

MODULE 4

FUNCTIONAL AGING AND EXERCISE

Learning Objectives

1. Name and describe the levels of the Hierarchy of Physical Function
2. Define the disablement process according to the Nagi Model of Disablement
3. List the components of physical function
4. Describe the functional trajectory of aging

Understanding Function

The older adult population is very heterogeneous and functional capabilities vary significantly from person to person. 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. An 80-year-old may be able to physically or mentally outperform someone 10 or 20 years younger.

In the textbook *Physical Dimensions of Aging* (1995, 2005), Dr. Waneen Spirduso created the Hierarchy of Physical Function which described five functional categories of older adults (Spirduso et al 2005). This hierarchical categorization has been helpful to understanding the

heterogeneity that exists within this group of individuals. More recently, however, FAI created the Hierarchy of Functional Aging which expanded Spirduso's original hierarchy to eight categories in order to better represent the diversity within the older adult population and to help tailor exercise programs for these individuals more effectively. The hierarchy is visually represented in the image below and each category is described in the following section.



FAI's Hierarchy of Functional Aging

Elite: The physically elite have achieved and maintained the highest levels of physical function in their age group and are often more fit than sedentary or insufficiently active individuals that are decades younger. Compared to others their age and gender the elite typically score in the top 1-5% of scores on functional and physical fitness tests. They train rather intensely on a regular basis and often compete in tournaments, races and events. Due to their high levels of activity (and usually excellent dietary habits) they are also in excellent health.

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 5-20% across the board.

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 their levels of muscle strength and balance may be at critically low levels. They are also typically of good to excellent health. When considering age

and gender matched performance norms they will typically score in the top 5-20% in 1-2 categories of fitness.

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.

Lower Independent: These individuals are minimally active or completely sedentary typically choosing hobbies and activities that require very little physical demand such as reading. Due to their relative inactivity they score below average on most functional fitness assessments. They are at a higher risk of functional decline and are typically on a steeper downward functional trajectory compared to higher independent or fit individuals. The variability in functional impairments is significant for this group of individuals as is the number and severity of chronic conditions.

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 in the section on frail individuals 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) and

therefore they continue to become less active and less 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 and so forth.

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.

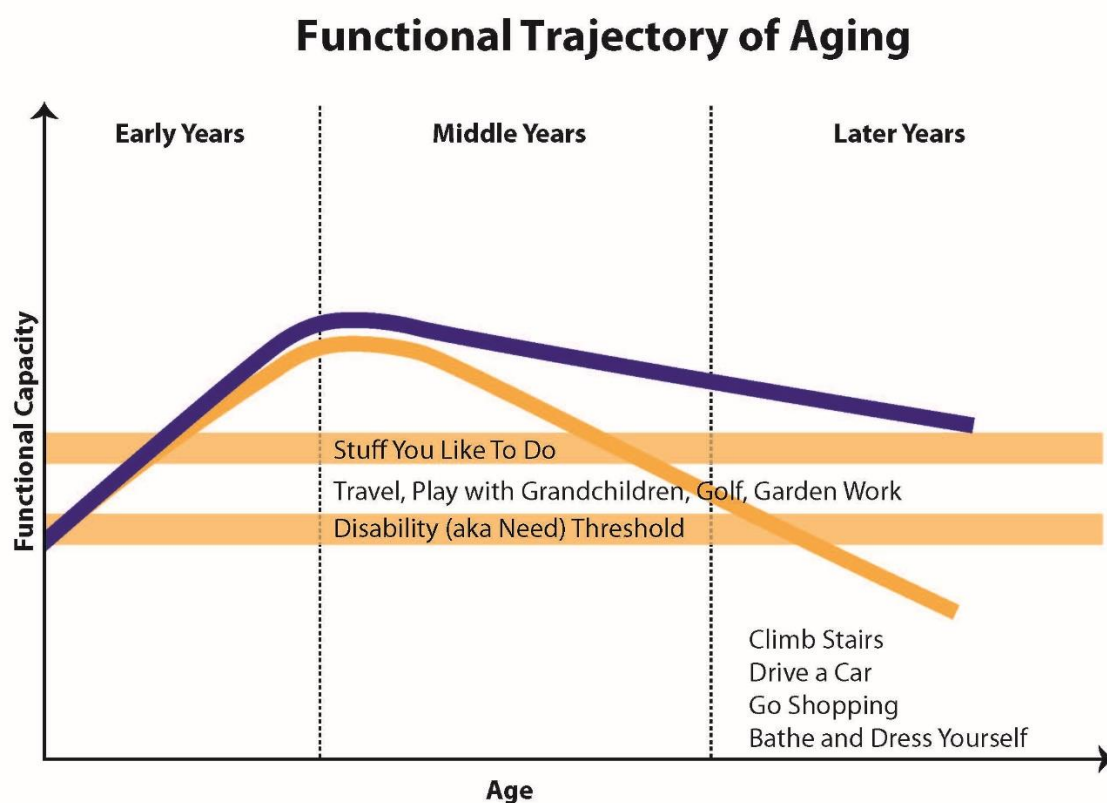
Dependent: These individuals are unable to perform all of the BADL's and are dependent on others and/or physical aids (e.g. canes, walkers, wheelchairs) to complete their daily tasks. The extent of their physical disability is determined by the degree to which they cannot perform BADL's and IADL's. Disability 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 may 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.

However, long before a person becomes physically disabled or dependent the person will experience difficulties performing the activities that they like to do such as work, leisure, travel and recreational activities. These activities provide joy, happiness, relaxation and essentially a high quality of life. They create opportunities for spending quality time with family, friends and loved ones. Older adults are very motivated to maintain these abilities for as long as possible.

Figure: Trajectories of Aging



The Functional Trajectory of Aging shows two basic patterns. The purple line represents someone who is able to maintain or slow their functional decline (typically because of a healthy lifestyle). The yellow line represents someone who is quickly losing their functional abilities. It does not show what happens when someone who is losing their functional abilities (yellow line) starts a functional exercise program. In that case their trajectory would be flattened and potentially even reversed. This is the real potential of an appropriate exercise program.

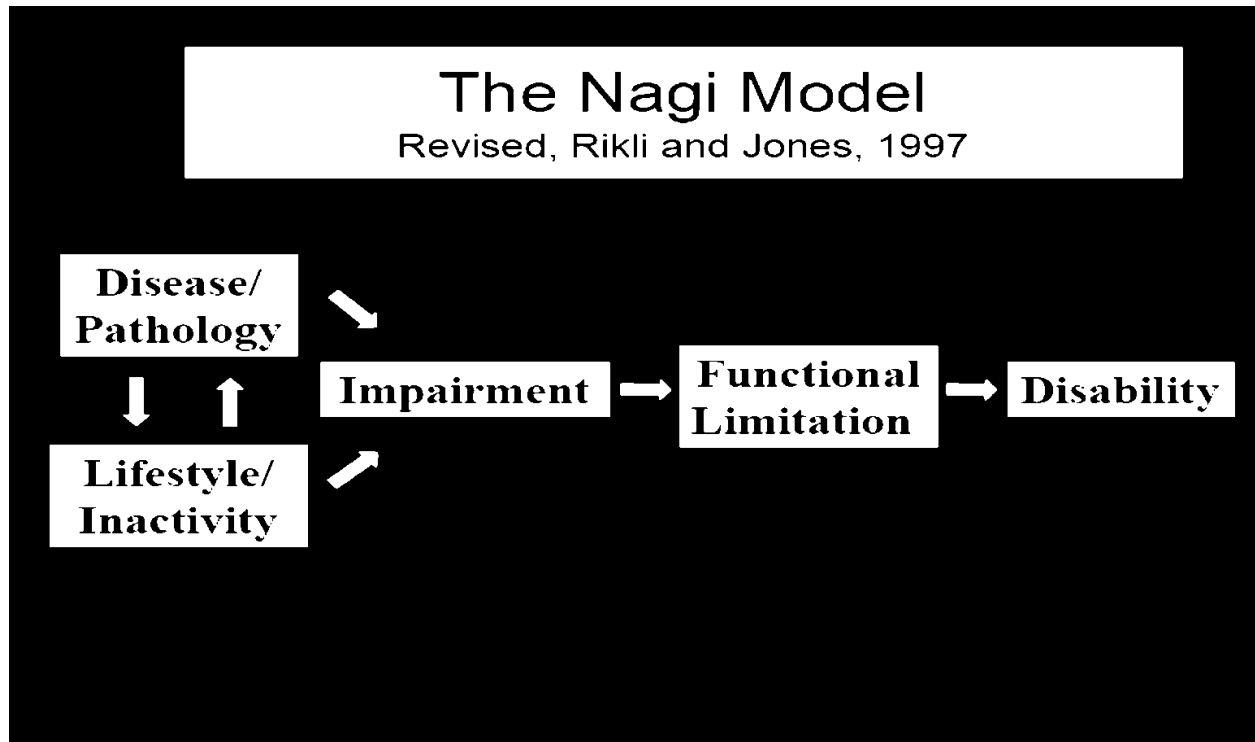
The pathway to **disablement** is a more complete look at the factors responsible for functional decline. It was first described by sociologist Saad Nagi in 1965 (Nagi 1965) and has been expanded upon by many others since (Figure 6) including the World Health Organization's International Classification of Function and Disability which is the basis of physical therapy and medical care. 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: 1) Active Pathology and/or Physical Inactivity; 2) Impairments; 3) Functional Limitations; and 4) 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

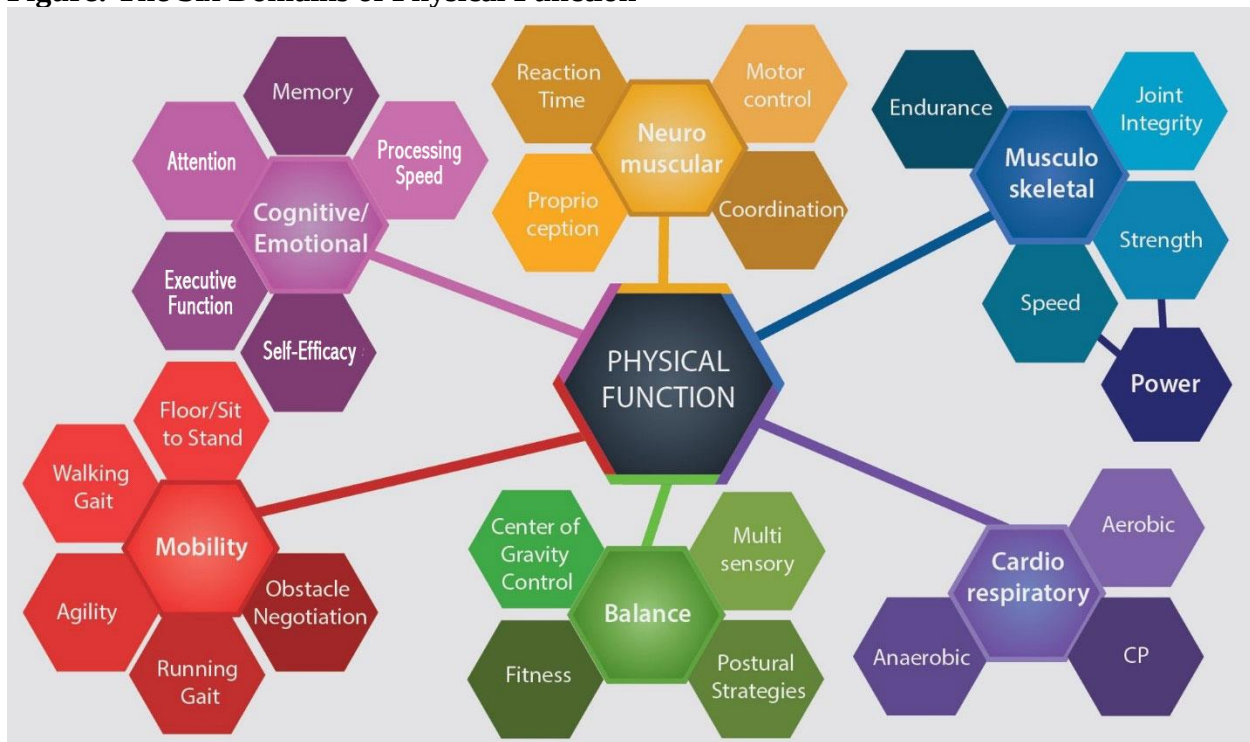


Exercise programs have shown modest success in improving functional capacity and delaying or avoiding disability in older adults with existing impairments and there is no clear optimal exercise program design (Paw et al 2008; Keysor and Jette 2001). Even the most basic or fundamental exercise programs 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 components such as those identified in the Domains of Physical Function (see figure below).

Figure: The Six Domains of Physical Function



The Functional Aging Training Model approach is built around the 6 primary functional domains:

1. Neuromuscular
2. Musculoskeletal
3. Cardiorespiratory
4. Balance
5. Mobility
6. Cognition/Emotion.

Each of these are important components of function and are important to address in an effective program. However, due to the huge variability in the aging process and different levels of function the specific components that need to be addressed will also vary widely. For some individuals simply addressing one specific domain is sufficient to improve function while for others it will be necessary to address multiple domains simultaneously. As will be discussed later on it will be the

responsibility of the trainer to determine which domain or domains need to be prioritized in an exercise program in order to maximize their functional abilities.

Each of these domains can be further divided into specific sub-domains and specific components that may need to be addressed individually. The balance domain is a great example because it is composed of numerous sub-domains and specific components. Many trainers try to include balance training in their clients' routines without fully understanding which specific sub-domain or component of balance they are working on. The error is that they may 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.

Conclusions

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

individuals vary so much in their impairments these improvements may not lead to satisfactory gains in functional abilities. Multi-component programs appear to be more effective and individualized programs that target the individual's specific impairments are likely the most effective. It is sometimes difficult to determine which functional domains, sub-domains or components to focus on. This is where assessment comes in. Assessing an individual's health and functional abilities is the first step in developing an effective, individualized exercise program.