

PALACKÝ UNIVERSITY OLMOUC

FACULTY OF HEALTH SCIENCES

Physiotherapy in Frail Individuals

Bachelor thesis

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Olomouc 2024

Annotation

Type of final project: Bachelor thesis

Topic of the final project: Frailty in older age

Title of the bachelor thesis: Physiotherapy in Frail Individuals

Title of the bachelor thesis in Czech: Fyzioterapie u křehkých jedinců

Date of assignment: 30. 11. 2023

Date of submission: 20. 5. 2024

School, Faculty, Department: Palacký University in Olomouc, Czech Republic

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Abstract:

The bachelor thesis deals with geriatric frailty. It consists of an analysis of the available literature related to this issue. It comprehensively covers individual aspects related to aging, the definition of geriatric frailty and possible measurement methods. The main part is then focused on possible physiotherapy approaches that lead to successful management of geriatric frailty and its possible prevention.

Abstract in Czech:

Bakalářská práce se zabývá geriatrickou křehkostí. Skládá se z analýzy dostupné literatury související s touto problematikou. Komplexně pokrývá jednotlivé aspekty související se stárnutím, definicí geriatrické křehkosti a možných metod měření. Stěžejní část je poté zaměřena na možné přístupy fyzioterapie, které vedou k jejímu úspěšnému zvládnutí i možné prevenci.

Keywords: Aging, geriatric frailty, frail individual, physiotherapy, physiotherapy in frail individuals

Keywords in Czech: Stárnutí, geriatrická křehkost, křehký jedinec, fyzioterapie, fyzioterapie u křehkých jedinců

Number of pages: 47

Declaration

I hereby declare that this thesis entitled **Physiotherapy in Frail Individuals** was written and completed by me personally. I also declare that all the sources and information used to complete the thesis are included in the references. I agree that the thesis could be made public in accordance with Article 47b of Act No. 111/1998 Coll., Higher Education Institutions and on Amendments and Supplements to Some Other Acts (the Higher Education Act), and in accordance with the current Directive on publishing of the final thesis.

I agree to making the work available for study purposes at Palacký University.

In Olomouc on 20.5.2024

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Acknowledgment

I would like to thank Mgr. Petra Gaul Aláčová, Ph.D. for a helping hand and a lot of advice during the whole study. At the same time, I would like to thank my family and friends for their help during my studies.

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Introduction

Aging is a natural phenomenon that occurs in human life. It is a complex process that affects many aspects of daily life and coping with normal daily activities to a significant degree. Ageing is a highly debated topic in contemporary society. The reason for this is the relentlessly increasing proportion of adults over 65 years of age in the total population. Together with the declining birth rate and the increase in the older population, a social problem of a global nature is taking shape which humanity will have to face in the future. It is because of the overlapping nature of this issue that led me to the decision to dedicate this work to investigating the characteristics, causes, measurement, and physiotherapeutic possibilities for geriatric frailty.

The changes that occur in the aging process are physiological, but (at the same time they have a significant impact on our psyche) also psychological. Both our thinking and physical activity are affected by this process. It is physical activity, or rather its limitations, in the form of geriatric frailty that is the main topic in this bachelor thesis. Patients suffering from frailty are characterized by diminishing muscle mass, reduced strength, endurance, and impaired balance, associated with a greater susceptibility to falls.

Geriatric frailty is a very complex issue, where not only the age of the individual plays a role, but his overall resilience to external influences. This very age has many forms and shapes, in the context of the bachelor thesis it is referred to as biological age. To grasp the correct definition of old age as it is understood in this bachelor thesis, a separate subchapter is devoted to this issue.

It is also crucial to distinguish between geriatric and frail patients to properly handle frail individuals. It is this distinction that is important for the correct application of the physiotherapy approach, as not every geriatric patient is necessarily a frail patient. However, the problem does not end with this distinction, as it is also crucial to correctly determine the degree of geriatric frailty in patients. There are several approaches how to determine this. Examples include the frailty deficit accumulation model and the frailty phenotype, which, although looking at frailty based on different parameters, are important tools in the assessment of frailty.

The physiotherapy for frail individuals can take many forms. When choosing a possible physiotherapy intervention, it is important to have a comprehensive focus and the right choice of physical activity to improve the quality of life of the frail individual. The motivation of the patient, the importance of the role of the family and the constant maintenance of physical health throughout life are also frequently discussed approaches in the case of physiotherapy. Hence, the importance of physiotherapy as a kind of stabilising element throughout the life of the individual has been linked here.

I firmly believe that physiotherapy in frail individuals, preventive measures and an active lifestyle are not only the right way to manage already developed geriatric frailty, but also a necessary component that is more than desirable to implement throughout a person's life. As already mentioned once in this thesis, geriatric frailty is, and very likely will be in the future, a global problem. I see physiotherapy as one possible tool that leads to minimizing the impact of the problems of a globally aging population.

The literature review was based on the articles and publications listed in the literature review section. The search strategy led to the use of both online and offline sources. The online sources used were searched through Google Scholar, Science Direct, PubMed and ResearchGate. A total of 55 articles and 5 book sources were used. All sources were written between 1981-2024.

1 Literature Review

This section comprises the main body of the thesis. The individual chapters will be discussed so that together they form a coherent body of knowledge to grasp the issue of frail patients and possible physiotherapy approaches.

1.1 Aging Process

It is important for this thesis to first define the basic concepts that are associated with the issue of frailty of individuals and their physical activity. Fundamental factor in the development of frailty syndrome is the aging process. Aging is a process in which a continual accumulation of changes occurs over time, which go hand in hand with an ever-increasing susceptibility to various diseases or death that accompany or cause advancing age (Denham, 1981). With increasing age, several physiological systems gradually decline structurally and functionally, even in the absence of serious diseases. Because of these age-related physiological changes, organ systems and their functions are affected, as well as number of other tissues that can affect activities of daily living and the maintenance of physical self-sufficiency in older adults (Wojtek et al., 2009).

Aging is a major factor in the development of age-related diseases affecting not only various organ systems such as musculoskeletal, nervous, cardiovascular, immune but also involved in the development of cancer (Li et al., 2021).

1.1.1 Types of aging process

Chalise (2019) in his article mentions the classification of five different types of aging. These are chronological, biological, psychological, social and functional ageing. The different types are discussed in more detail in the following section of the paper.

Chronological ageing is determined by the number of years a person has lived. If a person's chronological age is ten years older than someone else's, it does not necessarily mean that they will look older. The fact that someone appears older than their chronological age is dependent on biological, psychological, and social age. Therefore, it is possible to conclude that chronological age only reflects the number of years an individual.

In the case of biological ageing, cell loss occurs over time. Biological ageing can sometimes be thought of as physical/physical ageing. Biological ageing is characterised by a reduced ability of organs, tissues, reparative processes, and the immune system to function effectively, leading to a greater susceptibility to infection. In addition to external biological changes such as changes in hair, nails and skin, changes in the sensory organs also occur. The quality of vision, the perception of taste and smell changes, and hearing also deteriorates. Other organ systems - cardiovascular, respiratory, gastrointestinal, musculoskeletal, and urinary tract - are also negatively affected.

In the case of psychological ageing, there are personality changes, memory impairment, reduced learning ability, a decline in intelligence, or difficulties in coping with problems. Difficulties with memory or learning may be influenced by medication, depression, illness, stress or deficits in vision and hearing.

Social ageing involves not only assumptions about an individual's age-appropriate behaviour, but also about the relationships and roles that change with age. People of retirement age must deal with loneliness caused by children leaving home retirement and the loss of friends. The above shows that it is not only the older person's social life that is changing, but also the way society views the older person. It can therefore be said that older people are becoming a more vulnerable group and can therefore easily become, for example, the target of fraud and abuse. Functional ageing is based on comparing an individual with another person of a similar age.

1.1.2 Classification of the older adults

The distribution of the older adults may vary depending on the source or author chosen. The different types of classification are listed below.

Topinková and Neuwirth (1995) mention a general division into three basic age categories for older adults, which describes a time range to understand the range of old age. The age range between 65 - 74 years is referred to as young old. The range 75 - 84 years is referred to as old. Those aged 85 years and above are referred to as very old.

The National Service Framework for Older People (2001) indicates that older people are a heterogeneous group, and their range of needs is wide, yet offers a further variation

of dividing older people into three categories. It also describes the general health and social policy objectives that are specific to each group of older people.

Entering old age is a group where individuals have finished their working career or raising children. Therefore, the category consists of people in their 50s or after official retirement. These individuals maintain their independence and activity mostly until advanced age (late old age). Health and social policy aim to prolong the active life and health of the individual.

The next group is referred to as the *Transitional phase*, which describes the transitional boundary between a healthy, active life and frailty. These are mostly individuals in the age range of 70-89 years. However, this transition can occur at any time during the older age phase. Health and social policy here focus on early recognition and addressing possible causes that could result in the individual's impaired self-sufficiency.

The third group is *Frail older people*. This group is adversely affected by their mental or medical condition, their need for social care or a combination of all these factors. In most cases, frailty does not become apparent until late old age. Health and social policy seek to predict and address problems that may adversely affect an individual's quality of life.

1.1.3 Aging of society in the Czech Republic

The following table shows the medium variant values of the population aged 65 and above for both sexes in the Czech Republic. The actual values are shown in 2019 and 2023. The values in 2024, 2031, 2041 and 2051 are a prediction of the possible future aging of population in that age category.

Tab. 1 Development of the Czech population aged 65 and over (as of 1 January, in thousands), (ČSÚ, 2023)

| The age group/ Year | 2019 | 2023 | 2024 | 2031 | 2041 | 2051 |
|--------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|
| 65+ total | 2 086.6 | 2 207.8 | 2 240.2 | 2 399.7 | 2 743.0 | 3 096.8 |
| Proportion of 65+ year olds | 19.6% | 20.4% | 20.5% | 22.3% | 25.6% | 29.0% |
| 65–69 | 679.9 | 653.0 | 637.6 | 608.8 | 789.8 | 693.6 |
| 70–74 | 589.9 | 612.9 | 612.5 | 537.7 | 576.8 | 758.0 |
| 80–84 | 229.2 | 267.1 | 287.8 | 420.0 | 391.8 | 446.4 |
| 85–89 | 142.2 | 133.6 | 137.4 | 209.9 | 299.5 | 311.2 |

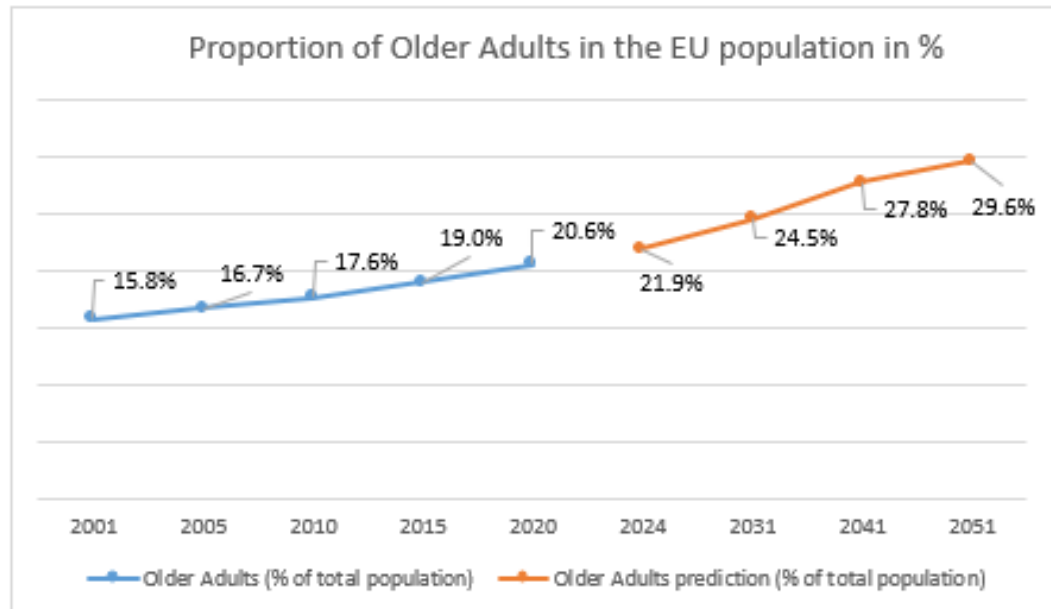
Based on the predicted values in the table, a continually increasing trend of population ageing can be observed. In 2051, the population in the Czech Republic aged sixty-five and over is expected to increase by 8.6%, which is approximately 889 000 more than in 2023. According to the National Health Information Portal, geriatric frailty affects approximately 7% of older adults (NZIP 2024). Since the number of people with geriatric frailty increases with the increasing number of people of retirement age, if the predicted numbers from the table are included, it could be assumed that in 2051 there could be about 216 776 patients suffering from geriatric frailty in the Czech Republic.

1.1.4 Aging in European Union and Worldwide

According to information available on the Eurostat Statistical Explained (2024) website, the EU age pyramid is changing. Low birth rates, together with higher life expectancy, are contributing to its formation. However, the most significant change is attributed to the increase in the structure of the older population. It can be said that the proportion of people of working age is declining at the expense of the growing number of people of retirement age. This phenomenon will result in an increase in the financial burden on people of working age, the reason being to provide the social expenditure linked to the ageing population.

As of 1 January 2023, there were 448.8 million people in the European Union (Eurostat Statistical Explained, 2024). The EU population is estimated to peak in 2026 (453.3 million). In 2050 it is estimated to decrease to 447.9 million (Eurostat, 2023).

Information on the proportion of the population over 65 years of age is provided by Eurostat (2020). The graph below shows a noticeable increase in the population aged 65+ over the years (as % of the total population).



Pic.1 Proportion of Older Adults in the EU population in % (Eurostat, 2024)

Putting the above data into context, it is possible to say that approximately 132.6 million EU citizens will be over the age of 65 in 2050. According to the Eurostat (2020) predicts, in 2100 a total of 69% of the EU population will be of working age (up to 64 years), 11% between 65 and 74 years, 11% between 75 and 84 years and 9% over 80 years. The ageing situation is predicted to be most severe in Poland, where the percentage of the population over 65 years of age in the total population of Poland is expected to reach almost 34%, which will put it above the EU average of 31% (Eurostat, 2020).

If we use the simplifying fact that 7% of the older adults in the Czech Republic are also frail, a total of 9.2 million people in the EU will face this syndrome in 2050.

However, population ageing is not typical only for the European Union and the Czech Republic.

According to the United Nations (2023), it is an irreversible global trend, characterised by longer life expectancy and smaller families. It is thus possible to observe

a worldwide decline in the proportion of young people, while the proportion of people of working age and the proportion of the older adults is increasing. Compared to the figures measured in 2021 for the number of people aged 65 and over in the total population, this group is expected to double in 2050, from 761 million to 1.6 billion. This means that 1 in 6 people will be over 65 (currently 1 in 10). It is the current and future growth of the population over 65 that adds to the importance of health promotion, prevention, and treatment of disease throughout a person's lifetime (United Nations, 2023).

1.2 Geriatric medicine

This part of the thesis is primarily concerned with defining, explaining the objectives, and describing the importance of the field of geriatrics and the multidisciplinary team, including a description of the geriatric patient.

The origin of the word "geriatrics" comes from Greek. The name is formed by combining the words "geros" meaning old person and "iatros" meaning healer (Burton and Mulley, 2003).

Kotsani et al. (2021) explain the term geriatric medicine as a medical discipline that deals with the older patients in terms of physical, psychological, functional, and social factors at different stages of care. The stages of care are acute, chronic, rehabilitative, preventive including end of life care for the older adult patient. In the article, Geo (2023) views geriatrics as a specialized medical field focused on the well-being and health of the older adults. It is further stated that due to the global increase in the number of older adults, geriatrics is gaining importance. Kalvach et al. (2008) describes geriatrics as a complex field with general internal medicine as its foundation, which further extends into other disciplines such as neurology, gerontopsychiatry, rehabilitation and nursing. The European Union of Medical Specialists (2021) states that the different manifestations of diseases in old age complicate early diagnosis, resulting in delayed treatment accompanied by the need for social support. The above-mentioned facts make geriatric medicine more complex than organ-oriented medicine and require a multidisciplinary team.

1.2.1 Multidisciplinary team

Kotsani et al. (2021) describe a multidisciplinary team as a team of health professionals who are tasked with performing a complete examination and then implementing the established treatment plan. Members of such a team include mainly geriatricians, social workers, nutritional therapists, physiotherapists, occupational therapists, nurses, speech therapists and clinical pharmacists. For example, dentists and other medical specialists may also be involved on request. The aim of geriatric medicine, led by a multidisciplinary team, is to improve the functional status, quality of life and increase the self-sufficiency of the older patient (European Union of Medical Specialists, 2021).

1.2.2 Comprehensive Geriatric Assessment (CGA)

The term Comprehensive Geriatric Assessment, or CGA for short, is a multidimensional interdisciplinary examination that focuses on the assessment of the patient's medical, psychological, and physical functions as well as socioeconomic problems. The goal is to uncover non-specific problems and develop a coordinated long-term treatment and care plan (Parker et al., 2018).

The classical biomedical model, which focuses on the disease and only on the physical examination, is not sufficient in the case of older adult patients because of their complexity and diversity. Due to the presence of chronic and multiple medical complications, the diagnosis does not give us a full picture of the severity of the functional and psychosocial consequences of the disease. In the context of geriatric medicine and the frail patient, more emphasis is placed on the overall health status. Overall health status is a more important indicator because it assesses the extent to which the disease affects the patient and his or her well-being, and ability to adapt to the environment, which in effect means that it is more comprehensive than the diagnosis itself. For this reason, the CGA is essential for assessing any areas of potential concern that may result in the older adult patient developing frailty. Theoretically, the results of a properly performed CGA could be, for example, to improve diagnosis, improve quality of life, optimize treatment, restore, or maintain autonomy, and reduce treatment costs (Bernabei et al., 2000).

1.2.3 Geriatric patient

According to Kalvach et al. (2008), the concept of a geriatric patient is not clearly defined, but they give examples that can bring the understanding of this topic closer.

Broadly speaking, a geriatric patient is defined as an ill older person who has reached a certain age. In economically developed countries, the age limit is above 75 years of age. This threshold is steadily moving up to 80 years, due to the improving health of the older adults. However, 65 is considered the lowest age for inclusion in geriatric programmes associated with the development of age-related diseases.

More narrowly, it is mainly the older adults who show an age-related decline in health potential resulting in the development of specific health problems.

1.2.4 Geriatric syndrome

Kalvach et al. (2008) outline possible approaches for defining geriatric syndromes. The first approach views geriatric syndrome as individual symptoms and health problems that are common and significant in geriatric patients. Another approach explains geriatric syndrome as more complex set of problems with internal interdependence, such as anorexia-malnutrition syndrome.

According to Inouye et al. (2007), the term geriatric syndrome is used to capture clinical conditions of older adult patients that cannot be classified into specific disease categories. However, they add that the term is not well defined. They also describe specific clinical aspects related to geriatric syndromes. One of these clinical aspects of a given geriatric syndrome is the presence of multiple risk factors and the involvement of multiple organ systems. Another aspect is the challenging and costly diagnostic procedures that may not be effective. They further argue that even if the exact diagnosis or cause of the syndrome are not established, therapeutic management of the clinical manifestations can help.

Kolář et al. (2020) mentions the most common geriatric syndromes, which include: anorexia with weight loss, hypomobility with deconditioning, muscle weakness, instability with falls, immobility, cognitive deficits, behavioural disorders, incontinence, and terminal geriatric deterioration.

1.3 Frailty

According to Qian-Li Xue (2011), geriatric frailty syndrome is defined as a clinical condition of increased vulnerability due to loss of supply and functions in various physiological systems due to the aging process. This means that there may be an impaired ability to cope with acute or everyday stressors. De Labra et al. (2015) add that frailty is a multi-component concept in which many domains are affected, such as gait, mobility, balance, muscle strength, motor processing, cognition, nutrition, endurance, and physical activity. Frailty is directly related to negative outcomes such as falls, disability, long-term care, hospitalisation, and mortality. Fried et al. (2009) state that aging is a prerequisite for frailty, but this does not mean that every aging individual is frail. Frailty increases with age, but this is not an absolute precondition.

Kalvach et al. (2008) mention in their book that a certain number of authors treat geriatric frailty only as a separate geriatric syndrome. This leads to a situation in which frailty syndrome is placed at the level of other syndromes. Frailty syndrome is thus equated by these authors with syndromes such as delirium, incontinence, etc. Hence, in this presentation, frailty is not understood as a global concept.

The above information is confirmed by Lee et al. (2020), who state in their article that the most accepted frailty measurement tools include the frailty definition phenotype and the frailty deficit accumulation. They further add that the fundamental difference between these two models of frailty is in the interpretation of aging and the mechanism of frailty.

The model of the frailty phenotype developed by Fried and colleagues views frailty as a biological syndrome of reduced physiological reserve. Consequently, there is a reduction in resilience and adaptive capacity, resulting in increased vulnerability to stressors and the development of the physical characteristics of frailty (Lee et al. 2020). According to Avers and Wong (2020) model of the frailty phenotype includes a total of five attributes of frailty. They list them as follows:

1. unintentional weight loss
2. self-exhaustion
3. muscle weakness

4. slow walking speed
5. low physical activity

This model is commonly used by physiotherapists as it appears to be useful in their practice. The usefulness then lies in the ability to influence all five of the above attributes. Avers and Wong (2020) further state in their publication a total of three categories of the frailty phenotype model:

1. not frail (zero characteristics)
2. prefrail (one to two characteristics)
3. frail (three or more characteristics)

The second model is the accumulation of frailty deficits, also known as the Frailty Index. The essence of this model, which was developed by Rockwood and colleagues, is based on the accumulation of age-related health, functional, and psychosocial deficits. The more deficits a person has, the greater the likelihood of adverse health outcomes (Lee et al. 2020).

The Frailty Index contains seventy items. It has been found that individuals who have four or more comorbidities are forty times more likely to be frail. The fundamental difference between the two models is that the frailty deficit accumulation model, considers any clinical indicator that is associated with a negative health outcome as a clinical deficit. In contrast, the frailty phenotype focuses only on five physical attributes that are the main indicators of frailty according to this model (Avers and Wong, 2020).

In the case of Frailty Index, it seems appropriate to also mention the existence of the Electoral Frailty Index. This instrument is also used to accumulate the frailty deficit. In total, the index uses 36 potential deficits from which the clinician can obtain a final frailty score for the patient. By this score, the patient is then classified as frail, mildly frail, moderately frail or near end of life (Healthcare Improvement Scotland, 2023).

Kalvach and Holmer (2008) describe the origin of frailty syndrome as a phenomenon that is conditioned by multiple causes and is also individually variable for everyone. Factors of biological involution, multimorbidity, adverse effects of medications, deconditioning to atrophy due to inactivity, psychosocial factors, genetic predisposition,

and challenging environments with barriers or handicapping situations are involved in the onset of the syndrome.

He further states that in frailty, there is a gradual cycle that decreases the health of an individual. For example, reduced mobility, for whatever reason, causes deconditioning with accompanying muscle weakness, which again leads to impaired mobility, which in turn negatively affects muscle strength and fitness. They describe that the frailty worsens over time, and there is a loss of resilience and ability to contribute to the whole body.

Kolář et al. (2020) confirm the above as they argue that geriatric frailty is complicated to translate into practice and quantify due to the spiralling nature of development and interacting elements. The issue of geriatric frailty has been studied in detail since the 1990s. Currently, it is one of the most discussed topics in the field of geriatrics (Nováková, 2012). As a result of aging, people begin to experience physical and psychological changes more frequently. Among the most important changes associated with aging are:

- Mental changes: apathy, exhaustion
- Physical changes: hypomobility, instability
- Nutritional changes: weight loss

The syndromes of greatest importance in relation to rehabilitation are hypomobility, deconditioning, muscle weakness, immobility, and instability with falls (Kolář et al., 2020).

1.3.1 Recognition and diagnosis of Frailty

The recommended methods of testing for frailty are the gait speed test, the TUGT (timed up and go test) or the PRISMA 7 questionnaire. In the following section, the individual testing methods are discussed in more detail.

- Gate speed test - This is a test assessing the patient's functional mobility. The principle is to assess the number of metres the patient is able to walk in a period of time (Mehmet, 2020). According to Avers and Wong (2020) 90% of frail patients have a walking speed < 0.8 m/s.

- Timed Up and Go Test - This test again examines an individual's functional mobility. As part of the test, the patient is seated in a chair, then asked to rise from the chair, walk 3 m to a pre-set marker, and then return to the starting point. Here the patient is asked to sit again. The resulting score is then the time required to perform the task (Ferrucci, 2007). According to Avers and Wong (2020), they set a time of 10 s for the recognition of frailty. Thus, if the patient performs the test for more than 10 s, he is considered a frail individual.
- PRISMA 7 - This is a test in the form of questionnaire questions. The respondent/patient is asked a total of 7 closed-ended questions to which he/she answers True or False. An example question is: Are you over 85 years old? Do you have any health problems in general that have forced you to limit your physical activities? (Raïche, 2007). In case the patient answers Yes to 3 or more questions, there is an increased risk of frailty (Salaffi, 2020). According to Avers and Wong (2020), the PRISMA 7, combined with sound clinical judgment and the use of the frailty phenotype, ranks as one of the best tests for examining frailty. This claim is validated by the British Geriatrics Society. However, even here, the authors mention the negative side of its use, due to its broad concept and possible unreliability.

However, the issue of recognition frailty in the older adults is a complex topic. The Centre for Reviews and Dissemination (2017) states that a pitfall of diagnostic tests is when commonly applied tests are sensitive and can thus identify more patients with frailty. To maintain their relevance, it is recommended to combine the aforementioned tests (Center for Reviews and Dissemination, 2017):

- Informal gait assessment
- By formal gait assessment - In this case, a criterion is set where the patient should be able to walk 5 m in 4 s.
- Personal assessment of their own health - In this case, the patient is asked to rate their own health on a scale of 1 to 10.

1.3.2 Grading Severity of Frailty

In this section, models of frailty are linked together with their examination. The Frailty Phenotype, Frailty Index, Clinical Frailty Scale (Avers and Wong, 2020) or the Electronic Frailty Index (Center for Reviews and Dissemination, 2017) can be used as assessment scales.

- The basic information regarding the Frailty Phenotype is already described above in the chapter dealing with frailty.
- The Frailty Index is also described in the chapter under frailty models.
- The Clinical Frailty Scale was created by the authors of the Frailty Index. Compared to the classic Frailty Index, it is intended to be a more user-friendly version of the Frailty Severity Score (Avers and Wong, 2020). The Index describes the condition of an individual on a scale of 1-9. Grade 1 here represents "Very Fit", which means that individuals who are energetic, active and engage in physical activity and exercise on a regular basis fall into this category. As each number on this scale moves upwards, the condition described becomes progressively worse. Physical activity decreases, medication increases, and consequently vulnerability increases and the ability to manage daily activities decreases. Furthermore, the need for assistance from another person increases. This frailty rating scale ends at level 9, which indicates a "Terminally ill" individual. These individuals have a life expectancy of less than 6 months but are not obviously frail.

1.4 Geriatric syndromes related to Frailty

1.4.1 Hypomobility syndrome

This term is understood as both limited mobility and a small amount of physical activity. Hypomobility is a complex geriatric syndrome that is caused by multiple factors, including physical, psychological, social, and environmental factors. Specific examples of the origins of the development of hypomobility include motor discomfort, loss of motivation, depression, instability, and a safety-inappropriate external environment. However, the above list is far from complete, as the author himself states that there are

nearly 20 common causes that can lead to the development of hypomobility itself (Kalvach et al. 2008).

Kolář et al. (2020), among others, see the cause of hypomobility in a lifelong aversion to physical activity. It also highlights the effect of the deterioration spiral. He describes that hypomobility, as such, subsequently leads to deconditioning, muscle weakness and negative changes in the movement stereotype, which in turn leads to a subsequent intensification of hypomobility.

1.4.2 Deconditioning syndrome

Deconditioning syndrome is described as a marked decrease in endurance, but usually this condition is accompanied by impaired skeletal muscle strength performance. Deconditioning is an important component of geriatric frailty. The occurrence of deconditioning in the older adults is attributed to severe hypomobility, but also to prolonged immobilization in bed. This complex process has a negative impact on several systems and functions. Maximal oxygen consumption and blood pressure decrease, the overall structure of the cardiovascular system changes, and there is a loss of slow-twitch muscle fibres in the muscles (Kalvach et al., 2008).

The loss of muscle mass and strength contributes to the development of involuntional sarcopenia. The normal activities and physical activities that the older adult used to perform without problems are getting above 70% of his maximum aerobic capacity. This creates considerable discomfort during exertion, accompanied by shortness of breath, sweating and palpitations. For this reason, the older adult needs to rest for a longer period. In most cases, this motor discomfort leads to a reduction in the physical activity of the older adults, resulting in a deepening of deconditioning and the development of a deterioration spiral (Kalvach et al., 2008).

1.4.3 Sarcopenia

Kabelka et al. (2022) explain the concept of sarcopenia as a degenerative process in which muscle mass is lost along with muscle quality. This means that skeletal muscle strength is negatively affected. Sarcopenia has a significant effect on protein metabolism. At the same time, protein metabolism affects the formation of skeletal muscle.

Sarcopenia is prevalent among older adults and is associated with many clinical consequences such as prolonged hospital stay, repeated hospital admissions, reduced quality of life, susceptibility to falls, fractures and increased mortality (Alhmly and Fielding, 2023).

According to Gray et al. (2021), sarcopenia is the result of biological changes at the level of muscle structure as well as hormonal imbalances. Kolář et al. (2020) confirm this statement and add that chronic inflammation, malnutrition, vitamin D deficiency and inadequate muscle activity are the main causes of the decline in muscle performance. Both authors agree on the complex pathophysiology.

Sarcopenia is divided into primary and secondary. Primary is linked to the aging process (age-related) without other causes. If other processes develop, e.g. diseases, inflammation or the influence of immobility and protein malnutrition, we speak of secondary sarcopenia. Another possibility of division is into acute and chronic, acute being defined by a period of half a year. When the time limit is exceeded, we speak of the chronic stage (Kabelka et al. 2022).

Sarcopenia together with frailty are interrelated and significant conditions affecting functional independence (Evans et al. 2010).

1.4.4 Instability syndrome with falls

According to Kalvach et al. (2008), instability is one of the main priorities of geriatric medicine and within the complexity of geriatric frailty, it has a direct link with other geriatric syndromes, which include mainly hypomobility, deconditioning and muscle weakness (sarcopenia) syndromes, as well as syndromes such as depression, malnutrition, and anxiety.

The following is basic information on postural control together with the systems involved. Risk factors leading to falls are also described.

Avers and Wong (2020) explain the concept of postural control as setting the center of gravity over the base of support. This continuous adjustment occurs in both static and dynamic situations. The main systems involved in postural control are the central nervous system, the neuromuscular system, and the sensory system. They also describe that all systems are affected by changes caused by aging, and although deficiencies in one

component of postural control do not necessarily mean that instability develops, the effect of combined deficits in multiple systems can lead to instability and falls.

The American Academy of Neurology (2008) mentions a general definition of falls that describes a fall as a sudden and unintended situation in which a person hits the ground. It includes dementia, stroke, gait problems, and balance problems among the diagnoses that are at increased risk for falls. There is a possible increased risk for people with Parkinson's disease, nerve damage, weakness, or loss of feeling in the lower limbs and people who use walking aids such as a cane or walker.

Kabelka et al. (2022) report that injuries from falls are accompanied by a risk of death or death from subsequent complications in up to 10% of falls. It also describes the risk factors involved in the occurrence of falls and categorizes them as follows:

Behavioral - this group includes mainly increased alcohol intake, insufficient physical activity, loss of muscle strength, poorly chosen footwear. At the same time, demotivation and life frustration are also included in this group.

Risk medications - the author mentions here various types of medications and gives as example antiepileptics, benzodiazepines, antiarrhythmics and diuretics. He also adds that in the case of patients with frailty syndrome, it is recommended to keep blood pressure values above 140/80 mmHg.

Biological - age, gender, race, physical decline, impaired visual acuity, as well as chronic diseases or strokes and neurodegenerative diseases, are considered biological factors.

Environmental - these risk factors include poor lighting, uneven surfaces, slippery surfaces or even obstacles while walking at home.

Socio-economic - social isolation, lack of finances for care, improper furnishings with inappropriate home settings are other potential risk factors.

1.5 Physiotherapy

The origin of the term Physical Therapy or also Physiotherapy comes from the combination of the Greek words "physis", which means natural strength and "therapeia", which means healing (Kolář, 2020).

World Physiotherapy (2023) describes physiotherapy as providing a service that has, as its main objective, to maintain, develop, and restore functional and motor skills throughout the course of life. This is provided by physiotherapists to individuals and populations when movement and function are adversely affected by, for example, the aging process, injury, pain, disease, as well as environmental factors. In addition to the interaction between the physiotherapist and the patient or client, physiotherapy also involves contact with other health professionals, family, and care providers. Thanks to this interaction, it is possible to assess movement potential and set goals using knowledge that is unique to the physiotherapist. Physiotherapists focus on maximizing quality of life and movement potential in support, prevention, treatment, and rehabilitation.

A complementary but equally important factor in the treatment of the geriatric patient, is motivation. It is the patient's motivation that remains as a crucial point for the application of successful physiotherapy techniques. The reason behind the importance of motivation is to gain patient's cooperation, which in turn plays a big role in patient engagement and ultimately influences the outcomes of physiotherapy. In the area of motivation, the patient's family is an important link to achieve it, as they can reassure the patient of its usefulness and importance (Nováková, 2012).

Nováková (2012) further adds that in terms of motivation, the situation is most difficult for a patient who lives a lonely life (without family or partner).

1.5.1 Physical activity

Another important component that needs to be defined is physical activity. According to the World Health Organization, physical activity is defined as any movement that requires energy expenditure and is performed using skeletal muscle. Therefore, physical activity is not only movement for activities such as running, cycling or any kind of sports, but also movement for transport purposes such as to work. It also claims that regular physical activity has been shown to be effective in preventing several diseases, including diabetes, stroke, heart disease and some forms of cancer. Physical activity also helps to maintain muscle mass, reduce fat tissue, and helps to improve quality of life and mental health (WHO, 2022).

According to the Physical Activity Guidelines for Americans (2018), the recommended physical activity for older adults is 150 to 300 minutes of moderate-intensity activity or 75 to 150 minutes of vigorous-intensity activity per week.

Study from 2019 proves that frailty is more common in older adults with low level of physical activity combined with sedentary lifestyle (Da Silva et al., 2019).

A 2018 study examined the effect of physical activity combined with resistance training in forty-one participants with an average age of 81.5 years. The study concluded that older adults experienced a reduction in frailty scores, increased mobility, and lower extremity muscle strength with the combination of resistance training and physical activity (Nagai et al., 2018).

1.5.2 Principles for selecting physical activity

Kolář et al. (2020) reported that maintaining mobility through physical activity positively affects health and quality of life. For the effect of exercise on the body to be perceived positively, it is important to select appropriate exercise based on these criteria:

- Health status - it is important to respect the limits of an individual's health status, as advanced age carries risks of chronic disease. For this reason, it is necessary to respect the individual's capabilities and diagnosis. The form of exercise with the appropriate intensity is then determined by means of a medical history, subjective assessment, and objective examination. Control of intensity is dependent on a safe level of heart rate. Limits, form, duration, and intensity of exercise are then determined, including education of the individual about cessation of physical activity in case of development of difficulties.
- Age - the individual's fitness test plays an important role here. The results are then compared with the age normative. This is followed by the determination of a safe heart rate and type of physical activity. For the selection of the right physical activity and the appropriate intensity, the factors of fitness, mobility and functionality of the musculoskeletal system are more important than age alone.

- Gender - the arrangement of the human body within sex differences, leads to the formation of different assumptions for the selection of physical activity. For example, in women, because of the increased percentage of osteoporosis, there is a limited choice of physical activity specific to which there is an increased risk of falling. At the same time, resistance training with appropriate loads for bone stimulation is included in women.
- Movement experience and body performance - here the main factors are fitness and movement experience from an earlier age. For lifelong physically active individuals, the load is more manageable even during ageing.

1.5.3 Physical training

Due to the findings of the previous sub-section dealing with physical activity, its effects and positive impact on the lives of frail individuals, attention will now be given to physical training. It is precisely its effects that the authors Pillatt, Nielsson and Scheneider (2019) have addressed in their publication. Due to the existence of numerous studies on the functionality of physical training, the authors examined existing articles to draw a unified conclusion. As a result, they found that physical activity appears to be highly beneficial in reducing frailty and its prevention.

Studies have found that an active lifestyle serves as a prevention of frailty. Multi-component physical training, including resistance, balance, gait, and strength exercises, have been proven as highly effective. Their positive impact is mainly attributed to their complexity and thus potential to alter various components of functional fitness in older persons. Areas where positive developments can be observed include improvements in gait, balance, and strength, while reducing the frequency of falls. The authors further add that it is advisable to combine physical training with, for example, whole-body vibration or the use of virtual gaming (Pillatt, Nielsson and Scheneider, 2019).

1.5.4 Resistance training

Lopez et al. (2017) in their article indicate that resistance training is one of the most important strategies not only for improving functional capacity and muscle mass, but also for increasing muscle strength and power. They also mention that resistance training is

an important component within the physical activity of frail individuals and is an important part of complex programs that include balance, endurance, and gait training. Resistance training performed under supervision is considered an appropriate intervention for the treatment of frailty.

Resistance training is a key strategy in the prevention and treatment of sarcopenia. Another benefit of resistance training is, for example, reducing the risk of falls, which are associated with injuries such as fractures. At the same time, this type of training is safe and effective. Therefore, it can be recommended for almost all populations, even for people with chronic diseases such as cardiovascular disease, cancer, second type diabetes, and even chronic obstructive pulmonary disease (Smith et al. 2022).

According to Keating et al. (2021), resistance training has a positive effect on both balance and gait, especially straight-line walking speed in people over 65 years of age.

1.5.5 Perturbation – Based Balance Training

Another suitable exercise programme within physiotherapy is Perturbation - Based Balance Training. McCrum et al. (2022) define this type of training as balance training that uses repetitive externally induced mechanical disturbance to elicit rapid responses to restore postural stability in a safe and controlled environment. The goal of this balance training is to improve the ability and recovery of stability in destabilizing moments that lead to falls in everyday life.

Mansfield et al. (2007) reported in their publication that falls are the leading cause of hospitalization, serious injury and loss of self-sufficiency in the older adults. It is for this reason that exercise programs for balance training appear to be highly effective. The authors address this issue by applying a balance exercise program that incorporates balance disorders. The study then uses these balance disturbances, as interventions themselves, to ward off age-induced loss by avoiding falling during a sudden loss of balance. It is the training of the ability or inability to cope with these situations that will ultimately influence whether the loss of balance is followed by a fall. The authors suggest forward and backward stepping along with lateral stability control as one of the appropriate exercises. The second proposed exercise works with an exercise aid in the form of handrails, which the patient is asked to grasp as quickly as possible. The reason

for this exercise is the often-delayed onset of arm reactions, and it is the delayed grasp reaction and this tendency that is predictive of falls Mansfield et al. (2007).

1.5.6 Otago Exercise Program

Another option in physiotherapy intervention for older adults is the Otago Exercise Program. This is a falls prevention program for older adults who are at increased risk for falls. The program consists of strength and balance exercises that gradually increase in difficulty. Exercises are performed up to three times a week with a time allotment of up to 30 minutes. The programme also includes regular walking up to three times a week for up to 30 minutes. Both exercise and walking can be done in the classroom/gym at home, or combined, that is, in the classroom/gym and at home (National Council on Aging, 2023).

A 2022 study examining the impact of the Otago Exercise Program on frailty included 72 people aged 65 and over in a nursing home setting. The outcomes of the study showed that the program has a positive impact on preventing and delaying frailty in nursing home residents. The authors further reported that the program may be effective in increasing independence, improving physical function in older adults, and may also reduce the number of hospitalizations and costs placed on the healthcare system (Sahin et al., 2022).

1.5.7 Aerobic training

The Physical Activity Guidelines for Americans (2018) explain aerobic activity as physical activity that involves the rhythmic movement of large muscles over an extended period of time. Aerobic activity is also known as cardio or endurance activity. Examples of aerobic activity include brisk walking, jogging, cycling, or swimming.

Majority of older adults develop cardiovascular deconditioning, which is usually the result of a sedentary lifestyle. The only time when exercise should not be performed in the context of cardiac diseases is when the individual is in acute crisis. Otherwise, aerobic training plays a very important role in the presence of cardiovascular diseases because aerobic exercise increases the state of fitness while improving the disease condition (Avers and Wong, 2020).

1.5.8 Aquatic exercise

Aquatic exercise programs are defined as a set of exercises that are performed in water. Exercises can be performed in shallow or deep water, can be accompanied by music and are predominantly performed in an upright position. At the same time, they include any type of physical exercise performed submerged in water. Water exercise is considered a suitable alternative intervention for older adults as water supports the body weight and reduces the fear of falls. In older adults, it improves functional fitness, health, and positively impacts quality of life (Lopez et al., 2021).

The hydrostatic support of the water provides individuals with deconditioning or joint pathology the opportunity to perform exercises with less impact on the joints. Therefore, it is also suitable for individuals with pain. Hydrostatic support provides an upright position, and the buoyancy of the water reduces the stress on the joints by 36% to 56%. The use of aquatic exercise is appropriate in improving strength, cardiorespiratory fitness, bone density, flexibility, and agility. Individuals who are unable to exercise due to pain or instability can become more active thanks to aquatic exercise and gain a baseline level of strength for land-based exercise (Avers and Wong, 2020).

The study, conducted in 2021, focused on the effect of aquatic exercise for 12 weeks, with an exercise frequency of three times a week and a time allowance of 60 minutes in the older adult South Korean women aged 70-82 years. The result of this study confirms that regular and concise aquatic exercise improves quality of life during aging, reduces the risk of cardiovascular disease, and the authors recommend this type of exercise as a prevention of frailty (Kim et al. 2021).

1.5.9 Flexibility training

Flexibility is an important component in the health of the older adults. Flexibility training increases range of motion in the joints, improves postural balance and flexibility. As a result, it reduces the risk of falls and improves quality of life for older adults. Postural imbalances, movement limitations and changes in gait parameters (walking speed and frequency, stride length) make daily activities and quality of life difficult. At the same time, they can be both a cause and a consequence of lack of flexibility in older adults (La Greca et al. 2022).

According to Stathokostas et al. (2012), flexibility training in older adults has a positive effect on increasing range of motion and can improve functional outcomes.

1.5.10 Tai Chi

Tai Chi is based on the holistic model of traditional Chinese medicine. It is a multi-component exercise of both body and mind. Tai Chi is reported to have a positive effect on symptoms and systems that are associated with decline in the aging process such as cardiovascular function, balance, gait, cognitive function, self-sufficiency, and quality of life (Wayne et al., 2013).

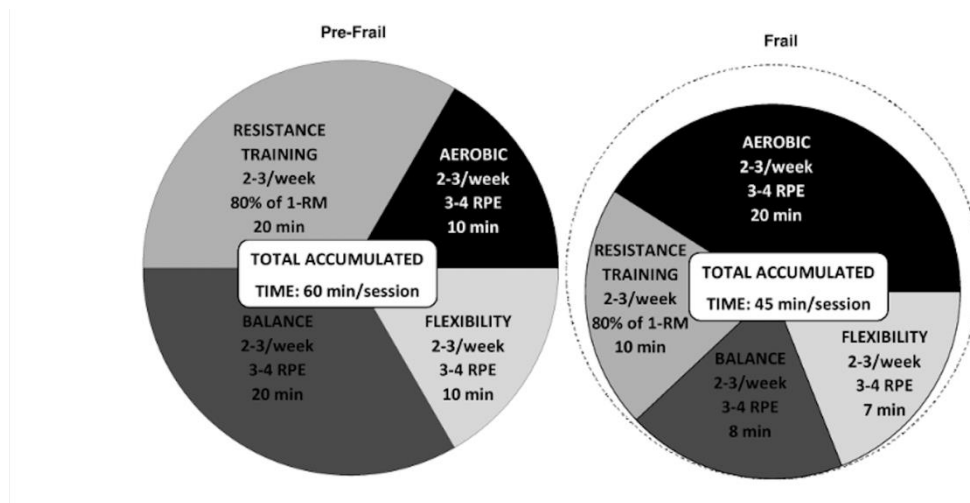
In a study in 2023, the effect of Tai Chi in community-dwelling older adults with hypertension was examined. Tai Chi was practiced in person by an instructor twice a week for a total of 12 weeks. As a result of this study, it was found that this exercise was well tolerated by older adults and was also associated with a modest improvement in frailty in older adults who were frail. The authors also reported that Tai Chi may be a suitable and effective method to counteract frailty in frail older adults with hypertension (Kohn et al., 2023).

Kasim et al. (2022) mentioned in their article that 12 weeks of Tai Chi practice, improved older adults' physiological and psychological health, which are involved in the development of frailty. They state that Tai Chi has the ability to improve vascular function, physical function, quality of life, and can reduce frailty.

Qao et al. (2022) report that older adults who regularly practice Tai Chi are less than half as likely to become prefrail or frail. At the same time, these older adults were characterized by a reduced incidence of impaired physical and mental activity.

1.5.11 Exercise prescription

Bray et al. (2016) in their article provide a recommended exercise prescription for prefrail and frail individuals. It also states that exercise is probably the best therapy for frailty.



Pic.2 Exercise prescription for pre-frail and frail individuals (Bray et al., 2016)

In both cases, it is a set of exercise sessions that consist of resistance training, aerobic exercise, balance exercise and flexibility training. The outer circle for the frailty pie chart, shows the difference between the total time volume for frail individuals and pre-frail individuals. For both groups, the exercise sessions are divided into four quadrants. The size of each quadrant is determined by the time allocation for a particular type of exercise from the total session. Each quadrant contains information about the type of exercise, the time allocation, and the number of training units per week.

In the middle of these two circular diagrams is the total time for one exercise session. At the same time, the sizes of the two diagrams differ in relation to the time allocation and the volume of the exercise session. The time volume is given in minutes.

For flexibility training and aerobic and balance components, the abbreviation RPE or rating of perceived exertion is given. RPE refers to the level of intensity with which individuals should perform the workout. The 3-4 values shown in the charts represent intensity in the form of "somewhat hard" on the Borg CR10 scale.

Another abbreviation given in the charts for resistance training is 1-RM or repetition maximum. This abbreviation describes the intensity at which individuals should perform resistance training and means one percent of the estimated maximum for one repetition. The authors also state that the program should start out around 55% 1-RM intensity for

improvements primarily focused on endurance and then work up to 80% 1-RM intensity for strength development, for maximum functional results.

The division of the groups into pre-frail and frail was determined using the Frailty Phenotype, which is presented in the chapter dealing with frailty in this thesis.

Discussion

This bachelor thesis focuses on physiotherapy in frail individuals. The process of aging is defined by Denham (1981) as the accumulation of changes over time that accompany susceptibility to various diseases with advancing age. Li et al. (2021) add that the development of age-related diseases not only affects organ systems but also contributes to cancer. Chalise (2019) describes the different types of aging, which include chronological aging, biological aging, social aging, and functional aging.

The general classification according to Topinková and Neuwirth (1995) divides the older adults according to age into young old (65 - 74 years), old-old (75 - 84 years) and very old (over 85 years). The National Service Framework for Older People (2001) describes a further division into Entering old age, Transitional phase, and Frail Older People.

The Czech Statistical Office (2023) predicts that in 2051 the total population of the Czech Republic with an age limit of over 65 years will be 3 096 800. According to the National Health Portal (2024), approximately 7% of the older population struggles with frailty. In 2100, the percentage of people aged 65 and over in the total European population is predicted by Eurostat (2020) to be 31%. The United Nations (2023) states that the global total population aged 65+ is expected to double in 2050, based on 2021 data, when the global total population aged 65+ was 761 million.

From the above data concerning the ageing of the population, both within the Czech Republic, the European Union and globally, it can be concluded that geriatric medicine will become increasingly important in the future.

Kotsani et al. (2021) explain the term geriatric medicine as a medical discipline that deals with the older patients' physical, psychological, functional, and social factors at different stages of care. The European Union of Medical Specialists (2021) adds that geriatric medicine is more complex than organ-based medicine and a multidisciplinary team is needed.

Kotsani et al. (2021) describe a multidisciplinary team as a team of health professionals who are tasked with performing a comprehensive examination and then implementing the established treatment plan. Parker et al. (2018) add that the goal of

geriatric medicine is to detect non-specific problems and develop a coordinated long-term treatment and care plan.

The lowest age limit for a patient to be enrolled in geriatric programs is 65 years, although in economically developed countries may move this to above 75 years (Kalvach et al.,2008).

The model of the frailty phenotype developed by Fried and colleagues views frailty as a biological syndrome of reduced physiological reserve. The second model is the accumulation of frailty deficits, which was developed by Rockwood and colleagues and is based on the accumulation of age-related health, functional and psychosocial deficits (Lee et al.,2020).

Kolář et al. (2020) state that the syndromes of hypomobility, deconditioning, muscle weakness, immobility and instability with falls are of greatest importance in the context of rehabilitation in frailty. Kalvach et al. (2008) describe hypomobility syndrome as both limited mobility and low volume of physical activity. Subsequently, they also describe the deconditioning syndrome as a marked decrease in endurance. Kabelka et al. (2022) explain the term sarcopenia as a degenerative process in which there is a loss of muscle mass and a concomitant loss of muscle quality. According to Kalvach et al. (2008), instability syndrome is one of the top priorities in geriatric medicine and has a direct link with other geriatric syndromes in the complexity of geriatric frailty.

World Physiotherapy (2023) describes physiotherapy as a service that has the primary aim of maintaining, developing, and restoring functional and motor skills across the lifespan. Physiotherapists focus on maximising quality of life and movement potential in support, prevention, treatment, and rehabilitation.

Therapeutic intervention related to frailty, working primarily with physical activity. Physical activity is defined as any movement that requires energy expenditure and is performed using skeletal muscle (WHO,2022). Da Silva et al. (2019) from a study reported that frailty is more common in older adults with low level of physical activity combined with sedentary lifestyle. Kolář et al. (2020) state that maintaining mobility through physical activities, positively affects feelings of health and quality of life.

The following is a summary of possible types of training for older adults.

Bray et al. (2016) provides a recommended exercise prescription for pre-frail and frail individuals. It also states that exercise is probably the best therapy when treating frailty.

Lopez et al. (2019) states that resistance training is a suitable intervention for the treatment of frailty.

The National Council on Aging (2023) indicates the Otago Exercise Program as another possible type of training for older adults who are at increased risk of falls.

Aquatic exercise has been reported by Lopez et al. (2021) to have an impact on functional fitness, health, and positively affects quality of life in older adults.

According to La Greca et al. (2022), flexibility is described as an important component within the health of the older adults and flexibility training increases range of motion in joints, improves postural balance and locomotion.

Tai Chi has a positive effect on symptoms and systems that are associated with decline within the aging process (Wayne et al., 2013).

Conclusion

Ageing is an inevitable process that affects each of us, whether we want it to or not. Physiological changes, combined with environmental influences, place a significant strain on human body. Consequently, it is older adults who are more prone to develop functional deficits that have a negative impact on their health and overall body condition.

The focus of this undergraduate thesis, is on the issue of geriatric frailty, which is very complex, and the various factors are deeply interrelated. Within geriatric medicine, which frailty falls under, a multidisciplinary team is of great importance. It is thanks to the collaboration of medical professionals that it is possible to provide, based on a comprehensive examination, the most appropriate and precise therapeutic plan that is necessary in the treatment of the frail individual.

In addition to defining and categorizing models of frailty, in this thesis I focus on describing those geriatric syndromes that are most commonly present in frail individuals. These syndromes include sarcopenia, deconditioning, hypomobility, and instability syndrome with falls. All these syndromes are interrelated, and if one syndrome worsens, multiple syndromes worsen at once.

Among the main options that can serve to reduce the impact of frailty on an individual, or even prevent frailty, is physical activity. Physical activity has a demonstrable effect on an individual's functional abilities and directly reflects on their resilience and overall health.

In this context, the work of a physiotherapist is needed. The physiotherapist will assess the condition of the individual based on his/her abilities, preferences, and other factors, and select the appropriate physical activity. As options for physiotherapeutic intervention in the case of frailty, basic information on physical training is provided, which focuses collectively on multiple aspects such as resistance training, balance, and strength. In addition, the meanings of different types of training such as resistance training, flexibility training and aerobic training are described separately. Subsequently, two examples of specific balance programs that are used to reduce the risk of falls and the development of frailty are also provided. As an example, complementing all types of exercise, the possibility of Tai Chi, which has a positive effect in the treatment of frailty,

is also mentioned. At the same time, a prescription for recommended physical training schedules for pre-frail and frail individuals is also given.

As the main goal of physiotherapy in frail individuals, in my opinion, is to promote prevention and reduce the effects of frailty syndrome as much as possible. Indeed, frailty drastically reduces an individual's independence and quality of life, which is why physiotherapy intervention is more than necessary.

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