

Applications of physiotherapy and occupational therapy in the prevention and treatment of frailty syndrome

Wykorzystanie fizjoterapii i terapii zajęciowej w profilaktyce i leczeniu zespołu słabości

Jerzy Rottermund¹, Andrzej Knapik²

¹ St. Elizabeth University of Health and Social Work, Bratislava, Slovak Republic

² Department of Adapted Physical Activity and Sport, Chair of Physiotherapy, School of Health Sciences in Katowice, Medical University of Silesia in Katowice, Poland

Abstract

A decreasing health level of elderly population enhances the occurrence of frailty syndrome (FS), which results from lowered functioning of almost all physiological systems. FS is characterized by declining physiological reserves and resilience to stress factors in the organisms of older adults. Pathophysiological changes contribute to disorders in the functions of the human organism. This study is aimed at indicating the potentialities of the use of physiotherapy and occupational therapy as preventive and medical measures in FS. The disease process is discussed here, as well as the possible therapies, which may improve the quality of life of FS patients. *Geriatrics 2021; 15: 15-21. doi: 10.53139/G.20211502*

Keywords: frailty syndrome, physiotherapy, occupational therapy, quality of life

Streszczenie

Obniżający się poziom zdrowia starszej populacji sprzyja wystąpieniu zespołu słabości (ZS), który staje się efektem obniżonej wydolności praktycznie wszystkich układów fizjologicznych. ZS charakteryzuje się zmniejszoną rezerwą czynnościową i brakiem odporności na czynniki stresogenne w organizmie osób starszych. Zmiany patofizjologiczne przyczyniają się do zaburzeń pracy organizmu człowieka. Celem niniejszego artykułu jest wskazanie na możliwość wykorzystania fizjoterapii i terapii zajęciowej jako środków profilaktycznych i leczniczych w ZS. W pracy omówiono proces chorobowy oraz możliwość prowadzenia stosownych terapii, co wpływa na jakość życia pacjentów z ZS. *Geriatrics 2021; 15: 15-21. doi: 10.53139/G.20211502*

Słowa kluczowe: Zespół słabości, fizjoterapia, terapia zajęciowa, jakość życia

Introduction

Over the last decades, the average lifespan has substantially increased, mostly owing to medical technology and better care for the societies in good economic conditions. However, the lifespan is not identical with the quality of life, as psychomotor functions of the elderly may deteriorate as an effect of natural involuntary processes and past illnesses and injuries. What occurs in older people is the decreasing performance and function of particular systems and organs, which leads to limited dexterity. Medical care for people after health incidents prolongs life for a few next years but does not guarantee a recovery to the earlier ability and activeness. In this way, the component of years lost due

to disability (YLDs) is getting longer, yet – the mortality ratio is decreasing [1]. A decreasing health level of the elderly population enhances the occurrence of frailty syndrome (FS), which results from lowered function of almost all physiological systems. FS is characterized by declining physiological reserves and resilience to stress factors in the organisms of older adults. Progressing pathophysiological changes contribute to disorders in the functioning of the human organism and become a warning sign in the development of FS [2]. Frailty syndrome may occur in any decade of life, still the likelihood of its occurrence increases after the age of 60 [3].

Lowered physical ability co-occurs with disordered cognitive functions, which hinder the performance of

basic daily activities. This in turn has impact on the deteriorating quality of life. Comorbidities (e.g. hypertension, diabetes, osteoporosis, depression), proneness to falling, malnutrition and dehydration [4], enhance the threat of FS. The risk of FS onset is associated with limited reserves and compensation potentialities, which results in malfunctioning of particular systems or organs. This influences the organism's reactions, the treatment or possible hospitalization, and increases the risk of complications or death [5, 6]. It should be stressed here that FS predicts progressing disability in general populations [7]. Yet, the frailty index is a responsive predictor of survival [8].

Some American studies, conducted almost 20 years ago, indicated that FS affected 6.9% of the whole population, the percentage increased with age and was higher for women than men [9]. The research overview made by Collard and his colleagues [10] showed that the frequency of FS occurrence in the whole population was 10.7%. In that study, two conditions were distinguished: physical FS (frailty) at the level of 9.9% and the intermediate state (prefrailty) at 44.2%. Other American studies specified FS in people aged over 65 at the level of 7% and a significant increase in FS cases was observed in patients at the age of over 80 (30%) [7].

Another cross-sectional study was carried out in 2014 on a sample of 1252 people older than 80 in Mexico. FS was identified in 20.6% and a significant increase of cases was observed in patients with congenital defects (57.6%). The conclusions were that 2 out of 10 older people suffered from FS and that this was interrelated with limitations in ADL and falls [11].

“In the Polish population, the problem of FS is hardly known” [2], which might result from the lack of statistical elaborations in the Polish specialist literature. Using the data of the Supreme Audit Office (NIK) and the prognoses for Poland [12], it is possible to specify the number of FS patients as not fewer than 1 million, with a steady tendency to increase. Some Polish studies inform that 40% of people aged 64-71 may be endangered with FS [13]. It can be predicted that in Poland in 2030 the number of FS patients will be 2 million.

There is a direct relation between an increase in the number of people affected by FS and an increase in financial resources invested in health and social care [14]. The increase in costs consists of public money and the private money of patients and their families.

Goals of the study

This study is aimed at indicating the potentialities of the use of occupational therapy and physiotherapy as preventive and medical measures in FS. They can delay the disease process and the treatment will start from a higher level of psychophysical ability, which might enhance patients' quality of life and reduce financial costs.

Characteristics of frailty syndrome

The onset of FS is determined by many factors, which occur one at a time or together. Their co-occurrence intensifies the advancement of the syndrome. Two types can be distinguished: the factors associated with lowered physical ability (lowered muscle strength related to sarcopenia, limited effort tolerance and lowered physical activity, slowness of movement and exhaustion) and psychosocial factors. As regards the latter, what should be emphasized is the deterioration of cognitive functions and sensory ability, frequent mood disorders often associated with depression and the social and family situation of seniors [15]. This disability is often accompanied by a relatively stable physical condition of the organism – in FS, the lack of self-regulation of physiological processes may result from minor health episodes or depressive states. Whitson et al. [16] drew attention to the possibility of FS onset with a relatively high level of physiological reserves as an effect of, for instance, a strong depressive episode (e.g. changing the address and environment for a worse one, death of a close person). Among the four translations of the term *frailty syndrome* into the Polish language – *zespół słabości, kruchości, wątości, zespół wyczerpania rezerw*, the last term can be retranslated into English as “reserves exhaustion syndrome [17].

As there is no gold standard for frailty assessment [18], for the needs of this study, only two evaluation scales will be indicated. They will allow for the assessment of a treated person's current state and, taking into account the earlier observations, for indicating the advancement degree of the disease.

Clinical scale of FS

The clinical 7-degree scale of FS, elaborated by Rockwood et al. [8] describes daily activity and independence:

- Very fit patient: healthy, active, regularly exercising, well-motivated.

- Well patient: without active disease, occasionally active.
- Managing well patient: with well-controlled disease symptoms, not regularly active.
- Vulnerable patient: with not fully controlled disease symptoms, slowed up.
- Mildly frail patient: dependent on others as regards complex instrumental activities of daily living (IADLs).
- daily living (ADL and IADL).
- Severely frail patient: totally dependent on others in daily activities of living or terminally ill.

This FS scale correlates with mortality and the necessity to provide broad aid and care in the processing of the syndrome. According to the research results, the mortality rate among patients in the 4th degree of FS is about 30% and increases in the next degrees to 50%-80% [19].

While defining FS, the research teams of Rockwood [8], Brown [20] and Fried [9] identified disorders with the lack of physical activity. Yet, Lipsits [21] in his definition of frailty draws attention to age and comorbidities.

Cardiovascular Health Study Scale

The most frequent tool for diagnosing FS is *Cardiovascular Health Study Scale*, elaborated by Fried and her collaborators. The scale comprises five physical criteria [9]:

- essential weight loss of 4.5 kg a year;
- weakening, assessed in the handgrip strength measurement with the use of a dynamometer (depending on BMI – for men the handgrip strength smaller than 29-32 kg, for women – smaller than 17-21 kg);
- exhaustion specified with the use of the depression rating scale [22] [access: 13.11.2018]);
- slowed walk pace assessed in corridor tests, measured in the speed of passage (walk time along a 4.57 m section over 6-7 seconds, depending on height and sex, fulfils the criterion of slow walk);
- lowered physical activity – on the basis of *Minnesota Leisure Time Activity Questionnaire* [23].

The FS risk (prefrail) group comprises people who fulfil 1 or 2 criteria, the syndrome is diagnosed after confirming at least 3 out of the 5 aforementioned criteria [13].

Among the population of healthy people, proper functioning is ensured by the ability at the level of 1/3 of the organs, the rest constitutes the so called functional reserve. The adults whose lowered physiological reserve has been confirmed are more vulnerable to ageing and involutionary processes take part faster. Every, even the smallest but an unfavourable, stimulus may trigger off the exceeding of the organism's compensation potentialities in maintaining the homeostasis [15]. Such a stressful stimulus which might result in the limitation of functional reserves in the organism can occur with pneumonia, heart muscle or brain oxygen deficiency, a limb fracture or a depressive episode.

The standard methods of preventing and treating frailty syndrome have not been elaborated so far. What should be applied are only preventive activities aimed at maintaining the physical and mental wellbeing, and in the case of health problems – aimed at preventing the effects and co-occurring complications. Pathophysiology of FS is complex and includes, among other things, metabolic, hormonal and neurohormonal disorders, as well as inflammatory processes and dysfunctions of the immunological system. Moreover, the following is of significance: nutrition disorders, vitamin D deficiency, chronic diseases and passive lifestyle [24]. Physiotherapy and occupational therapy excellently comply with preventive activities and complex treatment of FS.

Prevention and treatment in frailty syndrome

The first issue to be considered at the start of the therapy is the usually complex health condition of the elderly [15]. Due attention should be paid to comorbidities [25], their treatment and prevention of possible injuries. People at advanced age often suffer from nutrition disorders, which might result in both undernutrition and overweightness or obesity. The elderly who make use of physiotherapeutic activities and occupational therapy may introduce changes into their daily functioning. These activities involve the performing of movement exercises, which improve the level of metabolic parameters and individual physical ability, and the verification of the diet [26], which might have significant positive influence on reducing FS risk. It is also important to provide the senior population with the education concerning the conditions of a healthy and active lifestyle, as well as negative, pathogenic factors and the ways of counteracting them. Any

prevention should be oriented towards the prevention of effects and complications. Physical activity and broadly understood complex rehabilitation prevent the loss of the organism's vitality. It also enhances the physical capacity of the elderly, both with and without frailty syndrome [27].

Research reports confirm that appropriately dosed physical activity is beneficial for all age groups, also for people at advanced age, regardless the general health condition and the number and type of chronic diseases. Movement exercises enhance mobility, improve balance and motor coordination, increase the pace of walk, muscle strength and movement range. They also reduce the number of falls, increase mineral bone density, and ease pain in the movement organs. Movement exercises may have a relaxing effect and improve mood and the general frame of mind [4,28]. Physical activity and proper nutrition play an important role in the treatment of elderly patients with FS – keeping and improving fitness should be the superior goal of every member of a team taking care of an elderly person [29]. Both physiotherapy and occupational therapy can substantially help to achieve this aim.

In expert literature, there are many available research results confirming the effects of conducted therapies. Ng et al. [30] indicated an effective intervention among prefrailty patients and patients with full symptoms. The complex therapy comprised: physical training (90 min. twice a week), daily supplementation with vitamins and microelements, and cognitive therapy (2 hours a week). An improvement was noticed, especially in the muscle strength of lower limbs, walk pace, as well as an increase of physical activity and energy balance. More recent studies conducted in 2016 and 2017 [31,32] also confirm the sense of applying complex therapy. In this case, the research comprised physical exercises, nutrition supplementation and, additionally, a social support programme. This resulted in an improved nutritional state (MNA scale) and increased fitness and physical activity. The authors pointed to another important element – the fear of falling had been reduced. Moreover, the therapeutic programme implemented at home decreased seniors' feeling of loneliness and social isolation.

The research programme suggested by Binder et al. [33], conducted for three months (three times a week) and involving exercises with resistance of growing intensity along with the training of coordination, flexibility and speed, increased the muscle strength

of lower limbs of people aged more than 78. Increased muscle strength directly results in seniors' better mobility and certainty of movement. Simultaneously with promoting regular physical activity, the elderly with FS should be taught (in cooking classes) how to prepare meals with appropriate caloric content and how to equalize nutritional shortages. The elderly with confirmed undernutrition or the risk of its occurrence should be provided protein intake of 1.2-1.5 g/kg BW (except patients with advanced renal failure) in three equally spanned meals [34].

Any suggested physical activity during occupational therapy and physiotherapy should be diversified and should involve strength and aerobic training, as well as balance and stretching exercises. In the discussed group, moderate intensity of exercises is recommended, especially in the case of the elderly so far not used to movement. First of all, the effort ought to be focused on, if such a need arises, restoring the ability to perform basic self-service activities by a FS patient. Independence in dressing, washing, using the toilet, eating and the ability to move are the basic skills that enable daily functioning. The other necessary abilities involve more complicated activities of everyday life, such as e.g. shopping, preparing meals, using a phone or a computer, household jobs or gardening. Maintaining these competences on an adequate level or improving them gives seniors a chance to participate in family and social life – sometimes, even to continue their professional work [35]. Therefore, therapeutic classes should take into account the needs and wishes of an elderly person, as they know the best what are the things they cannot handle and what is the most difficult for them. The choice of methods and techniques depends on individual preferences and needs. The major intention of any classes will be improving the functional ability, balance and coordination.

Physiotherapists use the means and methods aimed at maintaining physical ability and they restore it to its maximal level after illnesses, injuries and accidents. Physiotherapy involves kinesiotherapy (movement therapy) and physical therapy (the use of natural or artificially generated physical factors in prevention and treatment). The suggested forms of therapy must be accepted and understood, because the complete knowledge of the therapeutic goals increases the motivation to participate in activities. The process of treatment requires permanent modification to the current state of a patient's health, its progress or regres-

sion. The multitude of available resources in complex physiotherapy allows for adjusting appropriate types of procedures to the direct needs of a senior. Movement exercises and physical therapy (both their frequency and dosing) must enhance the functional state and cannot – in any way – worsen the health condition. In this study, it is impossible to indicate particular exercises or procedures, as their application is always determined by a senior's needs and health condition. The choice of particular procedures largely depends on the physiotherapist's competences.

The occupational therapy addressed to elderly people with FS is a form of support aimed at improving the quality of their functioning. Therapeutic activities may have the form of individual or group classes. Various forms of music therapy, theatre therapy, bibliotherapy, film therapy, painting, cooking activities, games can be used. What is also often offered are the activities associated with gardening, DIY, knitting or sewing, even tourism and recreation. An important element of occupational therapy, especially in group activities, is the rebirth or establishing new interpersonal contacts, which soothes the feeling of loneliness and abandonment. Organizing events and trips in a group efficiently integrates and counteracts isolation. Participation in activities and spending time together in workshops or in open space motivate the elderly to further independent activity. The previously suffered illnesses and injuries result in deficiencies in physical ability and difficulties in functioning. Such situations pose a new challenge for occupational therapists. They should, within their competences, suggest appropriate orthopaedic equipment and teach their patients to perform the activities with the use of these aids. This also concerns the proper adaptation of homes to elderly people's functional ability so that they could participate in activities in fully safe conditions.

Recapitulation

Frailty syndrome is a multidimensional gerontological notion, which has been frequently discussed in works on geriatrics in the last 20 years. Regardless of different definitions, the authors conducting research agree as regards the recognized factors leading to the onset of the syndrome. These are: physical, cognitive, psychological, social, nutritional factors, as well as factors related to old age and multimorbidity. Experiencing old age requires from every person a kind of adjustment to the changes which take place in the

organism with age [36]. Therefore, the replacement of passive adaptation with active one becomes a necessity – physiotherapy, particularly kinesiotherapy with occupational therapy, will enable seniors to maintain more independence in the consecutive decades of life.

The overview of studies on FS indicates the necessity to undertake interventions aimed at eliminating risk factors and functional disorders. Jotheeswaran et al. [37] claim that these undertakings are much more effective among the elderly without comorbidities. Thus, prevention conducted in the population of elderly people may obviate the syndrome or relatively limit its consequences. In the case of diagnosing an initial stage of FS, its reversibility is possible.

The fundamental tasks of physiotherapy and occupational therapy in the complex strategy for prevention and treatment of FS are the following:

- improving functional potentialities of the elderly in everyday life;
- performing group or individual physical exercises (march, dance, cycling, tai-chi, exercises improving motor coordination and balance, stretching, strength training);
- quick recovery after diseases and injuries through appropriate rehabilitation and nutrition;
- good nutritional condition, an adequate diet with large amounts of proteins, vitamins and minerals;
- eliminating stress situations, psychological and social support;
- conducting a hygienic lifestyle with anti-infection prevention [38, 39].

A constant promotion of a high quality life and aiming at the biggest autonomy should become the foundation for all therapies. The FS diagnosis alongside the assessment of the psychophysical state of an elderly person makes it possible to introduce intervention activities. Complex therapies (physical, nutritional, cognitive and more sophisticated interventions) efficiently reduce negative influence of FS and decrease the frequency of syndrome cases [39]. The prevention, proper diagnostics and early recognition of frailty syndrome increase the possibility of finding an individual and targeted therapy. The prevention of unfavourable changes which limit everyday independence must be taken into account and should become the priority in undertaking efforts for a better quality of seniors' life. In the case of an elderly person endangered with frailty syndrome, an early diagnosis and some implemented therapies may become a basic element in preventing

disability, invalidation and full dependence on nursing guardians. In this way, seniors are given a better chance for favourable ageing and general wellbeing [40].

Konflikt interesów / Conflict of interest
Brak/None

Adres do korespondencji / Correspondence address
✉ Jerzy Rottermund
1St. Elizabeth University of Health and Social Work,
Bratislava, Slovak Republic
ul. Słoneczna 20, 43-450 Ustroń
☎ (+48) 668 966 015
✉ jerzy_rottermund@op.pl

Piśmiennictwo/References

- Murray ChJL. Global, regional, and national disability-adjusted life years (DALYs) for 306 diseases and injuries and healthy life expectancy (HALE) for 188 countries, 1990–2013: quantifying the epidemiological transition. *Lancet*, 2015;386:2145-91.
- Gabryś T, Bajorek A, Malinowska-Lipień J. Zespół słabości – zasadniczy problem zdrowotny osób starszych. Część I. *Gerontologia Polska*, 2015;1:21-33.
- van Assen MA, Pallast E, Fakiri F et al. Measuring frailty in Dutch community-dwelling older people: Reference values of the Tilburg Frailty Indicator (TFI). *Arch Gerontol Geriatr*. 2016;67:120-29.
- Rottermund J, Knapik A. Aktywność fizyczna przyczynkiem do satysfakcji w geriatrui. [in:] *Problemy edukacji, rehabilitacji i socjalizacji osób niepełnosprawnych*. Vol. XXI Interdyscyplinarność w opiece i wsparciu osób niepełnosprawnych. (eds.), S. Wrona, J. Rottermund, Wydawnictwo Uniwersytetu Śląskiego, Katowice, 2015;2:57-71.
- Olaroiu M, Ghinescu M, Naumov V et al. Does Frailty Predict Health Care Utilization in Community-Living Older Romanians? *Curr Gerontol Geriatr Res*. 2016. doi: 10.1155/2016/6851768
- Franchini M, Pieroni S, Fortunato L et al. Integrated information for integrated care in the general practice setting in Italy: using social network analysis to go beyond the diagnosis of frailty in the elderly. *Clin Trns Med*. 2016;5:24. doi: 10.1186/s40169-016-0105-6
- Singh M, Alexander K, Roger VL et al. Frailty and its potential relevance to cardiovascular care. *Mayo Clin Proc*. 2008;83(10):1146-53.
- Rockwood K, Song X et al. A global clinical measure of fitness and frailty in elderly people. *CMAJ*. 2005;173(5):489-95.
- Fried LP, Tangen C, Walston J et al. Frailty in older adults: evidence for a phenotype. *J Gerontol Biol Sci Med Sci*. 2001;56(3):M146-57.
- Collard RM, Boter H, Schoevers RA et al. Prevalence of frailty in community-dwelling older persons: a systematic review. *J Am Geriatr Soc*. 2012;60(8):487-92.
- Sánchez-García S, García-Peña C, Salvà A et al. Frailty in community-dwelling older adults: association with adverse outcomes. *Clinical Interventions in Aging*, 2017;12:1003-11.
- Harttgen K, Kowal P, Strulik H et al. Patterns of Frailty in Older Adults: Comparing Results from Higher and Lower Income Countries Using the Survey of Health, Ageing and Retirement in Europe (SHARE) and the Study on Global AGEing and Adult Health (SAGE). *PLoS One*, 2013;8(10):e75847.
- Uchmanowicz I, Jankowska-Polańska B, Łoboz-Rudnicka M et al. Cross-cultural adaptation and reliability testing of the Tilburg Frailty indicator for optimizing care of Polish patients with frailty syndrome. *Clin Interv Aging*, 2014;9:997-1001.
- Kane A, Hilmer SN, Mach J et al. Animal models of frailty: current applications in clinical research. *Clin Interv Aging*, 2016;11:1519-29.
- Dubiel M, Grodzicki T. Zespół słabości i jego potencjalne znaczenie w leczeniu chorób układu krążenia. *Med Dypł*. 2009;18(9).
- Whitson HE, Purser JL, Cohen HJ. Frailty Thy Name Is Phrailty? *J. Gerontology: Medical Sciences*, 2007;62(7):728-30.
- Życzkowska J, Grądalski T. Zespół słabości (frailty) - co powinien o nim wiedzieć onkolog? *Onkol. Prakt. Klin*. 2010;6(2):79-84.
- Searle SD, Mitnitski A, Gahbauer EA, Gill T.M, Rockwood K. A standard procedure for creating a frailty index. *BMC Geriatr*. 2008; 8:24. doi: 10.1186/1471-2318-8-24.
- Rockwood K, Abeysondera MJ, Mitnitski A. How should we grade frailty in nursing home patients? *J Am Med Dir Assoc*. 2007;8:595-603.
- Brown M, Sinacore DR et al. Physical and performance measures for the identification of mild to moderate frailty. *J Gerontol A Biol Sci Med Sci*. 2000;55(6):M350-55.
- Lipsitz LA. Dynamice of stability: The Physiologic Basis of functional health and frailty. *J Gerontol Biol Sci*. 2002;57A(3):B115-25.
- Center for Epidemiologic Studies Depression Scale, CES-D Digital Object Identifier (DOI): <http://dx.doi.org/10.13072/mids.120> [access: 03.03.2021].
- Pereira MA, FitzGerald SJ, Gregg EW et al. A collection of Physical Activity Questionnaires for health-related research. *Med Sci Sports Exerc*. 1997; (6 Suppl): S1-205.
- Chen X, Mao G, Leng SX. Frailty syndrome: an overview. *Clin Interv Aging*, 2014;9:433-41.
- Salive ME. Future Research Directions for Multimorbidity Involving Cardiovascular Diseases. *Clin Geriatr Med*. 2016;32(2):399-407.
- Jajor J, Nonn-Waszan S, Rostkowska E, Samborski W. Specyfika rehabilitacji ruchowej osób starszych. *Nowiny Lekarskie*, 2013;82(1): 89-96.
- Gill TM et al. Trajectories of disability in last year of life. *N Engl J Med*. 2013;362(13):1173-80.

28. Rottermund J, Knapik A, Wąsiński A, Szyszka M. Motywowanie osób starszych do aktywności fizycznej. [in:] Szyszka J, Dancik P, Wąsiński A, Daszkowska J.(eds.), Instytucjonalne i pozainstytucjonalne formy wsparcia osób starszych. Katolicki Uniwersytet Lubelski Jana Pawła II, Stalowa Wola-Bratysława, 2014:175-88.
29. Bujnowska-Fedak MM, Machaj Z, Steciwko A. Pacjent z zespołem słabości w praktyce lekarza rodzinnego. *Terapia*, 2013; 2(284): 20-27.
30. Ng TP, Feng L, Nyunt MS et al. Nutritional, Physical, Cognitive, and Combination Interventions and Frailty Reversal Among Older Adults: A Randomized Controlled Trial. *Am J Med*. 2015;128(11):1225-36.e1.
31. Luger E, Dorner TE, Haider S et al. Effects of a Home-Based and Volunteer-Administered Physical Training, Nutritional, and Social Support Program on Malnutrition and Frailty in Older Persons: A Randomized Controlled Trial. *J Am Med Dir Assoc*. 2016;17(7):671.e9–671.e16.
32. Kapan A, Luger E, Haider S. Fear of falling reduced by a lay led home-based program in frail community-dwelling older adults: A randomised controlled trial. *Arch Gerontol Geriatr*. 2017;68:25-32.
33. Binder EF, Yarasheski KE, Steger-May K et al., Effects of progressive resistance training on body composition in frail older adults: results of a randomized, controlled trial. *J Gerontol A Biol Sci Med Sci*. 2005;60(11):1425-31.
34. Deutz NE, Bauer JM, Barazzoni R et al. Protein intake and exercise for optimal muscle function with aging: recommendations from the ESPEN Expert Group. *Clin Nutr*. 2014;33(6):929-36.
35. Rottermund J, Nowotny J. *Terapia zajęciowa w rehabilitacji medycznej. Podręcznik dla studentów i terapeutów. Wydanie II, poszerzone*, Alfa-medica Press, Bielsko-Biała, 2020.
36. Janus E. Psychologiczno-społeczne aspekty starzenia się i starości. [in:] *Terapia zajęciowa w geriatrici*. (eds.), E. Janus, A. Bac, A. Kulis, A. Smrokowska-Reichman. Wydawnictwo Lekarskie PZWL, Warszawa, 2017:11-36.
37. Jotheeswaran AT, Dias A, Philp I et al. Identifying common impairments in frail and dependent older people: validation of the COPE assessment for non-specialised health workers in low resource primary health care settings. *BMC Geriatr*. 2015;15:123. doi: 10.1186/s12877-015-0121-1
38. Lang PO, Michel JP, Zekry D. Frailty Syndrome: A Transitional State in a Dynamic Process. *Gerontology*, 2009;55(5):539-49.
39. Bujnowska-Fedak MM, Waligóra J, D'Avanzo B et al. Approaches to therapy and prevention of frailty in the light of contemporary medicine. *Family Medicine & Primary Care Review*, 2017;3:289-97.
40. Knapik A. Jak starzeć się pomyślnie: aktywny senior dla siebie, rodziny i społeczności. [in:] *Determinanty pomyślnego starzenia się seniorów aglomeracji śląskiej*. (red.), C. Marcisz, A. Brzęk, A. Knapik. ŚIUM, Katowice, 2018:50-60.