



**THE ROLE OF GENDER AND COMORBIDITY ON
FUNCTION AND MOVEMENT IN ELDERLY POPULATION:
IMPORTANCE OF PHYSICAL ACTIVITY**

**UTICAJ POLA I KOMORBIDITETA NA
FUNKCIONALNOST I POKRETLJIVOST U POPULACIJI
STARIH OSOBA: ZNAČAJ FIZIČKE AKTIVNOSTI**

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Abstract

Aging is physiological process that includes numerous variables, among them: genetics, chronic diseases, lifestyle factors, and socioeconomic factors that interact with one another and thus affecting the person's functional and physical dimensions. Mobility difficulties are usually among the first signs of functional decline and thus affecting the quality of life in aged population. Chronic diseases including: diabetes, cardiovascular, musculoskeletal and neurological is shown to have important impact on disability in elderly. The fundamental dimension of mobility is walking as complex neuromotor activity that integrates sensory and motor functions. With regards to the individual's needs, adopted physical activity is recommended, in order to take into consideration differences in physical abilities, meaning that such activity was adjusted and modified to the elderly with disabilities needs. Despite the fact that females have lower rates of certain chronic diseases and mortality, they have more functional limitations and are more physically disabled versus males. Most age-dependent disorders arise from the disability for which long-term care costs outweigh health expenditure. Technological and medical development, health promotion and redistribution of health and social care services will be important for modifying ageing processes so that people will be living longer without severe disability. Further, on individual level, exercises, walking, cycling, and plays in free time are highly recommended for persons 60 years and older.

Keywords:

elderly,
mobility,
physical activity,
gender,
comorbidity

Sažetak

Starenje je fiziološki proces koji uključuje brojne varijable, među kojima su: genetika, hronična oboljenja, faktori načina života i socioekonomski faktori, koji međusobno interreaguju i time utiču na funkcionalne i fizičke dimenzije osobe. Teškoće u pokretu su obično među prvim znacima funkcionalne onesposobljenosti i time utiču na kvalitet života u starosnoj populaciji. U onesposobljenosti značajnu ulogu igraju Hronične bolesti kao što su: dijabetes, kardiovaskularne, mišićnoskeletne i neurološke bolesti. Fundamentalna osnova pokretljivosti je hod, kao kompleksna neuromotorna aktivnost koja integriše senzorne i motoričke funkcije. U analizi potreba pojedinaca preporučuje se adaptirana fizička aktivnost kako bi se uzelo u obzir razlike u fizičkim sposobnostima, što znači da je takva aktivnost prilagođena, kao i modifikovana starijim osobama sa invaliditetom. Uprkos činjenici da žene imaju niže stope određenih hroničnih bolesti i smrtnosti, one imaju više funkcionalnih ograničenja i fizički su više onesposobljene od muškaraca. Većina poremećaja koji su zavisni od starosti proizilaze iz onesposobljenosti za koju troškovi dugotrajne nege prevazilaze zdravstvene troškove. Tehnološki i medicinski razvoj, promocija zdravlja i preraspodela usluga zdravstvene i socijalne zaštite su važni za modifikaciju procesa starenja, tako da će ljudi živeti duže bez teške invalidnosti. Na individualnom nivou, za osobe starije od 60 godina veoma se preporučuju vežbe, hodanje, vožnja biciklom i druge aktivnosti u slobodno vreme.

Ključne reči:

starost,
mobilnost,
fizička aktivnost,
pol,
komorbiditet

Introduction

The estimation of functional status in elderly population is of particular importance and has significant impact on economic and societal functions of a community (1,2). It is well known that aged population has decline in muscle strength and muscle mass, decreased functional capacities, and reduced mobility, along with increased prevalence of certain risk factors (3). Thus, population aged 65 years and more belongs to the so-called group of "fourth age" which is associated with disability and dependence (4).

Previous studies have demonstrated that social participation of aged population has significant impact on active aging, as well as physical and mental health (5-7). The impact of this type of participation on health was shown to be more profound in older population, with a special attention to the fact that potential risks and protective factors associated with functional deterioration are differed in younger elderly (65-74 age years) versus older elderly (75 age years and more) (8).

Increase in longevity have lead scientists and medical practitioners to actively explore the effects of disability in elderly population, tending to achieve the state of longer active lives particularly in aged population, with reduction in disability (9,10). This is of great importance and in fact very complex task due to the fact that disability could be classified into 3 dimensions: physical, mental and social (10).

Aging and function

Aging is physiological process that includes numerous variables, among them: genetics, chronic diseases, lifestyle factors, and socioeconomic factors that interact with one another and thus affecting the person's functional and physical dimensions. Some of these variables are mod-

ifiable and some are non-modifiable. Aging can be without the influence of disease and environment, and therefore termed as primary aging with cellular structure and function deterioration, and with the influence of disease and environment, when it might be termed as secondary aging (11). It is known that age might be the risk factor for development and progression of numerous chronic diseases. Recent findings stress the possibility and importance of adaptability of numerous systems in humans and the role of exercise in their modification (12). However, there are individual variations in adaptive responses to exercise programs, whereas there is significant improvement for some individuals, while others show minimal changes (13). Therefore, for successful aging, it is advisable to promote regular physical activity, since it will not only reduce the risk of development of numerous chronic diseases, but it can pose additional influence in treatment of various diseases (13).

Mobility predictors in elderly

Mobility difficulties are usually among first signs of functional decline and thus affecting the quality of life in aged population. The fundamental dimension of mobility is walking as complex neuromotor activity that integrates sensory and motor functions (14,15). The aging process, thus, usually affects both functions with different levels of impairment, leading to the decrease in the capacity to maintain certain dimensions of mobility. Ferrucci et al, hypothesized that multiple physiological subsystems could have some influence on the ability to walk, therefore have conducted InCHIANTI study for evaluation of several subsystems: central and peripheral nervous system, muscles, bone/joints and energy production/delivery (14). Further, in the study of Idland et al, authors stressed out that the mobility predictors are: body mass index, step climbing capacity and balance (16). Considering the walk-

ing speed of elderly people, it was pointed out that it is influenced by several physiological and psychological factors (predictors) including: limb strength, balance, vision, pain and emotional dimension (17). Moreover, additional research provided the findings, which stressed out the physiological and psychological predictors that influence stairs ascent and descent performance (17). These factors were: knee extensors and flexors strength, lower limb proprioception, balance, fear of falling, pain and vitality (18). Such findings, clearly indicate complexity of how mobility in elderly, its type and influence of numerous factors that might be modified to the various degree of impairment.

Physical activity interventions and functioning

So far, numerous studies have investigated various models of physical activity in elderly. These programs were compared with various dimensions of overall quality of life in these individuals. Such programs could be performed in different settings: home-based setting, rehabilitation setting and hospital setting. In the study of Baker et al, aside the fact that multimodal exercise training might have influence on falls prevention in elderly, it has also limited effects on physical as well as functional outcomes (19). Systematic reviews dealt with the aspects of different types of progressive resistance training in older population, and arguable findings were addressed for functional performance improvement and its effects on physical disability (20,21). However, in meta-analysis of Liu and Latham it was pointed out that progressive resistance training might have positive influence on reduction of physical disability in elderly (22). Furthermore, highlights are that supervised training versus unsupervised mode has more significant influence on balance improvement and muscle strength in aged population (23). Considering other dimensions of functioning performance in older people, systematic review of Olanrewaju et al, stressed out a lack of evidence regarding the effectiveness of physical activity on cognition decline and prevention of dementia, but small benefits might be considered to brain health (24). Among numerous factors that pose the problems in elderly population, impaired balance and fallings are among them as well. Particularly fear of fall, falls and impaired balance are impacting the mobility and thus present serious health problems influencing numerous dimensions of person's quality of life (25). With regards to the individual's needs, adopted physical activity is recommended, in order to take into consideration differences in physical abilities, meaning that such activity was adjusted and modified to the elderly with disabilities needs in this case (25). Finally, in a systematic review of Martin et al, it was stressed out that physical therapist administered group-based exercise program is of benefit for balance improvements, greater patient satisfaction and falls prevention, as well as for improvement of quality of life (26). In addition, different levels of light physical activity (from low-intensity, moderate-intensity to high-intensity) are favorably associated

with numerous factors that could pose the risks in adult population, among them are: body mass index, systolic blood pressure, insulin sensitivity, C-reactive protein, triglycerides and fasting glucose (27). Thus, the effects of such activity interventions with different levels of intensities should be further explored in aged population. This is of particular attention, due to the fact that elderly, predominantly in everyday activities, perform light-intensity activities, with difficulties to perform severe-intensity and even moderate-intensity physical activity (28).

Gender and functioning in elderly

Despite the fact that females have lower rates of certain chronic diseases and mortality, they have more functional limitations and are more physically disabled versus males (29). The possible hypotheses for such observation are increased rates of musculoskeletal and neurodegenerative diseases in females, as well as psychosocial factors (29). Additionally, it was stated that behavioral factors have to the certain degree some contribution to the increased prevalence of disability in females (30). Further, other factors in aged females are contributors to a life with a disability. Among them are: longevity (females live longer than males), higher prevalence of chronic conditions that are not fatal, sedentary life style, etc. (30,31). Differences between genders in aged population could be explained by the assumption that males and females are to the different extent and thus with non-same susceptibility exposed to socioeconomic and health factors (32). Mood and cognitive impairments along with disability are more common in females, whereas comorbidity indexes and severity measured by Cumulative Illness Rating Scale (CIRS-G) where higher in males (33). Moreover, in the study of Carmel et al, gender differences in evaluation of will-to-live on survival in aged population was investigated. Authors noticed that such parameter is useful as prognostic factor in predicting long-term survival of older women (34).

Chronic diseases and disability

Diabetes

Diabetes in elderly presents a significant problem in two ways: first it affects organs and systems, causing vascular and neurological impairments, and secondly it affects physical activity, particularly everyday activity domains leading to physical disability and loss of independence (35). However, it should be stated as well that there might be some less commonly recognized factors which might be to the certain degree associated with diabetes, among them for instance depression, that could affect functional capacity, leading to the individual disability (36). In a systematic review of Lu et al, it was noticed that diabetes in older population was associated with cognitive decline, mobility decline and disability, and in older women with falls (37). These observations reflect the fact

of how the pathogenesis of functional limitation in aged population with diabetes is complex. Moreover, aged population is particularly susceptible to the frailty, due to the numerous pathophysiological alterations. It should be stressed that frailty in elderly is activated more quickly in presence of diabetes mellitus and thus, will influence more to the functional impairments and physical disability due to the decreased reserve and resistance to stressors (37).

Cardiovascular impairments

Concerning cardiovascular system in aged individuals, it should be stated that there are changes on several levels. Particularly, for vascular system over the aging period there is an increase amount of collagens, lower levels of elastin, and increased atherosclerotic plaques in the arterial walls, leading to decreased vascular compliance and elasticity (38). These individuals present with various degrees of hypertension. Further, in aged population usually the heart mass is increased with myocyte hypertrophy and fibroblasts activity (38).

The protective effects of physical activity in individuals with cardiovascular diseases (CVD) are considered to be: decreased inflammation and thrombosis along with slowing of atherosclerosis processes (39). Exercise training in healthy aged individuals along mention above, improve as well endothelial and baroreflex function, increase VO₂MAX and vagal tone (13,40). Therefore, it is noticed that physical activity participate in reduction of CVD risk, but it should be stated as well that increase in the amount of such activity will additionally reduce the risk for CVD (39). However, one should consider also that dose response curve between physical activity and the risk of CVD is not yet established.

Musculoskeletal impairments

Considering musculoskeletal impairments and conditions, it is stressed that they are the most prevalent chronic conditions (41). They increase the risk of activity limitations.

For the elderly population, when muscular system is analyzed and compared with various exercise modules, several aspects of muscle system should be considered: muscle strength, muscle power, muscle quality and muscle endurance (13).

During the aging process, it is obvious that strength of the muscle will decline and will affect functionality and to the certain degree the mobility of the person. Thus, adequate physical activity with proper intensity and adaptations is advised. Previous studies noticed that even though there is increase in the strength of the muscles during the exercise program, elderly present with lesser increase than younger adults (42,43).

However, special attention should be made to muscle power, since it was stated that loss of muscle power in aging population is more profound than muscle strength (44-46), and if the fact that the power as a parameter has more influence on functional performance than strength,

then preventing further decline by introducing of adaptive exercise programs is of greater importance.

Moreover, it is pointed out that arthritis represents the most common health condition in aged population and its impact on disability is more profound than even heart disease (47). Such condition is associated with multiple dimensions of disability including: personal care, performing physical tasks, transportation, and others, yet individuals with arthritis use less personal assistance than others with disabilities (48).

Further, regarding bone mineral density (BMD), it was noticed that reduction of BMD depends on age (49), thus aged population is in increased risk for development of osteopenia and osteoporosis. This will in addition increase the risk of bone fractures, thus preventive measures are advisable in elderly population. Therefore, physical activity is considered as potential preventive tool for osteoporosis. Since, aged population has numerous reductions in physiological capacities, adopted exercises particularly osteoanabolic should be recommended (50). Despite the fact that low intensity exercises (walking) have certain effects on BMD, higher intensity exercises (stairs climbing, jogging) have more impact on BMD in postmenopausal women (51). These findings suggest that there might be dose response differences between intensity of prescribed exercises and BMD.

Neurological impairments

The effects of neurological system (both peripheral and central) in aged population on mobility are better understood, if mobility is considered as complex construct with various determinants. Thus, the mobility could be considered to the certain degree, as a person's ability to adapt to certain environmental factors, where dysfunction in interaction between individual and environmental factors will lead to disability (52). It is known that changes in plasticity and adaptability of central nervous system (CNS) in aged population might affect mobility (53), and therefore could have an impact of individual's physical performance leading to disability. Further, the association between mobility and cognition was described as well (53). However, properly structured and performed exercises in aged individuals could have beneficial influence on brain plasticity and neuronal circuitry remodeling (54).

Sensory function is also another determinant that is affected by aging, and thus translating its effects on functioning and quality of life. It multidimensionally affects the person's functional and physical determinants including: hearing, vision, touch, smell, balance and others (55). Finally, there are as well structural changes in peripheral nervous system during the aging period that includes various degrees of demyelination and axonal loss (56). This leads to changes in functional studies particularly electrodiagnostic studies where decrease in nerve conduction velocity and changes in morphology of responses are seen, and thus affecting functionality and mobility of individuals. Therefore, special considerations should be applied when exercise modes are implementing in prevention pro-

grams and treatment of these individuals.

Conclusion remarks

The ageing population is driving the worldwide epidemic of chronic diseases contributors to the total burden in people aged 60 years and older (cardiovascular diseases present in 30.3%, malignant neoplasm in 15.1%, chronic respiratory diseases in 9.5%, musculoskeletal diseases in 7.5%, and neurological and mental disorders in 6.6%) (57). In addition, most age-dependent disorders (i.e., dementia, stroke, chronic obstructive pulmonary disease, and vision impairment), arises from disability for which long-term care costs outweigh health expenditure (58). Aging trends differ between countries, as a result of low fertility, low immigration, and long lives (59) and compression/extension of morbidity (60). There is no clear evidence for substantial variation of patterns of limitations in functioning between countries and within countries over time (60). In that regard, “studies that focus on refining measurements of health, functioning, and disability

in older people, with a core set of domains of functioning, that investigate the effects of these evolving patterns on the health-care system and their economic implications” are “urgently needed” (60,61).

Technological and medical development, health promotion and redistribution of health and social care services will be important for modifying ageing processes so that people will be living longer without severe disability. On individual level, exercises, walking, cycling, and plays in free time are highly recommended for persons 60 years and older; to start with light workouts and to intensify them over time, in regard to their capability (62,63). Strong evidence (62) shows that, in relation to the less active elderly, physically active peers have lower rates of coronary heart disease, hypertension, stroke, diabetes, colon and breast cancer, lower risk of falls, and a higher level of cardio respiratory and musculoskeletal readiness, weight, better bone composition, higher level of functional health, and better cognitive function. Therefore, physically active peers have fewer costs associated with the treatment of these chronic diseases.

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