

FUNCTIONAL AGING AND EXERCISE

Learning Objectives

1. Describe the Hierarchy of Physical Function
2. Describe the Nagi Model of Disablement
3. List the components of function
4. Recall aerobic exercise guidelines for older adults and how to monitor intensity
5. Recall resistance exercise guidelines for older adults

Understanding Function

The functional capabilities vary significantly within the mature population which is significantly heterogeneous. An individual's chronological age is only a rough guideline as to their functional age (i.e. their capabilities). Although functional capacity generally decreases with advancing age the degree and rate of decline are highly variable so that individuals of the same age can exhibit highly variable levels of function ranging from the physically dependent to elite athletes. Therefore, an 80 year old may be able to outperform someone 10 or 20 years younger. Dr. Waneen Spirduso described five functional categories of older adults (Spirduso et al 2005) that is helpful to understanding the heterogeneity that exists within this group of individuals. FAI has expanded this to eight categories in order to tailor exercise programs more effectively.

Hierarchy of Physical Function

1. Elite: The physically elite have achieved the highest level of physical function and are often more fit than sedentary individuals that are decades younger. Compared to others

their age and gender the elite score in the top 1% of scores. They train rather intensely on a regular basis and typically compete in tournaments with others their age such as Senior Olympics, Masters Tournaments, or in other general events. Due to their high levels of activity (and usually excellent dietary habits), they are also in excellent health.

2. Fully Fit: Fit older adults exercise primarily for their health and well-being rather than for competition and do so on a regular basis. Their exercise program is typically less intense and of shorter duration than the physically elite, and while they may still include sport-specific training in their routine, it is typically more for enjoyment than for true competition. The fully fit also enjoy higher than average levels of health and are typically estimated to be much younger than their chronological age by their peers. Fully fit individuals exceed the capabilities of others their own age in almost every category of fitness although they do not reach the performance levels of being considered elite. When considering age and gender matched performance norms they will score in the top

5-10% across the board.

3. Semi-Fit: This group of older adults differs from the fully fit individuals by only having one or two areas of fitness that excel rather than excelling in most or all of the areas. This is usually due to the fact that they exercise using only one modality. For example, swimmers may have really high levels of cardiorespiratory fitness but lack muscle strength and balance which may be at critically low levels.

4. Higher Independent: These individuals are physically active but may or may not exercise on a regular basis. If they do exercise it is typically minimal, of lower intensity and of limited variability. They are typically of average health, without any serious debilitating disease (although they may have chronic diseases) and fully functional. In general, individuals in this category are much more diverse compared to their more fit counterparts with scores ranging from average to somewhat above average.

5. Lower Independent: Individuals that are minimally active or completely sedentary and score below average on most functional fitness assessments fall into this category. They may or may not have more serious chronic conditions compared to their higher independent counterparts but are at much higher risk of failing health and functional loss due to their lack of physiologic reserve.

6. Pre-Frail: This is a critical transitional stage between independence and frailty that is characterized by meeting 1-2 of the 5

frailty criteria listed below (frail individuals must meet 3 or more). These individuals score lower than average on all functional fitness assessments and are on a steep downward functional trajectory towards frailty and dependence if the appropriate interventions are not made. Due to their low physical ability levels it is difficult for them to engage in instrumental activities of daily living (IADL's); therefore, they continue to become less and less active and engaged in life (occupational, social, recreational). This can quickly become a downward spiral; less activity leads to reduced physical abilities which leads to less physical activity and so on.

7. Frail: According to Campbell and Buchner (1997) frailty is a "condition or syndrome that results from a multi-system reduction in reserve capacity to the extent that a number of physiological systems are close to, or past, the threshold of symptomatic clinical failure. As a consequence the frail person is at increased risk of disability and death from minor external stresses." The criteria for diagnosing frailty include three or more of the following characteristics: 1) Unintended weight loss (at least 10lbs or >5% body weight in prior year); 2) Muscle weakness (grip strength in lowest 20% for gender and BMI; 3) Exhaustion or poor endurance; 4) Slow gait speed (typically a usual gait speed of less than 0.8m/s); and 5) Low levels of physical activity. Sarcopenia is a central feature of frailty and is of critical importance. Frail older adults can perform most or all basic activities of daily living (BADL's) such as bathing, dressing, transferring, toileting, and feeding although

they are typically unable to perform all of the instrumental activities of daily living (IADL's) such as shopping, doing laundry, preparing meals, and doing light housework. Since many frail older adults have difficulty ambulating the use of assistive devices (canes, walkers, and rollers) is common. Frail older adults are at high risk of suffering from an injurious fall, are more likely to have osteoporosis, and typically qualify for physical therapy services due to their condition.

8. Dependent: These individuals are unable to perform all of the BADL's and are dependent on others and/or physical

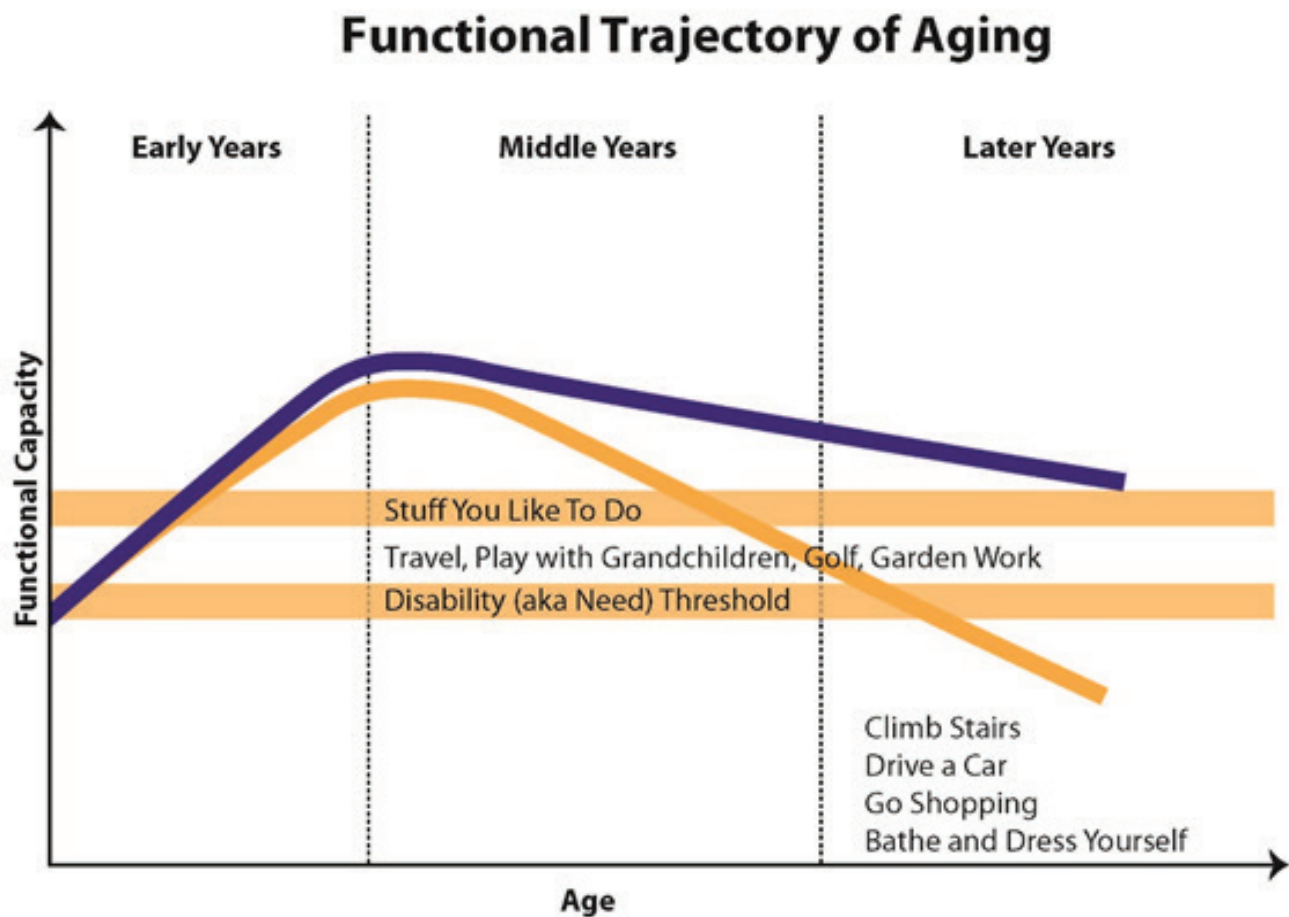
aids (e.g. canes, walkers, wheelchairs) to complete their daily tasks. The extent of their physical disability is determined by the degree to which they cannot perform BADL's and IADL's. Disability rates increase with chronological age and are higher in females, African Americans, and the poor. Individuals can move in and out of disablement such as following a stroke (where function is lost) and during rehabilitation (where function is often regained). It is unlikely that fitness professional will train dependent older adults unless they work in a nursing home or assisted living facility.



While it is easier to simply classify individuals into one category or another the truth is that these categories represent a continuum of functional capacity. Individuals may move back and forth between them depending on their current situation. For example, a physically fit individual who exercises regularly may experience some health problems or family issues that prevent him/her from training for an extended period of time. The lack of physical activity leads to a detraining effect so that they would now be considered independent rather than physically fit. The reverse could also happen in which an independent individual trains vigorously

to move up to the physically fit or even elite categories. It is helpful to recognize where individuals are on this continuum but maybe even more important to understand their aging trajectory, that is, in which direction they are heading and how rapidly (Figure 3). As people get older the tendency is to decline in functional ability (a downward trajectory) due to the effects of primary and secondary aging. The downward trajectory can be exacerbated by disease processes. If functional capacity declines to the point to where the individual can no longer fulfill their socially defined roles such as employee, caretaker or volunteer, then they are considered to be physically disabled.

FIGURE: TRAJECTORIES OF AGING

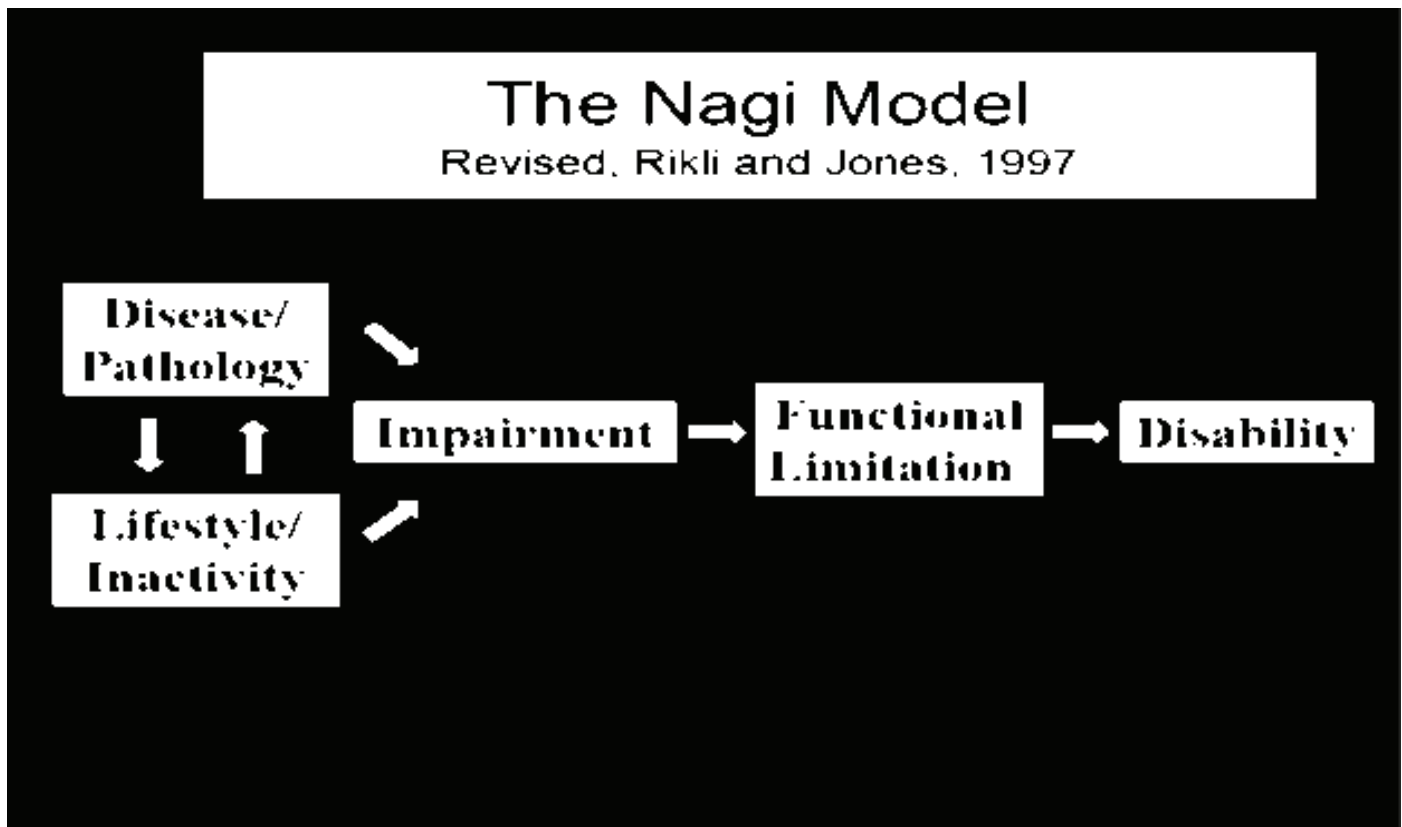


The pathway to **disablement** was first described by sociologist Saad Nagi in 1965 (Nagi 1965) and has been expanded upon by many others since (Figure 6). Understanding this basic pathway can help fitness professionals develop a more effective approach to training by gaining an appreciation for the complex mix of factors that may need to be addressed. In essence, understanding the process that leads to someone being disabled can give insight as to how we can better intervene in order to keep people healthy, functional and independent longer.

The steps in the pathway are: Active Pathology and/or Physical Inactivity, Impairments, Functional Limitations, and lastly, Disability. Let's start at the beginning of the pathway. Over time, diseases such as diabetes, cardiovascular disease, cancer, and osteoporosis can lead to physical impairments such as muscle weakness, poor cardiorespiratory endurance, inflexibility, and poor reaction time. Depending on the specific pathology or mix of pathologies, these impairments may be a direct result of the disease processes or may be indirectly due to lower levels of physical activity. Diseased individuals often have lower levels of activity which can exacerbate or accelerate the disease process and can also lead to the impairments mentioned above. However, even in the absence of disease physical inactivity can lead to impairments with advancing age. From an aging perspective, and as discussed earlier, the majority of reductions in impairments with advancing age (i.e. loss of muscle

strength, low cardiorespiratory endurance, etc.) is mainly due to deconditioning rather than the aging process itself. Population-based studies show that just maintaining an active lifestyle, without any formal exercise, helps to maintain physical conditioning and slow the losses experienced by less active individuals. Regardless, as impairments accumulate or worsen, then eventually the individual will experience limitations in their functional capabilities such as grasping objects, walking, stair climbing, and carrying objects. Individuals will experience limitations first in high-effort activities followed eventually by Instrumental Activities of Daily Living (e.g. shopping, transportation, etc.). If these limitations become severe enough, the individual could lose their ability to perform duties that are essential to their socially defined roles (e.g. caretaker, employee, volunteer) and would then require assistance to perform even Basic Activities of Daily Living (e.g. toileting, dressing, feeding oneself, etc.). Assistance could come from children, friends, social workers, or medical personnel. At this point an individual would be considered disabled.

FIGURE 6: THE MODIFIED NAGI MODEL OF DISABLEMENT



Exercise programs have shown modest success in improving functional capacity and delaying or avoiding disability in older adults with existing impairments and there is no clear optimal exercise program design (Paw et al 2008; Keysor and Jette 2001). Even the most basic or fundamental exercise programs have consistently been able to positively affect impairment-level factors such as muscle strength, muscle power, muscular endurance, cardiorespiratory endurance, flexibility, joint range of motion, and balance. However, the evidence for the beneficial effects of exercise on functional limitations is less clear. This is likely due to the wide variety of subject characteristics (age, gender, functional capabilities, disease processes) and exercise designs employed (frequency, intensity, type) as well as the lack of specificity between

the training intervention and the functional outcomes being assessed.

Recent systematic reviews have indicated that while exercise interventions may improve impairment level factors significantly this does not always lead to similar gains in functional capacity. In addition, subjects who experience the greatest gains in impairment level factors do not always experience the greatest gains in function. For example, an individual that performs a traditional progressive resistance strength program may significantly increase their strength but may only increase their ability to climb stairs, balance, get out of a chair, or carry objects by a small to moderate amount. By contrast, another individual may increase their strength to a much smaller degree and yet experience

large gains in functional tasks. Strength gains do not necessarily equate to similar functional gains. This should not necessarily be surprising since even though muscular strength is an important component necessary

for performing these tasks it is not the only component. Physical function depends on a myriad of physiological

FIGURE: DOMAINS OF PHYSICAL FUNCTION



The Functional Aging Training model approach is built around the 6 primary functional domains: Neuromuscular, Musculoskeletal, Cardiorespiratory, Balance, Mobility, and Cognition/Emotion. Each of these are critical to address in an effective program. However, each of these areas can be further divided into specific sub-domains that may need to be addressed individually. The balance domain is a great example. Many trainers try to include balance training in their

clients' routines without fully understanding which specific component of balance they are working on. The downfall is that they not be addressing the specific components of balance control that a particular client needs or all of their balance exercises unknowingly address the same component. Balance, like all of these domains, is multifactorial so it is vital that trainers understand how to identify which specific sub-domains their clients need to work on to improve physical function

and how to appropriately address each one through exercise programming, strategies, and movements. . As such, recent evidence highly suggests that exercise interventions that challenge multiple components of function may lead to better functional improvements than programs that focus on a single component (Rose 2010; Latham et al 2004; Signorile 2011). These techniques will be explored in more detail in other modules.

Exercise Training

It's never too late to start. The evidence strongly demonstrates that regular exercise can improve health and fitness for adults of all ages and even after years of sedentary and unhealthy behaviors. Training studies with individuals in their 90's and beyond have demonstrated significant (statistically and/or practically) improvements in aerobic power, muscle strength, muscle power, flexibility, balance, physical function and many aspects of health. However, for many of these areas the optimal exercise prescription has yet to be identified due to current limitations in the research.

Aerobic Exercise

Mature adults engage in less physical activity than their younger counterparts. Aerobic exercise has been shown to be safe and beneficial for adults of all ages. By engaging in regular aerobic exercise mature adults can decrease their risk of chronic diseases; manage their current diseases better; and increase aerobic exercise capacity (Chodzko-Zajko et al 2009). Exercise should be

of sufficient intensity (>60% VO₂max), frequency (> 3 days/wk) and duration (> 20 min) to elicit cardiovascular and health adaptations. Individuals without significant health risks or conditions can participate in more vigorous exercise and sports activity such as basketball or running. The mode of aerobic exercise is an important consideration and depends on the individual's orthopedic conditions, goals, and exercise history. Those with significant arthritis of the knees, hips or spine, joint replacements, osteoporosis, and other orthopedic conditions should avoid high-impact exercises such as jogging and instead should engage in low or non-impact exercises such as bicycling or swimming. This includes cardiovascular equipment such as an upright bike, recumbent bike, recumbent stepper, treadmill, elliptical trainer, and rower. Clients with a history of falling or with balance deficits should avoid activities with an increased risk of falling such as skiing, horseback riding, or skating.

Typical techniques to monitor exercise intensity such as heart rate and the "talk test" can still be used with mature clients. However, it is also useful to use rating of perceived exertion (RPE) in order to gauge intensity especially if the client is taking medications that suppress heart rate such as beta blockers. An RPE of 12-13 on the Borg 6-20 scale corresponds to moderate intensity aerobic exercise. RPE is often an easier tool for older clients to use when heart rate monitors are unavailable and counting a pulse rate is difficult. Maximal heart rate is

typically calculated as 220 minus age, but more recent information indicates that a more accurate equation for determining maximal heart rate is $208 - (0.7 \times \text{age})$ in healthy adults over the age of 40 (Tanaka et al 2001). The original formula tends to overestimate maximal heart rate in younger populations and underestimate them for older populations. Target heart rate should be calculated using either the direct or heart rate reserve methods according to the intensity desired. Although moderate-intensity exercise is generally recommended, the individual's health conditions and fitness status will determine the appropriate level of intensity that is both safe and effective. Many mature clients will be able to perform high-intensity interval training.

Resistance Exercise

Following traditional progressive resistance training, the muscular strength of older adults can increase anywhere from 25% to more than 100% depending on the exercise program being used, the duration of the training, age and gender of the client, and the specific muscle groups being trained (Chodzko-Zajko et al 2009). Muscle power also increases following resistance exercise training although evidence suggests that high-velocity training protocols may improve muscle power to a greater degree (Tschopp et al 2011; de Vreede et al 2005). It is recommended that mature adults engage in at least two days per week of moderate intensity strength training that includes 8-10 exercises involving the major muscle groups of 1-3 sets

of 8-12 repetitions each (Chodzko-Zajko et al 2009).

Mature adults can safely and effectively use a wide variety of resistance training methods and equipment such as resistance machines, resistance bands, free weights, body weight, hydraulic, and pneumatic equipment. Equipment selection is dependent on the individual's capabilities and goals. Each has its advantages and disadvantages. It is a misconception that mature adults should only use light dumbbells or easy resistance bands because they might become injured. The muscles of older adults need to be challenged in order to grow just as the muscles of younger adults do, and although this population has more orthopedic concerns than younger populations, resistance exercise has been shown to be generally safe.

However, resistance exercise techniques for mature adults need to go beyond these basic recommendations. As you will learn, there are many limitations to the traditional strength exercise approach. The Functional Aging Training™ model described later is an approach to resistance exercise that addresses the numerous and diverse functional needs of the mature adult.