



REVIEW PAPER

Piotr Czarnecki ¹(ABFGH), Justyna Podgórska-Bednarz ¹(ABFGH), Lidia Perenc ¹(ABFGH)

Forms of physical activity of the elderly

Institute of Health Sciences, Medical College of Rzeszów University, Rzeszów, Poland

ABSTRACT

Introduction. Physical activity is known to be an important factor influencing health throughout human life. This issue has become crucial for public health due to the aging of the population in both developed and developing countries.

Aim. is to present a literature review on the forms of physical activity undertaken by the elderly, as well as on issues related to physical activity and the population aging.

Material and methods. The study was prepared on the basis of a review of Polish and foreign literature. The following databases and data sources were used: EBSCO, ScienceDirect and Google Scholar. An additional source of data were the websites of the Central Statistical Office. Strictly defined key phrases were used during the collection of literature. The work has been divided into thematic subsections on the aging of the society, the impact of physical activity on health and the main topic, i.e. forms of physical activity selected by the elderly.

Analysis of the literature. The number of elderly people in Polish society has increased by almost 3.7 million over three decades. Therefore, an important topic is prophylaxis aimed at increasing the number of days in good health, largely covering the broadly understood activation of the elderly. The available data indicate that only 12% of elderly people undertake physical activity once a week. The most common form of spending free time actively is walking (as many as 73% of people in this population declare this form of physical activity in one of the presented studies).

Conclusion. Organized forms of physical activity are undertaken much less frequently by the analyzed age group mainly due to financial limitations and limited availability of sports infrastructure.

Keywords. aging, epidemiology, physical activity

Introduction

Aging is a biological and natural process, however, means of extending the number of days older people maintain in good health are still being sought. Numerous studies show unequivocally that the process of structural and functional changes can be slowed down by selecting appropriate preventive methods resulting

in the long-term maintenance of independence.^{1,2} Adequate physical activity and its frequency positively affect the health of the elderly, the quality of their life and its duration which is in line with the goals of gerontological prevention.³⁻⁵ Professional literature highlights that maintaining the health of the elderly at the highest possible level is crucial issue of the “successful aging”. It has

Corresponding author: Piotr Czarnecki, e-mail: pier_czarnecki@interia.pl

Participation of co-authors: A – Author of the concept and objectives of paper; B – collection of data; C – implementation of research; D – elaborate, analysis and interpretation of data; E – statistical analysis; F – preparation of a manuscript; G – working out the literature; H – obtaining funds

Received: 29.05.2020 | Accepted: 15.08.2020

Publication date: September 2020

long been known that health, quality of life and physical activity are closely related to each other. In the case of an organism aging, various types of pathophysiological changes occur, which have a negative impact on functional abilities. This stage of life is inextricably linked with a gradual decline in physical fitness, an increase in the frequency of limitations resulting in disability and chronic diseases. It should also be remembered that in the world literature numerous reports indicate not only the essence of physical exercise as a factor of primary prevention, but also of secondary prevention in the case of many non-communicable diseases. In turn, the lack of physical activity is the so-called population-attributable risk (PAR).⁴ However, it should be borne in mind that there is no amount of physical activity that can completely stop the natural aging process of the organism. There is also extensive evidence of the beneficial effects of physical activity not only on the physical sphere in the elderly, but also on the psychological and cognitive ones.⁵ Moreover, long-term cohort studies conducted by Wen. et al. clearly confirmed the positive effect of physical activity on the decrease in mortality regardless of the cause. It also seems important that even a smaller amount of time than the recommended 150 minutes a week can also bring positive health effects. 15 minutes of daily physical activity (or 90 minutes on a weekly basis) of moderate intensity can be beneficial for those at risk of cardiovascular disease.⁶ Thus, increasing the level of physical activity in older people is an important factor in supporting public health institutions and relieving the healthcare and social system.⁷⁻⁸

Aim

The aim of the present literature review is to show the forms of physical activity in the elderly. Additionally, the study covers issues related to physical activity and aging of the society.

Material and methods

The study was prepared on the basis of a review of Polish and foreign literature. For this purpose, the following databases and data sources were used: Medline, Science-Direct and Google Scholar. An additional source of data were the websites of the Central Statistical Office.

Key phrases were used in the course of literature search. They included the following phrases: forms of physical activity of the elderly, the role of physical activity in maintaining health in the elderly, aging of the population or guidelines for physical activity of the elderly. They were created on the basis of the main keywords: physical activity, epidemiology, the elderly, aging, health. The following keywords were precisely used: a) demographic data: demography, elderly people, Poland, European Union; b) forms of physical activity of the elderly: physical activity, forms of activity,

the elderly, health. Next, out of all papers found, the research team selected those that were relevant to the aim of the paper. The study presents data from various types of reports: research papers, reviews, analyzes of demographic data, and recommendations for physical activity in the elderly. A detailed description of the studies cited in the paper is presented in Table 1. Demographic data and some information on the physical activity of older people come from the databases of the Central Statistical Office, EUROSTAT, Public Opinion Research Center, World Health Organization and the Info Senior Report - Bank Association Polish.

The study was divided into thematic subsections on the aging of the society, the impact of physical activity and the main issue, i.e. forms of physical activity selected by the elderly. The presented literature includes items from the last 20 years in order to fully achieve the aim of the study.

Aging of the population

The aging of the population is a serious problem that Poland and other the European Union member states face. In Europe, as well as in highly developed non-European countries, the statistical life expectancy has increased by approx. 30 years compared to the beginning of the 20th century. These changes result from the technological progress and improved medical and hygienic conditions as well as access to food. Additionally, a low birth rate is observed in Poland, which becomes economic as well as social challenge for the state governments.⁹⁻¹⁰ The life expectancy of Poles has been systematically extending, this tendency was particularly visible after 1991. Over the last 10 years, it has increased for men by over 4 years, and for women by over 3 years. In 1950, there were over 2 million people over 60, which constituted 8.3% of the total population of Poland, while in 2001, almost 6 million, i.e. 16% of the population. This group amounted to slightly over 9 million in 2017, which is 24% of the total population. Over the course of 3 decades, the number of elderly people in the society has increased by almost 3.7 million. The number of people in very old age, i.e. over 80 years of age, is also growing faster and faster.⁹

The share of the 65+ population is growing successively in each EU Member State (European Union), EFTA (European Free Trade Association) countries and candidate countries. Over the last decade (the period of 2007-2017), the share of the above-mentioned age group in the general population has increased by 2.4 percentage points across the EU. Eurostat (EUROPOP2015) forecast showing the aging of the population indicates that the EU population will be around 528.6 million in 2050, in 2080 there will be a significant decline to 518.8.¹¹ There is also a significant shift in the increase in the percentage of people aged 80 and 80+ in

Table 1. Comparison of papers cited in the study

Study type	Numer of patients/ participants/ cases	Randomi- zation	Control	Demographics of importance (age, sex)	Main outcome	Measures
Barbosa de Lira CA, Viana Taveira H, Rufo-Tavares E et al. Engagement in a Community Physical Activity Program and Its Effects Upon the Health-Related Quality of Life of Elderly People: A Cross-Sectional Study. <i>Value Health Reg Issues – cross-sectional study</i>	100 (active group) 100 (sedentary group)	-	yes	physical activity [PA] group: n = 50 woman, 30 men; sedentary [S] group; n = 50 woman, 30 men;	Mortality due to all-causes declined by 4% (95% CI 2.5-7.0) and all-cancer mortality by 1% (0.3-4.5) with every additional 15 min of exercise over the minimum amount of 15 min a daily training	36-Item Short-Form Health Survey (SF-36)
Wen CP, Wai JP, Tsai MK, et al. Minimum amount of physical activity for reduced mortality and extended life expectancy: a prospective cohort study. <i>Lancet – prospektywne cohort study</i>	416 175	-	-	199 265 men, 216 910 women	The risk of mortality was increased in inactive individuals - 17% (HR 1.17, 95% CI 1.10-1.24) compared with low intensity PA group	self-administered questionnaire
Wyszyńska J, Dereń K, Hausner I, Mazur A. Selected factors influencing the level of physical activity in the elderly. <i>Eur J Clin Exp Med - survey research</i>	100	-	-	85 women 15 men	Lack of correlation was found between the level of total physical activity and sex, place of residence and BMI of participants	IPAQ, questionnaire developed by the authors
Gosik B. Rekreacja i aktywność ruchowa starszych osób. Przykład mieszkańców województwa łódzkiego. <i>Space - Society – Economy – survey research [Recreation and physical activity of elderly people. example of the inhabitants of the Lodzkie Voivodship] (in Polish)</i>	400	-	-	252 women 148 men	Only 28.6% of seniors express the willingness to undertake physical activity, while 45.2% only to some extent, and 26.2% do not feel such a need at all.	questionnaire developed by the authors
Baj-Korpak J, Różański P, Soroka A, Wysokińska E. Motywy i bariery uczestnictwa osób starszych w rekreacji ruchowej. <i>Rozprawy Społeczne – badanie ankietowe (diagnostic survey) [Motives and barriers of older people's participation in physical recreation.] (in Polish)</i>	110	-	-	110 women	94% of the respondents declared taking up active forms of recreation. Cycling (50%), Nordic walking (22%) and swimming (20%) were the most frequently undertook.	questionnaire developed by the authors
Łysak A, Walentukiewicz A, Drabik J, Dąbrowski A, Rowiński R. Aktywność fizyczna i niektóre jej uwarunkowania w populacji seniorów województwa pomorskiego. <i>Hygeia Public Health – survey research [Physical activity and some of its determinants in the population of seniors in the Pomeranian Province] (in Polish)</i>	249	-	-	120 women 129 men	The most popular activity were short walks around the home. 66.8% of the respondents declared taking up such an activity a few times or more per week. Poor health condition or lack of need to be physically active were main obstacles.	questionnaire developed by PolSenior
Marchewka A, Junkiewicz M. Aktywność fizyczna w młodości a jakość życia w starszym wieku. <i>Gerontologia Polska. – survey research [Physical activity in youth and the quality of life in old age.] (in Polish)</i>	59	-	-	39 women 20 men	The level of physical activity declared >the age of 35 years has great statistical influence for the quality of life at the old age.	questionnaire developed by the authors
Hu L, Smith L, Imm K.R, Jackson S.E, Yang L. Physical activity modifies the association between depression and cognitive function in older adults. <i>Journal of Affective Disorders – survey research</i>	2604	-	-	1327 women 1277 men	Moderate-to-vigorous physical activity modifies the depression-cognition relationship and helps to preserve cognition function.	National Health and Nutrition Examination Survey
Wiech M, Prusik K, Kortas J, et al. Changes in the ranges of motion in the joints of the upper and lower extremities in elderly people under the influence of the Nordic walking training. <i>Zmiany zakresów ruchów w stawach kończyn górnych i dolnych u osób starszych pod wpływem treningu Nordic. Journal Of Health Sciences – intervention study</i>	56	-	-	46 women 10 men	3-month training program turned out to bring the expected results by increasing the range of motion in the joints	measurements of range of motion in selected joints with SFTR method using a goniometer
Stankiewicz B, Majchrowski A, Zukow W. Nordic Walking as an alternative form of physical recreation = Nordic Walking jako alternatywna forma rekreacji ruchowej. <i>Journal of Health Sciences - survey research</i>	40	-	-	36 women 4 men	Nordic Walking as a form of physical activity is suitable for a wide range of individuals, diverse in terms of age and efficiency.	questionnaire developed by the authors
Duana Y, Wagner P, Zhanga R, Wulffb H, Brehmc W. Physical activity areas in urban parks and their use by the elderly from two cities in China and Germany. <i>Landscape and Urban Planning – observational study</i>	Hong Kong n=317, Leipzig n=311	-	-	Hong Kong 148 women, 169 men Leipzig 182 women, 129 men	Males demonstrated more intensive and frequent physical activity than women in both cities. The preferred physical activity of the elderly in the parks was walking or cycling.	questionnaire developed by the authors

the EU population. Estimates indicate that in the period 2017-2050 this percentage will double and will amount to 12.7% (for comparison: 5.5% - the initial, actual value for 2017).¹²

Physical activity of the elderly

The level of activity of people aged 65+ in Poland is much lower than in other EU countries. The analyzes carried out by Eurostat show that only 16% of this group undertakes physical activity within the time range from 1 to 149 minutes a day (detailed data are presented in Table 2). The reasons for such low activity of seniors may be health factors such as: injuries, general poor health, disability, communication, movement and economic barriers. The data from 2017 state that the average amount of retirement pension paid under the Social Insurance Institution benefits was PLN 2,133 (calculations for March 2017). Its average value in the group of men was PLN 2,700, and for women PLN 1,615 (the average difference for the group of men and women was slightly over PLN 1,000). Statistical data for Poland indicate that the average monthly household budget surplus is PLN 328.¹³ Therefore, the economic factor should not constitute the main barrier to the elderly people taking up physical activity, especially due to the fact that many forms of activity do not require additional financial outlays apart from costs of sport outfit and footwear.

Table 2. Time spent on health-promoting aerobic (non-work-related) physical activity by degree of urbanization after the age 65 - 2014 data¹⁴

	0 min.	1-149 min.	150-299 min.	150-300 min.	300 min. and more
Average (for city/sub-urbs/rural areas)	76.9	15.8	3.4	7.3	3.9
City	81.9	10.7	3.3	7.4	4.1
City and suburbs	75.1	17	3.4	7.9	4.5
Rural areas	73	20.2	3.4	6.8	3.5

A correlation was found between the place of residence and the level of activity of the elderly.

Gosik et al. focused on physical activity of seniors in the area of the former Łódź Province. One of the aspects of the study were the reasons why elderly people take up physical activity. The most frequently mentioned reasons were the improvement of well-being and fitness, which was declared by 25.9% of the respondents. Sequentially, the elderly indicated: medical recommendations (18.8%), improved sleep quality (16.8%), body weight normalization (8.1%) and better appearance (4.5%). Moreover, the researchers also asked about the reasons why elderly people do not take up physical activity. The percentage breakdown of responses for this aspect was as follows: 32.7% of seniors stated that they could not define them (no causes), 23.8% declared that

it was due to poor health, only 2.1% stated that it was the lack of access to equipment/facilities. The respondents also mentioned other less frequent limitations, such as: lack of financial resources, preferring passive forms of rest, lack of company and laziness, with a similar low number of indications.¹⁵

Forms of activity of the elderly

According to Małgorzata Halecka and Jerzy Halecki study, active forms of spending free time by the elderly can be divided into 5 groups:

1. recreation and hobby including outdoor activities such as walking or gardening, and sports activities. This group also includes activities undertaken as a part of taking up passions and interests. A number of sedentary activities such as – going to the cinema, theatre, doing crafts, etc. are also covered here.
2. receptive - i.e. activities undertaken at home, such as: watching TV, listening to the radio, reading, etc.
3. public oriented - including public, political, social or parish activities,
4. integration - consisting in active support for the work of local societies or participation in scientific and training activities as a part of e.g. seniors' clubs or the University of the Third Age,
5. other types of activity - other individual forms not mentioned above.

These authors also identified the most common leisure time activities of the elderly and so successively: slightly over 84% of seniors watch TV, 64% listen to the radio, 54% read the press, 51% go for a walk, 35% visit friends and 39% relax in the garden.¹⁶ These data were also confirmed by the study of the Public Opinion Research Center (CBOS), where 98% of seniors watch TV, 87% meet friends (at home), 81% go to church, 81% listen to music, 80% read, 77% visit relatives (outside home), 76% meet friends (outside home), 73% go for a walk and hike, 55% do gardening, 44% take care of grandchildren or great-grandchildren, 34% help with household chores, 29% support the family's economic activity, 22% look after ill or disabled relatives.¹⁷

Baj-Korpak et al. proved that the elderly more and more often choose active recreational activities of higher intensity, such as: cycling (50% of the respondents), Nordic Walking (22%), swimming (20%), jogging, dancing or fitness classes were chosen less frequently.¹⁸ On the other hand, the analysis of the results of the study by Łysak et al. aimed at determining the most frequent forms of physical activity undertaken by the elderly showed that 66.8% walk, 32.3% do gardening and 22.2% go hiking.¹⁹

Analyzing the above results, it can be concluded that the elderly do not meet the recommendations of the World Health Organization (WHO) for this age group regarding physical activity. The forms of physical activ-

ity they choose are mainly sedentary and low-intensity physical effort. Note that many of the forms of physical activity mentioned in the study will depend on factors such as the season and weather conditions. In the literature on the subject, education, the level of social status or the type of previously performed work are mentioned as factors conditioning undertaking physical activity.²⁰

An important aspect of participation in organized forms aimed at social activation and increasing the physical activity of this group of people is the positive impact on the quality of life. The study by Orzechowski indicated that participation in the classes of the University of the Third Age (UTA) can be a factor in preventing depression. Czopko et al. also pointed to the improvement of the quality of life of those participating in UTA classes.²¹⁻²²

The aging process is an unavoidable biological process in which physical activity is an important preventive factor. According to Drabik, the optimal dose of physical activity in connection with the health assessment are important for prophylactic purposes^{21,23}, due to the previously mentioned fact of the increase in the population of people aged 65+. The purpose of using physical exercise in people aged 65 and over has not changed significantly. According to The American College of Sports Medicine and the American Heart Association, recommendations for physical activity remain the same for the general population, but the WHO proposes to supplement the guidelines with additional exercises to prevent falls (at a frequency of twice a week) (Table 3).

Table 3. Recommendations for the time of physical activity (PA)²⁴⁻²⁶

	WHO	ACSM/AHA	Tudor-Locke
Medium Intensity PA	at least 150 minutes a week	30 minutes at least 5 times a week	
High Intensity PA	at least 75 minutes a week	20 minutes at least 3 times a week	6,000 – 8,500 steps a day for healthy people
Mixed PA	possibility to split the duration into at least 10 minutes or longer PA throughout the day		3,500 – 5,500 steps a day for people with chronic diseases and the disabled
Strength training	8–10 strength exercises of large muscle groups, 8 to 12 repetitions performed 2–3 times a week		
Flexibility and balance training	At least twice a week		Minimum 200–300 kcal/training Over 1000 kcal/week Optimally above 2000 kcal/week
Resistance training		at least 2 x a week, 8-10 sets of exercises, 10-12 repetitions	

Abbreviations used in the tables: PA - physical activity, WHO – World Health Organization, ACSM -

American College of Sports Medicine, AHA - American Heart Association

Physical activity plays a very important role in human life - exercise improves the biological state of the body, which translates into improvement in the mental, intellectual and social spheres.²⁷ It has also been proven that moderate and high intensity physical activity modifies the relationship between the incidence of depression and affects the level of cognitive functions. The studies indicate that as little as 150 minutes of moderate or high-intensity physical activity per week can prevent cognitive decline in people with symptoms of depression in an older age.²⁸

Among seniors, various forms of exercise are promoted, they are intended to slow down the biological aging process of the body, prevent diseases typical of this period of life, counteract physical limitations, perform a recreational form or return to fitness from before the disease / injury.²⁹ It is recommended that the elderly performed exercises that primarily affected such aspects as endurance, balance, strength and flexibility. The literature on the subject mentions many forms of physical activity, the most frequently chosen ones are: walking, jogging, gymnastics, swimming, cycling, hiking, skiing, walking, yoga and ballroom dancing.³⁰

At this point, it is appropriate to quote the results of the study by Fries, started in 1984, the main purpose of which was to determine the impact of regular running on the aging body. On the basis of monitoring the health of 500 regularly running elderly people for a period of 20 years, compared to the non-running controls, it was noted that: in the study group the number of deaths caused by cancer is lower, infections, cardiovascular diseases, nervous system diseases and other entities are less frequent. It has also been reported that running has a positive effect on life expectancy and maintaining overall physical fitness (thus delaying the time of dependency on other people's help).³¹

Recently, Nordic Walking has been very popular in this age group, hence Stankiewicz et al. conducted research on the impact of this form of exercise on the health of seniors.³²⁻³⁴ Based on the analysis of the study results, they found a positive effect of Nordic Walking on body posture, weight loss and reduction of pain in the locomotor system. This activity also increases the circulatory and respiratory capacity of seniors. An important feature of its impact is the reduction of muscle tension and pain in the neck area and shoulder girdle. Nordic Walking involves almost 90% of all muscles, reduces the load on the joints of the lower extremities, and increases the mobility of the spine. March with poles also improves agility, balance and coordination.³⁴

Another form of activity for the elderly considered to be one of the safest with holistic impact on the body is exercise in the water. Its natural properties are used while

exercising in an aquatic environment, such as: displacement (non-weight bearing activity), resistance and density (strengthening of muscle groups). This form of activity has a very beneficial effect on seniors. An additional advantage of exercising in an aquatic environment is the ability to perform movements that would be much more difficult or impossible to perform in other conditions.³⁵

The literature on the subject also draws attention to the fact that the infrastructure is used to support various forms of physical activity. An interesting analysis in this regard was carried out by Duana et al., who studied the use of city parks as important places related to PA of seniors. The researchers took into account 6 city parks located in two cities of Hong Kong (China) and Leipzig (Germany). It has been shown that the most exploited part of the parks are the paths where the people observed most often walked (in the case of both cities) and cycled (only in the case of Leipzig). Sports fields and playgrounds were used more often by people surveyed in Hong Kong. In general, in both cities, older people undertook low-intensity PA, and statistically more often they were men. The authors of the work emphasized in their conclusions that such data should be taken into account when designing urban recreational areas.³⁶

Haskell in his works emphasizes that the selection of an appropriate activity may depend on many physiological, demographic and environmental factors. He emphasizes the regularity that too small a “dose” will not have a positive effect on the functioning of the body, and too high will have a negative effect on its functioning. Many publications refer to health training involving large muscle groups, which is continuous (uninterrupted for several to several minutes) - aerobic training. This type of activity includes: marching, walking, cycling, cross-country skiing, swimming, rowing and running. Systematic aerobic training improves the efficiency of the system. In addition to this type of exercise, resistance exercises (strength) and stretching exercises should be included. The first part of the exercises should be a 7-10 minute warm-up, the final part should be low-intensity breathing and calming exercises that last 7 to 10 minutes.³⁷

Conclusion

The aging of the society is a phenomenon important from the socio-political perspective. The governments should be guided by the very current motto of Juvenalis “Mens sana in corpore sano” - “In a healthy body, healthy mind” and through integrated social efforts aimed at the physical activation of the elderly aimed at improving their health and functional state should fulfil the constitutional duty of the state which is to provide health care to specific groups such as children, pregnant women, disabled people and the elderly [art. 68 of the Constitution of the Republic of Poland].

The data available in the literature show that 1% of elderly people regularly practice sports, and 30% regularly walks. Overall, only 12% of people at the age of 60+ undertakes physical activity at least once a week.³⁸ The choice of PA itself is often determined by the existence of financial, social and health limitations, especially the relatively high costs of activities offered by the fitness club in relation to monthly unused funds remaining in households. However, it should be borne in mind that thanks to various pro-health programs and support from governmental and non-governmental organizations, the availability of various infrastructure facilities, e.g. outdoor gyms, which are a part of land development, both in cities and in rural areas, or health paths enabling cost-free undertaking of physical activity.

Certainly, it would be not without significance to promote physical activity as a preventive and health-enhancing measure in this social subpopulation.³⁹⁻⁴² These efforts should be undertaken by people who are authorities in the field of health, such as primary care physicians. Going further, the availability of various organized forms of physical activity strictly dedicated to the elderly should be improved.⁴³⁻⁴⁷ Also in rural areas, thanks to systemic support solutions.⁴⁸ All these activities will result in a modification of the current style of spending free time by seniors, and this in turn should translate into a delay in the negative effects of the aging process in the coming years, as well as a reduction in state budget funds allocated to convalescence and care among people over 65 years of age. Programs dedicated to the elderly should take into account individual interests and needs.⁴⁹

The well-known fact that PA is a relatively accessible, cheap and simple form of maintaining the body in good health is increasingly used in various prevention programs and programs aimed at activating the elderly, but there is still a need for many changes, which can be summarized as follows^{25, 50- 51}:

1. Social awareness of the importance of regular physical activity for health, fitness and mental condition should be increased,
2. It is necessary to implement popularizing and preventive programs activating the elderly,
3. It is important to encourage older people to participate in such programs by showing them tangible benefits,
4. It seems crucial to involve doctors in the cooperation, promoting movement among their patients as one of the methods of counteracting the negative effects of aging,
5. An important aspect is to increase the variety of classes in fitness clubs, while encouraging older people to take advantage of the rich offer,
6. Consideration should also be given to improving the accessibility to activities organized in the autumn and winter period,

7. The share of financing costs related to physical activity of the elderly by local governments should be increased.

References

8. Bień B. Sytuacja zdrowotna ludzi w podeszłym wieku w Polsce. [Health situation of elderly people in Poland] (in Polish) *Śłużba Zdrowia* 2000;14:61–64.
9. Stauden S. *Psychologia starzenia się i starości*. [Psychology of aging and old age] (in Polish) Warszawa: Wydawnictwo Naukowe PWN; 2011:82.
10. Duda K. *Proces starzenia się*. Marchewka A, Dąbrowski Z, Żołądź JA ed. *Fizjologia starzenia się. Profilaktyka i rehabilitacja*. [Aging physiology. Prevention and rehabilitation.] (in Polish) Kraków, Wydawnictwo Naukowe PWN; 2012: 1–31.
11. Kozdroń E, Leś A. Aktywność ruchowa w procesie pomyślnego starzenia się. Postępy Rehabilitacji. [Motor activity in the process of successful aging. Rehabilitation progress.] (in Polish) *Zeszyty Naukowe WSKFiT*. 2010;24(1):49–57.
12. Chodźko-Zajko WJ, Proctor DN, Fiararone Singh MA, et al. American College of Sports Medicine position stand. Exercise and physical activity for older adults. *Med Sci Sports Exerc.* 2009;41(7):1510–30.
13. Wen CP, Wai JP, Tsai MK, et al. Minimum amount of physical activity for reduced mortality and extended life expectancy: a prospective cohort study. *Lancet*. 2011;378:1244–1253.
14. Long-term Senior Policy in Poland for the years 2014–2020 in outline. Ministerstwo Prac i Polityki Społecznej. <https://das.mpips.gov.pl/source/Long-term%20Senior%20Policy.pdf>. Published December 24, 2013. Accessed July 1, 2019.
15. Barbosa de Lira CA, Viana Taveira H, Rufo-Tavares E et al. Engagement in a Community Physical Activity Program and Its Effects Upon the Health-Related Quality of Life of Elderly People: A Cross-Sectional Study. *Value Health Reg Issues*. 2018;17:183–188.
16. Information on the situation of the elderly based on research by the Central Statistical Office. Central Statistical Office. <https://stat.gov.pl/obszary-tematyczne/osoby-starsze/osoby-starsze/informacja-o-sytuacji-osob-starszych-na-podstawie-badan-glownego-urzedu-statystycznego,1,2.html>. Accessed July 1, 2019.
17. Ageing and health. World Health Organization. <https://www.who.int/news-room/fact-sheets/detail/ageing-and-health>. Published February 5, 2018. Accessed July 1, 2019.
18. Population structure and population aging. Eurostat. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Population_structure_and_ageing/pl. Accessed July 1, 2019.
19. Population structure and ageing. Eurostat. <https://ec.europa.eu/eurostat/statistics-explained/pdfscache/1271.pdf>. Accessed July 1, 2019.
20. Raport. Info Senior. Związek Banków Polskich. [Report. Senior Info. The Union of Polish Banks] (in Polish) https://zbp.pl/public/repozytorium/wydarzenia/images/styczen_2018/ZBP_InfoSenior_18.01_f.pdf. Published February, 2018. Accessed July 1, 2019.
21. Eurostat. <http://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do>. Accessed July 1, 2019.
22. Gosik B. Rekreacja i aktywność ruchowa starszych osób. przykład mieszkańców województwa łódzkiego. [Recreation and physical activity of elderly people. example of the inhabitants of the Lodzkie Voivodship] (in Polish) *Space - Society - Economy*. 2015;14:151–163.
23. Modrak M. *Trzeci poziom dojrzałości. Szczęśliwe życie po pięćdziesiątce*. [The third level of maturity. Happy life in your 50s.] (in Polish) Gliwice: Wydawnictwo Sensus; 2013:87–89.
24. Sposoby spędzania czasu na emeryturze. Centrum Badań Opinii Społecznej. [Ways of spending time in retirement. Public Opinion Research Center.] (in Polish) https://www.cbos.pl/SPISKOM.POL/2012/K_106_12.PDF. Published July, 2012. Accessed July 1, 2019.
25. Baj-Korpak J, Różański P, Soroka A, Wysokińska E. Motywy i bariery uczestnictwa osób starszych w rekreacji ruchowej. [Motives and barriers of older people's participation in physical recreation.] (in Polish) *Rozprawy Społeczne*. 2013;1(VII):125–130.
26. Łysak A, Walentukiewicz A, Drabik J, Dąbrowski A, Rowiński R, Aktywność fizyczna i niektóre jej uwarunkowania w populacji seniorów województwa pomorskiego. [Physical activity and some of its determinants in the population of seniors in the Pomeranian Province] (in Polish) *Hygeia Public Health*. 2014;49(3):549–553.
27. Zych AA. *Słownik gerontologii społecznej*. [Dictionary of Social Gerontology.] (in Polish) Warszawa: Wydawnictwo Żak; 2001:19.
28. Departament Badań Społecznych i Warunków Życia GUS, *Uniwersytety Trzeciego Wieku – wstępne wyniki badania za rok 2014/2015*, [Third Age Universities - preliminary research results for 2014/2015] (in Polish) Gdańsk: GUS; 2016:3.
29. Villar F, Celdrán M. Generativity in Older Age: A Challenge for Universities of the Third Age (U3A), *Educational Gerontology*. 2012;(38):666.
30. Halicka M, Halicki J. *Integracja społeczna i aktywność ludzi starszych*. [Social integration and activity of the elderly] (in Polish) Synak B. ed. *Polska starość*. Gdańsk: Wydawnictwo Uniwersytetu Gdańskiego; 2003:207.
31. Global Recommendations on Physical Activity for Health. World Health Organization <https://www.who.int/diet-physicalactivity/global-PA-recs-2010.pdf>. Accessed July 1, 2019.
32. Haskell WL, Lee IM, Pate RR, et al. Physical activity and public health: Updated recommendation for adults from the American college of sports medicine and the American heart association. *Circulation*. 2007;116(9):1081–1093.
33. Tudor-Locke C. Taking steps toward increased physical activity: using pedometers to measure and motivate. *Research Digest*. 2002;17(3):1–8.

34. Wyszynska J, Dereń K, Hausner I, Mazur A. Selected factors influencing the level of physical activity in the elderly. *Eur J Clin Exp Med* 2018;16(3):184–189.
35. Marchewka A, Junkiewicz M. Aktywność fizyczna w młodości a jakość życia w starszym wieku. [Physical activity in youth and the quality of life in old age.] (in Polish) *Gerontologia Polska*. 2008; 16(2):127-130.
37. Hu L, Smith L, Imm K.R, Jackson S.E, Yang L. Physical activity modifies the association between depression and cognitive function in older adults. *Journal of Affective Disorders*. 2019; 1(246): 800–805.
38. Kostka T, Kostka J. *Trening zdrowotny osób starszych. Fizjoterapia w geriatrici*. [Health training for the elderly. Physiotherapy in geriatrics.] (in Polish) Warszawa: Wydawnictwo Lekarskie PZWL; 2011: 31-44.
39. Cieślicka M, Stankiewicz B, Napierała M, Żukow W, Brzeziński M. *Aktywność fizyczna osób starszych*. [Physical activity of the elderly.] (in Polish) Maik W, Napierała M, Żukow W ed. *Wybrane problemy turystyki, rekreacji, fizjoterapii ochrony zdrowia człowieka*. Bydgoszcz; 2011:28- 37.
40. Kaźmierczak U, Radziemińska A, Dzierżanowski M et al. Korzyści z podejmowania regularnej aktywności fizycznej przez osoby starsze = The benefits of regular physical activity for the elderly. *Journal of Education, Health and Sport*. 2015;5(1):56-68.
41. Halicka M, Halicki J. *Integracja społeczna i aktywność ludzi starszych [Social integration and activity of the elderly] (in Polish)*, [in:] Synak B. (Ed.), *Polska starość*. Gdańsk: Wydawnictwo Uniwersytetu Gdańskiego; 2003:207.
42. Wiech M, Prusik K, Kortas J, et al. Changes in the ranges of motion in the joints of the upper and lower extremities in elderly people under the influence of the nordic walking training. Zmiany zakresów ruchów w stawach kończyn górnych i dolnych u osób starszych pod wpływem treningu Nordic. *Journal Of Health Sciences*. 2013;3(5):267-276.
43. Stankiewicz B, Majchrowski A, Zukow W. Nordic Walking as an alternative form of physical recreation = Nordic Walking jako alternatywna forma rekreacji ruchowej. *Journal of Health Sciences*. 2013;3(7):109-126
44. Łubkowska W, Szark-Eckardt M. *Korygowanie postawy ciała poprzez pływanie i ćwiczenia w wodzie*. [Correcting body posture by swimming and exercises in the water] (in Polish), Bydgoszcz: 2015:39-49.
45. Duana Y, Wagner P, Zhanga R, Wulff H, Brehm W. Physical activity areas in urban parks and their use by the elderly from two cities in China and Germany. *Landscape and Urban Planning*. 2018;178:261–269.
46. Recommendations for physical activity in the prevention of circulatory diseases. Department of Social and Preventive Medicine, Medical University of Lodz http://a.umed.pl/geriatria/pdf/Zalecenia_dotyczace_aktywnosci_ruchowej_w_profilaktyce_chorob_ukladu_krazenia.pdf. Accessed July 1, 2019.
47. Kozdroń E. Aktywność rekreacyjna w procesie pomyślnego starzenia się. [Recreational activity in the process of successful aging] (in Polish) *Zeszyty Naukowe WSKFiT*. 2014;9:75-84.
48. Bloomgarden ZT. Type 2 diabetes in the young. *Diabetes Care*. 2004;27:998-1010.
49. Cordeo-MacIntyre Z, Peterson R, Fukuda D, Gungur S. Obesity a Worldwide Problem. New Horizons. 24th International Council for Physical Activity and Fitness Research Symposium. Wrocław: 2006.
50. Dehgan M, Akhtar-Danesh N, Merchant A.T. Childhood obesity, prevalence and prevention. *Nutrition J*. 2005; 4:24.
51. Hawkins SA, Cockburn MG, Hamilton A.S, Mack T.M. An Estimate of Physical Activity Prevalence in a Large Population-Based Cohort. *Medicine & Science in sports & Exercise*, 2004;36(2):253-260.
52. Hawley J, Houmard J. Introduction-Preventing insulin resistance through exercise: a cellular approach. *Med Sci Sports Exerc*, 2004;36:1187-1190.
53. Pi-Sunyer FX. The obesity epidemic: pathophysiology and consequences of obesity. *Obes. Res*. 2003; 10:97-104.
54. Raitakari OT, Juonala M, Kahonen M. et al. Cardiovascular risk factors in childhood and carotid artery intima-media thickness in adulthood. The cardiovascular risk in young Finns study. *JAMA*, 2003;290:2277-2283.
55. Tremblay M, Willms J. Is the Canadian childhood obesity epidemic related to physical inactivity? *Int J Obes* 2003;27: 1100-1105.
56. US Department of Health and Human Services. The Surgeon General's Call to Action to Prevent and Decrease Overweight and Obesity. <https://www.cdc.gov/nccdphp/dnpa/pdf/CalltoAction.pdf>. Accessed July 1, 2019.
57. Osiński W. *Gerokinezylogia: Nauka i praktyka aktywności fizycznej w wieku starszym*. Warszawa; 2013:40–47.
58. Mazurek J, Szczygieł J, Blaszkowska A, Zgajewska K, Richter W. Aktualne zalecenia dotyczące aktywności ruchowej osób w podeszłym wieku. [Current recommendations regarding the physical activity of the elderly] (in Polish) *Gerontologia polska*. 2014:2:70-75.
59. Europa. Eurostat. <http://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do>. <http://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do>. Accessed July 1, 2019.