

PREVENTION AWARENESS: THE WAY TOWARDS A HEALTHY LIFESTYLE

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ABSTRACT — Background: Until recently, the notion of ageing was associated with older age, and only a few years ago new findings have come to light, shifting the start of ageing back to the age of late adulthood, and then gradually to younger age categories. At the same time, the possibility of prevention of main factors influencing the overall condition and independence of older people has been shown.

Objective/Purpose: The aim of the work is to ascertain the level of knowledge of various age groups of the population and possibilities for the prevention of older-age pathologies, to map certain lifestyle aspects of the current young generation, to provide groups of individuals from different age categories with information associated with this matter, to support the effectiveness of remembering through personal experience.

Material and methods: A diverse group of listeners (pupils, adolescents, adults, younger senior citizens) was familiarised with the subject through age-adapted lectures. Moreover, in order to address the diverse needs of the target population, we decided to use two primary distance learning dissemination channels, which have been accepted into mainstream education.

Results: A total of 1,463 probands from different age categories participated in the project. The results showed a low awareness of the necessity of lifelong prevention of atherosclerosis and osteoporosis, low levels of physical activity and short time spent outdoors among the project participants. Electronic support of the project outcomes was published in the form of a comprehensive e-learning course, and a web portal describing the prevention of older-age pathologies is available.

Conclusion: The education effectiveness was proved by the increase of correct answers immediately after the education, and after 2–3 months as well. The results confirmed our previous assumption of a low level of awareness among the population of the necessity of lifelong prevention of atherosclerosis and osteoporosis. Nevertheless, effectiveness of the education event was confirmed by an increase in the number of correct answers in tests performed immediately after the education.

INTRODUCTION

Until recently the notion of ageing was associated with older age, and only a few years ago new findings have come to light, shifting the start of ageing back to the age of late adulthood and then gradually to younger age categories. The fact that certain processes of tissue wear and damage develop from the adolescent and younger adult age is insufficiently well known to and accepted by the general public. The most significant long-term risk factors currently involve high blood pressure, high levels of fats and sugar in the blood, damage to and wear of joint cartilage, incorrect remodelling of bone tissue, loss of function

of muscles of the limbs and pelvic floor, and damage to nerve cells. Preventive measures usually involve certain restrictions and necessary activities different from the currently prevailing lifestyle, which typically involves surplus energy intake and low levels of activity. Increasing the awareness of these issues among different target groups, particularly the adolescents, and enhancing their motivation to adhere to principles of healthy lifestyle in the long term, proves to be a challenge. With the proper use of modern information and communication technologies for educational purposes, we are able to effectively disseminate these findings to the general public.

POSSIBILITIES OF PREVENTION

Metabolic syndrome

Avoiding metabolic syndrome, or the Kaplan's "deadly quartet", means avoiding its individual components, i.e. high blood pressure, high level of sugar in the blood stream, diabetes and obesity. In general terms, increased insulin resistance – i.e. the limited ability of cells to use insulin – is considered to be the basic pathogenic mechanism of the metabolic syndrome. Polygenic inheritance is presumed to be a possible cause; in the general population, however, insulin resistance is undoubtedly of secondary origin, most often caused by an excessive intake and a low output of energy, inappropriate composition of diet, stress, smoking, and certain medicines. The inability to utilise insulin leads to specific changes in the metabolism of lipids, i.e. higher peaks of serum lipid levels after food, retention of water and sodium, reduced ability to synthesise nitric oxide (NO), and activation of the sympathetic nervous system. The described process leads to an accumulated damage to the vascular epithelium and to the acceleration of atherosclerotic processes. It is nowadays known that the clinical correlate – i.e. visible atherosclerotic changes – can be already apparent in the second decade of life. Atherosclerosis affects an alarmingly large proportion of the population, and is the cause of 50% of deaths [1–4].

Osteoporosis and sarcopenia

Osteoporosis affects at least one third of men and a half of women in older age. Two thirds of women can expect the development of osteoporosis after an artificially induced menopause. Osteoporosis represents a serious medical problem resulting in a possible loss of independence after suffering an osteoporotic fracture, and it can also impact the person's social life. As regards prevention, the most important term is the so-called peak bone mass, which is generated in every individual up to the age of 30, and everyone then draws on this stockpile until the end of their life. The lower the generated reserve, the earlier osteoporosis develops. For the formation of bone mass, the level of activity and the intake of protein, calcium and vitamin D are decisive. In this area too, the current lifestyle of the population is very harmful: low levels of activity and less time spent outdoors results in a low exposure to sunlight, which is necessary for the conversion of provitamin D into active vitamin D in the skin. Under normal circumstances, this natural activation represents 80–90% of the body's vitamin D supply. In recent years, there have been repeated warnings of very low levels of vitamin D in all age categories in the countries of the temperate zone [5]. As regards the risk

of development of osteoporosis, individuals with lactose intolerance or with lactose malabsorption represent a very high-risk group due to their low intake of calcium and vitamin D. Incidence of these dysfunctions in the population has not yet been mapped precisely: not every patient with lactose resorption dysfunction has clinical symptoms, and not every patient with clinical symptoms of intolerance has an absorption dysfunction [6–10].

Incontinence

Currently, the most effective known method for the prevention of incontinence is an active maintenance of the muscle tone of the pelvic floor, preferably through a regular, targeted exercise starting after childbirth, and then from the fourth decade of life. But women very rarely stick to the exercises – not only before the first clinical problems arise, but even after they appear. However, data providing an estimate of incontinence in women above the age of 45 indicate that incontinence affects one in five of them, and that there is a significant upward trend [11,12].

Dementia

In the decades to come, the anticipated dementia epidemic will translate into a constant increase in the incidence of all forms of dementia, in particular Alzheimer's dementia (AD), and the numbers may even triple by 2050. At present, pharmacological intervention only improves clinical symptomology, and only if started in the earliest stage of dementia development. Prevention of possible risk factors of Alzheimer's dementia is therefore essential. Maximum possible physical activity and exercise, unless contraindicated, plays a fundamental role in the prevention of dementia. Intellectual activity and maintenance of social contacts as long as possible plays a similar role in the prevention of cognitive dysfunctions. A healthy lifestyle can influence the development of AD symptoms and slow them down, or even avert the process of progressive mental deterioration [13–17].

Depression

There is an increasing incidence of depression with increasing age: it is estimated that 15% of older people living in their homes and 30% of older people living in institutions suffer from depression. Results of our previous study performed in 2005–2012 among the Czech population of older people living in their homes confirmed that 18.5% of monitored older people suffered from depression. A negative inventory of life events – the most striking being retirement and the loss of social contacts, along with an increasing number of chronic illnesses and declining independence – has a significant impact on the incidence of depression in

older age. The seasonal nature of difficulties is also significant. Maintaining physical activity, targeted and timely finding of activities replacing employment activities, and last but not least, spending time outdoors (with regard to vitamin D supply), has a preventive effect [18–21].

Broad education considering composition of target population

The aim of our study was to ascertain the level of knowledge of various age groups of the population and possibilities for the prevention of older-age pathologies, to map out certain lifestyle aspects of the current young generation, to provide groups of individuals from different age categories with information associated with this matter, to support the effectiveness of remembering through personal experience, and to ascertain the level of remembering immediately after providing the information and later. Another aim in the case of the group of adolescents and younger adults was to help to develop a positive, humanistic approach of the younger generation to older people. In order to address the diverse needs and interests of the target population, we decided to use two primary distance learning dissemination channels, which have been accepted into the mainstream education: (i) a comprehensive e-learning course focused on the domain of geriatrics; (ii) a web-based portal covering selected topics of prevention in terms of ageing.

METHODS

The way in which the subject matter is presented should correspond to age of the audience. In the introduction of any education event, key terms must be defined. In this case, key terms involved peak bone age, bone architecture, bone construction, vitamin D, lifestyle, nutrition, ageing, the processes associated with ageing, etc. The explanation of the subject matter should be diverse and adapted to the individual. An active educational event should be supported by a factor constituting the conditions for permanent retention of the knowledge gained, for example a meaningful understanding, complemented with a practical illustration, active discussion or personal experience. We simulated the ankle stiffness by reinforced elbow and knee tapes, the hyperkyphosis of thoracic spine by vest with plastic construction and chest compressing belts, the muscle weakness by bracelets with weight. For simulation of sensoric deficits we used glasses with a restriction of the visual field and blurring and ear pads. We used cotton gloves to allow the experience of limited skin perception and its influence to take medications correctly – for example. Effectiveness of the learning process should be verified on an ongoing basis, preferably in the form of self-evaluation through a feedback questionnaire.

Pedagogical fundamentals of educational events

A group of 20–30 listeners was familiarised with the subject matter through age-adapted lectures. In total, more than 50 face-to-face sessions were organized across groups from different age categories in the South Moravian region. The lectures have been supported by the official project website together with e-learning course, which provide complete background including distance learning agenda describing the prevention of older-age pathologies. In case of pupils and adolescents, the lecture emphasized particularly osteoporosis and atherosclerosis; in case of adults and younger senior citizens, the lecture provided basic information about metabolic syndrome, dementia, depression, incontinence, and possibilities of prevention. Before the start of each lecture, the audience answered the following questionnaire associated with the given matter. Moreover, the practical part of educational activities (i.e. the experience) was realized via models of old age, which we developed as authors in cooperation with an external company, under the contractual arrangement provided by the Technology Transfer Office (TTO) of the Masaryk University.

1. What is osteoporosis?

- softening of the bones
- **thinning of the bones and increased brittleness of bones**
- increased bone density

2. From what age is it possible to influence the development of osteoporosis most effectively?

- **from 10–20 years of age**
- from 30–40 years of age
- from 50–60 years of age
- from 60–70 years of age

3. What function does calcium have in the human body?

- contraction of muscle fibre
- building of bones
- coagulability of blood
- **all of the above**

4. Which food is the richest in calcium?

- milk
- hard cheese
- **poppy seed**
- legumes

5. What is atherosclerosis?

- a disease causing cerebral stroke
- a disease causing heart attack
- a disease resulting in amputation of the leg
- a disease damaging the arterial epithelium
- **all of the above**

6. When does atherosclerosis start?

- from the age of 10
- from the age of 30
- from the age of 50
- from the age of 70

7. Smoking and atherosclerosis

- **smoking accelerates atherosclerosis**
- smoking slows down atherosclerosis
- smoking has no impact on the development of atherosclerosis

At the end of the lecture, the audience was invited to answer the same questions. Subsequently, the participants underwent training in the form of a competition/game using simulation models of ageing syndromes – hearing and sight dysfunctions, stiffening of the joints, curvature of the spine, reduction in hand sensitivity and dexterity. All participants were asked how much time they spend outdoors; levels of smoking were ascertained among students and adults. At the end of the lecture, students of the Faculty of Education were asked if they felt that they themselves had been influenced by the facts given in the lecture, and whether they would include the given matter in their future teaching. After two to three months, pupils of primary and secondary schools were asked to fill in questionnaires ascertaining the extent to which they had retained their knowledge, as well as changes in their attitude and behaviour since the time when the seminar was held. The results of testing were processed using the common methods of descriptive statistics and also using the McNemar's test and Fisher's exact test.

Theoretical fundamentals of e-learning strategy

The implementation of educational materials introducing the prevention requires an understanding of the impact of information and communication technology on the target population and on current teaching and learning practices in order to identify critical success factors that have to be addressed in an e-learning strategy [22]. The e-learning domain emphasises the role of the technology in providing content (information), delivery (access) and electronic services. We paid attention to educational issues such as the appropriate form of online instructional design and the creation of online learning communities. Based on that, we have implemented a modular online course in the local learning management system of the Masaryk University, meeting requirements and needs of the target audience. The course structure includes a plurality of structural elements and one or more relations that indicate dependence between individual structural elements. It defines a basic learning objective and serves the educational content with multimedia

files including a self-assessment agenda. The audience can freely visit the course of geriatrics without any access restrictions. In addition to e-learning, we designed and implemented a web-based portal, which combines a modern web design with static and interactive elements and provides a clear and crucial information about the prevention of main factors influencing the overall condition and independence of older people.

RESULTS

Educational events

A total of 1,463 participants followed the lecture (see Figure 1): the largest group (1,259 respondents) consisted of pupils of the final year of primary schools (PS) and pupils of secondary schools (SS), ranging from 12 to 18 years of age. Another group consisted of 69 students of the Faculty of Education (U), ranging from 20 to 26 years of age; the adult (employee) group included 78 respondents ranging from 27 to 55 years of age; and finally, the older age group consisted of 57 respondents ranging from 64 to 83 years of age. The representation of men and women in the individual categories varied, but over the entire set, the ratio was 41% men to 59% women. The evaluation of answers to the introductory test questions is shown in the Supplementary Table 1.

As expected, listening to the lecture had the greatest impact on the correctness of questions about the start of the first manifestations of atherosclerosis and the start of prevention of osteoporosis: the number of correct answers to these two questions increased by dozens of percent in all groups. The definition of osteoporosis did not represent a problem before the lecture in any group, apart from 16% of participants in the youngest age category. In contrast, less than a half of all participants in all age categories managed to choose the correct manifestations of atherosclerosis before the lecture; after the lecture, the number of correct answers had increased to a satisfying range of 57–86%. In order to verify the effect of the lecture and the comprehensibility of test questions in the youngest age category, i.e. in the group of pupils of primary and secondary schools, there was an evaluation of the type of change of question; the results are also shown in the Supplementary Table 1.

The short-term and long-term effectiveness of the lecture was evaluated through specific questions directed to individual age categories. Immediately after the lecture, students of the Faculty of Education were asked whether they felt they had been influenced by the provided information, whether they would change certain aspects of their lifestyle and whether they would include the newly acquired information in the teaching for their future pupils. Table 1 shows the distribution of answers.

TABLE 1. Evaluation of feedback provided by students of the Faculty of Education

Question	Yes	No
Did the lecture make you think about your own habits? N = 171	155 (90.6%)	16 (9.4%)
If the lecture made you think about your own habits, do you intend to change any of them? N = 155	126 (80.3%)	31 (19.7%)
Do you think that you will include a similar topic in the teaching of your future pupils? N = 147	141 (95.9%)	6 (4.1%)

TABLE 2. Number and percentage representation of correct answers before and after the lecture (according to groups)

Question	Lecture (N = 1463)	PS/SS ^{*,1}	p ²	U ¹	p ²	Employees	p ²	Seniors	p ²	Groups p ³
What is osteoporosis?	before	870 (74,9%)	<0,001	66 (97,1%)	0,500	70 (90,9%)	0,070	55 (96,5%)	1,000	<0,001
	after	976 (88,7%)		68 (100,0%)		75 (98,7%)		54 (96,4%)		<0,001
From what age is it possible to influence the development of osteoporosis most effectively?	before	337 (29,3%)	<0,001	40 (58,8%)	0,007	31 (40,8%)	<0,001	34 (61,8%)	0,001	0,002
	after	680 (62,4%)		53 (77,9%)		62 (80,5%)		50 (89,3%)		<0,001
What function does calcium have in the human body?	before	77 (6,6%)	<0,001	14 (20,6%)	0,219	6 (7,9%)	<0,001	4 (7,3%)	0,022	<0,001
	after	373 (35,6%)		18 (26,5%)		25 (32,9%)		13 (24,1%)		0,090
Which food has most calcium?	before	97 (8,2%)	<0,001	25 (36,8%)	<0,001	29 (38,2%)	<0,001	7 (12,7%)	<0,001	<0,001
	after	987 (86,8%)		65 (94,2%)		71 (93,4%)		48 (85,7%)		<0,001
What is arteriosclerosis?	before	189 (16,5%)	<0,001	28 (41,2%)	<0,001	27 (38,0%)	<0,001	27 (47,4%)	0,146	<0,001
	after	621 (57,5%)		53 (79,1%)		64 (86,5%)		31 (56,4%)		0,165
When does arteriosclerosis start?	before	151 (13,0%)	<0,001	16 (23,5%)	<0,001	8 (11,6%)	<0,001	11 (19,3%)	<0,001	0,108
	after	881 (79,9%)		62 (89,9%)		50 (67,6%)		43 (76,8%)		<0,001
Smoking and arteriosclerosis	before	940 (82,1%)	<0,001	69 (100,0%)	<0,001	65 (94,2%)	0,250	51 (92,7%)	0,250	0,010
	after	952 (92,9%)		66 (100,0%)		73 (98,6%)		55 (98,2%)		0,007

* Primary schools / secondary schools

¹ Total count and percentage representation² McNemar test³ Fischer exact test

TABLE 3. Feedback of influencing presented by the pupils of primary and secondary schools 2 to 3 months after listening to the lecture

Answer	Number of selection ¹ (N = 295)
The experience of simulating old age has helped me understand the process of ageing and older people in general	134 (45.4%)
I do at least 40 minutes of physical activity each day (recommendation of 10,000 steps each day = 7 km)	105 (35.6%)
I try to have a balanced energy intake – I do not overeat	91 (30.8%)
I pay attention to sun exposure in order to get enough vitamin D (at least 2 hours per week)	40 (13.6%)
Trying to make a change is pointless because “there is no cure for age”, as wise people say	28 (9.5%)
I was not interested by the activities because these are for old people and have nothing to do with me	18 (6.1%)

¹ Total count and percentage representation, multiple choice form

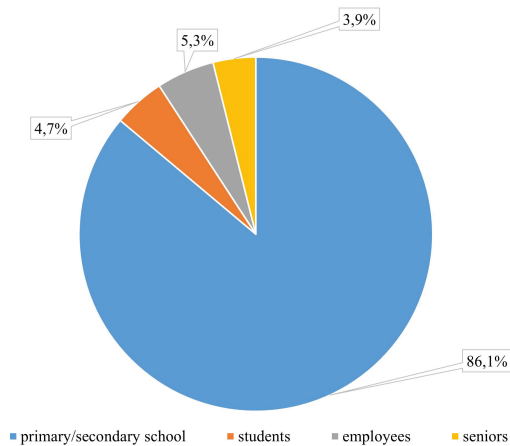


FIGURE 1. The distribution of target audience

Two to three months after the lecture, one quarter of the participants of the youngest age category ($N = 299$) were called on to answer the same questions as they were given before the lecture and immediately after, in order to ascertain the long-term effect of the educational event. Table 2 shows principal results of the study. Figure 2 shows the distribution of number of correct answers. Unfortunately, we are not able to link data from questionnaires before lectures and after 2 to 3 months, so the results are not shown for the same group of participants (n value is different).

In addition, this group of pupils from primary and secondary school filled in questionnaires ascertaining the level of their experienced influence in the area of lifestyle, intergenerational coexistence, and the overall view of the issue of ageing 2 to 3 months after listening to the lecture. Table 3 shows the distribution of answers.

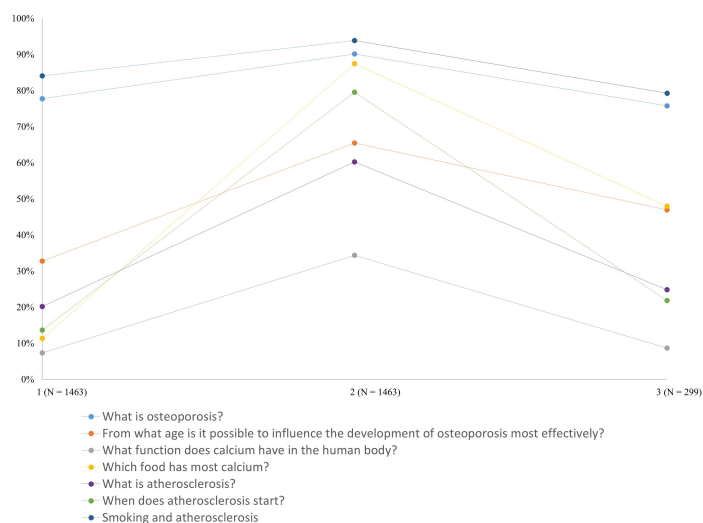


FIGURE 2. Representation of correct answers before lecture (1), immediately after lecture (2) and after 2 to 3 months (3)

E-learning

A sophisticated e-learning course on geriatrics [23] was developed within the presented project, in order to meet the target of making the information available for the largest target group possible. Publishing this reviewed e-learning course on the educational portal MEFANET [24] guaranteed that the project would make an impact far beyond the Masaryk University. The MEFANET platform makes it possible for students and teachers across all medical faculties in the Czech Republic and Slovakia to share educational materials easily and clearly, based on the horizontal accessibility and without any limitations. Apart from students, individuals from the general public can take the course at any time; the only limitation is the absence of tutor during their study. The course itself provides comprehensive information on selected chapters from geriatrics, based on an appropriately chosen combination of static educational texts, continuous testing, and multimedia elements. Figure 3 shows the interactive synopsis of one part of the course, which deals with the issue of sarcopenia, i.e. the loss of muscle tissue.

A web portal developed by the Department of Internal Medicine, Geriatrics and Practical Medicine (DIMGPL) [25] is available for individuals from general public who look for information on preventive measures (see Figure 4). Several dedicated chapters to key areas of prevention and healthy ageing are available for the public. Apart from texts, the portal also involves a set of educational presentations, which are available in the regimen of interactive viewing directly in the web browser, including the option of downloading or printing the material. Last but not least, the portal also involves photo galleries from educational events in individual schools.

The monitoring tool Google Analytics was integrated at the time of portal launch in order to evaluate the number of visits. This tool makes it possible to monitor the behaviour of users. It is a free service offered by Google that generates detailed statistics about the visits to a website; this user-friendly application is provided with the guarantee of Google technology. Due to the fact that monitoring was integrated on the portal, measurements of up-to-date statistics, reports and analyses based on the traffic and visitor's behavior are available. Figure 5 demonstrates the latest summary, where audience behavior is reported.

DISCUSSION

Even before listening to the lecture, participants of the educational event knew the definition of atherosclerosis and osteoporosis quite well, but they were unaware of the existence of the practically lifelong influencing of the start and rate of development of both of these diseases of ageing. The start of prevention of osteoporosis and the start of manifestations of atherosclerosis were the two questions where the performance of the education event resulted in the greatest increase in the number of correct answers; in the case of the youngest group, they were also the best results during the test taken 2 to 3 months later.

A question arises as to the appropriateness of topic for the selected age group of the youngest age category. For individuals around the age of 15, the matter of osteoporosis, affecting most frequently the generation of their grandmothers and most probably great grandmothers, obviously appears totally irrelevant and uninteresting. As a result, great emphasis was placed on a detailed explanation of the term peak bone mass, and on influencing of its formation in a sufficient quality, with reference to lifestyle of the current generation of adolescents and from the aspect of the level of activity and remaining outdoors. In an attempt to make this information more interesting and longer retained in the pupils' memory, the educational event was supported by a model simulating the gradual curving of the spine. In addition to the higher number of correct answers, the success of influencing was expressed by the fact that in their feedback after 2 to 3 months; one third of adolescents stated that they tried to stay outdoors for at least 40 minutes and adhere to the recommended level of activity.

From the aspect of influencing the attitudes of the group of students of the Faculty of Education, it was surprising that they expressed a good level of knowledge even before the educational event; they admitted that they thought about their lifestyle, that they would almost certainly include this topic in the teaching of their future pupils, but a far smaller percentage were planning to change their own lifestyle (although still four out of five). We can confirm the following good

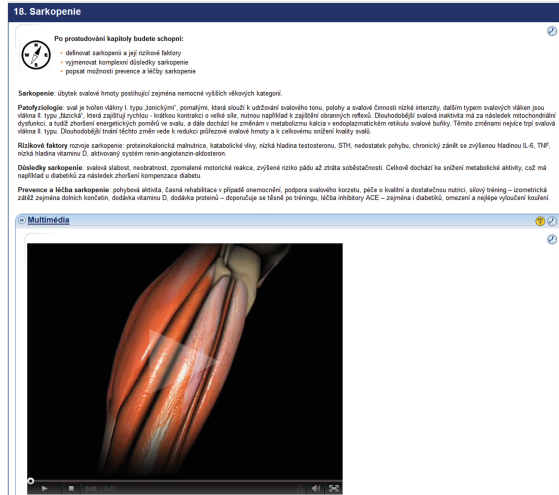


FIGURE 3. Geriatrics course interactive syllabus



FIGURE 4. Homepage of the project portal (www.starneme-uspesne.cz)

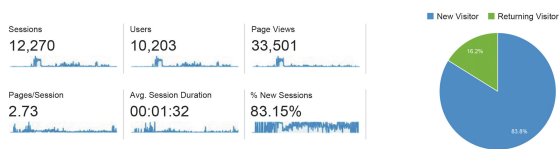


FIGURE 5. Google Analytics overview (from 1 July 2014 to 22 March 2016)

results of the education accompanied with experience: almost half participants of the youngest age group reported a better understanding to older people 2-3 months after the educational event; almost one third of the same group attempted to increase their activity level; and the same proportion realised that it was necessary to keep their energy intake under control. In the youngest age category, the percentage of those who did not understand or did not want to understand the purpose of the education event did not exceed 10%.

CONCLUSIONS

In the above-mentioned dissemination of the basic project objectives as regards the prevention of osteoporosis, sarcopenia or atherosclerosis, we used well-established methods based on educational seminars, accompanied by a public availability of supporting materials on the internet. On top of that, we developed an elaborated e-learning course, which guides the user through the basic issues related to the ageing process. We have used and progressively modified two prototypes models of old age in practice, now available for purchase. The quality of processing of the simulation sets is confirmed by the number of uses by the probands, which exceeded 1,500 cycles in a total of eight sets, without any signs of significant wear, and still functioning properly.

We can conclude our work with the following statements: (i) we confirmed the assumption of a low level of awareness among the population of the necessity of lifelong prevention of atherosclerosis and osteoporosis; (ii) the effectiveness of the educational event was confirmed by an increase in the number of correct answers in tests just after the educational event had finished; (iii) the retention of important information, albeit to a lesser extent, was confirmed by testing 2 to 3 months later; (iv) the positive influence on attitudes and behaviour due to the educational event with experience was evident in the group of pupils from primary and secondary schools, and in the group of students of the Faculty of Education.

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SUPPLEMENTARY MATERIAL

SUPPLEMENTARY TABLE 1. Statistics of correct answers (type of change) before and after lecture in the group of pupils of primary and secondary schools

Question	Incorrect before and correct after the lecture ¹	Correct before and correct after the lecture ¹	Incorrect before and incorrect after the lecture ¹	Correct before and incorrect after the lecture ¹
What is osteoporosis?	211 (16,8%)	924 (73,7%)	69 (5,5%)	49 (3,9%)
From what age is it possible to influence the development of osteoporosis most effectively?	463 (37,6%)	342 (27,8%)	365 (29,7%)	61 (5,0%)
What function does calcium have in the human body?	330 (27,3%)	73 (6,0%)	786 (65,1%)	19 (1,6%)
Which food has most calcium?	1010 (77,2%)	135 (10,3%)	159 (12,1%)	5 (0,4%)
What is arteriosclerosis?	518 (42,3%)	220 (18,0%)	450 (36,8%)	36 (2,9%)
When does arteriosclerosis start?	845 (66,9%)	156 (12,4%)	246 (19,5%)	16 (1,3%)
Smoking and arteriosclerosis	133 (11,3%)	970 (82,3%)	50 (4,2%)	25 (2,1%)

¹ Total count and percentage representation (N = 1463)

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