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PART I. DISEASES AND PROBLEMS DISTINGUISHED BY WHO AND FAO
DZIAŁ I. CHOROBY I PROBLEMY WYRÓŻNIONE PRZEZ WHO I FAO

PROPHYLAXIS OF LYME BORRELIOSIS AND RURAL RESIDENTS' AWARENESS

PROFILAKTYKA BORELIOZY Z LYME W ŚWIADOMOŚCI MIESZKAŃCÓW
OBSZARÓW WIEJSKICH

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Summary

Background. The study aimed to evaluate the scope and level of rural residents' knowledge on the prevention of Lyme borreliosis and how this knowledge is used by residents of some selected rural areas of Lublin Province.

Material and methods. A survey methodology was conducted with a sample of respondents of the Firlej and Kock communes (Lubartów County) and Borki commune (Radzyń Podlaski County). The study group involved 100 rural residents aged 18-67 years (mean 43; SD 0.14).

Results. Among rural residents participating in the study, 35% are engaged in agriculture, and 61% have backyard gardens. 14% of the respondents have experienced a single tick bite, while 26% multiple bites. Out of those respondents who have experienced tick bites, only 12.5% have undergone diagnostic tests for the presence of Lyme borreliosis. The reported bite sites were found mostly in the lower limb (55%), stomach (40%), upper limb (30%), and the observed symptoms included first of all: muscle pain (50%), headache (37.5%), impaired concentration (20%), fever (17.5%), bone and joint pain (12.5%). A total of 30% farmers and rural residents consider their knowledge on the prevention of tick-borne diseases as minimal.

Conclusions. It is necessary to undertake educational activities that would not only contribute to an increase in the level of knowledge of countryside residents on the prevention of tick-borne diseases but also lead to taking appropriate measures when bites occur.

Keywords: prevention, Lyme borreliosis, rural residents

Streszczenie

Wprowadzenie. Celem badań była ocena zakresu i poziomu wiedzy na temat profilaktyki boreliozy z Lyme i powszechności jej stosowania wśród mieszkańców wybranych obszarów wiejskich z terenu województwa lubelskiego.

Materiał i metody. Badania ankietowe przeprowadzono wśród mieszkańców gminy Firlej i Kock (powiat lubartowski) oraz gminy Borki (powiat radzyński). Grupę badaną stanowiło 100 mieszkańców obszarów wiejskich, w wieku 18-67 lat (śr. 43; SD 0,14).

Wyniki. Wśród mieszkańców wsi biorących udział w badaniu 35% zajmuje się rolnictwem, a 61% posiada przydomowy ogródek. Jednokrotnego pokłucia przez kleszcze doświadczyło 14% respondentów, zaś wielokrotnego 26%. Spośród osób pokłutych przez kleszcze tylko 12,5% wykonywało badania diagnostyczne w kierunku boreliozy z Lyme. Najczęściej badani informowali o ukłuciu w obrębie kończyny dolnej (55%), brzucha (40%), kończyny górnej (30%), a obserwowane objawy to bóle mięśni (50%) i bóle głowy (37,5%), osłabienie koncentracji (20%), gorączka (17,5%), bóle kostno-stawowe (12,5%). Łącznie 30% rolników i mieszkańców terenów wiejskich ocenia swoją wiedzę zakresie profilaktyki chorób odkleszczowych jako minimalną.

Wnioski. Konieczne jest podjęcie działań edukacyjnych, które przyczynią się do zwiększenia poziomu wiedzy mieszkańców wsi w zakresie zasad profilaktyki chorób odkleszczowych i podejmowania odpowiednich czynności w sytuacjach, kiedy dojdzie do pokłucia przez kleszcze.

Słowa kluczowe: profilaktyka, borelioza z Lyme, mieszkańcy wsi

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Introduction

Forestry workers, farmers, forest undergrowth pickers, hunters and people actively resting outdoors are most likely to get into contact with ticks which are vectors of *Borrelia burgdorferi* sensu lato (s.l.), *Anaplasma phagocytophilum*, *Babesia* spp. and tick-borne encephalitis virus [1,2,3]. For humans, the risk of getting infected with the listed pathogens depends on the ticks density and infection prevalence in a given area as well as the populations of wild animals – their reservoir [4]. In Poland, the proportion of particular genospecies of *B. burgdorferi* s.l. in tick infection varies. In Lublin Province, *I. ricinus* infections are caused primarily by *B. burgdorferi* sensu stricto (62.8%), *B. afzelii* (39.8%) and *B. garinii* (17.8%) [5]. *Anaplasma phagocytophilum* was found in 5.9% [6] and *I. ricinus* – in 8.9% [7]. The percentage of ticks infected by *Babesia microti* on Polish territory fluctuates, ranging from 0.6% – 16.3% [7].

In countries of the Northern Hemisphere, Lyme borreliosis is the most common tick-borne zoonosis [8]. According to The National Institute of Public Health – National Establishment for Hygiene in Poland, in 2015, there were reported 13 625 cases of Lyme borreliosis (incidence of 35.4/100 thousand) [9]. The number of the diagnosed cases of the disease in particular provinces differed. In Lublin Province, there was an increase in the incidence of Lyme borreliosis within a few years: in 2012 – 659 cases (incidence of 30.4 / 100 thousand) [10]; in 2013 - 816 (incidence of 37.8 / 100 thousand) [11]; 2014 – 854 (incidence of 39.7 / 100 thousand) [12]. In 2015, Lublin was ranked fourth in terms of the incidence of Lyme borreliosis in the country (incidence of 51/100 thousand, 1,094 cases) [9].

Infections of *B. burgdorferi* in conjunction with the developing clinical symptoms of Lyme borreliosis can have a significant impact on the quality of life and work of people in the agricultural sector. The results of the survey conducted among farmers in different parts of Lublin province show that the IgM/IgG antibodies anti-*B. burgdorferi* were found in about 28% – 38.5% of the respondents [13,14]. Farmers are more likely to experience tick bites and *B. burgdorferi* infection than those living in more urbanised areas, which led to the recognition of Lyme borreliosis as an occupational disease associated with farm work [15,16,17]. Farming system and the way it functions causes that farmers are exposed to tick bites throughout the whole activity period of these arachnids, i.e. from early spring to late autumn [18,19]. In eastern Poland, farms and fields are often located near deciduous and mixed forests, which contributes to the incidence of bites during fieldwork and while harvesting timber in woodlands [13,16,19,20]. Clinical symptoms accompanying Lyme borreliosis, which affect the osteoarticular system (Lyme arthritis) and the nervous system, (neuroborreliosis) can have a significant impact on work performance and efficiency especially in jobs that require physical effort, including farm work; that is what that farmers do. Unlike the other professional group – forestry workers, farmers do not undergo regular tests for Lyme borreliosis. Thus, it seems that only farmers' high awareness of the threat of tick-borne diseases, an ability to properly remove the tick needled in the skin and recognise the early symptoms of infection, enables them to take appropriate steps to diagnose the disease and commence treatment.

The study aimed to evaluate the scope and level of knowledge on the prevention of Lyme borreliosis and the way it is used by residents of some selected rural areas of Lublin Province.

Material and methods

Survey research was conducted among the residents of some rural areas located in Lublin Province: Firlej and Kock communes (Lubartów County) and Borki commune (Radzyń Podlaski County). The study group involved 100 rural residents, aged 18-67 years (mean 43; SD 0.14), including 62 women aged 18-67 years (mean 42.4; SD 0.48), and 38 men aged 22-66 years (mean 43.7; SD 0.51).

In order to achieve the research goal, the researcher used a questionnaire with 17 original questions on: the frequency of reported tick bites, methods for removing arachnids, bite sites, onset of symptoms which according to the respondents were associated with the bite, prevention methods used to minimize the number of stings, awareness of how domestic animal carry ticks into the living quarters, level of knowledge among rural population on Lyme borreliosis and need to increase it. The questionnaire research was conducted from July to October 2015, during individual meetings.

Results

Among the rural residents taking part in the study 35 persons (35%) work in agriculture; 44 respondents (44%) have another job, not connected with agriculture away from home, but have their home garden; 17 people (17%) do not work professionally but have a home garden; and 4 respondents (4%) do not have a garden and work away from home performing jobs unrelated to agriculture.

Forty respondents (40%) report that, despite living in a rural environment, they seldom stay in forested areas, 34 respondents (34%) tend to frequent forests and 26 respondents (26%) occasionally go to woods.

14 respondents (14%) have experienced a single tick bite, 26 persons have had multiple bites (26%), while 60 of those surveyed (60%) have not received any tick bite in their life.

Out of 40 respondents who declared having been bitten by a tick, 13 persons went to the doctor or nurse for help in order to remove the tick (32.5%), 11 respondents (27.5%) informed about grasping the tick with fingers and pulling it out, 6 people twisted the arachnid using tweezers (15%), 5 persons removed it with tweezers through a simple, energetic motion (12.5%), 2 respondents scraped it off with a fingernail (5%), 1 person doused the tick with a disinfectant (2.5%), and 2 respondents used other methods (5%). Nobody reported applying an oily substance to the tick so that it would come out on its own. Moreover, 9 persons (22.5%) disinfected the place after removing the tick.

Furthermore, the respondents reported on the areas of the body where they had spotted attached ticks. They most frequently informed about tick bites within the lower limb (22 cases, 55%), the belly area (16 cases, 40%), the upper limb (12 cases, 30%). The ticks were less often spotted on the back (3 cases, 7.5%), the neck (2 cases, 5%), the chest (2 cases, 5%) and the head (1 case, 2.5%).

The respondents also informed about the appearance of symptoms which they had linked with the tick bite. 9 patients (22.5%) indicated skin lesions, forms of erythema greater than 5 cm in diameter. However, the people bitten by ticks most often complained about muscle pain (20 people; 50%), and headache (15 people; 37.5%). Other reported symptoms included: concentration impairment (8 persons, 20%), fever (7 persons, 17.5%), osteoarticular pain (5; 12.5%), meningitis (4 persons; 10%), arthritis (3 persons; 7.5%), and facial nerve paralysis (1 person; 2.5%).

Only 5 persons (12.5%), out of 40, who had been bitten underwent diagnostic tests to detect Lyme borreliosis, while the others did not make such a diagnosis (35 people; 87.5%).

Next, the respondents were asked about the measures they took to reduce the risk of tick bites. They informed that while staying outdoors they use repellents but with varying frequency: 14 persons (14%) do it often, 36 people (36%) – rarely, and 50 respondents (50%) do not use them at all. Besides, 47 people (47%) often inspect their body after returning from forested areas in order to check if they have been bitten by a tick. Such actions are rarely taken by 42 respondents (42%), and 11 rural residents (11%) do not take this type of action.

Rural residents were also asked whether they know that cats and dogs can bring ticks on their fur into the household which are alive and not attached to the animal skin. The majority of the respondents (92 people; 92%) confirmed that they have such knowledge, but at the same time, many of them admitted that their animals are kept in the households. Also, 38 (38%) and 28 (28%) respondents respectively reported that cats and dogs are let into the house. Then, there were those who denied that cats and dogs are kept at homes (62% and 72% of the respondents respectively).

The respondents were asked to assess their knowledge level on Lyme borreliosis. 4 persons (4%) declared lack of knowledge in this respect, but 2 of them indicated that they were willing to increase it, while another 2 did not want to do it. 30 people (30%) estimated their knowledge of Lyme borreliosis as minimal – 2 persons from this group did not want to learn about it, 6 indicated that they had no opinion on this issue, while 22 people wanted to acquire some more knowledge about the disease. The largest group, i.e. 59 respondents (59%), estimated that their knowledge was at a medium level, out of whom 40 would like to deepen it, 10 chose the option 'I do not know' whether I want to increase it, and 9 people did not want to educate themselves in this area. Seven persons (7%) estimated that their knowledge of Lyme borreliosis was high and 3 more did not wish to increase it. Further, there were also those who wished to get more information (4 persons).

Finally, the rural residents were asked if they knew that Lyme borreliosis is considered to be an occupational disease for farmers. Only 29 people (29%) gave affirmative answers to this question while 71 persons (71%) said that they did not have any knowledge in this field.

Discussion

The Agricultural Social Insurance Fund (ASIF) reports that the number of one-time compensations paid by the Agricultural Social Insurance Fund because of Lyme borreliosis in 2009 involved 132 cases; in 2010 – 125; in 2011 – 146; in 2012 – 155, and in 2013 – 176 [15]. In 2014, damage to health in connection with Lyme borreliosis ranging from 6% to over 61% was found in 179 cases analysed by the Agricultural Social Insurance Fund [22], while in 2015 – in 197 [23].

The results of this study indicate that 71% of the surveyed persons living in the countryside did not know that Lyme borreliosis is recognised as an occupational illness of farmers. The results also proved that countryside residents rarely use medical consultations despite the self-perceived symptoms that are associated with tick

bites. After the bite occurred, only 12.5% of the respondents made diagnostic tests to detect Lyme borreliosis. However, the residents are willing to obtain a doctor or nurse's help with removing the tick (32.5%). Further, they most often informed about bite areas in the lower limb (55%), the stomach area (40%), the upper limb (30%), and the symptoms which were observed most often included: muscle pain (50%) and headache (37.5%), impaired concentration (20%), fever (17.5%), as well as bone and joint pain (12.5%). Bartosik et al. [18] recorded similar symptoms in the respondents who reported having been bitten among the inhabitants of south-eastern Poland. These included: fever (36%), joint pain (35%) and headache (34%) [18].

As there is no vaccine against Lyme borreliosis, the best form of preventing *B. burgdorferi* infections is to avoid being bitten by ticks. Individual prevention includes appropriate clothing, avoiding animal paths and trails, inspecting the body after visits in wooded areas, and using tick repellents [24]. According to the study by Bartosik et al. [18], 26% of the surveyed inhabitants of south-eastern Poland wore clothes protecting the body against tick bites, 13% used repellents, and 4% of the respondents inspected their body after returning from forested areas [18]. Among the surveyed inhabitants of Dolny Śląsk, 40% respondents did not use any methods of protection against ticks, and this applies more to men (46%) than women (24%). The respondents most frequently choose clothes that prevent ticks from direct access to the skin (31%) and use repellents (15%) [24]. Among the workers employed in forest exploitation in 4 forest inspectorates subordinate to The General Directorate of The State Forests in Lublin, 75% declared using repellents [25]. The authors' research reveals that 50% of the countryside residents do not use any repellents while being outdoors. It is more common to inspect the body to check for any tick bites. This type of prevention is often used by 47 persons (47%).

On the other hand, the study conducted among students of tourism and recreation in Biala Podlaska demonstrated that over 59% of the respondents do not use any tick repellents, while only 5.4% do that quite often. The habit of inspecting the body after returning from forested areas is always followed by 16.8% of the students [26] and 23.8% of the high school students in Biala Podlaska living in rural areas [27]. 12.8% students [26] and 12.2% high school students [27] have never performed this activity. In contrast, the surveyed students from the Czech Republic declared using repellents (64% women / 50% men) and wearing clothes covering up all of the body (50% women / 38% men) [28].

Quick and proper removal of the attached tick is an element of the Lyme borreliosis prophylaxis. The tick should be firmly and properly removed with tweezers, and then the bite area should be disinfected [29]. This way of removing ticks was declared by 18.3% of the surveyed students from Biala Podlaska, whereas 42.7% people disinfected the bite area after removing the tick [26]. High school students in Biala Podlaska who came from rural areas declared that they knew how to remove the attached tick in a proper way (49.1%) [27]. Only 19% people coming from rural and urban areas surveyed by Bartosik et al. [30] declared the use of the recommended method of removing ticks, i.e. tweezers, while pulling them out because doing it fingers turned out to be the most popular method (44%). Only 3% of the respondents used doctor's assistance when removing ticks [30]. The conducted studies reveal that the countryside residents often use doctor or nurse's aid when pulling the tick out (32.5%). If they remove the arachnids on their own, they either twist them with tweezers (15%) or extract them, also with tweezers, with one simple energetic move (12.5%). The bite area was disinfected by 22.5% of the respondents.

The obtained results indicate the need for education regarding the prevention of tick-borne diseases among farmers and inhabitants of rural areas since 30% of the respondents consider their knowledge as minimal. Many respondents feel the need to broaden their knowledge in this field. The ASIF official websites include educational information and prevention booklets, from which farmers can learn about the health and safety issues at work in a broad sense, including information on how to protect themselves from infections of pathogens transmitted by ticks [31]. The research by Pańczuk et al. illustrates the effectiveness of educational activities, as 43.9% of the students considered their knowledge as minimal before attending the lecture on the prevention of tick-borne diseases, including Lyme borreliosis. After the lecture, 97.3% of the respondents felt that their level of knowledge was high or medium [26]. In a similar study conducted among high school students, it was reported that 42.8% of the students considered the level of their knowledge as minimal, and 28.3% as medium, before attending the lecture. After the lecture, 74.5% of the students felt that their level of expertise was high [27]. Cisak's research results indicate the importance of educational activities in preventing tick-borne diseases among individuals from occupational risk groups [25].

Conclusions

It is necessary to undertake educational activities that will contribute to increasing the level of the countryside residents' knowledge with regard to the principles of tick-borne disease prophylaxis and undertaking appropriate measures when ticks occur.

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SPECIFICITY OF HEALTH-RELATED BEHAVIOURS IN MIDDLE AND LATE ADULTHOOD

SPECYFIKA ZACHOWAŃ ZDROWOTNYCH OSÓB W OKRESIE ŚREDNIEJ I PÓŹNEJ DOROSŁOŚCI

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Authors' contribution

Wkład autorów:

- A. Study design/planning
zaplanowanie badań
- B. Data collection/entry
zebranie danych
- C. Data analysis/statistics
dane – analiza i statystyki
- D. Data interpretation
interpretacja danych
- E. Preparation of manuscript
przygotowanie artykułu
- F. Literature analysis/search
wyszukiwanie i analiza literatury
- G. Funds collection
zebranie funduszy

Summary

Background. Engaging in health-related behaviours is conditioned by many factors, including psychological and social ones. The extent to which it is done is also determined by gender and age. Health-related activity has specific and, presumably, different meanings at different stages of adulthood, which is associated with implementing by people roles and tasks typical of a given period of life. The study aimed to determine the specifics of the health-related behaviour in middle and late adulthood.

Material and methods. The research was conducted on a group of 285 people, including 154 persons in middle adulthood, i.e. 40-58 years old ($M = 45.05$, $SD = 3.63$) - 77 women and 77 men, and 130 in late adulthood, i.e. 61-88 years old ($M = 71.32$ $SD = 5.81$) - 70 women and 60 men. The Health Behaviour Inventory by Z. Juczyński (2001) was used to measure health-related behaviours. The tool enabled determining the overall level of health-related behaviours and four selected categories, i.e. healthy eating habits, preventive behaviours, health-related practices and positive mental attitudes.

Results. The results indicate that women exhibit a higher level of health-related behaviours when compared to men (regardless of age), which is also evidenced in women in late adulthood when compared to those in middle adulthood. The extent of health-related behaviours in specific categories was also compared between groups. Functions of health-related behaviours were discussed with regard to their specifics of people's roles performed in society as well as the implementation of the development tasks typical of particular stages of adulthood.

Conclusions. It is recommended to adjust prevention and health promotion programmes to particular periods of human development and gender.

Keywords: health-related behaviours, middle adulthood, late adulthood

Streszczenie

Wprowadzenie. Podejmowanie zachowań zdrowotnych jest uwarunkowane wieloma czynnikami, w tym psychologicznymi i społecznymi. Różnią się one także w zależności od płci i wieku. Aktywność zdrowotna ma specyficzne i przypuszczalnie odmienne znaczenie na różnych etapach dorosłości, wiąże się z realizacją ról i zadań typowych dla danego okresu życia. Celem przeprowadzonych badań było ustalenie specyfiki zachowań zdrowotnych osób w okresie średniej i późnej dorosłości.

Materiał i metody. Badania przeprowadzono na grupie 285 osób, w tym przebadano 154 osób w wieku średniej dorosłości tj. 40-58 lat ($M=45,05$; $SD=3,63$) - 77 kobiet i 77 mężczyzn oraz 130 osób w wieku późnej dorosłości tj. 61-88 lat ($M=71,32$ $SD=5,81$) - 70 kobiet i 60 mężczyzn. Do pomiaru zachowań zdrowotnych zastosowano Inwentarz Zachowań Zdrowotnych (IZZ) autorstwa Z. Juczyńskiego (2001). Narzędzie to pozwala na ustalenie ogólnego wskaźnika zachowań zdrowotnych oraz nasilenia czterech kategorii zachowań - prawidłowych nawyków żywieniowych, zachowań profilaktycznych, praktyk zdrowotnych oraz pozytywnych nastawień psychicznych.

Wyniki. Wyniki badań wskazują na wyższy poziom zachowań zdrowotnych w grupie kobiet w porównaniu z mężczyznami (niezależnie od wieku) oraz w grupie osób w okresie późnej dorosłości w porównaniu z osobami w wieku średniej dorosłości. Dokonano także porównania poziomu poszczególnych kategorii zachowań zdrowotnych pomiędzy grupami. Omówiono funkcje zachowań zdrowotnych i powiązanie ich specyfiki z pełnieniem ról społecznych i realizacją zadań rozwojowych typowych dla poszczególnych etapów dorosłości.

Wnioski. Wskazane jest dostosowanie oddziaływań w zakresie profilaktyki i promocji zdrowia do okresu rozwojowego i płci.

Słowa kluczowe: zachowania zdrowotne, średnia dorosłość, późna dorosłość

Tables: 4

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Introduction

Human's health largely depends on the chosen lifestyle. Strengthening, protecting and recovering health is done through various human activities. They are referred to as "health-related behaviours"; that is habitual and/or deliberate forms of human activities which are closely connected with health on the basis of objective knowledge and subjective beliefs [1].

Taking up health-related behaviours is conditioned by many factors. The role of psychosocial factors is a frequent subject of research in this area [2,3,4,5]. Health-related behaviours also differ depending on the socio-demographic characteristics of the people who follow them in particular gender and age. Research on the socio-demographic determinants of health-related adult behaviours does not always provide clear results – some highlight the role of age and gender as differentiating factors; others do not confirm such findings [6, 7, 8, 9, 10, 11]. Qualitative and quantitative differences between health-related activities of women and men of all ages can arise from the specific period of development and the implementation of tasks typical of the period, including health-related behaviours. However, relatively little attention has been paid to this issue so far. The problem of the changing dynamics of health behaviours in adults also appears to be poorly known.

Meanwhile, the interest of researchers in the period of those 40+ is increasing. It might be because it is the time when the most common chronic diseases develop. It is also the critical moment for introducing prevention. There is consistent evidence of associations between mid-life behaviours and various late-life outcomes [12]. Healthy lifestyle and appropriate health-related behaviours can improve people's health condition and delay the occurrence of diseases [13, 14, 15, 16, 17]. This is important in the context of the rising number of older people in the general population in Poland and longer life-expectancy, which currently in Poland is, on average, 73.8 years for men and 81.6 for women. In relation to the year 1990, men live by 7.6 years longer and women by 6.4 years [18].

Developmental psychology divides the time after the age of 40 into middle and late adulthood. Most of the concepts of staging human development refer to the age to 55-60 years as middle age and to the time after 60 years - as late adulthood (ageing) [19, 20]. Each of these stages provides individuals' with unique challenges, as described in theory by Havighurst [21] and Erikson [22]. Robert Havighurst's proposal refers to the individual development of human requirements and social expectations. In his view, implementation of development tasks conditions more than individuals' well-being also determines the degree to which they are accepted. The concept by Erik Erikson is part of the neopsychoanalytic approach and includes eight development stages defining specific psychosocial tasks. Each development stage comprises a continuum between opposite poles, one of which determines the desired direction of development and the other, its possible disturbance.

Human development is very malleable in middle adulthood, and its direction depends mainly on the individual and social factors. It is a period associated with the so-called midlife crisis, menopause and the "empty nest syndrome". As for the physical and general health, a middle-aged person experiences menopause, i.e. loss of their reproductive capacity [19]. Development tasks typical of this stage, as indicated by Havighurst [21] include supporting the development of growing children, achieving social and civil responsibility, maintaining professional efficiency, personal treatment of spouses and adapting to the physiological changes of middle age.

During this stage, individuals manifest their concern for the vocation and education of the next generation, they engage in professional and creative work, moving on the continuum between generativity and stagnation [22]. A diversity of different roles of men and women can be seen. Women are increasingly focused on family life - raising children and caring for ageing parents, whereas men carry out more professional activities. Women seem to tend to take over control of health-related behaviours of their family members, e.g. tasks related to treatment, visits to doctors, preparing healthy meals.

The beginning of late adulthood is usually associated with retirement and the end of the professional activity. The pace of ageing in this period varies individually. This reduces the physical efficiency of the body, susceptibility to diseases is increased, and difficulties in treatment appear. As far as the biological dimension is concerned, catabolic processes prevail over the anabolic ones [20]. The period of late adulthood is full of many, so-called critical events [23]. They include the following: loss of health, lower fitness and physical attractiveness, loss of the loved ones, the prospect of death, retirement, loss of the social and economic status, the sense of usefulness and social prestige, or moving to either adult children or a nursing home. The development tasks of late adulthood, enumerated by Havighurst [21] include adapting to the decline in physical strength, retirement, reduced income and changing social roles, coming to terms with the death of a spouse, maintaining social relationships with people of own age and providing sufficient conditions for own existence.

Individuals attempt to reconcile their previous development stages and their identities, sum up their lives, which determines the new place on a continuum between integrity and despair. There appears wisdom; a virtue often worked out in this period of life [22]. The social context in which adult development takes place and the

undertaken activities seem to be different for men and women.

Each stage of life becomes much more age-specific. Thus, it seems reasonable to include the development context in the analysis of people's lifestyles at given stages. The issue of the specificity of the health-related activity of people in the context of their development in middle and late adulthood and the typical roles for men and women were the objectives undertaken in the own research.

Material and methods

The study aimed to determine the specifics of health-related behaviours of people in middle and late adulthood. The authors sought answers to the following research questions:

- What is the extent of health-related behaviours of women and men aged 40+?
- Are there any differences between the health-related behaviours of people in middle and late adulthood?
- Are there any differences between men and women in the health-related activity at various stages of development?

The study was conducted in a group of 284 people, including 154 middle-aged, i.e. 40-58 years old (M = 45.05, SD = 3.63) - 77 women and 77 men, and 130 people in their late adulthood, i.e. 61-88 years old (M = 71.32 SD = 5.81) - 70 women and 60 men.

The study was conducted in the city of Łódź. The study participants were chosen at random. The respondents classified as middle-aged were examined during gatherings in secondary schools where their children attended. The seniors represented the Third Age University and were examined in the institution. The research was voluntary and anonymous.

The Health Behaviour Inventory by Z. Juczyński [24] was applied for measuring the participants' health-related behaviours. The tool consists of 24 statements describing various types of health-related behaviours, the intensity of which is assessed on a scale from 1 ("almost never") to 5 ("almost always"). The overall rate of health-related behaviours was obtained after adding frequencies of following individual behaviours. This tool enables calculating the overall level of health-related behaviours and four categories of health-related behaviours, i.e.

- prevention behaviours (adherence to health recommendations and obtaining information about health and disease),
- proper eating habits (the type of the consumed food),
- health practices (habits associated with sleep, recreation and physical activity)
- positive mental attitudes (avoiding too strong emotions, tension and stress).

Results

In the first stage of statistical analyses, the whole group's level of health-related behaviours was determined (M = 80.48, SD = 15.60). By referring to standard category values, the overall mean level of health-related behaviours was determined, which indicated the average level of particular variables. Mean scores for various categories of health-related behaviours were also similar to those obtained in the standards. Then, using the t-test, differences were determined between health-related behaviours of women and men in the whole group (Table 1).

Table 1. Health-related behaviours in women and men

Variables - Health-related behaviours	Women		Men		t/ p
	M	SD	M	SD	
General index of health behaviours	83.50	15.28	77.24	15.33	3.44 **
Proper eating habits	20.88	4.95	18.02	4.98	4.85 ***
Prevention behaviours	20.62	4.98	18.66	4.92	3.33 **
Positive mental attitudes	21.39	4.31	21.02	4.28	.73 ni
Health practices	20.63	4.41	19.54	4.36	2.09 *

M – mean; SD – standard deviation; t – value of test t, p – significance level

*** p<0.001, ** p<0.01, *p<0.05

The mean results of health-related behaviours for men and women, when referred to the standard values, showed an average value (sten score of 5). Women, however, present a higher level of health-related activity than men – mainly in terms of healthy eating habits, preventive behaviours and health-related practices. These differences were not recorded only in the category of positive mental attitudes. The representatives of both sexes in a similar degree take care of their health in the psychological dimension, i.e. avoid stresses and tensions.

Then, differences between health-related behaviours of younger and older respondents (the dividing point being the age of 60) were calculated.

Table 2. Health-related behaviours in individuals in middle and late adulthood

Variables – Health-related behaviours	Middle adulthood		Late adulthood		t/ p
	M	SD	M	SD	
General index of health behaviours	72.58	12.43	89.85	13.69	-11.13 ***
Proper eating habits	17.40	4.39	22.00	4.89	-8.35 ***
Prevention behaviours	17.25	4.27	22.55	4.33	-10.35 ***
Positive mental attitudes	19.90	4.22	22.77	3.86	-5.93 ***
Health practices	18.06	3.62	22.53	4.03	-9.84 ***

M – mean; SD – standard deviation; t – value of test t, p – significance level

*** p<0.001, ** p<0.01, *p<0.05

Both the overall level of health-related behaviours and the extent of the behaviours in each category record higher levels in elderly patients, and these differences are highly statistically significant. People in late adulthood, i.e. older than 60, represent better nutritional habits, better health-related practices, they take care more of their health prevention and their mental state as compared to younger respondents.

The differences between the elderly and the youth are maintained when gender is taken into account, i.e. older men (M = 85.77, SD 14.31) show a statistically significantly higher overall level of behaviours conducive to health than younger men (M = 70.60, SD = 12.64; t = 6.58, p < 0.001). Also, women in late adulthood (M = 93.34, SD 12.18) take better care of their health than in the earlier stages of life (M = 74.87, SD = 12.21; t = 9.15; p < 0.001). These differences were also observed in each category of the health-related behaviours.

Then, it was verified whether the established differences between men and women are also typical of the two age groups, i.e. middle and late adulthood (Tab. 3 and 4).

Table 3. Health-related behaviours in men and women in middle adulthood

Variables – Health-related behaviours	Women		Men		t/ p
	M	SD	M	SD	
General index of health behaviours	74.87	12.21	70.60	12.64	2.14 *
Proper eating habits	18.51	4.40	16.39	4.24	3.05 **
Prevention behaviours	18.10	4.27	16.51	4.26	2.32 *
Positive mental attitudes	19.87	4.0	19.91	4.36	.05 ni
Health practices	18.44	3.73	17.79	3.62	1.08 ni

M – mean; SD – standard deviation; t – value of test t, p – significance level

** p<0.01, *p<0.05

Gender affects the health activity of respondents between 40 and 60 years of age, but the level of diversity is not high, and the differences only apply to specific categories of behaviours. Thus, taking into account the overall level of health-related behaviours and healthy dietary habits as well as preventive behaviours, it turned out that women take more care of their health than men, but the differences are not recorded in the categories of positive mental attitudes and everyday health-related practices.

Table 4. Health-related behaviours in men and women in late adulthood

Variables - Health-related behaviours	Women		Men		t p
	M	SD	M	SD	
General index of health behaviours	93.34	12.18	85.77	14.31	3.26 **
Proper eating habits	23.61	4.10	20.12	5.09	4.33 ***
Prevention behaviours	23.51	4.13	21.42	4.31	2.82 *
Positive mental attitudes	23.04	3.95	22.45	3.76	.87 ni
Health practices	23.17	3.77	21.78	4.21	1.98 ni

M - mean; SD - standard deviation; t - value of test t, p - significance level

*** p<0.001, ** p<0.01, *p<0.05

Among older respondents, over 60 years, greater attention to health is also noticeable in women, as compared with men, regarding the overall level of health-related behaviours and diet; it is lower though with regard to prevention. There were no differences between the genders concerning positive attitudes and daily mental health-related practices.

Conclusions and discussion

Having taken into account the entire surveyed group, the study shows that women over the age of 40 take up behaviours beneficial to health to a greater extent than men - they take care of the kind of food, adhering to health recommendations. To a lesser extent, these differences concern healthier habits, related to sleep and recreation. There were, however, no differences between both genders with regard to taking care of their mental health, i.e. positive mental attitude. The trend towards a more healthy lifestyle in women rather than men is visible both in middle and late adulthood. However, the rule does not apply to all types of health-related behaviours.

Differences in health-related behaviours between men and women can be explained by following gender stereotypes [25]. Women are expected pay greater attention to health, whereas men are supposed to limit the concern about health to promoting healthy activities or even risky for health behaviours. It turns out that women have the most significant impact on issues related to health and nutrition in families.

Many studies have confirmed the presence of higher levels of health-promoting behaviours in groups of women, as compared with men [11]. Differences between both genders can, however, apply to specific categories of behaviours. For example, studies conducted by Dolińska-Zygmunt [2] indicated that women preferred other health-related activities than men - alternative medicine, nutritional behaviours, avoiding stimulants, while men preferred physical activity.

However, in the case of seniors, i.e. people over the age of 60, studies do not always indicate the role of gender in affecting health-related behaviours [8,9,10]. In this period, the health status deteriorates, which is expected to be a factor strongly influencing health-related activities in both men and women.

Age seems to be of great importance for the health-related activity. In the own study, people in late adulthood presented significantly more health-promoting behaviours than younger ones in middle adulthood. These differences were evident in both the overall level and in each category of behaviours.

As indicated by the data in the literature, the number of medical behaviours related to contacts with healthcare services increases with age - their aim is primarily treating diseases [26]. Studies show that people in late adulthood present more pro-health behaviours than those in early adulthood [6, 27]. Previously, some other studies showed that older women far more often chose pro-health behaviours than those under the age of 60 [28].

The processes of ageing force people to re-evaluate their priorities and take up other strengthening and health-supporting activities. In the case of an illness, they often take up deliberate, intentional health-related behaviours, which result from individuals' own conscious decisions. Deterioration of the health status creates favourable conditions to make a decision and change one's behaviours from adverse to health to those benefiting it. In the light of studies, the health status is a significant factor influencing health-related behaviours [11].

The study conducted by Huy et al. [29] showed that individuals with a positive attitude to ageing showed a significantly better health behaviour than those who identified themselves with a traditional, less positive standpoint on ageing.

Some health-related behaviours can fade with age. For example, the studies conducted on the adult US citizens showed a decrease in physical activity with age [7]. It is possible, however, that one needs to take into account the specificities of particular behaviours and the development context typical of the particular stage of life to be able to observe the actual health-related behaviours. A decrease in the overall level of physical activity is not surprising, as it is more difficult to do exercise when people are older, but it can be replaced with other pro-health behaviours, related to the overall functioning. Changes in the health-related activity can occur, not so much with age, understood as the length of existence, but with going through various stages of development. Health-related activity at each of the stages can be connected with the challenges specific to that stage. Health-related behaviours can in fact be seen as part of a general lifestyle associated with the specificity of development tasks. The issue undoubtedly requires further research.

The following research and deliberations can lead to some conclusions related to health prevention and promotion. It would be advisable to adjust these effects to the development stage and gender [30,31]. It should be borne in mind that health-related behaviours can be enhanced at any age. Despite the health problems occurring after the age of 40 and in late adulthood, they are not necessarily associated with significantly reduced welfare. Despite experiencing physical health problems, individuals can experience an increase in terms of other dimensions of health (social, spiritual, emotional) and develop various forms of health-related behaviours. Furthermore, individual perceptions of ageing are an essential starting point for designing prevention programmes for older adults. Health-related activity should be integrated with ageing and the challenges that life brings at various stages.

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LONG-TERM COMPLICATIONS OF DIABETES AND THE RISK OF DIABETIC FOOT

PRZEWLEKŁE POWIKŁANIA CUKRZYCY I RYZYKO STOPY CUKRZYCOWEJ

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Authors' contribution

Wkład autorów:

- A. Study design/planning
zaplanowanie badań
- B. Data collection/entry
zebranie danych
- C. Data analysis/statistics
dane – analiza i statystyki
- D. Data interpretation
interpretacja danych
- E. Preparation of manuscript
przygotowanie artykułu
- F. Literature analysis/search
wyszukiwanie i analiza literatury
- G. Funds collection
zebranie funduszy

Summary

Background. Chronic complications of diabetes are presently the most vital problem in diabetology and the most significant challenge in the treatment of the diseases. Because of peripheral neuropathy and macroangiopathy, people with diabetes are particularly vulnerable to foot problems. The following study aims to evaluate the development of chronic complications in patients with type 2 diabetes, with a particular focus on the prevalence of limb ischemia symptoms.

Material and methods. The study involved patients with type 2 diabetes mellitus and non-diabetic persons at a similar age. Diabetics were divided into 2 groups. Group 1 consisted of type 2 diabetic patients with no trophic lesions of the limbs; Group 2 included patients with diabetic foot disease; and the control group (Group 3) were the non-diabetic elderly. The study was to analyse the incidence of retinopathy, nephropathy and neuropathy in both diabetic groups. Besides, it was to evaluate changes in macroangiopathy among diabetic patients and the control group.

Results. In all groups, symptoms of lower limb ischaemia were assessed, which allowed making comparisons between them. The studied material indicated that the occurrence of diabetic ulcers is mostly associated with macroangiopathy and its symptoms, polyneuropathy and particular types of neuropathy, retinopathy and horny foot skin.

Conclusions. An interdisciplinary approach to the problem of the diabetic foot allows recognising its early clinical symptoms.

Keywords: diabetes mellitus, chronic complications of diabetes, diabetic foot

Streszczenie

Wprowadzenie. Przewlekłe powikłania cukrzycy są obecnie najważniejszym problemem w diabetologii i stanowią największe wyzwanie w leczeniu cukrzycy. Z powodu obwodowej neuropatii i makroangiopatii chorzy na cukrzycę są grupą szczególnie narażoną na problemy zdrowotne stóp. Celem pracy jest ocena rozwoju przewlekłych powikłań u chorych na cukrzycę typu 2 ze szczególnym uwzględnieniem analizy częstości występowania objawów niedokrwienia kończyn.

Materiał i metody. Badaniem objęto chorych z cukrzycą typu 2 oraz osoby niechorujące na cukrzycę w podobnym przedziale wiekowym. Diabetyków podzielono na 2 grupy. Grupę 1- stanowili chorzy na cukrzycę typu 2 bez zmian troficznych kończyn, grupę 2- stanowili chorzy z zespołem stopy cukrzycowej, grupę kontrolną (grupa 3)- stanowiły osoby w wieku podeszłym niechorujące na cukrzycę. Przeanalizowano występowanie retinopatii, nefropatii i neuropatii w obu grupach diabetyków. Oceny zmian o charakterze makroangiopatii dokonano wśród chorych na cukrzycę i w grupie kontrolnej.

Wyniki. We wszystkich grupach oceniano objawy niedokrwienia kończyn dolnych. Dokonano porównań między grupami. W badanym materiale występowanie owrzodzeń cukrzycowych wiąże się w największym stopniu z makroangiopatią i jej objawami, polineuropatią i poszczególnymi typami neuropatii, retinopatią oraz występowaniem zrogowaciałego naskórka stóp.

Wnioski. Interdyscyplinarne podejście do problemu stopy cukrzycowej umożliwia rozpoznawanie jej wczesnych objawów klinicznych.

Słowa kluczowe: cukrzyca, przewlekłe powikłania cukrzycy, stopa cukrzycowa

Tables: 7

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Introduction

Chronic complications of diabetes are currently the most crucial problem in diabetology and the biggest challenge in the treatment of the disease [1]. The diabetic complications are understood as a heterogeneous group of ailments and symptoms that form specific sets determining the course of the disease [2]. Severe complications are immediate life-threatening conditions, chronic, and occur in nearly all patients with long-term diabetes, which causes disability and shortens life. Major long-term complications of diabetes include the specific changes in diabetic microangiopathy, increased arteriosclerosis, as well as diabetic nephropathy and neuropathy (diabetic nephropathy).

The foot of a diabetic person is particularly susceptible to atherosclerosis and neuropathy. Microvascular microangiopathy is visible in vascular arteries and capillary blood flow disorders. These changes cause ischemia of soft tissues and bones as well as the formation of necrosis. The most important effect of peripheral neuropathy in the foot of a diabetic patient is the loss of sensation that makes the foot more sensitive and prone to minor injuries. Even a small and harmless looking interruption of the skin can become a gateway to bacteria. The development of diabetic foot infections has dangerous consequences in the form of gangrene that necessitates amputation of the affected part of the foot.

The aim of the study is to assess the development of chronic complications in patients with type 2 diabetes, with a particular focus on the prevalence of limb ischemia symptoms.

Material and methods

The study involved patients with type 2 diabetes mellitus and non-diabetic persons at a similar age. Diabetics were divided into 2 groups. Group 1 consisted of type 2 diabetic patients with no trophic lesions (20 females, 21 males aged 40-80 years, mean age 63.8 years; duration of the disease 1-24 years, mean age 10.3 years; value of blood sugar 107-374 mg / dl; mean fasting plasma glucose level 182.1 mg / dl). Group 2 included patients with a diabetic foot syndrome (9 females, 13 males aged 38-81 years, mean age 59.3 years); duration of illness 2-41 years, mean 19.5 years; blood sugar value 149-323 mg / dl; mean fasting plasma glucose 220.1 mg / dl). Nine (9) persons in Group 1 and 14 in Group 2 reported low glucose. Glycosuria was found in 16 persons and acetone in urine in 4 people. Further, 40 people required insulin therapy. The glycolysed hemoglobin value in both groups ranged from 5.00% to 13.26% (in Group 1, mean HBA1C was 7.16; and in Group 2 – 8.30).

Group 3 (the control group) consisted of older adults who were not diabetic (31 women, 3 men, 58-84 years, mean age 69.2 years).

Body height and BMI variables in men and women showed some differences and, as for the older people, sexual dimorphism was noticeable in height and weight.

Full research material was collected in the group of 97 persons.

Diabetic complications were assessed on the basis of surveys and specialised research. The incidence of retinopathy, nephropathy and neuropathy in both diabetic groups was analysed. Changes in macroangiopathy were evaluated both in the diabetic patients and the control group. In all groups, the following variables were analysed: the prevalence of hypertension (RR $^{3}140 / 90$ mmHg); hyperlipidemia, taking 200 mg / dL as upper limit of normal value; triglyceride (TG) 200 mg / dl; overweight (BMI > 25kg ; obesity (BMI > 30 kg / m²) and smoking. Further, in all groups, the symptoms of lower limb ischaemia were evaluated. The continuous wave Doppler (calculating the cuboidal index) was used to measure the blood pressure in the ankle region. The pulse in lower limbs was assessed palpatively, femoral arteries were examined for vascular murmur and skin was inspected for its colour and presence of superficial lesions.

Comparisons between the groups were made towards diabetic complications, macroangiopathy, the incidence of lower limb ischaemia, and atheromatous risk factors. The findings are presented in the form of the chi-square test for independence, assuming statistical significance for p£ 0,05.

Results

The frequency of long-term complications in diabetic patients is illustrated in Table 1.

Table 1. Prevalence of long-term complications in diabetic patients (Group 1 and Group 2)

	Number of patients		percentage	
	Group 1	Group 2	Group 1	Group 2
Retinopathy	7	15	17%	68%
Nephropathy	4	5	10%	23%
Neuropathy	24	21	59%	95%
Polyneuropathy	11	20	27%	91%
Macroangiopathy	31	14	76%	64%

A statistically significant difference was observed in the occurrence of diabetic retinopathy in diabetics. Diabetic foot syndrome (Group 2) was two-fold higher in the retinopathy group than in the non-trophic group (Group 1).

As for nephropathy, no differences were found among diabetic patients in both groups. However, the urine test for the presence of protein in Group 1 showed significant albuminuria in 14 individuals, whereas in Group 2 – in 10 persons.

Elevated serum creatinine (> 1.1 mg / dl) was observed in 9 persons in Group1, and 8 in Group 2. Urea abnormalities (> 50mg / dl> 8.3mmol / l) were found in 6 persons in Group 1, and 7 in Group 2.

The percentage of people diagnosed with diabetic neuropathy was as follows: 59% in Group 1, and 95% in Group 2. Symmetrical polyneuropathy (sensory, motor, autonomic) was seen in 27% of the patients in Group 1, and in 91% in Group 2.

Dysfunction and deformity of the joints of the foot were found in 7% in Group 1 and 55% in Group 2. As for bone deformities (hamstring, clawed fingers), they were seen in 10% of the patients in Group 1, and in 27% in Group 2.

Differences in the incidence of neuropathy in the two groups of diabetic patients were statistically significant.

The numbers and percentage of cases of major vascular disease in all groups are shown in Table 2.

Table 2. Macroangiopathy – numbers of cases in particular groups

	Number of persons			Percentage		
	Group 1	Group 2	Group 3	Group 1	Group 2	Group 3
Ischemic heart disease	20	5	10	49%	23%	29%
Ischemic stroke	3	2	0	7%	9%	0%
Arterial atherosclerosis	22	11	4	53%	50%	11%

To illustrate the differences in the tested groups in terms of macroangiopathy, the following variables were isolated as distinct: stable and unstable angina, arrhythmia as well as myocardial infarction (Table 3). There was an increase in the number of ischemic heart disease cases in Group 1, which was close to the significance level ($p = 0.07$). There was found a significantly lower prevalence of stable angina ($p = 0.001$) in Groups 2 and 3, but there was no significant difference in the incidence of unstable angina, arrhythmias, myocardial infarction and ischemic stroke. The high prevalence of peripheral arterial atherosclerosis in Groups 1 and 2 is a statistically significant phenomenon. (Table 3)

Table 3. Large vessel disease – a comparison between Group 1, Group 2 and Group 3

		Group 1	Group 2	Group 3	Chi-square	p
Ischemic heart disease	yes	20	5	10	5.224	0.073
	no	21	17	24		
Stable angina	yes	13	1	1	14.360	0.001
	no	28	21	33		
Unstable angina	yes	4	3	3	0.358	0.836
	no	37	19	31		
Irregular heart rhythm	yes	8	2	4	1.561	0.458
	no	33	20	30		
Myocardial infarction	yes	6	3	2	1.565	0.457
	no	35	19	32		

Stroke	yes	3	2	0	2.937	0.230
	no	38	20	34		
Atherosclerosis of peripheral arteries	yes	22	11	4	15.521	0.0004
	no	19	11	30		

The bold font indicates a statistical significance of $p \leq 0.05$ in the test ; whereas the italics – the findings closest to the materiality level.

Observations of lower limb ischaemia symptoms and the comparison of their prevalence among groups are presented in Table 4.

In Group 1, 22 patients reported freezing feet and in groups 2 and 3, 17 persons in each. Intermittent claudication was diagnosed in 19 diabetics in Group 1, in 10 diabetics in Group 2, and in 3 elderly persons. No pulse on the dorsal foot and / or on the tibial posterior was reported only in patients with diabetes mellitus. Features of limb ischaemia (<0.9) showed 44% persons in Group 1; 45% in Group 2, and 9% in the control group. The biggest changes in the arterial auditory examination were in Group 1: murmur over the aorta (4 persons), murmur over the right iliac (8 persons), and murmur over the left hip (6 persons). Skin lesions in the form of wounds and ulcers were predominant in the diabetic patients in Group 2.

Table 4. Prevalence of lower limb ischemia symptoms in particular groups

	Number of persons			Percentage		
	Group 1	Group 2	Group 3	Group 1	Group 2	Group 3
Freezing feet	22	17	17	54%	77%	50%
Chromatic interruptions	19	10	3	46%	45%	9%
Ankle brachial index (<0.9)	18	10	3	44%	45%	9%
Absent dorsal artery pulse	11	9	0	27%	41%	0%
Absent posterior tibia pulse	8	8	0	20%	36%	0%
Murmur over the aorta	4	0	1	10%	0%	3%
Murmur over the iliac artery	14	1	6	34%	5%	18%
Wounds, ulcers	7	19	0	17%	86%	0%

A comparative analysis of the prevalence of lower limb ischemia between groups (Table 5) showed that the more frequent cases of cold feet in Group 1 could not be considered a statistically significant phenomenon. However, the low incidence of chromatic interruptions in the control group is a statistically significant phenomenon. An abnormal value of the ankle-brachial index (<0.9) was significantly higher in diabetic Groups (1 and 2). Very rare pulmonary arterial hypertension in both peripheral arteries in Group 3 as well as rarely observed pulmonary arterial hypertension in Group 1 appear to be statistically significant.

Table 5. Prevalence of lower limb ischemia symptoms between groups – a comparison

		Group 1	Group 2	Group 3	Chi-square	p
Freezing feet	yes	22	17	17	4.554	0.103
	no	19	5	17		
Chromatic interruptions	yes	19	10	3	13.835	0.001
	no	22	12	31		
Ankle brach (<0.9) (R or L)	yes	8	5	1	5.718	0.057
	no	33	17	33		
Absent dorsal artery pulse (R or L)	yes	6	5	0	7.629	0.022
	no	35	17	34		
Absent posterior tibia pulse (R or L)	yes	1	3	0	6.792	0.034
	no	40	19	34		

The bold font indicates a statistical significance of $p \leq 0.05$ in the test. R and L stand for 'right and 'left' foot

The number of people with superficial changes in feet and percentages in each group is shown in Table 6.

Table 6. Changes in feet – symptoms in particular groups

	Number of persons			Percentage		
	Group 1	Group 2	Group 3	Group 1	Group 2	Group 3
Corns	25	19	21	61%	86%	62%
Tinea pedis	10	4	4	24%	18%	12%
Ingrown nails	7	7	2	17%	32%	6%
Thick nails	9	10	10	22%	45%	29%
Cracking skin	12	9	1	29%	41%	3%
Excessive horny epidermis	16	18	22	39%	82%	65%

The most common cases of hypertrophy (86%), cracked skin (41%), hyperkeratosis (82%), ingrown nails (32%) and thick nails (45%) were observed in patients with diabetic foot syndrome. In the group with non-trophic changes of the limbs (Group 1), the most common disorders were foot corns (61%) and excessive keratinized epidermis (39%).

The findings of the research showing the number of people with hypertension, hyperlipidemia, overweight, obesity and smoking tobacco are presented in Table 7.

Table 7. Selected risk factors for atherosclerosis – number and proportion of cases in groups

	Number			Percentage		
	Group 1	Group 2	Group 3	Group 1	Group 2	Group 3
Hypertension	32	16	15	78%	73%	44%
Hyperlipidemia	23	10	20	56%	45%	59%
Overweight	15	5	13	37%	23%	38%
Obesity	21	9	0	51%	41%	0%
Smoking	14	10	4	34%	45%	12%

The diabetic group and the elderly group differed in cholesterol and triglyceride levels. In the diabetics group (Group1), significantly lower mean values of total cholesterol ($p = 0.006$) was found than in the elderly group and significantly lower mean triglyceride values ($p = 0.03$). An increased number of hypertensive cases were reported in the diabetic patients without diabetes mellitus as compared to the other study groups. Also, obesity cases turned out to be more frequent than those of overweight in all patients with diabetes (Groups 1 and 2). The elderly group reported only the problem of overweight. There was a statistically significant dominance of non-smokers in the control group than in the diabetic patients.

Discussion

A statistically significant difference in the occurrence of diabetic retinopathy between the two groups of diabetics was observed in the studied material. It is confirmed by the fact that the incidence of diabetic angiopathy of the blood vessels in the eyes increases with the duration of the disease and the severity of chronic hyperglycaemia.

Differences in the incidence of neuropathy in the two groups of diabetic patients were statistically significant. And so, there was a visible dominant diabetic neuropathy foot syndrome in Group 2. An autonomic necrosis disorder results in maladaptation of the foot, which contributes to its ulceration, especially when the sensory nerve is simultaneously impaired. The motor neuropathy leads to muscle atrophy, disturbs the equilibrium of rectifiers and flexors, resulting in a limited mobility of the joints. Further, there is an impaired ability to adapt to changes, which promotes the formation of ulcers. Sensory disturbance in feeling pain, temperature, touch and disturbed sensation lower the defence mechanisms in micro-injuries, which affects the formation of ulcers. [3, 4]

The primary cause of mortality among patients with type 2 diabetes is the cardiovascular disease. [5]. By presenting an analysis of 20 non-diabetic studies, Laakso has shown that increasing glycemic levels in diabetic patients above 6.1 mmol / l are associated with an increased risk of cardiovascular disease. Similarly, basing on the results of 12 prospective studies, it has been shown that hyperglycemia has been associated with cardiovascular complications in patients with type 2 diabetes. [5] Our observations indicate that the more frequent the incidence of ischemic heart disease, the higher the incidence of ischemic heart disease. The prevalence of ischemic stroke and peripheral arterial atherosclerosis occur in people with diabetes rather than those who are not diabetic. According to Luźniak [6], except for macroangiopathy of the lower limbs, the results were similar to those on the rates of morbidity associated with particular types of macroangiopathy. In the

material involving 1334 patients with type 2 diabetes, Luźniak et al. reported the following findings: ischemic heart disease 36%, stroke 5%, and atherosclerosis of the lower limb arteries 8%. [6] The results from our own studies showed a significantly higher incidence of atherosclerosis in the diabetic group compared to the control group.

In the comparative analysis between the two groups on the lower limb ischemia prevalence, absence of peripheral pulse and vascular murmur on one side in diabetic patients as well as peripheral arterial calcifications were more common. It could be assumed that this group is more likely to require clinical intervention due to the tightening of the lower limb arteries.

Diabetics with co-existing Arteriosclerosis obliterans (AO) feel cold feet. They often warm them up to 40 °C, which can easily be achieved by heating the skin with a hot compress. Then, blood flow should increase more than 10 times. [7] However, due to vascular disease, this condition cannot be achieved. Consequently, the skin breaks become glossy and ulcers or necrosis appear.

Some people with diabetes, despite an advanced AO, may have no intermittent claudication because they do not feel pain. This highlights the need for a periodic lower limb examination in diabetic patients for AO symptoms, even if the patient does not report them. Reducing intermittent claudication can be achieved by quitting smoking and a controlled exercise programme. [7]

Large and small vessels disease does not necessarily progress at the same rate. Often, in the case of ischemic symptoms of small vessels in toes, a pulse can be found on the dorsal artery or tibial posterior of the foot. Approximately, one third of the diabetic population may have small areas of gangrene with a perceptible pulse on the dorsal or posterior tibial artery.

Arterial insufficiency also results in other most common symptoms such as thickened toenails and fungal infection, which is also confirmed in our own studies. Besides, diabetic patients often suffer from nail distortion of their toes. Thickened clawed nails, a case of onychogryphosis, are a potential threat. When hooked on the bed linen or socks, the nails may get removed and, consequently, result in necrosis, necrotising bloody sores, ulcers and infection.

Patients may also have their nails strongly curved into the nail bed. Besides, curling nails may stick to the adjacent toes causing ulcers. Ingrown toenails are a potential source of infection, either due to ingrowing into the skin or being removed on one's own. The resulting foot infection may cause an amputation.

The analysis of risk factors for macroangiopathy in diabetic patients indicated significant values of systolic blood pressure ($p = 0.02$). The mean systolic pressure was higher in Group 1 than in the diabetic group with trophic limb changes. Also, when compared to the elderly group, the mean systolic pressure in Group 1 was higher. Hypertension is also diabetes-related. Patients with diabetes and coexisting high blood pressure are more likely to have increased morbidity and mortality of ischemic heart disease, stroke, or lower limb ischaemia. [6]

The diabetic group and the elderly group differed in cholesterol and triglyceride levels.

Obesity cases, rather than overweight cases, are more common in all patients with diabetes (Groups 1 and 2).

There was found a statistically significant prevalence of non-smokers in the diabetic control group.

Iwanicka et al. [8] assessed the vascular markers in patients with type 1 diabetes. The analysis included the duration of the disease and the degree of alignment. It has been shown that serum lipids are the major risk factors for macroangiopathy in children and adolescents, as they are an indicator of metabolic status.

Few prospective studies analysed the relationship between cigarette smoking and the incidence of diabetes complications. Villa, Galusa et al. [9] presented the results of a large-scale study by analysing the material collected during the period of 13 years in the USA (275,190 men and 434,637 women aged ≥ 30 years). The findings indicate a higher incidence of diabetic foot syndrome in individuals who have smoked two or more cigarette packs per day. In male smokers, this increase amounted to 45% with regard to those who never smoked. The increase in the incidence of diabetic foot syndrome in women was 74% when compared to non-smokers. [9]

Tobacco smoking impacts many factors that can increase insulin resistance and disrupt insulin action. [10]

Both active and passive effects of cigarette smoking predispose to cardiovascular incidents. Smoking increases inflammation, thrombosis, and oxidation of low-density lipoprotein cholesterol. [11]

Obesity, and especially the distribution of adipose tissue, is also a risk factor contributing to cardiovascular disease. However, abdominal fat deposition is a higher risk for cardiovascular disease than obesity itself. Eckel, Kahn et al. have been widely analysing the relationships between obesity and type 2 diabetes. [12] The authors gather evidence to show that even a small reduction in body weight can improve glycemic control and reduce the risk of diabetes. [12]

Patients with diabetes are particularly vulnerable to foot problems due to peripheral neuropathy and macroangiopathy. Detecting high-risk patients, educating them and directing those with recognised complications to specialist centres, as well as treating comorbidities are the most critical tasks of the healthcare system.

Persons with diabetes should be under continuous podiatry care to ensure that they are provided with professional prevention, treatment and rehabilitation that would prevent diabetic foot syndrome. Indications for referring a diabetic foot to the clinic include peripheral neuropathy, advanced limb ischemia, calluses, imprints, ingrown toenails, non-treatable ulcer, foot infection, and foot deformities.

Numerous etiologic factors contributing to the development of diabetic foot disease can be identified by simple and cost-effective equipment in the primary care (a monofilament test or vibration sensation test). Specialist counselling centres for diabetic care should also be equipped with Mini Doppler, Pedobarograph, surgical tools and specialised dressings. Careful examination, in combination with physical and subjective testing, makes it possible to identify high-risk patients and help determine the type of intervention. Effective preventive measures include patient education, good metabolic control, smoking cessation, and careful foot care. [13]

Early diagnosis of etiologic factors and dressing of ulcers is essential for a successful outcome in the prevention of diabetic foot syndrome.

Sieradzki et al., point to the results of the annual operation of the Diabetes Office in Krakow, which with the help of a multi-specialty care team showed that in the total number of patients treated, i.e. 86, the amputation rate was only 2%. [14, 15]

Conclusions

1. The conducted examination has shown that a larger percentage of ischemic heart disease, a higher prevalence of ischemic stroke and atherosclerosis was diagnosed in patients with type 2 diabetes when compared to the general population.
2. While examining the symptoms of lower limb ischemia, more frequent abnormal values of the ankle-brachial index (<0.9) were observed in diabetic patients. Further, few cases of absence of pulmonary arterial pulmonary edema in patients without trophic changes in the limbs, few cases of peripheral arteries in the non diabetic group and lower incidence of intermittent claudication were found in the control group.
3. As for the predictors of macroangiopathy, there were reported: an increase in hypertension in the diabetic group with no foot symptoms and more frequent obesity cases (rather than overweight) in all diabetics. Besides, more non-smokers were found in the control group when compared with diabetic patients.
4. Diabetic ulcers are mostly associated with macroangiopathy and its manifestations; polyneuropathy and specific types of neuropathy; retinopathy as well as horny foot skin.

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CONSUMPTION OF SELECTED BEVERAGES AND TEENAGERS' PERCEPTION OF OWN HEALTH

KONSUMPCJA WYBRANYCH NAPOJÓW A POSTRZEGANIE ZDROWIA PRZEZ MŁODZIEŻ

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Authors' contribution

Wkład autorów:

- A. Study design/planning
zaplanowanie badań
- B. Data collection/entry
zebranie danych
- C. Data analysis/statistics
dane – analiza i statystyki
- D. Data interpretation
interpretacja danych
- E. Preparation of manuscript
przygotowanie artykułu
- F. Literature analysis/search
wyszukiwanie i analiza literatury
- G. Funds collection
zebranie funduszy

Summary

Background. Health can be perceived as a set of individual determinants that enable a person to develop in various areas. Some people view their health subjectively to realise their own goals. The following study aims to investigate health- and eating-related behaviours in young people with regard to selected alcoholic beverages.

Material and methods. The group of people involved in the study consisted of 77 teenagers from a high school aged 17 to 18 years. The mean age of the entire group was 17.1 years (SD = 0.8 years). As for gender, the sample was dominated by women, who accounted for 58.4% (n = 45) of all the respondents, while men – 41.6% (n = 32).

Results. When asked about the significance of good health and proper nutrition for teens, a large number of the girls participating in this survey, i.e. 51.9%, declared that health was important to them, whereas 29.9% claimed that it was very important. Furthermore, the teenagers involved in the study often claimed that they eat healthily (rho = 0.42; p < 0.01) and 40.3% perceived their diet as healthy. Only 2.6% of the respondents viewed their diet as improper.

Conclusions. Particular attention should be paid to building a sense of personal responsibility for health in young people. Health promotion programmes targeting young people should be aimed at developing their personality features which are indirectly associated with increasing awareness and responsibility for their own health, encouraging the individual to make right choices with regard to food products, including the type and quantity of beverages available on the market.

Keywords: health promotion, teenagers, nutrition, energy drinks

Streszczenie

Wprowadzenie. Zdrowie można postrzegać jako zbiór indywidualnych uwarunkowań, które umożliwiają rozwój człowieka w różnych obszarach. Niektórzy ludzie subiektywnie postrzegają swoje zdrowie, aby zrealizować swoje własne cele. Celem poniższego badania było zbadanie zachowań zdrowotnych i żywieniowych związanych ludzi młodych w odniesieniu do wybranych napojów alkoholowych.

Materiał i metody. Grupę osób biorących udział w badaniu stanowiło 77 nastolatków ze szkoły średniej w wieku od 17 do 18 lat. Średnia wieku całej grupy osób badanych wynosiła 17,1 lat (SD=0,8 lat). Pod względem płci, w badanej próbie dominowały kobiety, które stanowiły 58,4% (n=45) ogółu badanych, natomiast mężczyźni – 41,6% (n=32).

Wyniki. Jeśli chodzi o znaczenie dobrego zdrowia i prawidłowego odżywiania nastolatków, duża liczba dziewcząt uczestniczących w tym badaniu, tj. 51,9%, zadeklarowała, że zdrowie jest dla nich ważne, podczas gdy 29,9% twierdziło, że było to bardzo ważne.

Ponadto nastolatki biorące udział w badaniu często twierdziły, że zdrowo odżywiają się (rho = 0,42; p < 0,01), a 40,3% postrzega dietę jako zdrową. Tylko 2,6% respondentów uważa swoją dietę za niewłaściwą.

Wnioski. Szczególną uwagę należy zwrócić na budowanie poczucia osobistej odpowiedzialności za zdrowie u osób młodych. Programy promocji zdrowia skierowane do młodych ludzi powinny mieć na celu rozwijanie ich cech osobowości, które są pośrednio związane ze wzrostem świadomości i odpowiedzialności za własne zdrowie, zachęcanie jednostki do dokonywania właściwych wyborów w odniesieniu do produktów spożywczych i ilości napojów dostępnych na rynku.

Słowa kluczowe: promocja zdrowia, młodzież, żywienie, napoje energetyczne

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Introduction

The World Health Organization (WHO) emphasises that health stands for something more than merely the absence of disease. Thus, a multi-dimensional approach to this issue should be adopted, and health itself should be treated as a “state of complete physical, mental and social well-being” [1]. In this context, individual and subjective perceptions of health, not only physical but also mental, social and spiritual, seem vitally important [2]. Health is also an individual set of determinants, which enable one to develop individually at a particular pace and in the chosen area [3]. Thus, increased awareness of health may contribute to better social well-being [4].

In developmental psychology, the development of the individual is observed at various stages, throughout the course of their life, with particular attention paid to factors affecting development (the so-called developmental changes). Therefore, depending on their age and stage of development, people may differ from one another regarding their approach to health. There are those who perceive their health subjectively through the perspective of the set goals [5,6]. As the developmental psychology indicates, persuading individuals to take control over their own health seems crucial (locus of control- LOC) [7]. However, people understand controlling their lives differently. Some, advocating an internal locus of control, believe that they can direct their own lives, whereas others, with an external locus of control, assume that they have no influence over their own health. Individuals with an internal locus will show a higher awareness of the impact their behaviour may have on their health. Those with an external locus of control attribute the current state of their own health to external factors, such as environment, medical care, genetics, etc. Persons of this type will be convinced that their health is independent of any activities undertaken by them and it derives from outside factors [7]. Accordingly, the individuals who attribute the state of their health to external factors may adopt inappropriate defence mechanisms when taking responsibility for their own health [8]. Defence mechanisms are defined as unconscious, automatic thoughts and behaviours that are intended to counteract a negative emotional state, e.g. fear, and overcome low self-esteem [9].

One of the major unhealthy types of behaviour in terms of health risk, particularly in young people, is the growing trend of using alcoholic beverages as well as sugary drinks. These beverages contain large amounts of sucrose which, when consumed at excessive amounts, can be an essential factor contributing to an increase in body weight, consequently leading to obesity [6]. In the American studies conducted that 42% of young people drank energy drinks [10]. These results were confirmed by subsequent studies conducted [11], according to which 48% of young people also consumed energy drinks once a month. 10.4% of the surveyed group of young people declared that they consumed such beverages on a daily basis. In the category of younger teenagers (12 year-olds) [12], 28% regularly used energy drinks, but the percentage in 17 year-olds was higher and amounted to 31% [13]. One of the main reasons for purchasing such beverages was to reduce sleepiness (45%) and enhance mental performance (24%).

Another type of behaviour observed amongst young people, which poses a significant health-risk, is the consumption of alcohol. Alcoholic beverages are the most widely used psychoactive substances in adolescents. According to ESPAD, 87 % of the respondents consumed alcohol at least once in their lifetime. The most popular alcoholic beverage among young people is beer and the least – wine. One of the reasons for alcohol use amongst young people are poor relationships with peers (55%) [14].

The following study aimed at characterising teenagers’ views on health and whether they regard health as a valid and valuable component in their lives. Next, it intended to examine dietary behaviours associated with the consumption of selected types of beverages. The present study was also an attempt to identify new ways in which health could be promoted in adolescents.

The following research questions were formulated:

1. Is health a vital value in young people’s lives?
2. Is there any relationship between the subjectively declared frequency of making health-oriented dietary decisions, the consumption of selected beverages and the perception of individual’s health?

Material and methods

The group of people involved in the study consisted of 77 teenagers from a high school aged 17 to 18 years. The mean age of the entire group was 17.1 years (SD = 0.8 years). As for gender, the sample was dominated by women, who accounted for 58.4% (n = 45) of all the respondents, while men – 41.6% (n = 32). The questionnaire method was used in the form of a survey which included, among others, inquiries about the frequency of using selected beverages. The study analysed the following groups of beverages:

1. energy drinks,
2. sweet soft drinks,
3. alcoholic beverages such as beer, wine and hard alcohol and liqueurs, e.g. vodka.

To assess the degree of subjectivity of how health is perceived in the teenagers' lives, the following statement was used: "For me, health is" The respondents' task was to choose an item on a five-scale, where 1 meant "completely unimportant", 2 "unimportant", 3 – "of average importance", 4 – "important", and 5 – "very important". To assess the degree of compliance with a proper diet in teenagers, the following statement was used: "I try to eat healthy food." Again, the task of the respondents was to choose one item from those indicated on the five-response scale, where 1 meant "very rarely", 2 – "rarely", 3 – "on average, often", 4 – "often", 5 – "very often." To evaluate the frequency of consumption, the following question was formulated: "How often have you consumed the following types of drinks during the last 12 months?" On the five-response scale, 1 stood for "never", 2 – for "once a month or less frequently", 3 – "a couple of times a month", 4 – "several times a week", and 5 – "on a daily basis". The remainder of the survey checked how frequently the respondents drank alcoholic beverages together with energy drinks, sweetened carbonated drinks, cola drinks, coffee, tea or smoked cigarettes. For this purpose, the question: "How often, during the last 12 months, have you consumed alcohol together with other drinks or smoked cigarettes". The five-response scale was provided, where 1 stood for "never", 2 – "once a month or less frequently", 3 – "several times a month", 4 – "several times a week", 5 – "on a daily basis".

The statistical analysis was performed using the SPSS 21 statistical programme. The Spearman correlation coefficient (ρ) was used for the evaluation of compounds used between variables. In the presented statistical analysis, the statistical significance was accepted at $p < 0.05$.

Results

As for the importance of good health and proper nutrition for teens, a large number of the girls participating in this survey, i.e. 51.9%, declared that health was important to them, whereas 29.9% claimed that it was very important.

Furthermore, the teenagers involved in the study often claimed that they eat healthily ($\rho = 0.42$; $p < 0.01$) and 40.3% perceived their diet as healthy. Only 2.6% of the respondents viewed their diet as improper.

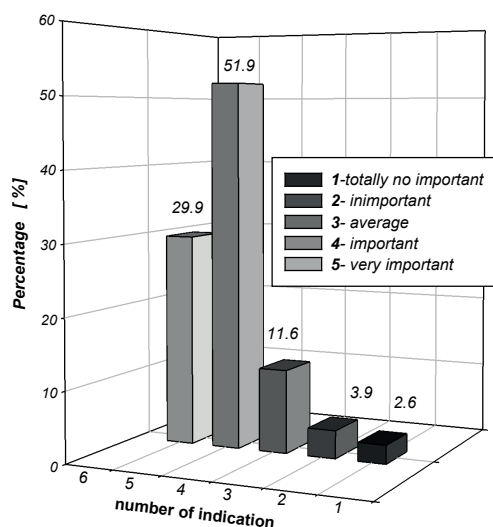


Figure 1. Significance of health amongst the youth

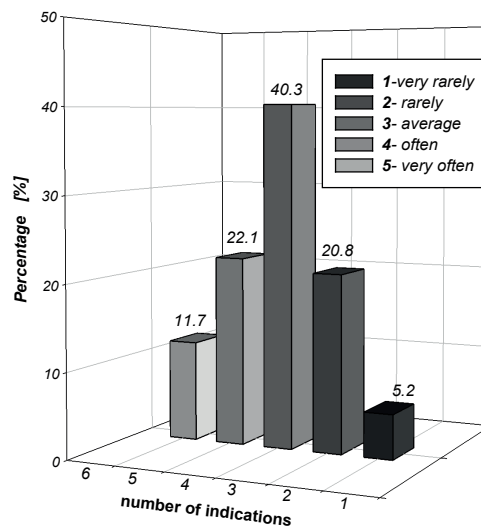


Figure 2. Proper diet followed by young people

Types of beverages and frequency of their consumption

The study showed that a high number of young people consumed energy drinks. While analysing the responses to the survey's inquiries, it was noted that 61% of the adolescents consumed energy drinks (Figure 3), and as many as 73% consumed sugary drinks. As for the percentage of those who consumed alcoholic drinks, it was shown that 53% of the respondents drank beer, 39% – wine, and – 45% indulged in spirit drinks, such as vodka 45% (Figure 3).

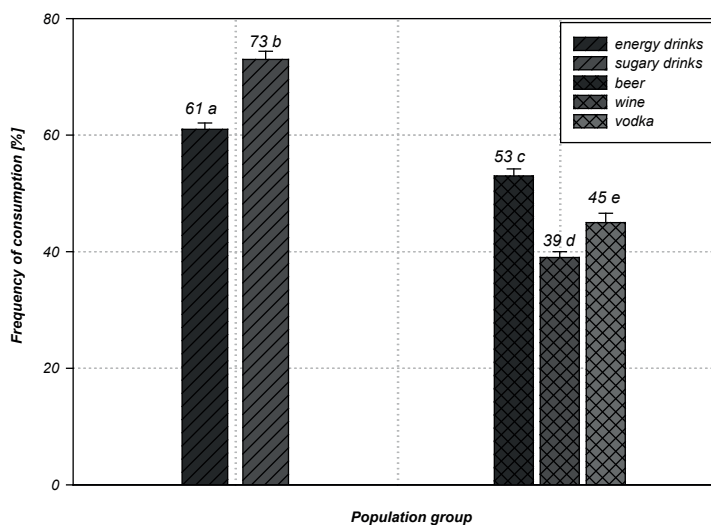


Figure 3. Consumption of energy, sugary and alcoholic drinks among young people

Perception of own health and the consumption of selected drinks

Health was an important aspect of lifestyle for the teens involved in the study. Still, the declared frequency of consumption of carbonated soft drinks amounted to ($\rho = -0.23, P < 0.05$), beer ($\rho = -0.35, P < 0.01$) wine ($\rho = -0.35, p < 0.01$) and vodka ($\rho = -0.38, p < 0.01$). There was no relationship between the frequency of consumption of energy drinks and the way one’s own health was perceived ($\rho = -0.20, p > 0.05$) (Table 1).

Table 1. Level of subjective understanding of health and the consumption of energy drinks

		energy drinks	carbonated soft drinks	beer	wine	vodka and alcoholic drinks and liqueur
Level of subjective understanding of health	ρ	-0.20	-0.23	-0.35	-0.35	-0.38
	p	0.08	0.04	0.01	0.01	0.01
	N	77	77	77	77	77

It turned out that health was more important for the teens participating in the study as they were less likely to consume alcohol together with energy drinks ($\rho = -0.23, P < 0.05$), carbonated sweetened drinks ($\rho = -0.30; p < 0.01$), coffee ($\rho = -0.24, p < 0.05$) and smoking ($\rho = -0.28, p < 0.05$). No significant relationship between was found between the frequency of consuming alcoholic drinks such as cola and drinking tea (Table 2).

Table 2. Frequency of consuming combined drinks by young people

		Frequency of combining drinks					
energy		kind of drink					
		sugary	Coca cola	coffee	tea	cigarettes	
Level of subjective understanding of health	ρ	-0.23	-0.30	-0.21	-0.24	-0.18	-0.28
	p	0.04	0.01	0.06	0.04	0.11	0.02
	N	77	77	77	77	77	77

Healthy eating and the consumption of selected drinks among teenagers

Teenagers seek to ensure that they follow a proper way of eating and what they declare is negatively correlated with how frequently they consume selected drinks. The findings for sugary carbonated drinks amounted to ($\rho = -0.28, p < 0.05$), beer ($\rho = -0.36; p < 0.01$) and consumption of vodka and alcoholic beverages ($\rho = -0.30; p < 0.01$) (Table 3).

Table 3. Eating habits amongst the sampled group and the rate of consuming drinks

		energy drinks	carbonated soft drinks	beer	wine	vodka and alcoholic drinks and liqueur
I eat healthily	rho	-0.08	-0.28	-0.36	-0.22	-0.30
	p	0.52	0.01	0.01	0.06	0.01
	N	77	77	77	77	77

The more often teenagers declared that they eat healthily, the less often they declared that they drank alcohol together with carbonated sugary drinks ($\rho = -0.31$, $P < 0.01$), cola drinks ($\rho = -0.24$; $p < 0.05$), coffee ($\rho = -0.36$; $p < 0.01$) and tea ($\rho = -0.29$, $p < 0.01$). There was no significant relationship between cigarette smoking and the consumption of energy drinks amongst the sampled group of young people (Table 4).

Table 4. Frequency of combining drinks and smoking cigarettes with regard to healthy eating

Frequency of combining drinks							
energy		kind of drink					
		sugary	Coca cola	coffee	tea	cigarettes	
I eat healthily	rho	-0.13	-0.31	-0.24	-0.36	-0.29	-0.21
	p	0.24	0.01	0.03	0.01	0.01	0.07
	N	77	77	77	77	77	77

Discussion

The presented results of the study showed that health is an essential value in teenagers' life. Therefore, a critical area of activity should be to support young people in maintaining proper health by encouraging adequate health-promoting behaviours.

In the case of adolescents participating in the study, 29.9% declared that their health was very important for them. 19.7% of the high school students recognised that health was very important for them [3]. Also, it should be noted that around 40% of the youngsters involved in the studied group perceived their diet as normal, and only 2.6% of the respondents said they did not engage in healthy eating. The presented research differed from other authors [3], who showed that about 26% of the young people aged 17-19 years had never followed any diet, and as many as about 40% of the respondents were aware of their unhealthy eating habits. The presented difference may be associated with the ongoing social changes, which emphasise the need to properly control food intake for health benefits. Currently, people have easy access to the knowledge on nutrition and how different diets are used. Media and press abound in publications focusing on topics related to dietetics. This can lead to a greater awareness of own healthy behaviour and an increased interest in the subject of nutrition also among teenagers. In this context, the use of proven and reliable sources of nutritional knowledge becomes essential. One of the most popular forms of acquiring knowledge, including expertise on dietetics, is the Internet.

One of the harmful eating habits observed among young people is the frequency of consumption of energy, isotonic and sugary drinks. The consumption of energy drinks is a significant part of people's diet [15], as 45% of young person's regularly use energy drinks. The percentage of such beverage consumption amongst young people aged between 12-17 years was slightly lower at 31%. The present study shows that many young people admit that they consume energy drinks [13].

As scientific publications stress, the use of energy drinks is propelled not only to advertising but also their popularity due to the high amount of caffeine. Another reason for purchasing such beverages is taste. In addition, it is emphasized that more boys than girls are turning to energy drinks. These relationships are confirmed by the data obtained from the report prepared by NSW (2013) [16], according to which the consumption of energy drinks by young people aged 16-17 was higher in boys by 0.6% when compared to girls. Furthermore, getting involved in sports, consuming energising and sweet, or fizzy drinks was significantly higher in boys than girls, i.e. 1.5%, 1.3% and 0.9% respectively [12,17]. The study showed that a significant proportion of respondents admitted to consuming sweetened beverages. The obtained data are consistent with the findings by other researchers. Sugary drinks were frequently consumed 2-4 times a week, mainly by girls, (28% of the studied population) [3].

Further, the combination of alcohol and energy drinks was the subject of the research [18]. The consumption of these drinks with vodka resulted in reducing the symptoms of alcohol poisoning. A report prepared by the NSW (2013) [16] shows that 37.7% of the respondents consumed energy drinks in combination with alcohol at least once a month. What seemed disturbing though was the fact that also young people between 16 and 17 years (26.1%) would drink alcohol together with energy drinks. Besides, as the study [19] showed, 19% of the young people consuming energy, isotonic or carbonated drinks did not show any desire to eat any solid food. There is, therefore, a dangerous dependence of avoiding meals while consuming fluids. It can be assumed that such behaviour is the result of various types of diets followed by young people.

An important aspect of the research was finding out whether the use of alcohol is combined with various drinks and stimulants, and how it relates to proper nutrition. As it was shown, the more teenagers declared that they eat healthily, the less often they drank alcohol together with consuming sweetened carbonated drinks, cola, coffee and tea [14,20].

Presently, many health programmes targeting teenagers are introduced as there is a growing fear of the negative consequences of drinking alcohol and the harm it can cause to one's health. In contrast, the conducted research shows that a good way of promoting health in adolescents might be strengthening the feeling of how important health is in youngsters' lives. Such an attitude involves identifying health-promoting behaviours that are conducive to maintaining proper health, rather than focusing on spreading fears amongst teenagers, for example, through highlighting the negative consequences of improper diets.

Conclusions

Particular attention should be paid to building a sense of personal responsibility for health in young people. Health promotion programmes targeting young people should be aimed at developing their personality features which are indirectly associated with increasing awareness and responsibility for their own health, encouraging the individual to make right choices with regard to food products, including the type and quantity of beverages available on the market.

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SICKNESS RATE AND PREVALENCE OF THYROID CANCER IN A SPECIFIC REGION OF UKRAINE 30 YEARS AFTER CHERNOBYL DISASTER

CZĘSTOTLIWOŚĆ ZACHOROWAŃ I ROZPOWSZECHNIENIE SIĘ RAKA TARCZYCY W SZCZEGÓLNYM REGIONIE UKRAINY 30 LAT PO KATASTROFIE W CZARNOBYLU

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Wkład autorów:
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B. Data collection/entry
zebranie danych
C. Data analysis/statistics
dane – analiza i statystyki
D. Data interpretation
interpretacja danych
E. Preparation of manuscript
przygotowanie artykułu
F. Literature analysis/search
wyszukiwanie i analiza literatury
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Summary

Background. The study aimed to determine the effect of iodine deficiency and increased radiation on morbidity of thyroid cancer in patients living in the Ternopil region of Ukraine. The task was solved by comparing the patients with thyroid cancer from the district areas with iodine deficiency and increased radiation with those coming from the regions with normal iodine content and a normal radioactive background.

Material and methods. The area of the Ternopil region was divided into the following 1) the northern area, with sufficient iodine content in food, radiation background – 0.09 mcSv/h; 2) the central and western areas, endemic in terms of iodine content and increased background radiation (up to 0.13 mcSv/h); and 3) the southern area, with sufficient iodine but increased background radiation (up to 0.15 mcSv/h). To conduct the analysis and determine the sickness rate, the patients were grouped depending on sex and age.

Results. The sickness rate and prevalence of thyroid cancer in males in 2016 were 4-6 times lower when compared to females in all areas. The sickness rate of the females in the areas with increased radiation turned out to be age-dependent with a 1.25-3.2 times increase when compared to the areas with normal conditions. In the areas of the increased background radiation and dietary iodine insufficiency, the sickness rate of females was 1.54-5.4 times higher than the index in the areas with normal conditions.

Conclusions. The highest rates prevalence and sickness rate of thyroid cancer in Ternopil region of Ukraine were observed in women over 51 years. The prevalence was 2 times, and the sickness rate 3 times higher in women over 51 years in the areas with iodine deficiency and an increased radiation background when compared to those in the areas with normal iodine and radiation background.

Keywords: thyroid cancer, morbidity, Ukraine, the Ternopil region

Streszczenie

Wprowadzenie. Celem pracy było określenie wpływu niedoboru jodu i zwiększonej radiacji na zachorowalność na raka tarczycy pacjentów mieszkających w ukraińskim obwodzie tarnopolskim. Porównano grupę pacjentów chorujących na nowotwory tarczycy pochodzącą z obszarów, gdzie stwierdzono niedobór jodu i zwiększone promieniowanie z pacjentami, z grupą u których stwierdzono tę samą chorobę, ale pochodzą z regionów o normalnej zawartości jodu i normalnym promieniowaniu radioaktywnym.

Materiał i metody. Obwód tarnopolski został podzielony na następujące sfery: 1) północną, z wystarczającą ilością jodu w żywności oraz promieniowaniem – 0,09 mcSv / h; 2) centralną i zachodnią, endemiczną pod względem zawartości jodu oraz zwiększonym promieniowaniem (do 0,13 mcSv / h); oraz 3) południową, z wystarczającą ilością jodu, ale zwiększonym promieniowaniem (do 0,15 mcSv / h). Aby przeanalizować częstotliwość występowania choroby, pacjentów pogrupowano w zależności od płci i wieku.

Wyniki. W 2016 r. wskaźnik zachorowalności i częstość występowania raka tarczycy u mężczyzn był 4-6 razy niższy niż u kobiet we wszystkich badanych obszarach. Wskaźnik zachorowalności u kobiet na obszarach o podwyższonym promieniowaniu skutkowałem średnim wzrostem, w zależności od wieku, tj. o 1,25-3,2, w stosunku do osób pochodzących z obszarów nienapromieniowanych. Na terenach zwiększonego promieniowania i niedoboru jodu wskaźnik zachorowalności u kobiet był 1,54-5,4 razy wyższy od spotykanego na obszarach nieskażonych.

Wnioski. Najwyższe wskaźniki zachorowalności na raka tarczycy w tym regionie Ukrainy zaobserwowano u kobiet powyżej 51 roku życia. Częstość występowania raka na obszarach z niedoborem jodu i zwiększonym promieniowaniem była 2 razy większa, a liczba zachorowań 3 razy większa, niż u kobiet pochodzących z obszarów o normalnym poziomie jodu i promieniowania.

Słowa kluczowe: rak tarczycy, zachorowalność, Ukraina, obwód tarnopolski

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Introduction

Due to the focused attention of healthcare bodies and the public, the prevalence of thyroid cancer has been recorded reliably since the Chernobyl disaster. In the authors' judgment, family doctors, particularly those working in the rural areas, should be alerted to the issue. This may contribute to early diagnosis and, thereafter, better treatment outcome.

As far back as 1976, thyroid cancer was regarded as an uncommon disease and was rated as "other tumours" [1] in the statistical bulletins of the Ministry of Public Health of the then USSR. Radiation is known to be a strong causative factor of thyroid cancer morbidity. The amount of iodine, consumed with food, is also reported to take effect. The objective of the research work is to compare the role of various factors in the pathogenesis of thyroid cancer. For this purpose, the number of thyroid cancer cases in the Ternopil region were analysed. The specificity of the territory is that some areas are endemic in terms of iodine content, some exhibit increased background radiation, while others are normal both in iodine content and radiation level.

Material and methods

The data from the Ukrainian National Cancer Register on the Ternopil region in 2016 were used in the analysis [2]. The areas were grouped as follows 1) the northern one, with a sufficient iodine content in food, radiation background – 0.09 mcSv/h; 2) the central and western areas, endemic in terms of iodine content and increased background radiation (up to 0.13 mcSv/h); and 3) the southern area, with normal amount of iodine but increased background radiation (up to 0.15 mcSv/h) [3]. To conduct the sickness rate analysis, the patients were grouped depending on sex and age. There were fewer males and the sickness rate in some groups was less than 1 percent. All the men were pooled in a single group. The Pearson χ^2 test was applied for establishing index difference reliability. The Pearson χ^2 test is a nonparametric method, commonly used for evaluating significant differences between the actual qualitative characteristic of sampling in each category, and merely theoretical quantity which might be expected in test groups, provided that the null hypothesis is correct. The method allows assessing the statistical significance of differences between 2 or more relative indices. The χ^2 test is used in analysing contingency tables, containing information on the occurrence frequency, depending on the presence of the risk factor.

To determine the statistical significance of differences between the thyroid cancer sickness rate and the prevalence of the disease in different areas, we calculated the Pearson χ^2 criterion and compared it with the critical value. In case the Pearson χ^2 test value surpassed the critical one, a statistical interrelation of the studied risk factor and the result was concluded, and the level of significance taken into account.

The criterion calculated value having been determined, the Pearson χ^2 test critical value was found and recorded in the table. The value amounted to 3.841 (significance level $p=0.05$ and degree of freedom 1).

Results and discussion

The sickness rate and prevalence of thyroid cancer in males in 2016 were found to be 4-7 times lower in all the areas when compared to females (Table 1.). No reliable difference between different age groups was found that could be attributed to an insignificant sickness rate. Therefore, the sickness rate and prevalence in all male age groups were determined in a single group (Fig.1).

Table 1. Sickness rate and prevalence of thyroid cancer in the areas of Ternopil region of Ukraine depending on the content of iodine and the radiation background level in 2016

Index Sex, age	Areas with decreased iodine content and increased radiation background		Areas with increased radiation background		Areas with normal iodine content and radiation background	
	Prevalence	Sickness rate	Prevalence	Sickness rate	Prevalence	Sickness rate
	Per 1000000 population		Per 1000000 population		Per 1000000 population	
Females, 18-25 years	25.9	4.2	23.9	2.9*	7.5*	0.9*
Females, 26-40 years	31.0	4.8	32.1	3.9	26.4	3.1*
Females, 41-50 years	69.2	9.7	50.2	6.1*	35.8*	4.4*
Females, older than 51 years	75.3	10.4	46.6*	5.8*	28.3*	4.6*

Males, 18 years and older	7.3	1.1	9.5	1.1	5.5*	0.7*
mean value	32.1	6.0	26.6	3.3*	16.9*	2.1*

*- reliable result difference ($P < 0.05$) as to the corresponding index in the area with decreased iodine content and increased radiation background

In the Ternopil region, the sickness rate and prevalence of thyroid cancer in females are lower than in Ukraine on the whole [4] and the USA [5, 6], but higher as compared to the indices in Europe [7, 8].

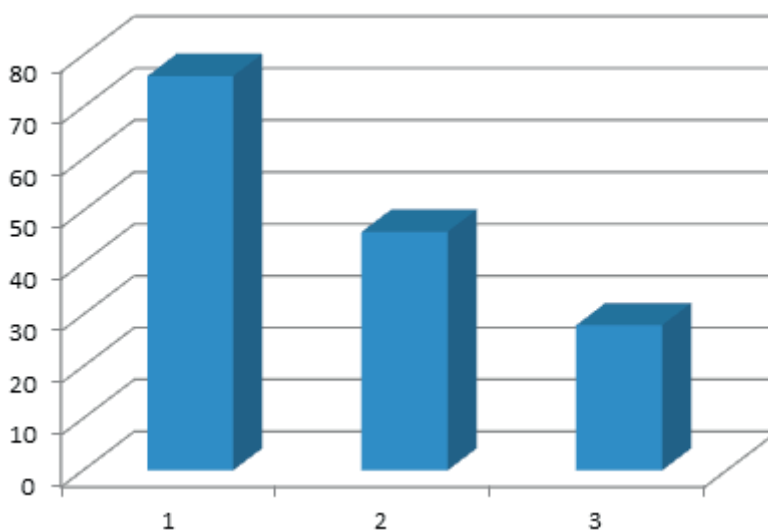


Figure 1. Prevalence of thyroid cancer in women over 51 years old in the areas with decreased iodine content and increased radiation background (1), increased radiation background (2) and normal iodine content and increased radiation background (3)

Our findings confirm the other research data which indicate that thyroid cancer occurs 3-10 times more often in females when compared to males [4]. According to the Ukrainian National Cancer Register [2], in 2009 thyroid cancer was diagnosed in Ukraine in 2267 persons (420 males and 1847 females, i.e. 18 and 81 percent respectively). Besides, the highest morbidity indices were noted in females in the age range 45-69 years. In the Ternopil region, the highest sickness rate was observed in females above 51 years. The mean value of morbidity in Russia [9] was 4 percent, whereas in Ukraine it amounted to 6 percent in the areas of increased radioactive background and insufficient iodine content; only 3.3 percent in the areas with increased radioactive background; and 2.1 percent in the areas with normal radioactive background and sufficient dietary iodine content. Obviously, age-dependant morbidity in the areas of the Ternopil region with the increased radioactive background is on average 1.25-3.2 times the index of the sickness rate in the areas with normal conditions. In the areas with increased radioactive background and insufficient food iodine content, the sickness rate is on average 1.54-5.4 times the index in normal areas.

The thyroid cancer morbidity index largely depends on the settlement area. Age-adjusted morbidity index (2008) in the USA was 6.8 new cases per 100,000 population, with females revealing higher sickness rate [6]. The highest index was noted in Hawaii (119 for females and 45 for males). The lowest registered morbidity index equalled to 1.4 per 100,000 females and 0.4 per 100,000 males. In Europe, mean thyroid cancer morbidity index is 1.2-3 per 100,000 population, the lowest values being found in the Netherlands, Slovakia and Denmark [9]. The residents of New Caledonia reveal high index – 80.9 per 100,000 population. In Russia, thyroid cancer morbidity index in 1995 was 1.1 for males and 4.0 – for females per 100,000 populations, while in 2002 – 1.4 and 7.2, respectively [10]. Within the period 1990-2010, the indices in Sankt-Petersburg were 3.5-6.7 for females and 1.4-2.2 – for males (per 100,000 population). These data may indicate that thyroid cancer development depends on the environment and ethnic (genetic) risk factors. For instance, the risk of thyroid cancer development has been found to be 10 times higher in the relatives of patients with thyroid cancer [9].

The indices of thyroid cancer prevalence in the Ternopil region in 2016 correlate with the sickness rate indices in different age groups, with both indices increasing with ageing. Thyroid cancer is more common

in females. However, prevalence indices are lower here than on average in Ukraine and in the world as such. According to the Connecticut register (USA) [11], thyroid cancer prevalence in the USA is 67.7 cases per 100,000 population for females and 23.7 cases – for males. The highest thyroid cancer prevalence in the Ternopil region is 32 cases for females and 6 cases for males (per 100.000 population). This can be attributed to the fact that the patients do not report to the oncologist and, therefore, are usually overlooked by the medics. There are just a few main reasons for avoiding examination: primarily, irresponsibility and reluctance to undergo treatment, often due to the lack of funds; and secondly, common lethal outcome. Nevertheless, in the authors' judgment, 30 years after the Chernobyl disaster, the Ternopil region reveals similar and even lower indices of thyroid cancer sickness rate and prevalence as compared with those in Europe and the USA. The catastrophe gave rise to a number of extremely pessimistic predictions as to the increase of thyroid cancer sickness rate in Ukraine, which, fortunately, proved to be grossly exaggerated. A possible explanation is that, from the ecological standpoint, the Ternopil region is regarded as the cleanest in Ukraine.

Radiation is considered to be the only factor which causes thyroid cancer. However, our findings show that dietary iodine insufficiency appreciably contributes to the effect of the increased radioactive background. This may be attributed to the fact that increasing the contact area of thyroid cells and blood under absolute or relative iodine insufficiency is a basic mechanism of developing thyroid tissue hyperplasia. Iodine insufficiency may lead to a constant stimulation of the thyroid tissue due to the increased content of thyroid-stimulating hormone (TSH). Our findings suggest that the iodine insufficiency factor may be coupled with the radiation effect.

Conclusions

30 years after Chernobyl disaster, in 2016, the Ternopil region, partly stricken by the accident, reveals similar and even lower indices of thyroid cancer sickness rate and prevalence, as compared with those in Europe and the USA.

The highest prevalence and sickness rate of thyroid cancer were observed in women over 51 years. The incidence was 2 times, and the sickness rate 3 times higher in women over 51 years in the areas with iodine deficiency and an increased radiation background compared to those in areas with normal iodine and radiation background.

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PART II. PHYSICAL ACTIVITY OF SOCIAL AND PROFESSIONAL GROUPS
DZIAŁ II. AKTYWNOŚĆ FIZYCZNA GRUP SPOŁECZNYCH I ZAWODOWYCH

HEALTH PROBLEMS OF SENIORS: SELECTED DISEASES OF THE OLD AGE

PROBLEMY ZDROWOTNE SENIORÓW NA PRZYKŁADZIE
WYBRANYCH CHORÓB WIEKU STARSZEGO

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zebranie danych
C. Data analysis/statistics
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D. Data interpretation
interpretacja danych
E. Preparation of manuscript
przygotowanie artykułu
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Summary

Since the mid-eighties, the Polish society has witnessed a steady increase in the 65+ population. This demographic trend calls for a change in the organisation of health services and healthcare for this segment of the society. Old age is a difficult period in human life, especially if one has not been prepared for it. Individuals experience a number of health restrictions, while the quality of life at that stage of life depends mostly on the accuracy of identifying health needs, their types and the quality of the available solutions. The following paper aims to present literature on the most common health problems amongst the elderly in Poland. Numerous scientific centres in Poland (and abroad) which work with seniors have confirmed that the health situation of this age group is highly unsatisfactory. Seniors often face problems which affect their functioning, independence and self-care. Impairment may be caused by geriatric disorders, which include cardiovascular diseases (the most common cause of death in Poland among persons aged 65+), cancer, diabetes, balance disorders, impaired mobility, falling down, dementia, depression, insomnia, incontinence, soiling, impaired vision and hearing, lower limb muscle cramps at night, and bedsores. The rapid ageing of the society poses numerous challenges for healthcare organisers, educators and doctors with regard to educating, preventing and treating seniors in Poland.

Keywords: elderly, health problems, demographic situation

Streszczenie

W polskim społeczeństwie od połowy lat osiemdziesiątych systematycznie wzrasta liczba osób powyżej 65 roku życia. Te zmiany demograficzne wymuszają konieczność zmian w organizacji ochrony zdrowia i opieki nad tą grupą osób. Starość jest trudnym okresem w życiu człowieka, zwłaszcza jeśli nie został on do tego okresu przygotowany. Doświadcza w szczególności wielu ograniczeń zdrowotnych a jakość życia w tym okresie w znacznej mierze zależy od rodzajów i trafności rozpoznawania potrzeb zdrowotnych oraz jakości ich zaspokajania. Celem niniejszej pracy jest przedstawienie w świetle literatury przedmiotu najczęstszych problemów zdrowotnych polskich seniorów. Liczne ośrodki naukowe w Polsce (również i zagranicą) zajmujące się sytuacją osób starszych i potwierdzają, iż sytuacja zdrowotna tej populacji jest wielce niezadowolająca. Osoby w wieku starszym często borykają się z problemami wpływającymi na ich funkcjonowanie, samodzielność i samopielęgnowanie. Na stany powodujące upośledzenie funkcjonowania człowieka składają się wielkie zespoły geriatryczne, do których zalicza się: choroby układu krążenia (które są najczęstszą przyczyną zgonów w Polsce wśród osób po 65 roku życia), nowotwory, cukrzyca, zaburzenia równowagi, upośledzenie lokomocji, upadki, zespoły otępienne, depresję, bezsenność, nietrzymanie moczu i stolca, zaparcia, upośledzenie wzroku i słuchu, kurcze nocne mięśni kończyn dolnych, odleżyny. Przyspieszone starzenia się społeczeństwa stawia przed organizatorami ochrony zdrowia, szkolnictwa i lekarzami wiele wyzwań w zakresie edukacji, prewencji i leczenia populacji geriatrycznej w Polsce.

Słowa kluczowe: starość, problemy zdrowotne, sytuacja demograficzna

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Introduction

Since the mid-eighties, the Polish society has witnessed a steady increase in the 65+ population [1]. This demographic trend calls for a change in the organization of health services and healthcare for this segment of the society. Scientific research and long-term demographic forecasts serve as a foundation for developing guidelines for new health policies that would meet seniors' needs [1,2,3].

Social, educational and health adaptation, along with physical activity, increase the potential health of seniors and their appreciation for well-being and independence, as well as active participation in social life [4]. Innovative programmes play a significant role in maintaining the strength and physical fitness of seniors, while recovery programmes help cope with sight, hearing and mobility impairments before they lead to disability and dependency on others at a later stage in life [4,5].

Old age is a difficult period in human life, especially if one has not been prepared for it. Individuals experience a number of health and social restrictions, while the quality of life in this period depends largely on the adequately identified health and social needs, their types and the quality of solutions. Limited fitness, multiple diseases and pathological changes of the body, loneliness – all these lead to the deterioration of the old people's social situation and living conditions [4,5,6,7,8].

Healthcare workers and social workers should pay particular attention to the so-called 'pre-old age' period, which is the time enabling the soon-to-be seniors to prepare for old age and still enjoy physical and intellectual fitness and independence [6].

Aim of the work

The following paper aims to present the available literature on the most common health problems amongst the elderly in Poland.

Brief description of the status of knowledge

Aging and old age

Although seemingly related, the concepts of 'old age', an important, final period of life, and 'aging' are defined in a different way [5].

The concepts of old age and ageing may be considered in two ways – as an individual or collective phenomenon which impacts a group of individuals in the society, country or region. As an individual phenomenon, old age is a biological stage that completes the cycle of human life [5,6,7]. On the other hand, according to Kirkwood, ageing is a process of progressive impairment of vital body functions and loss of adaptability to environmental changes with increasing probability of death. In general, an inevitable result of the ageing process is the state of 'being old'. Thus, ageing, as accepted in the literature under a psychogerontological definition, is a dynamic process, while old age is a static one [5].

According to the life cycle theory by D.J. Levinson, old age is one of the stages, which is not homogeneous and can be divided into subsequent periods. The life cycle theory describes the changes in the psyche and behaviours which take place in an individual at the successive stages of life. The first phase of life is the phase of learning, gaining experience (including childhood and youth). The next one is adulthood – a period of implementation of knowledge. Finally, the last phase – old age – is a phase of regression. These phases may start and finish at different times, and there are no rigid limits for the beginning and the end of particular phases of life cycles [5,6].

The psychological concept of life cycle created by E. Erikson divides life into eight stages. The last step is late adulthood, which begins at the age of 60-65 [5,9,10].

Thus, ageing is a natural process which cannot be stopped or reversed. Every man goes through this process, but they do it differently [5,11,12].

Table 1. Division of old age by the World Health Organization (WHO)

No.	Division of the old age	Age group
1.	'young old'	60-75 years old
2.	'old'	75-90 years old
3.	'oldest old'	individuals over 90

Source: Chodorowski Z. Geriatria: postępy w diagnostyce i terapii. Gdynia: Grafica; 2007 (in Polish).

According to the United Nations, the age of 65 is considered the beginning of old age [5].

Old age is not only the number of years a person has lived. One may distinguish the so-called 'calendar age' (chronological) and 'biological age'. There may be a significant discrepancy between the chronological age and biological age which is caused by numerous factors [10,12].

Aging as a demographic process

The numbers and structure of the 65+ population.

In the last 25 years, Poland has seen a slowdown in the demographic growth and significant changes in the age structure of its population. The ongoing ageing process of the Polish society results from a favourable phenomenon of longer life expectancy and a less desired low total fertility rate. Furthermore, these trends are also intensified by an increased emigration of young people [1,13].

Although Poland is still perceived as a demographically young country in Europe since the early 1990s the average age of a Polish citizen has increased by almost 7 years [14].

In 2013, the mean age for the entire Polish population was less than 39 years: 40 for women and almost 37 for men [2,3,4].

Over the years 1989-2013, changes in the age structure of the population concerned mostly groups of children and adolescents (0-17 years), which faced the largest decrease, whilst the highest increase was visible in the so-called immobile production-age population (45-59/64 years), as well as the retirees (60/65+), including the groups aged 65 and more. The proportion of people aged 18-44 remained virtually unchanged in that period.

At the end of 2013, Poland had a population of 38.5 million, including approximately 5.7 million of 65+ citizens. In the years 1989-2013, the number of seniors increased by almost 1.9 million. Its share in the total population grew by 4.7 percentage points, i.e. from 10% in 1989 to 14.7% in 2013. For comparison, the proportion of children and adolescents decreased in that period by more than 10%, from almost 30% to just over 18% [15].

Over the past 25 years, the subpopulation of seniors experienced the highest increase of individuals aged 80+. Their share in the total Polish population doubled – from less than 2% in 1989 to almost 4% in 2013 (approx. from 753,000 to 1,483,000 people). For comparison – the share of the slightly younger age group (65-79 years) increased in that period from 8% to less than 11% in the general population. This is a direct example of ageing of the Polish population, i.e. the result of increased life expectancy (increase in the 'oldest' age group). Additionally, the fertility rate in Poland is much lower, as the number of older people in the general population is growing while that of children and adolescents decreasing [5,13,14].

Further, the process of demographic ageing is inconsistent as there are differences between the genders. The two subpopulations age at a different pace, which is the result of the so-called excessive male mortality. Women aged 65+ represent 15.7% of the female sub-population, whereas men 65+ account for only 10.4% of the male subpopulation [13].

Table 2. The average life expectancy of women by voivodships in Poland

No.	The average life expectancy of women	Voivodship in Poland
1.	78.5 - 79.5	Lubusz, Lower Silesian, Silesian, Lodz,
2.	79.5 - 80.5	Western-Pomeranian, Pomeranian, Warmian-Masurian, Kuyavian-Pomeranian, Greater Poland, Opole, Lublin,
3.	80.5 - 81.5	Lesser Poland, Subcarpathian, Swietokrzyskie, Masovian, Podlasie.

Source: GUS, Rocznik Demograficzny 2012, GUS. Warszawa; 2012 (in Polish).

Table 3. The average life expectancy of men by voivodships in Poland

No.	The average life expectancy of men	Voivodship in Poland
1.	68.0 - 69.5	Lodz,
2.	69.5 - 71.0	Western-Pomeranian, Lubusz, Lower Silesian, Silesian, Lublin, Warmian-Masurian,
3.	71.0 - 72.5	Opole, Greater Poland, Kuyavian-Pomeranian, Pomeranian, Masovian, Podlasie,
4.	72.5 - 74.0	Leser Poland, Subcarpathian

Source: GUS, Rocznik Demograficzny 2012, GUS. Warszawa; 2012 (in Polish).

Also, as researchers predict, the most advanced age group in the year 2030 will live in the south-western and southern region of Poland (the Sudetes and Upper Silesia), as well as north-western, central and north-eastern Poland [5,15].

Health of seniors

Seniors often face problems which affect their functioning, independence and self-care. Impairment may be caused by geriatric disorders, which include cardiovascular diseases, cancer, diabetes, balance disorders, impaired locomotion, falling down, dementia, depression, insomnia, incontinence, soiling, impaired vision and hearing, night cramps of lower limbs, bedsores. Typically, the above-mentioned diseases and symptoms occur chronically and simultaneously, which complicates treatments. At the later stages, the disorders and symptoms often lead to disabilities and make seniors dependent on others [4,6,9,16,17].

Also, the incidence of cardiovascular disease spikes with age. Unhealthy lifestyle is the main contributor to such diseases. Research has shown that senior men are more at risk than their female peers [17]. Heart diseases and cardiovascular system diseases are very dangerous for seniors, as they heavily strain the whole organism. Presently, cardiovascular diseases are among the leading causes of death. Chronic diseases of the cardiovascular system are a major health risk, but by maintaining appropriate guidelines, one can largely reduce symptoms and control the disease. One should also know which preventive examinations help in the early detection of the disease [5,8].

One of the most common and frequent diseases in seniors is hypertension. The diagnosis of this problem is possible after observing persistent blood pressure over 140/90 mmHg (systolic/diastolic pressure), followed by a consultation with a doctor. The critical factor in treating and controlling the disease are daily measurements of pressure that help monitor the effectiveness of a drug therapy. Typically, this chronic disease requires an extended treatment, often until the end of the patient's life. Treating and consequently reducing blood pressure is extremely important as untreated hypertension may lead to, among others, heart attack, stroke or circulatory failure. It is worth mentioning that hypertension may not show symptoms for many years (sometimes they never appear), and patients may interpret fatigue and shortness of breath as an obvious consequence of age – not a symptom of a disease. For this reason, one should measure blood pressure, and if the result is high, the measurements must be done regularly to enable fast reaction if it maintains a high level [6,9,12].

Besides, seniors are often diagnosed with cancer. This results from the development of many types of cancer, and its symptoms may be negligible or completely atypical. Another reason is the fact that seniors rarely remember about preventive check-ups which would allow early detection of cancer when it is often completely treatable. Another reason is the decline of natural immunity, which accompanies the ageing process and ultimately leads to increased susceptibility to diseases. Definitely, cancer may also result from years of neglecting health, following poor diet or smoking. One should know how to improve the chance of early detection of cancer in seniors, as well as reduce the risk of cancer at the old age. The key seems to be a healthy and active lifestyle, regardless of age, as well as necessary preventive check-ups [5,6].

Diabetes in seniors

Type 2 diabetes (non-insulin-dependent) is a chronic disease. It is a metabolic syndrome characterised by insulin resistance and insulin deficiency. At the initial stage of the disease, there is a qualitative irregularity in insulin secretion. The first phase of quick insulin secretion disappears, along with its pulsating secretion. It is believed that both defects reduce the sensitivity of tissues to insulin. At the later stage of the disease, the amount of secreted insulin is reduced [5,18].

Diabetes is present on almost all continents and in all human populations. The incidence and prevalence, however, varies in different countries, and even among different ethnic groups. It has been observed that the prevalence of diabetes significantly increases in countries that experience rapid development rates. Then, lifestyles change dramatically, mainly with regard to diets, leisure time activities and preventive measures. Furthermore, approximately 20% of populations were aged 65+ in many Western societies at the recent turn of centuries. One in five people in this age group has diabetes, and one in five is diagnosed with glucose tolerance. For these reasons, diabetes is going to be the primary health problem of the 21 century. Presently, in Poland, for every person with diabetes (diagnosed or not), there is one person with impaired glucose tolerance. In total, it gives about 1.6 million people with reduced carbohydrate processing. The World Health Organization's experts estimate that by 2020, the number of people with diabetes worldwide will have exceeded 100 million people (by 2025, the diabetes incidence will increase even further). 85% of those persons will suffer from type 2 diabetes. This type of diabetes is often associated with obesity (80% of the patients are overweight to some extent) [9,11].

According to the American study NHANES II, the prevalence of diabetes and impaired glucose tolerance in patients aged 55-64 years is 13.4% (diabetes) and 15.1% (impaired glucose tolerance), while in the 65-74 age group it is 18.7% and 22.8%, respectively. As these results indicate, the prevalence of diabetes and impaired glucose tolerance in the 65+ age group is as high as 41.5% in total. The development of this type of diabetes is a slow process. Patients often do not experience any clinical symptoms for many years. Vascular complications, however, develop unnoticed and lead to severe consequences. These are recognised primarily by specialised doctors, not GPs. Complications are the leading cause of morbidity and mortality in type 2 diabetes patients. Diabetologists emphasise that approximately 50% of cases are not diagnosed [5].

Further, the human body decreases insulin secretion in old age (65+), develops insulin resistance, and increases the growth of hyperglycaemic effect of other hormones. Numerous other factors are involved as well, such as increased body fat, decreased physical activity, abnormal renal function, increased activity of the sympathetic nervous system, diabetogenic drugs (e.g. methylxanthines, B-blockers, diuretics, steroids) [6,19].

When diabetes is diagnosed in an older patient, the doctor is obliged to thoroughly investigate the case to determine the current state of the patient's health and potential complications. They should also assess their everyday activity, mental performance, and familiarise the patient with social conditions. The doctor must also solicit the names of all the drugs taken by the patient. If the patient takes medicines which affect glucose tolerance, withdrawal or dose reduction of such medication should be considered. Preliminary clinical evaluation is necessary to select individual treatment goals.

Currently, diabetologists have five interdependent treatments available:

- diet
- physical activity
- oral antidiabetic drugs
- insulin
- health education [5].

Senile dementia

Senile dementia (also known as senility) is a disease associated with an impaired cognitive function. Usually, it affects people over 65 years old and more often occurs in women than in men. It is difficult to diagnose since it is often confused with other diseases. With age, older people tend to have more problems with memory and cognition, but dementia is a disease whose symptoms develop rapidly. Proper and timely treatment can significantly improve the quality of life of affected seniors [20,21].

The first symptom that could indicate senile dementia is memory impairment, which is often attributed to old age and therefore downplayed. The person with senile dementia can recall events that occurred many years earlier but cannot remember what they did the day before. Subsequently, the following symptoms may appear like memory loss, personality changes, mood swings, apathy and malaise [22].

The leading cause of senile dementia is brain damage, which is a symptom of many neurodegenerative diseases, ultimately leading to the degeneration of nerve tissue. One of the most common diseases leading to dementia is Alzheimer's disease, which causes the so-called Alzheimer's type dementia. Brain research conducted on people who died of Alzheimer's disease showed deposits which prevented connections between nerve cells. These cells died and formed blockades, which impaired transfer of information from one neuron to another. Another reason for the appearance of senile dementia is Pick's disease, which is characterised by similar disorders leading to the degeneration of the temporal and frontal lobes. There is also Parkinson's disease dementia, Lewy bodies dementia, Huntington's disease dementia and Creutzfeld-Jakob disease characterised by rapidly progressive dementia [22,23,24].

Dementia cannot be prevented entirely as it is partially associated with ageing, but it can be slowed down [25,26].

Causes of deaths and mortality

Aging is accompanied mostly by cardiovascular disease. Despite the drop in the percentage of deaths from cardiovascular disease among 65+ year-olds over the last quarter of a century, the condition is still responsible for over half of the deaths of seniors. In 2012, it caused 54% of deaths, including ischemic heart disease (13%) and atherosclerosis (11%). In 2012, the incidence of deaths resulting from cardiovascular disease was nearly twice as high in seniors as among 65+ year-olds. Additionally, the share of seniors (aged 85+) in the total number of deaths caused by cardiovascular diseases amounted to over 80% [5,27].

The second most common cause of death are tumours, including cancer.

In the last two decades, there was an increase in the proportion of seniors (by 7.5 percentage points) who died of tumours/cancer. In 1990, the proportion of deaths from tumours/cancer among seniors was approximately 16%, whereas in 2012 it amounted to 23%.

The data of the National Cancer Registry (KRN) indicate that nowadays every second case of cancer is detected in people aged 65+. The scale of this phenomenon may be illustrated by the number of cancers found among seniors only in one year. According to the latest data from KRN, in 2011 it was more than 73,000, which is an increase of almost 30% compared to the year 2000. The most common cancers in seniors include trachea cancer, bronchus and lungs cancer, and colorectal cancer [13,28].

Other causes of death among seniors include diabetes, pneumonia, diseases of the genitourinary tract (including inflammation of the kidneys), stomach ulcers and duodenal ulcers, and chronic liver disease [5].

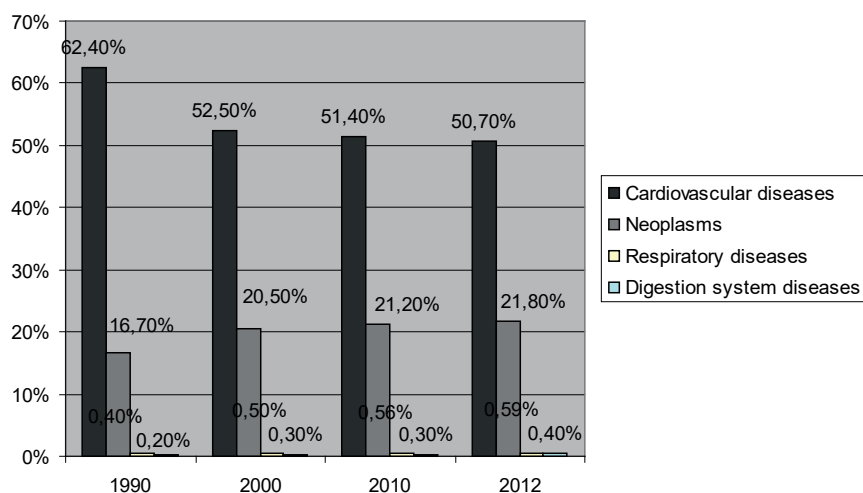


Figure 1. Selected causes of deaths in the 65+ age group (%) in 1990, 2000, 2010, 2012

Source: Ślusarska B, Nowicki GJ, Bartoszek A, Wittwer S, Zboina B, Naylor K. Health problems of the elderly aged 65-75 years survived by a community nurse. *Gerontol Pol* 2016; 24(2): 17-25.

Furthermore, the structure of deaths classified by cause varies by gender. Among women, a frequent cause of death is cardiovascular disease, while men tend to die of cancer [5,6,9].

Discussion

Intensified ageing of the Polish society poses numerous challenges for healthcare organisers, educators and doctors in terms of educating, preventing and treating seniors. Increased spending for the social security system and healthcare is foreseen [5]. It is necessary to introduce a social policy which would promote understanding of correlations between the current lifestyle and the quality of life at old age – both in terms of health, physical fitness and financial security. The ageing of the society has great consequences in terms of national finances. There is an increasing demand for retirement benefits and the need for health services specific to a particular old age. Therefore, legislation changes are necessary to define the framework for the future pension system and the social system [5,6,28].

A good example of successful reforms is Finland. The position of the Finnish seniors on the labour market was strengthened by supporting their decision to stay professionally active or restore their activity. Another country is Japan, where the reforms had a positive impact on national finances.

Japan developed a positive image of senior workers and created an environment for cooperation between enterprises, the government and human resources.

Great Britain also serves as an example of an improved national budget. The social care system was reformed, and benefits reduced, while the retirement age was raised and higher pension got correlated to the extended period of professional activity.

The Polish population is not enthusiastic about such innovative reforms. Changing governing parties make it very challenging to keep a single direction of reforms [5,6]. Consequently, the increasing demographic ageing is a severe problem for the healthcare sector in Poland.

With an increased frequency, seniors report a demand to use healthcare services, nursing treatment, medical consultations, and rehabilitation [12]. Poland lacks a model of Comprehensive Geriatric Assessment (KOG), based on a regular comprehensive study of the health of elderly patients which would take into account their family situation and living conditions. Only close cooperation between doctors, nurses and social workers could provide basic care for the elderly [29,30].

Conclusions

The accelerated ageing population poses a severe challenge to the organisers of health, education, and doctors in the field of education, prevention and treatment of the Polish geriatric population. The deepening process of demographic ageing is therefore a serious problem for the Polish healthcare sector.

Accordingly, it is recommended that a system of institutions for seniors (social welfare homes, long-term care facilities, day-care centres) should be created that would be financed in a uniform manner and with an inclusion of public funds. Comprehensive support for families who care for seniors should be insured, enabling those who pursue their professional life reconcile their work and care of seniors. Finally, a system of community services for dependent seniors should be created allowing them to remain in the environment where they live.

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PHYSICAL ACTIVITY IN STUDENTS FROM THE VISEGRAD COUNTRIES BY BMI STATUS

AKTYWNOŚĆ FIZYCZNA STUDENTÓW W KRAJACH GRUPY WYSZEHRADZKIEJ WEDŁUG WSKAŹNIKA BMI

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Summary

Background. This study aims to analyse the relationship between physical activity (PA) and body mass index (BMI) in undergraduate university students of three fields of study from the four Visegrad Group countries – Slovakia, the Czech Republic, Poland, and Hungary.

Material and methods. The research was conducted in 2015 on adolescent undergraduate university student populations in three fields of study – humanities, medical, and technical sciences. The sample included 2,484 students in total. The data was collected using the extended version of the standardised International Physical Activity Questionnaire (IPAQ). Students completed the questionnaire via the INDARES online system.

Results. The results confirmed significant differences in PA between sexes in favour of males both in its overall manifestation and in the individual levels of PA intensity ($p < 0.05$). The comparison of the four countries revealed significant differences in PA in males and females in all PA domains ($p < 0.05$). The evaluation of the total BMI, as well as the one measured in individual countries confirmed a significant difference between sexes in favour of males ($p < 0.05$). The study of the relationship between PA and BMI did not reveal a statistically significant dependence in any of the tested domains. This conclusion applies both to males and females.

Conclusions. Males are generally more physically active than females overall and in individual fields of study. Also, males exhibit higher BMI in all the studied categories. No significant relation between PA intensity and volume and BMI was found in either sex.

Keywords: student, field of study, IPAQ, BMI, V4

Streszczenie

Wprowadzenie. Celem badania jest analiza związku pomiędzy aktywnością fizyczną (PA) a wskaźnikiem masy ciała (BMI) u studentów studiów licencjackich z trzech kierunków z czterech krajów Grupy Wyszehradzkiej - Słowacji, Czech, Polski i Węgier.

Materiał i metody. Badania przeprowadzono w 2015 r. Na studiach dla młodzieży z trzech kierunków: humanistycznym, medycznym i technicznym. Próba obejmowała ogółem 2484 studentów. Dane zebrano za pomocą długiej wersji standardowego Międzynarodowego Kwestionariusza Aktywności Fizycznej (IPAQ). Studenci wypełniali ankietę za pośrednictwem systemu internetowego INDARES.

Wyniki. Wyniki potwierdziły istotne różnice w PA między płciami na korzyść mężczyzn zarówno w ich ogólnej aktywności, jak i w poszczególnych poziomach intensywności PA ($p < 0,05$). Porównanie czterech krajów wykazało istotne różnice w PA u mężczyzn (z wyjątkiem PA w czasie wolnym), a także u kobiet we wszystkich obszarach PA ($p < 0,05$). Najbardziej aktywni fizycznie spośród badanych grup byli polscy mężczyźni i słowackie kobiety. Ocena BMI ogółem oraz w poszczególnych krajach potwierdziła istotną różnicę między płciami na korzyść mężczyzn ($p < 0,05$). Badanie zależności między PA i BMI nie wykazało statystycznie istotnej zależności w żadnej z kategorii. Wniosek ten dotyczy zarówno mężczyzn, jak i kobiet.

Wnioski. Mężczyźni są fizycznie bardziej aktywni niż kobiety ogólnie i na poszczególnych kierunkach. Mężczyźni mają również wyższy BMI we wszystkich badanych kategoriach. Nie stwierdzono istotnej zależności między intensywnością i objętością PA a BMI u obu płci.

Słowa kluczowe: student, kierunek studiów, IPAQ, BMI, V4

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Introduction

Despite the numerous and scientifically proven facts about the need and significance of regular physical activity (PA) in people's lives, there is no positive response in today's people's lifestyles. As a result, this is the first time in human history that people are not prepared to do something about the absence of PA caused by changes in lifestyle or do not think about it as they do not fully feel the consequence of such an attitude during ontogenesis [1]. What is worse, people tend to pass on bad habits formed during childhood and adolescence to adulthood. A young person's transfer from high school to university could serve as an example. On the one hand, the number of hours spent sitting at a school desk decreases due to a different organisation of classes at the two institutions [2]; on the other hand, the fact that universities vary their study plans forces students to limit their leisure time and become more responsible for their course programme [3,4]. Also, to a large extent, young people's relationship with PA is limited by the contemporary lifestyle [5]. In our perspective, there is a constant clash in attitudes towards active and inactive pastimes, resulting in a decrease in PA and an increase in inactive lifestyles [6]. Yet physical activity is of irreplaceable importance not only in health promotion and disease prevention but also in the process of socialisation and formation of proper habits in children and youth. From this and other points of view, it seems vital to know that today's population of children and adolescents demonstrate a lower PA level than the biological need. The minimum demand for PA is delimited by the so-called threshold level; an amount of PA necessary for healthy development of an organism. The threshold level changes over time with an individual's age [7]. According to Sallis and Patrick (1994), adolescents should be physically active daily or almost every day. They should engage in at least 30 minutes of low-intensity PA every day and at least 20 minutes of vigorous PA at least three times a week [8]. LeMasurier et al. (2003) consider this threshold to be ten thousand steps per day [9], which, in principle, corresponds to the Healthy People 2010 recommendations on promotion of health in adult populations [10].

Among the consequences of an unhealthy lifestyle with limited PA, one should mention an increased prevalence of obesity [11]. An adequate weight in an individual is ensured by a proper balance between energy intake and expenditure. However, the contemporary lifestyle has disturbed this balance, which is mostly due to physical inactivity [12] and low-quality food, offered by an ever-increasing number of fast-food establishments, which are consumed with highly sweetened beverages [13]. The quality of contemporary diet and nutrition is significantly influenced by changes in the eating habits of whole families, the prevalence of a sedentary lifestyle, and the media [14].

This is one of the reasons why the abovementioned problem of defining the threshold PA levels is not the only that is being discussed nowadays. Also, the question of PA's influence on human body composition is raised. Monitoring children and adolescents' basic physical characteristics does not serve to assess their appearance, but is also a crucial means of assessing their current health. To determine the presence or absence of obesity or measure whether a person's body weight is adequate for their height, the body mass index (BMI) is currently used. This index is widely applied and easily calculable, but because it does not take into account the muscle to fat ratio its use is only appropriate for non-athletes [15]. The research focused on monitoring the body composition of physically active and inactive people shows that PA positively impacts the percentage of non-fat tissue by increasing its volume and decreasing the amount of body fat [16]. Furthermore, as Hendl, Dobrý et al. (2011) point out, active engagement of youth in sports has a proven effect on lower BMI in adulthood [17].

This study's objective was to analyse the relationship between PA and the body mass index (BMI) in undergraduate university students in three fields of study. The students came from the four countries of the Visegrad Group – Slovakia, the Czech Republic, Poland, and Hungary.

Material and methods

The project was designed so that the data would be collected in cities with 50-200 thousand inhabitants. Basing on the requirements, four universities partook in this research: Faculty of Sports, the University of Prešov in Prešov, Slovak Republic; Palacký University, Czech Republic; Pope John Paul II State School of Higher Education, Białá Podlaska, Poland; and University of Pécs, Hungary.

The study was conducted in 2015 on adolescent undergraduate university students of three fields of study – humanities, as well as medical and technical courses. In total, the sample included 2,484 persons. Due to incomplete data or mistakes and errors in the answer sheets, the statistical analysis was performed on the sample of 2,176 students – 1,033 males (47.5 %) and 1,143 females (52.5 %). The data was collected using the extended self-administered version of the standardised International Physical Activity Questionnaire [18]. The IPAQ defines physical activity levels as follows: a low activity level of 600 MET-min/week, a medium activity level of 600-1,500 MET-min/week, and a high activity level of more than 1,500 MET-min/week. The IPAQ

distinguishes between sedentary, moderate, and vigorous activities, such as sports or household chores, to which different MET values are assigned. Students completed the questionnaire in class via the INDARES online system. The surveys gave us information about the individuals' height, body weight, and amount of weekly PA in these categories: vigorous and moderate PA, walking, school-related PA, transportation PA, housework PA, and recreation, sport, and leisure-time PA.

The ANOVA method, the Pearson correlation coefficient, the Kruskal-Wallis test, and the Mann-Whitney U test were used for statistical analysis. The level of statistical significance was set at $p < 0.05$.

Results

Our first goal was to compare university students' PA by sex. Basing on the collected data, we could reject our hypothesis that sex plays no significant role in university students' partaking in PA. It turned out that physical activity expressed in MET-min/week is higher among males than females ($p < 0.05$) not only in the overall amount of PA ($M = 5,971.77$ MET-min/week, $F = 5,177.96$ MET-min/week) and in its individual categories but also in special recreational and sport activities carried out in leisure time (Table 1).

Table 1. Mean physical activity MET/week/sex

	male	female	sig
MET total	5971.77*	5177.96*	.013
Vigorous MET total	1932.56*	1239.83*	.000
Moderate MET total	2416.69	2154.45	.136
Walking MET total	1622.52*	1783.68*	.006
Job-related physical activity total MET	1875.76*	1498.06*	.001
Transportation physical activity total MET	1145.22	1088.72	.808
Housework, house maintenance, and caring for family total MET	1131.19*	1124.08*	.007
Recreation, sport, and leisure-time physical activity total MET	1819.59*	1467.09*	.000

MET = metabolic equivalent, statistics = Mann-Whitney U test,

* the significance level is 0.05

In addition to the information about the students' overall PA, we were also interested in PA intensity. The Kruskal-Wallis test revealed differences ($p < 0.05$) in PA intensity between sexes as well. We found that male students prefer vigorous PA to moderate PA, whereas the opposite is true of female students.

We were, therefore, interested in discovering how the students' attitude towards PA is manifested in the individual fields of study (Table 2).

Table 2. Mean physical activity MET/week/grade/sex

	male			female		
	university humanities field	university medical field	university technical field	university humanities field	university medical field	university technical field
MET total	6495.20*	7111.64*	5085.46*	5269.91	5246.68	4969.04
Vigorous MET total	2273.09*	2385.81*	1509.75*	1234.01	1316.64	1136.47
Moderate MET total	2597.09	2587.63	2229.62	2179.72	1967.32	2392.99
Walking MET total	1625.02*	2138.20*	1346.09*	1856.19	1962.72	1439.59
Job-related physical activity total MET	2044.50	2363.20	1526.04	1442.16	1717.37	1250.00
Transportation physical activity total MET	1136.48	1334.98	1048.64	1093.06	1101.66	1064.93
Housework, house maintenance, and caring for family total MET	1275.61	1193.30	1021.30	1175.23	1041.09	1182.03
Recreation, sport, and leisure-time physical activity total MET	2038.61*	2220.16*	1489.48*	1559.47	1386.56	1472.08

MET = metabolic equivalent, statistics = Kruskal-Wallis test,

*the significance level is 0.05

Significant differences ($p < 0.05$) between fields of study were only found in males – the most active are those in the medical field of study when it comes to recreation and sports PA (2,220.16 NET-min/week), vigorous PA (2,385.81 MET-min/week), and overall PA (7,111.64 MET-min/week).

As for the students' PA by country (Table 3), we found no significant differences ($p < 0.05$) in males in any of the individual PA categories, except for recreation and sports PA as well as transportation PA.

Table 3. Mean physical activity MET/week/country of study/male

	Slovakia	Poland	Czech Republic	Hungary	sig.
MET total	5382.11*	7477.54*	7165.74*	3325.50*	.00
Vigorous MET total	1694.50*	2390.45*	2327.85*	1162.14*	.00
Moderate MET total	2327.11*	2938.43*	2806.43*	1397.69*	.00
Walking MET total	1360.49*	2148.66*	2031.46*	765.67*	.00
Job-related physical activity total MET	1854.68*	2599.21*	2428.76*	340.24*	.00
Transportation physical activity total MET	1095.68*	1529.58*	1520.18*	297.62*	.00
Housework, house maintenance, and caring for family total MET	975.47*	1364.89*	1322.27*	784.52*	.00
Recreation, sport, and leisure-time physical activity total MET	1456.28	1983.86	1894.53	1903.12	.258

MET – metabolic equivalent, statistics: Kruskal-Wallis Test, *the significance level is 0.05

On the other hand, there were significant differences ($p < 0.05$) in females (Table 4) in all PA forms. Overall, the most physically active are Slovak female university students (7,075.89 MET-min/week), while the least physically active are Hungarian female students (3,626.90 MET-min/week).

Table 4. Mean physical activity MET/week/country of study/female

	Slovakia	Poland	Czech Republic	Hungary	sig.
MET total	7075.89*	5049.28*	5144.46*	3626.90*	.00
Vigorous MET total	1914.40*	1024.04*	1139.30*	1016.65*	.00
Moderate MET total	2393.85*	2273.17*	2208.47*	1711.20*	.00
Walking MET total	2767.64*	1752.07*	1796.70*	899.05*	.00
Job-related physical activity total MET	2600.95*	1500.78*	1551.24*	413.19*	.00
Transportation physical activity total MET	1497.31*	1209.66*	1246.66*	375.45*	.00
Housework, house maintenance, and caring for family total MET	1286.41*	1158.88*	1106.85*	943.43*	.015
Recreation, sport, and leisure-time physical activity total MET	1691.23*	1179.96*	1239.72*	1894.83*	.00

MET – metabolic equivalent, statistics: Kruskal-Wallis Test, *the significance level is 0.05

The other studied variable was the BMI height-weight index. Similarly to overall PA, there were significant differences ($p < 0.05$) between sexes in BMI as well (Table 5).

Table 5. BMI – description by sex

Sex	Mean	Std. deviation	F	Sig.
male	24.13	3.403	341.054*	.000
female	21.54	3.142		
total	22.77	3.515		

BMI – Body mass index, statistics: Anova, F – test criterion*

After comparing the individual categories of BMI, we can confirm that a few more than three quarters of the observed students have a healthy BMI, more than 20 % are overweight, and almost 10 % are underweight (Table 6).

Table 6. BMI category – description by sex

	underweight		healthy weight		overweight	
	count	row n %	count	row n %	count	row n %
male	30	2.9	649	62.8	354	34.3
female	151	13.2	848	74.2	144	12.6
total	181	8.3	1497	68.8	498	22.9

BMI – Body mass index

Our main research objective was to analyse whether there is a relation between BMI and PA in university students. Using the Pearson correlation coefficient (and, where appropriate, the Spearman correlation coefficient as a verification means), we discovered that neither overall BMI nor individual BMI categories have any significant relation to the particular forms of PA performed by the students (Table 7).

Table 7. Correlation between BMI/BMI category and individual components of physical activity

	male		female	
	BMI	BMI category	BMI	BMI category
BMI	1	.811	1	.798
BMI category	.811	1	.798	1
Walking MET total	-.056	-.085	-.033	-.036
Moderate MET total	.004	-.010	.044	.003
Vigorous MET total	-.023	-.038	-.013	-.018
MET total	-.028	-.050	.003	-.021
Job-related physical activity total MET	-.042	-.072	-.031	-.041
Transportation physical activity total MET	-.013	-.020	-.006	-.022
Housework, house maintenance, and caring for family total MET	.026	.000	.044	.013
Recreation, sport, and leisure-time physical activity total MET	-.027	-.024	.018	.004
Physical activity level	.002	-.008	.022	.048

BMI – Body mass index

Discussion

The PA results obtained through this international Visegrad Fund research show differences in PA realisation between sexes in the surveyed university students (Table 1). Males are significantly more physically active overall and in most of the studied categories ($p < 0.05$), except transportation PA and moderate PA, which did not show statistical significance in the Mann-Whitney U test. Paradoxically, these two PA components come first and second, volume-wise, in males' overall PA structure. In females, PA structure is comprised mostly of moderate intensity PA, job-related PA, and recreation, sport, and leisure-time PA. Comparing our results with the results of the studies conducted in comparable surrounding countries, we can conclude that our sample was more physically active in all categories. In the newest research, Czech students reported PA levels of 5,758 (males) and 4,502 (females) MET-min/week [2]. Much lower levels were found in a sample of Ukrainian university students who reported on average 3,560.5 MET-min/week [19]. In a similar study conducted on Ukrainian youth aged 17 to 22, males reported PA levels of 3,863 and females of 3,365 MET-min/week [21]. Polish youth aged 16 to 18, which is partially comparable to the age of university freshmen, reported even lower levels of PA – 2,640 (males) and 2,219 (females) MET-min/week [22]. According to sex, both in our study and in other similar research, males are physically more active than females.

As already indicated in the results section, the difference in interest in PA between sexes is complemented by the results of PA intensity analysis. As many as 60 % of male students prefer vigorous PA to moderate PA (35

%). In female students, the situation is entirely opposite – vigorous PA is followed by approx. 45 %, but moderate PA by as much as half of the sample. What is positive about this comparison is that both groups prefer moderate and vigorous PA to low-intensity PA.

When analysing PA volume in individual fields of study (Table 2), we discovered that significant differences ($p < 0.05$) were present only in males in overall PA and three of its components – moderate PA, walking, and recreation, sport, and leisure-time PA. In all of these cases, the most physically active were male medical students. The lowest overall PA in its individual components was found in male technical students. In females, there was no statistically significant difference in PA in any of the observed categories. Female humanities students reported higher numbers in overall PA as well as in recreation, sport, and leisure-time PA. Female technical students' PA volume was highest in the categories of moderate PA and housework PA. Physical activity of female medical students was distributed very evenly, and the highest volume was reported in the categories of vigorous PA, walking, job-related PA, and transportation PA.

We were interested in finding out whether the PA intensity data for the whole studied sample would change when we looked at fields of study. The statistical analysis using the Kruskal-Wallis test ($p < 0.05$) revealed that the differences found in PA volume between the fields of study are not mirrored in any significant way in PA intensity. This conclusion is valid overall as well as when comparing both sexes.

A completely different situation was revealed by PA volume analysis in each of the V4 countries. In this case, statistically significant differences in PA ($p < 0.05$) were found in females in all the studied categories (Table 4). The most physically active are Slovak female university students, who reached the highest PA volume in all categories except for recreation, sport, and leisure time PA, in which Hungarian female students were the most active. However, Hungarian female students are the least physically active in all the other categories as well as the overall value. In males, there were no significant differences between the countries regarding two categories – walking and recreation, sport, and leisure-time PA (Table 3). The lowest PA volume in all its categories was found in Polish male students, as was the case with Hungarian female students.

The analysis of PA intensity with regard to a particular country rendered opposite results than those of PA evaluation by fields of study. Significant differences were revealed in the male as well as the female populations. Interestingly, in both cases, the ranking of countries in PA volume repeats in the PA intensity ranking, which means that more moderate and vigorous PA is reported by Polish male students and the lowest levels by Hungarian male students. The situation is similar in females, with the highest percentage of vigorous PA reported by Slovak female students and the lowest by Hungarian female students.

Because the objective of our research was to find out whether there is a relation between the studied variables, i.e. physical activity and body mass index in university students, the next observed variable was BMI. Similarly to overall PA, there were also significant differences ($p < 0.05$) between sexes overall and within countries, with the exception of Czech students (Table 5).

Statistically significant differences within sexes ($p < 0.05$) between the studied countries are only found in men. Czech male students have the highest BMI (24.6), while Hungarian male students have the lowest (23.2). In females, the recorded quantitative indicators of height and weight and the subsequently calculated BMI were more homogenous, without statistical significance, with the highest mean BMI found in Hungarian female students (21.7) and the lowest mean BMI in the female student population from Slovakia (21.3).

When analysing BMI according to fields of study, we found significant differences only in the male sample ($p < 0.05$). The overall mean BMI was 24.5, and we found the highest numbers in male students doing technical courses (24.4) and the lowest in male humanities students (23.6). In females, similarly as in the comparison by country, BMI numbers are more homogenous, i.e. there was no statistically significant difference found between different fields of study. The overall mean BMI was 21.5, with the highest BMI, similarly to males, recorded in female technical students (21.7) and the lowest in female medical students (21.4).

After dividing the studied sample into three categories – underweight, healthy weight, and overweight – we found out that while approx. three quarters of the students demonstrate correct weight (62.8 % of males and 74.2 % of females), 34.3 % of men and 12.6 % of women are overweight (Table 6). Our research objective, however, was to find out if there was any relation between BMI and PA in university students, whether overall or in their individual forms. Using relevant parametric and nonparametric statistical characteristics, we concluded that BMI (overall), as well as in its individual categories, does not show any relation to PA overall and its particular forms (Table 7).

Conclusions

We can conclude that the achieved results confirmed significant differences in PA between sexes in favour of males both in its overall manifestation as well as its particular intensity levels ($p < 0.05$), except moderate PA and transportation PA. Differences between individual fields of study appeared only in males in overall PA as well as in walking and recreation, sport, and leisure-time PA ($p < 0.05$) in favour of those in the medical field of study. The comparison of individual countries revealed significant differences in PA within both the male (except for leisure-time PA) and the female samples in all PA categories ($p < 0.05$). The most physically active are Polish males and Slovak females. The comparison of BMI overall and within the four countries confirmed a significant variation between sexes in favour of males ($p < 0.05$). Regarding individual nations, the highest BMI was recorded in Czech male and Hungarian female students and the lowest in Hungarian male and Slovak female students. As for the fields of study, a significant difference of $p < 0.05$ manifesting itself only in males, the highest BMI is evidenced in students in the technical field of study and the lowest in humanities. The examination of the relation between PA and BMI did not reveal any statistically significant dependence in any of the categories. This conclusion applies both to males and females.

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PHYSICAL DEVELOPMENT AND BODY COMPOSITION PARAMETERS IN 4-11-YEAR-OLD CHILDREN

ROZWÓJ FIZYCZNY I PARAMETRY SKŁADU CIAŁA DZIECI W WIEKU 4-11 LAT

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zebranie danych
- C. Data analysis/statistics
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- D. Data interpretation
interpretacja danych
- E. Preparation of manuscript
przygotowanie artykułu
- F. Literature analysis/search
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- G. Funds collection
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Summary

Background. In this paper, we present the results of the study concerning body development and body composition parameters dependency.

Material and methods. The monitored sample consisted of 78 probands aged of 4 – 11 years: group I, 4 – 5 year-olds (13 probands) 5.17 ± 0.52 years; group II, 6 – 7 year-olds (30 probands) 6.99 ± 0.52 years; group III, 8 – 9 year-olds (25 probands) 8.8 ± 0.52 years; group IV, 10 – 11 year-olds (10 probands) 10.92 ± 0.53 years. To diagnose parameters of body composition the InBody 120 device was used.

Results. As for the parameters of body composition, a rising linear trend was recorded with increasing age. Statistically significant ($p < 0.05$) values were found between age groups in body height ($p = 3.76E-24$), body weight ($p = 4.65E-16$), quantity of fat mass ($p = 0.0475$), quantity of skeletal muscles ($p = 1.31E-20$), total quantity of water in body ($p = 2.23E-20$), quantity of proteins ($p = 1.83E-20$), quantity of minerals ($p = 2.06E-19$) and in the level of basal metabolism ($p = 1.77E-20$).

Conclusions. Our results of body height and body weight correspond to those obtained in national anthropometric measurements. BMI values respond to the developmental trends, but they differ in the achieved values of comparable age groups as our probands have achieved lower values than the Slovak population.

Keywords: somatic parameters, bio-impedance, overweight, age differences

Streszczenie

Wprowadzenie. Artykuł przedstawia wyniki badań dotyczących rozwoju ciała i parametrów jego składu. W badaniach wzięły udział dzieci w wieku przedszkolnym i młodszym.

Materiał i metody. Monitorowana grupa składała się z 78 uczestników w wieku 4 - 11 lat, w tym 13 dzieci w wieku 4 - 5 lat, 5,17 ± 0,52 lat; 30 - w wieku 6 - 7 lat, 6,99 ± 0,52 lat; 25 - w wieku 8 - 9 lat, 8,8 ± 0,52 lat oraz 10 - w wieku 10 - 11 lat, 10,92 ± 0,53 lat. Do przeprowadzenia badań i zdiagnozowania parametrów składu ciała użyto urządzenia InBody 120.

Wyniki. Odnotowano liniowy trend wzrostowy w parametrach składu ciała związany z wiekiem badanych. Statystycznie istotne wartości ($p < 0,05$) odnotowano między grupami wiekowymi a wysokością ($p = 3,76E-24$), masą ciała ($p = 4,65E-16$), ilością masy tłuszczowej ($p = 0,0475$), liczbą mięśni szkieletowych ($p = 1,31E-20$), całkowitą ilością wody w ciele ($p = 2,23E-20$), ilością białek ($p = 1,83E-20$), ilością minerałów ($p = 2,06E-19$) oraz poziomem podstawowego metabolizmu ($p = 1,77E-20$).

Wnioski. Uzyskane wyniki dotyczące wysokości i masy ciała odpowiadają trendom krajowych pomiarów antropometrycznych. Wartości BMI zgodne są z tendencjami rozwojowymi, ale różnią się osiągniętymi wartościami porównywalnych grup wiekowych, gdyż badana grupa badawcza osiągnęła niższe wartości niż populacja słowacka.

Słowa kluczowe: parametry somatyczne, bioimpedancja, nadwaga, różnice wieku

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Introduction

Childhood obesity is one of the most severe problems of public health in the 21st century. The problem is global, and it constantly affects many countries with low and middle income, mainly in urban environments. Worldwide, the number of overweight children at the age of five was estimated to be over 42 million in 2015 [1].

It is assumed that overweight children and those with obesity will remain obese up to the adulthood, and cardiovascular and locomotor diseases are likely to occur in many of them. Therefore, monitoring the indicators and prevention of childhood obesity require particular attention [1].

The authors note that in overweight children, the risk of becoming overweight in adulthood is minimally twice as high as in children with healthy weight when transferring obesity to adulthood [2]. Marinov and Pastucha add that a relative risk of being obese in 35 years is in the presence of obesity in the age range 1 – 6 years two times higher, 5 – 10 years five times higher, 10 – 14 years ten times higher and 15 – 18 years fifty times higher than in healthy individuals [3].

One of the main reasons for obesity and overweight in children are genetic factors, the behaviour itself, but also the family environment in which the child grows up [4].

Accordingly, body composition assessment achieves a vital position in studies on nutrition, physical activity and health due to an important role of the organ components in human health, particularly when it comes to the impact of excess body fat and the primary factors of chronic diseases [5].

The authors consider that in evaluating the body mass index (BMI), this parameter is one of the assessment criteria of a national standard which was created on the basis of monitoring anthropometric parameters of individuals in a particular country [6]. Further, body mass index acquires the minimum values around the age of 6 years in the individual's life, rising slowly until adulthood [7].

Most studies assess the level of obesity based on anthropometric measurements such as BMI and standard deviation of weight and height scores. Although the body mass index does not estimate the quantity of fat in the body, it remains the most used method for assessing the degree of obesity due to its availability.

The body mass index is an essential indicator of nutrition and indicator of health risk [8].

Several methods are available to assess the body composition, and the criteria that should be taken into account when choosing a proper method of determining it. These include the space the individual intends to assess, costs, the validity/reliability of obtained values, the applicability of the method, and the level of training necessary for an examiner [9].

Between 5 and 11 years, there are some continually increasing parameters of body composition which are observable in both genders, i.e. fat-free mass (FFM), fat mass (FM) and percentage of body fat (PBF) [10].

Fat mass (FM), not body weight (BW), is the best parameter for assessing health and condition. Assessing body composition should be an inseparable part of the health and fitness profile of condition of each individual regardless of body weight [11].

Material and methods

The research involved children in pre-school and younger school age. The monitored sample consisted of 78 probands at the age of 4 – 11 years. The study was performed using the form of a cross-sectional study where the monitored group was divided into four age groups: group I, 4 – 5 year-olds (13 probands) 5.17 ±0.52 years; group II, 6 – 7 year-olds (30 probands) 6.99 ±0.52 years; group III, 8 – 9 year-olds (25 probands) 8.8 ±0.52 years, and group IV, 10 – 11 year-olds (10 probands) 10.92 ±0.53 years.

We tested the essential somatic indicators: body height, body weight and BMI. Body height was measured using an anthropometer. Besides, we applied the diagnostic device InBody 120 (Biospace Co., Ltd.; Seoul, Korea) to assess body weight.

We used the InBody 120 device (Biospace Co., Ltd., Seoul, Korea) to diagnose parameters of body composition. The results of body composition parameters were obtained using a direct analysis of segment multi-frequency bioelectric impedance. The InBody device had been chosen mainly for its ability to analyse a wide range of values of human body composition, but also for its clinical reliability ($r = 0.974$). Using the method of 8-point tactile electrodes, the device diagnoses the body by segment using the most accurate technology DSM-BIA. InBody technology DSM-BIA directly divides a human body into 5 segments (2 upper extremities, 2 lower extremities and torso); due to a different composition and different resistance, it is possible to determine as accurately as possible the ratio of individual substances in the body. We recorded the history of measurements using the database software Lookin'Body120 version 1.2.2.7. Bioelectrical impedance (BIA) is a relatively simple, fast and non-invasive method for evaluating the body composition. Besides, it is widely used due to its reliability. This method detects parameters of body composition utilising a small alternating current [12]. Out of the measured

values of impedance and other corrections presented by [13], we analysed the percentage of body fat (PBF), skeletal muscle mass (SMM), visceral fat level (VFL), waist to hip ratio (WHR), total body water (TBW), protein mass (PM), mineral mass (MM) and basal metabolic rate (BMR).

All the tested individuals turned out to be healthy and did not exhibit any signs of disturbances in the body development. At first, the probands were informed about the tests' performance and evaluation methodology. Before the survey, we received informed consent from the parents about the possibility of implementing the study. The research has been approved by the ethics committee Matej Bel University in Banská Bystrica.

Primary statistical characteristics were used in the survey, i.e. the arithmetic mean, standard deviation, maximum and minimum. The statistical significance concerning physical development and performance between genders was determined using a t-test. An ANOVA was used to evaluate the statistically significant variations in the level of physical performance among the age groups. Statistical dependence was assessed at significance level $p < 0.05$.

Results

The findings into the level of body development and body composition parameters point to the linear dependencies of differences between age groups (Table 1).

Table 1. Physical development parameters and body composition between age groups

	4 - 5 years (n=13)	6 - 7 years (n=30)	8 - 9 years (n=25)	10 - 11 years (n=10)	ANOVA (p-value)
BH [cm]	113.46 ±3.57	125.03 ±6.1	135.32 ±4.4	144.5 ±5.76	3.76E-24*
BW [kg]	19.48 ±2.66	25.03 ±3.21	30.61 ±4.43	33.58 ±3.02	4.65E-16*
BMI [kg.m ⁻²]	15.08 ±1.39	16.02 ±1.87	16.08 ±0.99	16.64 ±2.07	0.0975
PBF [%]	14.79 ±3.2	16.2 ±6.64	15.69 ±6.38	13.74 ±4.5	0.6756
FM [kg]	2.93 ±0.96	4.15 ±2.21	4.89 ±1.39	5.01 ± 2.81	0.0475*
SMM [kg]	7.7 ±1.17	10.31 ±1.44	13.15 ±1.51	15.22 ±1.99	1.31E-20*
VFL [i]	1.38 ±0.51	1.43 ±0.94	1.6 ±1.04	1.2 ±0.42	0.6492
WHR [i]	0.71 ±0.03	0.72 ±0.03	0.74 ±0.05	0.72 ±0.02	0.1197
TBW [L]	12.11 ±1.43	15.28 ±1.77	18.74 ±1.86	21.26 ±2.43	2.23E-20*
PM [kg]	3.22 ±0.38	4.09 ±0.48	5.01 ±0.5	5.71 ±0.66	1.83E-20*
MM [kg]	1.23 ±0.11	1.48 ±0.17	1.78 ±0.17	2.03 ±0.21	2.06E-19*
BMR [kcal]	726.92 ±41.2	819.8 ±51.8	921.12 ±54.4	995.8 ±71.39	1.77E-20*

Note: BH – body height, BW – body weight, BMI – body mass index, PBF – percentage of body fat, FM – fat mass, SMM – skeletal muscle mass, VFL – visceral fat level, WHR – waist to hip ratio, TBW – total body water, PM – protein mass, MM – mineral mass, BMR – basal metabolic rate, * – statistical significant $p < 0.05$

There were noted statistically significant changes between age groups in particular parameters of body development. In body height, there was shown a statistical significant ($p < 0.05$) change between age groups of selected subjects $p = 3.76E-24$. Our results strongly correspond to the theoretical assumptions on the linear development of body height in children and adolescents (Figure 1).

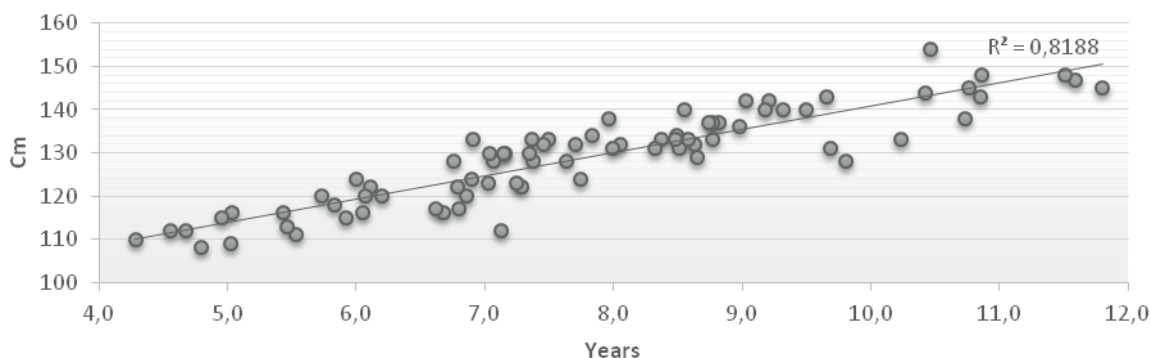


Figure 1. Body height and age dependency

In body weight, a statistically significant variation ($p < 0.05$) was shown between the age groups of the selected subjects $p = 4.65E-16$. The highest increase in body height and body weight was observed between the 4-5-year-olds and 6-7-year-olds. On the contrary, the smallest increase was evidenced between the 8-9-year-olds and 10-11-year-olds.

Our results correspond to the theoretical assumptions on the linear development of body weight in children and adolescents (Figure 2).

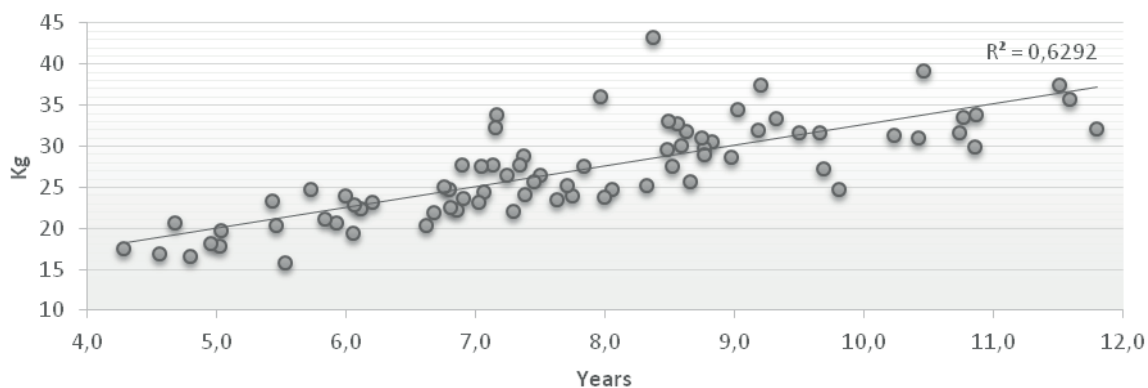


Figure 2. Body weight and age dependency

In body mass index, a slight linear growth was recorded in BMI with increasing age. A statistically significant difference ($p > 0.05$) between the age groups of the selected subjects $p = 0.0975$ was not shown (Figure 3).

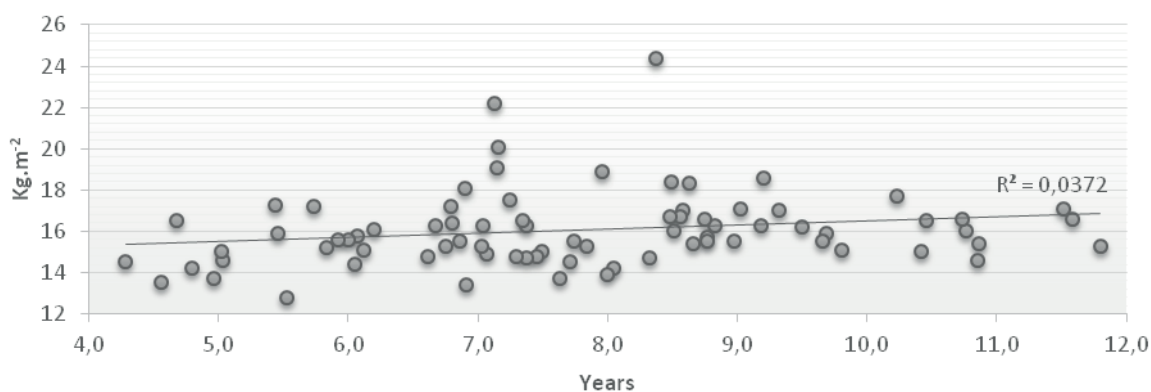


Figure 3. BMI and age dependency

In the parameter percentage of body fat (PBF), there was not shown a statistically significant difference between the age groups. The changes were fluctuating with the reduction in fat rate from the age of 6 - 7. Since this parameter indicates the rate of fat mass (FM) and total weight (TW), significant changes take place in the parameters of fat mass in a body increasing the total body weight.

In fat mass (FM), a slight linear growth was recorded with increasing age. A statistically significant variation ($p < 0.05$) was shown between the age groups of the selected subjects $p = 0.475$ (Figure 4).

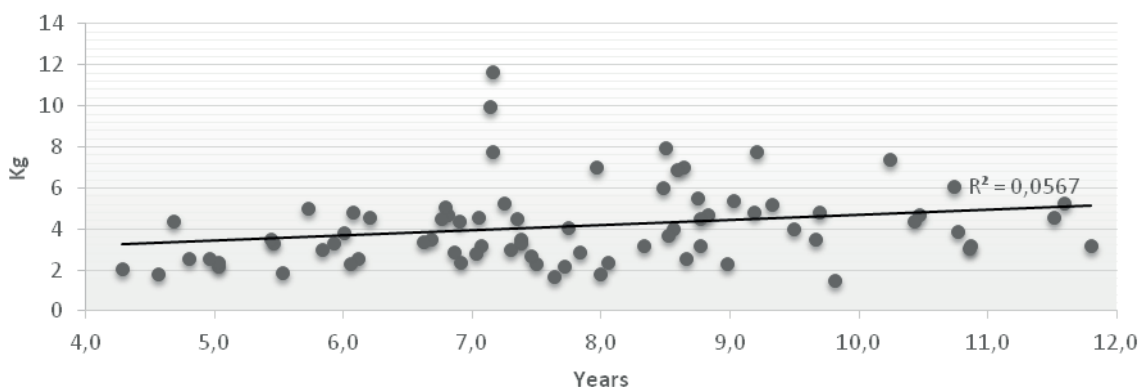


Figure 4. Fat mass (FM) and age dependency

In skeletal muscle mass, a linear growth was recorded with increasing age. A statistically significant change ($p < 0.05$) between the age groups of the selected subjects was shown $p = 1.31E-20$ (Figure 5).

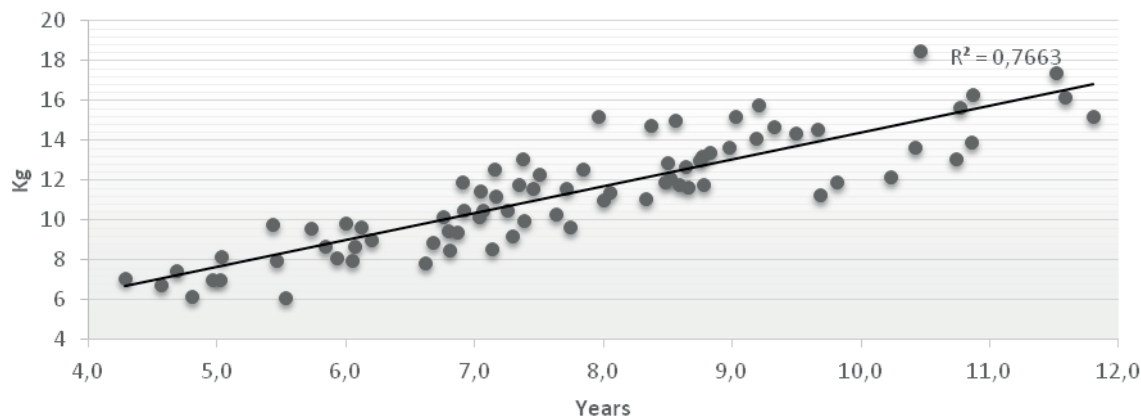


Figure 5. Skeletal muscle mass (SMM) and age dependency

There is no linear dependence on age in these parameters: visceral fat level (VFL) and waist to hip ratio (WHR), as it sticks to the index rating. Only small, but not statistically significant differences were recorded in the above-mentioned parameters.

In total body water (TBW), a linear growth was recorded with increasing age. A statistically significant ($p < 0.05$) difference between the age groups of selected subjects was shown $p = 2.23E-20$ (Figure 6).

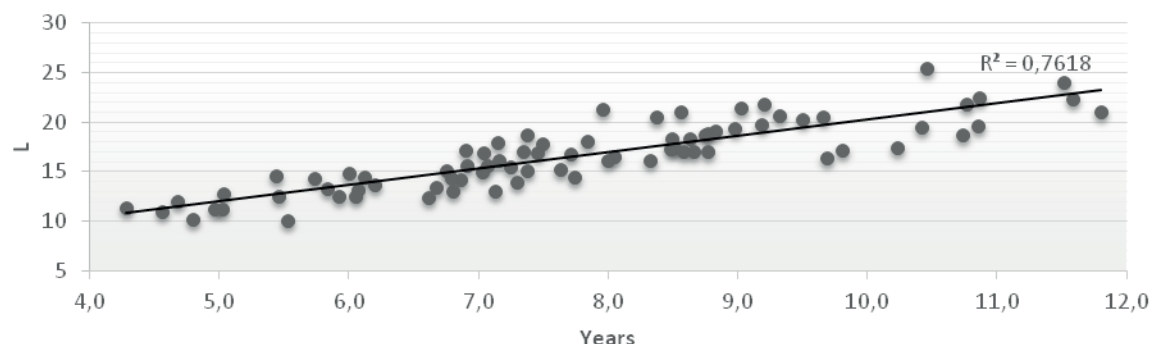


Figure 6. Total body water (TBW) and age dependency

In protein mass (PM), a linear growth was recorded with increasing age. A statistically significant change ($p < 0.05$) was shown between the age groups of the selected subjects $p = 1.83E-20$ (Figure 7).

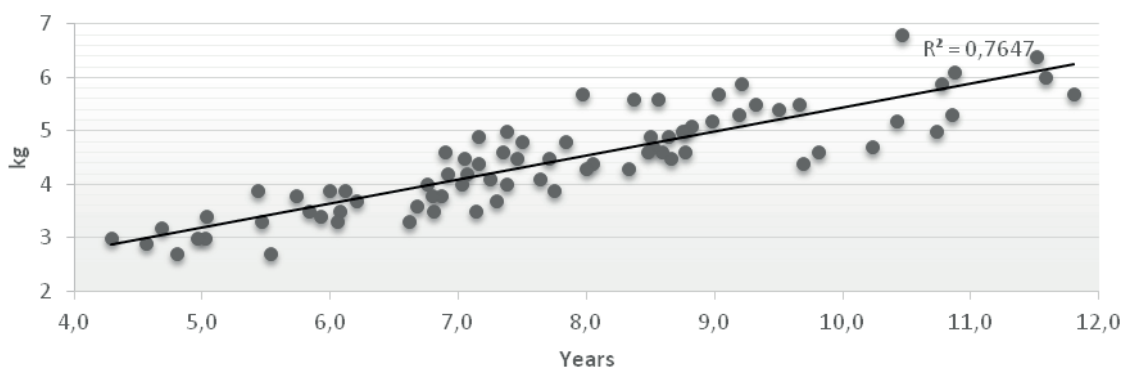


Figure 7. Protein mass (PM) and age dependency

In mineral mass (MM), a linear growth was recorded with increasing age. A statistically significant variation ($p < 0.05$) was shown between the age groups of the selected subjects $p = 2.06E-19$ (Figure 8).

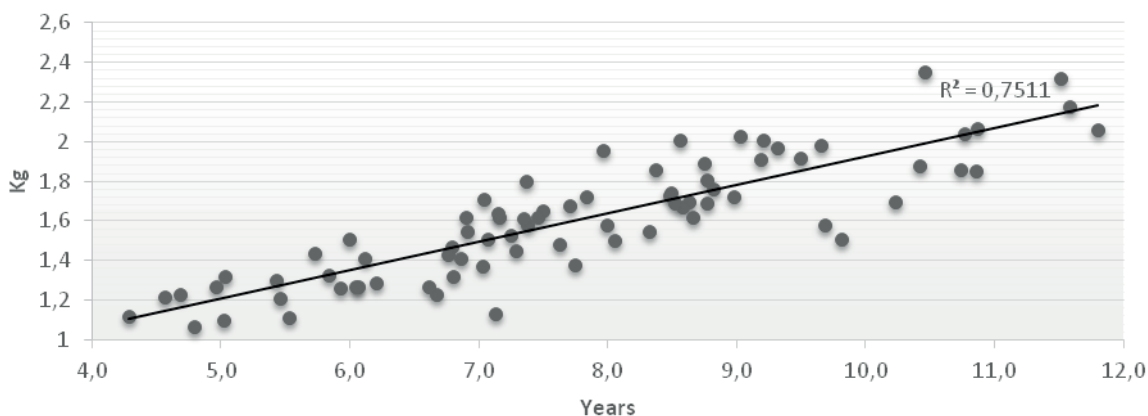


Figure 8. Mineral mass (MM) and age dependency

In the level of basal metabolic rate (BMR), a linear growth was recorded with increasing age. A statistically significant change ($p < 0.05$) was shown between the age groups of the selected subjects $p = 1.77E-20$ (Figure 9).

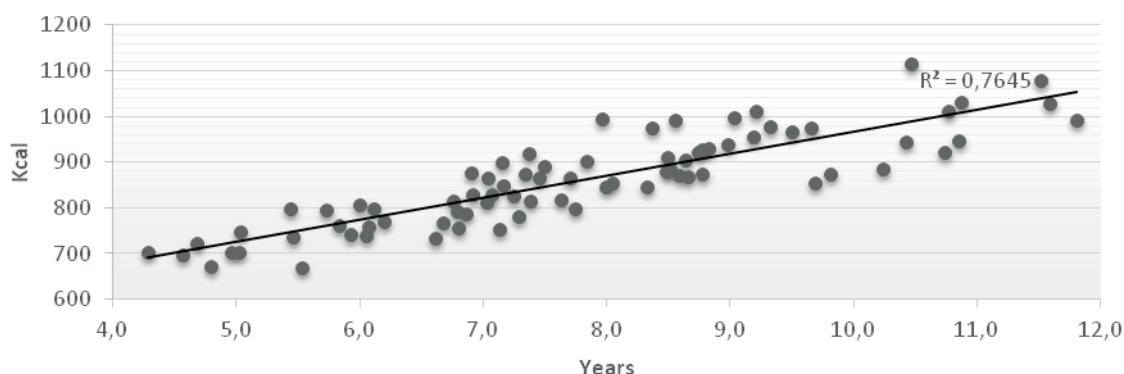


Figure 9. Basal metabolic rate (BMR) and age dependency

Discussion

Based on the results of the VII National survey, the fact was revealed about how the acceleration trends in the mentioned population groups in growth and the secular trend gradually stops. However, an accelerated increase of body weight values is negative when the growth slows down, which was reflected in a significant increase

of average BMI values in all age groups of boys and girls as well as in higher peripheral rates [14]. Our results of body height and body weight correspond to the general developmental trends. The BMI values correspond to the developmental trend but they differ in values of comparable age groups in those probands have reached lower values than the Slovak population [14].

The authors focused on comparing the quantity of body activity in 5-7-year-old children from the Prešov region and their body composition parameters. In the tested sample, an average body height – 116.1 cm, body weight 23.5 kg, BMI 15.75 kg.m⁻² were recorded. In body composition parameters, there were recorded on average 8.2 kg of skeletal muscle mass, 18.2% of fat mass, 3.37 kg of proteins, and 1.19 kg of minerals. The waist to hip ratio was 0.74 - 0.75 and the level of basal metabolism was 728.1 kcal in girls and 758.6 kcal in boys. Our results of 6-7-year-old children are higher in the parameters of physical development. Our probands achieved lower values in the parameters indicating the risk of obesity, fat mass (FM) and waist to hip ratio (WHR). As for the intersexual comparison, there were not noticed any significant changes in the parameters of body composition, except for the parameters concerning the nutritional status (quantity of minerals and proteins) [15].

Comparing our results with the research implemented on children in South Africa [16], we notice differences with our group. In body mass index, there are found lower values compared to our research. They recorded 13.6 kg.mm⁻² in 7 year-old children, 13.9 kg.m⁻² in 8 year-olds, 14.15 kg m⁻² in 9 year-olds. In percentage of body fat parameter (PBF), there was evidenced 12.8-16.8% in 7 year-old children, 13.1-17.8% in 8 year-olds and 12.9-16.1% in 9 year-olds. Thus, the authors may conclude that 77% of the population was malnourished and no child was classified as overweight. These results are caused by regional differences.

When comparing our findings with the research results in the study implemented on the UK pupil populations [17, 18], we note partial differences between the age groups. In 5-7-year-old children, the average body height is 120.9 cm, body weight 22.7 kg and BMI 15.4 kg.m⁻². They recorded 6.2 kg of skeletal muscle mass (SMM) in the group, but our group achieved significantly higher values. In 8-10-year-old children, the average body height is 137.3 cm, body weight is 33.9 kg and BMI is 17.75 kg.m⁻². They point to 9.55 kg of skeletal muscle mass (SMM) in the group, but our probands reached significantly higher values. In our groups, we recorded significantly higher values of skeletal muscle mass for total body weight and lower values of fat mass.

In turn, a cross-sectional study which examined 332 boys and 269 girls at the age of 8 to 11 in Turkey showed that girls had demonstrated a higher body fat mass. In the presented study, they noted expected results according to the age groups in the anthropometric parameters and parameters of body composition. Higher values of fat-free body mass (FFM) were recorded in boys when compared to girls. A higher value of WHR was observed in boys when compared to girls. However, girls had higher values of fat mass (FM) and percentage of body fat (PBF) when compared to boys. In the monitored groups, there were recorded significantly higher values of percentage of body fat than found in the present survey. The average percentage of fat at the age of 8 is 16.3%. The highest fat mass values 17.2% were noted at the age of 11. Fat mass (FM) increases in both genders in all monitored age groups [19].

Conclusions

In most indicators of body development and body composition, there were recorded statistically significant differences ($p < 0.05$) and linear dependence between the age groups. In body mass index (BMI), we recorded slightly increasing values. We did not notice significant differences between groups in the following indicators: percentage of body fat (PBF), visceral fat level (VFL), and waist to hip ratio (WHR). The positive thing is that risk factors of obesity do not significantly increase with an increasing age with regard to BMI and the waist to hip ratio.

The necessary somatic parameters of the physical development of the monitored children correspond to the secular trend and the linear growth of the National Anthropometric Measurements [14]. BMI values respond to the developmental trend, but they differ in the achieved values of comparable age groups as our probands have achieved lower values than the whole population of children from Slovakia.

When comparing our findings with the previous research, we recorded lower values of risk factors of obesity in our groups than in children of the Slovak population [14]. When comparing them with international research findings, our results differ in the achieved values, which may be caused by regional differences.

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PHYSICAL ACTIVITY ASSESSMENT TOOLS IN MONITORING PHYSICAL ACTIVITY: THE GLOBAL PHYSICAL ACTIVITY QUESTIONNAIRE (GPAQ), THE INTERNATIONAL PHYSICAL ACTIVITY QUESTIONNAIRE (IPAQ) OR ACCELEROMETERS – CHOOSING THE BEST TOOLS

NARZĘDZIA BADAWCZE W MONITOROWANIU AKTYWNOŚCI FIZYCZNEJ: GLOBALNY KWESTIONARIUSZ AKTYWNOŚCI FIZYCZNEJ (GPAQ), MIĘDZYNARODOWY KWESTIONARIUSZ AKTYWNOŚCI FIZYCZNEJ (IPAQ) CZY AKCELEROMETRY – JAKI WYBÓR JEST NAJLEPSZY?

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- A. Study design/planning
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- B. Data collection/entry
zebranie danych
- C. Data analysis/statistics
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- D. Data interpretation
interpretacja danych
- E. Preparation of manuscript
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Summary

Assessing physical activity in epidemiological studies is a severe challenge for researchers, whose overriding aim is to obtain accurate, truthful and reliable data on the level of physical activity in different population groups. Presently, both objective and subjective measurement methods are used. The tools used in objective methods are usually pedometers and accelerometers, while in subjective are used questionnaires conducted and run either as self-reported or by a trained interviewer. At the end of the 1990s, experts in the field of epidemiology of physical activity began developing normalised and standardised tools for subjective assessment of physical activity. After several years of experience, we know that well-chosen and properly validated tools used in the testing process conducted in accordance with recommended standards are a prerequisite for obtaining accurate, truthful and reliable data. Although there are over 90 different questionnaires for physical activity, the two most commonly used are the International Physical Activity Questionnaire (IPAQ) and the Global Physical Activity Questionnaire (GPAQ). On the other hand, objective tools such as pedometers or accelerometers are used more and more frequently in cohort and experimental studies, but also those concerning populations. The article reviews the literature on the criteria of selection and usage of these popular tools. The advantages and disadvantages of each of them and the results of the most important comparative validation studies are discussed.

Keywords: physical activity, population studies, cohort studies, GPAQ, IPAQ, accelerometer

Streszczenie

Ocena aktywności fizycznej w badaniach epidemiologicznych jest poważnym wyzwaniem dla badaczy. Celem nadrzędnym jest pozyskanie dokładnych, prawdziwych i rzetelnych danych dotyczących poziomu aktywności fizycznej różnych populacji. Obecnie, wykorzystywane są zarówno obiektywne jak i subiektywne metody pomiarowe. Narzędziami w badaniach obiektywnych są najczęściej pedometry oraz akcelerometry, natomiast w subiektywnych różnego rodzaju kwestionariusze prowadzone samodzielnie lub przez przeszkolonego ankietera. Pod koniec lat 90. XX wieku, eksperci zajmujący się epidemiologią aktywności fizycznej rozpoczęli opracowywanie znormalizowanych i wystandardizowanych narzędzi do subiektywnej oceny wysiłków fizycznych. Po kilkunastu latach doświadczeń wiemy, że dobrze dobrane i prawidłowo zwalidowane narzędzia oraz przeprowadzenie procesu badawczego zgodnie z zalecanymi standardami, jest niezbędnym warunkiem do pozyskania dokładnych, prawdziwych i rzetelnych danych. Chociaż istnieje ponad 90 różnych kwestionariuszy aktywności fizycznej, najczęściej wykorzystywane są dwa: Międzynarodowy Kwestionariusz Aktywności Fizycznej (IPAQ) oraz Globalny Kwestionariusz Aktywności Fizycznej (GPAQ). W badaniach kohortowych i eksperymentalnych ale także coraz częściej w badaniach populacyjnych są wykorzystywane narzędzia obiektywne w postaci pedometrów lub akcelerometrów. W artykule dokonano przeglądu piśmiennictwa na temat kryteriów wyboru i zasad korzystania z tych popularnych narzędzi. Omówiono zalety i wady każdego z nich oraz zamieszczono wyniki najważniejszych porównawczych badań walidacyjnych.

Słowa kluczowe: aktywność fizyczna, badania populacyjne, badania kohortowe, GPAQ, IPAQ, akcelerometr

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Introduction

Physical activity is fundamental to people's life. The human body has evolved over millions of years into a complex organism capable of performing complex motor tasks using both big and small muscle groups. Walking, jogging, throwing or picking up different items are activities that involve most muscles. In the past, as hunter-gatherers, people had to travel long distances to find food or avoid being attacked by wild animals. As food was difficult to obtain, the human body had to adopt energy-saving behaviours. Despite the development of civilisation, body's movement was still used in agriculture, construction, transport as well as in the army and sports.

Nowadays, many forms of motor activity have been neglected in everyday life. The widespread impression that there are many active people who perform various sports and support leisure forms (running, cycling, Nordic Walking or downhill skiing) is misleading as most persons are not involved in physical activity. In the population dimension, there is a systematic decline in the level of physical activity (daily or weekly energy expenditure associated with physical activity). It seems that increasing knowledge in this area of human activity is not fully utilised to explain adverse changes [1].

It is commonly accepted that regular physical activity (PA) is one of the most effective prevention of chronic non-communicable diseases (NCDs) such as type II diabetes, stroke, hypertension, obesity or ischemic heart disease. There is much scientific evidence from systematic screening studies that shows the relationship between low levels of physical activity and increased mortality due to the above causes. Further, it has been proven beyond doubt that there is a direct link between physical activity and cardiovascular health; reduction of the risk of coronary heart disease (CHD) and other cardiovascular diseases (CVD) such as a stroke or hypertension. A systematic physical effort improves circulatory-respiratory fitness, which is directly influenced by its intensity, frequency and duration. There exists a significant positive relationship between a daily dose of physical activity and the development of CVD and CHD [2-6].

The level of 150 minutes of moderate-intensity effort a week can lead to a reduction of the risk of getting ill. There is also a direct link between physical activity and metabolic health, including a lower risk of developing type II diabetes and metabolic syndrome [7]. The data indicate that the implementation of the above-presented level of physical activity significantly reduces the risk of the mentioned diseases. Besides, positive dependency is noted between the volume of aerobic exercise and maintaining normal body weight. Accumulation of energy expenditure related to the undertaken efforts is an essential element of energy balance. It turns out that the sum of energy expenditure that can be achieved by performing a short, at least a 10 minute, exercise session has the same effect in this regard as one long effort. The evidence for the beneficial effects of physical exercise in this context is less consistent than in the case of resistance training, which is partly due to an equalising increase in lean body mass [8]. The relationship between the level of physical activity and maintaining a proper weight is dependent on a considerable inter-personal variability.

In order to maintain healthy body weight, it is necessary to increase the weekly energy expenditure. The data from 12-month randomised controlled examinations indicate that an aerobic exercise for at least 150 minutes per week leads to a weight loss of around 1-3% [9]. This result is sufficient to maintain proper values for one's age and height. Besides, active people gain bone mineral density, thereby reducing the risk of bone fracture (especially a hip fracture) and spinal injuries. A more extensive amount of exercise training aggregates skeletal muscle mass, strength and body neuromuscular activation [10]. Regular physical activity is also associated with the prevention of cancer, mainly colon cancer. The data show that moderate to high-intensity physical activity, performed for at least 45-60 minutes per day, is necessary to achieve a significant reduction in the risk of developing malignant neoplasms [11]. In general, much of the so-called hard evidence indicates that lower mortality rates caused by coronary heart disease, high blood pressure, stroke, type II diabetes, metabolic syndrome, colon cancer, breast cancer or even depression are visible in more active individuals than the less active ones. There is also substantial evidence that active persons exhibit higher levels of circulatory-respiratory and muscle performance. They are more likely to have regular body weight and "healthier" tissue composition than the physically inactive ones [12].

Taking all of the above facts into consideration, the World Health Organization (WHO) has developed guidelines stating that adults who wish to maintain or improve health should do at least 150 minutes of aerobic physical exercise of a moderate or high-intensity level, or respectively 75 minutes of moderate or intense aerobic physical exercise per week. In order to achieve the recommended amount of minimum activity (WHO), it is essential to do the work in cycles lasting at least 10 minutes. These recommendations are even more restrictive for children and adolescents. And so, children and adolescents aged 5-17 should do intensive and moderate-intensity physical exercise for no less than 60 minutes per day (the total time). Exceeding the above recommended 60-minute activity provides many additional health benefits. Similarly as in adults, children and adolescents should do

most of their daily exercise in the form of aerobic endeavours. In the case of children, it is crucial to involve them in intensive efforts as often as possible, including those that strengthen muscles and bones [13].

Monitoring and assessing the level of physical activity of entire populations, as well as different social cohorts are processes aimed at determining the variability of the studied phenomena, which in turn enables implementation of corrective measures early enough as well as measuring the effectiveness and efficiency of the introduced programmes [14]. Regardless of the chosen means (methods, tools), monitoring physical activity should constitute an important part of the assessment of implementation and effects of the WHO strategies concerning global diet, physical activity and health. In line with its own government's commitment to the WHO guidelines, each country should seriously engage in physical activity control. Implementation of the surveillance will allow for periodic evaluation of the effectiveness of programmes and policies at the national level and an increase of physical activity at the population level; thereby reducing the risk of developing NCDs [15].

Significance of the research tools in measuring physical activity

The study of health behaviours, including physical activity, both in young people and adults, is essential for effective public health action. In 2008, Guthold et al. [16] conducted the most extensive cross-sectional physical activity survey covering representative populations of all geographical WHO regions. The study involved 259 526 people from 51 countries. It used the International Physical Activity Questionnaire (IPAQ) - short form. Before, such a massive comparable cross-sectional study conducted internationally had been done only in regard to smoking and the incidence of obesity. As far as physical activity was concerned, there were no adequate monitoring systems. The IPAQ questionnaire, developed for the use in population-based health-promoting physical activity (HEPA) surveys, was the first one that enabled such a large project.

The Global Physical Activity Questionnaire (GPAQ) was developed as part of the WHO Global Programme on Risk Factors (STEPS) in 2002. The STEPS programme was introduced to monitor 8 key non-communicable chronic disease risk factors (NCDs), particularly in developing countries. [17] The GPAQ questionnaire is optimised when compared with the IPAQ-S and IPAQ-L questionnaires as it is a tool used for measuring physical activity on a population scale. The results of validation studies show that the GPAQ fulfils both repeatability and accuracy criteria compared to other instruments used in subjective research methods [18]. The authors of the questionnaire encourage researchers to use the tool especially in countries with lower levels of economic development and high social differentiation, the more that there are several areas in which further useful work could be done. For example, it seems desirable to conduct further GPAQ tests in some countries in order to build a more comprehensive evidence base that could be used internationally, particularly in the Eastern Mediterranean and European regions [19].

Physical activity monitoring systems using the IPAQ and GPAQ questionnaires have become very common. Increasingly, more advanced tools, i.e. electronic monitors – accelerometers, are employed to oversee physical activity especially in the most economically developed countries in the world [20-23]. Perhaps in the next few years, this technology will become cheaper and more accessible, which would enable conducting extensive national and international observations over the next few years.

The implementation of the Global Strategy for Diet, Physical Activity and Health (DPAS) [24] has resulted in a significant demand for internationally comparable physical activity data that could be used in quantification of health threats and trends surveillance within countries. Being familiar with commonly used tools in the world's research is vital for proper preparation of research projects whose results would be of interest to other researchers. Our review of the literature on the issue discusses problems related to the most commonly used methods of physical activity surveillance. Thus, it could be helpful for all those who wish to be informed about the existing methods, techniques and research tools in their proper choices.

Subjective methods for evaluating physical activity

The work of expert teams trying to develop the first normalised physical activity questionnaire began around 1998, along with the development of the IPAQ. The goal was to construct a comprehensive measuring tool for assessing energy expenditure that would be related to physical effort in different areas of people's everyday life.

International Physical Activity Questionnaire (IPAQ)

The construction of the questionnaire enables its adaptation to a wide range of languages and cultures. The reliability and usefulness of this population survey questionnaire were validated in 12 countries already in 2003,

and the results demonstrated acceptable measurement properties [25]. The short form (IPAQ-S) can be used in population and cohort studies to monitor health risks and to assess the level of physical activity. This version consists of 7 questions concerning a week time dimension, in which moderate and high-intensity efforts are performed as well as walking and sitting. The data obtained from the IPAQ-S questionnaire enable classifying a population into three groups: inactive, moderately active and very active. Researchers can complete the study using two techniques – a self-administered one or a telephone interview [26].

Since 2005, researchers have also had access to a long form of IPAQ-L, which is used as a normalised tool for estimating the physical activity in populations from different countries and socio-cultural circles, which allows for an assessment of energy expenditure for each domain of activity (PA domains). The IPAQ-L is designed for a comprehensive evaluation of everyday moderate or intense physical activity in such domains as job-related activity, transportation, housework, sport and recreation, and sedentary behaviour. It enables monitoring physical activity in population and cohort studies of people aged 15 to 69 years. This version is most often used as an evaluation tool in interventional studies of different cohorts, such as people with diabetes, cancer, arthritis or arthritis in the elderly [27-29]. The IPAQ – long form is also used in large physical activity research, which intends to obtain detailed information on frequency, intensity and place of the reported activity. However, the construction of this form of the questionnaire does not allow to conduct a study in teenagers, especially under 15 years of age. Therefore, a modified version of IPAQ-A was developed and used in testing European teenagers aged 12-17 in the HELENA study [30].

Global Physical Activity Questionnaire (GPAQ)

The Global Physical Activity Questionnaire (GPAQ) has been developed as an intermediate tool for both versions of IPAQ, and it is supposed to minimise differences in the assessment of physical activity between different countries. This questionnaire takes advantage of all good solutions used in IPAQ-S and IPAQ-L but avoids interpretative discrepancies that appear when the IPAQ questionnaire is used. The goal of the GPAQ was to provide a tool that would provide credible and reliable results from population-based physical activity surveys, especially in developing countries where behavioural patterns differ from those in highly developed countries. An initial validation and qualitative studies were conducted in nine countries, and their results were satisfactory [19]. The Global Observatory for Physical Activity Steering Committee together with the WHO and the US Centres for Disease Control and Prevention introduced minor changes when in the final version of GPAQv2. The GPAQ assesses physical activity in all domains of life (work, transport or leisure). Currently, it is used by over 100 countries as the GPAQ has become the most common tool in diagnostic and evaluation studies of physical activity, especially in developing countries [31].

The reliability and sureness of the GPAQ were initially assessed using pedometers and accelerometers under a survey conducted in nine countries [19]. The chiropractic verification showed a moderate correlation coefficient (Spearman $\rho = 0.35$) with total physical activity. The validation of the GPAQ carried out in a similar way in other countries such as China, Ethiopia, Indonesia and Japan also showed significant but mild to moderate correlations, and the Spearman coefficient ρ ranged from 0.23 to 0.35 for the total level of physical activity. The accelerometer-based validation of the GPAQ was performed in China and South Africa. It showed mild to moderate correlation coefficients (0.23-0.40) for sedentary activity, and a significant correlation coefficient (0.26) for moderate to vigorous activity (MVPA) [32]. Further validation studies using accelerometers were conducted in Malaysia, South America, the United States and Europe [18,33,34]. Using the GPAQ has several advantages as the questionnaire focuses mainly on three general domains of one's activity involving efforts made at work while being active and while resting. These features increase its applicability compared to the IPAQ questionnaire. In addition, the GPAQ is also concise – it contains 16 questions (11 fewer when compared to 27 items in the IPAQ-L). Besides, it is standardised so that it can be used in international research regardless of a geographic region and socio-cultural and economic characteristics of the population.

The GPAQ was designed for face-to-face interviews conducted by trained interviewers. Further, sample “socially-populated” demonstration cards were developed for each of the activities indicated in the GPAQ, including intensive and moderate activity at work, transport activity, leisure activities as well as sitting. Demonstration cards are prepared so as to help respondents better understand the activity meant by the pollster. The development of such cards for a particular population should take into account the local features of the surveyed population [35]. Although the GPAQ is highly credible and widely used for international comparisons, it can cause problems in some populations or cohorts connected with atypical and heterogeneous forms of physical activity [36].

Objective methods for evaluating physical activity: pedometer and accelerometer

Exact measurements of the level of physical activity in a population are essential for assessing the effectiveness of interventions aimed at changing people's behaviour in reducing sedentarism and advocating an active lifestyle. In the case of cardiovascular disease, type II diabetes or multi-cause mortality, increasing the weekly physical activity to a minimum of half an hour in at least 5 days a week brings measurable benefits [13]. This means that the highest risk of becoming ill concerns the most inactive people. Therefore, it seems sensible to focus on interventions in these cohorts that represent the lowest levels of physical activity. Although self-reporting of physical activity by means of questionnaires is widely used, mainly because of the low cost, ease of implementation and low burden on participants, this method of doing research has significant limitations in estimating accurate data. Self-evaluation tends to show an overestimation of the actual physical activity [37].

Some large population studies have used objective tools, i.e. pedometers and accelerometers, for several years. Pedometers record steps, while accelerometers are very advanced electronic devices that record all movements performed by the person while estimating intensity, duration and energy expenditure. Pedometers seem a better and more accessible choice in large observational and intervention studies because of low cost and immediate feedback. However, in estimating energy consumption, pedometers lack accuracy, and the error rate is high (30% or more vs. 2.5%) compared to accelerometers [38,39]. Currently, accelerometers are the most modern method of objective physical activity surveillance and, at the same time, a standard method of evaluating the reliability of physical activity questionnaires [40]. The use of accelerometers in large studies is costly, but researchers are increasingly turning to them in population studies [41].

Conclusions

Lack of physical activity (physical inactivity) contributes to the development of chronic non-communicable diseases, especially in rich countries, which is also increasingly true of low- and middle-income countries. Understanding why people are more or less physically active may help to conduct interventions based on hard scientific data. These data should be gained from reliable research. Over the last decades, knowledge on the determinants of physical activity in societies has increased significantly. Also, ecological models determining physical activity have been developed basing on a wide range of causes influencing people's health. Besides, new research areas have been identified in which determinants of an active lifestyle are going to be surveyed. Knowledge of these determinants, especially in low- and middle-income countries, could reduce the upward trend in civilisation diseases. Such research should however be based on the most advanced and widely used tools in the world.

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EFFECTS OF HIGH-CARBOHYDRATE PRODUCTS CONSUMPTION ON POSTPRANDIAL GLYCEMIA IN RUNNERS

WPŁYW SPOŻYCIA PRODUKTÓW BOGATYCH W WĘGLOWODANY NA GLIKEMIEJ POPOSIŁKOWĄ WŚRÓD BIEGACZY

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Authors' contribution

Wkład autorów:

- A. Study design/planning
zaplanowanie badań
- B. Data collection/entry
zebranie danych
- C. Data analysis/statistics
dane – analiza i statystyki
- D. Data interpretation
interpretacja danych
- E. Preparation of manuscript
przygotowanie artykułu
- F. Literature analysis/search
wyszukiwanie i analiza literatury
- G. Funds collection
zebranie funduszy

Summary

Background. Running causes that people become more and more willing to engage in physical activity. It is an valid exercise that significantly decreases postprandial glycemia. The higher the training load, the more important it is to complement nutrients necessary for organism regeneration. Modern food industry provides many products that can help in re-synthesis of muscle glycogen. The study presents a mutual correlation between consuming high-carbohydrate products with and without having exercise afterwards and the shape of the blood glucose curve.

Material and methods. Nine healthy and hard training male adult athletes participated in 2-part (P1 and P2) research: P1 with, and P2 without run. After the run, the athletes had a specified meal, after which capillary blood glucose test was taken for P1 before the run and for both groups 2-3 min, at 30, 60, 90 and 120 min after the meal.

Results. The comparison of the area under the curve (AUC) at rest and after 1 hr run showed statistically significant variations after every 30 minutes period and in the overall AUC. The smallest AUC occurred after consuming chips and spinach pasta and the highest after potatoes, white and brown rice.

Conclusions. Physical activity does not change the way glucose is released into the blood, but it lowers postprandial glycemia, especially after 30-90 minutes after training completion. This study indicates that consuming potatoes and rice leads to the highest rate of muscle glucose uptake and further faster glycogen re-synthesis after the run. Accordingly, these products can be a good choice for athletes having a short break between training bouts.

Keywords: postprandial glycemia, endurance, running, dietary carbohydrates, glycemic index

Streszczenie

Wprowadzenie. W ostatnich latach bieganie stało się bardzo popularną formą aktywności fizycznej, która skutecznie obniża glikemii poposiłkową. Wraz ze wzrostem obciążeń treningowych, nabiera znaczenia odpowiednie uzupełnienie składników odżywczych, w celu zapewnienia optymalnej regeneracji. Współczesny przemysł spożywczy dostarcza wielu produktów mogących pomóc w resyntezie zapasów glikogenu mięśniowego. Celem pracy jest określenie wzajemnej korelacji między spożyciem produktów bogatych w węglowodany po lub bez treningu oraz kształtem krzywej poposiłkowej stężenia glukozy we krwi.

Materiał i metody. Dziewięciu zdrowych, dobrze wytrenowanych biegaczy uczestniczyło w badaniu stężenia glukozy w krwi kapilarnej po 2-3, 30, 60, 90 i 120 minutach po określonym posiłku. W pierwszej części (P1) spożycie był poprzedzone treningiem biegowym. W części drugiej (P2) pobranie pokarmu nie odbywało się po wysiłku fizycznym.

Wyniki. Porównanie pola pod krzywą stężenia (AUC) glukozy we krwi w warunkach odpoczynku i po godzinie biegu pokazało znaczące różnice zarówno w całkowitym AUC, jak i w ilości glukozy po 30 minutach od spożycia posiłku. Najmniejsze AUC wykazano po spożyciu frytek i makaronu ze szpinakiem, a największe po gotowanych ziemniakach oraz białym i brązowym ryżu.

Wnioski. Wysiłek fizyczny nie wpływa na sposób uwalniania glukozy do krwi po posiłku, ale wpływa na obniżenie glikemii poposiłkowej, szczególnie po 30-60 minutach od zakończenia treningu. Uzyskane wyniki mogą sugerować, że spożycie ryżu i ziemniaków po bieganiu może przyczyniać się do szybszej resyntezy glikogenu mięśniowego, co może być szczególnie korzystne w przypadku krótkich odstępów czasu między kolejnymi sesjami treningowymi.

Słowa kluczowe: glikemia poposiłkowa, wytrzymałość, bieganie, produkty bogate w węglowodany, indeks glikemiczny

Tables: 0

Figures: 3

References: 23

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Introduction

Grain and cereal-grain food products constitute an essential part of the human diet by providing a high proportion of carbohydrates, proteins, fats, dietary fibre, B-group vitamins and minerals [1]. Scientists from Harvard School of Public Health (2011) recommend physical activity and weight control as the most effective ways of preventing metabolic diseases. The other group of foods enumerated by the nutrition pyramid which are essential to human health includes vegetables, fruits, healthy oils and wholegrain products [2].

As indicated by Edwards et al., the structural integrity of wheat endosperm has great influence on postprandial metabolism. An adequate amount of grain and cereal-grain food in one's diet is one of the factors used for treatment and prevention of diabetes, cardiovascular diseases, colon cancer and too high level of cholesterol in blood [3]. Furthermore, consumption of adequate carbohydrates can also affect people's emotions and mood [4]. Lacoppidan et al. found that Nordic diet, rich in fish, cabbage, rye bread and oatmeal, is significantly associated with lower risk of type 2 diabetes [5]. Further, whole grain products contain significant amounts of fibre, which is shown to decrease insulin and peptide C levels and reduce the percentage of small and dense LDL [6].

Besides, Bailey et al. showed that going for a light-intensity walk after finishing a meal has a positive influence on postprandial glycemia. Thus, proper diet, in connection with physical activity, has a beneficial impact on insulin and glucose levels in the blood after the meal and can reduce cardio-metabolic disease risk [7].

Presently, there is a new trend towards increasing the number of covered kilometres as well as intensifying training and quantity of training sessions per day. Many factors play a significant role in the recovery process after highly intensive training. These include types of administered exercise, the meal ingestion-time, the number of ingested carbohydrates (CHO), as well as the glycemic response to the ingested food or supplements. Accordingly, consuming food products or dietary supplements rich in carbohydrates is recommended to achieve the most optimal body's recovery [8]. There are also suggestions to add proteins to CHO, which might augment the process of recovery by increasing the rate of glycogen synthesis [9, 10].

Modern food industry supplies athletes with numerous products. It is essential to choose a proper source of carbohydrates, tailored to the individual's needs.

Ormsbee et al. outline that the most common source of delivering carbohydrates for the athletes are food products such as cereals, pasta, rice, groats, potatoes and others; however, liquids and solid forms of different supplements are used as well. Also, the degree of processing of food products significantly affects the glycemic index [11].

The purpose of this study was to determine the influence of ingesting different food products on the immediately after exercise glycemic response.

Material and methods

Participants

Nine healthy male adult athletes who trained extensively (at least 100 km/6 training sessions/ week) took part in the research. All of them were in the same phase of training, i.e. mesocycle. Each of them was precisely informed about the aim of the study, the research proceeding, their function in the study as well as the possible consequences as indicated by the protocol of Bioethical Commission of Gdansk Medical University No NKEBN/14/2008 of February the 12th 2008. Then, a voluntary participation agreement was signed the parties – the runners and the Gdansk Medical University was signed by the parties simultaneously.

Carbohydrate products

Pure glucose powder and ten selected high-CHO products with a different glycemic index (GI) were examined according to how frequently they were consumed by the participants. The chosen products included three different types of pasta and rice, two types of groats, one sort of chips and potatoes. To conduct a quantitative analysis of ash, water, proteins, fats and carbohydrates in the chosen products, the AOAC method was used for quantification. The dietary fibre content in the selected products was estimated according to "Tables of food composition and nutritive value" [12].

The analytical scale (XA RADWAG) was used to measure suitable product portions ($\pm 0,1g$). The food samples were prepared according to the manufacturer's recommendations. The products were served after having been washed, rinsed with water and washed again. To facilitate the consumption 1 g of mixed spices (equal parts of oregano, basil, granulated garlic, thyme, Provençal herbs and salt) was added to each of the sample. The glucose solution contained 50 g of glucose powder and 450 mL of mineral water.

Preparation of tested products

All of the runners who took part in the research performed one-hour run at the intensity of 70-75% of maximal heart rate (HR_{max}) estimated by equation proposed by Tanaka et al. [13]. To avoid individual differences, the estimated HR_{max} was compared to the HR_{max} recorded during the competitions held in the previous 3 months. HR was measured by two different electronic devices with GPS technology (Garmin Forerunner 305 and Polar RS300X). The runs were performed in natural conditions and on the same flat course (0–5 AMSL) with similar weather conditions, i.e. 4–6 °C degrees.

Postprandial glycemia measurement

The postprandial glycemia changes were determined by using the Accu-Check Active glucometer (Roche), in capillary blood samples taken from finger-tips. The fingers were cleaned with the sterile swabs using salicylic alcohol before each sample collection. The single-use needles were applied for every single prick and measurements were conducted using the second blood drop. The double-check was applied in case of suspiciously high or low results to eliminate any mistakes during the procedure.

Research design

The study lasted from November 2009 until January 2010. The athletes had postprandial glycemia measured after the run or at rest every 2 weeks. Figure 1 presents the scheme of the research proceedings.

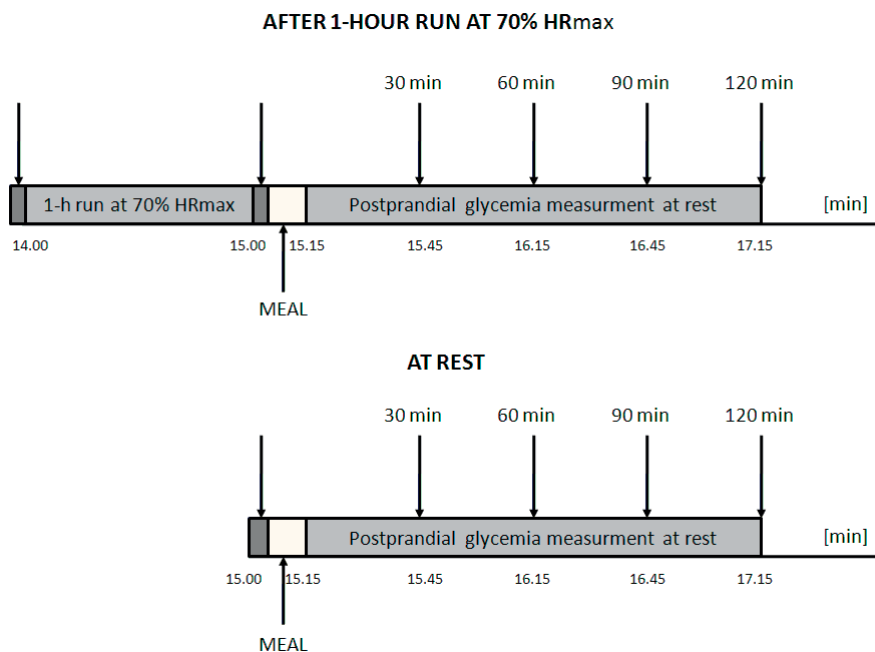


Figure 1. Scheme of the research procedure

The first part (P1) of the research was to have a meal with 400 – 500 mL of mineral water just after the run and the other part (P2) was administered without the run. The research started at 2 pm or 3 pm. The athletes could not have any meals during the 2,5 h preceding the test, and the last meal had to have low or moderate GI. They were asked to eat the same food products on the day the measurements were taken. Glycemic measurements for P1 were made before the run and for both groups 2 – 3 min, at 30, 60, 90 and 120 min after the meal.

Statistical analysis

All the gathered data were analysed to detect any changes in postprandial glycemia. The Mann-Whitney U test was used to calculate the differences between blood glucose value and the area under the curve values (AUC) at rest and after the run. Statistica software (version 8.0, StatSoft Polska Sp. z o.o., Warsaw, Poland) was applied to do all statistical analyses. The assumed significance level was 0.05.

Results

Blood glucose concentrations changes are presented in figure 2.

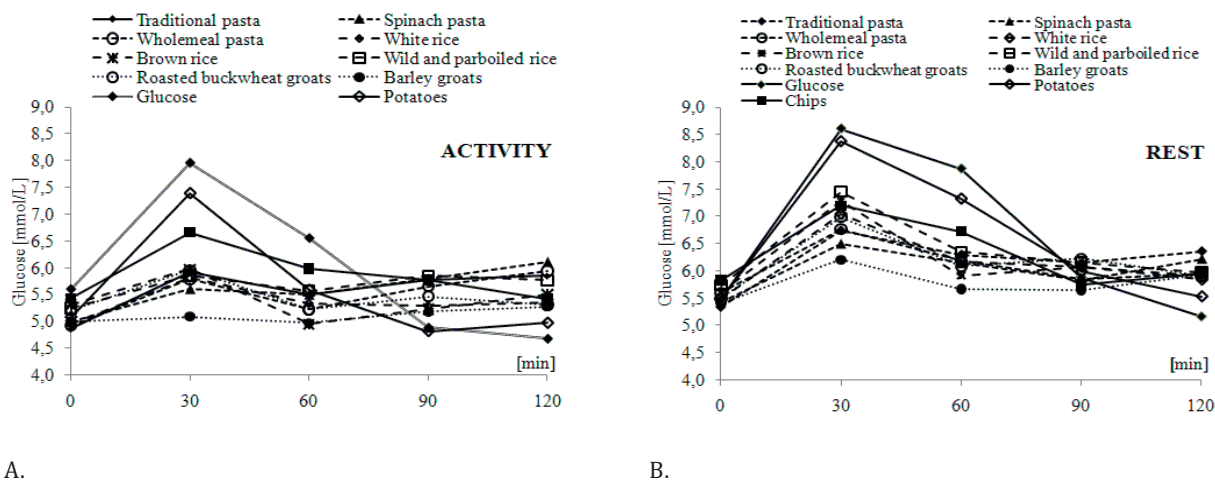


Figure 2. Postprandial glucose after eating 11 products without doing exercise (A) and after doing exercise (B)

The glycemic profile

There were several different postprandial glycemic profiles observed during the course of the study. The peak of the glucose values appeared 30 minutes after the consumption of all the examined products. The postprandial glycemic values were also estimated at rest.

The highest glycemia

The highest level of blood glucose after a run was observed in the first 30 minutes after eating most of the tested products. The glucose values peak occurred 120 minutes after having wholemeal pasta or barley groats. As for the consumption of wild and parboiled rice after exercising, similar results were obtained with peak glucose values achieved at 30 minutes and 90 minutes. The highest average blood glucose concentrations at rest and after one-hour run were visible after the consumption of 10% glucose solution (8.60 mmol/L and 7.96 mmol/L respectively) and potatoes (8.38 mmol/L and 7.39 mmol/L respectively).

The lowest glycemia

The lowest glycemia values at rest (P2) were observed 90 minutes after eating three kinds of pasta, barley groats and chips; and then 120 minutes after eating three kinds of rice, buckwheat groats, glucose and potatoes. The lowest values of postprandial glycemia after a run were noticed 60 minutes after consuming a vast majority of the examined products except for white rice and potatoes (90-minute postprandial glycemia) and chips and glucose (120-minute postprandial glycemia). The lowest average blood glucose concentrations in both cases were recorded for 10% glucose solution and potatoes.

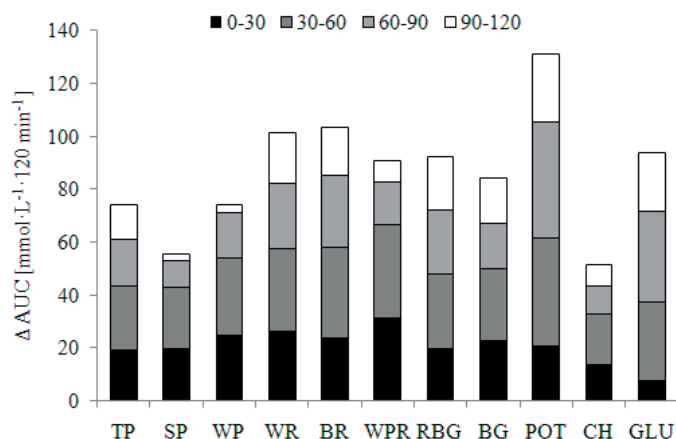
The glucose values stayed above the initial level (baseline) at rest (P2) for 120 minutes after the mean except when chips were consumed (90 minutes after consumption) and glucose (120 minutes after consumption), which have the results below the baseline. In P1, the results of glucose values for brown rice and barley groats stayed under the baseline at 60 minutes, and 90 minutes after the meal.

Glycemia in rest conditions and after running

One hour-run decreased postprandial glycemia when compared to that at rest. Statistically significant variations ($p < 0.05$) were observed after consuming most of the tested products. There was no statistically significant variation in postprandial glycemia found after having chips and glucose; however, when compared to other conditions, the postprandial glycemia decreased within one hour.

AUC comparison

The determined AUC value for all the examined products is visible in Figure 3. The research has shown that the highest AUC at 30, 60, 90 minutes and overall at rest conditions occurred after consuming glucose and potatoes.



TP – traditional pasta; SP – spinach pasta; WP – wholemeal pasta; WR – white rice; BR – brown rice; WPR – wild and parboiled rice; BG – roasted buckwheat groats; BG – barley groats; POT – potatoes CH – chips; GLU - glucose

Figure 3. Differences between AUC value at rest and after 1-h run at 75% HR_{max} at 30, 60, 90 and 120 minutes after consuming the examined products portions

Considering the first 30 minutes, the highest ΔAUC was the consequence of having wild and parboiled rice while, at the consecutive three thirty minutes periods, the highest ΔAUC was found after consuming potatoes. Also, the potatoes intake resulted in the highest overall ΔAUC.

The intake of glucose in the first 30 minutes, chips in the second and spinach pasta in the third and fourth 30 minutes time resulted in the smallest ΔAUC value. The smallest overall ΔAUC was also achieved after consuming chips and spinach pasta. The statistically significant differences ($p < 0.05$) of ΔAUC in each 30 minute time period and overall ΔAUC were obtained after seven examined products, excluding spinach pasta, potatoes, chips and glucose.

Discussion

Profiles of postprandial glycemia

The research showed that the profiles of postprandial glycemic response to the examined products at rest were similar to those indicated by other authors [10, 14, 15].

Stevenson et al. presented a 24-hour glycemic profile obtained after breakfast and lunch which based on two different carbohydrates products and showed that pasta gives higher and lower peak faster than in our study [16]. Such a discrepancy might result from a higher carbohydrates content in a single portion as well as an addition of an apple and pear juice that contains simple carbohydrates. In fact, Stevenson et al. proved that the initial glycemic values before a low-GI breakfast (at the fasting state) and a low-GI lunch with a three-hour gap in-between were similar and the peak glucose appeared in the first 30 minutes time. However, the shape of the Stevenson's research curves supports the general solidity of our study [16].

Effect of training on postprandial glycemia

One-hour run at the intensity of 70 – 75% of HR_{max} caused changes in the muscle and liver glycogen content, which resulted in decreased postprandial glycemia when compared to that at rest. The recent research indicates that aerobic exercises which increase the glucose uptake during the activity, simultaneously increase the tissue sensitivity to insulin several hours after the exercise cessation. As Richter and Hargreaves' study demonstrates, contraction-stimulated muscle glucose uptake results from increasing GLUT-4 membrane translocation. It also depends on the actual glycogen content [17]. Furthermore, as several other studies indicate, exercise-induced glycogen depletion stimulates several insulin-independent intracellular mechanisms. Although the signalling pathways underlying GLUT-4 surface translocation are not yet entirely clear, some mechanisms involving AMP-activated protein kinase (AMPK), calcium, p38 mitogen-activated protein kinase (p38 MAPK), nitric oxide synthase (NOS) or bradykinin have been proposed [18]. The effects of exercise-stimulated glucose uptake are extended to the first rapid phase of recovery lasting for about 30 to 60 minutes, which allows for fast glycogen synthesis through the insulin-independent pathways. According to Ivy and Kuo, the provision of carbohydrates

after exercise rapidly increases the insulin concentration and also starts the second insulin dependent phase of recovery with further GLUT-4 translocation and glycogen synthesis [19]. This may explain lower glycemia values after one-hour run observed in our study.

Ivy recommended consuming CHO immediately after exercise cessation because of faster glycogen resynthesis in the first hours [20]. This effect may additionally be multiplied by an intake of high-GI products [10].

Proper selection of high-carbohydrate products for athletes

Our study showed that the consumption of specific products, like potatoes, white or brown rice provides easily digestible carbohydrates and should be recommended after training especially if the recovery period between the following sessions is short. Different sorts of pasta, wild or parboiled rice as well as buckwheat and barley groats should also be consumed. In order to make sure that the proper recovery has been obtained by athletes, a long enough gap between the following sessions is recommended. Despite high glycemic values, consuming chips had also resulted in the lowest Δ AUC. This is probably due to the technological process and their nutritive elements content. Chips have high-fat content, which might have an adverse effect on glucose release and absorption of some carbohydrates. Processed foods may change postprandial glycemia achieved consuming meals based on corn, rice or potatoes, as demonstrated by Brand et al. [21]. Besides as Björck et al. show, changes in glycemic response can also be caused by amylase and amylopectin content in saliva [22].

A very low Δ AUC observed at the first 30 minutes after 10% glucose solution consumption might indicate faster glucose blood absorption than glucose muscle uptake.

Our study involved only male athletes, but Folch et al. demonstrated similar results for both sexes [23]. Accordingly, because of higher glycemic values and Δ AUC after potatoes intake, white or brown rice are recommended, as they decrease glycemic volume and facilitate CHO absorption. All this may ensure proper recovery of athletes.

Conclusions

It was observed that high-CHO products result in a typical postprandial glycemia profile with the glucose values peak visible in the first 30 minutes after consumption at rest. Physical activity decreases postprandial glycemia. It seems crucial to choose an appropriate source of carbohydrates adapted for individual needs. A variety of available cereal products allows for adjusting the best quality of carbohydrates to the type and intensity of particular physical activity. Athletes who take a short break between subsequent training bouts should pay attention to rice and potatoes as products that ensure high muscle glucose uptake and faster glycogen re-synthesis. Finally, physically active people should beware of consuming pasta and chips because they cause slower glucose blood release and muscle glucose uptake.

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GUIDELINES FOR THE AUTHORS / RULES OF PUBLISHING

- Journal *Health Problems of Civilization*

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“Health Problems of Civilization” is a scientific journal which is the continuation of the “Human and Health” (ISSN 2082-7288). The journal is issued exclusively in English and concerns various groups of subjects such as: biomedical aspects of health, modern diseases, physical activity, obesity, health-related behaviors. Some authors of particular articles are the acknowledged specialists in the field of medical sciences and physical culture sciences.

The mission of our journal is to popularize knowledge concerning people’s various health problems in the face of dynamic changes of modern life caused by civilization growth, industrialization, urbanization and environmental changes. Papers should be submitted to the Editorial Office on-line via: <http://www.editorialsystem.com/hpc/login/>

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- References.

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- Summary (150-200 words; in Polish and English, structured)
- Introduction
- Case description
- Conclusions
- References.

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- Key words (from the Medical Subject Headings [MeSH] catalogue of the Index Medicus; in Polish and English)
- Summary (150-250 words; in Polish and English)
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Journal issue with part number:

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obowiązki w sposób wyważony, obiektywny i sprawiedliwy, unikając dyskryminacji ze względu na płeć, orientację, religijne bądź polityczne poglądy, pochodzenie etniczne lub geograficzne autorów.

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