Perhaps most important for coaching, curiosity promotes new ways of thinking and acting. Perspective change is the bread and butter of coaching. Kashdan writes, “People who feel curious challenge their views of self, others, and the world with an inevitable stretching of information, knowledge and skills.” Coaches know that this is an important route to meaningful change.

Curiosity also helps in goal fulfillment. Kashdan and Steger (2007) studied people over the course of 21 days and found that people who were highly curious were more likely to persist in attaining their goals, even in the face of obstacles, and were also more likely to express gratitude to their benefactors. This led to higher levels of perceived meaning and purpose.

Curiosity also can help our clients build neurological connections as they explore new experiences and seek out new information.

Finally, according to Kashdan, curiosity leads to more efficient decision-making and helps us grow in our ability to see the relationships among disparate ideas, leading to more creativity.

**Conclusion**

It is not surprising that curiosity and achieving our best life have been found to be linked.
A comprehensive research review titled, “Medicare’s search for effective obesity interventions: Diets are not the answer” stated that dieters who manage to sustain a weight loss are the rare exception, rather than the rule. Dieters who gain back more weight than they lost may very well be the norm… (page 230).

If diets don’t work what does? Most of us would agree that regular aerobic activity is an appropriate recommendation for increasing energy expenditure, and indeed it is. However, during the past two decades, there has been considerable interest in the role of resistance exercise for enhanced fat loss due to its positive impact on resting energy expenditure.

In 1994, two landmark studies were published regarding the effects of standard strength training on resting metabolic rate in older adults. Campbell et al. at Tufts University conducted a carefully controlled study in which subjects ate measured meals and performed no physical training except for three sets of four resistance exercises, three days each week. After 12 weeks on this basic strength training program, the participants increased their lean weight by about three pounds and their resting metabolic rate by about 7%. This represented approximately 100 additional calories burned at rest on a daily basis.

That same year, Pratley and associates conducted a similar study with senior men. The research subjects performed relatively brief strength training sessions (one set of 14 resistance exercises) three days each week for 16 weeks. At the conclusion of the strength training program, the participants increased their lean weight by 3.5 pounds and their resting metabolic rate by about 8%. This represented approximately 120 additional calories burned at rest on a daily basis.

A few years later, Hunter and colleagues at the University of Alabama at Birmingham conducted a longer-term study on strength training and resting energy expenditure. The senior subjects performed two sets of 11 resistance exercises, three days a week for 26 weeks. After six months of training, the program participants increased their lean weight by 4.5 pounds and their resting metabolic rate by about 7%. This represented approximately 100 additional calories burned at rest on a daily basis.

While it appears that regular resistance exercise results in a higher resting metabolism, it is less clear what mechanisms are responsible for this increase. Although one factor may be the additional lean weight (much of which is water), this most likely accounts for a relatively small percentage of the rise in resting metabolic rate. So what is the best explanation for the 7 to 8% elevation in resting energy expenditure experienced by the subjects in these strength training studies? A recent study conducted at Wayne State University suggests muscle repair and remodeling processes that follow a physically demanding strength training session may be largely responsible for the resting metabolic increase.

In 2008, Hackney and associates administered a
single session of resistance exercise to eight untrained and eight trained individuals, all of whom performed eight sets of six repetitions for each of eight standard exercises. The untrained participants experienced a consistent 9% elevation in resting energy expenditure at 24 hours, 48 hours, and 72 hours after their strength training session. The trained participants’ resting energy expenditure was 4% above normal 24 hours post-workout, 10% above normal 48 hours post-workout, and 8% above normal 72 hours post-workout. The trained exercisers averaged an 8% elevation in resting energy expenditure for three days following their strength training session.

Based on these findings, it would appear that the increased resting metabolic rate associated with resistance exercise has less to do with additional lean weight and more to do with energy requirements for remodeling muscle tissue that has experienced training-induced microtrauma. Assuming that one performs strength exercise every two or three days, resting energy expenditure may remain elevated throughout the training program due to ongoing muscle microtrauma and tissue remodeling processes. If this is the case, the 7 to 8% increase in resting metabolic rate measured at the completion of the 12-week, 14-week, and 26-week strength training programs presented above most likely began after the initial exercise session and continued throughout the study duration.

If regular resistance exercise can induce a 7% increase in resting energy expenditure, trainees with a resting metabolic rate of 1500 calories per day would use an extra 100 calories a day or (potentially) an additional 36,000 calories per year. Other things equal, this could possibly result in a 10-pound fat loss over the course of one year. Unlike dieting alone which leads to lean weight loss and metabolic decrease, strength training results in lean weight gain and metabolic increase. It would therefore seem that strength exercise may offer a more sensible and successful means than dieting alone for attaining and maintaining desirable bodyweight and body composition.

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References

Coaching News (continued from page 9)

Imagine life without curiosity. It would be a grim, boring existence.

Our mission as coaches should be three-fold. First, we should be curious about curiosity, encouraging research in our field. Second, we should model curiosity for our clients in our powerful questions, active listening, and perceptive reflections. Third, we should facilitate curiosity, helping clients develop and use their curiosity to enhance their lives and their health, so that they can live longer, more fulfilling lives.

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BJ Richstone, Psy.D., is a Harvard-trained clinical psychologist and Certified Professional Coach. She has a Doctorate in Ministry and is a published spiritual author. She has appeared nationally on radio and television.

Margaret Moore (Coach Meg), MBA, is the founder & CEO of Wellcoaches Corporation, a strategic partner of ACSM, widely recognized as setting a gold standard for professional coaches in healthcare. She is co-director, Institute of Coaching, at McLean Hospital/ Harvard Medical School. She co-authored the ACSM-endorsed Lippincott, Williams & Wilkins Coaching Psychology Manual, the first coaching textbook in healthcare. (www.wellcoaches.com • www.institutecoaching.org • www.coachmeg.com • coachmeg@wellcoaches.com)

References
Cardiac Rehabilitation (continued from page 8)

limit exercise intensity. To do this, the clinician would monitor HR and blood pressure during a few exercise sessions to identify the highest work rate at which the patient remains below the rate-pressure product associated with the ischemic threshold identified during the dobutamine test. The resultant target HR range would then be set at 10 to 15 beats below this corresponding HR. Although this recommendation is based on sound physiologic principles, it should be noted that the validity of this method has not been studied.

Vasodilator stress tests (e.g., adenosine, persantine) depend on medication-induced coronary artery vasodilatation and assess ischemia by altering blood supply through the concept of “coronary steal.” During this test, normal coronary arteries dilate to a greater extent than arteries with atherosclerosis and “steal” blood supply. Some testing laboratories include low levels of steady rate exercise during the test, but this should not be mistaken for exercise test data. Since these tests do not increase myocardial oxygen demand (HR and blood pressure response are flat) and do not assess functional capacity, they provide little, if any, useful information for the exercise prescription.

Finally, when a pharmacological stress test is negative, ACSM’s current recommendations state “if good HR increase: 70 to 85% HRmax.” It is not clear if this is referring to the highest HR observed during the test or a predicted maximum HR. As was discussed above, the HR response during pharmacological testing is not reflective of the HR response that would be observed during an exercise test and is not useful for the exercise prescription. In addition, maximum HR predicted from equations, such as 220-age, is not a useful tool in older patients, patients with cardiovascular disease, and those on beta blockade therapy. The mechanisms underlying the variability associated with predicted maximum HR are not clear, but may be due variations in genetics, autonomic function, and beta receptor activity.

In conclusion, defining exercise intensity without a recent exercise test can be challenging. Further research to validate methods in these situations is needed. In this absence, sound physiological principles should guide clinical decisions. Towards this end, the knowledge, experience, and skills of the clinical exercise physiologist are important and contribute to the “art” of exercise prescription.

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REFERENCES
The first step in developing an exercise prescription is to determine the client’s goals. Goals must be realistic, measurable, and achievable. By applying behavioral change theory, such as the theory of self-efficacy and the readiness for change model, the exercise professional involves the client in the goal-setting process. Asking about a client’s self-efficacy (self-confidence) to make lifestyle changes regarding exercise, determining the barriers to exercise that may be encountered, and helping the individual make a plan to address those barriers, increases ownership in the exercise plan and may help the client adhere to the program.

When the goals have been determined, apply the FITT principle to address those goals. The FITT principle stands for Frequency, Intensity, Time (duration), and Type (mode) of exercise; it provides a simple way to outline the components of any exercise prescription. Whether a client wants to improve cardiorespiratory fitness or gain muscular endurance, whether he/she wants to lose weight, recover from heart surgery, or train for the Olympics, the exercise professional can use the acronym “FITT” to delineate an appropriate exercise prescription.

The first three components must actually be considered together as the total volume of physical activity will have an impact on the health/fitness benefits achieved. When frequency (F) of exercise is increased, it may be prudent to cut down on the intensity (I) or the time (T) spent exercising. Alternatively, when intensity (I) is low, a person may need to exercise for a longer duration (T) to reach their specific goals. Considering the fourth component, type (T) of exercise, the principle of specificity of training informs us that the mode of activity needed for cardiorespiratory benefits is aerobic; resistance training exercises will be necessary for improvements in muscular fitness; and stretching exercises are needed for improving flexibility. For each aspect of overall fitness, there are many activities to choose from, some requiring little to no skill, others requiring high levels of fitness. Encourage the client to choose an appropriate mode (or modes) of exercise based on their goals, access to facilities and equipment, current health status, physical ability, and personal preference.

For health benefits, recent guidelines specify that healthy adults between the ages of 18 and 65 years should participate in at least 30 minutes of moderate-intensity aerobic activities on five days per week, or 20 minutes of vigorous aerobic activity on three days of the week, or some combination of moderate- and vigorous-intensity aerobic activity. Moderate- and vigorous-intensity activities are described as equivalents to a brisk walk or jog respectively, and by the person’s heart rate and breathing response to exercise. The guidelines also specify that the 30
minutes of moderate-intensity activity may be accumulated in 10-minute bouts if necessary. Moreover, this group also is encouraged to include two non-consecutive days of activity which promote improvements in muscular fitness/strength. A separate document was presented to clarify the recommendations for adults over the age of 65, and for those aged 50 to 64 years with various health limitations.

For cardiorespiratory fitness, a minimum threshold of frequency, intensity and duration of aerobic exercise must be attained before benefits are achieved, although the appropriate dose of exercise can vary from one individual to the next. In general, the recommended frequency is three to five days/week, intensity may vary from 40% to 85% of one’s VO₂ reserve (VO₂R), and duration may be from 20 to over 60 minutes. In some cases, the volume of exercise is specified by calories (kcal) expended in a week. Clients also may need to be reminded that while exercise is good, more is not always better; an excessive amount of exercise can increase the risk of an overuse injury.

Intensity is the component of the exercise prescription that usually needs most clarification. Some clients feel that exercise is a “no pain, no gain” experience, and it is up to the exercise professional to dissuade that line of thinking. Intensity can be prescribed in terms of heart rate (HR), aerobic capacity (VO₂), metabolic equivalents (METs), or perceived exertion (RPE). These are well-described in the eighth edition of the ACSM Guidelines for Exercise Testing and Prescription. Using HR as a gauge of intensity is very helpful if the client can accurately find his/her pulse or has access to a HR monitor and he/she is not taking any medications that impact HR. Intensity prescriptions using percentage of VO₂R or METs may be helpful if they can be translated into specific activities or to more precise workout levels on a specific piece of equipment. However, unless the client has participated in a maximum-effort graded exercise test, any prescription using HR, VO₂R, or MET level is only an estimate. Conversely, if the client can be made to understand how to use the RPE scale appropriately, someone who exercises at a level of “fairly light” to “somewhat hard” or “hard” is usually exercising at an appropriate HR, VO₂R or MET level.” It is up to the exercise professional to determine which explanation of exercise intensity will be most helpful to each individual client.

The acronym SENSE (Start Exercise Nice and Slow… Everytime) can be used to explain that every exercise training session should include a warm-up period along with the conditioning phase, stretching, and cool-down activities. In addition, the client whose exercise routine has been interrupted for any extended time needs to be reminded that is important to restart slowly and not expect to pick up where one left off.

In summary, while the client does not need to understand all the scientific principles of exercise, the exercise professional must be aware of all of these guidelines to help each individual determine an appropriate prescription that will make “SENSE” and “FITT” their unique needs.

About the Author

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References:

SELF-TEST #1 (1 CEC): The following questions were taken from “Exercise Recommendations for the Frail Population” published in this issue on page 3.

1. Which of the following is NOT a criteria for frailty?
   a. Feeling of exhaustion
   b. Depression
   c. Low physical activity
   d. Slow walking speed

2. Obesity is a potential contributing factor to frailty.
   a. True
   b. False

3. Sarcopenia can most effectively be countered with:
   a. Aerobic training
   b. Flexibility training
   c. Resistance training
   d. Yoga and Tai Chi

4. Resistance training for frail persons should be performed using _____ repetitions per set.
   a. 6-10
   b. 8-12
   c. 12-15

5. _____ is the most common aerobic activity in older adults.
   a. Walking
   b. Cycling
   c. Swimming
   d. Rowing

SELF-TEST #2 (1 CEC): The following questions were taken from “Agility Training for the General Population” published in this issue on page 5.

1. ________ drills are preprogrammed drills, performed in a predictable and unchanging environment.
   a. Open
   b. Semi-open
   c. Closed
   d. Skill

2. Agility training should not be performed by:
   a. those who are pregnant
   b. those who are overweight
   c. those with more than 4 to 6 months of resistance training experience
   d. all of the above

3. Drills that are partially preprogrammed and partially random are classified as ________ drills.
   a. Open
   b. Semi-programmed
   c. Closed
   d. Skill

4. According to the author, prior to engaging in agility training clients should have approximately _______ to _______ months of consistent resistance training experience.
   a. 1-2
   b. 2-3
   c. 3-4
   d. 4-6

5. According to this article, agility training may be beneficial to the general population for:
   a. Improving proprioceptive capabilities
   b. Injury prevention
   c. The development of motor programs
   d. All of the above

SELF-TEST #3 (1 CEC): The following questions were taken from “Prescribing Exercise in Cardiac Rehabilitation Without an Exercise Test” published in this issue on page 7.

1. ACSM’s Guidelines for Exercise Testing and Prescription, 8th edition does not address the determination of target heart rate in patients with heart disease in the absence of an exercise test.
   a. True
   b. False

2. According to the article, which of the following is NOT a typical reason to conduct a symptom-limited exercise test in patients with heart disease entering cardiac rehabilitation:
   a. Identify residual ischemia
   b. Assess breathing reserve
   c. Risk stratification
   d. Quantify functional capacity

3. According to the article, what is the anticipated percent of heart rate reserve when exercise intensity is established using rest plus 20 in patients with heart disease?
   a. <50%
   b. 50-60%
   c. 60-70%
   d. 70-80%

4. Per ACSM’s Guidelines for Exercise Testing and Prescription, 8th edition, which of the following is NOT suggested as a guide to titrate exercise intensity?
   a. Rating of perceived exertion
   b. Signs
   c. Symptoms
   d. Resting heart rate

5. According to the article, a vasodilator stress test (e.g., adenosine):
   a. Is useful for establishing an exercise target heart rate range
   b. Is useful for establishing an exercise target heart rate range if exercise is included
   c. Is useful for establishing an exercise intensity based on perceived exertion
   d. Is not useful for establishing an exercise target heart rate range

SELF-TEST #4 (1 CEC): The following questions were taken from “Making Sense of the Exercise Prescription” published in this issue on page 13.

1. The behavioral change theory that address self-confidence to exercise is:
   a. The self-esteem theory
   b. The stages of change model
   c. The self-efficacy theory
   d. The theory of self-reliance

2. For a client who has not performed a maximal exercise test, the most accurate marker of exercise intensity may be:
   a. Heart rate
   b. VO2
   c. MET level
   d. Rate of Perceived Exertion

3. When prescribing moderate-intensity exercise for health benefits, the recommended duration and frequency of exercise is:
   a. 20 minutes, 2 times per week
   b. 30 minutes, 5 times per week
   c. 40 minutes, 4 times per week
   d. 60 minutes, 5 times per week

4. The acronym SENSE can be used to help remind a client to include start slowly:
   a. During an individual exercise session
   b. When beginning an exercise program
   c. When restarting an exercise program after a period of inactivity
   d. All of the above

5. A thorough explanation of all of the scientific principles behind an exercise prescription will help a client adhere to an exercise program.
   a. True
   b. False
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