

# Means and methods of physical activity in the context of prevention and treatment of Alzheimer's disease (analysis of Russian-language scientific resources) and the perspective of implementing the unique achievements of the "Polish School of Safe Falling"

## Authors' Contribution:

- A Study Design
- B Data Collection
- C Statistical Analysis
- D Manuscript Preparation
- E Funds Collection

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## Abstract

### Background and Study Aim:

One of the ways to optimize the physical health, cognition, activity and well-being of people with Alzheimer's disease (AD) is through the use of exercise. In this aspect, publications of Russian-language researchers are extremely sparsely in the world's leading databases. Objective – knowledge contained in publications in the Russian-language segment of research on the use of means and methods of physical activity for people with Alzheimer's disease.

### Material and Methods:

The publications in the National Repository Academic Texts (Ukraine), Russian Science Citation Index and Scientific Electronic Library (Russia) databases are analysed. For primary analysis, 24883 sources were selected that match the search criteria.

### Results:

The relevance of complex rehabilitation and recreation of patients with AD has been confirmed. The value of aerobic physical activity in combination with cognitive training has also been confirmed. An important place in the prevention and correction of cognitive impairment is the organization of monitoring the condition of the elderly. It is highlighted the promising indicators recommended for monitoring: the use of informative tests and gamification elements; ensuring the prevention of injuries.

### Conclusions:

The Russian-language segment of scientific research it subsides a bit to global trends in problem solving. However, the superiority of Russian-language scientific research resources on various aspects of the training of athletes with disabilities can be a good example for maintaining the health of people with Alzheimer's disease. The organization of monitoring of the health status of the elderly allows for timely detection of disorders and their correction at the level of functional disorders. The importance and urgency of addressing fall prevention not only in AD patients will grow.

### Key words:

aerobic • athletes • cognitive • exercise • fall • lifestyle • prevention • therapy

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Authors have declared that no competing interest exists

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**Dementia** – loss of cognitive abilities, including memory, concentration, communication, planning, and abstract thinking, resulting from brain injury or from a disease such as Alzheimer's disease or Parkinson's disease.

**Cognitive-bias** – a systematic deviation from norms of rationality and objectivity in judgment or perception.

**Pharmacotherapy** – treatment of disease through the use of drugs.

**Intelligence** – the definition of intelligence is the ability to retain knowledge, use reasoning to solve problems or have above average brain power.

**Neurodegenerative** – designating or of a disease or condition, as Alzheimer's disease, characterized by the degeneration of nervous tissue.

**Circadian-rhythm** – a daily rhythmic activity cycle, based on 24-hour intervals, that is exhibited by many organisms.

**Melatonin** – a hormone produced in the pineal gland that plays a role in regulating biological rhythms, including sleep and reproductive cycles.

**Art-therapy** – psychotherapy that incorporates the production of visual art, such as painting or sculpture, in order to understand and express one's feelings.

**Gamification** – applying gaming principles to non-gaming websites in order to engage more with the public and increase traffic. Gamification is reward based either with points, titles or freebies.

**Screening** – the initial evaluation of a person, intended to determine suitability for a particular treatment modality.

## INTRODUCTION

The World Health Organization (WHO) estimates that as at September 2021, more than 55 million people worldwide are suffering from dementia and about 10 million new cases are reported annually. Alzheimer's disease (AD) is the most common form of dementia and can account for 60–70% of cases [1]. Previous diseases of infectious or non-infectious aetiology [2], age-related changes [3] can lead to structural changes in the neurons of the brain. WHO predicts the number of people with dementia will reach 78 million by 2030 and 139 million by 2050 [1]. According to the Alzheimer's Association in Russia, more than 1.5 million people suffer from dementia [4]. The progression of AD ultimately leads to impaired motor function and dementia. In this context, the measures that are aimed at reducing the risk factors for the occurrence of the disease become important. WHO notes that this approach will prevent up to 40% of dementia cases [1]. According to WHO [1], there is currently no therapy to cure dementia or change the course of its development. One of the few ways to support and improve the lives of people with dementia is to optimize physical health, cognitive ability, activity, and well-being. The evidence of the safety of physical exercises for people with intellectual disabilities is presented in the recommendations of "Virtus" – International Federation for athletes with intellectual impairment [5, 6]. These guidelines are developed in accordance with the WHO definition.

The COVID-19 pandemic has become an additional risk factor for the condition of people with AD. Restrictive measures to contain the spread of COVID-19 adversely affect the emotional-behavioural environment of patients with AD. People with cognitive impairments are especially vulnerable during periods of self-isolation. Their need for medical and social rehabilitation cannot be adequately met with the introduction of quarantine measures. All these consequences must be taken into account after overcoming the COVID-19 crisis [7-9].

One of the areas of prevention and reduction of risk factors for AD is physical activity, a healthy lifestyle, exercise in combination with elements of psychological regulation. Trends in research directions on the problems of using means and methods of physical culture in the prevention and treatment of people with AD are traced in the most authoritative journals of the Web of Science Core Collection (WoS) base.

Lifestyle patterns determine the AD prevention strategy. Promoting healthy lifestyles at a young age will provide protection against AD in the future. Regular physical activity, a sufficient amount of motor activity form motor memory and motor experience. New physical activity programs are founded on this basis. That is, the formed motor experience in young people acts as a preventive and health-improving factor in old age.

The level of cognitive functions is of great importance in choosing the direction of exercise for people with AD. It is known that physical activity (PA) has become a well-known lifestyle factor that can influence the structure and function of the brain [10-13]. This is evidenced by numerous studies. Gronek et al. [14] reviewed the effects of physical activity and exercise on AD. The authors concluded that some studies require more information on physical activity in people with AD. Cammisuli et al. [15] found little evidence that aerobic exercise improves cognitive performance in AD patients. It also remains unclear whether the benefits of exercise are apparent at all stages of AD development.

The review of Zueva et al. [16] is devoted to the analysis of circadian disorders in the elderly, including AD. The authors hypothesized that lifestyle optimization would help prevent and correct AD disorders. Another study [17] evaluated the effect of exercise on cognitive function in patients diagnosed with AD. The authors note that exercise intervention can improve AD cognitive function or slow cognitive decline. However, this relationship has not always been confirmed in different studies.

Studies have shown that exercise and cognitive function are closely related. In this aspect, an important criterion for evaluating the possible form of AD is connected speech-language (CSL). This is indicated by the studies of Evans et al. [18]. The authors argue that CSL analysis provides an inexpensive way to assess preclinical changes in cognitive status.

McGough et al. believe that physical activity and exercise can play a key role in preventing and slowing down functional decline. This ultimately reduces the prevalence of dementia [19]. In another study, exercise was considered as a pre-clinical, advanced stage treatment and as a prevention strategy for AD [20]. The results of the study show that physical inactivity is one of the most common preventable risk factors for AD. It is also noted that higher levels of physical activity are associated with a lower risk of developing this disease. These findings are supported by the study of De la Rosa et al. [21]. The authors highlighted the role of exercise (aerobic and strength) as a therapeutic strategy for the treatment and prevention of AD. It is noted that older people who play sports are more likely to retain their cognitive abilities.

Research has shown that lifestyle factors can stop the progression of AD, especially exercise. Exercise has been shown to be effective in controlling blood pressure, mild chronic inflammation, and improving cognitive function in people with AD [22].

The studies by Abe et al. [23] show that healthy daily activities and participation in community life can help improve and prevent weakness / adverse events. Another study shows that psychosocial health is an important factor in the lifestyle of older people [24]. It is also confirmed that a healthy lifestyle benefits the physical, psychological, cognitive and social functioning of people with AD into old age [25-27].

Optimizing physical health involves the use of exercise as a means that positively affects the quality of life of people with AD. In turn, exercise is closely related to cognitive ability. Ultimately, the combination of physical and mental activity affects the activity and well-being of people with AD. This is confirmed by numerous studies that are available in the WoS database.

An analysis of studies on the WoS database showed that a healthy lifestyle largely depends on physical activity, lack of bad habits, nutrition,

environment, and more. In this aspect, people with AD have their own specific lifestyle characteristics. People with AD often need help and require special attention from the community. Physical activity of moderate intensity plays an important role in their life.

An analysis of survey studies based on the WoS database shows that they did not take into account some aspects of both the theory and methodology of physical education and Russian-language resources. Also, since these publications, the results of newer studies have appeared. All this taken together testifies to the need to analyse research on Russian-language databases. One of the directions of this approach can be the analysis of research involving athletes participating in various Olympiads [28-30].

The Russian-language segment of research on the problems of people with AD is presented in several directions. Among them are the following: exercise in a lifestyle context; physical activity as a criterion for the prevention of AD; physical exercise combined with cognitive training.

Lifestyle changes in older people are difficult and slow. The formed stereotype of the lifestyle is difficult to change, this can provoke a deterioration in health. Therefore, it is better for people who do not have sufficient motor experience to recommend other methods of compensating for cognitive impairments. These methods should ensure the performance of tasks for logic, concentration, and support for fine motor skills. These include reading, puzzle solving, knitting, etc. Regardless of professional experience and lifestyle, the main postulate is that the one who does nothing suffers. Compensating for cognitive impairment in older adults requires constant self-improvement.

Parfenov [31] believes that general practitioners and neurologists in Russia are not sufficiently aware of modern methods of therapy for people with AD. This largely determines the errors in patient management. Patients with AD relatively rarely receive advice on non-drug therapies that include regular physical activity. The Parfenov and Kabaeva [32] found that regular physical activity and mental activity are associated with a decrease in the incidence of AD.

In the study by Mayevskaya et al. [33] discusses specific recommendations that an AD patient should receive from a doctor: motivation to

**Stratification** – stratification is the dividing of people or things into different groups or layers.

**Monitoring** – the act of listening, carrying out surveillance on, and/or recording the emissions of one's own or allied forces for the purpose of maintaining and improving procedural standards and security, or for reference, as applicable.

change lifestyle, amount of physical activity, optimal eating style. These principles will help healthy people achieve active longevity by preventing cardiovascular disease, AD, and a range of other disorders.

Studies by Russian scientists have shown that the prevalence of dementia in the country is progressively increasing [34]. The author recommends pay more attention to the correction of modifiable risk factors caused by lifestyle as primary prevention. Another study [35] noted that in the treatment of mild and moderate cognitive impairments, a balanced diet, moderate physical and intellectual exercise are of primary importance.

Bulgakova's review [36] confirmed the effectiveness of the rehabilitation of AD patients by restoring the human circadian system. Normalization of the level and concentration of melatonin, regulation of sleep and wakefulness processes ensure the prevention of cognitive impairment. Functional nutrition and physical activity are adequate tools for such an impact.

Zimushkina et al. [37] evaluated the effectiveness of the use of dosed physical activity in the complex treatment of patients with stage I and II dementia in AD. The greatest effect was observed in women who received complex therapy with the inclusion of dosed walking. Another study [38] found that dosed exercise in AD patients optimizes the results of drug treatment, especially in women.

Medvedeva et al. [39] note that the prevention of dementia is facilitated by a high level of education of the patient, physical activity, activity in the social and intellectual spheres. Another study showed that healthy diet, mental and physical activity can be considered as the first line of defense against the development and progression of pre-dementia conditions and dementia [40]. Research by Naumenko et al. [41] show that preventive measures should include regular physical activity, proper nutrition, and an adequate level of mental stress.

In other studies are presented some of the most well-known methods of creating such an environment (lifestyle), which can exclude or postpone (often for years) the onset of AD disease [42-44]. The authors recommend an adequate and effective combination therapy, including rational pharmacotherapy, educational conversations, cognitive-behavioral therapy sessions,

relaxation and remedial gymnastics sessions. It also provides data on the cognitive rehabilitation of patients with the sequelae of stroke and mild cognitive impairments. The effectiveness of the use of a combination of aerobic exercise with cognitive training in the elderly has been proven.

Some studies have focused on solving the problems of caregivers for people with AD. Gavrilova et al. [45] found that therapeutic interventions for AD resulted in a marked reduction in both physical and mental stress on caregivers.

A search in the WoS database and also the Russian Science Citation Index (RSCI) indicates a fairly broad representation of research on non-drug therapy methods, which include the psychological aspects of human activity. To a lesser extent, studies are presented on the use of approaches that are based on the provisions of the theory and methodology of physical education. Therefore, it makes sense to focus on approaches to teaching and improving movement for people with AD using exercise. This approach characterizes people with AD as beginners who are just beginning to master movement in the face of confounding factors (dysfunctions of various bodily functions).

The aim of this review is knowledge contained in publications in the Russian-language segment of research on the use of means and methods of physical activity for people with Alzheimer's disease.

## MATERIAL AND METHODS

### Data sources

As of 12.09.2021, the following bibliometric databases have been selected for the research sampling process:

- Web of Science Core Collection (WoS); Web of Science Core Collection (RSCI – Russian Science Citation Index); National Repository Academic Texts (Ukraine) [46]; Scientific Electronic Library eLIBRARY.RU (Russia) [47].

The main criterion for the selection of databases was the quality of information sources. There were 23725 records (Web of Science Core Collection – Science Citation Index Expanded, Social Sciences Citation Index) matching the search criteria “Alzheimer” in the title of the publication. The articles have been published

over the past 5 years and represent a variety of subject areas. TOP-10 of them is presented in Table 1. The following WoS subject areas are of greatest interest in the context of the article's topic: Education Educational Research, Education Special, Hospitality Leisure Sport Tourism, Psychology Educational, Rehabilitation, Sport Sciences (Table 1). These subject areas cover 60 sources. All sources are in English. We also searched for publications of a review nature (Systematic review and meta-analysis). 73 such publications were found. Of these, only 3 articles addressed the use of exercise for the prevention and treatment of AD. A search was also conducted for studies on the quality of life of older persons. 13 publications on this topic were found.

A similar information search algorithm was carried out on the basis of the Russian-language resources WoS – RSCI. In this section of the WOS – RSCI database are presented sources for the period 2005-2021. The search keyword is “Alzheimer”. A total of 764 sources of RSCI categories were

found. Subject areas were identified that are of greatest interest. These subject areas cover publications in 17 journals (Table 2).

Research topics on the quality of life of people of different ages are presented in 125 publications. Most of them are targeted at young people and people of working age. A search was conducted for information on exercise use among people with AD and athletes with a variety of disabilities. A total of 81 publications were found.

We searched for information using the keyword “Alzheimer” in the Ukrainian database of the National Repository Academic Texts [46]: 21 publications were found. Of these, only one study was carried out in the context of the use of exercise in the rehabilitation of patients with Alzheimer's disease [48].

A search was carried out in the Scientific Electronic Library eLIBRARY.RU (Russia) [47]. Restrictions were set for searching in this library:

**Table 1.** Results analysis table for web of science categories field (Web of Science Core Collection) – ordinal variable: from the highest proportion (%).

Category	Items (N; %)
	<b>All subject areas (n = 23725)</b>
Subject area (top 10 items)	Neurosciences (9194; 38.75%), Clinical Neurology (4587; <b>19.33%</b> ), Biochemistry Molecular Biology (2636; <b>11.11%</b> ), Geriatrics Gerontology (2280; <b>9.61%</b> ), Pharmacology Pharmacy (1770; <b>7.46%</b> ), Psychiatry (1570; <b>6.62%</b> ), Cell Biology (1357; <b>5.72%</b> ), Multidisciplinary Sciences (1069; <b>4.51%</b> ), Medicine Research Experimental (929; <b>3.92%</b> ), Chemistry Multidisciplinary (920; <b>3.88%</b> )
	<b>Subject areas in the context of article (n = 60)</b>
Subject area	Rehabilitation (34; <b>56.66%</b> ), Sport Sciences (33; <b>55.00%</b> ), Hospitality Leisure Sport Tourism (4; <b>6.67%</b> ), Psychology Educational (2; <b>3.33%</b> ), Education Educational Research (1; <b>1.67%</b> ), Education Special (1; <b>1.67%</b> )

**Table 2.** Results analysis table for Web of Science categories field (WoS – RSCI)

Category	Items (N; %)
Subject area (Leading subject areas)	Physiology (28; <b>58.33%</b> ), Humanities Multidisciplinary (6; <b>12.50%</b> ), Social Sciences Interdisciplinary (6; 12.500 %), Public Environmental Occupational Health (4; 8.333 %), Food Science Technology (3; 6.250 %), Multidisciplinary Sciences (3; 6.250 %), Nutrition Dietetics (3; 6.250 %), Rehabilitation (3; 6.250 %), Education Educational Research (2; 4.167 %), Hospitality Leisure Sport Tourism (2; 4.167 %), Psychology Educational (2; 4.167 %), Sport Sciences (2; 4.167 %), Health Care Sciences Services (1; 2.083 %)
Source Titles	Neuroscience and Behavioral Physiology Sechenov Physiology Journal (13; 27.083 %), Uspekhi Fiziologicheskikh Nauk (11; 22.917 %), Doklady Akademii Nauk (3; 6.2%), Nutrition (2; 4.17%), Profilakticheskaya Meditsina (2; 4.167 %), Progress in Physiological Science (2; 4.167 %), Russian Journal of Physiology (2; 4.167 %), Tomsk State University Journal (2; 4.167 %), Vestnik Rossiiskogo Universiteta Druzhby Narodov Seriya Psikhologiya I Pedagogika (2; 4.167 %), Voprosy Kurortologii Fizioterapii i Lechebnoi Fizicheskoi Kul Tury (2; 4.167 %), Gigiena i Sanitariya (1; 2.08%), Izvestiya Rossiiskogo Gosudarstvennogo Pedagogicheskogo Universiteta im A I Gertsena (1; 2.083 %), Izvestiya Vysshikh Uchebnykh Zavedenii Pishchevaya Tekhnologiya (1; 2.083 %), Journal of Restorative Medicine and Rehabilitation (1; 2.083 %), Myasnaya Industriya (1; 2.083 %), Problemy Sotsial Noi Gigieny Zdravookhraneniya I Istorii Meditsiny (1; 2.083 %), Voprosy Pitaniya (1; 2.083 %)



Russian journals that are included in the Russian-language WoS-RISC database were excluded. Of the greatest interest were studies of the preparation of athletes with various physical and mental disabilities. On this topic, 287 articles were found in journals. Of these, 55 publications were selected related to the training process of athletes. Of these, 9 publications were allocated: 7 studies involving adult athletes with intellectual disabilities; 2 studies involving children with intellectual disabilities.

### Method of Study

*First stage.* To clarify global trends in AD research, the Web of Science Core Collection database was used: the publication period over the last 5 years was considered. The search results are presented in Table 1. According to the information of the most significant categories (Table 1, 60 sources), we analysed the trends in the use of means and methods of physical culture and sports in the prevention and rehabilitation of patients with AD. For this, a search was carried out using the keyword “Alzheimer” in the title of the publication. A subsequent search for the found results was conducted using keywords that characterize AD: *physical, exercise, rehabilitation, aerobic, review and meta-analysis*.

*Second stage.* A similar search algorithm was used for the Russian-language RSCI database. The search was carried out using the following keywords: *healthy lifestyle – older adults; disabilities-athletes; exercises; longevity; obesity; physical activity; physical exercises; walk*. The search results are presented in Table 2. The data from this database were used to search for publications related to the use of the main provisions of the theory and methods of physical education. The purpose of this search is to obtain examples of the use of means and methods of physical culture and sports in the preparation of athletes and other people with various physical and cognitive impairments.

*Third stage.* Search for information on the keyword “Alzheimer” in the Ukrainian database of the National Repository Academic Texts [46]. We also searched for information in the Scientific Electronic Library eLIBRARY.RU (Russia) [47]. The search was carried out using keywords: *Paralympic, Special Olympics, training, intellectual disabilities*. The search was also carried out in two journals, which often publish articles on the problems of children and adults with intellectual

disabilities: journal “Uchenye zapiski universiteta imeni P.F. Lesgafta” (Russia) [49], journal “Adaptive Physical Education” (Russia) [50].

### Data analysis

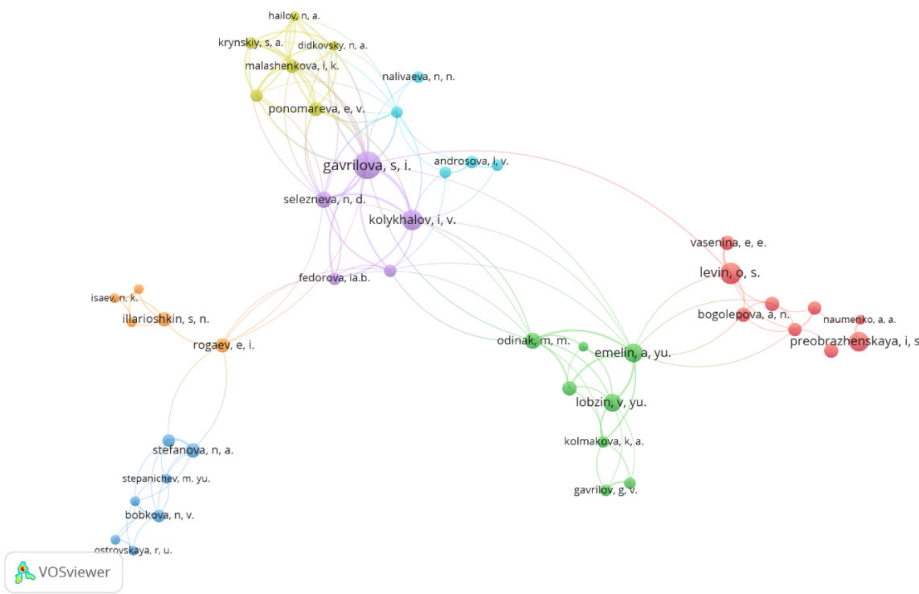
To identify the leading research leaders on the problems of our research, we used bibliometric methods [51, 52] of processing the obtained information in the context of AD. For this we used VOSviewer 1.6.17, a software tool for constructing and visualizing bibliometric networks [53]. The most important for the study was the implementation of the keyword analysis method [51] and the direct citation analysis [52]. The methodology for calculating the main indicators for the analysis and identification of the most significant categories of research is detailed in the work of van Eck and Waltman [54]. We used the most cited links to identify promising areas of research in this category. Distance-based bibliometric maps have been used - these are maps in which the distance between two elements reflects the strength of the relationship between the elements. A shorter distance usually indicates a stronger bond. The validity of this approach is confirmed in studies of the problems of AD [55] and physical activity of people [56, 57].

## RESULTS

To determine the leading research on AD problems in the Russian-language WoS-RISC database, we used two criteria: the number of publications and the number of citations. The research sample consisted of 764 publications. For the analysis, we used the VOSviewer (Visualizing scientific landscapes) program, which was used to build the maps.

For the research sample ( $n = 764$ ), a bibliometric citation map was built (Figure 1). To determine the main references, the sample was limited to the following variables: the maximum number of co-authors 25; the minimum number of author's documents is 5; the minimum number of citations of an author is 0. Out of 1823 authors, 84 have reached the indicated limits. Of these, 45 authors with the highest overall link strength were selected. The most significant studies are concentrated around the publications of the authors with the tag “Gavrilova S.I.” (Figure 1).

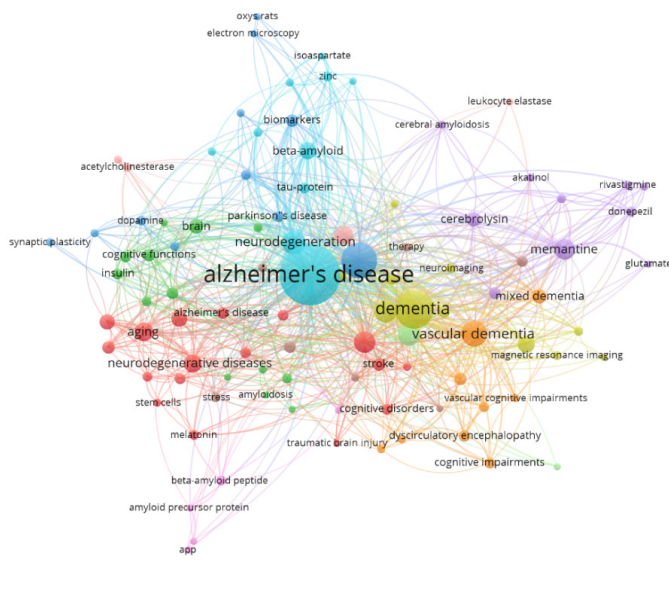
To determine the leading thematic research areas, the sample ( $n = 764$ ) was limited by the following variables: the minimum number of



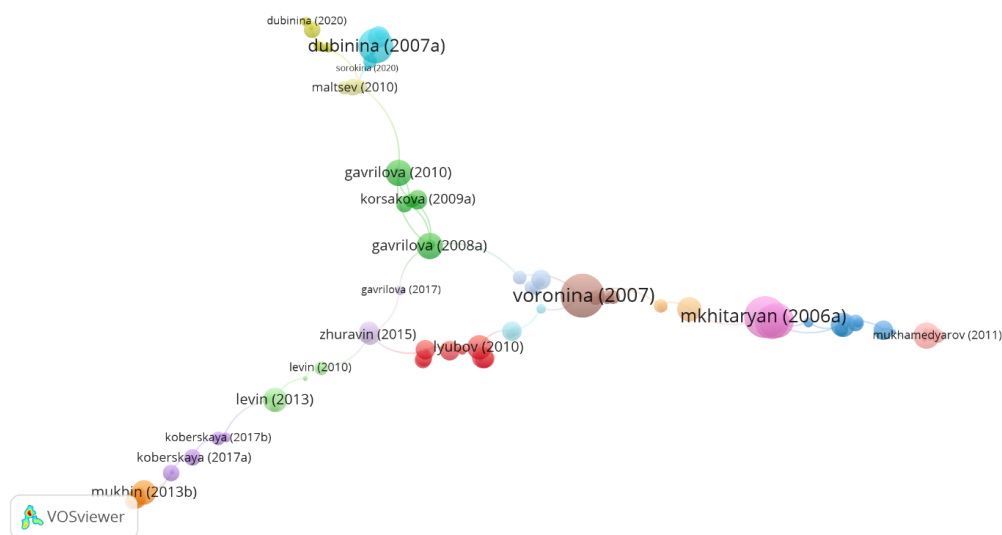
**Figure 1.** Key links in the study of people with AD (direct citation analysis, density visualization, weight – citations).

occurrences of a keyword 5. Out of 2105 keywords, 90 correspond to the threshold value. For each of the 99 keywords, the total strength of concurrent association with other keywords is calculated. The keywords with the highest overall link strength were selected. The number of selected keywords is 99. The results of the analysis are presented in Figure 2.

On the map (Figure 2), the size of keywords corresponds to the number of links received, and spatial proximity reflects the strength of the relationship between items. Interpretation of the data in Figure 2 is the same as for Figure 1. The more important the item, the larger its label and circle. According to Figure 2, one can single out studies that can be classified as the most demanded.



**Figure 2.** Research fronts of problems of people with AD (analysis of related words, visualization of cluster density, weight – quotes).



**Figure 3.** Areas of research on the problems of people with AD (direct analysis of citation, visualization of cluster density, weight – citations).

These include studies by topic (in order of importance): Alzheimer’s diseases, dementia, vascular dementia, etc. in descending order.

To improve the quality and accuracy of the analysis, word analysis was combined with direct citation analysis. From the data obtained (n = 764), the 105 most cited were selected, based on which a citations map was constructed (Figure 3).

Interpretation of the data in Figure 3 is the same as for Figure 1 – the more important the item, the larger its label and circle. According to Figure 3 it is possible to single out studies that can be classified as the most demanded. These include studies by topic (in order of importance): Alzheimer’s diseases, dementia, vascular dementia, etc. in descending order.

As follows from these Figures 1-3, publications in the context of the use of physical exercise, maintaining a healthy lifestyle are not among the priority research areas. Therefore, further analysis was carried out on a sample (n = 81), which includes studies on the use of exercise for people with AD and athletes with various physical and mental disabilities.

Analysis of the data (Figure 4) indicates that there is no relationship between the most cited publications and keywords. The most sought-after research is shown as: the more important the item, the larger its label and circle. The analysis shows that there are publications that show the

possibilities of using the results of studies with the participation of athletes with disabilities in the practice of working with people with AD.

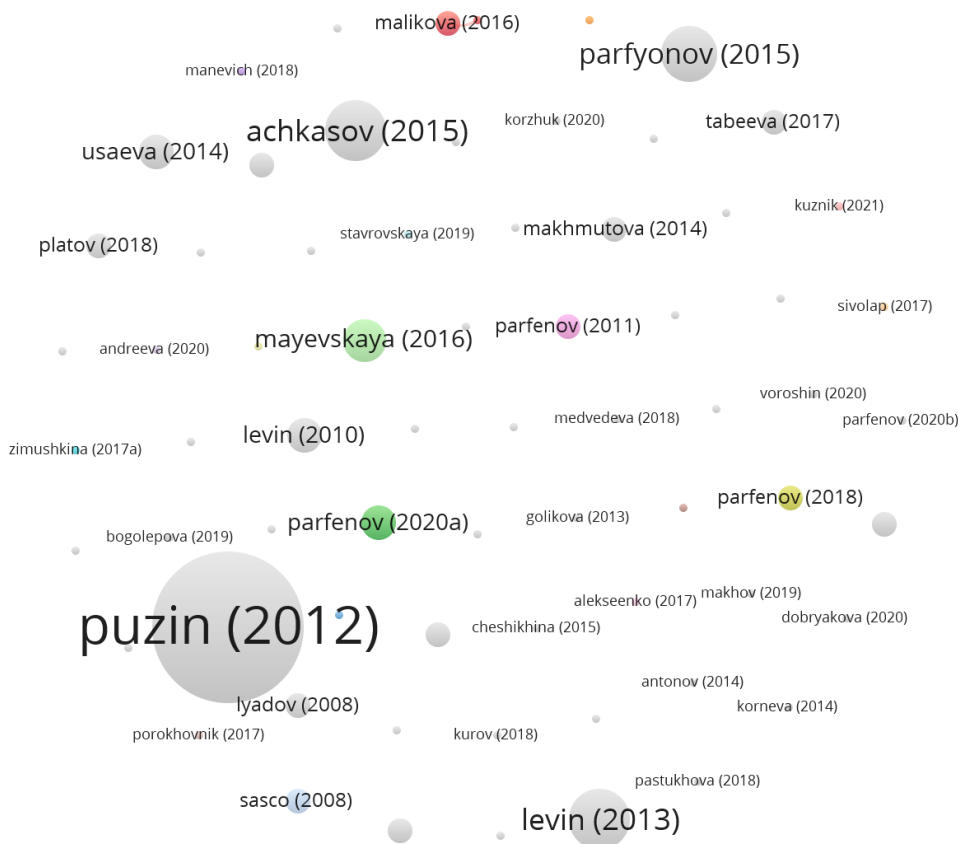
## DISCUSSION

### Reason for the use of exercise for people with AD

Existing literary sources confirm the relevance of the problem of rehabilitation and recreation of people with AD. The solution to this problem should be comprehensive, based on the restructuring of the way of life. Lifestyle is the foundation of rehabilitation and wellness programs. Asiene [58] analysed the problem of social support for the elderly population of the Baltic countries. It was noted that only 5% of older people assess their health as good or very good; more than half are inclined to consider their health bad or very bad. This increases the urgency of organizing the rehabilitation of this category of people. The rehabilitation system should be multifaceted and include medical and vocational rehabilitation, education, social work, compensation for missing income. A promising solution is the organization of specialized centres and boarding houses for people with AD.

In our opinion, an important point in scientific research is the choice of an adequate design option. Analysis of existing publications confirms the importance of selection criteria and grouping of participants. They should include age, gender,





**Figure 4.** Areas of research on the problems of using means and methods of physical activity (sports) for people with AD and athletes with various physical and mental disabilities (direct analysis of citation, visualization of cluster density, weight – quotes).

lifestyle and professional features. They reflect the changes in the state of the participants. The last two criteria are manageable. Therefore, they are most important when analysing health status. Cognitive functions are less affected in people with sufficient mental and physical exertion compared to monotonous workers.

Research in the Russian-language WoS / RISC database on the use of physical exercise in the prevention and treatment of people with AD has two main directions: the use of means and methods of physical activity (sports) in the prevention and treatment of people with AD; training process of athletes participating in various Special Olympics [28-30] for people with physical and mental disabilities. It should be noted that in the first case, only aerobic physical activity is used. In the training process of athletes, the main goal is to achieve maximum results. Therefore, physical activity of an extreme nature is included in the training process of athletes.

We believe that people with AD and the prevention of AD may benefit from aerobic physical activity, which is used in the training process of disabled athletes. Confirmation and justification of this position is presented in the studies of the Russian-language segment of publications.

A review by Manevich [43] is devoted to modern methods of cognitive rehabilitation in elderly patients with neurodegenerative diseases (AD, Parkinson's disease). The effectiveness of the use of a combination of aerobic exercise with cognitive training in the elderly has been proven. In complex therapy, it is possible to use psychotherapy methods. A multimodal approach to cognitive rehabilitation in the elderly is advisable.

In our opinion, the mechanisms of the development of cognitive impairments determine specific requirements for the recommended motor activity. It should be as diverse as possible. The basis of such activities is the solution of problems

that require the analysis and processing of information. Decision making should be time-limited. Practicing complex coordination sports meets these requirements as much as possible. People with AD are encouraged to practice sports, martial arts, and dance sports. Walking, jogging, cycling and skiing cannot be rated positively. These types of physical activity are characterized by a fairly high monotony.

The most important evidence of the possibility of including physical exercise in the daily life of people with intellectual disabilities is the recommendations of the International Paralympic Committee [5]. These guidelines are based on the WHO requirements for athletes with intellectual disabilities. However, the choice of types of sports competitions is limited to several disciplines. For example, the Paralympic Committee of Russia lists the following sports [59]: non-Paralympic disciplines (alpine skiing, cross-country skiing, rowing, basketball, highway cycling, judo, equestrian sports, mini-football (futsal), powerlifting, tennis, football); Paralympic disciplines (athletics, table tennis, swimming). The age requirements for the athletes are as follows: the age of the athlete must be over 18 years old; an athlete can compete in his/her age group [60]. The level of world records of athletes with intellectual disabilities in relation to the achievements of healthy athletes is [61]: in shot put 66% (men) and 52% (women); in long jump with a run up - 84% (men) and 76% (women); in running on 1500 meters 96% (men) and 90% (women).

In our opinion, this ratio can be a criterion in assessing the capabilities of people with AD in comparison with healthy people of the same age.

### Exercise safety for people with AD

People with AD require special attention from their healthcare team, family members, and their caregivers. We found no studies that address the safety concerns of exercise and / or exercise for people with AD. In this aspect, research involving athletes of different ages with intellectual disabilities can serve as a benchmark.

The proof of the safe impact of physical activity on the body of athletes with intellectual disabilities is the correct organization of the process of preparing and holding sports competitions [6]. The process of training such athletes is described in sufficient detail in the manual for children's sports schools – the Russian Federal Standard

for Sports Training in the Sport of Persons with Intellectual Disabilities [62]. The program distinguishes the following components of the organization of the school's work: medical and biological control, pedagogical and medical control, the organization of psychological training, plans for the use of restorative means. There are also recommendations on the volume, intensity of physical activity, depending on the age of young athletes and the stage of preparation. The Russian Paralympic Committee provides specific recommendations on the conditions for the participation of athletes in national and international competitions [60]. Athletes must have a diagnosis of intellectual impairment and meet the minimum requirements [5]:

1. Intellectual impairment with a score of 75 or lower on an internationally recognized and professionally conducted IQ test (for example, WISC-R or WAIS-III),
2. Demonstrated limitations in social/interpersonal skills, communication skills or self-care skills.
3. Developmental evidence of an intellectual impairments under the age of 18.

The safety of physical exercise largely depends on the correct organization of the training of athletes. Bryskyn et al. [63] give an example of an eight-week training program in athletics, which is prepared on the basis of a rational combination of exercises in accordance with the general theory of athletes training. The program also takes into account the nosological characteristics of athletes. The authors note the importance of orienting the Special Olympics programs towards the formation of the life experience of athletes, self-service and socialization skills. A safe structure of the training session is proposed, which includes: introductory remarks, warm-up (20 min.); repetition of the passed material (20 min.); classes with the introduction of new elements (60 min.); final and recovery exercises (25 min.); discussion of results, summing up (10 min.).

The possibilities of constructing training programs for people AD is compiled taking into account the provisions of the theory and methodology of physical education and adaptive physical culture. In this regard, we can recommend materials known in the Russian-speaking environment [64-66]. The authors emphasize that

physical activity is directly correlated with the development of cognitive (intellectual) processes of a person throughout his life.

The safety of people with AD is largely ensured by the people around them. For children with AD, parenting is an important aspect of upbringing and education. For older people – the participation of family members and people closed to them in maintaining the level of health. In the studies of Russian authors [66, 67-69], the need to teach parents of children with AD the basics of physical education is noted. Fedorova and Bakhrakh [68] place a special emphasis on the formation of pedagogical competencies in parents, which are necessary for participation in adaptive physical education of children with intellectual disabilities in a family. Shelekhov [67] proposes a method of involving parents in the process of physical rehabilitation of children with disabilities. In a study by Iastrebov et al. [70] is given guidance for older people and their families to provide various types of assistance and support to older age groups. Some aspects of such support are declared by “HelpAge International” (Ukraine) [71].

### Exercise characteristics for people with AD

Research materials in the WoS database are characterized by specific recommendations and detailed instructions. This is confirmed by the following several of the most significant publications in the WoS database. In research Hess and Smart [22] recommends the use of isometric exercises. This can prove to be an important strategy in preventing, ameliorating, or delaying the progression of AD. Baker et al. [72] conducted a study on 28 adults with AD (57–83 years) for 6 months. The authors concluded that aerobic exercise improves cognitive performance in older adults with glucose intolerance. Castellano et al. [73] conducted a study involving 10 patients with mild AD. Research has shown that aerobic exercise improves energy metabolism in the brain. This could potentially be associated with some improvement in cognitive function. Systematic reviews by various authors [15, 17, 14] indicate that exercise and physical activity improve cognition in AD patients. However, some studies have not demonstrated a beneficial effect of exercise on cognitive function in AD patients. The authors argue that exercise as a treatment for AD has been shown to improve cognitive function, decrease neuropsychiatric symptoms, and slower decline in daily activity [20]. Exercise has been shown to

have fewer side effects and better adherence to treatment than drugs. This was confirmed in other studies [19, 74, 21, 13, 75].

Among the Russian-language segment of research, the following can be distinguished. Mrykhin [76] suggests using the following methods for the rehabilitation of cognitive impairments in patients with dementia: training aimed at improving memory; programs based on listening to music, regular dance classes; programs aimed at increasing the activity of patients at home (in particular, cooking); art therapy. However, there are not enough convincing studies proving the effectiveness of this or that method of rehabilitation.

In our opinion, the results of studies with the participation of older people can confirm the effectiveness of various types of physical exercise and / or physical activity.

Agranovich et al. [77] found that the inclusion of physical activity in the standard drug therapy of elderly and senile patients contributes to a significant improvement in their general condition. The study involved patients of medical institutions (n = 148, age 60-74). Patients of the main group, in addition to drug therapy, were prescribed regular exercise therapy.

Another study [78] presents a technology for the complex use of specialized developmental physical activity in elderly women. The authors took into account the specifics of the professional intellectual activity of women. This approach contributes to a significant improvement in the psychophysical state of women, health indicators and physical performance.

Lubysheva and Nazarenko [79] conducted a pedagogical experiment in which women (n = 24, age 55-59 years) took part in the health group. It was used the following forms and types of physical activity such as: I – morning exercises, II – independent daily performance of strength physical exercises, III – organized classes in the health group. Every four weeks, the exercises gradually became more difficult. Women have mastered running without taking into account the time for 2000 meters; rational alternation of fast walking and running; flexion and extension of the arms in the lying position, lifting the body from the supine position. The training effect of the exercises was manifested in the improvement of the functional indicators of women.

Aksović et al. [80] analysed studies on the effect of aerobic exercise on health indicators in the elderly population. The authors recommend walking, which improves maximum oxygen consumption. The introduction of high-impact activities (cycling and jogging) has a greater effect on the cardiorespiratory fitness of the elderly population. The results clearly show the benefits of aerobic training for cardiorespiratory training in the elderly. The effect may vary depending on the duration, type of activity, and characteristics of the person.

Sürücü et al. [81] investigated the effect of six weeks of slow, controlled breathing exercises on heart rate variability in physically active healthy people. The experimental group was engaged in breathing exercises (15 minutes a day – three days a week) for six weeks. The results show that only slow, controlled breathing exercises for six weeks can be used to improve parasympathetic activity in physically active people.

There are also studies using swimming elements and technical devices. Wu et al. investigated the effect of swimming exercises on AD models [74]. Exercise training has multifactorial benefits in AD. This fact represents a promising new therapeutic option for preventing neurodegeneration in older adults with AD. Another study evaluated the effect of prolonged treadmill exercise on pathological AD cascades [82].

We believe that for people with AD, monotonous (cyclic) exercises will be less effective compared to playing sports, martial arts, and dance sports. It should be noted that the majority of publications in the Russian-language segment are focused on the use of standard programs of physical therapy for medical institutions. This does not allow for an individual approach to patients. It also affects the effectiveness of cooperation between the patient, the doctor and the therapist.

The following areas are of greatest interest in the Russian-language segment of research. The study by Ovchinnikov [83] is devoted to the current trend in the development of physical rehabilitation – dance therapy for the elderly. In boarding houses and health resorts, it is included in the health maintenance program. It is on the example of dancing that one can see the system for controlling the movements of the human body. Ballroom dancing, waltz are recognized as the best option for the elderly, because smooth, light and strictly subordinate to the rhythm of the movement is easier to

master. It was found that waltzing improves balance, coordination and work of the respiratory organs, speeds up walking, makes people more collected and attentive.

Dance therapy performs a natural social function of maintaining the physical and psycho-emotional state of a person [84]. In modern society, dances perform a health-improving and aesthetic function, are a means of meeting certain needs [85].

In human motor activity, dances embody a unique combination of sports and leisure [86]. Regular practice allows to achieve a versatile physical and biological efficiency of the body's vital processes. This is expressed in: stimulation of mental activity (dancers need to memorize complex movements and follow the rhythm); improving attention (the dancer must constantly monitor the actions of the parterre); improving the tone of the articular and muscular apparatus; increasing serotonin levels, reducing stress and depression; normalization of blood pressure; improving sleep function, digestion, etc. (due to physical and intellectual activity).

Music therapy is currently widely used in the treatment and rehabilitation of AD patients [87]. One type of such therapy is playing music. They involve the use of music in group games that are held either indoors or outdoors in the form of physical therapy and physical therapy.

Radchenko et al. [88] note that cyclic muscular aerobic work for a long time has a beneficial effect on the brain. In turn, this contributes to more effective visual control, spatial orientation, motor control. These elements are closely related to age. The authors provide recommendations for older people with a sedentary lifestyle.

One of the symptoms of AD is problems with coordination and execution of simple motor actions. These activities include getting dressed, brushing teeth, swallowing, doing several things at the same time (for example, walking and talking on the phone). In our opinion, one of the approaches to maintaining the level and reducing the rate of loss of domestic motor skills is physical exercise.

The study by Pinchuk [48] developed a set of exercises to stimulate physical activity in patients with AD. The complex included exercises in the “lying” and “sitting” positions (daily for an hour, with

music); walking after breakfast and dinner (15 minutes each); walking in the afternoon (30 minutes). The authors note that the use of a set of gymnastic exercises reduced the rate of loss of simple everyday automated skills.

Aksay [89] investigated the balance skills of older adults during daily brushing. The study involved 360 elderly people aged 70 to 80 years. Participants in the experimental group were asked to stand on one leg for 4 minutes (2 minutes in the morning and 2 minutes in the evening every day) while brushing their teeth for 50 weeks. It was found that there is a significant relationship between the balance skills of the elderly and 4 minutes of one-legged standing practice for 4 minutes a day.

In our opinion, guidelines that target children with AD can be used in many cases for older adults. This is because older adults with AD are in fact new to learning significantly reduced motor actions. In this aspect of the application program, exercise for children can be very helpful in maintaining or recovering lost motor function. Such programs are also useful in dealing with AD children.

In the study by Chicherina et al. [90] is recommended to use the following program of activities with children aged 9-11 years with a diagnosis of AD (3 hours per week):

- *Correction of inhibition of motor reaction* – exercises according to the scheme “signal ® perception ® assessment ® response by action”.
- *Formation of commensurability of motor actions* – exercises for dexterity, speed and coordination of movements.
- *Compensation of muscle tension differentiation* – jumping exercises, throwing tennis balls at a target and at a distance.
- *Formation of the ability to feel comfortable in space* – general developmental exercises with closed eyes.
- *Formation of the correct sequence of movement fulfillment “in time”* – exercises aimed at performing a motor action at a strictly defined time of execution (performing general developmental exercises for 8, 10, 12, 14 counts).

Zelenin [91] carried out a theoretical analysis of the influence of simulators on the main functions

of the nervous system during exercise. Exercises on physiological simulators: promote the effective positioning of body parts; stimulate the maintenance of a stable spatial position of the body; stimulate the distribution and redistribution of muscle efforts; facilitate a stable body position; provide spatial orientation. Another study [90] recommended the use of a ski trainer and an exercise bike. Exercises on such simulators allow to standardize the coordinated movements of the upper and lower extremities.

In our opinion, the listed exercises can be recommended for elderly people with AD, depending on their ability to reproduce everyday motor actions.

Physical exercise and/or physical activity in the preparation of athletes with various physical disabilities or cognitive impairments

From the analysis of publications, it is obvious that most studies of the problems of people with AD did not consider approaches based on the theory and methodology of physical activity and sports. Such approaches are widely represented in studies involving athletes with various physical disabilities or cognitive impairments. The validity of such approaches is confirmed by studies carried out on participants in various Olympiads [28-30]. The results of such studies demonstrate the ability of these athletes to operate in extreme conditions. It is quite possible to use publications in Russian and Ukrainian as sources of information. This is due to the fact that at the Paralympic Games in Tokyo in 2021, two countries of the former USSR (Russia, Ukraine) were in the top five best countries. This fact may indicate the presence of publications in Russian/Ukrainian on the topic of this study. This is confirmed by the data of Scientific Electronic Library eLIBRARY.RU (Russia) [47].

Understanding the mechanism of the effect of physical activity on cognitive functions is well traced in studies in adaptive sports. In this aspect, it is likely that some of the training methods for athletes can be adapted or used in the work with people with AD. We have noticed several studies of this nature.

The substantiation of the correctness of the use of ideomotor training is the study by Iunusov [92]. The author used exercises for mental reproduction of previously mastered motor acts by Paralympic athletes. Classes included: three sessions per week of 15 minutes (creating images of



individually selected elements); one lesson per week (concentration on tasks and combinations that are important for oneself). At the first stage (6 weeks), the training program included practical exercises on creating vivid external images of behaviour before the start. At the second stage (6 weeks), internal images were created, which contained specific sensations during pre-start concentration and the development of muscle efforts. The process of creating these figurative schemes was monitored by objective indicators such as heart rate, respiration, and pulse. It was found that intensive repetition of the mentally performed movement contributed to the stabilization and consolidation of skills.

Kapilevich et al. [93] studied the effects of physical activity on the electrical activity of the brain, cerebral blood flow and cognitive function in athletes involved in cyclic and acyclic sports. The studies were carried out with the participation of healthy young men aged 18 to 23 years. The authors found that cyclic loads have a positive effect on cognitive functions, while such effects are not recorded with strength loads. Research shows the nature of stress that affects cognitive performance. The authors recommend using this approach when choosing physical activity for activities with AD people.

### **Pedagogical supervision of physical exercise for people with AD**

Organization of monitoring of their condition takes a special place in the prevention and correction of cognitive disorders in the elderly. In this context, promising areas of research should be indicated. One of them is lifestyle gamification. It involves the creation of mobile applications for monitoring physical activity. Taking into account the peculiarities of the state of health, it is necessary to fix specifically specific activities, and not a simple amount of activity (number of steps, load time, etc.).

The review by Manevich [42] notes the promise of creating computer programs (including applications for smartphones) for the early detection and rehabilitation of cognitive disorders in the elderly.

The organization of long-term rehabilitation in AD is considered from the standpoint of using artificial intelligence [36]. Artificial intelligence is a tool to improve the quality and longevity of life for people with AD. An important link is the screening of populations and the stratification of

people at high risk of neurodegeneration. This approach reduces the likelihood of illness and disability. Mental and physical fitness helps to maintain brain activity in older people.

An important component of classes with the use of physical activity is pedagogical control. For this purpose, tests of various directions are used. In this aspect, tests of motor abilities are distinguished with the inclusion of various factors that distract the student's attention.

Ansai et al. [94, 95] investigated the risk factors for falls in older people compared with people with mild AD. Evaluation included variables for health status, calorie expenditure, functional status, functional mobility (10 m walk test, dual task test, and timed transition phases). The authors found differences in gait, dual task performance, and history of falls between older adults with preserved cognitive function, mild cognitive impairment, and mild AD. It was also noted that less time spent in the swing-to-seat phase was found to be an independent predictor of falls.

In this context, we believe it makes sense to take advantage of professional advice on the use of exercise in combination with confounding factors. These guidelines can be helpful for people with AD.

It is obvious that the CSL tests [18] and the 10-meter walk test, Timed Up and Go Test [94, 95] can be used in the prevention and assessment of the level of disorders associated with AD. Another recommended test is the "Talking test," which is used in conjunction with exercise. This test allows to determine the intensity of physical activity by the level of comfort in running (walking) with a conversation. At the same time, it is necessary to identify predictors of success that will be characteristic of people with AD. Popichev et al. [96] conducted a study with the participation of 30 university students. As a load, a recreational run of 3000 meters is proposed. To determine the intensity of the load on the cardiovascular system, the "Talking test" is proposed. It is as follows: if a student is able to maintain a conversation with a running partner while running, then the load does not create unnecessary stress for the body. An important indicator of the level of physical fitness of students is the recovery time, which is determined by 10 seconds in the 1st, 3rd, 5th minutes of rest. If by the 5th minute the pulse has recovered, then this indicates an excellent adaptation to the load and

good recovery of the cardiovascular system. A similar "Talking test" was used by Kambachokov [97]. The test was used to regulate the pace of running and the length of the distance in classes with students. Mishina et al. [98] used the "Talking test" to monitor the intensity and safety of exercise programs in outpatient cardiac rehabilitation.

Studies using the "Talking test" have shown that it can be used for people of different ages and health levels: in the classes of university students, in outpatient cardiac rehabilitation of patients.

The study by Niznikowski et al. [99] studied the influence of two different types of verbal guidance in the process of teaching gymnastic exercises. The results obtained demonstrate that a large amount of urgent verbal information from the coach about the technical mistakes that were made has a negative effect on the process of teaching motor actions. The limitation of corrective actions to the key elements of the motor task provides a significantly better learning outcome.

Another promising direction is the substantiation and development of adequate criteria for assessing health status. Traditional tests and functional tests to assess physical qualities will not be informative in the analysis of AD. The exception is tests for reaction speed, coordination, condition of the vestibular apparatus. The development of computer tests and their batteries for smartphones and tablets is promising. The developments of such a plan were used to highlight the factors of the success of single combats athletes [100].

A promising area of monitoring the condition of people with AD is the use of biochemical tests. The most convenient object of analysis is saliva since its collection does not require any traumatic manipulations. When forming a battery of biochemical indicators, the criteria for evaluating the system of lipid peroxidation - antioxidant system (AOS) should be recognized as promising. The informative value of such a battery has been confirmed by monitoring the state of single combats athletes [101].

Another promising area of monitoring is the registration and analysis of the state of speech. The detection of primary speech impairments can be used as a screening test for the presence of cognitive impairments. Analysis of the state of speech allows you to assess the connection with social

factors - communication deficit, loneliness. In the elderly, they act as aggravating factors for cognitive impairment.

Aksay [89] investigated the postures of older people (age 70-80) when standing on one leg while brushing their teeth. The Functional Reach Test [102], Timed up and go Test [103], and Single Leg Stance Test [104] were used to measure the risk of falling and maintaining balance. Such tests have been shown to work well in studies of motor actions in older people.

In our opinion, this approach to testing for people with AD is quite reasonable. Performing a simple movement action (such as walking) in conjunction with verbal guidance from an instructor can be used in practice with people with AD.

Voroshin et al. [105] recommend using the methods of pedagogical control adopted in Paralympic sports, taking into account the functional and intellectual limitations of the athlete [105]. Belyaev and Malygina [106] recommend the following tests for men 36-60 years old and women 36-55 years old: *Strength qualities*: 1 - Eurofit Sit Up Test (number of times per minute); 2 - flexion and extension of the arms in the lying position (number of times); 3 - pull-ups on the bar (number of times; men - high bar, women - low bar). *Speed-strength qualities* - long jump from a place (cm).

In the study by Krasnoperova et al. [107] for beginner athletes with AD, it is recommended to use orthostatic testing (isometric loading with maximum static tension of all muscle groups). The authors recommend using non-invasive techniques: rhythmocardiography, electromyography, bioimpedance analysis of body composition. It was determined that the most favourable for the training process is the optimal state of cardioregulatory processes at rest (moderate prevalence of parasympathetic activity) and the autonomous variant of the reaction of the mechanisms of cardioregulation in response to orthostatic testing. This ratio characterizes a good level of the organism's adaptive capabilities. It is also necessary to normalize the body mass index.

In studies with the participation of Ukrainian young athletes, the need to build training programs based on the safety of physical exercises and the pedagogical process as a whole is noted [108-110]. The authors focused on the use of health-preserving technologies and tests,

which are distinguished by the adequacy of the age characteristics of young athletes [108, 110]. The authors used wearable sensors to continuously track the personal location and physical activity of schoolchildren [109]. Similar devices for measuring physical activity are widely used in studies with the participation of Russian youth [111] and much less in older people.

Another study with the participation of Ukrainian schoolchildren [112] notes the need to use the optimal ratio of teaching aids and motor training. The authors used tests that indicated errors: in assessing the accuracy of time; in the assessment of muscle effort during visual control; in assessing vestibular stability.

We believe that this approach may well be used in assessing the characteristics of the movement of people with AD. This is a fairly simple way to measure the level of important health indicators in people with AD.

In our opinion, in monitoring the main indicators of the health of people with AD, it is necessary to use tests that are characterized by objectivity, reliability and validity. Such tests must meet the requirements for their adequacy in relation to the health and age of the participants. In this aspect, tests used in studies involving athletes with special needs (including those with cognitive impairments) are a good example. For people with AD, a guideline that demonstrates the ability to monitor physical activity while tracking the location of the participant is fine.

### **Fall prevention for people with AD**

According to WHO [113] “37.3 million falls that are severe enough to require medical attention occur each year. Older people have the highest risk of death or serious injury arising from a fall and the risk increases with age. This risk level may be in part due to physical, sensory, and cognitive changes associated with aging, in combination with environments that are not adapted for an aging population.” In order to prevent possible falls, it is recommended to use special tests for the elderly [114].

Possible falls in people with AD are closely related to maintaining balance while performing various motor actions – walking, standing, sitting and getting up from a chair and other everyday movements. The Russian-language segment of

such studies is represented by a small number of publications.

Demin et al. [115] assessed postural balance in men aged 65–89 years depending on postural stability and instability. A significant increase in biological age and a decrease in age-related self-esteem were revealed. Also, a deterioration in postural balance was revealed in the surveyed men who experienced at least one fall, compared with their peers who avoided falls during the year.

Gudkov et al. [116] evaluated the influence of the level of anxiety and components of postural balance in elderly women (n = 232, age 55–69 years) on the formation of the risk of developing falling syndrome. Women have experienced two or more falls in the past 12 months. The authors proposed criteria for assessing the risk of falls for individual preventive programs to prevent serious consequences in the event of such events.

The study by Gudkov and Dyomin [117] compared postural balance in men aged 65–85 years with postural instability and the same number of falls, experiencing and not experiencing fear of probable falls. The results obtained indicate that the emergence of a feeling of fear of possible falls in elderly and senile people with postural instability has an objective basis. Such a basis is presented in the form of more pronounced violations on the part of the postural control system compared to persons who do not experience any fear of probable falls.

Shcherbina et al. [118] note that gait disorders are a major cause of functional impairment and morbidity in the elderly. Most gait disorders in the elderly are multifactorial and have neurological components. Shiryayeva et al. [119] determined the indicators of the dynamic component of postural balance and subjective characteristics of the functional state of the body in elderly women (n = 246, age 60–74) with postural instability. The authors note that the decrease in the quality of the dynamic component of the postural balance can be largely illustrated by the deterioration of the subjective characteristics of the functional state of the body in elderly women.

We give same thought about the more effective prevention of the effects of lost balance and unintentional fall in the last subsection of this discussion.

## Physical activity and employment of older people

Labour activity in older people depends a lot on their physical condition. In this direction, research is useful, the results of which can be adapted for people with AD. An important factor is the adequacy of physical activity to the level and nature of cognitive impairment in people with AD. Particular attention in such activities should be paid to creating a favourable atmosphere and external design space. Several factors are prerequisites for employment opportunities for older people: family relationships and loneliness; availability of special employment programs; recovery and rehabilitation measures.

Belokon [120] examines the problems of relationships between the elderly: in the family (especially with the younger generation); with power structures; gender problems of the elderly (loneliness in old age is two-thirds a woman's problem); the attitude of the elderly to work. Guseva and Zhukova [121] analysed the reasons for the retirement of study participants (age 60). Most of them were named as the reason – staff reduction. This does not correspond to the satisfactory functional state of the study participants. Therefore, today programs for part-time employment of older people, for retraining people over 50 years old according to special programs are relevant.

Physical exercises and a healthy lifestyle have proven themselves well as restorative and rehabilitative measures.

In the study by Golovina et al. [122] is shown that regular physical activity is an integral part of the well-being of older women (55–68 years). In another study [78], it was found that attention to the motor activity of older people is caused by the desire to work and be in demand in the labor market. Lysenko et al. [123] investigated the two-week use of special breathing exercises in combination with the peptide bioregulator Cortexin on the functional state of the body of elderly teachers. This approach increases the professional performance of elderly teachers more effectively than monotherapy with pharmacological drugs. In the study by Poliakov and Tomarevska [124], the main changes in the general working capacity of an elderly person (n = 45, 80–94 years) were established. The study of physiological parameters showed that about 70% of people of the “fourth age” have a significant decrease in the level of self-care and general performance. At the

same time, those surveyed with a higher body mass index have better functional indicators of physical and mental activity. The main changes in the general working capacity of an elderly person have been established, in particular, their physiological components of the characteristics have been clarified.

In our opinion, maintaining the working capacity of older people (including people with AD) is more related to their social adaptation and the ability to maintain basic everyday self-service skills. We agree that some of the elderly people may well show an appropriate level of performance and be in demand in the labour market. However, this requires conducting research of a different plan, which is beyond the scope of our study.

## Art therapy by means of design and visual arts in the context of motor actions of people with AD

Art therapy is a good addition to rehabilitation measures for people with special needs (including people with AD). It is known that motor actions are test-related to cognitive functions. In this direction, one can single out the publications of Ukrainian and Russian researchers who are focused on the use of art therapy tools in combination with motor actions. These actions include: drawing (fine motor skills of the hands and maintaining a person's posture during classes); various hand manipulations using tools (design tools - making various items); dances (motor actions with an emotional background).

Art therapy should be seen as a form of psychotherapeutic and rehabilitative technology through the visual arts [125]. This approach realizes educational, developmental, diagnostic, corrective and socializing functions. The visual arts are also aimed at restoring or maintaining the functions of fine motor skills of the hands and maintaining a person's posture.

The study by Mrykhin [78] notes the importance of enhancing patient activity at home using various art therapy tools. Reviews by Mishkulynets [126] and Sereda et al. [127] discuss the features of the application of various methods of art therapy in working with children with special needs. The authors highlight various drawing techniques such as: fingers, palms, environmental objects (crumpled paper, cubes, sponges, toothbrushes, candle, pencil, chalk).

Separately, the authors focus on color. It is also recommended to use dance movement therapy. This approach is confirmed by other studies that are focused on preschool children with intellectual disabilities [128].

In the study by Gundertajlo et al. [129] is presented the concept of introducing art therapy into the rehabilitation practice of children's hospitals. The essence of art therapy as a specific type of psychotherapeutic assistance and human rehabilitation is revealed. The modern experience of using art therapy in children's hospitals in Ukraine is presented. The authors highlight the fine arts as a means of helping a child to recover. It is recommended to use drawing techniques and working with plastic material.

Art therapy techniques for working with emotions and feelings are presented in the work of Kal'ka and Koval'chuk [130]. The authors provide a detailed content of 18 lessons using the means of visual arts. Classes are focused on working with children and adults who have cognitive impairments. The lessons are based on fine motor skills of the hands.

Susla [131] recommends the use of sand therapy for children with disabilities. Sand therapy promotes the development of fine motor skills and mental abilities. It also allows to stimulate the child, to develop his sensorimotor skills. Fedij [132] discusses in detail several directions of art therapy. Among them, there are three areas that are associated with motor activity: sand therapy; choreographic therapy; rhythmoplasty; kinesitherapy. The author confirms that ideomotor acts are a kind of kinesitherapy. This allows you to perform an aesthetic effect on a child in a limited space (classroom, apartment). Also, the curricula and programs "Aesthetics" are presented in detail [133].

We believe that it is the emphasis on the development of fine motor skills of the hands and other movements that allows to achieve great results. This is very important for the physical development of children with intellectual disabilities.

In general, the Russian segment of research on the problems of using means and methods of physical culture and sports in the Russian-language WoS/RSCI database is similar in terms of topics to publications in the main WoS database. However, there are some differences between studies of

age populations. Thus, most of the studies by Russian scientists on the topic "Healthy lifestyle" are focused on solving the problems of young people and people of working age. In studies of older people, there are few recommendations for a healthy lifestyle that includes consistent exercise. There is also a peculiarity in the fact that the Russian segment of research in the field of physical activity (sports) is distinguished by the presence of publications of a fundamental nature with the participation of people with disabilities. Among them, research on the preparation of athletes with physical and mental disabilities for various Olympics stands out. It is possible that it is these studies of the capabilities of athletes with special needs in extreme conditions that can be used to some extent for people with AD.

### **The perspective of implementing the unique achievements of the "Polish School of Safe Falling"**

Not only does this review show that falling is perhaps the greatest threat and cause of stress in AD patients. With such dynamics of the phenomenon in the context of the aging of the human population and the expansion of civilization diseases, it is surprising that the unique achievements of Polish scientists, educators and practitioners are not recognizable in the global sphere of science. The year 1972, i.e. the period of the Iron Curtain, can be regarded as the symbolic date of the beginning of the unique "Polish School of Safe Falling". Ewaryst Jaskólski and Zbigniew Nowacki published the theory of safe (soft) falling [134], and Roman M. Kalina published a series of 22 mini-articles dedicated to "ABC Self-defence" in a local military magazine (the first 5 concerned the justification for and the methodology of safe fall). Soon Jaskólski and Kalina would engage in long-term scientific cooperation (lasting until Jakólski's death) whose key issue was safe fall [135].

Both main creators of the "Polish School of Safe Falling" were inspired by the philosophy and practice of judo. They based their original technique and methodology of safe fall (ukemi waza) on the practice of judo. Today, the epidemiology of bodily injuries and death leaves no doubt that the sports dimension of judo, like many sports, can even be a lethal threat during training and competition [136-138]. The authors of a review dedicated to the epidemiology of farmers' falls rightly pointed out that basing the prevention of the effects of unintentional falls, especially in the farming population, on the methodology and techniques of judo



should reasonably be limited [139]. These remarks by no means negate the health and utilitarian qualities of judo training [140, 141] under the guidance of a competent teacher.

The astonishment expressed above is deepened by the fact that these unique scientific achievements (also documented with motor skills [142-144] and see “ArchBudo Academy” in Archives of Budo) available since 2008 in the global scientific space [145] are rarely quoted by researchers dealing with preventing the effects of unintentional falls. The broad recommendation of the “Polish School of Safe Falling” is not the aim of this work. However, the problem is so important [146], *inter alia*, in relation to the AD patient population that we only signal, in our opinion, the most important achievements of universal significance.

Kalina and a team of scientists, educators, students (PhD and graduate students) and physiotherapists proved that neither age, sex, health condition, physical fitness are an obstacle to learning safe fall techniques [145]. In a sense, the culmination of this in-depth research and innovative educational programs in the fields of physical education, recreation, and since 2008, physiotherapy, is the promotion of a doctor of health sciences with this unique specialty, physiotherapist Bartłomiej Gąsienica Walczak. The subject of his PhD dissertation “Motor, methodological and mental qualifications of physiotherapy students in the field of safe falling – the perspective of preventing falls in people with visual impairments, an immobilized or amputated limb” [147] testifies to a complementary approach to the issue of public health. The importance and urgency of solving this problem will only increase.

Safe fall methodology and techniques are not dedicated to all groups with an increased risk of falling. Other unique products are suitable especially

in relation to patients with AD and other neurodegenerative diseases, to the elderly, but also to preschool children: fun forms of safe fall and numerous motor simulations shaping the habits of protecting distal parts of the body in situations of loss of balance and fall [147, 148]. Above all, non-apparatus and quasi-apparatus tests [150] which serve to diagnose and reduce the susceptibility of the body injuries during the fall (SFI) [151, 152] have universal application and are 100% safe.

In our opinion, providing a detailed overview and promoting scientific, didactic and preventive achievements of the “Polish School of Safe Falling” is a necessary current task if science is to fulfil its social mission on a global scale as effectively as possible (in this case in relation to people most at risk of consequences of an unintended fall) [150-154].

## CONCLUSIONS

The Russian-language segment of scientific research on the use of exercise in the prevention and treatment of people with AD it subsidizes a bit to the trends in problem solving in WoS publications. However, there is a superiority in the Russian-language scientific resources of research involving athletes with disabilities (including those with cognitive impairments). Such studies provide a good example for maintaining the health of people with AD.

Prevention of AD must be comprehensive. The importance and urgency of addressing fall prevention not only in AD patients will grow. Promoting a healthy lifestyle in young people provides protection against AD in old age. The organization of monitoring the health status of the elderly allows timely detection of violations and their correction at the level of functional disorders.

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