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From the Editors

Numerous epidemiological studies prove that properly dosed physical activity reduces the risk of civilization diseases, including hypokinetic diseases, such as cardiovascular and respiratory diseases, disorders of muscular and osteoarticular systems, type 2 diabetes, some types of cancer and many others. It should be also added that physical activity becomes an important means of therapy to cure the abovementioned diseases. Undertaking the pro-health frequency and intensity of physical activity at different age stages is necessary for the effective prevention and therapy. That is why it is emphasised that physical effort nowadays is not a matter of choice but a biological imperative.

Our journal "Human and Health" was created in 2010 and since 2014, it has been published as "Health Problems of Civilization". The scientific scope of the journal covers exactly the role of physical activity in the modern lifestyle of people. To acknowledge this fact, in 2018 the title of the journal was extended to "Health Problems of Civilization. Physical activity: diseases and issues recognised by the WHO". In effect, there have been numerous articles published in our journal by foreign authors. In this issue, there are the articles written by the authors from the following countries: Belgium, Croatia, the Czech Republic, Denmark, Hungary, Portugal, Serbia, Slovakia, Turkey and Ukraine.

A couple years of indexing the journal in ESCI have exerted a beneficial influence on the visibility of the published articles. The citation number of the articles from "Health Problems of Civilization" in Web of Science is increasing annually and equals 44 citations in 2018.

Editor-in-Chief
professor Józef Bergier

Od Redakcji

Liczne badania epidemiologiczne dokumentują, że odpowiednio dozowany wysiłek fizyczny redukuje ryzyko zapadalności na choroby cywilizacyjne, w tym hipokinetyczne, takie jak schorzenia układu krążeniowo-oddechowego, mięśniowego, kostno-stawowego, cukrzycy typu II, niektóre nowotwory i wiele innych. Dodać należy równocześnie, iż wysiłek fizyczny staje się ważnym środkiem terapii w tych chorobach. Warunkiem skuteczności działań profilaktycznych i terapeutycznych jest podejmowanie aktywności fizycznej o prozdrowotnych parametrach wysiłkowych odpowiednio często na różnych etapach wieku. Z tego powodu podkreśla się, że wysiłek fizyczny nie jest dziś dla człowieka kwestią swobodnego wyboru, lecz biologicznym nakazem.

Nasze czasopismo pt. „Human and Health” powstało w 2010 roku (pod nazwą „Health Problems of Civilization” od 2014). W swojej działalności naukowej podejmuje właśnie rolę aktywności fizycznej we współczesnym stylu życia pokoleń. Potwierdzeniem tego faktu jest rozwiniecie tytułu „Health Problems of Civilization” w 2018 roku o „Physical activity: diseases and issues recognised by the WHO”. Efektem tych prac są artykuły wielu gości z zagranicy. W bieżącym numerze: autorzy z Belgii, Chorwacji, Czech, Danii, Portugalii, Serbii, Słowacji, Turcji, Ukrainy i Węgier.

Kilkuletnie indeksowanie czasopisma w ESCI korzystnie wpływa na widoczność publikowanych w nim prac. Cytowania artykułów „Health Problems of Civilization” w bazie Web of Science wzrastają rok do roku i w 2018 ich ilość wynosi 44.

Redaktor Naczelny
prof. zw. dr hab. Józef Bergier

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

GLOBAL PHYSICAL ACTIVITY QUESTIONNAIRE (GPAQ)
– THE POLISH VERSION

GLOBALNY KWESTIONARIUSZ AKTYWNOŚCI FIZYCZNEJ (GPAQ)
– WERSJA POLSKA

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zaplanowanie badań
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zebranie danych
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D. Data interpretation
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Summary

The increasingly appreciated role of physical activity in societies concerned about their health requires proper assessment. The main tools for measuring the level of physical activity comprise some relevant questionnaires, among which the best known in the foreign literature is Global Physical Activity Questionnaire (GPAQ). However, this questionnaire is not yet available in the Polish language version. The following article presents one such attempt that has taken into account the Polish conditions and lifestyle following the guidelines of the GPAQ Guide, which meets the recommendations of the World Health Organization (WHO). The source text was translated into Polish and then a reverse translation was made involving four steps.

Keywords: GPAQ, the Polish version, physical activity

Streszczenie

Powszechnie doceniana rola aktywności fizycznej społeczeństw w trosce o ich zdrowie wymaga odpowiedniej oceny. Głównymi narzędziami do pomiaru poziomu aktywności fizycznej są nadal odpowiednie kwestionariusze. Swoje miejsce w literaturze zagranicznej posiada Globalny Kwestionariusz Aktywności Fizycznej (GPAQ). Kwestionariusz ten nie jest dotychczas dostępny w wersji polskojęzycznej. Takiego opracowania dokonano w niniejszym artykule, zgodnie z zaleceniami Światowej Organizacji Zdrowia (WHO), uwzględniając dostosowanie do warunków polskich i stylu życia, zgodnie z wytycznymi Przewodnika GPAQ. Tekst źródłowy przetłumaczono na język polski, a następnie dokonano tłumaczenia zwrotnego z uwzględnieniem czterech kroków postępowania.

Słowa kluczowe: GPAQ, wersja polska, aktywność fizyczna

Introduction

The policy of increasing the level of daily, weekly and possibly all-year-round physical activity becomes a vital challenge in the care on human health at all stages of life [1]. Still, the most commonly used methodology to determine it are questionnaires, which is probably due to their high availability.

It is estimated that European residents get involved in physical activity rather irregularly [2]. Meanwhile, the optimal level of physical activity is the prerequisite for maintaining adequate health [3]. The European Commission in its questionnaire concerning health regards physical activity as one of its main determinants, as indicated by the WHO [4].

In the first period when physical activity was tested in the European Union Member States, a short

Wstęp

Polityka zwiększenia poziomu codziennej, tygodniowej i możliwie całorocznej aktywności fizycznej, staje się ważnym wyzwaniem w trosce o nasze zdrowie na wszystkich etapach (okresach) życia [1]. Z wielu sposobów jej określenia wciąż najpowszechniej stosowane są kwestionariusze, zapewne z powodu dużej dostępności do jej oceny.

Szacuje się, że duża grupa mieszkańców Europy podejmuje nieregularnie aktywność fizyczną [2]. Tymczasem warunkiem utrzymania odpowiedniego zdrowia jest optymalny poziom aktywności fizycznej [3]. Komisja Europejska w ankiecie dotyczącej zdrowia ujmuje aktywność fizyczną jako jedną z głównych determinantów zdrowia wg WHO [4]. W pierwszym okresie badania aktywności fizycznej w państwach

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version of IPAQ (the International Physical Activity Questionnaire) was used - IPAQ, STEPwise Approach to Chronic Disease Risk Factor Surveillance - STEPS) [3]. Also, in Poland, the most popular questionnaires examining physical activity are the IPAQ ones, both their short and extended versions, which have been adapted to the Polish conditions in 2007 by the Biernat team [5].

Another widely-applied worldwide questionnaire examining the level of physical activity is the Global Physical Activity Questionnaire (GPAQ), still unavailable in the Polish-language version. This questionnaire was developed by the WHO in 2002 to monitor the physical activity of populations in various countries of the world [6, 7]. The GPAQ questionnaire is a synthetic combination of the short and extended versions of the IPAQ. On the one hand, unlike the short version of the questionnaire, the IPAQ concerns various domains (work-related, transportation or leisure time activities) and, on the other, unlike the extended version of IPAQ, it is much shorter, covering only 16 items in contrast to the IPAQ's 27. In addition to physical activity, the GPAQ questionnaire, like the IPAQ, also assesses the time of sitting or reclining.

The above-described questionnaire has already been used in over 100 countries, mainly under the STEPS programme. For example, the research involving the GPAQ questionnaire was conducted on the continents of Asia, Africa and America [6], as well as selected European countries [8, 9]. Initially, the GPAQ survey was developed in a way that allowed the trained personnel to conduct their study through a direct interview technique, thus including illiterate respondents. For this purpose, there had been prepared some cards with drawings illustrating different activities.

Methodology

The following article aims to present the Polish version of the GPAQ. The authors of the work have prepared the Polish version of the GPAQ following the WHO recommendations and adapting the tool to the Polish conditions and their unique lifestyle. It should be remembered that the Polish practice of having respondents fulfil the International Physical Activity Questionnaire on their own results in their overestimating the time and intensity of efforts [10]. In the GPAQ questionnaire, as in the IPAQ [11], only physical activity lasting a minimum of 10 minutes is taken into account, because only such an effort brings noticeable health benefits. On the other hand, there is an underestimation of the time spent sitting and reclining, which requires additional explanations during the research concerning, for example, time spent while sitting at work [9].

członkowskich Unii Europejskiej przeprowadzono za pomocą krótkiej wersji IPAQ (International Physical Activity Questionnaire - IPAQ, STEPwise Approach to Chronic Disease Risk Factor Surveillance - STEPS) [3].

Najbardziej popularnymi kwestionariuszami badającymi aktywność fizyczną w Polsce są kwestionariusze IPAQ, zarówno krótka jak i długa wersja, które zostały dostosowane do warunków Polskich w 2007 r. przez zespół Biernat [5].

Innym popularnym na całym świecie kwestionariuszem badającym poziom aktywności fizycznej jest niedostępny do chwili obecnej w polskojęzycznej wersji Globalny Kwestionariusz Aktywności Fizycznej (GPAQ). Kwestionariusz ten został opracowany przez WHO w 2002 roku w celu monitorowania aktywności fizycznej populacji w różnych krajach świata [6, 7]. Kwestionariusz GPAQ stanowi syntetyczne połączenie krótkiej i długiej wersji kwestionariusza IPAQ. Z jednej strony, w odróżnieniu od krótkiej wersji kwestionariusza IPAQ, dotyczy różnych domen (praca, przemieszczanie się, czas wolny), natomiast w odróżnieniu od długiej wersji IPAQ jest dużo krótszy, obejmując tylko 16 pozycji, a nie tak jak IPAQ 27. Poza aktywnością fizyczną kwestionariusz GPAQ podobnie jak IPAQ ocenia również czas siedzenia lub odpoczynku w pozycji leżącej.

Omawiany kwestionariusz był wykorzystywany już w ponad 100 krajach, głównie w ramach programu STEPS. Badania przy pomocy kwestionariusza GPAQ prowadzone były na kontynentach Azji, Afryki i Ameryki [6], oraz wybranych krajach Europy [8, 9]. Początkowo kwestionariusz GPAQ został opracowany w sposób umożliwiający przeprowadzanie badania przez wyszkolony personel, techniką wywiadu bezpośredniego, również z respondentami niepiśmienymi. Do tego celu przygotowane zostały przykłady na kartach w postaci rysunków.

Metodologia

Celem niniejszej pracy jest przygotowanie polskiej wersji GPAQ. Polska wersja GPAQ została przygotowana przez autorów tej pracy, zgodnie z zaleceniami WHO uwzględniając dostosowanie do warunków polskich i specyfiki stylu życia. Należy pamiętać, że polskie doświadczenia z samodzielnego wypełniania Międzynarodowego Kwestionariusza Aktywności Fizycznej wskazuje na przeszacowanie czasu i intensywności wykonywanych wysiłków [10]. W kwestionariuszu GPAQ, podobnie jak w IPAQ [11], bierze się pod uwagę tylko aktywność fizyczną trwająca bez przerwy minimum 10 minut, gdyż tylko takie wysiłki przynoszą zauważalne korzyści dla zdrowia. Odnotowuje się natomiast niedoszacowanie czasu spędzanego siedząc, dlatego potrzebne są dodatkowe wyjaśnienia w trakcie badań dotyczące np. czasu spędzonego siedząc w trakcie pracy zawodowej [9].

Adapting the GPAQ questionnaire to the Polish conditions

The process aimed at obtaining the Polish language version of the English-language GPAQ questionnaire. The objective of the adaptation of the tool was creating a questionnaire that would not be translated literally but one regarded as a meaningful and natural survey for Poles. The source text was translated into Polish and then a reverse translation was made including the following steps:

1. Translation from English to Polish by a native speaker of Polish with a very good command of English, including knowledge of the terminology in the area covering the translation with an emphasis on conceptual translation, not a literal one.
2. A bilingual panel of experts (of English and Polish). The stage aimed at finding and correcting inappropriate expressions / concepts of the translation. The process resulted in creating a translated version of the questionnaire.
3. Reverse translation. The questionnaire was translated back into English by an independent translator whose native language is English and who has a very good knowledge of Polish. The translation discrepancies have been discussed by a bilingual panel of experts.
4. Initial tests. After the completion of the translation process, the questionnaire was used in a group of 10 people by applying a direct interview technique in order to check whether the translated terms and phrases employed in the questionnaire are understandable for the representatives of the target research group.

Description of the questionnaire

The global GPAQ activity questionnaire consists of four independent parts, containing 16 questions. The questions refer to the time devoted to physical activity lasting a minimum of 10-minute continuous effort in the respondent's typical week. The first three parts of the questionnaire concern the domains of work-related activity, transportation activity and recreational activity. In the fourth part, there is a question concerning the time spent sitting or reclining at work, at home, while moving around or during social events. Respondents answering particular questions about their activity choose the level of its intensity disregarding the number of days in a typical week or the number of minutes on a typical day. There are two types to choose from: vigorous-intensity activities (i.e. the ones requiring

Przebieg prac adaptacyjnych kwestionariusza GPAQ do polskich warunków

Celem tego procesu było uzyskanie polskiej wersji językowej angielskojęzycznego kwestionariusza GPAQ. Przystosowanie narzędzia miało na celu zgodność z założeniami WHO stworzyć kwestionariusz, który nie będzie dosłownie tłumaczony, lecz w sposób zrozumiały i naturalny dla Polaków. Tekst źródłowy przetłumaczono na język polski, a następnie dokonano tłumaczenia zwrotnego w następujących krokach:

1. Tłumaczenie z języka angielskiego na język polski przez osobę, której językiem ojczystym jest język polski i posiada bardzo dobrą znajomość języka angielskiego, w tym znajomość terminologii obszaru objętego tłumaczeniem, kładącą nacisk na tłumaczenia pojęciowe, a nie dosłowne.
2. Dwujęzyczny panel ekspertów (w języku angielskim i języku polskim). Celem tego etapu było znalezienie i poprawienie nieodpowiednich wyrażen/koncepcji tłumaczenia. W wyniku tego procesu powstała przetłumaczona wersja kwestionariusza.
3. Tłumaczenie zwrotne. Kwestionariusz został przetłumaczony z powrotem na język angielski przez niezależnego tłumacza, którego językiem ojczystym jest język angielski i posiada bardzo dobrą znajomość języka polskiego. Rozbieżności tłumaczeniowe zostały omówione przez dwujęzyczny panel ekspertów.
4. Wstępne testy. Po zakończonym procesie tłumaczenia kwestionariusz został skierowany techniką wywiadu bezpośredniego do grupy 10 osób w celu sprawdzenia, czy zastosowane w kwestionariuszu przetłumaczone terminy i wyrażenia są zrozumiałe dla przedstawicieli docelowej grupy badawczej.

Opis kwestionariusza

Kwestionariusz globalnej aktywności GPAQ składa się z czterech niezależnych części zawierających 16 pytań. Pytania dotyczą czasu poświęconego na aktywność fizyczną trwającą minimum 10 minut bez przerwy w ciągu typowego dla respondenta tygodnia. Pierwsze trzy części kwestionariusza obejmują aktywność w pracy, aktywność w przemieszczaniu się oraz aktywność rekreacyjną. W czwartej części zadane jest jedno pytanie o czas spędzony na siedzeniu lub odpoczynku w pozycji leżącej w pracy, w domu, w trakcie przemieszczania się, lub przy okazji spotkań towarzyskich. Respondenci odpowiadając na poszczególne pytania dotyczące ich aktywności poza ilością dni w typowym tygodniu oraz ilością minut w typowym dniu wybierają poziom intensywności. Do wyboru są dwa rodzaje: czynności o dużej intensywności (czyli czynności wymagające dużego wy-

high physical effort, causing a significant increase in breathing or heart rate) and moderate-intensity activities (the ones requiring moderate physical effort, resulting in small increase of breathing or heart rate). The first part (questions 1-6) concerns work-related physical activity, agricultural activities, household chores, social work, education and any other paid or unpaid work undertaken at home or outside. This part of the question concerns two intensity levels: vigorous and moderate. The second part (questions 7-9) relates to the domain of transportation. In this part, one should disregard the time devoted to physical activity at work, as this information was included in the first tested domain. This part involves transportation-related activities in a typical week, e.g. travel to and from work, while shopping, going to church, etc. Further, the questions of this domain apply only to walking and cycling for at least 10 minutes continuously. In this part, the intensity levels of effort are not considered. The third part (questions 10-15) concerns activities undertaken in leisure time involving recreational, fitness and sports purposes, excluding at the same time the activities mentioned in the two previous parts. In this domain, as in the case of the first one, there are two intensity levels to choose from (vigorous intensity and moderate intensity). Part four (question 16) refers to sedentary behaviour. In this part, one should sum up the average amount of time during the day spent sitting or reclining, both at work, home or while to and from places. Sitting behind a desk, on a bench, sitting with friends, driving a car, bus, train, reading, eating meals, watching TV, etc. should also be taken into account

siłku fizycznego, powodujące znaczne przyspieszenie oddechu i bicia serca) oraz czynności o umiarkowanej intensywności (czynności wymagające umiarkowanego wysiłku fizycznego, powodujące małe przyspieszenia oddechu i bicia serca). Pierwsza część (pytania 1-6) dotyczy aktywności fizycznej w trakcie pracy, w rolnictwie, w obowiązkach domowych, pracach społecznych, nauki i każdej innej płatnej lub nieodpłatnej pracy podejmowanej w domu lub poza domem. W tej części pytania dotyczą dwóch poziomów intensywności: dużej oraz umiarkowanej. Druga część (pytania 7-9) dotyczy aktywności w domenie przemieszczania się. W tej części należy pominąć czas poświęcony na aktywność fizyczną w pracy, o której była mowa w pierwszej domenie. Ta część obejmuje czynności związane z przemieszczaniem się w typowym tygodniu np. do pracy, na zakupy, do kościoła itp. Pytania tej domeny dotyczą wyłącznie chodzenia oraz jazdy rowerem przez co najmniej 10 minut bez przerwy. W tej części nie są rozpatrywane poziomy intensywności wysiłków. Trzecia część (pytania 10-15) dotyczy aktywności podejmowanych w czasie wolnym dla celów rekreacyjnych, fitnessowych, sportowych, przy wykluczeniu czynności, o których była mowa w dwóch wcześniejszych częściach. W tej domenie, podobnie jak w przypadku części pierwszej, pytania dotyczą dwóch poziomów intensywności (dużej intensywności oraz intensywności umiarkowanej). Część czwarta (pytanie 16) dotyczy czasu spędzonego siedząc. W tej części należy zsumować średnią ilość czasu w ciągu dnia na siedzenie lub odpoczynek w pozycji leżącej, w pracy, w domu oraz w trakcie przemieszczania się. Należy uwzględnić siedzenie za biurkiem, w ławce, siedzenie ze znajomymi, przyjaciółmi, jazdę samochodem, autobusem, pociągiem, czytanie, jedzenie posiłków, oglądanie telewizji itp.

Calculating and clearing the data on physical activity

When preparing the data for calculations, all cases exceeding 16 hours of activity in one day or exceeding 7 days a week should be removed, as indicated by the guidelines of the GPAQ Guide. The following MET metabolic equivalent values are used to calculate the total energy expenditure of a person using the GPAQ questionnaire data:

Table 1. Metabolic Equivalent of Task - MET
Tabela 1. Równoważnik metaboliczny - MET

Domain/ Domena	Intensity level/ Poziom intensywności	MET value/ Wartość MET
Work/ Praca	<ul style="list-style-type: none"> Moderate/ Umiarkowany Vigorous/ Duży 	4.0 8.0
Transportation/ Przemieszczanie się	<ul style="list-style-type: none"> Cycling and walking/ Jazda na rowerze i chodzenie 	4.0
Recreation/ Rekreacja	<ul style="list-style-type: none"> Moderate/ Umiarkowany Vigorous/ Duży 	4.0 8.0

Obliczenia i czyszczenie danych dotyczących aktywności fizycznej

W trakcie przygotowania danych do obliczeń należy, zgodnie z wytycznymi Przewodnika GPAQ, usunąć przypadki przekraczające 16 godzin aktywności w przeciągu jednego dnia lub przekraczające 7 dni w tygodniu. Do obliczenia całkowitego wydatku energetycznego danej osoby za pomocą danych kwestionariusza GPAQ stosuje się następujące wartości równoważnika metabolicznego MET:

MET is commonly used to express the intensity of physical activity. It is the ratio between a person's metabolic rate during a specific effort to a particular reference in the metabolic index at rest. One MET is defined as energy expenditure during quiet sitting, and it is equivalent to the consumption of calories 1 kcal / kg / hour (a value assumed for a statistical adult – mean age 40, mean body weight 70 kg).

WHO recommendations for a pro-health dose of physical activity

According to the recommendations of the WHO and taking into account all domains under consideration (activity at work, traveling to and from places and leisure time activity time), adults should demonstrate at least:

- 150 minutes of moderate-intensity physical activity or
- 75 minutes of vigorous-intensity physical activity or
- the sum of physical activity of moderate- and vigorous-intensity activity, reaching at least 600 MET minutes.

Conclusions

The former experience of the authors researching physical activity shows that the best form of conducting studies is an interview carried out by very well trained interviewers. This is also recommended in the case of the Polish version of the GPAQ. Special instruction is also needed so that attention is drawn to understanding the questions. One should verify the responses regarding the amount of time in each domain exceeding four hours a day, except for sitting. Considering the fact that physical activity is seasonal and specific to residents of different countries, the most favourable time for conducting research in Poland is October and November, as well as March, as indicated in the Polish version of the IPAQ [4].

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MET jest powszechnie stosowany do wyrażenia intensywności aktywności fizycznej. Stanowi on stosunek pomiędzy wskaźnikiem metabolicznym danej osoby podczas wysiłku, a wskaźnikiem metabolicznym w spoczynku. Jeden MET definiuje się jako wydatek energetyczny podczas spokojnego siedzenia i jest on równoważny zużyciu kalorii 1 kcal/kg/godzinę (wartość przyjmowana dla statystycznej osoby dorosłej – średni wiek 40 lat, średnia masa ciała 70 kg).

Zalecenia WHO dotyczące prozdrowotnej dawki aktywności fizycznej

Według zaleceń WHO w ciągu jednego tygodnia osoby dorosłe powinny wykazać się, przy uwzględnieniu wszystkich rozpatrywanych domen (aktywności w pracy, podczas przemieszczania się i w czasie wolnym), przynajmniej:

- 150 minutami aktywności fizycznej o umiarkowanej intensywności lub
- 75 minutami aktywności fizycznej o dużej intensywności lub
- sumą aktywności fizycznej o umiarkowanej i dużej intensywności aktywności, uzyskując przynajmniej 600 MET minut.

Podsumowanie

Dotychczasowe doświadczenia autorów badań nad aktywnością fizyczną pokazują, że najlepszą formą ich przeprowadzenia powinien być wywiad z udziałem bardzo dobrze przeszkolonych ankietatorów. Takie zalecenia przedkładamy także dla polskiej wersji GPAQ. Potrzebna jest także specjalna instrukcja, w której zwraca się uwagę na zrozumienie pytań. Należy zweryfikować odpowiedzi dotyczące ilości czasu w każdej z domen, poza siedzeniem, przekraczające cztery godziny dziennie. Biorąc pod uwagę, że aktywność fizyczna ma charakter sezonowy, który jest specyficzny dla mieszkańców różnych państw, termin w miesiącach październik i listopad oraz marzec jest najbardziej korzystny do badań w Polsce idąc za argumentacją polskiej wersji IPAQ [4].

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Appendix / Załącznik

Globalny Kwestionariusz Aktywności Fizycznej

Wielostopniowy system monitorowania czynników ryzyka przewlekłych chorób niezakaźnych



Surveillance and Population-Based Prevention
Prevention of Noncommunicable Diseases Department
World Health Organization
20 Avenue Appia, 1211 Geneva 27, Switzerland
For further information: www.who.int/chp/steps

Aktywność Fizyczna			
<p>Chcemy spytać Pana/nią o czas spędzany na różnego typu fizycznej aktywności w ciągu typowego tygodnia. Prosimy, aby odpowiedział/a Pan/i, nawet jeśli nie uważa się Pan/i za osobę aktywną fizycznie.</p> <p>Najpierw proszę pomyśleć o czasie poświęconym na pracę. Proszę pomyśleć o pracy jako czynnościach, które ma Pan/i do wykonania, pracując płatnie lub nieodpłatnie – praca zawodowa, studia/nauka, obowiązki domowe, prace w rolnictwie, ogrodzie oraz wszystkie inne prace podejmowane w domu lub poza domem.</p> <p>Odpowiadając na poniższe pytania, proszę przyjąć, że: „czynności o dużej intensywności” to czynności wymagające dużego wysiłku fizycznego, powodujące znaczne przyśpieszenie oddechu i bicia serca; „czynności o umiarkowanej intensywności” to czynności wymagające umiarkowanego fizycznego wysiłku, powodujące małe przyśpieszenie oddechu i bicia serca.</p>			
Pytania		Odpowiedź	Kod
Aktywność w pracy			
1	Czy Pana/i praca wymaga czynności o dużej intensywności, powodującej znaczne przyśpieszenie oddechu i bicia serca [jak np. noszenie lub dźwiganie ciężkich ładunków, kopanie lub roboty budowlane] przez co najmniej 10 minut bez przerwy? [PODAJ PRZYKŁADY] (UŻYJ KART INFORMACYJNYCH)	Tak 1 Nie 2 Jeśli nie, przejdź do P4	P1
2	W ilu dniach, w typowym tygodniu wykonuje Pan/i czynności o dużej intensywności, jako część swojej pracy?	Liczba dni <input type="text"/>	P2
3	Ile czasu w typowym dniu pracy spędza Pan/i na wykonywaniu czynności o dużej intensywności?	Godziny : minuty <input type="text"/> : <input type="text"/> godz. min.	P3 (a-b)
4	Czy Pana/i praca wymaga czynności o umiarkowanej intensywności, powodujących małe przyśpieszenie oddechu i bicia serca, takich jak szybki spacer [lub przenoszenie lekkich ładunków] przez co najmniej 10 minut bez przerwy?	Tak 1 Nie 2 Jeśli nie, przejdź do P 7	P4

5	W typowym tygodniu, w ilu dniach wykonuje Pan/i czynności o umiarkowanej intensywności, jako część swojej pracy?	Liczba dni	___	P5
6	W typowym dniu pracy, ile czasu spędza Pan/i na wykonywaniu czynności o umiarkowanej intensywności?	Godziny : minuty	___:___ godz. min.	P6 (a-b)
Przemieszczanie się				
Kolejne pytania nie dotyczą wysiłków fizycznych wykonywanych w pracy, o którą już był/a Pan/i pytany/a poprzednio. Obecnie, chciałbym spytać, w jaki sposób, zazwyczaj, przemieszcza się Pan/i np. do pracy, na zakupy, do marketu, do kościoła.				
7	Czy w typowym tygodniu w celu przemieszczania się chodzi Pan/i lub jeździ rowerem przez co najmniej 10 minut bez przerwy?	Tak	1	P7
		Nie	2 <i>Jeśli nie, przejdź do P 10</i>	
8	Ile dni w typowym tygodniu, chodzi Pan/i lub jeździ rowerem przez co najmniej 10 minut bez przerwy?	Liczba dni	___	P8
9	Ile czasu w typowym dniu chodzi Pan/i lub jeździ rowerem przez co najmniej 10 minut bez przerwy?	Godziny : minuty	___:___ godz. min.	P9 (a-b)
Aktywność rekreacyjna				
W kolejnych pytaniach proszę nie brać pod uwagę wysiłków fizycznych wykonywanych w pracy i w trakcie przemieszczania się, o które był/a Pan/i już pytany/a. Obecnie, chciałbym spytać o Pana/i aktywność podejmowaną w czasie wolnym dla celów rekreacyjnych, fitnessowych, sportowych.				
10	Czy uprawia Pan/i sport, fitness lub podejmuje aktywność rekreacyjną o dużej intensywności, powodujące znaczne przyśpieszenie oddechu i bicia serca, takie jak bieganie, gra w piłkę nożną itp. przez co najmniej 10 minut bez przerwy?	Tak	1	P10
		Nie	2 <i>Jeśli nie, przejdź do P 13</i>	
11	W ilu dniach, w typowym tygodniu uprawia Pan/i sport, fitness lub podejmuje aktywność rekreacyjną o dużej intensywności?	Liczba dni	___	P11
12	Ile czasu w typowym dniu spędza Pan/i na uprawianiu sportu, fitness lub aktywności rekreacyjnej o dużej intensywności?	Godziny : minuty	___:___ godz. min.	P12 (a-b)
13	Czy uprawia Pan/i sport, fitness lub podejmuje aktywność rekreacyjną o umiarkowanej intensywności, powodujące małe przyśpieszenie oddechu i bicia serca, takie jak [jazda rowerem, pływanie, siatkówka] przez co najmniej 10 minut bez przerwy?	Tak	1	P13
		Nie	2 <i>Jeśli nie, przejdź do P16</i>	
14	W ilu dniach, w typowym tygodniu uprawia Pan/i sport, fitness lub podejmuje aktywność rekreacyjną o umiarkowanej intensywności?	Liczba dni	___	P14
15	Ile czasu w typowym dniu spędza Pan/i na uprawianiu sportu, fitness lub aktywności rekreacyjnej o umiarkowanej intensywności?	Godziny : minuty	___:___ godz. min.	P15 (a-b)
Aktywność sedentarna				
Poniższe pytanie dotyczy siedzenia lub odpoczynku w pozycji leżącej w pracy, w domu, w trakcie przemieszczania się tam i z powrotem, lub przy okazji spotkań towarzyskich [siedzenie za biurkiem, siedzenie ze znajomymi, przyjaciółmi, jazdę samochodem, autobusem, pociągami, czytanie, grę w karty, oglądanie telewizji], lecz nie wliczając czasu poświęconego na sen.				
16	Ile czasu w typowym dniu spędza Pan/i na siedzeniu lub odpoczynku w pozycji leżącej?	Godziny : minuty	___:___ godz. min.	P16 (a-b)

SCHOOL-BASED PHYSICAL ACTIVITY AND GOOD PRACTICES IN EUROPE

DOBRE PRAKTYKI W ZAKRESIE SZKOLNEJ AKTYWNOŚCI FIZYCZNEJ W EUROPIE

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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. Despite the known benefits of physical activity for children, inactivity levels remain high in Europe. Schools are considered ideal settings for promoting physical activity. Nonetheless, they often fail to achieve their full potential in increasing the levels of exercise among students. This study aimed to examine the current evidence regarding physical activity promotion in the European Union school context, and to understand how key scientific evidence and World Health Organization (WHO) guidance are used.

Material and methods. Representatives of all 28 European Union Member States were asked to complete a survey to understand their national school-based physical activity practices.

Results. Responses from 22 countries were received. Of all the initiatives, most included fostering of positive attitudes to physical activity or health, while a few incorporated gender-based considerations in their design. Lastly, intersectoral collaboration in the creation of the physical education curricula is yet to be fully integrated among European Union Member States.

Conclusions. There is a substantial focus on physical activity promotion in schools across the European Union, although the school context could be utilized to a greater degree. In general, further efforts in this area are required in order to have a stronger positive effect on physical activity levels in European Union children.

Keywords: physical activity, child, school, health policy, preschool

Streszczenie

Wprowadzenie. Pomimo powszechnie znanych korzyści wynikających z aktywności fizycznej dzieci, jej poziom w Europie nadal pozostaje niski. Szkoły są uważane za idealne miejsca do promowania aktywności fizycznej, jednakich potencjał często nie jest w pełni wykorzystywany. Celem tego badania jest analiza aktualnych danych dotyczących promowania aktywności fizycznej w szkołach w Unii Europejskiej oraz zrozumienie sposobów wykorzystywania kluczowych dowodów naukowych oraz wytycznych WHO.

Materiał i metody. Reprezentantów wszystkich 28 państw członkowskich Unii Europejskiej poproszono o wypełnienie ankiety, której celem było poznanie szkolnych praktyk w zakresie aktywności fizycznej.

Wyniki. Otrzymano odpowiedzi z 22 krajów. Spośród przedstawionych inicjatyw większość obejmowała promowanie pozytywnego nastawienia do aktywności fizycznej i zdrowia. Tylko w niewielu przypadkach uwzględniono aspekty związane z płcią. Okazało się, że międzysektorowa współpraca w tworzeniu programów nauczania wychowania fizycznego nie jest jeszcze w pełni zintegrowana wśród państw członkowskich Unii Europejskiej.

Wnioski. W całej Unii Europejskiej kładzie się duży nacisk na promowanie aktywności fizycznej w szkołach, choć rola szkoły w tym zakresie powinna być wykorzystana w większym stopniu. Reasumując, należy podjąć dalsze działania, które mogą podnieść poziom aktywności fizycznej dzieci w Unii Europejskiej.

Słowa kluczowe: aktywność fizyczna, dziecko, szkoła, polityka zdrowotna, przedszkole

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Introduction

Social and psychological developments take place during childhood and lay the foundation for good health and activity levels throughout the life-course. This makes it crucial to address a child's physical activity (PA) habits at a young age before a sedentary lifestyle can be adopted [1, 2]. Benefits of engaging in PA for children include physical aspects, such as contributing to growth and development, developing healthy cardiovascular, musculoskeletal and metabolic functions, as well as maintaining a healthy body weight. Beneficial mental aspects include improved cognitive skills and mood [3-6]. Furthermore, since PA can relieve tension, restlessness and improve concentration, physically active students are more likely to have good conduct in class and achieve better academic performance [7, 8].

Despite the known benefits of PA, academic demands can negatively influence the time spent on physical activities. Furthermore, there is a tendency for children and adolescents to spend more time in sedentary activities, as environments and opportunities for active play have decreased [9]. This may contribute to the high levels of physical inactivity in Europe. Data from the Health Behavior in School-aged Children (HBSC) survey, indicate that in 2014, only 15% of girls and 25% of boys were physically active for 60 minutes or more per day across European Union (EU) Member States [10]. Physical inactivity and sedentary behaviors have been linked to several conditions such as an increased risk of developing type 2 diabetes, cardiovascular disease and childhood obesity [11].

When it comes to activity levels throughout the life-course, data from the HBSC survey, shows a decrease in moderate-to-vigorous PA with age, with the lowest levels found among 15-year-old adolescents [10]. To prevent this decline, promoting PA in years prior to adolescence may be part of the solution. School has been identified as an ideal venue for fostering PA [7]. Some advantages of using this setting include: the fact that physical education (PE) has been implemented as part of the formal school curriculum in all EU Member States [12], and that a large number of children that can be reached through schools [13]. Schools can also reach those from disadvantaged groups such as those from lower socio-economic groups or children with disabilities [7]. Additionally, schools allow for the possibility of long-term strategies, as most children attend the same school for long periods of time. Lastly, they provide the possibility of including both structural and operational changes, which increases the variety of opportunities for PA promotion [14].

Besides the World Health Organization (WHO) general recommendations on PA [4], other regional mechanisms are in place to provide guidance of how to increase all forms of PA throughout the life-course, such as WHO's Physical Activity Strategy for the European Region 2016-2025 (PAS) [9]. This strategy considers PA as being a leading factor in health and well-being in Europe and it was approved by all 28 EU Member States. Particular attention is given to the burden of non-communicable disease associated with insufficient activity levels and sedentary behaviors throughout the life-course. One of the main objectives within the PAS, is promoting PA in preschools and schools [9]. The PAS suggests that schools should provide an appropriate number of regular physical education lessons that integrate knowledge about PA, as well as activities that incorporate mobility, movement, teamwork, and the competitive aspects of sport. This approach allows all children and adolescents to enjoy PA, regardless of their preferences or training levels, and also enjoy the same health benefits. Furthermore, PA initiatives should promote skills and positive attitudes that support and enable children and adolescents to lead physically active lives. Lastly, the PAS recommends ensuring the availability of playgrounds and appropriate teaching resources and materials. At the policy level, the PAS [9] highlights the importance of employing an intersectoral approach that involves the education, sports, and health sectors in the design of the PE curricula. This approach can lead to better synergies, in order to improve population health and health equity [15]. The PAS also suggests that PA, health knowledge and skills should be a mandatory part of the training curriculum and continuing professional development for all future teachers, sports trainers and childcare professionals, not only for those teaching PE classes [9].

Recommendations and standards for PA interventions in schools have also been suggested by scholars [13, 14, 16, 17]. Available literature suggests that interventions carried out in the school environment should comprise of periods longer than six months and should include age-appropriate activities for improved consolidation of healthy habits [14, 16, 17]. Utilizing theoretical models to support the design, variable selection, form of analysis, and evaluation of interventions is also recommended [14]. Involving not only children and adolescents, but also their parents or guardians in the given initiative is also imperative to insure optimal outcomes [13]. Lastly, scholars recommend considering gender differences when planning interventions, as it was observed that boys respond more effectively to structural interventions such as changes to the physical environment and to the structure of PE classes, whereas girls respond better to behavioral interventions [14, 18-20].

Despite the availability of recommendations and guidelines to promote PA in the school context, there is limited evidence regarding how countries utilize this guidance in national initiatives and policies. Therefore,

the aim of this study was to examine current evidence regarding best practice in the promotion of PA in the EU school context and to understand how guidance from the PAS [9] and available scientific evidence [13, 14, 16, 17] is reflected in PA-related actions in EU Member States.

Material and methods

The research team developed a survey on school-based PA for the purpose of this cross-sectional study. All 28 EU Member States were contacted through representatives of the EU Health Enhancing Physical Activity (HEPA) Focal Points Network. Focal Points are contact persons from national authorities within the public health and or sport sectors, appointed by each EU Member State, to coordinate the process of providing data on PA to the European Commission (EC) and the WHO. The survey was sent to Focal Points by email, along with instructions for completion and a description of the study. The survey was designed based on guidance from the PAS [9] and recent recommendations from scientific literature, regarding school-based PA initiatives. Seven questions were included in the survey; three of them had an open-ended nature, while four were close-ended questions. The survey provided a list of options and asked the respondents to choose the most appropriate answer, along with open boxes for additional comments underneath all closed questions. The first question asked if any changes had been made in the amount of mandatory or voluntary hours of PE in pre-schools and/or primary schools in their country since 2015, as this was the date for the last EC/WHO survey on PA. The second and third questions requested examples of best practices of PA in the school context, so Focal Points could highlight any relevant local or national initiatives in their country and tick off any applicable options. The following options were included:

- Fostering positive attitudes to PA and health (such as supporting all levels of abilities and promoting PA and health in a relaxed and inclusive environment);
- Age specific activities or considerations (referring to consideration of physical development and age in the planning of the activities);
- Gender specific activities (activities that reflect the different needs and preferences of boys and girls);
- The initiative includes a theoretical framework as a basis for its design (such as behavior change theories);
- Improvements in playgrounds or play areas (for example, ensuring the availability of safe and appealing environments for sports and active play);
- Continuing education on PA for teachers (any additional training for general or PE teachers);
- Other (any other consideration in the design of the initiative).

Questions 4 and 5 were identical to questions three and four, allowing for respondents to provide one additional example of a school-based initiative. Furthermore, question 6 requested information on which governmental bodies or sectors design the school PE curricula in their country. Focal Points were asked to tick-off one or more of the following options: a) education sector; b) sports sector; c) health sector; or d) other. Option d) included an open text box, where respondents could elaborate on their answer. Lastly, question 7 was of open-ended nature, and invited Focal Points to state any other relevant developments for this age group in their country.

Results

Of the 28 EU Member States contacted, 22 returned a completed survey. Responses were received between September and October 2016. Furthermore, no response was received from Austria, Bulgaria, France, Lithuania, Luxembourg and Slovakia. Additionally, Belgium returned one response per region for a total of three replies, in order to best represent the country. However, these responses were combined and assessed as one Member State.

Regarding the changes in the amount of mandatory or voluntary hours of PE in pre-schools and/or primary schools, three countries indicated that the mandatory hours of PE have increased since 2015 (Table 1). Nonetheless, in Greece, there were two types of primary schools, and while the hours increased for the 'Classic city' primary schools, they decreased for the 'Unified Reformed Curriculum' primary schools. Therefore, no changes for Greece are reported in Table 1.

Table 1. Overview of changes in mandatory or voluntary hours of Physical Education in primary schools in 22/28 EU Member States since 2015

Country	Lessons/hours of PE per week in 2015	Changes in 2016	Details
Belgium	FLE: 2 hours. GER: min. 2 lessons of 50 minutes. FRE: 2 hours. All mandatory.	=	N/A
Croatia	Grades 1-3: 3 hours. Grades 4-8: 2 hours. All mandatory.	=	N/A
Cyprus	1.5 hours (2 periods) mandatory.	>	3 periods for 5 th and 6 th grade
Czech Republic	2 hours mandatory; Additional 3 hours optional.	=	N/A
Denmark	3.75 hours (45 min. per day) mandatory.	=	N/A
Estonia	2 lessons mandatory.	=	N/A
Finland	2 hours mandatory.	=	N/A
Germany	3-5 hours mandatory depending on the region.	=	N/A
Greece	2 hours for grades A-D. 3 hours for grades E and F.	=	Increase in 'Classic City' schools and decrease in schools with 'Unified Reformed' Curriculum. Precise number of hours not available.
Hungary	5 lessons of 45 minutes mandatory.	=	N/A
Ireland	1 hour mandatory.	=	N/A
Italy	2 hours mandatory.	>	Amount of additional hours not indicated.
Latvia	2 hours mandatory.	=	N/A
Malta	1.5 hours mandatory.	=	N/A
Netherlands	On average 144 min. in grades 1 and 2 and 87 minutes in grades 3-8. PE is mandatory, but the specific amount is decided by each school individually	=	N/A
Poland	For grades 1-3, PE is integrated into the educational system. For grades 4-6, 4 lessons of 45 minutes are mandatory.	=	N/A
Portugal	2 hours mandatory.	>	Optional increase in PE for children in grades 1-4.
Romania	For grades 1-2, 2 mandatory hours plus 1 optional hour of play and movement.	=	N/A
Slovenia	2-3 mandatory lessons of 45 minutes each.	=	N/A
Spain	Average of 2 hours, but varies per region.	=	N/A
Sweden	1.5 hours mandatory	=	N/A
United Kingdom	ENG: No minimum. SCO: 2 hours mandatory. WAL: 2 hours, optional. NI: 2 hours mandatory.	=	N/A

=, no change; >, increase in the number of hours; N/A, no answer; PE, physical education; FLE, Flemish community; GER, German-speaking community; FRE, French speaking community; ENG, England; SCO, Scotland; WAL, Wales; NI, Northern Ireland.

One to two best practice examples of national or local PA initiatives were provided by EU Member States for a total of 34 examples (belonging to 21 out of the 22 respondents Member States). Results were compiled

to illustrate which aspects of the PAS [9] and recommendations from scientific literature [13, 14, 16, 17], were included (Table 2).

Table 2. Overview of the main results from Focal Point survey by country

Country	Initiative name	Age group	Positive attitudes	Age specific	Gender specific	Theoretical framework	Play areas	Continuing education
Belgium	Stichting Vlaamse Schoolsport (Foundation Vlaamse Schoolsport) [Flemish Community]	6 to 18	Yes	Yes	Yes	Yes	Yes	No
	Multimove action for children [Flemish Community]	3 to 8	Yes	Yes	No	Yes	No	Yes
	Fitte Schule (Fit school) [German-speaking Community]	6 to 12	Yes	Yes	No	No	Yes	Yes
	Program for school sport in the German-speaking Community	3 to 18	Yes	Yes	No	Yes	Yes	No
Croatia	National program "Living healthy"	7 to 10	Yes	Yes	No	Yes	Yes	Yes
Czech Republic	Sazka Olympijský víťež (Sazka Olympic multi-event contest)	6 to 15	Yes	Yes	No	No	No	No
	Plavecko-běžec pohár (Swimming-running Cup)	9 to 15	Yes	No	No	No	No	No
Cyprus	Extra Curricular School Sport Activities	6 to 18	Yes	Yes	Yes	Yes	No	Yes
	School Sport Games	12 to 18	Yes	Yes	Yes	Yes	No	Yes
Denmark	Sunde Børn Bevæger Skolen (Healthy children move the school)	6 to 16	Yes	Yes	No	Yes	No	No
Estonia	Sport for all program for schools	7 to 18	Yes	Yes	Yes	No	No	Yes
Finland	Finnish Schools on the Move	7 to 12	Yes	Yes	Yes	Yes	Yes	Yes
Germany	Nationale Action Plan "In Form"	All age groups	Yes	Yes	No	Yes	Yes	No
Greece	Panhellenic School Sports Day	6 to 18	Yes	No	No	No	No	No
	European Sports Week	6 to 18	Yes	No	No	No	No	No
Hungary	A Sport Legyen a Tied! (May sports be with you!)	7 to 14	Yes	No	No	No	Yes	No
	TE IS Program	10 to 18	Yes	Yes	No	Yes	No	No
Ireland	National Physical Activity Plan	All age groups	Yes	Yes	No	Yes	No	Yes
Italy	Sport di Classe (Class Sport)	6 to 10	Yes	No	No	No	Yes	No
	Sportathlon	10 to 14	No	No	Yes	No	Yes	No
Latvia	"Sporto visa klase" (All class do sports)	9 to 11	Yes	Yes	No	No	No	No

Country	Initiative name	Age group	Positive attitudes	Age specific	Gender specific	Theoretical framework	Play areas	Continuing education
Malta	OnTheMove	1 to 16	Yes	Yes	No	Yes	Yes	No
	Move 360	8 to 10	Yes	Yes	No	Yes	No	No
Netherlands	De gezonde basisschool van de Toekomst – Movare Limburg (The healthy primary school of the Future - Movare Limburg)	4 to 12	Yes	Yes	Yes	Yes	Yes	Yes
	Stanislascollege Rijswijk - beweegvmbo	13 to 16	Yes	No	Yes	Yes	Yes	No
Portugal	Extension of “Desporto Escolar” (School Sports)	5 to 9	No	Yes	No	No	No	No
	CNID Cup	11 to 18	No	Yes	No	No	No	No
Romania	Mini Handball National School Sport Olympiad	7 to 11	No	No	No	No	No	Yes
	Secondary Schools Olympiad	11 to 15	No	No	No	No	No	Yes
Slovenia	“Zdrav življenjski slog” (Healthy lifestyle)	6 to 16	Yes	Yes	No	Yes	No	No
Sweden	Sports program in after-school-child-care	7 to 12	Yes	Yes	No	Yes	No	No
Spain	“¡Dame 10!” (Give me 10!)	3-6 and 6-12	Yes	Yes	No	Yes	No	Yes
	U.D.A., Unidades Didacticas Activas (Active teaching units)	6 to 17	Yes	Yes	Yes	Yes	No	Yes
United Kingdom	The Daily Mile	5 to 11	Yes	No	No	No	No	No

From the best practice examples reported, two Member States included all six of the recommendations or guidance in at least one of the initiatives, three included five recommendations, five countries included four, four countries included three, three included two and four countries included only one recommendation or guidance from the PAS [9] or scientific evidence [13, 14, 16, 17]. Additionally, one country did not provide any best practice examples.

Regarding the age groups targeted, 71% of the best practice examples addressed children aged six and above. Furthermore, 18% also included children below six years of age. One initiative (3%) targeted preschool children exclusively, while 8% of the initiatives involved citizens of all ages.

Moreover, almost all countries (90%, $n = 20$) included the fostering of positive attitudes towards PA and/or health, 82% ($n = 18$) included age-specific considerations, 32% ($n = 7$) included gender specific activities, 59% ($n = 13$) used a theoretical framework, 41% ($n = 9$) included improvements in play areas, and 41% ($n = 9$) included continuing education for teachers.

Lastly, seven countries highlighted additional aspects included in the good practice examples. Czech Republic and Slovenia added that the initiative also targeted disadvantaged groups such as those with physical and mental disabilities for the former and socially excluded children for the latter. In Finland, there was focus on active commuting, encouraging active breaks, reducing sitting time, as well as cooperation with other sectors. In Germany, intersectoral networking and the identification of best practices were a priority. In Greece, the focus was on developing social skills, diversity, acceptance, and cooperation. In the initiative from Latvia, there was also a focus on comparing children in the initiative with those who only receive 2 mandatory hours of PE per week, in order to show the benefits of PA. Lastly, the initiative provided by Romania also considered encouraging students with athletic abilities.

Regarding the number of governmental sectors used in the design of the school PE curricula (Figure 1), 14 (64%) countries responded that one sector was included, 4 (18%) countries indicated that two sectors were used, and another 4 (18%) indicated that three or more sectors were used.

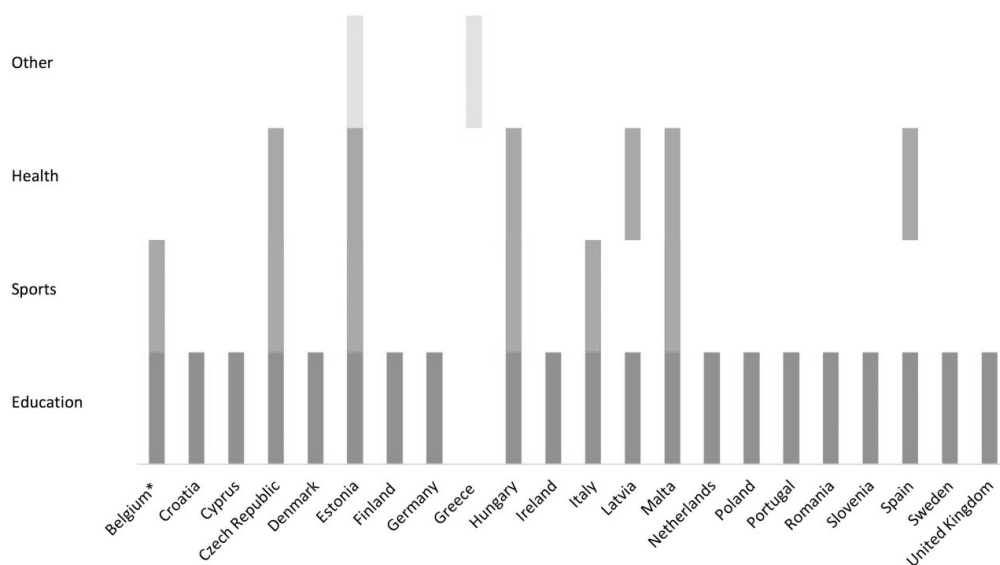


Figure 1. Types of governmental sectors involved in the design of the school Physical Education curricula

*Average data for the three Communities in Belgium

As illustrated in Figure 1, almost all countries (95%) involved the education sector in the design of the school PE curricula. Six countries (27%) included the sports sector, and another six utilized the health sector. Additionally, some countries indicated that other bodies aside from those suggested are involved in the design of the PE curricula. Greece reported that the Institute for Educational Policy and the Department of PE are in charge of this matter. In the case of the United Kingdom, head teachers also participate in these curriculum decisions.

Data presented for Belgium was averaged from the three survey responses provided by the Focal Points. More specifically, The Flemish community included three all bodies, The German-speaking community included the education and sport sectors and the French community involved only the education sector in the design on the PE curricula.

Member States were invited to provide additional comments on this issue. Belgium (Flemish Community), highlighted the existence of a working group on nutrition and exercise, in which different sectors are represented, where they consult each other and decide on actions and measures to be taken. In Cyprus, the Ministry of Education and Culture, organizes various alternative and innovative activities in an effort to introduce school children to the benefits of PA. In Czech Republic, the issue of promotion of PA in the school environment meets the National Strategy Health 2020 and the Framework Educational Program (National Curriculum) as two strategic documents. In Finland, new recommendations have been developed for PA in early childhood [21]. In Greece, there is a two-year project targeting children with reduced PA levels, especially those from socially vulnerable groups, such as low-income families or refugees. The aim of this project is to increase PA and to improve their health. In the Netherlands in 2015, the Ministry of Education started a public debate to call for input into the school curriculum, in order to better optimize the curriculum in the future. Poland indicated that the education sector plays a leading role in the design of the PE curriculum, although the decision is made in cooperation with the sport sector. Lastly, the Swedish Education Act, which includes pre-school and after-school-child-care, emphasizes promotion of a healthy lifestyle among children.

When it comes to question 7, on the request for an update on any other relevant developments for this age group in their country, eight countries provided information. This is further summarized in Table 3.

Table 3. Relevant developments in the area of school-based physical activity or health promotion

Country	Relevant development
Belgium	The Flemish Institute for Health Promotion and Disease is taking actions towards reducing sedentary behavior. In 2013, the government decided to implement a center for the early promotion of physical, mental and social development in children and adolescents (German-speaking Community).
Czech Republic	In almost every county and city office, NGOs and schools organize local, public actions focused on healthy lifestyle choices, which involve HEPA.
Netherlands	The Ministry of Education and the Primary Education Council launched the Physical Education Plan in 2017, so that each primary school pupil gets at least two hours of PE per week, taught by a qualified teacher. In response to this, members of parliament took initiatives to make three hours of PE a week provided by specialized PE teachers mandatory.
Portugal	A national surveillance platform has been introduced in order to enable the evaluation of physical fitness and PA in all school-aged children in Portugal.
Slovenia	Actions at governmental level are being taken to expand the curricula with 5 hours per week of PA, with the involvement of specialized PA teachers, in combination with generalized teachers.
Spain	A research group was established to organize a congress for PA teachers to exchange experiences in promoting PA and health in the school setting. There is also a program which offers a formative curriculum for schools on the promotion of healthy habits and the use of sport as a tool for education and health.
England	The amount of funding for PE and sports in schools is planned to be doubled from £160m in September 2017 to £320m over the next few years.

Discussion

The aim of this study was to examine the current evidence regarding the promotion of PA in EU schools, and to understand how guidance from the PAS [9] and available scientific evidence [13, 14, 16, 17] is reflected in PA interventions in EU Member States.

As such, this study contains four main findings. Firstly, numerous actions are being taken to promote PA in schools. Secondly, intersectoral collaboration in the design of the PE curricula is not a fully integrated practice among EU Member States. Thirdly, it seems that limited focus is given to considerations on gender differences in the design of PA initiatives. Fourthly, schools could be utilized to a larger degree as HEPA promoting venues.

Results from this study indicate a vast interest among EU counties in promoting PA in school-aged children, through good practice examples, as well as through more recent developments in national agendas. For example, the assignment of the HEPA Focal Points in all EU Member States, indicates that there are resources set aside to tackle the high prevalence of physical inactivity [22], as well as an openness towards collaboration between countries. Furthermore, three countries had increased the hours of PE in schools between 2015 and 2016, while others highlighted relevant developments such as increasing budgets for HEPA promotion or ensuring the provision of specialized teachers for PE. These are all positive indications that EU Member States are taking action towards promoting HEPA and reducing the prevalence of physical inactivity in children.

As a second finding, intersectoral collaboration in the design of the school PE curriculum is yet to be fully integrated among EU Member States. Despite guidance from public bodies such as the WHO and European Commission, it seems as EU Member States have yet to adopt this fully in their HEPA strategies. Although in most EU Member States the education sector is primarily responsible for planning the PE curriculum, by involving other sectors such as the sports and health sectors considerations can be made as to the specific requirements for equipment and venues for PA. This can lead to greater quality PA and more opportunities for PA in the school setting.

Thirdly, based on the good practice examples provided by the Focal Points, it may seem that limited focus is given to gender considerations when planning school-based PA interventions. This may be an area with room for improvement, as research shows that girls respond differently to PA interventions than boys [18], and are considered a more vulnerable group when it comes to PA engagement [9]. Nonetheless, since few examples were provided from each country, these may not be representative of general focus of PA initiatives in EU Member States. Additionally, some interventions may not explicitly include gender specific considerations, but may offer activities based on skills and preferences of the children and thereby indirectly address their gender differences.

Lastly, although the benefits of PA for children seem to be recognized throughout the EU, the amount of mandatory hours allotted to organized PE varies among countries, with an average being around two hours

per week [12]. Considering the WHO recommendation of 60 minutes of PA per day for children [4], this only contributes to a fraction of the time in which children should be physically active [23]. Although other PA opportunities are offered by some EU Member States, such as PA during breaks, within lessons, as well as after school activities [5], considering the long hours that children spend in schools, this setting could be utilized to a greater degree to ensure higher PA levels in school-aged children.

Strengths

Overall this study possesses several strengths. Firstly, employing the EU HEPA Focal Points as providers of country-specific information allowed for first-hand and up to date information about Member State's actions towards PA in schools. Secondly, the high survey response rate (78.5%) is an important strength of this study, providing evidence from a large geographical area in the EU.

Limitations

This study is not without limitations. Firstly, it relies on self-reported survey information, which could involve responder bias, as the Focal Points were likely to respond in a positive manner about their country. Additionally, the inclusion of open questions could have led to misinterpretations and placed limitations on the accuracy of the data provided. Moreover, there may have been a misunderstanding of the concept of 'school-aged' children within the respondents, as a specific age group was not specified. This may have influenced the type of responses given. Lastly, only two best practice examples were requested from Focal Points, therefore general conclusions cannot be drawn, as the data may not be representative of the general status of school-based PA initiatives in the given country.

Conclusions

Results of this study show that in general, there is a substantial focus on PA promotion in schools across EU Member States, although the school context could be utilized to a greater degree as a HEPA-promoting venue. Furthermore, the majority of the best practice examples comply with WHO guidance in terms of fostering positive attitudes to PA. Nonetheless, when it comes to gender-specific considerations in the design of PA initiatives, this may be an area with room for improvement. Utilizing multiple sectors in the design of the PA curricula has yet to be fully integrated in EU Member States. Overall, further efforts in this area could have a greater influence on PA levels in children in Europe. Nonetheless, future research should focus on analyzing school-based PA best practices, in order to be able to draw further conclusions on the focus and needs of EU Member States in this context.

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Conflicts of Interest: The authors declare no conflict of interest.

Disclaimer: JB is WHO staff member. Any views expressed here are his own.

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FACTORS INFLUENCING LEVEL OF PHYSICAL ACTIVITY AMONG FEMALE STUDENTS FROM THE VISEGRAD COUNTRIES

CZYNNIKI WPŁYWAJĄCE NA POZIOM AKTYWNOŚCI FIZYCZNEJ STUDENTEK Z PAŃSTW WYSZEHRADZKICH

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zapl  nowanie bada  

B. Data collection/entry

zebranie danych

C. Data analysis/statistics

dane – analiza i statystyki

D. Data interpretation

interpretacja danych

E. Preparation of manuscript

przygotowanie artyku  u

F. Literature analysis/search

wyszukiwanie i analiza literatury

G. Funds collection

zebranie funduszy

Summary

Background. Our study aims to illustrate the diversity in levels of physical activity among female students from the Visegrad countries (V4), in four domains: job-related activity, transportation physical activity, housework, house maintenance, and caring for family, as well as recreation, sport, and leisure-time physical activity. These domains were correlated with factors including: BMI, field of study, physical fitness self-assessment and amount of leisure time.

Material and methods. In total 1,169 female students from V4 countries: the Czech Republic, Slovakia, Hungary and Poland were involved in the study. In terms of conducting the study, the long version of the International Physical Activity Questionnaire IPAQ, was utilised.

Results. Female students from the V4 countries were characterized by moderate (47.5%) and high (43.7%) levels of physical activity, and the WHO recommendations on health-related quality of life were fulfilled in more than 80% of the respondents.

Conclusions. Analysis showed statistically significant differences in BMI, where underweight students (59.3%) demonstrated a moderate level of physical activity. The physical fitness self-assessment of female students from the V4 countries shows significant differences in their level of physical activity in all analysed areas and indicates that field of study as well as their amount of leisure time do not notably affect their level of physical activity.

Keywords: physical activity, female students, IPAQ, V4

Streszczenie

Wprowadzenie. Celem pracy by  o ukazanie zr  nicowania poziomu aktywno  ci fizycznej studentek z pa  stw wyszehradzkich (V4) w czterech obszarach tj. w pracy zawodowej/na uczelni, w przemieszczaniu si  , w pracach domowych oraz sporcie w zale  no  ci od wska  znika BMI, kierunku studi  w, samooceny sprawno  ci fizycznej i ilo  ci posiadanego czasu wolnego.

Material i metody. Badaniom poddano 1169 studentek z grupy pa  stw V4: Czech, S  wacji, W  gier i Polski. W pracy zastosowano metod   sond  u diagnostycznego z wykorzystaniem Mi  dzynarodowego Kwestionariusza Aktywno  ci Fizycznej IPAQ - wersja d  uga.

Wyniki. Studentki pa  stw V4 charakteryzowa  y si   umiarkowanym (47,5%) i wysokim (43,7%) poziomem aktywno  ci fizycznej, a prozdrowotne rekomendacje WHO spe  ni  o ponad 80% badanych.

Wnioski. Analiza statystyczna wykaza  a istotne statystycznie zr  nicowanie w przypadku wska  znika BMI, gdzie studentki z niedowag   (59,3%) uzyska  y umiarkowany poziom aktywno  ci fizycznej. Samoocena sprawno  ci fizycznej studentek z pa  stw V4 istotnie r  znicowa  a ich poziom aktywno  ci fizycznej we wszystkich analizowanych obszarach, a kierunek studi  w oraz ilo  c posiadanego czasu wolnego nie r  znicuje istotnie statystycznie poziomu aktywno  ci fizycznej.

S  wa kluczowe: aktywno  c fizyczna, studentki, IPAQ, V4

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Introduction

Physical activity plays an important role in modern society and in the life of each human being. What seems disturbing though is that the amount of daily activity undertaken is reducing.

The studies by Bauman et al. [1] conducted in 20 countries with the help of the International Physical Activity Questionnaire (IPAQ) found that a high level of physical activity was achieved in more than half of the populations in only eight countries. According to the International Prevalence Study on Physical Activity, it appears that the highest percentage of people with a low level of physical activity was reported in Belgium, Japan, Saudi Arabia and Taiwan (40%). Further, international comparisons show that the least active populations are those in France (43%), Belgium (40%) and the United Kingdom (37%). Still, according to the WHO World Health Survey reports, physical inactivity is highest in Brazil (over 30%) and Spain (25%). When the data from the Central Statistical Office of Poland was analysed, it was noticed that the percentage of Poles with high levels of physical activity is relatively small (28%) and comparable to that found in other countries i.e. Finland (24%) and Sweden (33%), whose inhabitants are generally considered to be highly active [2]. And, although Poles understand the role of physical activity in health and have increasingly attached more importance to regular sporting activities, the analysis of research findings leads to the conclusion that the Polish society actually participate in low levels of physical activity.

The recently observed decrease in physical activity is one of the most important threats to public health, and recent estimates suggest that about 2 million deaths a year worldwide are caused by a lack of physical activity [3].

The analysed survey reports on physical activity show similar trends. Physical activity is more common among men than women. Sport appeals to young people and regular exercise decreases with age. Further, studies indicate that it is the residents of urban rather than rural areas who participate in physical activity, which is largely related to greater accessibility to municipal sports facilities and equipment. Another factor is education, where the number of people who exercise regularly tend also to have higher levels of education [4-6].

The issue of physical activity among female students has been discussed increasingly by both the research community in Poland [7-11] and abroad [12-21]. These publications relate primarily to the assessment of the level of activity undertaken in everyday life, work and leisure time.

The time spent at university is the final stage of formal education during which students can be provided and monitored by large-scale physical activity programme that would ensure a better quality of life. Despite this, most of the activity undertaken by students consists of studying or performing activities of daily living, and with technological advances, the energy expenditure intended for such activity continues to decrease. However, it should be remembered that improperly conducted exercise can cause injury. Therefore, when implementing any health-enhancing physical activity, one should follow expert guidelines. Accordingly, adults aged 18-65 should undertake 30 minutes of moderate physical activity 5 days a week, or 20 minutes of intense physical exercise 3 days a week. It is also recommended that adults undertake weight training 2 days per week [3]. However, despite numerous recommendations issued by health institutions involved in researching physical activity, little effort has been made to educate the public about these guidelines. According to Kay [12], only 36% of the respondents in the United States were aware of any recommendations on physical activity for health.

Despite numerous studies concerning this particular issue, it seems reasonable to continue to seek data about physical activity among students.

The following article aims to present the existing differences in levels of physical activity among female students from the V4 countries in four essential for humans life domains: i.e. job-related activity, transportation physical activity, housework, house maintenance, and caring for family, as well as recreation, sport, and leisure-time physical activity in regard to BMI, the field of study, physical fitness self-assessment and amount of leisure time.

Material and methods

The study was conducted in May 2015 and in total it involved 1169 students from the Visegrad countries: the Czech Republic (24.3%), Slovakia (21.4%), Hungary (22.6%) and Poland (31.7%). 117 surveys were rejected as incomplete. The average age of the respondents was 21.5. Table 1. shows the detailed characteristics of the surveyed participants.

Table 1. Characteristics of the participants

	Country				Total (n=1169)
	Slovakia (n=250)	Poland (n=371)	Czech Republic (n=284)	Hungary (n=264)	
Course of study					
humanities courses	29.2%	35.6%	32.0%	34.1%	33.0%
medical courses	57.6%	34.8%	37.7%	30.7%	39.4%
technical courses	13.2%	29.7%	30.3%	35.2%	27.5%
BMI Index					
underweight	13.2%	14.1%	13.7%	11.0%	13.2%
healthy weight	75.2%	72.4%	73.6%	76.8%	74.2%
overweight	11.6%	13.5%	12.7%	12.2%	12.6%
Self-assessment of physical fitness					
high	12.5%	7.8%	8.0%	21.3%	11.9%
medium	74.6%	76.8%	77.5%	66.5%	74.2%
low	12.9%	15.4%	14.5%	12.2%	13.9%
Amount of leisure time					
sufficient	43.3%	55.0%	52.5%	29.7%	46.2%
insufficient	48.9%	43.7%	44.6%	62.0%	49.2%
no leisure time	7.8%	1.4%	2.9%	8.4%	4.7%

The research was carried out in 2015 as part of the Standard Grant programme of the International Visegrad Fund. The project "Physical and recreational activity and nutrition of youth from the Visegrad countries" aimed to integrate scientists from partner universities in the Czech Republic, Poland, Slovakia and Hungary by enabling them to conduct research together and exchange their own experiences and knowledge.

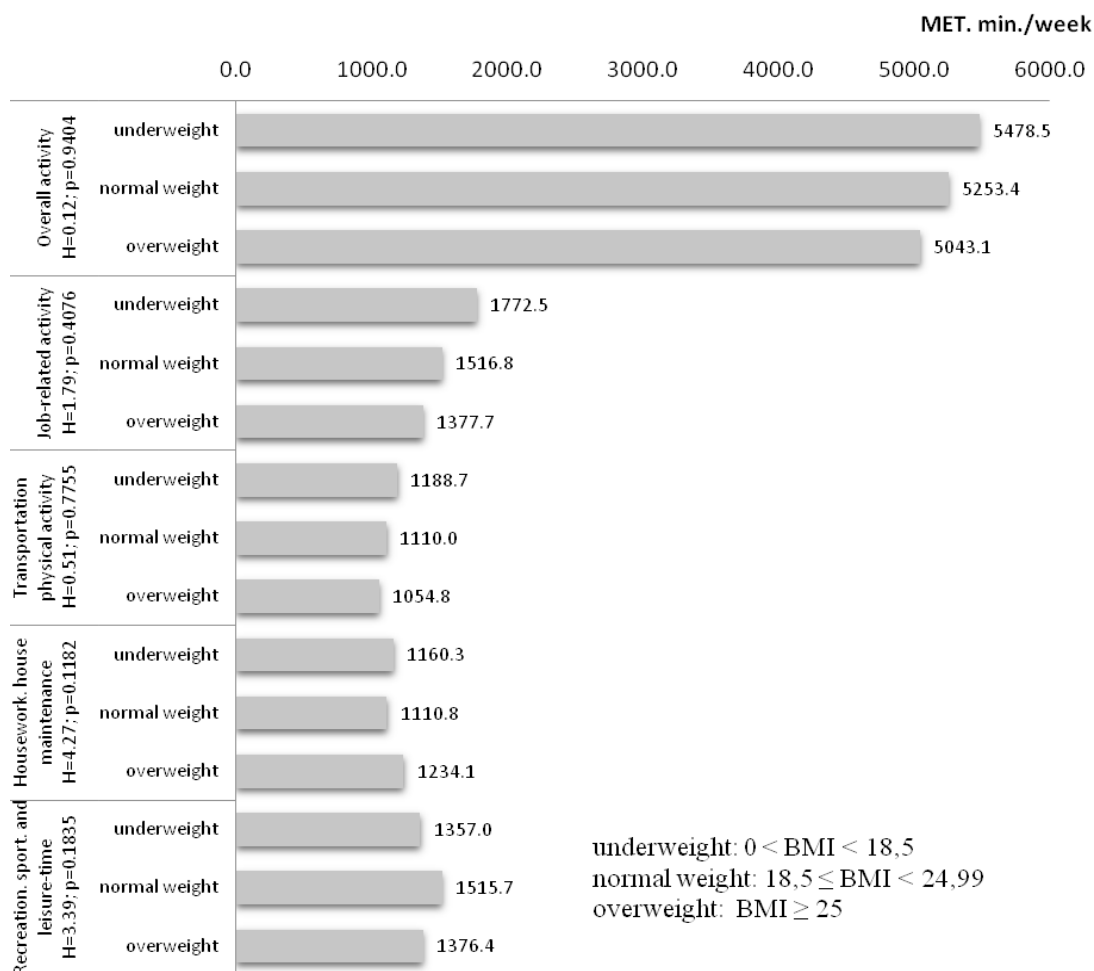
The study involved a diagnostic survey utilizing the International Physical Activity Questionnaire IPAQ – the long version, which allowed us to analyse physical activity in different areas of human life (job-related activity, transportation physical activity, housework, house maintenance, and caring for family, as well as recreation, sport, and leisure-time physical activity). The questionnaire's core questions were supplemented with those concerning the data on height and weight, which enabled us to calculate the participant's Body Mass Index (BMI), as well as information on the field of study, physical fitness self-assessment and amount of leisure time. In the presented analysis, the level of physical activity was assessed on the basis of the MET indicator (Metabolic Equivalent of Task), which informs us about the individual metabolic rate change during an exercise compared to the same change at rest. Basing on the study findings, the researcher concluded that the surveyed persons could be classified according to their level of physical activity. Three levels of activity were distinguished: high, moderate and low [9]:

1. High - the category comprises people who meet one of the following criteria:
 - 3 or more days of intense physical effort, a total of at least 1,500 MET min./week,
 - 7 or more days of any combination of efforts (walking, moderate or intense efforts) exceeding 3000 MET min./week.
2. Moderate – the category involving those who meet one of the following three criteria:
 - 3 or more days of intense physical effort, no more than 20 minutes a day,
 - 5 or more days of moderate effort or walking, no more than 30 minutes a day,
 - 5 or more days of any combination of physical activity (walking, moderate or intense exercise) exceeding 600 MET min./week.
3. Low – the category consisting of those persons who did not show any physical activity or did not meet the conditions for high and moderate levels.

The statistical data analysis was done by STATISTICA V.10. To detect statistically significant we used the Chi-square test of independence for quality features. To check for statistically significant differences in the level of total physical activity and its areas (domains) due to the amount of available leisure time, the level of physical fitness self-assessment, the course of study and BMI, an arithmetic mean was calculated using the nonparametric Kruskal-Wallis test. If any significant differences were found, the post-hoc U Mann-Whitney test was used to examine which variables were involved. In all the analysed cases, the significance level was assumed at $p = 0.05$.

Results

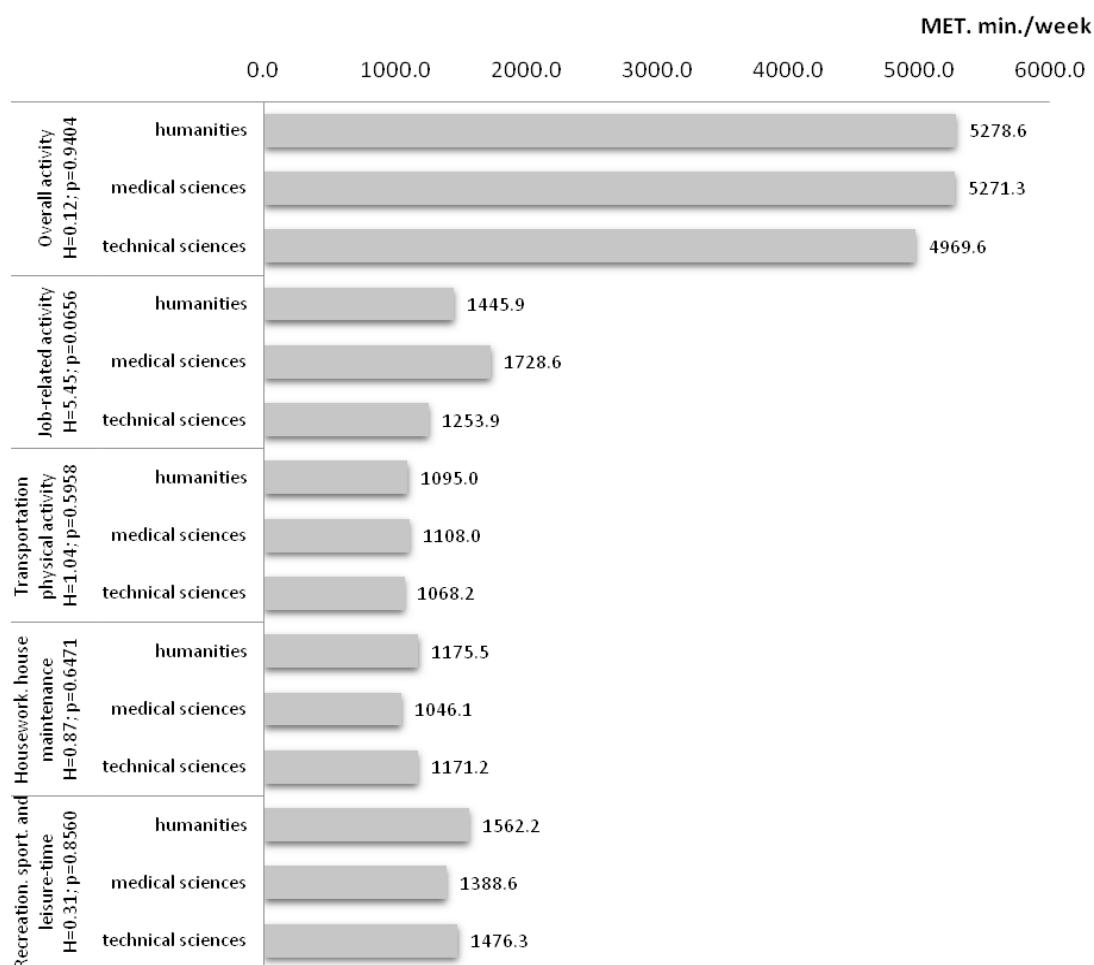
The most commonly used measure to provide an idea of one's figure is the BMI index. It is the quotient of body mass (in kilograms) and square of body height (in meters). The index allows to determine insufficient weight and overweight. In case of adults (over 18 years old), it assumes the value below 18.5 to indicate body mass deficiency, 18.5 to 24.99 – norm and over 25 – overweight [22]. When BMI was correlated with the level of physical activity in female students from the V4 countries, it was found that underweight persons showed the highest level of overall activity (5478.5 MET. min./wk.), job-related physical activity (1772.5 MET. min./wk.), and transportation physical activity (1188.7 MET. min./wk.). Normal-weight students demonstrated the highest level of recreation, sport, and leisure time activity (1515.7 MET. min./wk.), whereas those who were overweight engaged in the highest level of housework, house maintenance and caring for family activity (1234.1 MET. min./wk.). The statistical analysis showed no significant impact of BMI on physical activity levels of the surveyed female students in any of the tested area (Figure 1).



H - value of the Kruskal-Wallis test

Figure 1. Level of physical activity and its domains in comparison to the BMI of female students

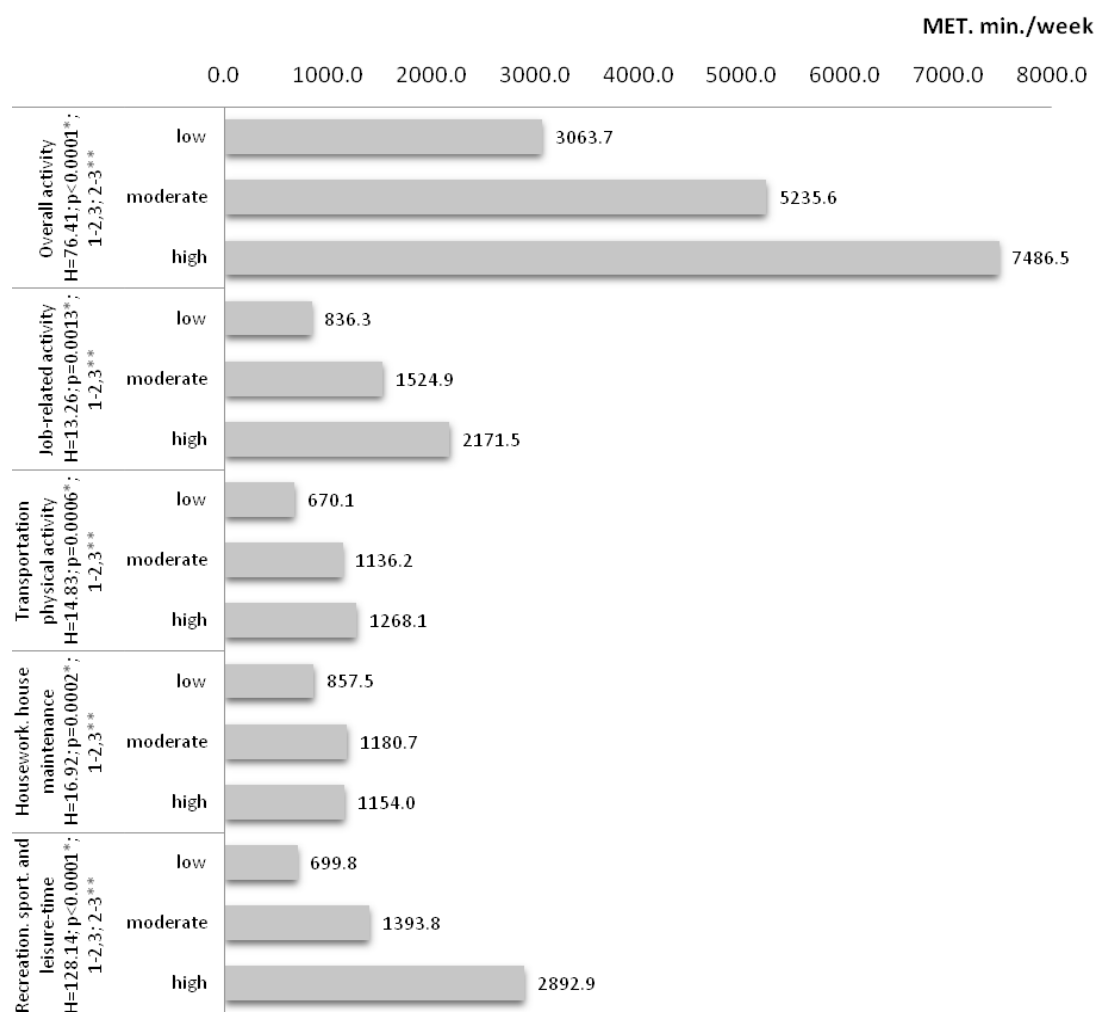
When the impact of the course of study on the level of physical activity was analysed, it was found that the overall physical activity levels of female students of humanities and medical sciences were similar, which amounted to 5278.6 MET. min./wk. and 5271.3 MET. min./wk. respectively. The female students studying humanities demonstrated the highest level of physical activity in two areas: housework, house maintenance and caring for family, as well as recreation, sport and leisure time while, in the other two areas, i.e. job-related physical activity and transportation physical activity, the medical science female students undertook more activity. The lowest level of overall physical activity was recorded among the female technical sciences students (4969.6 MET. min./wk.). Statistical analysis did not show any significant influence of the course of study on the physical activity levels of the surveyed students in any particular area (Figure 2).



H - value of the Kruskal-Wallis test

Figure 2. Level of physical activity and its domains in comparison to the female students' course of study

In contrast to the previously presented determinants of physical activity, in the case of physical activity self-assessment, the analysis showed a statistically significant effect of physical fitness self-assessment on the respondents' level of physical activity in all areas. In every case, the female students who evaluated their fitness level as low achieved significantly lower results in the overall level of physical activity than those with high and moderate self-esteem. Additionally, in the case of two activity domains, i.e. overall activity as well as recreation, sport, and leisure-time physical activity, there was observed a significantly higher activity level in female students with high physical fitness self-esteem not only in relation to those with low self-esteem but also in relation to the respondents with a moderate physical fitness self-esteem (Figure 3).



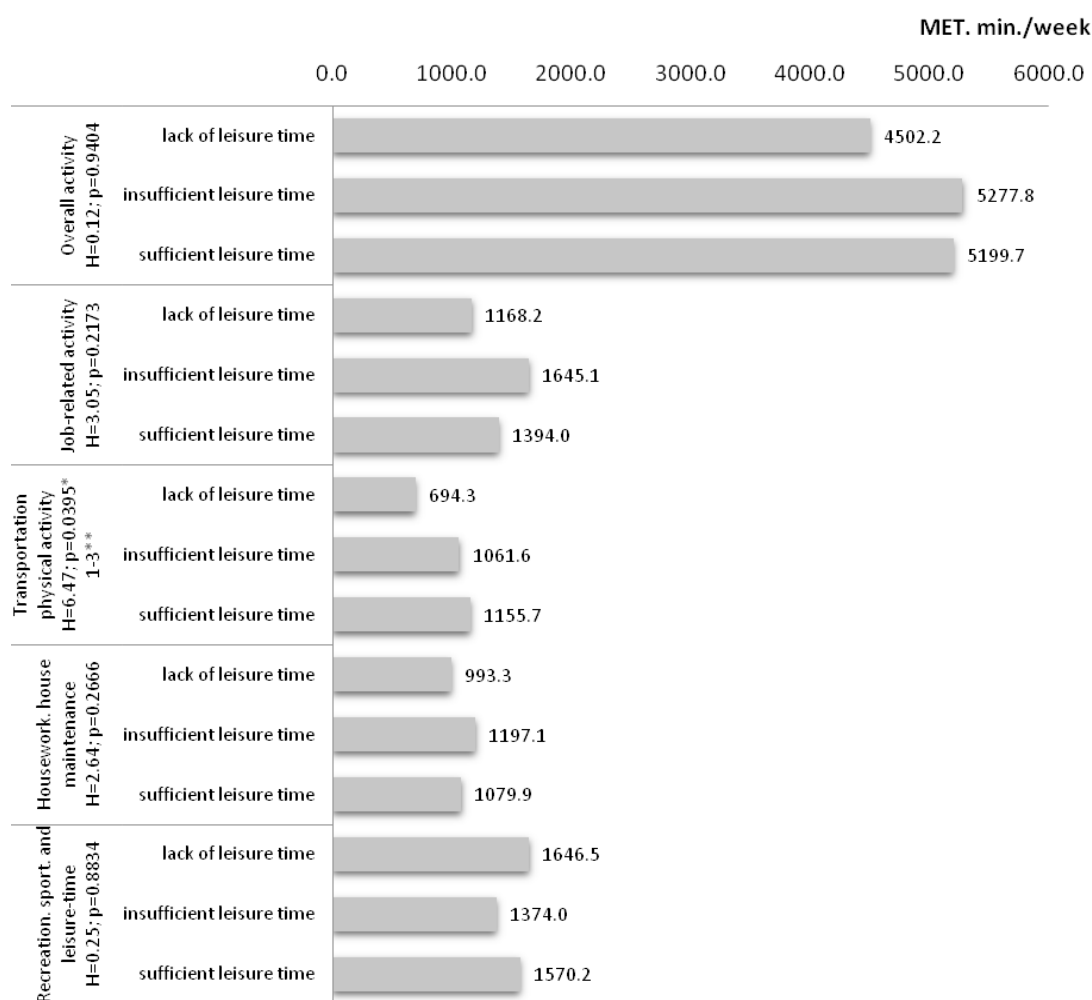
H - value of the Kruskal-Wallis test

* - significant differences at $p < 0.05$

** - levels of physical fitness self-assessment between which there is statistically significant differences in the Mann-Whitney U post hoc test; 1-low, 2-moderate, 3-high

Figure 3. Level of physical activity and its domains in comparison to the level of physical fitness self-assessment of female students

Another significant factor in our research was analysing the impact of the amount of leisure time on female levels of activity. The lowest level of overall activity was visible in students lacking leisure time (4502.2 MET. min./wk.), who achieved the highest level only in the area of sport (1646.5 MET. min./wk.). In contrast, the highest level of overall activity was shown by students having little leisure time (5277.8 MET. min./wk.). It seems that job-related physical activity and activity involved in housework, house maintenance and caring for family had the greatest impact on this factor. The statistical analysis showed a significant effect of the amount of leisure time on physical activity levels only in the area of transportation physical activity ($p = 0.0395$), at the expense of those who did not have leisure time (694.3 MET. min./wk.), and in favour of those with a sufficient amount of leisure time (1155.7 MET. min./wk.) (Figure 4).



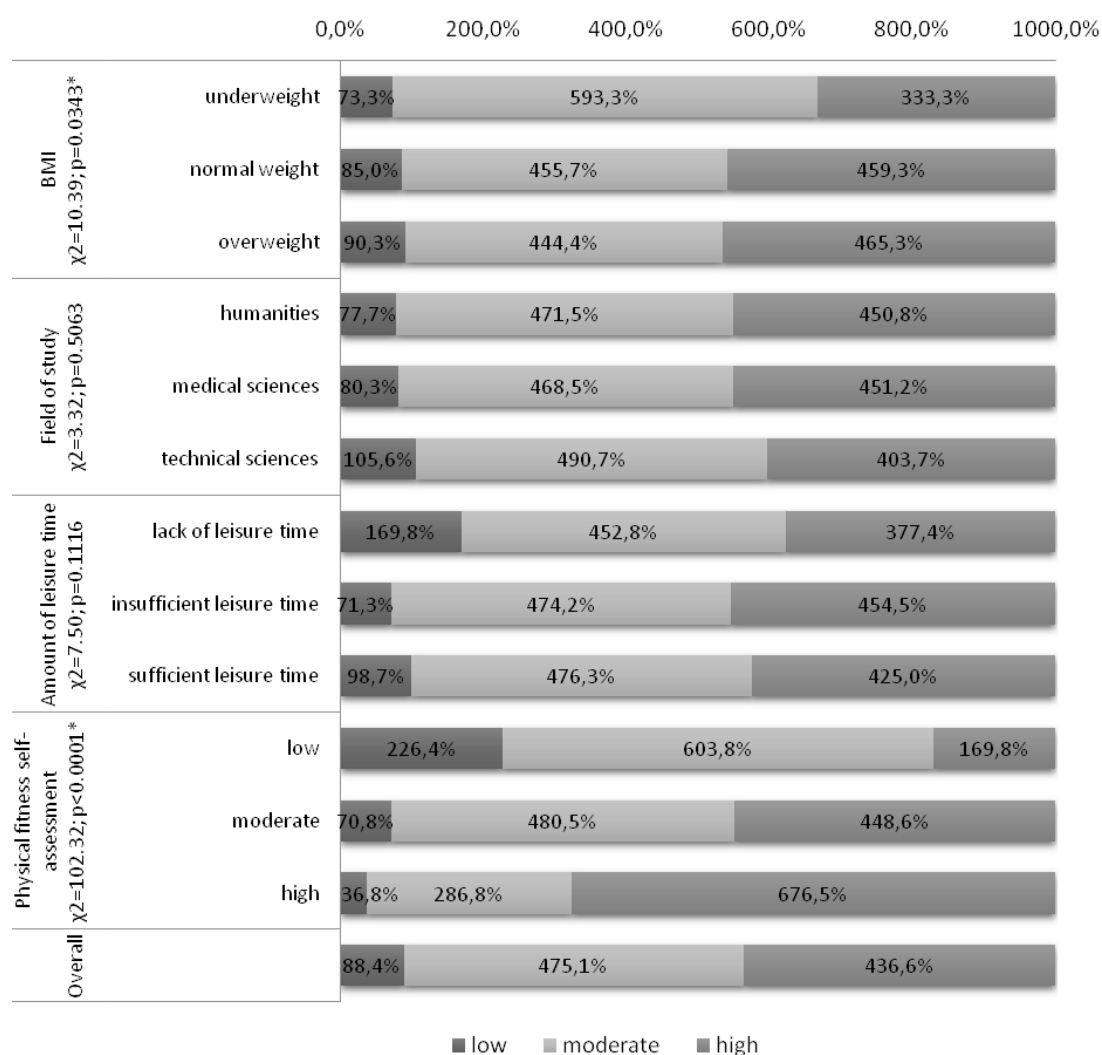
H - value of the Kruskal-Wallis test

* - significant differences at $p < 0.05$

** - amounts of leisure time between which there is a significant statistical variation in Mann-Whitney U post hoc test; 1-low, 2-moderate, 3-high

Figure 4. Level of physical activity and its domains in comparison to female student leisure time

Most of the surveyed female students showed an average (47.5%) and high (43.7%), level of physical activity. The statistical analysis revealed statistically significant differences in the case of BMI ($p = 0.0343$), where as many as 59.3% of underweight persons achieved a moderate level of physical activity and physical fitness self-assessment ($p < 0.0001$), where a rise of self-assessment from low, through moderate to high has increased the physical activity in female students from a high level of 17.0% to 44.9%, and ultimately to 67.7%. When the other factors, i.e. courses of studies and the amount of leisure time are taken into account, the statistical analysis showed no significant differences in the level of students' physical activity (Figure 5).



χ^2 - Pearson's chi squared test

* - significant differences at $p < 0.05$

Figure 5. Level of physical activity in students in comparison to the selected domains

Physical activity measured in the domain of recreation, sport and leisure time indicated that 80.7% of the surveyed female students from the V4 countries meet the latest WHO recommendations on the health-related amount of physical activity (Figure 6). The group consisted of persons who reported at least 150 min./wk. of moderate effort, or at least 75 min./wk. of vigorous effort or cumulative efforts (vigorous and moderate levels) lasting for at least 10 minutes. The remaining respondents, i.e. nearly 20%, did not meet these criteria.

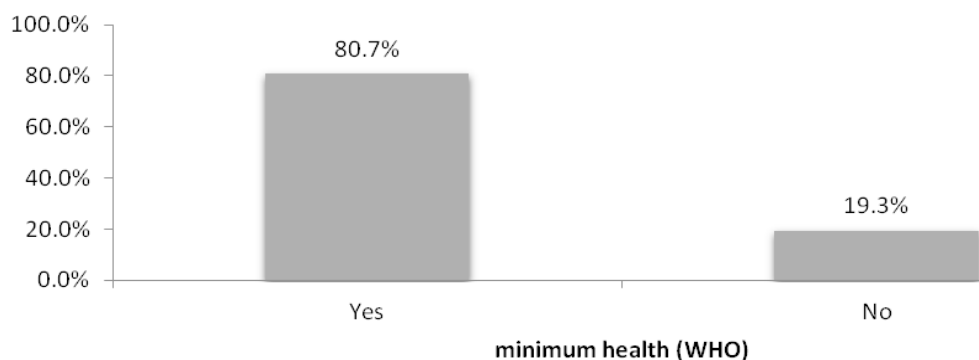


Figure 6. Percentage of female students from V4 countries achieving the minimum requirement of physical activity for health according to the WHO

Discussion

The research findings presented in the work show different levels of physical activity for different domains among female students' life in the V4 countries with regard to BMI, field of study, physical fitness self-assessment and amount of leisure time. In order to achieve the objectives of this study, the long version of the International Physical Activity Questionnaire (IPAQ) was used.

What seems worth noting was that the majority of the surveyed female students from V4 countries showed a moderate (47.5%) and high (43.7%) level of physical activity. However, different test results were obtained by Guven, Ozcan, Tasgin and Arslan [23], who observed a lower level of physical activity among Turkish female students. A high level of physical activity was visible only in 24.9% of the respondents, while moderate and low in 44.9% and 30.2% respectively.

Nevertheless, high and moderate levels of physical activity effectively lowered the proportion of students with abnormal body weights. Among the female students from the V4 countries, only every fourth was seen as underweight or overweight. When compared to the European populations, this seems to be a very positive finding, since the percentage of obese women in Poland is estimated to have reached 15.2%, which ranks our country below the average for the European Union female population, i.e. (16.5%) [24]. Furthermore, the studies indicated that there is a statistically significant statistical variation with regard to BMI, where as many as 59.3% of the underweight population obtained a moderate level of physical activity. This is confirmed by the research findings conducted by Lipecki Lic and Kukla [25], who analysed the data on physical activity in relation to BMI in female students of the University of Economics in Krakow, and who found that women with lower body weight showed a higher average level of physical activity. Thus, it can be assumed that, to some extent, the obtained findings indicate that physical activity plays a vital role in maintaining proper energy balance in the body.

Another important element in achieving the objective of the study was obtaining information on different levels of physical activity in female students from the V4 countries, with regard to their field of study. A similar level of overall physical activity, i.e. 45.1%, was observed in female students in humanities and medical sciences. The study also confirmed that humanities and medical sciences students exhibited higher levels of physical activity than those doing technical studies courses (10.6%). Similar findings were reported by Mędreła-Kuder [26], who surveyed Polish female students in medical and technical computing universities in Cracow. She proved that female students studying humanities had more positive attitudes towards physical activity than the ones attending technical computing courses. Slightly different data were obtained in the study conducted in India. A high level of physical activity was seen in almost every third female student of medical sciences (32.9%), and a low level of activity in one – in every fifth (16.8%) [27].

When physical activity levels were tested in regard to physical fitness self-assessment, it was found that the highest levels of physical activity were represented by the female students with high physical fitness self-esteem (67.7%), which indicates that they were fitter when compared with the female students of the Medical University of Lublin [28] and the University of Economics in Krakow [25].

When considering physical activity, one remember that activity is largely determined by the amount of leisure time one has. Based on the analysis of the survey findings, one may say that the lowest level of physical activity was visible in female students from the V4 countries who did not possess much leisure time (17%). Numerous scientific studies point to the fact that the primary reason for lack of physical activity was a deficit of time – it was this factor that most Poles pointed to when justifying their low physical activity [2]. Further, the research findings obtained by Biernat [9] indicate a low level of activity undertaken in leisure time. According to the author, it does not bode well for Poles, because technological advances and society trends increasingly deprives people of opportunities to exercise and undertake physical work.

The conducted research indicates that the pro-health recommendations issued by the WHO are met by more than 80% of the female students from the V4 countries. In the UK, only 43.8% of the population (age 35.3 ± 10.4 years) declare participation in recreational activities while in the Netherlands – 48.5% (age 32.7 ± 10.9 years) [29], which is surprising as these countries are known for being very active in this respect and, additionally, their respondents are younger.

The research findings collected by numerous authors show that, although in recent years physical activity increased, it is still sporadic and unsystematic [2]. This finding is all the more important as, when chosen consciously and undertaken habitually, physical activity can become a pillar of human health. Thus, more effort should be put into educating the public on the physical activity guidelines and raising young women's awareness about their significance in health preservation.

Conclusions

The analysis of the survey findings leads to the following conclusions:

1. Female students from the V4 countries demonstrated moderate (47.5%) and high (43.7%) levels of physical activity; thus, health-related recommendations issued by the WHO are met by more than 80% of the respondents.
2. The statistical analysis showed significant statistical differences in the BMI index, as a higher level of physical activity was achieved in females with healthy BMI index and overweight and lower in those with lower level of physical activity.
3. Self-evaluation of physical fitness in female students from V4 countries significantly impacts their level of physical activity in all analysed areas.
4. The field of study and the amount of leisure time do not impact significantly on levels of physical activity.

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EVALUATION OF HEALTH BENEFITS OF PERIPHERAL RESISTANCE TRAINING BASED ON ENERGY EXPENDITURE IN WOMEN AGED 25-35 YEARS

OCENA PROZDROWOTNYCH KORZYŚCI Z OBWODOWEGO TRENINGU OPOROWEGO NA PODSTAWIE WYSIŁKOWEGO WYDATKU ENERGETYCZNEGO U KOBIET W WIEKU 25-35 LAT

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B. Data collection/entry

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C. Data analysis/statistics

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D. Data interpretation

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G. Funds collection

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Summary

Background. The aim of this study was to evaluate the potential health benefits of peripheral strength training in women according to the ACSM protocol.

Material and methods. This study involved 90 women aged 29.2±3.3 years, who performed three sets of 10 resistance exercises repeated 10-15 times with a 60% load of 1RM. Energy expenditure (EE) during the exercises was measured with the Caltrac Monitor accelerometer. Their intensity (relative EE) was expressed in kcal/min. Results were compared to the recommended volume of daily physical activity according to the proposals of Paffenbarter and colleagues. Effort of at least moderate intensity (5.5-7.4 kcal/min) was considered to be beneficial for health.

Results. The average EE of the entire training was 293 kcal, resistance exercises 230 kcal and the average intensity effort was 7.3 kcal/min. It was shown that peripheral resistance training, according to the ACSM Protocol, allowed all examined women to fulfil pro-health recommendations for the volume and intensity of daily physical activity (in terms of absolute and relative energy expenditure).

Conclusions. Peripheral resistance training in accordance with ACSM protocol can be recommended to women aged 25-35 as a form of implementation of pro-health recommendations in the scope of due daily energy expenditure on physical effort, as well as its intensity.

Keywords: physical activity, recommendations, energy expenditure, resistance training, women

Streszczenie

Wprowadzenie. Celem badań była ocena potencjalnych korzyści zdrowotnych obwodowego treningu siłowego prowadzonego wg protokołu ACSM u kobiet.

Materiał i metody. Badano 90 kobiet w wieku 29.2±3.3 lat, które wykonywały trzykrotnie 10 ćwiczeń oporowych powtarzanych 10-15 razy z obciążeniem 60% 1RM. Wydatek energetyczny (EE) podczas ćwiczeń mierzono akcelerometrem Caltrac Monitor. Ich intensywność (względny EE) ujęto w kcal/min. Uzyskane wyniki porównano do zalecanej dla zdrowia objętości dziennej aktywności fizycznej wg propozycji Paffenbargera i współautorów. Za prozdrowotny uznano wysiłek o co najmniej umiarkowanej intensywności (5.5-7.4 kcal/min).

Wyniki. Średni EE całego treningu wyniósł 293 kcal, ćwiczeń oporowych 230 kcal, średnia intensywność wysiłku kształtowała się na poziomie 7.3 kcal/min. Wykazano, iż obwodowy trening oporowy wg Protokołu ACSM pozwolił wszystkim badanym kobietom na wypełnienie prozdrowotnych zaleceń dla objętości i intensywności dziennego wysiłku fizycznego (w zakresie bezwzględnego i względnego wydatku energetycznego).

Wnioski. Obwodowy trening oporowy wg protokołu ACSM można polecać kobietom w wieku 25-35 lat jako formę realizacji prozdrowotnych rekomendacji w zakresie należnego dziennego wydatku energetycznego na wysiłek fizyczny, jak i jego intensywności.

Słowa kluczowe: aktywność fizyczna, zalecenia, wydatek energetyczny, trening oporowy, kobiety

Tables: 3

Figures: 0

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Introduction

It is increasingly considered that undertaking physical activity for health purposes is an expression of personal culture and civilisation progress in the awareness of societies with regard to the importance of maintaining one's own health. The current state of knowledge allows us to treat physical activity as an independent positive factor and a measure of health, as well as a basic health behaviour [1, 2]. Meanwhile, the results of national studies, aimed at assessing physical activity in the Polish society in the context of achieving health benefits, indicate that this level is unsatisfactory [3, 4, 5, 6].

In recent decades there has been a steady progress in the identification of the complex of physical activity parameters in the guidelines for health promotion in people of different ages, as well as a tendency to tighten the minimum criteria for their level [7, 8, 9, 10, 11]. As a result, there has been a growing interest in searching for and improving the tools for measuring (estimating) different parameters of physical activity, enabling the assessment of its potential and pro-health benefits of the exercising (training) person.

An important indicator of the level of physical activity (PA) is energy expenditure (EE) and caloric cost (CC), considered to be the basic criterion for assessing its health beneficial character [7, 12, 13]. The monitoring of energy expenditure, while undertaking various physical activities in everyday life or during health training, is a largely ignored issue [14], which especially (in particular) concerns the measurement (estimation) of energy of the strength (resistance) exercises [15, 16]. In the past, the energy cost (EC) of such an effort was estimated, among others, indirectly through the analysis of gas exchange (indirect calorimetry) during strength exercises and in the post-workout restitution phase [17, 18]. In experimental studies, the indirect calorimetry method is generally used to evaluate energy expenditure during resistance training (RT) of women and men [19, 20, 21]. It is necessary in this case to possess expensive measuring equipment, however, its use in research of a large group of people practising, for example, resistance training is not possible, therefore the commonly available technique of accelerometry is also used [22].

The necessity to explore reliable tools for evaluation of energy expenditure during resistance exercises results from the current recommendations for pro-health PA. The imperative to perform them not less than twice a week, with at least moderate intensity, is taken into account [10, 11]. The volume and intensity indicators of resistance exercises can be absolute energy expenditure (AEE) expressed in kilocalories (kcal) and relative energy expenditure (REE) expressed in kilocalories per minute (kcal/min) or as a conventional METs unit (kcal/kg/h) [23, 9, 24].

Performing resistance exercises of the recommended characteristics is to be used in adults, mainly for the prevention of diseases of the motor and nervous systems, such as: chronic back, joints and muscles pain, osteoporosis, sarcopenia, Parkinson's disease, which are included in the group of civilization and hypokinetic diseases (due to the lack of physical activity). Not without significance is also the improvement of functional fitness that facilitates everyday life activities and general physical condition necessary for a satisfactory quality of individual life [8, 25, 26, 27].

The aim of this study is to evaluate the health benefits of resistance exercises carried out in the form of a circuit resistance training in accordance with the ACSM protocol (ACSM Resistance Training Protocol) [10] based on the monitoring of energy expenditure during exercise with the Caltrac Monitor accelerometer in women aged 25-35 years.

Material and methods

The study was conducted at the turn of April and May 2015 among 90 women aged 29.2 ± 3.3 years attending regular (three times a week) strength training in the fitness centre "Aqua Planet" in Trzebinia, Małopolskie Voivodeship (Poland). Recruitment for the study was conducted in the form of voluntary applications (arbitrary selection) from among women with 2-3 years of training experience. The participants were acquainted with the aim and programme (scope) and the planned scope of the research a few days before the start of the training. It was also pointed out that it is possible to resign at any time during the research without stating the reasons. Descriptive characteristics of basic features and indicators of somatic structure of the studied women are presented in Table 1.

Table 1. Descriptive statistics of biometric parameters of the studied women (n=90)

Parameters	Unit of measure	\bar{x}	SD	Min	Max
BH	cm	165.0	4.8	159.0	185.0
BM	kg	60.5	5.0	51.0	70.0
BMI	kg/m ²	22.2	1.2	19.9	24.8
BF	%	22.5	4.8	11.0	33.0
VFI	unit	2.4	1.5	1.0	7.0

Note:

BH – body height, BM – body mass, BMI – body mass index, FR – fat rage, VFI – visceral fat indicator.

The following measurements were included in the programme:

- body height with the use of medical weight Radwag model 100/200 OW,
- body composition with the use of Tanita MC780S bioimpedance analyser,
- the caloric cost of strength training in the form of circuit resistance training – CRT with a single-axis Caltrac Monitor accelerometer from Muscle Dynamitics. Inc. Torrance. CA, USA.

In the first stage of the study, carried out in the morning on an empty stomach, after at least eight hours of sleep and 12 breaks from increased physical activity, the body height (BH), body mass (BM), relative body mass indexes (BMI), degree of body fatness (BF) and visceral (cellular) fat indicator (VFI) were measured with the women wearing a shirt and training shorts.

In the afternoon hours of the second stage, physical effort during circuit resistance training was monitored with the Caltrac Monitor accelerometer. The data on gender, age, height and weight were entered into the device's memory and carried in a special case attached to a belt placed at the height of the waist. The accelerometer provided the data on absolute (kcal) and relative (kcal/min) energy expenditure of this type of classes separately for the warm-up (EE WUP), the first (EE I), the second (EE II) and the third (EE III) circuit training. After each reading of the caloric cost, the device was reset.

During the warm-up (endurance effort) the Caltrac Monitor was set to the basic mode, whereas when performing resistance exercises (strength effort) to the strength training mode. All monitored trainings, carried out in accordance with ACSM recommendations [10], consisted of a warm-up (introductory part), exercises for the main muscle parts (main part), stretching and calming exercises (final part). The cross-country warm-up for all subjects was carried out on a moving treadmill at a speed of 7 km/h over a period of 10 minutes.

After the warm-up, the subjects performed three sets of 10 exercises (1-8 with an external load of 9-10 with own body weight). The training circuit consisted of the following exercises according to the order in which they were performed: 1. Barbell squats, 2. Barbell bench press, 3. Deadlift, 4. Wide-grip lat pulldown, 5. Dumbbell shoulder press, 6. Standing dumbbell calf raise, 7. Close-grip EZ bar curl, 8. EZ bar skullcrusher, 9. Sit-ups, 10 Push-ups.

Exercises 1-8 and 10 were performed 10 times, the ninth was repeated fifteen times. A single exercise with the acceptance of the starting position lasted about 60 seconds, the transition to the next position (a form of active rest break between exercises) lasted 30 seconds. The total time of performing a single set of exercises was 15 minutes, while a set of three was 45 minutes.

Throughout one day, 3-5 persons, for whom individual loads were prepared at successive workstations of the training circuit, were examined individually. The amount of external load (training weight) was set in exercises 1-8 at 60% of 1RM of the examined person. The size of 1RM for particular exercises was estimated for each of the women on the basis of Brzycki's formula [28] $1RM = W \times 36 / (37 - R)$, where: W – the external load with which one has been trained so far in a specific exercise (result of an interview with the respondents), R – the maximum number of repetitions with W (result of R tests for a specific exercise).

Obtained data on absolute and relative caloric cost (volume and intensity) of peripheral training was used to assess its pro-health value (health benefiting character). Physical effort of about 300 kcal per day is considered beneficial for health in 20-59 years old and a body weight of 70 kg [7]. Based on this assumption, the daily volume of health benefiting exercise was estimated for each of the women according to the formula: $RAEE [kcal/day] = 300 [kcal/day] \times BM [kg] / 70 [kg]$, where: RAEE – due daily caloric cost (recommended daily volume) of physical activity, BM – body weight of the person for whom RAEE was determined. In the case of exercise intensity, physical effort of at least moderate intensity, i.e. between 5.5-7.4 kcal/min [10, 11, 23], was considered to be health benefiting.

Arithmetic averages (\bar{x}), standard deviations (SD) and minimum (Min) and maximum (Max) values for the variables under consideration were used in the statistical elaboration of the collected empirical material. All analyses were carried out with the use of Statistica 12.0 computer application by StatSoft.

Results

The average absolute energy expenditure (volume of exercise) during the circuit resistance training in the group of 25-35 years old women was 292.9 ± 8.1 kcal (10-minute initial part of EE WUP~62 kcal, 45-minute main part of EE I-III~230 kcal). The average relative energy expenditure (effort intensity) was 7.3 ± 0.2 kcal/min and was 1.5 kcal/min higher in the main part of the training compared to the warm-up (Table 2).

Table 2. Volume (kcal) and intensity (kcal/min) of physical activity during CRT in a group of women (n=90)

Parameters	Unit of measure	\bar{x}	SD	Min	Max
EE VEO	kcal	61.7	5.1	52.0	71.4
	kcal/min	6.2	0.5	5.2	7.1
EE I	kcal	77.5	3.8	70.0	86.0
	kcal/min	7.7	0.4	7.0	8.6
EE II	kcal	76.4	3.1	70.0	85.0
	kcal/min	7.6	0.3	7.0	8.5
EE III	kcal	77.3	3.0	70.0	83.0
	kcal/min	7.7	0.3	7.0	8.3
EE	kcal	292.9	8.1	273.1	312.3
	kcal/min	7.3	0.2	6.8	7.8

Note:

EE WP – caloric cost of the warm-up, EE I – caloric cost of the first circuit, EE II – caloric cost of the second circuit, EE III – caloric cost of the third circuit, EE – caloric cost of the circuit training.

In the observed group of women, the absolute caloric cost of hourly peripheral training according to ACSM guidelines was on average 44.7 ± 18.0 kcal (10-27%) higher than recommended for health benefits, while the relative cost was 1.8 ± 0.2 kcal/min (29-37%). The minimum and maximum values of variables characterizing the implementation of pro-health recommendations in terms of volume (EE-RAEE) and intensity (EE-RREE) of physical activity indicate that all women met (fulfilled) them in over 100 percent during circuit resistance training carried out according to ACSM guidelines (Table 3).

Table 3. Degree of implementation of pro-health volume (kcal, %) and intensity (kcal/min, %) of physical activity during CRT in the group of women (n=90)

Parameters	Unit of measure	\bar{x}	SD	Min	Max
EE-RAEE	kcal	44.7	18.0	8.4	78.1
	%	118.6	8.6	102.9	136.7
EE-RREE	kcal/min	1.8	0.2	1.3	2.3
	%	133.1	3.7	124.1	142.0

Note:

EE-RAEE – volume of exercise during peripheral training compared to that recommended for obtaining health benefits (RAEE=248±20 kcal, 210-290 kcal).

EE-RREE – exercise intensity during peripheral training compared to that recommended for obtaining health benefits, i.e. medium (moderate) intensity (RREE=5.5-7.4 kcal/min).

Discussion

In the course of this study it was assessed to what extent the resistance training of women, conducted as a circuit resistance training according to ACSM (single-set resistance training protocol), meets the requirements (recommendations) for physical activity for pro-health PA in terms of volume and intensity (absolute and relative energy expenditure). Women aged 25-35 years with at least 2 years of personal experience of participation in regular strength trainings were examined. Most of the subjects had a normal body structure (BMI=19.9-24.8 kg/m²), however, there were individual cases of women with elevated body fat content (BF>32%) [29]. At the same time, the average level of visceral adipose tissue (VFI=1.0-7.0 unit) allows to treat patients with low risk of cardiovascular diseases (arterial hypertension, ischemic heart disease) or metabolic diseases (insulin resistance, type II diabetes).

After the warm-up, the examined patients were able to perform the three-set of resistance training without interruption consisting of 10 strength exercises over a period of three years. The selection of exercises, the size of external load, the number of repetitions of a single exercise and the number of repetitions of an exercise circuit was based on strictly defined recommendations of ACSM experts for health benefiting CRT [9, 10].

The Caltrac Monitor accelerometer was used in the assessment of energy expenditure during the exercises, as it is one of the few devices of this type that allows for different modes of recording accelerations in endurance (aerobic) and resistance (anaerobic) exercises. It allowed to estimate both the energy expenditure during warm-up on the moving treadmill in the so-called basic mode and during resistance exercises in the force training mode. In order to increase the reliability of the observations of energy expenditure during the power training, the research was conducted individually in optimal external circumstances (in the presence of members of the research team only).

In previous studies, the energy expenditure during aerobic efforts was assessed more frequently, mainly on the basis of the amount of oxygen absorbed or achieved during exercise pulse [30], while resistance training (weight training) was the subject of less frequent studies [18, 32].

The results of our own research indicate a high similarity of the average energy expenditure during exercise on three consecutive circuits and their relatively low differentiation in the studied group of women. This may indicate a high state of strength fitness (strength conditions), resulting from training experience. On the other hand, the unified nature and duration of exercises was most probably the reason for a significant similarity of the mean (\bar{x}) results and their slight dispersion (SD) in the assessment of the volume and intensity of physical activity in subsequent exercise circuits. It probably also indicates the usefulness of the research tool (Caltrac Monitor) in monitoring energy expenditure during circuit resistance training, which requires empirical confirmation in further studies. The hypothesis seems to confirm the fact that the collected empirical material was to a large extent similar to the results of previous studies in which energy expenditure during strength training was assessed. For example, in the Phillips & Ziuraitis [32] study, conducted among 12 women and men with the technique of indirect calorimetry, the energy expenditure during one exercise circuit reached an average level of about 81 kcal in women. In a pioneering study conducted by Wilmore et al. [23] women aged 17-26 years consumed more than 360 kcal during one hour's circuit weight training, which is comparable to their own study of about 90 kcal in 15 minutes (single set circuit training). It is worth mentioning, however, that these women were younger and practising sports. Almost identical to their own were also the results of the EE assessment with the Caltrac Monitor accelerometer during the recreational practice of selected combat sports by young men who were beginners in these forms of physical activity. During an hour-long strength and speed training effort, they spent 270 kcal/hour, i.e. 67 kcal per quarter of an hour [15].

The average intensity of effort during the whole 60-minute CRT reached the level of 7.3 kcal/min (7.2 ± 0.5 METs) in subsequent training circuits, respectively: 7.7, 7.6, 7.7 kcal/min (7.6, 7.5, 7.8 METs). Therefore, it was an effort at the borderline of moderate and high intensity [11]. In a study by Wilmore et al. [23] and Reilly [33], the intensity of women's effort during circuit weight training ranged from slightly lower 6.6-6.7 kcal/min. For comparison, the intensity of exercises (relative EE) from the MMA area in novice participants was determined at the level of 6.0 ± 2.1 kcal/min (6 METs) [34, 35]. In compendia of intensity of various forms of physical activity, peripheral training was classified as conditionings exercise with moderate (4.3 METs) or high effort (8.0 METs) [24]. In the latter case, the breaks between exercises should be with minimal rest, whereas the resistance to overcome should be high, i.e. exercise with kettlebells. This was the nature of the exercises in our own research, hence their intensity was close to the lower limit of the high level.

The research has shown that during the observed strength training in the form of circuit resistance training, all women significantly exceeded the daily energy expenditure on physical activity recommended for health by Paffenbarter and others [7] (on average by more than 40%). Its implementation would ensure that the majority of the examined patients have already completed two-set resistance training of the ACSM protocol.

In previous studies, the most frequently evaluated were the compliance with pro-health recommendations based on aerobic (endurance) and mixed effort exercises [36, 37, 15, 38, 39, 40]. For instance, Scheers and others [38] demonstrated that the WHO recommended weekly volume of physical activity of moderate intensity (150 min. MPA) was implemented by more than 68% of women. In the case of high-intensity efforts (75 min. VPA), only less than 16% of this group met this criterion.

In the aforementioned studies by Mynarski and co-authors [15], approximately 80% of young men practising recreational combat sports met the criteria for pro-health intensity of effort. In this context, it should be added here that the parameters of recommended health benefits (PA) are the same for women and men.

Few similar studies have been carried out on the fulfilment of pro-health recommendations regarding the intensity of strength training, which should be undertaken at least twice a week with at least moderate intensity.

Most of these observations were based on a small number of research samples, as compared to the ones described in this study (90 women) [25, 26, 27]. The criterion of intensity of effort was met by all participants of own research already during the single-set resistance training.

To conclude, it is important to emphasise that the studied women met both evaluated criteria of pro-health physical activity, which should be considered a fundamental value of strength training. The results of the research conducted so far indicate that the percentage of respondents meeting specific recommendations decreases with the number of criteria included in them [36, 35, 38, 40].

Conclusions

1. During peripheral resistance training according to ACSM protocol, the examined women significantly exceeded the recommended daily energy expenditure.
2. Strength (resistance) exercises performed during resistance training were at least of moderate intensity in all subjects.
3. Peripheral strength training can be recommended to women aged 25-35 as a form of implementing pro-health recommendations for daily energy expenditure and recommended intensity of effort.

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SELECTED LIFESTYLE FACTORS OF FEMALE UNIVERSITY STUDENTS AS RELATED TO SPORTS ACTIVITIES

WYBRANE CZYNNIKI STYLU ŻYCIA STUDENTEK W ŚWIETLE AKTYWNOŚCI SPORTOWEJ

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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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F. Literature analysis/search

wyszukiwanie i analiza literatury

G. Funds collection

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Summary

Background. The transition from high school to college is an important milestone in the life of adolescents. In this stage of life, they are already aware of their responsibility for their health, which allows them to develop their health habits. The aim of this study was to increase the knowledge about selected aspects of female university students' lifestyle, including sports, sleep, stress, alcohol and smoking.

Material and methods. This cross-sectional research was carried out with 1,055 female university students in their first year of study at two universities in Slovakia as part of the VEGA grant project no. 1/0825/17 "Recommendations for physical activities in prevention and control of non-communicable diseases and their implementation in the Eastern part of Slovakia" implemented at P.J. Šafárik University in Košice. Data was collected on lifestyle factors, including frequency and regularity of participating in sports during the preceding half year, by means of a questionnaire.

Results. Students of both universities reported low levels of engagement in sport activity in the preceding six months, in terms of frequency and regularity of its weekly performance. There appeared to be a statistically significant relationship between the frequency of sport activity and fatigue after waking. Other relationships were not found to be statistically significant.

Conclusions. The scope of educational work by university education experts should include appropriate ways of influencing the lifestyle of first-year university students towards maintaining their good health. This can be carried out within the context of health education during compulsory and optional physical education classes.

Keywords: sleep, alcohol, stress, smoking, sporting activity

Streszczenie

Wprowadzenie. Przejście ze szkoły średniej na studia jest ważnym krokiem w życiu nastolatków. Na tym etapie życia są już świadomi swojej odpowiedzialności za własne zdrowie, co pozwala im rozwijać nawyki zdrowotne. Celem badań było poszerzenie wiedzy na temat wybranych aspektów stylu życia, takich jak sport, sen, stres, alkohol i palenie papierosów.

Materiał i metody. Badania przekrojowe przeprowadzono w grupie 1055 studentek na pierwszym roku studiów na dwóch uniwersytetach na Słowacji w ramach projektu grantowego VEGA nr 1/0825/17 „Wskazania do aktywności fizycznej w celu zapobiegania i kontroli chorób niezakaźnych oraz ich wdrożenie we wschodniej części Słowacji” przeprowadzonego na Uniwersytecie P. J. Šafárika w Košiciach. Dane dotyczące częstotliwości i regularności uprawiania sportu, wybranych czynników stylu życia w przebiegu ostatniego półrocza zebrano za pomocą kwestionariusza.

Wyniki. U studentek obu uczelni odnotowaliśmy niski poziom zaangażowania w aktywność sportową w poprzednich sześciu miesiącach pod względem tygodniowej częstotliwości i regularności jej realizowania. Stwierdziliśmy istotną korelację pomiędzy częstotliwością aktywności sportowej a zmęczeniem po przebudzeniu. Inne zależności nie zostały uznane za statystycznie istotne.

Wnioski. Zakres prac edukacyjnych prowadzonych przez nauczycieli akademickich powinien uwzględniać odpowiednie sposoby wpływania na styl życia studentów pierwszego roku w celu utrzymania ich dobrego stanu zdrowia. Można to zrobić w kontekście edukacji zdrowotnej podczas obowiązkowych i nieobowiązkowych zajęć wychowania fizycznego.

Słowa kluczowe: sen, alkohol, stres, palenie papierosów, aktywność sportowa

Tables: 7

Figures: 1

References: 34

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Introduction

University students are an important target group of the adult population in terms of healthy lifestyle. At this stage of life, they are no longer dependent on parents and family in day-to-day activities, and they have to take responsibility for their behavior and their own health [1]. Risk behavior in adolescence, including but not limited to lack of exercise, smoking, alcohol consumption and stress all determine lifestyle in later periods of life. A lifestyle that supports good health includes sufficient time spent relaxing and regenerating mental power and physical strength and so sleep duration and quality plays a significant role. Adolescence is a critical developmental period in life that commonly involves sleep deprivation [2]. It has been proved that health behaviors such as sleep and physical activity (PA) are associated with increased cognitive performance and better study results in students [3, 4]. In addition to academic performance, sleep deprivation can also affect health and mood. According to Harrison and Horn [5], insufficient sleep reduces creative thinking by up to 60% and flexibility of decision-making by almost 40%.

The next serious risk factor that increasingly affects university students is stress. Commencing post-secondary studies, becoming more independent from parents, changing living conditions (including housing), and a change in personal habits are stressors that most students have to cope with. It has been proven that regular PA can be associated with increased levels of life satisfaction in all age groups: in children and adolescents, in young adults, in adults generally and in the elderly [6]. Exercise and sports influence the human psyche both in the short and the long term [7]. According to Biddle & Mutrie [7], physical exercise can be as effective in alleviating the symptoms of anxiety as any other treatment or medication. However, it has not been determined how PA is involved in reducing stress and suppressing the symptoms of depression.

Consumption of addictive substances, especially tobacco and alcohol, together with inadequate diet and low PA levels, significantly affect deaths and diseases that occur in the European region [8, 9]. According to Toumborou et al. [10] the consumption of various addictive substances is the cause of one third of deaths among young people worldwide. Gore et al. [11] further reported consumption of these substances as the fifth most common risky behavior in the lives of 10 to 24-year-olds.

Entering college is an important milestone when new lifestyle habits are formed or existing ones get modified. If changes for the worse become common routine, it will obviously decrease the students' potential for a healthy life.

The aim of this study is to analyze the following aspects of lifestyle in relation to sporting activity: hours of sleep, fatigue after awakening, stress levels in everyday life, alcohol consumption and smoking.

Material and methods

The set for this cross-sectional research consisted of intentionally selected female university students in their first year of study (n=1,055) from 5 faculties of the University of Pavol Jozef Šafárik in Košice (hereinafter UPJŠ, n=727) and from 8 faculties of the Technical University in Košice (hereinafter TUKE, n=328), undertaking initial measurements at the beginning of the winter semesters of academic years 2012/2013 and 2013/2014. The basic characteristics of the set are presented in Table 1. For most female students of the Medical Faculty of UPJŠ and for all TUKE students, the physical education classes during which they underwent the diagnostics were compulsory (n=554). For the rest of the female students at UPJŠ, the class was optional (n=501).

Table 1. Characteristics of the sample of female students

UPJŠ				TUKE			
Number of students		age		Number of students		age	
n	%	n	SD	n	%	M	SD
731	69.7	19.22	2.17	328	56.5	19.55	1.16

Legend: n - absolute frequency % - relative frequency, SD - standard deviation, M - Mean

In order to collect data relevant for this work, the following questions from the questionnaire battery were used:

- Have you done physical exercise or sports regularly within the past six months?
- How much sleep do you get on average?
- Do you often feel tired after waking up in the morning?
- Use the provided scale to rate the stress in your life over the past six months.
- How often do you consume alcohol?
- Do you smoke? If yes, how many cigarettes a day?

The research was carried out within the framework of VEGA grant project no. 1/0825/17 "Recommendations for physical activities in prevention and control of non-communicable diseases and their implementation in the Eastern part of Slovakia" implemented at UPJŠ. All variables were determined in relation to the amount of weekly sporting activity.

All statistical data was processed using IBM's SPSS v24 software application. The Chi-square test of independence was applied to determine the independence of the examined attributes. In case the null hypothesis on independence of the variables was rejected (i.e. $p < 0.05$), z-scores were calculated for mean signed deviation (the sign represents the direction of the deviation, i.e. "+" the increase in empirical against expected, "-" the decrease of empirical against expected) that shall specify dependencies in the columns (one sign for 95% significance, two signs at 99%, and three at 99.9% significance). The mean signed deviation diagram further shows the simultaneously verified significance of the correlation coefficients (at the significance level of 0.05 and 0.01). The Kendall rank correlation coefficient was used to determine the tightness of the relationship between the observed variables. Testing the frequency distribution ratio between the categories of the variable "frequency of sporting activity over the past six months" for each row independently was done by the means of the z-test. Statistical hypotheses were tested at a significance level of $\alpha \leq 0.05$.

The anonymous questionnaire used for data collection included a consent form so that the respondents could give consent for the use and processing of their data for scientific purposes.

Results

PA of female university students was determined by the reported frequency of sporting activity (SA) per week in the period of the prior six months (Figure 1). For the purposes of this study, we combined the categories of frequency of sporting activity into three groups in order to compare individual lifestyle variables: 1) students who performed SA irregularly or not at all, 2) students who did SA regularly once a week and 3) students who carried out SA regularly two, three or even more times a week.

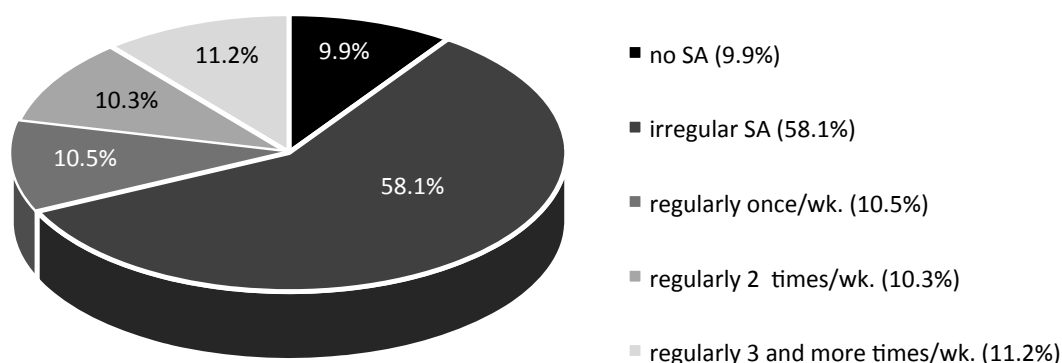


Figure 1. Frequency of weekly SA by female students during the past half a year

From the descriptive statistical data of SA by students of the two largest universities in Eastern Slovakia, it was apparent that approximately 68% of the female students were engaged in such activity irregularly or not at all. The most active group, i.e. those doing sports 2 or more times a week, comprised 21.5% of the students, which is 46.4% less than the students who performed SA irregularly or not at all. The difference was statistically significant ($\chi^2 = 254.343$; $p < 0.05$). The ratio of the percentual frequency of the number of students which performed SA once a week versus the group which performed SA most frequently (57.5%; $\chi^2 = 443.552$, $p < 0.05$) and group of students which performed SA irregularly or not at all (110; $\chi^2 = 39.811$, $p < 0.05$) was statistically significant.

Length of sleep

Sleep is an important lifestyle factor that helps regenerate the central nervous system. Students were asked to indicate the exact number of hours of sleep per day. The average length of sleep reported was 7.3 ± 1.15 (SD; Table 2). The average length of sleep of the students in groups by the frequency of SA was within the range of 7.27-7.31 (SD=1.10-1.19), indicating a uniform distribution of the examined parameter in each group. Approximately 44% of students reported more than 7 hours of sleep (9.8% of whom slept more than 8 hours, 10.6 vs. 9.0 vs. 7.5%,

ranked in ascending order according to the frequency of SA). Although in all groups by their frequency of SA (Table 3) the students also reported average sleep durations of 5 hours and less (4.2% vs. 4.5% vs. 3.5%, ranked in ascending order by the frequency of SA), which is considered insufficient for regeneration and relaxation; the positive finding is that this group represented only 4.1% of the total number of female students. For the proper use of chi-squared independence test, the values were categorized as follows: less than 6 hours of sleep, 6 hours, 6 to 7 hours, 7 to 8 hours, and more than 8 hours of sleep per day.

Table 2. Statistical values of average length of sleep in relation to the frequency of SA in female university students

Weekly frequency of SA	M	min.	max	SD
irregularly or not at all	7.30	4	14	1.17
regularly once a week	7.31	5	12	1.19
regular 2-3 times a week	7.27	4	10	1.1

Legend: M-mean, min.-minimum length of sleep, max.-maximum length of sleep, SD – standard deviation

Table 3. Statistical values of length of sleep in relation to the frequency of SA in female university students

Length of sleep	Weekly frequency of SA							
	irregular or none		regularly once a week		regularly 2-3-times a week		Total	
	n	%	n	%	n	%	n	%
< 6 hrs	32	4.5	6	5.4	9	4.0	47	4.5
6 hrs	134	18.7	19	17.1	47	20.7	200	19.0
> 6 ≤ 7 hrs	246	34.3	38	34.2	62	27.3	346	32.8
> 7 ≤ 8 hrs	229	31.9	38	34.2	9	40.5	359	34.0
> 8 hrs	7	10.6	10	9.0	17	7.5	103	9.8
Total	717	100%	111	100%	227	100%	1,055	100%

Legend: n - absolute frequency, % - relative frequency

At $p > 0.05$ ($\chi^2 = 8.385$, $df = 6$) we found that there is no statistically significant relationship between the length of sleep and the weekly frequency of SA. The difference in frequency between groups of SA categorized by the average length of sleep is minimal. A statistically significant difference was only observed in the category of $> 7 \leq 8$ hours' sleep, i.e. 31.9% vs. 40.5% ($p < 0.05$) between the group doing sports most frequently and the group of female students who performed SA irregularly or not at all. Similar results, showing minimal dependence of the length of sleep on the frequency of performing SA in males, were found in the study by Uher et al. [2013].

Morning fatigue after waking reported by the respondents

Sleep duration and sleep quality are equally important. The best indicator of sleep quality may be the feeling of tiredness after waking. The students indicated their subjective feeling of fatigue after waking on a scale which included: no, mostly no, mostly yes and yes. Almost 5% of female students involved in the study did not feel fatigue after waking up (Table 4), regardless of the frequency of SA per week. The lowest percentage of those feeling fatigue after waking was observed among students with the highest frequency of SA. Female students with more frequent SA reported the lowest fatigue after waking. The answers mostly not and not at all were provided by 60% of them. However, as many as 12% of students felt fatigue after waking in the subgroups of those who performed SA irregularly or not at all. When comparing the number of students among groups with varying frequencies of SA, statistically significant differences in fatigue were observed in the "yes" category between the students who performed SA irregularly or not at all vs. those who did sports once a week (12.1% vs. 5.5%) and those who performed sports most frequently (12.1% vs. 6.6%). Statistically significant differences in fatigue were found between students who did sports irregularly or not at all, and those who did sports one time per week in the "mostly not" (41.8% vs 54.6%) and "mostly yes" (42.4% vs. 31.3%) fatigue categories. However, in the "mostly yes" category, a statistically significant difference was further found between students doing SA once a week and those performing SA two or more times a week.

Table 4. Subjective evaluation of fatigue after waking in relation to the weekly frequency of SA in female university students

Fatigue after waking	Weekly frequency of SA							
	irregular or none		regularly once a week		regularly 2-3 times a week		Total	
	n	%	n	%	n	%	n	%
no	26	3.6	5	4.6	1	7.5	48	4.6
mostly no	300	41.8	52	47.7	124	54.6	476	45.2
mostly yes	304	42.4	46	42.2	71	31.3	421	40.0
Yes	87	12.1	6	5.5	15	6.6	108	10.3
Total	717	100%	109	100%	227	100%	1053	100%

Legend: n - absolute frequency, % - relative frequency

There was a significant association between the variables fatigue after waking and frequency of SA ($\chi^2 = 25.340$, $p \leq 0.05$ and $\tau_b = -.134$, $p \leq 0.05$). In terms of rank correlation, we may talk about a negative, low level of correlation.

Stress

University study, in terms of its demand on students during the semester and the change elicited by transition to university, is closely linked to increased psychological tension and stress. Female students were asked to subjectively assess their level of stress in the past six months of their lives on a numerical, seven-degree scale. The scale was anchored by 1 (*no stress*) and 7 (*extreme stress*).

Even at the beginning of the semester, approximately 5% of female students experienced extreme stress and about 16% of them substantial stress (Table 5). On the contrary, only a minimal number of respondents (0.5% in total) felt no stress at all. Among the female students who performed SA irregularly or not at all and those doing sports once a week, there was only one student, while in the group performing sports 2 and more times a week there were 3 students out of a total of 1,055 students. For the correct use of the chi-squared independence test, we merged extreme stress levels 1 and 2 into one category and levels 6 and 7 into another joint category. Our finding shows that subjectively evaluated stress rated for the past six months was not mutually interrelated with the frequency of SA ($\chi^2 = 9.558$, $df = 8$, $p > 0.05$).

Table 5. Stress levels in relation to the weekly frequency of SA in female university students

Stress level	Weekly frequency of SA							
	irregular or none		regularly once a week		regularly 2-3 times a week		Total	
	n	%	n	%	n	%	n	%
None	4	6.3	5	5.0	22	11.1	67	7.2
3	68	10.8	16	15.8	26	13.1	110	11.8
medium	205	32.4	29	28.7	59	29.8	293	31.5
5	183	29.0	31	30.7	50	25.3	264	28.4
extreme	136	21.5	20	19.8	41	20.7	197	21.2
Total	632	100%	101	100%	198	100%	931	100%

Legend: n - absolute frequency, % - relative frequency

Risk factors - alcohol consumption and smoking

Alcohol is the most commonly used legal addictive psychoactive substance in Slovakia. We analyzed the relationship between alcohol consumption and weekly frequency of SA. Since we did not include the question about smoking until the second year of the study, the multiplicity of the set relative to this question was lower ($n = 404$).

The options for answers to the question regarding the frequency of alcohol consumption are presented in Table 6. In our research, female students consumed alcohol mostly on an occasional basis (59.5%; Table 6). In terms of SA frequency, it was below 60% for students who did not participate in sports and those who performed SA irregularly, and above 60% for those who performed SA regularly. A high percentage of female students reported that they had never consumed alcohol (12% of the group which participated in SA irregularly or not at all and 7.2% of those who did sports one time a week). Approximately 15% of students with the higher weekly frequency of SA did not ever drink alcohol. Given the fact that the research focused on female students in their first two weeks of the semester, it would be useful to follow further developments during their post-secondary

education. Although a low percentage of students admitted daily or almost daily intake of alcohol, this may be evidence of habits previously developed at secondary school. However, this percentage is very low (from 0.7% in the group which participated in SA irregularly or not at all, up to 1.8% of female students who performed SA 2 to 3 times a week). No statistically significant correlation between alcohol consumption and the frequency of SA was observed ($\chi^2 = 16.064$, df 14, $p > 0.05$).

Table 6. Frequency of alcohol consumption in relation to weekly frequency of SA in female university students

Frequency of alcohol consumption	Weekly frequency of SA							
	irregular or none		regularly once a week		regularly 2-3 times a week		Total	
	n	%	n	%	n	%	n	%
Never	83	11.6	8	7.2	3	15.2	125	11.9
occasionally	412	57.7	75	67.6	137	61.2	624	59.5
1-2 times a month	84	11.8	10	9.0	14	6.3	108	10.3
3-4 times a month	5	7.8	7	6.3	15	6.7	78	7.4
1-2 times a week	60	8.4	9	8.1	18	8.0	87	8.3
3-4 times a week	10	1.4	1	0.9	2	0.9	13	1.2
5-6 times a week	4	0.6	0	0.0	0	0.0	4	0.4
daily, almost daily	5	0.7	1	0.9	4	1.8	10	1.0
Total	714	100%	111	100%	224	100%	1049	100%

Legend: n - absolute frequency, % - relative frequency

Smoking is one of the most common habits or addictions having a negative impact on human health. This is a health problem across all societies that causes serious cardiovascular, oncological and other diseases.

When asked about smoking, students that admitted smoking also reported how many cigarettes they smoked a day. The individual variables, grouped accordingly, are listed in Table 7. We found out that more than three quarters of female students did not smoke (Table 7). This includes not only the group which participated in SA irregularly or not at all (almost 80%), but also the group engaged in sports regularly (over 80%). On the other hand, we still observed a high number of those smoking regularly on a daily basis. In the group which participated in SA irregularly or not at all it was almost 21%, in those who did sports 1 x weekly it represented 12.5% and in students who participated in sports 2 and more times a week it was 17%. Only a minimal number of students admitted smoking more than 10 cigarettes a day. This group accounted for six students in the group which participated in SA irregularly or not at all compared to only one student from among those who did sports at least once a week. Not one in the most frequently exercising group reported such a large daily amount of cigarettes. When all groups were considered as one, almost 17% of the students involved in the study smoked on a daily basis. We can assert that the representation of female students in the different categories by the variable of smoking frequency, comparing the individual groups according to the frequency of sports activity over the past six months, was statistically not significant. The group who participated in sports once per week had the highest frequency of smoking as compared to the other groups, but this difference was not significant.

Table 7. Frequency of smoking in relation to weekly frequency of SA in female university students

	Weekly frequency of SA							
	irregular or none		regularly once a week		regularly 2-3 times a week		Total	
	n	%	n	%	n	%	n	%
non-smoker	219	79.3	35	87.5	73	83.0	327	80.9
1-5 cigarettes	37	13.4	4	10.0	13	14.8	54	13.4
6-10 cigarettes	14	5.1	0	0.0	2	2.3	16	4.0
11-15 cigarettes	5	1.8	0	0.0	0	0.0	5	1.2
more than 15 cigarettes	1	0.4	1	2.5	0	0.0	2	0.5
Total	276	100%	40	100%	88	100%	404	100%

Legend: n - absolute frequency, % - relative frequency

Discussion

Sleep is a basic physiological need just as much as sufficient fluid intake and appropriate quantities of nutritious foods. Sleep is of particular importance for university students because of their increased mental activity. Students suffering from sleep deprivation experience increased levels of depression, anxiety, stress and various health problems [13]. In our study, the average length of sleep reported by first year female university students was approximately 7.3 hours, regardless of the frequency of SA per week. Differences between groups with respect to SA are negligible. With reference to the American Academy of Sleep Medicine and the Sleep Research Society [14], we can assert that the female students participating in our study have sufficient sleep duration. According to Buman [15], the average length of sleep gradually decreases from 8.4 hours at the age of 11-12 years down to 6.9 hours at the age of 18 to 19. For illustration, in a study by Kukačka & Lundáková [16], 8.8% out of a total of 1,151 university students (of which 744 were women) from the University of Bohemia, claimed that 6 hours or even less sleep were sufficient for them. The most frequently reported length of sleep in the research quoted above was 7-8 hours (77.8%). Only 3.1% of the set indicated sleeping for 10 hours or longer. As far as women are concerned in the same work, they demonstrably prefer a sleep time duration of 8 hours (approximately 40%), or 7 hours (approximately 35%), which corresponds with our results. Within all our research groups in relation to SA, the minimum sleep time duration observed in the students in our study is 4 to 5 hours, which is generally considered insufficient for regeneration. Sleep time duration of less than 6 hours is reported by only 4.5% of the set. Bartel et al. [17] studied adults in Australia, Canada, and the Netherlands examining several variables in relation to sleep. According to the results, high intensity of exercise was associated with longer sleep duration, but at a more frequent weekly SA. However, there was no difference in the length of sleep among young people who practiced mild physical exercise, regardless of the weekly frequency of SA. Our study does not compare the intensity of the SA performed in relation to its length, but only to its frequency. Thus the results only indicate a similar tendency regarding the latter.

Sleep quality is equally important as length of sleep. Praško [18] claims that the indicator of good quality sleep is arising from bed sufficiently rested and full of energy. Sleep deprivation may increase inattention among the youth, particularly in the morning. Female students participating in our research did not feel sleepy and tired after waking up in the morning, regardless of the frequency of weekly SA. Students with the most frequent SA reported the lowest fatigue after waking, but this difference was not significant. Morning fatigue among female students is not unusual, as evidenced by several studies. Such is the work of Kwan et al. [19] who studied risk behavior in university students from all over Canada ($n = 8,182$, of which 5,542 were women). In this study, low quality sleep was found in 75.6% of the respondents. In another study by Hussain et al. [20] who examined Australian students ($n = 355$, of which 244 women), more than half of the respondents experienced fatigue or lack of energy. In the study of Kukačka and Lundáková [16] only 18.6% of the students at a Czech university ($n = 1,151$, of which 744 women) were fully satisfied with their sleep.

Stress is a natural part of a person's life, including university students. What matters is its degree and the ability to adapt. University students face a number of stressors, such as academic overload, constant pressure to succeed, competition among colleagues, and future uncertainty [21]. The first year of college in particular is a critical period for the first occurrence of depressive symptoms. As many as 4.2% of female students in our study felt extreme stress at the beginning of the semester. Only a minimum number of respondents felt no stress at all. According to Tavalacci et al. [21], physical activity is beneficial for mental health and stress perception. Our results do not clearly support the above statement as we found no significant relationship between stress level and weekly frequency of SA. However, in the study by Zusková et al. [22], which examined the relationship between the level of stress and subjective evaluation of the amount of physical activity in the past year, a significant negative relationship of the two variables had been confirmed both in the set of male students and female students (females $\chi^2 = 36.6133$, $df = 12$, $p < 0.01$; males $\chi^2 = 27.2819$, $df = 12$, $p < 0.01$). The study by Doležalová and Pinkavová [23] found that 61.1% of the respondents indicated their course of study in college being their main source of stress, while 22% of them blamed their stress on time pressure. Similar results regarding the perception of stress were observed in female college students studying medicine in the Netherlands [24]. The authors cited above have concluded that female students are more sensitive to stress and find it harder to study under the pressure of having to meet expectations. Sokratous et al. [25] found a prevalence of mild depression symptoms (almost 19%), and clinically significant depression symptoms (25%) while examining university students on Cyprus. The authors found substantial differences in clinically significant symptoms of depression by gender, with a higher incidence in women ($\chi^2 = 8.53$, $df = 1$, $p = 0.003$). Therefore, the prevention of health-related psychological problems in female students is important. Appropriate leisure-time activities can compensate for a perception of elevated stress levels.

Alcohol is one of the most widespread drugs in the world. The university environment tends to promote smoking and drinking of alcoholic beverages [26, 27]. Data on average alcohol consumption by students in their first year of study are concerning. In the study by Podstawski et al. [28], a relatively high percentage of female students (9%) admitted regular alcohol consumption every day; what is more, more than 12% of the respondents admitted at least one case of drinking until loss of consciousness in their first year. However, the preponderance of women in the same study (61%) reported drinking only occasionally during the first academic year. Such findings correspond with our results. Most female students in our research consume alcohol only occasionally (over 57%), regardless of the weekly volume of SA. Moreover, a relatively high percentage of them (from 7.2% to 15%) claim they have never consumed alcohol. This figure is highest in the group doing sports most frequently, but the difference between the groups is statistically not significant. Some authors [26, 27], observed substantially higher alcohol consumption by those doing more PA compared to students who did not engage in any PA. The results of our study do not correspond with such findings. Most certainly, the different results may be influenced by the factor of gender. Higher alcohol consumption is observed in men [3, 28]. Also, the fact that the participants of the research were first-year students, at the beginning of their studies, could have eliminated the impact of "student life". Many authors present behavioral changes over in the course of study at college [29, 30]. The study by Kwan [19] points out the decline in physical activity and the increase in drinking to impairment and smoking during the transition to early adulthood. As Kwan's study shows, young adults struggle with excessive drinking and smoking, while their participation in PA is reduced steadily.

As many as 20% of female students in our study admit smoking on a regular basis, which is a considerable number. Such finding is perceived negative considering the fact that university students smoke tobacco products substantially less, on average, than the rest of society [31]. On the other hand, the author claims that the cause of alcohol consumption and smoking can be an attempt to escape from school-related problems. A percentage of smokers comparable to our study was found among university students by Terebessy et al. [32], who reported a smoking prevalence of 18.6% in both male and female students at a Budapest university (n=629 students, of which 341 were women) during 3 consecutive years. A somewhat higher prevalence of smoking among female students (19.2%) was found in a study by Hussain et al. [20] involving Australian students.

The above variables do not represent a comprehensive and systematic compilation of all lifestyle factors; they represent only some of them. Many such factors are preventable, their early detection and modification go hand in hand with health education. Primary prevention can have a positive impact on many of them and save considerable resources exerted to prevent negative consequences.

To improve the lifestyle of first-year college students, it is necessary to create meaningful, holistic programs that encourage physical activity. These programs should therefore not only focus on a certain type of sporting activity, but should also take into account other aspects of lifestyle. In particular, based on our results, it is necessary to consider the regularity of doing sports which is further related to the quality of sleep. As female students have a tendency to assess their stress levels higher than average, they may benefit from adopting behavior that works in a compensatory way. Such compensation definitely includes sports activity and good quality sleep. Although the study results do not indicate increased risk of alcohol consumption and smoking, it is very important to prevent such risky behaviors. In particular, this prevention may include making sure that students have sufficient knowledge of the possible consequences of the above risky behaviors. In view of the sporting activity that is part of PA, female students represent a riskier group [33, 34], and therefore related programs need to be designed specifically for the female gender.

Study limitations

The present study was a cross-sectional research where no long-term data were available to assess the differences in the observed lifestyle factors. The questions used in the research were originally formulated for needs of a VEGA research grant project, which may distort explicit comparisons with other such studies. As a result, the data obtained may be considered to have a high level of subjectivity.

The strength of this study remains the high frequency of the studied cohort. Although the data are of high value for predicting the Eastern Slovak region, the results cannot be globalized within Slovakia due to socio-economic diversity.

The sample was comprised of first-year female university students at two Eastern Slovak universities, which is considered a further strength of this study, considering the possibility to partly control homogeneity of the cohort and the demographic factor. However, it also represents a constraint because the results may not be representative at the national level.

Conclusions

In this cross-sectional research, we analyzed the relationship between selected aspects of lifestyle and the frequency of SA, including exercise. We looked at sleep (both hours of sleep and fatigue after waking), subjective assessment of the level of stress in the past six months, alcohol consumption and smoking. There appears to be a statistically significant relationship between the frequency of SA and fatigue after waking. Other relationships have not been found to be statistically significant. Unfavorable results regarding the length of sleep in relation to the frequency of alcohol consumption and smoking draw attention to the need for appropriate interventions to modify the behavior of first year university students. Professionally-oriented young people at this age already have responsibility for their own health. The scope of educational and pedagogical work by university education experts should include appropriate ways of influencing the lifestyle of first-year university students towards maintaining their good health. This can be carried out within the context of health education during compulsory and optional classes of Physical Education.

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THE RELATIONSHIP BETWEEN FAMILY SOCIO-ECONOMIC STATUS, FAMILY SOCIAL SUPPORT AND ADOLESCENT PHYSICAL ACTIVITY

ZWIĄZEK POMIĘDZY STATUSEM SPOŁECZNO-EKONOMICZNYM RODZICÓW, WSPARCIEM SOCJALNYM DLA RODZINY A AKTYWNOŚCIĄ FIZYCZNĄ MŁODZIEŻY

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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. There are numerous benefits of undertaking regular physical activity on health. The World Health Organization (WHO) recommends for young people to undertake at least 60 minutes of moderately intense physical activity daily. Despite the well-known health benefits of exercise, the levels of physically inactive young people are continuously increasing. A large number of studies have found a relationship between socio-economic status and chronic disease. The aim of our study was to examine: the association between family socio-economic status and adolescent physical activity and also to assess the link between social support and adolescents' physical activity and finally to examine whether there are any gender differences. **Material and methods.** There were 3396 final year secondary school students from 33 randomly selected secondary schools from Zagreb included in our study. The study was conducted from April 2015 to June 2016. Physical activity was measured using a short version of the International Physical Activity Questionnaire (IPAQ-SF). Socio-economic status and family social support was assessed using questionnaires.

Results. Boys were significantly more physically active than girls. The results of the logistic regression analysis did not determine a statistically significant association between the socio-economic status and physical activity of the participants.

Conclusions. Family social support and socio-economic status were not positively related to physical activity in Croatian adolescents.

Keywords: IPAQ-SF, socio-economic status, Croatia, students, social capital

Streszczenie

Wprowadzenie. Regularna aktywność fizyczna ma liczne korzyści dla zdrowia, co zostało naukowo potwierdzone badaniami wstępnymi. Światowa Organizacja Zdrowia (WHO) zaleca, aby codzienna aktywność fizyczna dzieci i młodzieży o intensywności umiarkowanej do wzmożonej wynosiła co najmniej 60 minut. Pomimo korzyści zdrowotnych oraz zaleceń WHO liczba dzieci i młodzieży niepodlegających aktywności fizycznej stale rośnie. Liczne badania stwierdzają pozytywny związek między statusem społeczno-ekonomicznym a chorobami przewlekłymi i wskaźnikami umieralności. Niniejsze badanie miało na celu: 1) analizę związku pomiędzy statusem społeczno-ekonomicznym rodziców a aktywnością fizyczną młodzieży; 2) ocenę związku pomiędzy wsparciem socjalnym rodziców a aktywnością fizyczną młodzieży oraz ustalenie, czy istnieją różnice w odniesieniu do płci.

Materiał i metody. W badaniu wzięło udział 3396 uczniów ostatniego roku szkoły średniej z 33 losowo wybranych szkół średnich z Zagrzebia. Badanie to było prowadzone od kwietnia do czerwca w roku szkolnym 2015/2016. Aktywność fizyczną mierzono za pomocą skróconej wersji Międzynarodowego Kwestionariusza Aktywności Fizycznej (IPAQ-SF). Status społeczno-ekonomiczny oraz wsparcie socjalne rodziców oceniono za pomocą kwestionariuszy.

Wyniki. Chłopcy wykazywali znacznie większą aktywność fizyczną niż dziewczęta. Wyniki analizy regresji logistycznej nie wskazują na statystycznie istotny związek pomiędzy statusem społeczno-ekonomicznym a aktywnością fizyczną uczestników.

Wnioski. Wsparcie socjalne dla rodziny oraz status społeczno-ekonomiczny rodziców nie wywierają korzystnego wpływu na aktywność fizyczną chorwackiej młodzieży.

Słowa kluczowe: IPAQ-SF, status społeczno-ekonomiczny, Chorwacja, uczniowie, kapitał społeczny

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Introduction

Daily physical activity is an essential for optimum growth and development of children and young people. The numerous benefits of regular physical activity on health have been proven from previous research [1]. The World Health Organization (WHO) recommends at least 60 minutes of physical activity moderate to vigorous intensity daily for children and young people. Despite the numerous health benefits and WHO's recommendations, the prevalence of physically inactive adolescents and children has been increasing [2]. According to the WHO, physical inactivity is one of the leading risk factors for global mortality [3].

Levels of physical activity is affected by several factors, and in the recent years there has been an increase in research interest on the impact of socio-economic status on levels of physical activity [4]. Socio-economic status (SES) is defined as an economic and social measure of an individual's position in the social hierarchy based on income, education level and occupation [5]. SES is an important predictor of health as it influences the attitudes, experiences and exposure of people to health risk factors. A large number of studies have found a relationship between lower socio-economic status and chronic diseases and their mortality rates [6, 7]. The relationship between lower socio-economic status and health is not limited exclusively to adults. The children of low SES parents are exposed to a higher risk of cardiovascular disease and unhealthy lifestyle than the children of higher SES parents [8]. However, some research has revealed a negative relationship between the level of physical activity among young people and the parental socio-economic status [9-11].

Family social support is an important factor in the life of children and adolescents. Previous studies have determined a positive association between family social support and physical activity of adolescents [12]. Physical activity habits of the parents' [13], parental attitudes and beliefs toward physical activity [14] and social support of parents are some of the factors who have been positively associated with children and youth physical activity. However, some research have shown the contrary, revealing a negative relationship between the level of family social support and physical activity of adolescents [15].

Due to the conflicting results of the research conducted so far, the main objective of our study was to identify the relationship between parents' socio-economic status, family social support and physical activity among adolescents and to examine whether there are gender differences in order to better understand the importance of physical activity on the health of adolescents.

Material and methods

Subjects

The sample was drawn from the population of final year secondary school students from Zagreb. A planned number of respondents were 4000, from 33 randomly selected secondary schools. After data collection the total number of useable respondents was 3396 (1726 female students and 1670 male students) who participated in this study. Questionnaires containing a majority of missing information (N = 604) were excluded from the analysis. Informed written consent was obtained from the students before filling out the questionnaires. The average age of the adolescents was 18.1 y (range 17/20).

Socio-economic status

Socio-economic status (SES) is based on the employment of both parents at the time the study was conducted. The employment of the father and the mother was categorized into three groups: high SES marked with number 1 (e.g. managerial positions), middle SES marked with number 2 (e.g. white-collar worker) and low SES marked with number 3 (e.g. blue-collar worker) [16]. Socio-economic status of parents was calculated based on the combination of the socio-economic status of the mother and of the father. The values in the variable of the father's and the mother's SES were added up and the variable was then dichotomized to a high socio-economic status (the sum of answers ranging from 2 to 4) and to a low socio-economic status (the sum of answers ranging from 5 to 6).

Family social support

Family social support was assessed by the single item: 'Do you feel your family understands and gives attention to you during high school?' [17]. The response options were rated 1-5 on a Likert scale: 5 'strongly agree'; 4 'agree'; 3 'neither agree or disagree'; 2 'disagree'; 1 'strongly disagree'. The responses 1-3 dichotomized variable indicating lower perceived family social support and responses 4-5 indicating higher perceived family social support.

Assessment of physical activity

Physical activity (PA) was assessed by using the short version of the International Physical Activity Questionnaire (IPAQ-SF). This version consists of nine items and provides information on the time spent walking, in vigorous- and moderate-intensity activity and in sedentary activity. Participants of the study were instructed to refer to all areas of physical activity over the previous seven days. The questionnaire was translated into Croatian and metric characteristics were determined. In 2016, Ajman, Đapić-Štriga and Novak [18] identified the reliability level of the questionnaire to 0.64. The results referring to the physical activity level obtained by the IPAQ-SF questionnaire were categorized into one of three possible categories of physical activity (Table 2): insufficient activity (0-600 MET-min./week), minimum activity (601-3000 MET-min./week) and sufficient activity ($x > 3001$ MET-min./week), in order to be in line with the recommendations of the WHO on at least 60 minutes of moderate to vigorous intensity physical activity daily for children and young people [19]. In further data analysis, the variable of physical activity was dichotomized to satisfactory (high level PA) physical activity indicated by number 0 and insufficient physical activity (low and moderate PA level) indicated by number 1.

Procedure

The study was conducted from April 2015 to June 2016. Questionnaires were distributed during physical education classes and filled out by 4000 students. Questionnaires containing a majority of missing information ($N = 604$) were excluded from the analysis. A total of 3396 questionnaires were available for data analysis. A response rate of 84.9% was obtained. Surveys were designed to protect the privacy of the students by enabling anonymous participation. The study protocol was approved by Committee for Scientific Research and Ethics, Faculty of Kinesiology University of Zagreb.

Statistical analysis

The data were analyzed using SPSS (IBM SPSS Statistics for Windows, Version 20.0.). The data analysis involved descriptive statistics, nonparametric test and multivariate analysis. The descriptive statistic parameters were calculated for the physical activity variable. Distribution normality was tested using the Kolmogorov-Smirnov test. The frequency response was calculated for the socio-economic status variables. Statistically significant differences were identified using the Mann-Whitney U test, regarding the gender of the participants. The association of physical activity with family social support and socio-economic status was examined with a logistic regression model, odds ratios (ORs) and 95% confidence intervals (CIs) for low physical activity were calculated.

Results

Descriptive statistics for the physical activity and determinant variables are shown in Table 1. In all categories evaluating the level of physical activity, the average values are higher among male students, which indicates that the level of physical activity in the male is higher than the level of physical activity in female students. The results of the Kolmogorov-Smirnov test indicate that the distribution of results of all items of the physical activity questionnaire deviates significantly from the normal distribution. The average values in variable family social support and socio-economic status are higher among female students, but gender differences in these characteristics didn't determine this value as being significant.

Table 1. Physical activity, family social support and socio-economic status and their relationship with the gender of participants

(MET-min./week)	Male (N = 1726)	Female (N = 1670)	p
Physical activity (total)	6563.83 ± 7226.42	5618.48 ± 6996.37	< 0.05
Physical activity (low)	1123.65 ± 1456.06	539.98 ± 1102.46	< 0.05
Physical activity (moderate)	1267.16 ± 2133.13	982.52 ± 2063.06	< 0.05
Physical activity (high)	4173.01 ± 5906.68	4095.98 ± 5849.34	< 0.05
Family social support	4.19 ± 0.89	4.21 ± 0.90	n.s.
Socio-economic status	3.86 ± 1.65	3.87 ± 1.65	n.s.

n.s. - not significant

The results indicate that the level of physical activity in male students is higher than that of female students. When the data was sorted into the physical activity categories it is obvious that the level of physical activity is higher at boys than the girls (Table 2).

Table 2. Percentage of female and male respondents in physical activity categories

	Total (N = 3396)	Female (N = 1670)	Male (N = 1726)
0 - 600 MET-min/week	14.00	16.90	11.00
601 - 3000 MET- min/week	26.86	29.10	24.40
> 3001 MET- min/week	59.14	54.00	64.60

The parents' SES in this sample indicates that the percentage of both fathers and mothers of the respondents holding managerial positions, white-collar jobs and blue-collar jobs is similar. The highest percentage of fathers is employed in managerial positions, a slightly smaller number hold a blue-collar job, while the smallest number of fathers hold white-collar jobs. The highest percentage of mothers hold blue-collar jobs, followed by managerial positions, while the lowest percentage hold a white-collar job (Table 3). According to the results of the study, there were not unemployed parents. The results have shown that there is no statistically significant difference in socio-economic status among male and female students. The values in the variable of the father's and the mother's SES were combined and the value was then dichotomized to a high socio-economic status (the sum of answers ranging from 2 to 4) and to a low socio-economic status (the sum of answers ranging from 5 to 6).

Table 3. The socio-economic status of parents among student participants

SES	Father			Mother		
	Manager	Blue collar	White collar	Manager	Blue collar	White collar
Total	39.80	21.80	38.40	38.60	21.90	39.50
Male	39.70	22.50	37.80	37.50	23.30	39.20
Female	39.90	21.60	38.50	38.90	22.60	38.50

In the next step, all data was dichotomized and Spearman correlations between socio-economic status, family social support and physical activity are shown in Table 4. For both sexes, socio-economic status and family social support was not significantly related to adolescents' self-reported physical activity.

Table 4. Correlation between socio-economic status, family social support and physical activity

	PA males	PA females	PA total
Socio-economic status	0.70	0.08	0.33
Family social support	0.12	0.63	0.36

$p < 0.01$

Logistic regression analysis found the connection between the physical activity variable and the socio-economic status variable. The results of the logistic regression analysis have shown that there is no statistically significant connection between the socio-economic status of the family, family social support and physical activity of the respondents (Table 5).

Table 5. Odds ratios of physical activity among high school students in Croatia

	Low physical activity (N)	Model 1 OR (95% CI)
Family social support		
High	2797	1.00
Low	599	0.93 (0.78-1.11)
Self-perceived socioeconomic status		
High/Middle	2192	1.00
Low	1204	0.93 (0.81-1.07)
Gender		
Male	1726	1.00
Female	1670	1,551 (1.35-1.78)

OR- odds ratio; CI- confidence interval

Discussion

This study examined the associations between socio-economic status, family social support and adolescent physical activity. Evidence from the study confirms some of the earlier findings that parental social support and the social class of the families were not positively related to adolescent self-reported physical activity. This supports the theory that parents do not have a strong influence on the physical activity habits of adolescents (Table 4).

The results of the logistic regression analysis have shown that there is no statistically significant connection between the socio-economic status of the parents, family social support and physical activity of the respondents and odds ratios (ORs) and 95% confidence intervals (CIs) for low physical activity were calculated (Table 5).

The results of the logistic regression analysis suggest that socio-economic status and family social support does not have a positive connection with the level of physical activity among male and female final year secondary school students, which complies with previous research in this area [9-11]. The results of this study are compatible with the conclusions of the research conducted by Macintyre and Mutrie (2004) [20], which confirmed that SES does not affect the overall level of physical activity, but only the participation in sports clubs.

Family support has been found to influence the participation of physical activity of young people [4]. Previous studies have shown that parental participation in physical activity, encouragement and accessibility to transportation to sporting events have been linked to higher levels of activity among children and adolescents [21]. Our results do not indicate an association between family social support and adolescents' self-reported physical activity. Similar results were also found by Kimiecik, Horn, Shurin (1996) [14] on a sample of 81 families. They tried to establish the link between the physical activity of parents and children, and mutual trust. Results indicate that mutual trust is not associated with physical activity of one or the other. Morgan McKenzie, Sallis, Nader (2003) [22] on a sample of 214 young people also come to the conclusion that the trust and support of parents are not positively associated with physical activity of their children.

The reason of these results can be found in the fact that adolescence is the age at which young people are almost independent of their parents and significant part of free time they spend alone or hanging out with their peers, and the influence of parents on their everyday decisions is much smaller than in earlier age [23].

Physical inactivity and a sedentary lifestyle have unfortunately been recognized as one of the characteristics of modern life. Research has shown that adolescence is the most important life period for creating positive healthy habits, primarily for physical activity whose habits will be practiced at a later stage in life as well [24]. There is a growing prevalence of young people who do not meet the recommended targets for physical activity given by WHO. The results of two global surveys, Health Behaviour in School-aged Children (HBSC) and Global School-Based Student Health Survey (GSHS), covering 105 countries, indicate that 80.3% of respondents do not meet the given recommendations on physical activity [25, 26]. The results of this study have shown that 40.80% of respondents also do not meet these targets, which represent a significantly better result compared to the results of the aforementioned studies.

The level of physical activity is gender-dependent. A number of studies has revealed a higher level of physical activity in boys than in girls [27, 28]. In a sample of adolescents, scientific research has also confirmed that boys are more active than girls. Based on the results of the questionnaire on physical activity, Mota et al. (2008) [29] found that 56.50% of female respondents and 84.80% of male respondents reported a sufficient level of physical activity. In a sample of adolescents from Texas (USA), Springer et al. (2010) [30] concluded that 42.20% of female respondents and 60.00% of male respondents reported a sufficient level of physical activity. However, Mak et al. (2011) [31], based on the results of the questionnaire on physical activity conducted on a sample of adolescents from Hong Kong, established that 70.30% of female respondents and 75.10% of male respondents reported a sufficient level of physical activity. Another international study which was conducted on sample of adolescents from four European countries (Czech Republic, Poland, Slovakia and Hungary), Bergier et al. (2016) [32] concluded that 56.70% to 77.80% of male students occurred in high PA level category opposite to female students where this rate was from 42.4% to 67.40%. Authors also found significant differences between the four countries ($\chi^2=131.814$ $p<0.001$). In Slovakia, Poland and the Czech Republic significant differences were established between sexes, but this was not true for Hungary which showed no significant difference between the two groups.

The results of our study, carried out on a sample of final year secondary school students, are similar to the results of previously conducted research and indicate that female respondents are less physically active than male respondents (54.00% of female respondents and 64.60% of male respondents meet the recommendations on physical activity). The research conducted by Petrić et al. in 2014. [33] on a sample of secondary school students from Istria aged between 16 and 18 showed that 33.10% of female students and 36.90% of male students

reported a sufficient level of physical activity. This study also confirms the hypothesis that boys are more physically active than girls, but the results obtained from the sample of Istrian adolescents differ substantially from the results of this study where a much larger number of respondents who meet the recommendations on physical activity was identified, which may be attributed to the regional aspect. There is a trend of a higher level of physical activity among boys due to their greater interest in sport and sports events and to the fact that boys are often involved in team sports in their free time, while girls are more interested in fashion and show business and are prone to doing independent exercise in their free time [34].

Conclusions

The results of this study have shown that 40.80% of respondents do not meet the given recommendations on physical activity, which represents a significantly better result compared to the results of two global surveys, Health Behaviour in School-aged Children (HBSC) and Global School-Based Student Health Survey (GSHS), which covered 105 countries and found that 80.30% of respondents did not meet the given recommendations. The results, carried out on a sample of final year secondary school students, are similar to the results of previously conducted research and indicate that female respondents are less physically active than male respondents. The results of socio-economic status have shown that the percentage of both fathers and mothers of the respondents holding managerial positions, white-collar jobs and blue-collar jobs is very much similar and that there is no statistically significant difference in socio-economic status among male and female students. The results of family social support have shown that parents equally support male and female respondents to be physically active. The results of the statistical analysis have shown that socio-economic status and family social support does not affect the level of physical activity among male and female final year secondary school students, which complies with previous research.

The advantages of this study are reflected in the fact that the sample of respondents included more than 3000 students in their final year of grammar schools and vocational schools. This study has identified the level of physical activity based on a representative sample of adolescents, the population covered the least by scientific research. However, this study has some limitations. Subjective methods of assessment of physical activity, family social support and socio-economic status were used, so there may be the certain methodological bias which could result in a statistical error in sample results.

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BIOMECHANICAL DYSFUNCTION IN PATIENTS WITH PRIMARY OSTEOARTHRITIS OF THE KNEE: THE ROLE OF PHYSICAL THERAPY

ZABURZENIA BIOMECHANICZNE U PACJENTÓW Z PIERWOTNĄ CHOROBA ZWYRODNIENIOWĄ STAWU KOLANOWEGO: ROLA TERAPII FIZYCZNEJ

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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
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Summary

Biomechanical factors such as reduced muscle strength and narrowing of the knee joint play an important role in the initiation and progression of primary osteoarthritis. Pharmacological treatment is not always effective and, in some cases, is accompanied by side effects. However, some factors associated with osteoarthritis, such as muscle dysfunction and decreased physical activity, may be improved through physical rehabilitation. In this article, we describe the pathogenesis, clinical manifestations and approaches to physical rehabilitation for biomechanical disorders associated with primary osteoarthritis of the knee (gonarthrosis).

Keywords: primary osteoarthritis of knee, biomechanical dysfunction, physical rehabilitation

Streszczenie

Czynniki biomechaniczne, takie jak zmniejszona siła mięśni i zwężenie szczeliny stawowej, odgrywają ważną rolę w inicjacji i progresji pierwotnej gonartrozy. Zabiegi klasyczne, głównie farmakologiczne, nie zawsze są skuteczne, a w niektórych przypadkach towarzyszą im niepożądane działania uboczne. Jednak czynniki związane z chorobą, takie jak zaburzenia funkcji mięśni i zmniejszona aktywność fizyczna, można wyeliminować dzięki metodom rehabilitacji fizycznej. W niniejszym artykule została opisana współczesna koncepcja dotycząca patogenezy, objawów klinicznych i metod rehabilitacji fizycznej zaburzeń biomechanicznych u pacjentów z pierwotną gonartrozą.

Słowa kluczowe: choroba zwyrodnieniowa stawu kolanowego, zaburzenia biomechaniczne, rehabilitacja fizyczna

Introduction

In recent years, osteoarthritis (OA) has attained increasing medical and social significance due to its substantial prevalence, the rapid development of functional disorder (especially with joints of the lower extremities), the presence of both temporary and permanent disability, and a decline in the patients' quality of life. OA is present in 10-15% of the population in Europe and the United States. It affects people of all age groups, but is most common in the elderly. After 60 years of age, the prevalence of OA is twice that observed in middle-aged people. While the exact cause of OA remains unknown, the pathogenetic role of biomechanical dysfunction is proven. For knee joints, mechanical demand and biomechanical changes are important factors for the initiation and progression of OA [1].

Aim of the work

This review focuses on the effects of biomechanical dysfunction on the pathogenesis and progression of primary OA of the knee and the role of physical therapy in its management.

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Brief description of current knowledge

The decline in the functional volume of the articular cartilage in patients with OA of the knee is uneven, is accompanied by pathological changes in the axis of the lower limb and is a result of dysfunction of connective tissue and muscular structures [2].

In clinical practice, chronic pain is common in patients with OA due to local non-articular pathogenetic mechanisms. External articular changes in patients with OA of the knees result in compensatory, adaptive reactions. In such cases, the trigger mechanisms of pain are anatomical, functional and biomechanical. Muscles surrounding the knee are sensitive to both internal or external negative influences on the joint. [3]. Therefore, OA is often accompanied by muscular dysfunction which leads to limitation of joint mobility and pain.

Muscles play a crucial role in maintaining joint mobility, stability and function [4], helping to absorb mechanical stresses and transfer forces through the joints and provide dynamic resistance to normal and damaged joints [4]. It is known that nociceptive impulses in and around affected joints inhibit the activity of muscles and spinal nerves. Such protective inhibition affects not only the condition of muscles which directly support the joint, but can also affect the activity of other distant muscles. According to the multiple researchers [4], disorders of proprioceptive impulses lead to a decrease of periarticular muscle tone and, as a consequence, an increased mechanical load on the joint.

The stability of the knee is provided by active (dynamic) stabilizers that include muscle-tendon complexes and passive (static) stabilizers that include the joint capsule, articular cartilage, ligaments, meniscus, and bone. The dynamic stabilizers provide the most opportunity for compensatory stability [5]. The most important muscle stabilizer is the quadriceps, without which stability of the knee is not possible. Its strength and precise coordination can even compensate for the failure of ligament function. Weakness of the quadriceps may be a risk factor or even an etiological factor for pathological changes in patients with OA of the knees. Quadriceps weakness was found in patients with preclinical and clinical gonarthrosis.

According to the previous studies [3, 4, 6], muscle weakness was associated with the initiation and progression of OA of the knee and is one of the earliest and most frequent symptoms in patients with OA of knee. It is a more likely predictor of disability than joint narrowing or the presence of pain. Research [3] has also shown that an important risk factor for the development of OA of the knees is specific weakness of the quadriceps, which develops as a result of joint instability and decreased muscle capacity during and after physical exercise. In addition, there is a decrease in strength and endurance of many groups of muscles with age and the development of OA, especially of the knees, can exacerbate this weakness and lead to functional disorders. Reduced physical activity resulting from pain in patients with OA leads to further decreases in muscle volume and increased joint instability [4]. Consequently, chronic articular pain in patients with OA leads to muscle atrophy, weakness, an imbalance between agonist and antagonist muscles, restriction of joint movements and aggravation of periarticular tissues.

Physical therapy is recommended in clinical guidelines for the treatment of OA of the knee published over the last decade (NICE (2008), EULAR (2007, 2013, 2016), OARSI (2010), ACR (2012), ESCO (2014, 2016)).

Different physical exercises are used in rehabilitation programs. These include aerobic exercises to increase endurance and strengthening exercises of different intensity, from moderate to high, to support the muscles around the joints, especially in the case of instability.

Physical training in patients with OA should be directed towards joint stabilization and relieving joint tension by strengthening muscles and ligaments [7]. Static tension on skeletal muscles leads to improved muscular strength and increased mass of hypotrophic muscles, with minimal stress on the affected joint.

The objective of physical rehabilitation in the presence of chronic inflammation with pronounced synovitis is the reduction of intra-articulation pressure. This can be achieved by positioning, muscle relaxation exercises (autogenous training, including progressive relaxation) and traction therapy [8]. In the initial stages of synovitis, the main aim of physical rehabilitation is to strengthen the periarticular muscles, since a strong muscle mass provides a dampening function, ensuring a smooth transfer of translational forces to the articular surface, protecting the joint from twisting and hypermobility. Physical activity improves microcirculation in the articular structures, and dynamic exercises improve the circulation of synovial fluid in the joint [9].

Aerobic exercises from mild to moderate intensity are well tolerated by patients with knee OA, and muscle strength training at moderate intensity is well tolerated in elderly patients with OA. Although there is no clear evidence to support which type of exercise (isometric, isotonic, isoquintic, concentric, eccentric or dynamic) maximizes muscle strength [10], exercises with both isometric and isotonic character can be used in rehabilitation programs.

According to previous studies [11], proprioceptive exercises are better at reducing pain compared with isokinetic exercises and may be more effective in rehabilitation programs for patients with knee OA compared to isometric quadriceps exercises.

Exercises in water have short-term, clinically significant effect on pain and quality of life.

Clinical studies [12] show that modifications to patterns of walking favourably alter knee loads and these biomechanical changes can lead to clinically significant improvement in symptoms. However, further studies are needed to determine the type of modification needed to maximize beneficial effects. Long term benefit requires willingness to learn and commitment from patients.

The maximum beneficial effect of physical exercises on the strength of the knee extensor and flexor muscles was achieved within 6 months after beginning the exercises, was maintained for 1-3 years but usually lost after 5 years. This may due to inadequate intensity or frequency of exercises to maintain benefit [10]. Other studies [13] have shown that benefit of physical therapy is not just on the knee joint muscles but also on the hip muscles, which play a role in the treatment OA of the knee joint.

The inclusion of treadmill walking in the rehabilitation program for 12 weeks contributes significantly to improving joint function, the ability to perform essential daily tasks and quality of life [14]. Tele-rehabilitation can also be used to improve access to specialty care for the growing number of patients with traumatic injuries [15].

The clinical experience of Solodilov demonstrated that, in elderly patients with OA of the knee, physical exercise, in combination with manual joint mobilization, not only reduces knee symptoms but also has a beneficial effect on joint biomechanics, reducing asymmetry of the knee. As a result of this correction, there is improvement in walking patterns and mobility [16].

However, despite recent studies that show the benefits of exercises for people with OA, the majority of people, especially with lower limb OA, are insufficiently physically active. Patients with OA have different levels of motivation to change their physical activity and a change in behaviour may take many months to become routine. Tele-rehabilitation, motivational interviewing and evidence-based rehabilitation methods are used by health care professionals to help patients with OA achieve mutually agreed physical activity goals.

Conclusions

1. Pain, muscle weakness and biomechanical dysfunction affect the progression of OA, making muscle strengthen exercises of paramount importance in the prevention and rehabilitation of primary OA of the knee.
2. Physical rehabilitation strategies that actively change lower limb biomechanics are a promising strategy for the treatment of symptoms as well as for prevention of OA progression.
3. Different types and combinations of physical rehabilitation, depending on the biomechanical dysfunction, have the potential to improve the adaptive and compensatory function of joints, muscles and other periarticular tissues with minimal risk of adverse events.

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PART II. OTHER
DZIAŁ II. RÓŻNE

PERCEPTION OF HEALTH, OBESITY RISK AND DIETARY HABITS IN YOUTH

PERCEPCJA ZDROWIA, ŚWIADOMOŚĆ RYZYKA OTYŁOŚCI
I NAWYKI ŻYWIENIOWE U MŁODZIEŻY

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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. The aim of this study was to determine the relationship between eating behaviour, health perception and obesity risk awareness in adolescents.

Material and methods. This cross-sectional study was completed with 579 adolescents. Stratified and simple random sampling methods were used in the selection of the high schools, classes and students. The data was collected through the information form, Dutch Eating Behaviour Questionnaire and Perception of Health Scale.

Results. The mean score of health perception of the adolescents was 52.34 ± 7.59 . There was a positive relationship between total health perception score and emotional eating behaviour score of the adolescents ($p=0.003$). There was a negative relationship between total health perception score restricted eating behaviour ($p=0.029$), and external eating behaviour score ($p<0.001$). The emotional eating behaviour ($p=0.007$), external eating behaviour ($p=0.001$) and total eating behaviour score ($p<0.001$) of the adolescents who believed they had an obesity risk were found to be higher than the adolescents who believed they did not.

Conclusions. The adolescents with better health perception are less affected by the environment and are able to restrict their food choices. The adolescents who think that they have an obesity risk consume more food due to their emotional state and external exposure.

Keywords: obesity, adolescents, eating behaviour, health perception, risk awareness

Streszczenie

Wprowadzenie. Praca miała na celu określenie związku pomiędzy percepcją zdrowia, świadomością ryzyka otyłości a nawykami żywieniowymi u młodzieży.

Materiał i metody. To przekrojowe badanie zostało przeprowadzone wśród 579 nastolatków. W doborze szkół, klas i studentów wykorzystano próbę warstwową i proste losowe metody selekcji. Dane zebrano z wykorzystaniem formularza, kwestionariusza postrzegania zdrowia i holenderskiego kwestionariusza nawyków żywieniowych.

Wyniki. Średni wynik percepcji zdrowotnej uczestników w badanej grupie określono jako $52,34 \pm 7,59$. Istniała pozytywna zależność pomiędzy całkowitą percepcją zdrowia uczestników a ich nawykami żywieniowymi ($p=0,003$), oraz negatywna zależność pomiędzy oceną ich ograniczonych nawyków żywieniowych ($p=0,029$) a zewnętrznymi nawykami żywieniowymi ($p<0,001$). Wyniki emocjonalnych nawyków żywieniowych osób, które uważają, że są zagrożone otyłością ($p=0,007$), ich wyniki zewnętrznych nawyków żywieniowych ($p=0,001$) oraz zachowania ($p=0,001$) były wyższe niż u tych osób, które uważały, że nie są zagrożone otyłością.

Wnioski. Środowisko ma mniejszy wpływ na młodych ludzi, których charakteryzuje wyższy poziom percepcji zdrowia, a także którzy ograniczają swój wybór żywności. Z drugiej strony ci, którzy sądzą, że są zagrożeni otyłością, spożywają więcej pokarmu z powodu stanów emocjonalnych i wpływów zewnętrznych.

Słowa kluczowe: otyłość, młodzież, nawyki żywieniowe, percepcja zdrowia, świadomość ryzyka

Tables: 3

Figures: 0

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Introduction

The obesity epidemic is one of the fastest growing threats all over the world. Overweight and obesity are conditions characterised by abnormal or excessive fat accumulation [1]. Childhood obesity is considered one of the most severe public health challenges of the 21st century. Globally, around one in 10 young people aged 5–17 years are overweight or obese, with levels increasing rapidly in many countries and regions in recent years [2]. In Europe, fifteen-year-olds reported as overweight were 15% (boys) and 9% (girls) [3]. In a systematic review and meta-analysis by Maïano et al. (2016), the prevalence of overweight, overweight-obesity, and obesity in adolescents were 18%, 33%, and 15%, respectively [4]. Adolescent obesity is associated with obesity in adulthood [5]; it can also have long-term health implications [3, 6].

Genetic, endocrine conditions and lifestyle factors, which include physical inactivity and eating habits, are known as a cause of overweight or obesity among adolescents [1, 6]. Unhealthy eating behaviours and physical inactivity among adolescents are common [6]. Among adolescents, the leading cause of overweight is wrong eating habits [6, 7]. There are individual differences in eating behaviour in adolescents. The factors affecting eating behaviour are the physical, developmental, and social changes that occur during adolescence [8]. Research related to adolescent obesity have focused on individual characteristics and the environmental influences on eating behaviours [7, 8]. One study reported that eating behaviours of adolescents are affected by cognitive mechanisms [9]. Khodabakhsh and Kiani (2014) stated: “anxious mood and emotions expression can influence eating behaviours” [10]. The emotional eating behaviour and external eating behaviour may play a significant role in the development of obesity [10, 11]. The most important way to reduce obesity risk factors is awareness about causes and consequences of obesity, which are the keys to combating obesity [12, 13]. Also, understanding obesity risk perception is essential when developing health strategies to combat this epidemic. Muturi et al. (2016) reported that awareness and risk perception are important in the behaviour change process [8]. The lifestyle and eating habits acquired at a young age translate into health in adulthood [14]. However, there is very little information literature on the awareness of obesity, its health risks and risk factors among adolescents. The purpose of this study was to determine the relationship between health perceptions, obesity risk awareness and eating behaviours in adolescents.

This study aimed to answer the following questions:

Does the perception of obesity risk affect eating behaviour in adolescents?

Does the awareness of obesity-related health problems affect eating behaviour in adolescents?

Is there a relationship between the health perception and eating behaviour in adolescents?

Material and methods

This cross-sectional study was conducted between September 2015 and June 2016 among adolescents studying in high schools located in the centre of a city situated in the west of Turkey. The study population were the adolescents (N=16,559) studying in 28 different high schools located in the city centre of Aydın province in the 2015-2016 school year. Stratified and simple random sampling methods were used in the selection of the sample. The high schools in the city centre were divided into two strata: vocational/technical high schools and general high schools. The students studying in the 1st and 2nd grade in 5 different high schools (two vocational/technical high schools, two general high schools and one private high school) were selected by simple random sampling method considering the density of the high schools in the strata. The sample size, when the number of the individuals in the population of the study was known, was determined as at least 173 adolescents according to the proportion of overweight and obese children, taking the prevalence of adolescent obesity as 12% at 95% confidence interval and at the significance level of 0.05. The adolescents who could speak and write Turkish and agreed to participate in the study and were allowed by their parents to participate in the study were included in the study. The study was completed with a total of 579 adolescents.

The data were collected using an information form, Dutch Eating Behaviour Questionnaire (DEBQ) and Perception of Health Scale. In addition, a standard weighing scale was used to measure the weight of the adolescents, and a tape measure was used for the height of the adolescents.

The information form contained information related to the socio-demographic characteristics of the students (age, gender, income level etc.), Body Mass Index (BMI) and the obesity risk.

The Dutch Eating Behaviour Questionnaire (DEBQ) consists of three sub-scales and 33 items evaluating the emotional eating behaviours (e.g. Do you eat dessert when you are sad?), external eating behaviours (e.g. If food smells and looks good, do you eat more than usual?), and restrained eating behaviours (e.g. ‘Do you try to eat less at mealtimes than you would like to eat?’). The items in the questionnaire are evaluated with 5-point Likert scale (1=never, 2=rarely, 3=sometimes, 4=often, 5=very often). Cronbach-alpha internal consistency coefficients

of the original scale were found to be 0.95 for emotional eating behaviour, 0.81 for external eating behaviour and 0.95 for restrained eating behaviour [15, 16].

The Perception of Health Scale is a five-point Likert-type scale consisting of 15 items and four sub-factors (control centre, self-awareness, precision and importance of health). The lowest score that may be obtained from the scale is 15, and the highest score is 75 [17]. Cronbach's alpha reliability coefficient of the original scale is 0.90 for the control centre, 0.91 for self-awareness, 0.91 for precision and 0.82 for the importance of health. It was found in the Turkish validity and reliability study that while the test re-test reliability coefficient of the total scale was $\alpha=0.77$, reliability coefficients of the sub-scales were 0.76 for control centre, 0.63 for self-awareness, 0.71 for precision and 0.60 for the importance of health [18].

The researchers made an appointment with the school administration before reporting to the school on the appointed day. Explanations were given to the student group in the class determined by the simple random sampling method. The adolescents who agreed to participate in the study filled out the questionnaires by a self-report method.

The study was conducted according to the guidelines laid down in the Declaration of Helsinki. Official permission was obtained from the institutional review board of Aydın Province National Education Directorate in order to conduct this study. All participants and their parents were informed about the study and gave verbal informed consent before the enrolment.

In determining the nutritional status of the adolescents, their body mass index (BMI, weight [kg]/height [m²]) were calculated from their weight and height measurement data, and percentile curves were used based on BMI. BMI percentiles for age and gender were calculated according to the 2008 standard growth charts for Turkish children [19]. In this study, overweight was defined as a BMI at or above the 85th percentile and below the 95th percentile for children and teens of the same age and sex. Obesity was defined as a BMI at or above the 95th percentile for children and teens of the same age and sex [19]. Overweight and obese categories were combined, normal and underweight ones were shown separately.

Analyses were done using PASW Statistical Program version 22.0 (SPSS Inc, IBM, IL, USA). Data were represented as number, percentage or mean, standard deviation, where appropriate. The suitability of dependent variables (emotional eating behaviour, external eating behaviour, restrained eating behaviour, and perception of health scores) to normal distribution was tested using skewness and kurtosis values. Accordingly, all variables were accepted to have normal distribution since the skewness and the kurtosis values were between -1.00 and +1.00. Student's t-test, One-way ANOVA and Turkey HSD tests were used for the comparison between independent variables and DEBQ score. The association between the perception of health and eating behaviour was analysed using Pearson correlations. The two-sided level of significance was set at $p<0.05$.

Results

The mean BMI value was 20.43 kg/m² (SD=3.20). It was determined that 56.5% (n=327) of the adolescents were male, 80% (n=463) were in 9th grade, 73.4% (n=425) had sufficient income level and 92.2% (n=534) did not smoke. Only 11.6% (n=67) of the participants were overweight or obese. However, 33.5% (n=193) reported that they perceived themselves as overweight or obese (Table 1).

Table 1. Characteristics of participants (N=579)

Characteristics	Mean (SD)
Age (yrs)	15.24 (0.59)
Height (cm)	169 (9.03)
Weight (kg)	59.17 (12.03)
BMI (kg/m ²)	20.43 (3.20)
	Number (%)
Sex	
Female	252 (43.5)
Male	327 (56.5)
Grade	
9 th grade	463 (80.0)
10 th grade	116 (20.0)
Perceived family income	
Unsatisfactory	154 (26.6)
Satisfactory	425 (73.4)

Smoking	
Yes	45 (7.8)
No	534 (92.2)
Weight status	
Underweight	102 (17.6)
Normal	410 (70.8)
Overweight or obese	67 (11.6)
Perception of weight	
Underweight	111 (19.2)
Normal	274 (47.3)
Overweight or obese	193 (33.5)

We examined the associations between participants' some characteristics such as obesity risk perception, obesity risk awareness, the BMI percentile and eating behaviours scores (Table 2).

Table 2. Associations of obesity risk perception, obesity risk awareness, and BMI percentile levels with DEBQ Scores

Characteristics	Emotional eating behaviour score	External eating behaviour score	Restrained eating behaviour Score
	Mean (SD)	Mean (SD)	Mean (SD)
Obesity risk perception			
Yes	26.53 (9.13)	32.27 (15.95)	27.88 (9.58)
No	23.49 (8.43)	27.03 (12.62)	26.73 (7.83)
t; p values	2.733; 0.007	3.251; 0.001	1.150; 0.251
Obesity risk awareness			
Yes	24.68 (8.78)	28.20 (14.31)	26.80 (8.37)
No	23.43 (8.44)	27.43 (12.53)	26.93 (7.92)
t; p values	1.672; 0.095	0.673; 0.501	0.182; 0.856
BMI percentile			
Underweight	20.65 (9.01)	26.80 (12.59)	28.57 (9.03)
Normal	24.33 (8.51)	28.17 (13.47)	26.78 (7.77)
Overweight or obese	26.16 (7.01)	26.37 (12.50)	24.92 (8.09)
F; p values	10.452; < 0.001	0.831; 0.436	4.280; 0.014

BMI, Body Mass Index.

Emotional eating behaviour score ($p=0.007$) and external eating behaviour score ($p=0.001$) of the adolescents who perceived themselves as having the risk of developing obesity were found to be higher than the group not perceiving any risk. Although emotional eating behaviour score and external eating behaviour score of those who were aware of some health problems caused by obesity were higher than those who were not aware of the health problems related to the obesity, this difference was not statistically significant ($p>0.05$). According to the BMI percentile, it was found that emotional eating behaviour score of the underweight adolescents was significantly lower than the adolescents in the other group ($p<0.001$). It was also observed that as the BMI percentile increased in the adolescents, emotional eating behaviour score increased. Similarly, there was a statistically significant difference among the restrained eating behaviour scores of underweight, normal and overweight or obese groups ($p=0.014$). Further analysis revealed that this was due to the difference between the overweight / obese group and the underweight group. In other words, restrained eating behaviour score of the overweight / obese adolescents was lower than the restrained eating behaviour score of the underweight adolescents. It was found that there was a very weak relationship among the health perception scores of the participants and emotional eating behaviour score ($p=0.003$) and restrained eating behaviour score ($p=0.029$), and there was also a weak relationship between the health perception scores and external eating behaviour score ($p<0.001$) (Table 3).

Table 3. Correlations between perception of health score and eating behaviour sub-scores of the participants (Pearson Correlation)

Eating Behaviour Sub-scores	Perception of Health
Emotional eating behaviour	$r=0.124^{**}$; $p=0.003$
External eating behaviour	$r=-0.246^{**}$; $p<0.001$
Restrained eating behaviour	$r=-0.090^{*}$; $p=0.029$

*Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Discussion

It has been reported that obesity is on the rise and the trend cannot be explained only by genetic changes but also by environmental factors [16, 20]. Environmental factors can trigger obesity by affecting the nutrient intake of a person. Pressure from “obesogenic” environment increases obesity rates [21]. Eating behaviours of the social circle (family or peers) of individuals can affect the eating behaviours of the individual [22]. It has been reported that external eating is the predictor of the willingness to nutrient [23]. It was determined in our study that the adolescents were more inclined to the external eating behaviour despite their awareness of obesity risk. In other words, we found that the adolescents who believed they would develop obesity ate more depending on the images or smells in their surroundings (external eating) than the adolescents who believe they would not develop obesity. In this regard, it may be thought that the risk of developing obesity may also increase in the adolescents who indicated that their desire to eat increased due to environmental exposure.

Individuals may exhibit an excessive eating behaviour called “emotional eating behaviour” in response to emotional arousal or stress. In other words, they can use eating as a coping mechanism to reduce negative emotions [24, 25]. This study found that the adolescents who thought that they would develop obesity ate more when they were depressed, angry or anxious (emotional eating) than those who thought they would not develop obesity. The adolescents in our study group maintain their emotional eating behaviours even if they are aware that they may develop obesity or obesity may cause health problems. Despite their awareness, adolescents still do not change their eating habits. In other words, the self-consciousness of the adolescents alone does not seem sufficient for them to change their eating habits or behaviours. In this case, factors such as environmental influences and lifestyle behaviours of the family and social circle of the individuals can play a crucial role. For this reason, the effects of other variables related to emotional eating in the adolescents must be revealed, and in addition to dietary behaviour, interventions that focus on stress management need to be performed.

Adolescence is a fragile developmental stage sometimes characterised by exposure to stressful life events and by weakened mental health effects. It has been shown in the literature that there is a relationship among life stress and emotional symptoms and emotional eating behaviour [10, 26]. Wilson et al. (2015) reported that the stress which the adolescents perceived affected their emotional eating behaviours [27]. Similarly to the findings in the literature, it can be said for our study that the risk of developing obesity is high in the adolescents who show emotional eating behaviour. In our study, the fact that the emotional eating behaviours scores of the overweight/obese adolescents are significantly higher than the healthy and underweight adolescents supports our prediction.

Restrained eating refers to how far away the individuals are from the food to be able to keep their body weight under control. The desire for nutrients is the most important factor in appetite control [28]. Fear of obesity can contribute to an individual showing more restrained eating behaviour to lose weight [26]. Previous studies showed that higher BMI in adolescents was associated with more restrained eating behaviour [24, 26]. Contrary to the previous studies, it was found in our study that overweight and obese adolescents had a lower restrained eating behaviour score than those who were underweight or had normal weight. Unlike the previous studies, the overweight and obese adolescents in our study group did not appear to have any restraint on the amount of food they eat. The reason why the overweight and obese adolescents in our study do not restrict eating may be related to the fact that they eat more food depending on the emotional influences.

The health beliefs, attitudes and perceptions of the individuals are among the factors affecting their health behaviour. A positive relationship between health perception and eating habits can be observed [29]. In one study, a strong positive correlation was found between health perception and healthy diet [30]. It was found in our study that there was a positive relationship between health perception score and emotional eating behaviour score. Based on this finding, it can be said that the positive health perception cannot limit the emotional eating behaviour. This finding shows that the adolescents eat more food due to the emotional influences. There was a negative relationship between health perception score and restrained eating behaviour score and external

eating behaviour score of the adolescents in the study group. This finding shows that the adolescents with more positive health perception are less affected by the environment and they impose limitations on food selection. While planning the health education for the nutritional behaviours of the adolescents, it is important to be focused on improving their health perceptions as well as providing training on a healthy diet. Thus, it can be ensured that adolescents not only know what they should do but also why they should do so [29].

There were some limitations to this study. The first of these limitations is that this study was conducted with the adolescents studying in a high school in the centre of a city located in the west of Turkey. Adolescents who were not in high schools were not included in the study. The second limitation is that the age range (14-17 years) of the adolescents participating in the study was rather narrow. For this reason, this study failed to represent the other adolescent ages. Another limitation of our study is that it is cross-sectional. Therefore, it was not possible to evaluate the change longitudinally in the eating behaviours of the adolescents. The fact that the emotional state of the adolescents was not questioned may have led to the failure to determine the relationship between emotional problems and eating behaviour.

Conclusions

The adolescents with better health perception are less affected by the environment, and they impose limitations on food selection. Overweight and obese adolescents tend to eat more depending on the emotional influences and environmental factors. Awareness of personal obesity risk as well as the causes of obesity and health risks of obesity do not positively affect the eating behaviours of the adolescents. We recommend that the relationship between the eating behaviours of the adolescents and the change in BMI percentile values should be evaluated in an observational cohort study from the beginning of adolescence to the end of the adolescence. Observation of the adolescents regarding their emotional eating behaviours and planning initiatives for stress control may be necessary in preventing obesity.

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TEACHERS' EXPECTATIONS REGARDING THE FAMILY, THE SCHOOL, THE CHURCH AND THE MASS MEDIA VIS-À-VIS THE PREVENTION OF TEEN MOTHERHOOD

OCZEKIWANIA NAUCZYCIELI DOTYCZĄCE ROLI RODZINY, SZKOŁY, KOŚCIOŁA I ŚRODKÓW MASOWEGO PRZEKAZU W PROFILAKTYCE MACIERZYŃSTWA NASTOLETNIICH UCZENNICH

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- 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
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Summary

Background. In the recent years, the birth rate among teenage girls has decreased. Although more and more teenagers, especially girls, begin their sexual lives earlier, their knowledge on contraception is usually unsatisfactory and a significant number of adolescents either do not use contraception or use unreliable contraception methods. The lack of sex education at schools leads to teenage students' lacking knowledge and support in this matter.

Material and methods. The tool applied in the research was a previously prepared survey questionnaire entitled *Teachers' and class tutors' opinions on teen motherhood* serving as the research tool.

Results. The interviewees are convinced that in order to prevent pregnancies among adolescent girls, teenagers should be treated individually and provided with reliable knowledge and support. On the other hand, the respondents deem recommendable to warn teenagers of negative consequences that having sex brings and of stigmatisation the sexually active and pregnant girls face. Moreover, the interviewed teachers find it appropriate to promote only sympto-thermal contraception methods.

Conclusions. The inconsistency and high restrictiveness in teachers' opinions affect their involvement in teenagers' sex education and their support towards pregnant students and underage mothers.

Keywords: adolescent, prevention, early motherhood, teacher, sex education

Streszczenie

Wprowadzenie. W ostatnich kilkunastu latach w Polsce obniża się skala urodzeń dzieci przez nastoletnie dziewczęta. Dzieje się tak pomimo tego, że nastąpił wzrost częstości wczesnego rozpoczynania życia seksualnego przez młodzież, zwłaszcza dziewczęta, niezadowolający jest poziom wiedzy młodzieży na temat antykoncepcji oraz występuje znacząca skala nastolatków niekorzystających z antykoncepcji, bądź stosujących zawodne metody. Ze względu na abstynencyjny model edukacji seksualnej w szkole, uczniowie nie otrzymują dostatecznego wsparcia w omawianym zakresie.

Materiał i metody. Narzędziem zastosowanym w badaniu był wcześniej przygotowany kwestionariusz ankiety pt. *Opinie nauczycieli i wychowawców na temat macierzyństwa nastolatków*.

Wyniki. Stwierdzono, że badani z jednej strony są przekonani, iż w celu zapobiegania wczesnym ciążom należy traktować nastolatków w sposób podmiotowy, dostarczać im rzetelnej wiedzy oraz udzielać wsparcia. Z drugiej strony uznają za pożądane straszenie nastolatków negatywnymi konsekwencjami współżycia i piętnowanie osób aktywnych seksualnie oraz ciężarnych dziewcząt. Uznają przy tym za właściwe promowanie jedynie objawowo-termicznych metod antykoncepcji.

Wnioski. Ta niespójność i duża skala restrykcyjności poglądów nie pozwala na optymizm w ocenie udziału nauczycieli w edukacji seksualnej młodzieży, ani ich roli w realnym wsparciu uczennic w sytuacji ciąży i macierzyństwa.

Słowa kluczowe: adolescenci, profilaktyka, wczesne macierzyństwo, nauczyciel, edukacja seksualna

Tables: 7

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Introduction

In the recent years, like in the majority of the EU countries [1, 2, 3¹] and in the United States [4], the birth rate among teenage girls in Poland has decreased. The phenomenon occurs although more and more teenagers, particularly girls, begin their sexual lives earlier than in the past and the age median for having the first sexual intercourse is decreasing [5, 6]. It proves that teenagers use more efficient contraception. Teenage motherhood with its health and social consequences [cf. 7] constitute the problems which should be considered to be the most important challenges for sex education and prevention at schools. Hence, not only are the attitudes of teachers essential, but also their view on the extent of measures to be taken by schools and on the expected involvement of parents, the Church and the media.

Early sexual initiation. Teen motherhood phenomenon

The subject-related literature describes a lot of procreation and teen motherhood preconditions (teenagers' promiscuous attitude to sex, family disfunctions, ineffective sex education promoting sexual abstinence and the depraving influence of the media). The key reason for the phenomenon is the precipitous sexual initiation of teenage girls. Moreover, they or their partners either do not use contraception at all or use inefficient contraception methods.

On the basis on the analyses of Polish studies from the years 1957-2011, it may be stated that:

- the sexual initiation age of teenagers keeps decreasing / tends to decrease;
- the difference between the sexual initiation age of boys and girls has been also decreasing for the last years;
- since the 90's, the percentage of persons undertaking sexual activity before the age of 16 and especially before the age of 15 (the boundary age of legal protection) has increased.

In 1990, the research of HBSC (*Health Behaviour in School-aged Children*) revealed that in a sample of 18-year-olds, 36% of boys and 18% of girls declared having experienced sexual initiation [8]; in 2010, the percentages were 45% and 38% respectively [9], and the research conducted by IBE [*Educational Research Institute*] in 2015 showed 53% and 48% respectively [10]. The data show another tendency – the percentage of girls undertaking sexual activity is increasing much quicker. It is proved by the research done by IBE in 2014, which revealed that 17.4% of the interviewed 15-year-olds had already begun sexual initiation, the number of girls was slightly higher than the one of boys (18.5% and 16% respectively) [11].

When it comes to contraception used by adolescents, little has changed in the last ten years. Zbigniew Izdebski's research conducted in 2004 revealed that, during the last sexual intercourse, the teenagers most often used condoms (56%), much more rarely contraceptive pills (16%); spermicidal suppositories, gels, foams, creams (5%), contraceptive diaphragms (3%) and intrauterine spirals (2.3%). A high percentage of the adolescents admitted having used very unreliable methods such as coitus interruptus (so called *withdrawal method*) (22%) and natural methods, including calendar and sympto-thermal methods (13%) [12]. The research done by IBE 11 years later showed similar results. Adolescents at the age of 18, during the last sexual intercourse, used condoms (65%), hormonal contraceptives (17%) and natural methods (11%). The study revealed a positive change, too. A smaller percentage of respondents (12%) used withdrawal method [10].

It is impossible to state how many teenage girls decide to have an abortion. Its partial penalisation in Poland does not allow together reliable statistical data.

Hence, the research results on the knowledge about fertility and contraception are very alarming. The study done by the Educational Research Institute showed that the majority of the adolescents knew how condoms work; however, a half of them knew how hormonal contraceptives work and one third knew the functioning of intrauterine spirals. Only 41% of young women and 22% of men were aware that the sentence 'the majority of women are the most likely to get pregnant just after the menstruation' is false. Over one third of the interviewees believe withdrawal method to be reliable [10].

Despite the insufficient knowledge about fertility and contraception, in the years 1989-2000, the number of teenage girls getting pregnant lowered about 45%. The tendency has continued in the recent years. In 2004, there were 20,606 cases when girls under 19 became mothers and they constituted 4.96% of all live births this year, whereas in 2013 there were 14,492 such cases and the percentage of live births among mothers under 19 was 3.92% [13].

¹ In the European Union, approximately 6% of young women become mothers before the age of 18; however, the percentage varies from 3% in Italy, the Netherlands, Spain and Sweden up to 12% in Hungary, Slovakia and 13% in Great Britain.

Material and methods

In the presented article, the author has tried to answer the following questions:

1. What are the opinions of teachers on the role of the principal socialisation institutions: school, the Church and the mass media in the teen motherhood prevention?
2. Do the chosen sociodemographic qualities of the interviewed teachers, their professional status and family background influence their opinions on the role of the principal socialisation institutions in the teen motherhood prevention?

The tool applied in the research was a previously prepared survey questionnaire entitled *Teachers' and class tutors' opinions on teen motherhood* serving as the research tool.

In the process of research conceptualisation, 6 dependent variables were distinguished and they were opinions on the following: the role of school in the prevention of teen motherhood, the evaluation system of pregnant students, the role of the family, the Church, and the mass media in the prevention of early motherhood, and the desired actions of the Church with regard to underage mothers and pregnant girls. The variables were subject to operationalisation using the competent expert method (13 educationalists participated in the research). At the operationalisation stage, values of variables and the final number of indicators were determined – from 9 up to 28 indicators per each variable. Each value of a particular variable was assigned with the same number of indicators.

The respondents answered the questions by choosing multiple answers from the list of variables. Additionally, in one of the questions, they were asked to evaluate (using a four-point scale) 12 school situations presenting ways of categorising pregnant girls who previously received good notes and behaved in an exemplary way and the ones who obtained bad notes and behaved reprehensively.

The project also included three global independent variables and 13 detailed variables within them:

1. sociodemographic qualities (sex, age, place of residence, evaluation of one's economic status),
2. professional status (professional development degree, level of satisfaction with the executed profession, experience in work with pregnant students or underage mothers, the group of the subjects taught),
3. family conditions (having siblings, a regular partner, children, daughters).

The research was conducted at lower and higher secondary schools of the Jarosław district in 2014. Since the issue of gender and sexuality are subject to firm political and ideological pressure in Poland, it should be underlined that the inhabitants of the region are characterised by conservative attitudes to family and sexual life, strong attachment to religious traditions and strongly right-wing political beliefs. According to the statistics, in the years 2011-2015, the ratio of marriages registered (per 1,000 inhabitants) in the Jarosław district was 5.42. It was higher than the country average – 5.04. The ratio of divorces was 1.16 (per 1000 inhabitants) and it was much lower than the country average – 1.72 [14]. The inhabitants of the district are very religious in comparison with Poles in general. The Catholic Church statistical data reveal that 60.2% of the faithful of the Przemyśl diocese, encompassing the Jarosław district, participate in masses (the country average is 40%) [15]. The district inhabitants strongly identify with the right-wing political party Law and Justice. In the parliamentary elections in 2015, the party received there over 50% of the votes (the average in Poland was 38%) [16].

The analyses were done based on the answers of 408 teachers from 36 lower secondary schools and 11 higher secondary schools. The sample constituted 29.3% of all teachers working at such schools in the Jarosław district (1,391 teachers). 48% of the respondents declared having experienced work with pregnant students or underage mothers; 40% of the interviewees taught such students and 8% worked in a school which the pregnant girls attended.

Results

Opinions on the role of the family in the prevention of teen motherhood

The most important sexual socialisation institution is family. The research of HBSC on a sample of 15-year-olds conducted in 5 countries (Finland, Scotland, France, Poland and the USA) proved a relation between a low socioeconomic status of a family and early initiation age in all the countries [17]. Early sexual initiation is often connected with the lack of bonds and unity in a family [18]. The studies showed a statistically relevant relation between the sexual initiation age of parents and their children [19]. According to Miller, family may be at the same time a peril and a protection against early pregnancy. The risk factors mentioned include: living with one parent, a low social status, having an older and sexually active sibling or a pregnant sibling, motherhood of a teenage sister, being a victim of sexual violence, living in dangerous neighbourhoods. The protecting factors

include a close parent-child relation and efficient parent control; clearly precised negative attitudes of parents regarding risky sexual behaviours of teenagers [20].

One of the research questions concerned the ways of preventing underage students' pregnancies. The respondents could choose answers from 28 sentences (they could choose max. 5 of them) regarding 7 action types.

Table 1. Teachers' opinions on the role of the family in the early motherhood prevention; the sample of 408 respondents; the total number of the responses – 1,686 (it was possible to choose up to 5 answers)

Areas of family actions relating to the early motherhood prevention among students	Number of answers given in every category – 1,686 answers in total
giving reasonable freedom	652 (38.7%)
good sex education within the family	516 (30.6%)
warning of negative consequences	174 (10.3%)
full management of a teenager's free time	146 (8.7%)
religious activation of a teenager	96 (5.7%)
stricter educational control in the family	76 (4.5%)
destroying child's relationships with a partner	26 (1.5%)

Teachers believe that the most efficient way in which parents can prevent teen motherhood is giving reasonable freedom (38.6%) and providing adolescents with good sex education (30.5%). Over 10% of the respondents reckon that parents should warn adolescent children of negative consequences teen motherhood brings, particularly by trying to convince them that boys cannot and do not want to engage in parental responsibilities and hence, they could not be counted on in case of a pregnancy.

The analysis of the interconnections between the variables proved that there is a statistically important link between gender ($p=0.023$; Cramer's V 0.093; Pearson's C 0.114), place of residence ($p=0.029$; Cramer's V 0.091; Pearson's C 0.112), professional satisfaction level ($p=0.009$; Cramer's V 0.080; Pearson's C 0.173), having children ($p=0.026$; Cramer's V 0.092; Pearson's C 0.112) and the teachers' opinions on the role of the family in the prevention of teen motherhood among students.

The research revealed that men, more often than women, think that an efficient approach to early motherhood prevention is religious activation of teenagers. Women, on the other hand, more often opt for warning adolescents of an unplanned pregnancy's negative consequences and putting greater emphasis on sex education within the family. Teachers who live in the countryside, more often than others, recommend an increased parental control and intensification of students' religious activities. Teachers who are not very satisfied with their professional job are more often in favour of religious activation of students but they are also for doing all their best to destroy newly developed relationships of their students. Teachers satisfied with their job more often opt for giving students reasonable freedom and treating them individually. Teachers who do not have their own children believe, more often than the others, that the best prevention is increased religious practice of students. Teachers who are parents opt for giving teenagers reasonable freedom.

The research analysis reveals that teachers' opinions are discrepant. On the one hand, almost 70% of the respondents are convinced that the most efficient action to be taken is openness in conversations on sex supported by the belief that teenagers should be treated as individuals and partners. On the other hand, over 60% of the teachers think that tight control of adolescents, e.g. sending them to Catholic schools, limiting their contacts with others (14.7%) or even a cyclical control of a hymen at a gynaecologist (40.7%), is reasonable. It is astonishing that although everyone would like girls to trust their future life partners, teachers depreciate boys trying to highlight their weak points (51.7%) and prove that they would be completely irresponsible as parents (17.6%).

Teachers' opinions on the role of the school in the teen motherhood prevention

As a part of educational programmes, Polish schools undertake activities aiming at the prevention of teen motherhood. The current form of sex education, its status, organisation, the form of the curriculum, the choice of teachers and, particularly, the subjects discussed in coursebooks do not allow for positive assessment of the lessons' efficiency [21].

Sex education in Polish schools is not common and takes different forms. According to the official data of the Ministry of National Education, in the school year 2012/2013, 73% of the students in primary schools and 75% in lower secondary schools took part in the classes of family life education. In secondary schools, the number

was significantly lower as it was 37% for general upper-secondary schools, 42% for profiled upper-secondary schools, 51% for technical upper-secondary schools and 48% for basic vocational schools [22].

When it comes to preventional activities, Polish schools usually implement programmes on addictions, whereas risky behaviours are a rarely discussed subject and it usually concerns HIV/AIDS. Programmes such as *Archipelago of Treasures*, *PION* (the Polish version of the American programme *Sexuality Teaching in the context of Adult Responsibility*) have a very limited scope and they are usually organised by NGO organisations. They are based on the persuasion method and they treat the problem holistically (they also concern alcohol and drugs) and promote abstinence. In this context, the prevention programme called *Be responsible. Responsibility and partnership education within the family* which has been carried out in over 100 schools since 2004 may be considered as unique. It is the Polish version of the American programme *The Baby Think it Over*, developed by researchers of the University of Zielona Góra, which used an innovative idea of taking care of a baby [23]. The fact that in Poland there are so few prevention programmes regarding teenagers' sexual activity is unfavourable taking into account their positive impact on adolescents' behaviour and the fact that adolescents get pregnant 3 years later [24].

According to the data revealed, 58.8% of teachers prefer the permissive teen motherhood prevention model, 29.9% - the happy medium model, and only 11.3% - the restrictive one. Detailed data show that the majority of respondents think that the following factors are important in the teen motherhood prevention: sex education provided by parents (62%), family life education classes taught by sexologists and gynaecologists (52%), obligatory classes on risky sexual behaviour prevention (41%). The promotion of sexual abstinence till marriage is chosen by 27%. Only 20% of the teachers asked reckon that in order to prevent unwanted pregnancies, teachers should teach about contraception methods.

It was proved that having a husband/wife or a regular life partner may influence the opinion on the efficient model of early motherhood prevention at schools ($p=0.014$; Cramer's V 0.124; Pearson's C 0.211). Persons that have never been in a stable relationship (15.4%) much more often preferred the restrictive model than the others (10.8%). Persons who used to be in a stable relationship prefer more often than the others the permissive model (73% vs. 57.4%).

The Polish law states that 'the school has an obligation to grant a leave to a pregnant student and provide her with all the necessary help needed to graduate' (the law from 1993, art. 2) [25]. As a result, one of the most interesting questions concerned teachers' opinion on evaluating pregnant students. Teachers were asked if the social role fulfilment of a student, her behaviour and notes should be taken into account in the assessment or not.

The research showed that only 46.3% of the teachers think that pregnant students should be treated and evaluated equally as other students. The remaining part believe that requirements and evaluation criteria should be adjusted not because of the pregnancy of a student, but based on her notes and behaviour from before she got pregnant.

Table 2. Teachers' opinions on the liberal assessment of the learning progress and the behaviour of pregnant students, the sample of 383 respondents

Teachers' opinions on the liberal assessment of pregnant students	Number of teachers assessing pregnant students who, so far, have fulfilled their school obligations	
	in a good way	in a bad way
acceptance of liberal assessment	146 (38.1%)	79 (20.6%)
inconsistent opinions	168 (43.9%)	191 (49.9%)
no acceptance of liberal assessment	69 (18.0%)	113 (29.5%)

Table 3. Teachers' opinions on the strict assessment of the learning progress and the behaviour of pregnant students, the sample of 383 respondents

Teachers' opinions on the strict assessment of pregnant students	Number of teachers assessing pregnant students who, so far, have fulfilled their school obligations	
	in a good way	in a bad way
acceptance of strict assessment	10 (2.6%)	22 (5.7%)
inconsistent opinions	143 (37.2%)	199 (51.8%)
no acceptance of strict assessment	213 (60.2%)	163 (42.4%)

As the data in Tables 2 and 3 show, a part of the respondents reckon that pregnant students should be assessed taking into account their attitude to school obligations from before they got pregnant. 38.1% of the teachers are convinced that pregnant girls who, so far, have exemplarily fulfilled their school obligations should be treated

more liberally than the ones who, so far, have not been good students (20.6%). Some teachers also believe that pregnant students who have so far behaved reprehensibly and got bad notes (5.7%) should be assessed stricter than the ones that have received good notes and behaved correctly (2.6%).

The analysis of the opinion background revealed that women more often opt for the liberal treatment of pregnant students (both good – women 37.2%, men 30.1%, and bad behaving ones – women 22.5%, men 7.2%) ($p=0.048$; Cramer's V 0.132; Pearson's C 0.185).

Teachers' opinions on the role of the Church in the teen motherhood prevention

Although religious traditions are not the only determinant in shaping the human world of values, they are a very significant factor regarding sexuality. The position of the Catholic Church against teenagers' sexual activity is accurately described by the following citation of a priest:

Although the majority of young people in fact accept sexual intercourses before getting married, it should be underlined that such a behavior is morally bad. In such cases, partners have sexual intercourses without taking into account its possible consequences, a possibility that a child may be born (...) using contraception is morally bad, as it deprives a sexual intercourse of its basic objective: procreation [26].

In Poland, especially in its South-East part, religious devotion is very common. Moreover, religious institutions are a great authority, also in adolescent sex socialisation (e.g. after turning 17 years old, they commonly participate in so called premarital education classes organised by their parishes). Hence, it is reasonable to find out what teachers' opinions on the role of the Church in the teen motherhood prevention are. The respondents chose their answers from 20 sentences (they could choose max. 4 of them) that referred to 5 types of actions.

Table 4. Teachers' opinions on the role of the Church in the teen motherhood prevention, the sample of 408 respondents, the total number of answers – 1,397 (it was possible to choose up to 5 answers)

Expected actions to be taken by the Church in the teen motherhood prevention	Number of answers given in every category – 1,397 answers in total
providing teenagers with support and advice from priests	528 (37.8%)
organising teenagers' free time in a constructive way	521 (37.3%)
providing sexual education with the respect of religious beliefs	243 (17.4%)
stigmatising teenagers' sexual activity	88 (6.3%)
stigmatising persons who violated the purity norm as a lesson for other persons	17 (1.2%)

As it was shown in Table 4, in order to prevent teen motherhood, teachers think that priests should provide teenagers with spiritual support (37.8% of the answers) and manage their free time (37.3%). Over 17% of the respondents are convinced that the role of the Church also includes delivering sex education to adolescents. Numerous answers (7.5%) expressed an expectation that the Church ought to stigmatise teenagers (particularly girls) for undertaking sexual activities. The interviewees also added that the Church should preach sermons stigmatising teenagers who have sex and pregnant girls, warn immorally behaving girls against social stigmatisation and visit couples living together without marriage in order to preach them.

The analysis revealed that the more siblings the teachers interviewed had, the more often they thought that clergymen should stigmatise teenage girls who have violated purity norms (as a lesson for others) and criticise teenagers' sexual activity ($p=0.042$; Cramer's V 0.069; Pearson's C 0.154).

Table 5. Teachers' opinions on the most expected actions to be taken by the Church in the prevention of teen motherhood, the sample of 408 respondents (the table includes only the answers that were given by at least 10% of the interviewees)

Expected actions to be taken by the Church in the prevention of teen motherhood	N=408
offering advisory services for the youth at parishes where clergymen would be willing to speak with young people	270 (66.2%)
organising church groups, e.g. associations, the Light-Life Movement meetings	155 (38.0%)
meetings, film screenings on moral dilemmas concerning sexuality	155 (38.0%)
organising feasts, dancing meetings, bonfires for teenagers (without alcohol)	154 (37.8%)
organising premarital education classes	139 (34.1%)
offering a possibility to speak with clergymen anonymously on the Internet	122 (29.9%)

hosting a website by a clergyman on broadly understood human sexuality which is compliant with religious values	82 (20.1%)
organising individual confessions for the young in parishes	54 (13.2%)
discussing in detail advantages of natural contraception and disadvantages of chemical contraception	52 (12.8%)

The analysis of the answers showed that teachers expect from priests supportive conversations with the young, also on the Internet; sex education and good adolescents' free time management.

Table 6. Teachers' opinions on the expected reactions of the Church to pregnant adolescents and underage mothers, the sample of 408 respondents, based on a multiple choice question (it was possible to choose 2 reaction models)

Expected reactions of clergymen to pregnant adolescents and underage mothers	N=408
direct and indirect stigmatising attitudes	97 (23.8%)
no actions taken at all	12 (2.9%)
tolerant attitudes without getting involved in direct help	236 (57.8%)
tolerant attitudes with deep involvement in direct help	311 (76.2%)

It was stated that 23.8% of the interviewees consider that, in order to deter adolescents from sexual activity and simultaneously prevent teen motherhood, clergymen should stigmatise all pregnant students. According to the research participants, the actions can be direct or indirect and mainly based on: criticising adolescents' lack of responsibility in the sexual sphere, exposing the impurity sin during lessons, presenting premarital impurity as a reason of further failures in marriages but also as a reason of social stigmatisation and exclusion. It seems that the respondents believe that the strong reaction of the Church to an adolescent's pregnancy (no matter what consequences it will bring to her) can be an efficient method discouraging young people from having sex.

Nevertheless, the analysis did not show any statistically important connections between the examined variables.

Teachers's opinions on the role of the mass media in the teen motherhood prevention

In the last 25 years, popular culture and especially the electronic media have significantly influenced the sexual socialisation process. *Sexing the Media* [27] causes many worrying phenomena that endanger appropriate psychosexual development. The relation between the media and sex is visible in so called *striptease culture* (what was private in the past, now it has become public), 'democratisation of desire' (common availability of means for expressing sexuality) and 'pornchic' (pornography appearing in the world of pop culture) [28, 29]. Research reports from all over the world prove that the teenage sexualisation phenomenon is very common. It particularly refers to 'girl sexualisation' [30, 31].

Table 7. Teachers' opinions on the role of the mass media in the prevention of teen motherhood, the sample of 408 respondents, the total number of answers – 1,612 (it was possible to choose up to 5 answers)

Exemplary areas of actions taken by the mass media	Number of answers given in every category – 1,612 answers in total
promoting sexual responsibility	503 (31.2%)
promoting sexual abstinence	326 (20.2%)
warning of promiscuous lifestyle's social consequences	309 (19.2%)
promoting natural family planning methods	298 (18.5%)
warning of an unplanned pregnancy's consequences	127 (7.9%)
promoting contraception	40 (2.5%)
promoting life without children as comfortable and modern	9 (0.6%)

When it comes to the opinions on the role of the mass media in the prevention of teen motherhood, the researchers could choose up to 4 from 28 statements which related to 7 areas of actions.

According to the data in Table 7, teachers expect that the mass media will promote sexual responsibility (31.2%), sexual abstinence (20.2%) and warn of promiscuous lifestyle's consequences (19.2%). 18.5% of the experts asked want to promote natural family planning methods.

The analysis of teachers' opinions revealed that none of the qualities (sociodemographic qualities, professional status or family background) differentiates the opinions in a statistically important way.

The analysis also showed that 14 sentences out of 28 possible answers were chosen by at least 10% of the respondents. On one hand, teachers expect that the mass media will show health and social risks that result from having numerous sexual partners (42.9%) or abortion (18.4%). But on the other hand, the mass media are expected to recommend only sympto-thermal contraception methods (the Catholic approach – 30.9%). Moreover, the respondents would like the media to promote sexual abstinence before marriage as the condition of future family happiness (15.2%) and remaining a virgin until getting married (12.3%). It is crucial that the interviewees expect from the media (39.7%) a promotion of conscious and planned parenthood.

Conclusions

In the preparation of the present research project, the authors assumed teachers to be the most competent persons to assess the influence of different socialisation institutions in the teen motherhood prevention due to the character of their job, appropriate qualifications and experience in work with pregnant students.

The research results analysis revealed that teachers:

- expect parents to give children reasonable freedom, to provide them with sex education, to control children (in an extreme way), to involve them more in housework, to activate them religiously and to depreciate boys as potential fathers and life partners in the eyes of girls;
- believe it reasonable to implement the permissive sex education model and to promote sexual abstinence among students. Only one fifth of them support teaching students about contraception methods. Teachers generally think that the evaluation system of pregnant students should be diversified taking into account their involvement in school obligations from before they got pregnant;
- expect that clergymen and the Church take a number of actions, such as e.g. providing adolescents with moral support, organising teenagers' free time, offering sex education. The teachers would also like the Church to react more restrictively to pregnant adolescents which will deter other teenagers from sexual activity;
- have also high expectations with regard to the media and believe that their actions should be concentrated on promoting sexual responsibility but particularly on sexual abstinence, advocating sympto-thermal contraception methods, warning against very negative consequences of having sex: sexually transmitted diseases, an unwanted pregnancy and a risk of being abandoned by a partner.

It was stated that teachers who work in the Jarosław district have inconsistent opinions on the role of different educational environments in the teen motherhood prevention. The results show that the interviewees are, on the one hand, convinced that in order to prevent early pregnancies of students, adolescents should be treated individually and provided with support and reliable sex education. On the other hand, they deem it necessary to warn students of tragic consequences having sex brings and of stigmatisation of the young who undertake sexual activity. The inconsistency and a wide scale of restrictiveness visible in the respondents' opinions do not allow for optimism about teachers' participation in the creation and realisation of educational and preventive programmes on risky sexual behaviors of the youth or about real support given to pregnant students and underage mothers.

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CHARACTERISTICS AS WELL AS PAST AND PRESENT POSSIBILITIES OF USING MICROORGANISMS LISTED ON THE CDC LIST A OF BIOLOGICAL AGENTS IN BIOTERRORIST ATTACKS

CHARAKTERYSTYKA ORAZ HISTORYCZNE I WSPÓŁCZESNE MOŻLIWOŚCI UŻYCIA DROBNOUSTROJÓW ZNAJDUJĄCYCH SIĘ NA LIŚCIE A CZYNNIKÓW BIOLOGICZNYCH CDC W ATAKU BIOTERRORYSTYCZNYM

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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

The study aims at characterising four bacterial infectious agents listed on the CDC A list, i.e. Anthrax (*Bacillus anthracis*), plague (*Yersinia pestis*), botulism (*Clostridium botulinum*) and tularemia (*Francisella tularensis*) as potential tools used in a bioterrorist attack causing diseases. The paper also includes information on their occurrence in Poland and the EU. Despite the real threat of terrorism in the 21st century and large-scale activities aimed at limiting the occurrence of this phenomenon, it should be borne in mind that pathogens listed on the CDC list A, although spotted primarily in animals, can be a real threat to people's health and life. Among the discussed microorganisms, only *Francisella tularensis* and *Clostridium botulinum* cause sporadic diseases in Poland; however, it should be remembered that both *Bacillus anthracis*, occurring in Europe, and *Yersinia pestis*, occurring in Asia and Africa, can pose real threats to human health and life not only in natural infections, but when used as a biological weapon.

Keywords: *Francisella tularensis*, bioterrorism, *Bacillus anthracis*, *Yersinia pestis*, *Clostridium botulinum*

Streszczenie

Celem pracy jest charakterystyka czterech bakteryjnych czynników zakaźnych oraz wywoływanych przez nie jednostek chorobowych znajdujących się na liście A CDC jako potencjalnych narzędzi stosowanych w ataku bioterrorystycznym: węglik (*Bacillus anthracis*), dżumy (*Yersinia pestis*), botulizmu (*Clostridium botulinum*) oraz tularemii (*Francisella tularensis*). W pracy zamieszczono również informacje na temat ich występowania w Polsce i UE. Pomimo realnego zagrożenia terroryzmem w XXI wieku i zakrojonych na szeroką skalę działań mających na celu ograniczenie występowania tego zjawiska, należy mieć na uwadze, że patogeny wymienione na liście A CDC, mimo, że występują przede wszystkim u zwierząt, mogą stanowić realne zagrożenie zdrowia i życia ludzi. Wśród omawianych drobnoustrojów, jedynie *Francisella tularensis* i *Clostridium botulinum* wywołują sporadyczne zachorowania w Polsce, jednak należy mieć na uwadze, że zarówno *Bacillus anthracis* występujący w Europie oraz *Yersinia pestis* występujący w Azji i Afryce mogą stanowić realne zagrożenia dla zdrowia i życia człowieka nie tylko w przypadku naturalnych zakażeń, ale przede wszystkim w przypadku użycia ich jako broni biologicznej.

Słowa kluczowe: *Francisella tularensis*, bioterroryzm, *Bacillus anthracis*, *Yersinia pestis*, *Clostridium botulinum*

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Introduction

Bioterrorism is one of many types of broadly understood terrorist activities, involving the use of bacteria, viruses or toxins to destabilise the economic system of the state or trigger epidemics that can lead to the death of a large number of people in a short time [1].

In 2000, the Centre for Disease Control and Prevention (CDC) based in Atlanta published a list of biological agents that could be used in a potential biological attack and which can be classified into 4 groups (A, B, C and D). The group of the highest risk are bacterial and viral infectious agents included in list A [2].

The aim of the following study is to characterise the four bacterial infectious agents found on A list A and present information on their occurrence in Poland and the EU.

Bacillus anthracis - anthrax

The first records of human anthrax disease come from antiquity in the works by Hippocrates and Virgil. In 1877, Koch developed his postulates describing it as the perpetrator of an infectious disease and, a dozen years later, Louis Pasteur made the first vaccine against anthrax in animals. During the Second World War, Japan carried out intensified research on bacteriological weapons in the area of Manchuria. To this end, two units were established: the first - unit 731, which was strictly interested in the development of bacteriological weapons, and the other one - unit 710, which was to apply the theoretical knowledge gained by the first team in practice [3].

During the Second World War, Great Britain also conducted research related to the use of bacteria as a biological weapon. In 1941, an experiment was carried out with bombs containing anthrax on an unpopulated Grianard island near Scotland. As a result of this incident, the survival forms of anthrax were recorded for almost 50 years after the discontinuation of the research [4].

In turn, the United States began research into bacteriological weapons in the years 1941-1943. For this purpose, Camp Detrick research centres (now Fort Detrick) and Camp Frederick were built [5]. Initially, the research programme included only anthrax spores, bacteria of the *Brucella* genus; however, in a short time it was extended to other pathogens (plague, cholera, Q fever) [5].

During the Cold War, scientists from the USSR skilfully used the knowledge of German engineers who were taken prisoners of war. They also broadened their knowledge thanks to the materials obtained during the Manchuria occupation. In the 1970s, in Sverdlovsk, under the camouflage of biotechnology research, the Soviet Union carried out a research programme into biological weapons called "Biopreparat". Due to the negligence of one of the employees of the complex 19, a catastrophe happened. The improper oversight of the personnel resulted in airborne dust entering the atmosphere (it is estimated that about 1-2g of anthrax spores was released), which spread to the areas close to the research centre with the wind [6]. The data on people infected and deaths in Sverdlovsk vary and range from 79 to 96 persons infected with anthrax, and 68 to 105 dead. [8].

After the attack on the World Trade Centre and the Pentagon, on September 11, 2001, the first letters with anthrax spores were sent to television stations, the headquarters of the New Jersey Post, and to American Media in Florida. As a result of these incidents, 5 people died. Public institutions, and, in particular the buildings of the Supreme Court, Congress as well as post offices, were contaminated [7].

It was Saddam Hussein, the Iraqi leader, who was blamed for the attack using anthrax. The rumour about combining anthrax with bentonite, which was supposed to make it more volatile, and a statement about the modification of *B. anthracis* spores with silicon into a bacteriological weapon, turned out to be untrue. However, in 2002, it was discovered that the terrorist organization Al-Khaida was preparing for a bioterrorist attack with the use of anthrax bacilli in Afghanistan [5, 7].

Anthrax is caused by *bacillus anthracis*. The etiologic agent of anthrax is Gram-positive sporangiae, whose vegetative form is about 3-10µm long. The characteristic features of anthrax macrophages include the lack of red blood cell production, inactivity, growth in the atmosphere with an increased content of CO₂, as well as the production of spores in the presence of oxygen. In the surviving form, anthrax bacilli exhibit very high resistance to environmental factors, low and high temperature, pH changes, drying and most disinfectants. There is a polypeptide shell containing D-glutamic acid in *B. anthracis* virulent strains that determines bacterial resistance to phagocytosis and lysis. *B. anthracis* produces three exotoxins: a protective antigen (PA), a lethal factor (LF), an edema factor (EF), which act synergistically. LF inhibits phagocytosis and stimulates IL-1 TNF-α synthesis leading to toxemia. Increasing the concentration of cAMP, EF causes tissue edema [9].

Human infections are rare, usually by direct contact or by products of animal origin (meat intake, contact with contaminated skin and hair). The basic reservoir of anthrax bacilli is the soil in which the bacterial spores can survive for years.

The occurrence of anthrax in humans in natural conditions is associated with the presence of bacteria among domestic animals. Above all, one gets ill after a direct contact with sick animals, blood, secretions and excretions. For this reason, people involved in agriculture, i.e. farmers, shepherds, butchers, technicians and veterinary surgeons, are most vulnerable to becoming ill. Also, those working in the broadly understood processing of animal-derived materials are endangered. There were recorded some cases of people becoming ill after contact with clothes contaminated with anthrax (wearing fur) and in people using heroin intravenously. The infection is much less frequent in the droplet (5%) and food (about 1%) transmission [10].

The incubation period is short and ranges from 1 to 7 days. The most common and, at the same time, the mildest form of anthrax is the skin form. The lung form is less frequently observed, which results from the use of anthrax as a biological weapon or, as described above, an accident in Sverdlovsk. When intestinal bacteria are ingested, intestinal and oropharyngeal forms may develop [14].

The cutaneous form of anthrax develops due to the penetration of bacterial spores in the abrasion area, its cutting or insect bites. Initially, an itchy papule appears, which grows days into a follicle within 2-3, and then transforms into a pustule with a scab surrounded by painless shaft with blisters (black pustules) [9].

The pulmonary form of anthrax occurs following the inhalation of a significant amount of spores (from 8-10,000). The first symptoms appear after 1-4 days. If the infection dose is a small, the incubation period is up to 60 days. In this form, the disease has a two-phase course. The first phase is characterised by low fever, dry cough and malaise. After a period of relative improvement, the patient's condition deteriorates rapidly and high fever, shortness of breath, cyanosis and retrosternal pain appear. In the final stage, anthrax is disseminated to the CNS leading to toxemia with sepsis. Irrespective of the used antibiotics in this stage, mortality is very high and amounts to over 90% [11].

Oral-pharyngeal and intestinal forms occur sporadically and depend on the place of entry of the micro-organism into specific sections of the gastrointestinal tract. In the oropharyngeal form, ulcers resembling skin forms appear within the oral mucosa, hard palate and throat. Conditions characteristic of this form include: sore throat, difficulty in swallowing, fever and swelling of neck tissues. In the intestinal form, the place of penetration of the microorganism concerns the cecum and is characterised by the occurrence of nausea, vomiting, bloody diarrhea and later occlusion of the gastrointestinal tract [10].

The drugs of choice are penicillin, doxycycline and fluoroquinolones. Therapy with the addition of rifampicin, clindamycin or chloramphenicol is also warranted. Treatment usually lasts for 14 days, but in severe cases it can be extended up to 60 days [10].

Routine laboratory testing for the identification of anthrax bacillus includes microscopic examination, multiplication and isolation of the germ together with its biochemical identification and drug resistance, a biological test on laboratory animals and a serological test for the detection of antigen in the capsular anthrax bacilli (Ascoli thermocapsule reaction) or factors exotoxin traits (ELISA) [9]. Direct microscopic examination consists in the search for enveloped, Foth-fixed or Olta-type bacilli, or by the Fadyean method, or in the preparations of organ imprints using the Gram method. The presence of Gram-positive bacilli, arranged in structures resembling a bamboo stick, suggests an anthrax infection. Isolation and culture includes cultures from blood or tissue sections on plain agar, agar with 5% sheep blood and selective media, PLED B and PLED A. On a solid medium, anthrax bacilli form colonies with a very characteristic fibrous structure and jagged jelly-like edges. There are also new diagnostic techniques that are successfully used which include: gas chromatography for a direct detection of *B. anthracis* metabolic products, PCR techniques using primers complementary to plasmid DNA to detect the presence of spores or vegetative forms, and improved immunoenzymatic techniques for the detection of PA antigen and exotoxins of anthrax bacilli with the use of monoclonal bodies [9].

According to the ECDC, in 2014, there were 16 cases of anthrax in the European Union (9 in Hungary, 4 in Spain, 2 in Romania and 1 in Greece). In 2011, there were 5 cases (2 in Romania and Greece, 1 in Bulgaria), in 2012 - 14 cases (6 in the United Kingdom, 4 in Germany, 1 in France, 2 in Denmark, 1 in Bulgaria). In 2013, the number of cases decreased to 6, with one case reported in Bulgaria, Croatia, Portugal, Romania and two cases in Great Britain. No cases of anthrax were reported in Poland in humans in the years 2011-2016, [12].

***Clostridium botulinum* - botulism**

Another disease – botulism – poisoning after consumption of sausage (sausage - *botulus* in Latin), was first described by Leon VI, a Byzantine emperor and philosopher, living at the turn of the 9th and 10th centuries. In the United States, the first case of poisoning with botulinum toxin was recorded in 1735 and the source of infection was sausage, but other cases involved other food products of animal origin. The research on the possibility of using botulinum toxin as a biological weapon was carried out during the Second World War (Japan, USSR, the United States) [13].

Generally, to date, no botulinum toxin has been reported during military operations, despite advanced scientific programmes on its use as a bacteriological weapon by the world armies (Japan - the 1930s, Great Britain and Canada – the Second World War, the United States and the USSR – the cold war). In 1990, members of the Japanese sect the Supreme Truth attempted to spread *C. botulinum* in the centre of Tokyo. The trials ended in failure due to difficulties in obtaining a toxin in the form of a spray [14].

Botulism can develop after eating food containing a bacterial toxin, bacterial cells themselves, but also by absorbing the toxin present in wounds infected with *C. botulinum*. There is also the possibility of the aerogenic route of toxin infections. Traditionally, botulism is divided into food poisoning, wound infection, botulism in infants and botulism of unknown etiology (intestinal).

C. botulinum is a Gram-positive, anaerobic spore-producing rod. The characteristic feature of the microorganism is the production of toxins marked with letters A to G. Toxins A, B, E, F are responsible for human disease, whereas toxins C and D – in animals, while the role of toxin G is not fully understood. Poisoning with toxins A and B is associated with food intake of animal or vegetable origin, whereas toxic E toxicity results from the consumption of fish products. Individual toxins differ in amino acid composition, susceptibility to proteolytic enzymes and lack of cross-reactivity of neutralising antibodies, which means in practice that the A-antitoxin does not neutralise toxins belonging to other types. Botulinum toxin is the strongest of the known natural toxins. It is believed that 1g of botulinum toxin can kill over a million people. The toxin is a protein complex consisting of a light chain with a molecular weight of approximately 50kDa, and a heavy 10kDa, connected by a disulfide bridge. It has found application in medicine and cosmetology, where it is used to smooth out facial and neck wrinkles. The mechanism of action of the toxin is to inhibit the release of acetylcholine, in synapses of the peripheral system between motor neurons and muscle fibers, which leads to their paralysis. The return to the proper muscle function occurs after the formation of a damaged synapse and lasts from 3 to 6 months [13].

All forms of botulism are related to the absorption of the toxin into the circulatory system from the surface of mucous membranes of the digestive and respiratory systems as well as from wounds. It should be noted that the toxin is not able to penetrate skin that is intact. In the case of food poisoning, the onset of the disease is sudden and ranges from 18 to 36 hours. Neurological symptoms may be preceded by gastrointestinal complaints (vomiting, abdominal pain, diarrhoea) and malaise. The severity and extent of the lesions depends mainly on the dose of neurotoxin. The disease is characterised by acute bilateral symmetrical nerve damage ranging from cranial nerves and descending paresis or muscle paralysis. The patient is conscious, fully oriented and does not get feverish. Other common symptoms include: dry mouth, double vision due to paralysis of muscles that move the eyeball hypersensitivity to light. Then, there are symptoms of bulbar palsy, swallowing difficulties and speech disorders. There is a progressive weakening of the respiratory muscles, as well as muscles in the limbs and torso. In the case of contamination of wounds with the botulinum toxin, the same neurological symptoms are found; however, there are no gastrointestinal complaints. In the case of infant botulism, the symptoms depend on the degree of neuromuscular paralysis and include weak crying, weakness of sucking ability, dysphagia, general weakness (the so-called faint child), respiratory failure and apnea [14].

The source of infection in food poisoning is improperly conserved food contaminated with a botulinum toxin. If the wound is infected with a botulinum toxin, the source of the infection is soil contaminated with bacteria. In addition, botulism occurs in people who have undergone various types of injuries such as: deep stab wounds, incorrectly treated open fractures and in those who inject drugs. In the case of infant botulism, the disease is caused by ingestion of *C. botulinum* spores, then a toxin is produced in the child's body. The most common source of bacteria in this case is honey or corn syrup administered to infants [13].

Botulism therapy includes combined specific and symptomatic treatment. Specific treatment involves the administration of anti-botulism serum containing antibodies that neutralise the toxin. The most frequently used antitoxin is foreign species (horse), and sometimes – human immunoglobulins. It is believed that the antitoxin is effective up to 72 hours after the onset of the first symptoms. Due to the necessity of fast antitoxin administration with a simultaneous long period of identification of the type of toxin, multipurpose preparations, i.e. mixtures of A + B + E antitoxins [14,] are used.

The laboratory diagnosis of botulism includes direct techniques; that is a detection of botulinum toxin in patients' blood serum or in other biological material, as well as a indirect detection of botulinum toxin or a toxinogenic strain in food or feed whose consumption was preceded by the onset of symptoms of poisoning. Isolation and cultivation of *C. botulinum* is performed on liquid and solid Wrzowska-Sheadler media or VL substrates. Samples with sown substrates are divided into two groups: the first are heated at 75 degrees for 35 minutes, the other remain without heating [13].

As the ECDC indicates, there were 123 persons diagnosed with the disease in 2014, with the statistical data coming from 29 European countries. The highest incidence rates were recorded in Romania (31), Poland (17)

and Hungary [12]. In former years, the number of cases was as follows: in 2011 there was an increase to 115 cases (21– in Poland, 24 in Italy and 18 in Romania), in 2012 there was a drop in Europe compared to previous years to 72 cases (9 cases in Poland, whereas in Italy 20 and in Romania 15). In 2013, there was another increase in incidence – 82 cases (9 in Poland, 25 in Romania and 15 in France) [12].

***Yersinia pestis* - plague**

Black plague (black death) was known in antiquity. It is mentioned already in the records by Thucydides or even the book of Samuel of the Old Testament. The plague epidemic also affected ancient Rome under Marcus Aurelius, when it claimed the lives of nearly 70 million people, while Justiniana's plague, lasting less than half a century, caused the deaths of about 10 million Roman citizens. The next plague epidemic returned to Europe only in the Middle Ages. The climate conditions at the end of the thirteenth century in Europe, with the simultaneous increase in population, caused shortages of food, which in turn affected the resilience of people and livestock. At the beginning of the 14th century, famine affected the north-western part of Europe, reducing the size of the continent's population by about 10% [15].

The etiological factor of the plague is the bacterium *Yersinia pestis*, which was used for the first time during the biological siege of Kaffa (today's Crimea) by the Tartars (1346), who threw the body of the plague-infected patients across the city walls. Watching the rapid spread of the plague in the city, Kaffa defenders began to flee from the battlefield to Venice, Genoa, Constantinople and other ports in the Mediterranean. Probably this event was the cause of the most famous pandemic plague in Europe [15].

The black death pathogen was also used in 1422 at the Battle of Carolstein and in 1710 during the Russo-Swedish War, when the Russians captured Reval - today's Tallin, by transferring infected corpses through the city walls [16]. The plague epidemic also affected Toruń in 1708, where during 5-month period over 4,000 people died. From the mid-sixteenth to the mid-eighteenth century, plague haunted Toruń up to sixteen times.

Since 1932, Japanese scientists multiplied the production of *Y. pestis* bacteria and bred fleas and rats infected with the pathogen, and its effectiveness was verified on prisoners of war and the Chinese population [17]. During the Cold War, research into the use of the microorganism as a bacteriological weapon was conducted by the Soviet Union and the United States. American scientists, however, interrupted these studies in 1969, whereas Soviet biologists continued them until the nineties of the twentieth century [6, 7].

Plague is an acute infectious disease spreading enzootically among rodents and transmitted to humans by fleas. The basic forms of this disease are bubonic plague (*pestis bubonica*), pneumonic plague and occasional sepsis plague. The etiological factor is *Y. pestis*, which belongs to the *Enterobacteriaceae* family. It assumes the shape of a small-sized kernel, dyes bipolarly, and is relatively anaerobic and catalase-sensitive [18].

The incubation period of the disease is about 6 days and covers the time elapsing from the skin puncture by flea in the form of a cigarette or respiratory infection in the pulmonary form. The fumed form is characterised by a variety of clinical features. Symptoms include: fever, drowsiness, drowsiness or arousal, enlarged lymph nodes, inguinal and axillary, painfulness, softness and spontaneous puncture. A successful prognosis for the follicular form concerns only half of the patients. The pulmonary form proceeds rapidly, often even staggering. There appear symptoms of respiratory failure (dyspnoea, cyanosis), cough with profuse sputum and disturbances of consciousness. In the post-septic form, there may occur intravascular coagulation (DIC) with haemorrhagic diathesis and necrosis of the distal limbs [19].

The primary treatment is the antibiotic treatment with doxycycline, streptomycin, gentamicin, chloramphenicol, cephalosporins and carbapenems [12].

The detection and diagnosis of *Y. pestis* requires a routine examination including microscopic examination of a direct material, which is most often blood, exudation or purulence, isolation and cultivation of the germ from pleural effusion and sputum, as well as a biological test consisting in infecting a guinea pig with the material collected from the patient.

According to the ECDC, the highest incidence occurred in 201, in Madagascar, when 482 cases were reported infected and 81 people died. In the African countries of the Democratic Republic of Congo and the aforementioned Madagascar, there were 97% of all cases occurring all over the world. Plague has not been observed in Europe for years; however, it is found sporadically on the eastern slopes of the Caucasus, in China, Mongolia, Vietnam, Cambodia, Indonesia, Iran up to the borders of Saudi Arabia and Yemen. In Africa, active outbreaks of plague occur in South Africa, Namibia, Lesotho, Kenya, Tanzania and Mozambique. In North America, plague is endemic in the 15 western states [12, 20]. The last cases in Poland were recorded in the south-eastern borderlands at the end of the 18th century.

***Francisella tularensis* - tularemia**

In antiquity (the end of the fourteenth century BC), tularemia was known and used by Hittites, who would use infected animals to spread the disease to the enemy. Hence, tularemia is known as the "Hittite epidemic" or the "Hittite disease" [6, 7, 21].

Tularemia was first described in Japan in the late nineteenth century, but the name *Francisella* comes from Edward Francis, an American researcher who discovered these bacteria in 1911 in squirrels in Tulare County, California. In humans, this disease was first described in 1924 in a patient with severe pneumonia, with spleen and lymph node damage [22].

The first works on the use of *F. tularensis* as biological weapons were carried out in the 1930s simultaneously in the US, USSR and Japan [23]. It is believed that the mass incidence in German soldiers in the years 1942-1943, during the siege of Stalingrad, was the result of the use of these bacteria by Soviet soldiers. Then, these rods were successfully tested in Manitoba in 1932-1945 and research on potential use as a biological weapon continued after the end of the Second World War in both the US and the USSR. In spite of the official declaration by the USSR in 1973 concerning the destruction of the arsenal of biological weapons, work on these bacteria was also carried out in the early 90s of the twentieth century [6, 7, 17].

In Poland, for the first time tularemia was diagnosed in humans in 1949 in Łódź, and the source of the disease was hare skin. Subsequent cases were noted in the 1950s as a result of contact with rabbits and laboratory animals [7].

Tularemia is an acute zoonotic infectious disease found in natural conditions in rodents and rabbits. Cattle, pigs, dogs, cats, domestic and wild birds, non-domestic animals, and primate also suffer from tularemia. It is caused by the small, relatively aerobic, intracellular Gram-negative rod *Francisella tularensis*, with the dimension 0.2-0.3 x 0.7 µm, characterised by high variability of shapes. *F. tularensis* rods are sensitive to high temperature and most commonly used disinfectants. However, the bacteria are killed within 30 minutes when exposed to the influence of sunlight, at 58 °C - 10 minutes. They survive for a relatively long time in the natural environment; in soil and water reservoirs for over 3 months and in the frozen state - even for a few years [12].

The disease can occur through vectors such as flies, ticks and mosquitoes. Ticks can be a natural reservoir of this microorganism for a long time and the cause of frequent epidemics and epizootics in a given area. Human infection occurs due to contact with sick animals or inhaling dust contaminated with animal droppings, which takes place mainly in farms dealing producing animals and, to a lesser extent, due to contaminated food and water. It is also possible to transfer the micro-organism through the conjunctiva or damaged skin.

Tularemia occurs in several clinical forms. The most common (45-85%) form is ulcer-nodal, resulting from a contact with contaminated tissues of animals or bites by infected arthropods [19]. At the site of infection, clots appear, which after 48 hours are 1-2 cm in size. Next, they turn into pustules and then ulcers. The bacteria then pass to the lymph nodes and from there to the internal organs or CNS. The consequence of consuming contaminated food, feed or water may be two further forms of tularemia: gastrointestinal and anginal. The first one most often takes the form of mild diarrhoea, or a more severe one, manifesting itself with intestinal ulceration, the other one – the angina form is an exudative inflammation of the mouth and throat, which is accompanied by swelling of the lymph nodes of the neck, whose common complication may be pneumonia. The consequence of the penetration of the microorganism via the aerogenic pathway, but also as a complication of other forms of tularemia, is the pulmonary form, occurring in less than 5% of cases. The disease may take the form of hyperacute or, with slowly emerging clinical symptoms, have a non-specific character: fever, muscle pain, chest pain, dry cough and pneumonia. It can enlarge nodal lymph nodes and cause effusion in the pleural cavity. There appear also granulomatous changes in lung tissue as well as abscesses. Rare forms of tularemia are the ocular node, which are the result of the mechanical introduction of conjunctival bacilli (rubbing the eyes with the fingers) and the major form, characterised by sudden fever without skin lesions, muscle pain, headache, chills. The complication of this form is the breakdown of striated muscles, inflammation of the liver, kidneys, meninges and joints. In the major form, mortality is very high and reaches 50% [23].

Bacteriological research towards *F. tularensis* involves culturing the tested biological material on appropriate solid microbiological media, i.e. CHA agar medium (Cystine Heart Agar) and CHA + SS selective agar medium (with the addition of inhibiting substances) growth of foreign bacterial flora. Identification of *F. tularensis* involves the following tests: oxidase test (-), catalase test (+), slide agglutination test with anti-F serum. tularensis (+), Gram stain (Gram negative cocoons) [23, 24].

According to the ECDC, in 2015 in the EU countries (with no data from Denmark, Malta and Portugal), there were 1,079 human cases detected in laboratories, which represents an increase of nearly 125% in relation to 2014. At the same time, 9 infections were recorded in Poland. There were 6 cases in Poland in 2011 (544 in the EU), 6 cases in 2012 (in the EU 942), and in 2013 there was noted an increase to 8 cases (a drop to 279 in the EU). In 2014, the highest number of cases was recorded in Poland in 5 years (11 cases). In the same year, 480

cases were reported in the EU. In 2015, the disease was most commonly found in Sweden (859 people), Finland (104), the Czech Republic (56) and Hungary (35). There was not a single case of its occurrence in Estonia, Greece, Latvia, Luxembourg, Portugal and Slovenia [12].

Despite the real threat of terrorism in the 21st century and large-scale activities aimed at reducing the occurrence of this phenomenon, it should be borne in mind that pathogens listed on the CDC list A may pose a real threat to human health and their lives.

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THE USE OF ANTI-C6VlsE IgG IN THE ASSESSMENT OF THE EFFECTIVENESS OF LYME DISEASE TREATMENT – A PRELIMINARY REPORT

ZASTOSOWANIE PRZECIWCIAŁ ANTY-C6VlsE W OCENIE SKUTECZNOŚCI LECZENIA BORELIOZY Z LYME – DONIESIENIE WSTĘPNE

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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
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G. Funds collection
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Summary

Background. The aim of this study was to evaluate the dynamics of changes in IgG anti-C6VlsE concentration in patients treated for Lyme borreliosis in relation to clinical manifestations of the disease.

Material and methods. The study group consisted of 20 patients from Ternopil and surrounding areas (Western Ukraine) with clinical symptoms of Lyme borreliosis. IgG anti-C6VlsE was measured three times: before starting the patients on antibiotic therapy, immediately after its completion and 3-4 months after the end of antibiotic therapy.

Results. In 40% of the patients the IgG anti-C6VlsE concentration decreased 3-4 months after the treatment, but only in half of them it was associated with elimination of symptoms. 60% of patients did not show any tendency to decrease in IgG anti-C6VlsE concentrations after 3-4 months after the treatment, and 25% of patients in this group had an improvement in health condition.

Conclusions. It cannot be excluded that IgG anti-C6VlsE may be important in the serological evaluation of the efficacy of Lyme borreliosis treatment, especially in early stage patients. However, this requires further research, which should be extended to a larger group of patients. It is also important that the assessment of anti-C6VlsE antibody concentration should be performed additionally for a period longer than 4 months from the end of antibiotic therapy.

Keywords: VlsE, *Borrelia burgdorferi*, Lyme borreliosis, Ukraine

Streszczenie

Wprowadzenie. Celem badań była ocena dynamiki zmian stężenia IgG anty-C6VlsE u pacjentów leczonych w związku z boreliozą z Lyme w stosunku do manifestacji klinicznych choroby.

Materiał i metody. Grupę badaną stanowiło 20 pacjentów z klinicznymi objawami boreliozy z Lyme z Tarnopola i okolic (Ukraina Zachodnia). IgG anty-C6VlsE oznaczano trzykrotnie: przed wdrożeniem antybiotykoterapii, bezpośrednio po jej zakończeniu i 3-4 miesiące od zakończenia antybiotykoterapii.

Wyniki. U 40% badanych stwierdzono obniżenie stężenia IgG anty-C6VlsE po 3-4 miesiącach po leczeniu, przy czym tylko u połowy z nich wiązało się to z eliminacją dolegliwości. U 60% pacjentów nie stwierdzono tendencji obniżania stężeń IgG anty-C6VlsE po 3-4 miesiącach po leczeniu, a u 25% tej grupy nastąpiła poprawa stanu zdrowia.

Wnioski. Nie wykluczone, że IgG anty-C6VlsE może mieć znaczenie w serologicznej ocenie skuteczności leczenia boreliozy z Lyme, zwłaszcza u osób we wczesnym okresie choroby. Wymaga to jednak dalszych badań, którymi należałoby objąć licznieszą grupę pacjentów. Istotne jest także, by ocena stężenia przeciwciał anty-C6VlsE dokonywana była dodatkowo w okresie dłuższym niż 4 miesiące od zakończenia antybiotykoterapii.

Słowa kluczowe: VlsE, *Borrelia burgdorferi*, borelioza z Lyme, Ukraina

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Introduction

Borrelia burgdorferi sensu lato (*B. burgdorferi* s. l.) including *B. burgdorferi* sensu stricto, *B. afzelii*, *B. garinii* are responsible for generating symptoms of Lyme borreliosis in European countries. Clinical manifestations of the disease include early skin lesions such as erythema migrans (EM), Lyme arthritis, neuroborreliosis and skin lesions such as acrodermatitis chronica atrophicans (ACA) [1, 2]. The laboratory diagnosis of Lyme borreliosis is based on the results of serological tests and clinical manifestations observed in the patient [2, 3]. According to the recommendations valid in Poland and many other European countries, serological diagnosis of Lyme borreliosis should be carried out according to a two-stage protocol (ELISA test, Western blot test) [4]. There are no uniform diagnostic recommendations for Lyme borreliosis in Ukraine, but according to the Order of the Minister of Health of Ukraine N133 from 19th July 1995, the disease was classified as a particularly dangerous infection.

Serological tests used in the diagnosis of Lyme borreliosis cannot be used to assess the efficacy of treatment. The effectiveness of antibiotic therapy should be assessed on the basis of the disappearance of clinical manifestations of the disease [5]. As a result, laboratory markers with high sensitivity and diagnostic specificity are still being sought to monitor the effectiveness of the treatment of this disease. High hopes in this respect were associated with anti-C6VlsE *B. burgdorferi* antibodies. In some patients there was a decrease in their titre after effective antibiotic therapy. Therefore, the possibility of their use in the evaluation of the efficacy of Lyme borreliosis treatment is still considered [6]. VlsE (variable major protein-like sequence, expressed), is an immunogenic molecule responsible for the antigenic variability of *B. burgdorferi*. Its construction distinguishes six variable regions and six unchanging regions. Unchanging regions (IR1-IR6) are conservative for the genotypes of the *B. burgdorferi* s. l. complex. [7]. It is suggested that supplementing the diagnostic panel with recombinant *B. burgdorferi* s. l. proteins, including C6 peptide from VlsE, may significantly increase the sensitivity of serological tests [3]. The aim of this study was to evaluate the dynamics of changes in IgG anti-C6VlsE concentration in patients treated for Lyme borreliosis in relation to clinical manifestations of the disease.

Material and methods

Study group

The study group consisted of 20 patients with clinical symptoms of Lyme borreliosis and antibodies for specific *B. burgdorferi* antigen proteins: 18 adults aged 25 to 62 years (mean 50.83, SD 9.54) and 2 children aged 4 and 9 years. The subjects came from Ternopil and surrounding areas (Western Ukraine). The process of diagnosis and treatment for Lyme borreliosis was carried out in the Department of Infectious Diseases and Epidemiology, Dermatology and Venereology, I. Ya. Horbachevsky Ternopil State Medical University.

Blood was collected three times to determine IgG anti-C6VlsE antibodies:

- before starting antibiotic therapy (sample 1),
- after the end of antibiotic therapy (sample 2),
- 3-4 months after the end of antibiotic therapy (sample 3).

The study was approved by the Bioethics Committee of I. Ya. Horbachevsky Ternopil State Medical University, No 42, 04/09/2017.

Questionnaire

All patients answered questions concerning: tick bites (the place where the tick was inserted into the body, the number of bites, time elapsed from the moment of inserting the tick until its removal from the body, the method of removing the tick), occurrence of erythema migrans (EM) and other symptoms that were related to the fact of tick bites and the coexistence of chronic diseases.

Serological tests

Serum IgG anti-C6VlsE antibodies were assayed using the Lyme Trace ELISA (IgG) test (Euroimmun, Germany). This test is based on recombinant VlsE from *B. burgdorferi* sensu stricto and *B. afzelii*, which are the etiological factors of Lyme borreliosis in Europe. IgG anti-C6VlsE concentration is expressed in RU/ml. The test was performed according to the manufacturer's instructions.

Statistical analyses

Statistical analyses were performed on the basis of Statistica v. 10. The ANOVA Friedman test was used to analyse the variance of repeated measurements. This test is used when measurements of the test variable are made several times ($k \geq 2$). Kendall's coefficient of concordance: values close to 0 are the mismatch between cases, values close to 1 are the correspondence between repeated measurements. Assumed significance level $p < 0.05$.

Results

Analysis of answers given by respondents in the questionnaire

Detailed data on the history of tick bites and symptoms associated with this event as well as the general health status of the respondents are presented in Table 1.

Seventy percent (70%) of people from the study group declare the occurrence of tick bites: single bites (35%), double bites (10%), multiple bites (25%). The most frequent bites occurred in the forest areas (40%). Ticks inserted into the skin were found in the lower limbs (50%), back (20%), upper limbs and abdomen (15% each), and the in the neck area (5%). Respondents often used the help of medical personnel (doctor, nurse) to remove ticks (25%). Some people used incorrect actions, such as pulling the tick with their fingers (25%), lubricating the tick with fat so the insect gets out by himself (15%) or scratching the tick with their fingernails (20%). Only 5% of the respondents removed the tick within 12 hours of its insertion into the skin. 40% of patients reported EM after a tick bite - 25% of patients up to 30 days after the tick bite, while 15% of respondents did not remember the amount of time that passed from the tick bite. Other symptoms reported by subjects due to tick bite are presented in Table 1. Fifty-five percent (55%) of the study group remains under the care of a cardiologist, neurologist, dermatologist or other specialist in chronic diseases. Data concerning drugs taken by patients are presented in Table 1.

Table 1. Exposure to ticks and general health characteristics

Answers provided		N(%)
Tick bites		
The area	agricultural land	2(10%)
	forest	8(40%)
	meadow/grassland	1(5%)
	fruit orchard	1(5%)
	green areas	2(10%)
The number of tick bites	bitten once	7(35%)
	bitten twice	2(10%)
	multiple bites	5(25%)
Tick bites which were not noted		6(30%)
Place of tick bite	upper limb	3(15%)
	lower limb	10(50%)
	neck	1(5%)
	back	4(20%)
	stomach	3(15%)
Removal of the tick	up to 12 hours	1(5%)
	up to 24 hours	6(30%)
	up to 48 hours	3(15%)
	3 days	1(5%)
	1 month	1(5%)
	I do not remember	2(10%)

Method of removal	by a physician/nurse	5(25%)
	pulled out with fingers	5(25%)
	scratching with a nail	4(20%)
	spreading a tick with oily substance to make it go out on its own	3(15%)
	disinfecting a place after removing a tick	4(20%)
General health		
Patients who are under the care of a cardiologist, neurologist, dermatologist or other specialist in the field of chronic diseases		11(55%)
Used medicinal preparations	in cardiovascular diseases	2(10%)
	in digestive system diseases	1(5%)
	antihistamines	1(5%)
	hormones	4(20%)
	antibiotics	4(20%)
	other	4(20%)

N (%) - the number of people (percentage)

Serological tests - IgG-antigen concentration C6VlsE

IgG anti-C6VlsE concentrations were measured three times in serum samples: before antibiotic therapy (sample 1), after antibiotic therapy (sample 2), 3-4 months after antibiotic therapy (sample 3).

Depending on the obtained results of IgG-antigen C6VlsE concentration, subsequent serum samples were divided into groups:

- group A - patients with a decrease in IgG anti-C6VlsE concentration in three consecutive serum samples;
- group B - patients with an increase in IgG anti-C6VlsE concentration after antibiotic therapy (sample 2) compared to the pre-treatment status (sample 1), followed by a decrease in IgG anti-C6VlsE concentration 3-4 months after treatment completion (sample 3);
- group C - patients with an increase in IgG anti-C6VlsE concentration in three consecutive serum samples;
- group D - patients in whom IgG anti-C6VlsE concentration decreased after antibiotic therapy (sample 2) compared to the pre-treatment status (sample 1), followed by an increase in IgG anti-C6VlsE concentration 3-4 months after treatment completion (sample 3);
- group E - patients with high concentrations (<250 RU/ml) of IgG anti-C6VlsE in subsequent serum samples;
- group F - patients with low concentrations (3.57 - 8.94 RU/ml) of IgG anti-C6VlsE in subsequent serum samples.

A detailed summary of the results together with information on antibiotic therapy and symptoms of Lyme borreliosis before and after treatment is presented in Table 2 .

Table 2. IgG anti-C6VlsE concentrations and observed clinical signs before and after the treatment for Lyme borreliosis

N(%)	Group	IgG anty-C6VlsE			Symptoms before treatment	Treatment	Result of treatment
		Sample 1	Sample 2	Sample 3			
3(15)	A	211	115	101	EM simultaneously diagnosed with anaplasmosis	3	CR
		178	85.1	32.4	EM	1	CR
		98.6	14.1	5.59	EM, concentration disorders	3	CR

5(25)	B	112	153	55.5	EM	1	LTC – neurological complications
		5.88	13.7	4.12	muscle pain, bones and joints pain	4,5	LTC – musculoskeletal system
		77.4	177	70.4	bones and joints pain	1	LTC – musculoskeletal system
		36.4	44.4	25.5	EM	1	LTC – musculoskeletal system, neurological complications
		11.1	14.3	5.9	EM, muscles pains, bones and joints pain	1	CR
1(5)	C	3.53	111	139	bones and joints pain	3	LTC – musculoskeletal system, uveitis
2(10)	D	46.5	34.6	54.4	bones and joints pain	1	CR
		14.1	7.16	15.9	fever, bones and joints pain, concentration disorders	1	CR
5(25)	E	>250	>250	>250	bones and joints pain	3	LTC – musculoskeletal system
		>250	>250	>250	EM	6	LTC – problems with the pulmonary system
		>250	>250	>250	EM, bones and joints pain arthritis, concentration disorders	7	LTC – musculoskeletal system, uveitis
		>250	>250	>250	meningitis	8	CR
		>250	>250	>250	bones and joints pain, concentration disorders	1	LTC – musculoskeletal system
4(20)	F	4.15	3.57	5.62	bones and joints pain	1,5	LTC – musculoskeletal system
		7.16	7.81	8.94	erythema nodosum, bones and joints pain	1,5	LTC – musculoskeletal system
		7.57	6.12	5.68	muscle pain, bones and joints pains	1,5	LTC – musculoskeletal system
		3.77	4.24	4,8	bones and joints pains	1,5	LTC – musculoskeletal system

Markings in the table:

N (%) - the number of people (percentage)

Groups of patients: A, B, C, D, E, F - explanation of the abbreviations is included in the text

Treatment:

1. Doxycycline, 100mg twice daily for 21 days
2. Azithromycin, 500mg twice daily for 10 days
3. Doxycycline, 100mg twice daily for 14 days + Azithromycin, 500mg twice daily for 10 days
4. Doxycycline, 100mg twice daily for 14 days + Bicillin 5 for 10 days
5. Treatment with hormones in anamnesis
6. Doxycycline, 100mg twice daily for 14 days + treatment of ascaris and lamblia
7. Doxycycline, 100mg twice daily for 21 days + Levofloxacin, 500mg twice daily for 10 days
8. Ceftriaxone 1000mg twice daily for 12 days + Azithromycin, 500mg twice daily for 12 days+ hormones

Result of treatment:

CR- Complete recovery

LTC - Long-term consequences

Group A patients

In 15% of patients a decrease in IgG anti-C6VIsE concentration was observed in three consecutive serum samples (Figure 1). The mean pre-treatment IgG anti-C6VIsE (sample 1) was 162.53 RU/ml (SD 57.77); after antibiotic therapy (sample 2) 71.40 RU/ml (SD 51.82); 3-4 months after treatment (sample 3) 46.33 RU/ml (SD 49.20). In the analysed cases significant differences were found between measurements ($p=0.04979$) and strong correlation (1.00). In all patients in this group the symptoms of Lyme borreliosis were eliminated (Table. 2).

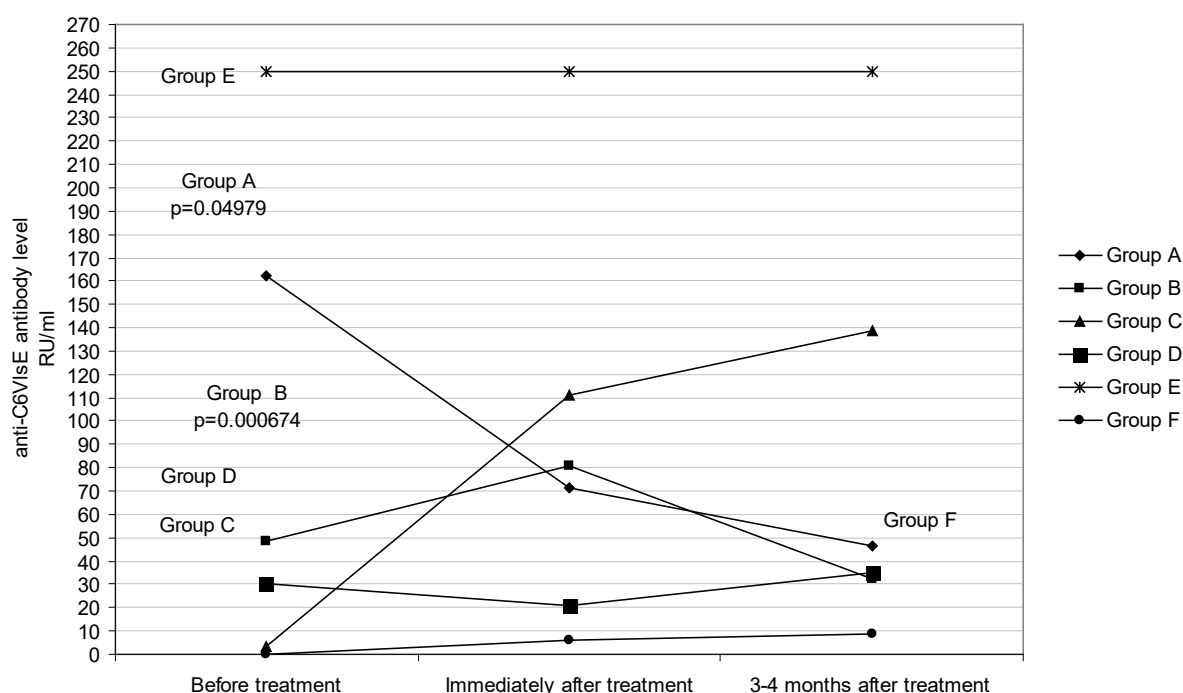


Figure 1. Dynamics of IgG anti-C6VIsE changes in patients treated for Lyme borreliosis

Group B patients

In 25% of patients, including 1 child, IgG anti-C6VIsE concentration increased after antibiotic therapy (sample 2) and then IgG anti-C6VIsE concentration decreased 3-4 months after treatment completion (sample 3) (Figure 1). Mean IgG anti-C6VIsE values were: sample 1 - 48.55 RU/ml (SD 45.35); sample 2 - 80.48 RU/ml (SD 78.60); sample 3 - 32.28 RU/ml (SD 29.69). In the analysed cases significant differences were found between measurements ($p=0.000674$) and strong correlation (1.00). In 80% of patients in this group the symptoms of Lyme borreliosis were not eliminated (Table 2).

Group C patients

In 5% of the subjects an increase in IgG anti-C6VlsE concentration was observed in subsequent samples (1 - 3.53 RU/ml; 2 - 111 RU/ml; 3 - 139 RU/ml). The symptoms of Lyme borreliosis were not eliminated (Figure 1, Table 2).

Group D patients

In 10% of patients, IgG anti-C6VlsE concentration decreased after antibiotic therapy (sample 2) compared to sample 1, followed by an increase in IgG anti-C6VlsE concentration 3-4 months after treatment completion (sample 3) (Figure 1). Average IgG anti-C6VlsE values were: sample 1 - 30.30 RU/ml (SD 22.91); sample 2 - 20.88 (SD 19.40); sample 3 - 35.15 (SD 27.22). The differences were not significant ($p=0.13534$). The symptoms of Lyme borreliosis were eliminated (Table 2).

Group E patients

In 25% of patients, including 1 child, high concentrations (>250 RU/ml) of IgG anti-C6VlsE were found in three consecutive serum samples (Figure 1, Table 2). In one adult in this group of patients the symptoms of Lyme borreliosis were eliminated.

Group F patients

In 20% of three consecutive serum samples low IgG anti-C6VlsE concentrations were found, ranging from 3.57 to 8.94 RU/ml. (Figure 1, Table 2). There was no elimination of Lyme borreliosis symptoms in the subjects.

Discussion

In the absence of a Lyme borreliosis vaccine, the only way to avoid infection with *B. burgdorferi* s. l. spirochetes is to consciously apply the principles of prevention. Among other things, it is important to remove the tick embedded in the skin as quickly and correctly as possible. Unfortunately, many people still use inappropriate practices such as lubricating the tick with fat so it detaches from the skin on its own (15%) or scratching the tick off (20%) and only 5% of respondents removed the tick within 12 hours of its insertion into the skin. In other studies (not published) carried out among Ukrainian foresters, 18.8% of them declared tick lubrication with greasy substance. It is therefore important to strive for continuous education for people at risk of tick bites in connection with their work or staying in areas where these arachnids are found.

The diagnosis of Lyme borreliosis is based on characteristic skin lesions such as EM and borreliolymphoma. Other early symptoms include Lyme carditis, Lyme arthritis and early neuroborreliosis. Late changes include neuroborreliosis, Lyme arthritis, acrodermatitis chronica atrophicans (ACA). In about 80% of patients EM is diagnosed, which appears between 3 to 30 days after infection with *B. burgdorferi* s. l. and spontaneously disappears within about 4 weeks. The diagnosis is based on the clinical picture and does not require confirmation by serological tests [8]. This early symptom of Lyme borreliosis was reported by 40% of patients in the study group. Bone and joint pain occurred in 65% of subjected individuals, concentration disorders in 20% and muscle pain in 15%.

Antibiotic therapy implemented in patients with early symptoms of the disease is usually effective. However, in individuals with advanced clinical manifestations such as Lyme arthritis, it may take a few weeks or months for the patient to notice improvement in their health from the time of starting them on antibiotics. Treatment may also not bring the improvement in health expected by the patient. It is estimated that about 10% of individuals experience chronic fatigue, muscle pain and other non-specific problems of a continuous or recurrent nature, despite starting them on antibiotic therapy for Lyme borreliosis. These symptoms may be subjective and the mechanism of their generation has not been explained [9]. In some cases, the group of signs and symptoms are referred as the post-treatment Lyme disease syndrome (PTLDS) [10].

From the group of 20 patients treated for Lyme borreliosis, 35% had an improvement in health after antibiotic therapy. In 65% of individuals the symptoms of the disease persisted or exacerbated 3-4 months after the end of the treatment. These were most often bone and joint ailments and muscle pains (55%), while neurological disorders occurred in 10% of the patients.

It cannot be excluded that in some patients accompanying chronic diseases and the treatment used in this connection had an impact on the ailments experienced by the examined patients. It is also difficult to assess

whether some of these ailments could have been subjective feelings. In diagnostic practice, the possibility of using anti-C6VlsE antibodies to evaluate the efficacy of Lyme borreliosis treatment is taken into account, as some patients showed a decrease in their titre after effective antibiotic therapy [6]. IR6 (C6) specific antibodies were detected in 78% of serum samples from patients with symptoms of Lyme borreliosis, while less than 12% of samples responded to IR2 or IR4 [7]. Studies conducted by Philipp have shown that in patients with symptoms of Lyme borreliosis (early localized, early disseminated symptoms) who received treatment, the anti-C6VlsE *B. burgdorferi* antibody titre decreased fourfold or even to undetectable levels within 6 to 12 months after treatment. This decrease was observed in 89% of patients with EM and in 100% of patients with multiple-EM [9]. Withdrawal of IgG antibodies to VlsE antigen within 2 to 6 months after treatment was also found in other studies in patients with early localized Lyme borreliosis [2]. According to Philipp and his team, the decrease in anti-C6VlsE antibody titre after antibiotic treatment may result due to the properties of VlsE protein [11]. The analysis of the results showed that the dynamics of IgG anti-C6VlsE concentration changes in patients treated for Lyme borreliosis may vary. In 40% of the patients IgG anti-C6VlsE concentration decreased 3-4 months after the treatment, but only in half of them it was associated with the elimination of the ailments. 60% of patients did not show any tendency of IgG anti-C6VlsE concentrations decrease after 3-4 months after treatment, and 25% of this group had an improvement in health condition. The dynamics of IgG anti-C6VlsE changes may depend on the severity and duration of clinical signs of Lyme borreliosis. In patients with PTLDS there was no correlation between the decrease in C6 antibody titre and the outcome of treatment and it was therefore concluded that they could not be used to assess the outcome of treatment in this population [12].

Conclusions

It is not excluded that IgG anti-C6VlsE may be important in the serological evaluation of the efficacy of Lyme borreliosis treatment, especially in patients in the early stage of the disease. However, this requires further research, which should be extended to a larger group of patients. It is also important that the assessment of anti-C6VlsE antibody concentration is performed additionally for a period longer than 4 months from the end of antibiotic therapy.

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ANTAGONISTIC INTERACTION OF LACOSAMIDE WITH CARBAMAZEPINE AND VALPROATE IN THE MOUSE TONIC-CLONIC SEIZURE MODEL

ANTAGONISTYCZNA INTERAKCJA LAKOZAMIDU Z KARBAMAZEPINĄ I WALPROAINIANEM W MODELU DRGAWEK TONICZNO-KLONICZNYCH U MYSZY

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Authors' contribution

Wkład autorów:

- A. Study design/planning
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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
- G. Funds collection
zebranie funduszy

Summary

Background. It is estimated that approximately 1% of people worldwide suffer from epilepsy. Currently available antiepileptic drugs (AEDs) are able to control epileptic seizures in about 70% of cases. In the remaining patients (30%), the application of two or three AEDs in combination is necessary for effective seizure management. The goal of this work was to characterize the interaction of three AEDs: lacosamide (LCM), carbamazepine (CBZ) and valproate (VPA) at the fixed-ratio of 1:1:1 in the mouse tonic-clonic seizure model.

Material and methods. Male albino Swiss mice, after receiving a combination of LCM, CBZ and VPA, were challenged with electric current to evoke tonic hind limb extension (seizure activity). Protection of the mice from tonic-clonic seizures was assessed by isobolographic analysis to determine the type of interaction occurring between these drugs.

Results. Type I isobolographic analysis revealed that the combination of LCM, CBZ and VPA produced infra-additive (antagonistic) interaction in the mouse tonic-clonic seizure model.

Conclusions. Since the three-drug mixture of LCM, CBZ and VPA exerted an antagonistic interaction in the tonic-clonic seizure test in mice, we would caution physicians against treating epilepsy patients with this unfavorable combination.

Keywords: antiepileptic drugs, isobolography, maximal electroshock, three-drug combination, antagonism

Streszczenie

Wprowadzenie. Szacuje się, że około 1% osób na całym świecie cierpi na padaczkę. Obecnie dostępne leki przeciwpadaczkowe pozwalają na opanowanie napadów padaczkowych w około 70% przypadków. U pozostałych pacjentów z padaczką (30%) konieczne jest zastosowanie dwóch lub trzech leków przeciwpadaczkowych w kombinacji. Celem pracy było scharakteryzowanie interakcji między trzema lekami przeciwpadaczkowymi: lakoamidem (LCM), karbamazepiną (CBZ) i walproinianem (VPA) w stałym stosunku dawek 1:1:1 w modelu drgawek toniczno-klonicznych u myszy.

Materiał i metody. Samce myszy albino Swiss, po otrzymaniu kombinacji LCM, CBZ i VPA, poddano działaniu prądu elektrycznego, aby wywołać toniczny wyprost kończyn tylnych (aktywność drgawkową). Ochronę myszy przed napadami toniczno-klonicznymi oszacowano za pomocą analizy izobolograficznej, aby określić typ interakcji zachodzącej między tymi lekami.

Wyniki. Analiza izobolograficzna typu I ujawniła, że kombinacja LCM, CBZ i VPA powodowała oddziaływanie infra-addytywne (antagonistyczne) w modelu drgawek toniczno-klonicznych u myszy.

Wnioski. Ponieważ trójlekowa mieszanina LCM, CBZ i VPA wywierała antagonistyczną interakcję w teście napadów toniczno-klonicznych u myszy, specjalne ostrzeżenie jest konieczne dla lekarzy, aby nie leczyć pacjentów z padaczką tą niekorzystną kombinacją.

Słowa kluczowe: leki przeciwpadaczkowe, izoblografia, elektrowstrząsy, kombinacja trzech leków, antagonizm

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Introduction

Epilepsy is one of the most frequently occurring neurological diseases, affecting almost 1% of the population worldwide [1]. Pharmacotherapy with currently available antiepileptic drugs (AEDs) is the treatment of choice for patients with epilepsy. However, the application of one AED, as monotherapy, is sometimes insufficient to halt seizure attacks in epilepsy patients [2, 3]. In such a situation, physicians prescribe two or three AEDs. The AEDs selected for combinatorial therapy are based on theoretical presumptions suggesting it is beneficial to combine AEDs with diverse molecular mechanisms of action [4]. This has been a “golden rule” followed by physicians since 2002, when this treatment method was clinically confirmed in patients with resistant epilepsy [2, 3].

Recently, several favorable combinations of AEDs have been clinically confirmed [5]; however, with 25 currently licensed AEDs, there can be (theoretically) 13,800 distinct three-drug combinations. Only a few of these combinations have been clinically verified [2, 3], and the efficacy of the remaining three-drug combinations have yet to be clinically established or publicly revealed. In order to aid clinicians in their choice on how to combine AEDs, preclinical studies in animal models can provide useful information on favorable combinations that could be utilized in patients with epilepsy for seizure suppression [6-10]. Several triplicate AED combinations have been found to be either beneficial, producing synergy, or neutral, with additivity determined by isobolography in an experimental animal model of epilepsy [6-9]. It is believed that synergistic interactions observed in experimental animal models of epilepsy will be similarly synergistic in humans—this is a basic concept resulting from translational study data [4].

Generally, the application of three drugs produces interactions that may be pharmacokinetic, pharmacodynamic or both [11]. Theoretically, some AED combinations may be beneficial due to a reduction of drug doses. However, it is highly likely that some AED combinations may produce unfavorable effects. Theoretical presumptions can aid physicians in selecting proper combinations of AEDs that exert a favorable interaction in mammals, and it is known that various molecular mechanisms of action contribute to the wide range of seizure suppression exerted by AEDs [4, 12].

Since induction, propagation and amplification of seizures are complex processes and, unfortunately, not fully understood, seizure suppression often requires medicating with various AEDs [4, 13]. Undoubtedly, various AEDs with diverse molecular mechanisms of action should synergistically cooperate in terms of seizure suppression [12].

The aim of this study was to continue our previous experiments and assess the type of interaction between three AEDs: lacosamide (LCM), carbamazepine (CBZ) and valproate (VPA) in the tonic-clonic seizure model in mice. To search for interaction among the AEDs, we used type I isobolographic analysis of interaction, which is considered a gold standard in the evaluation of drug properties in preclinical studies [14]. The selection of AEDs in this study was not serendipitous because two of the studied AEDs, VPA and CBZ, are widely prescribed AEDs (as first-line drugs) for patients with tonic-clonic seizures, partial onset convulsions with or without secondary generalization [15, 16]. LCM has recently been licensed as an add-on drug for patients with partial-onset seizures with or without secondary generalization [17]. Thus, from a theoretical point of view, the combination of LCM, CBZ and VPA should likely be beneficial, offering the patients with epilepsy a suppression of tonic-clonic seizures. Moreover, the choice of these AEDs (LCM, CBZ and VPA) was considered to be ideal because the drugs in combination, due to their diverse molecular mechanisms of action, should theoretically provide maximal therapeutic effects and no or minimal side effects [18]. Thus, to confirm our hypothesis that the combination of LCM with CBZ and VPA was an “ideal” selection, we conducted experiments on male albino Swiss mice as described previously [6, 8, 9, 19].

Material and methods

Adult male albino Swiss mice (8 week-old, weighing 22-26 g) were used in this study. All experimental procedures carried out in this study were in strict accordance with the Guide for the Care and Use of Experimental Animals [20], and approved by the Local Ethics Committee (License no.: 45/2014).

LCM (Vimpat®, UCB Pharma, Brussels, Belgium) and CBZ (Polfa, Starogard Gdanski, Poland) were suspended in a 1% solution of Tween 80 (Sigma-Aldrich, Poznań, Poland) in distilled water, while VPA (Sigma-Aldrich, Poznań, Poland) was dissolved directly in sterile distilled water. All three drugs (LCM, CBZ and VPA) were administered i.p., 30 min before the tonic-clonic seizures and all behavioral tests.

A rodent shocker (Hugo Sachs, type 221, Freiburg, Germany) was used to induce seizure activity in animals by a current (25 mA, 500 V, 50 Hz, 0.2 s stimulus duration) delivered *via* ear-clip electrodes. The seizure activity in the experimental mice manifested in the form of tonic hind limb extension. Different increasing drug doses

were administered to animals in order to determine a variable percentage of protection from tonic-clonic seizures. Doses of drugs and their corresponding protective effects were linearly related using dose-response effect functions [21]. The anticonvulsant potency of CBZ, LCM and VPA when administered alone was expressed as median effective doses (ED_{50} in mg/kg) of the AEDs, protecting 50% of mice from tonic-clonic seizures. Similarly, the anticonvulsant potency of the three-drug mixture in the fixed-ratio of 1:1:1 was expressed as the experimental median effective dose ($ED_{50\text{ exp}}$ value) protecting 50% of mice from tonic-clonic seizures.

Characterization of interactions among three AEDs was performed with isobolographic analysis of interaction, as described previously [6-8]. The test for parallelism of dose-response effects for LCM, CBZ and VPA was performed with the log-probit method [21]. Subsequently, we calculated median additive dose for the mixture of three AEDs at the fixed-ratio combination of 1:1:1 ($ED_{50\text{ add}}$ —i.e., a dose of the mixture that theoretically protected 50% of the tested mice from tonic-clonic seizures). The equations underlying the calculations have been described previously [6-8]. Next, the anticonvulsant effects produced by the three-drug mixture of LCM, CBZ and VPA (at the fixed-ratio of 1:1:1) were evaluated and expressed as the $ED_{50\text{ exp}}$ value, reflecting a dose of the mixture that protected 50% of the mice from tonic-clonic seizures.

Acute adverse effect potentials produced by the mixture of three AEDs (LCM, CBZ and VPA, applied in doses reflecting the $ED_{50\text{ exp}}$ value from the tonic-clonic seizure model) were determined in three standard behavioral tests: the chimney test (assessing motor coordination), grip-strength test (assessing skeletal muscular strength) and passive avoidance task (evaluating long-term memory and learning) in experimental animals, as described elsewhere [22].

The experimentally determined $ED_{50\text{ exp}}$ value from the tonic-clonic seizure model was statistically compared with its theoretical additive $ED_{50\text{ add}}$ value using the unpaired Student's *t*-test. Impairment of motor coordination in mice from the chimney test was statistically analyzed with Fisher's exact probability test. Mean muscular strengths of the animals from the grip-strength test were statistically compared with Student's *t*-test. Median retention times from the passive avoidance task were statistically analyzed with Mann-Whitney U-test. All data were statistically analyzed with GraphPad Prism version 7.0 for Windows (GraphPad Software, San Diego, CA, USA).

Results

The experimentally-derived ED_{50} values for LCM, CBZ and VPA (all three AEDs administered alone) in the mouse tonic-clonic seizure model were 7.27 ± 0.77 mg/kg, 14.25 ± 0.79 mg/kg, and 298.6 ± 15.15 mg/kg, respectively (results not shown). The equations for the dose-response functions, along with the test for parallelism for the respective AEDs (LCM, CBZ and VPA), are presented in Figure 1. The log-probit line for CBZ was parallel to that of VPA (Figure 1). In contrast, LCM's log-probit line was non-parallel to that of CBZ and VPA in the mouse tonic-clonic seizure model (Figure 1). The mixture of LCM, CBZ and VPA at the fixed-ratio of 1:1:1 produced anticonvulsant activity and the experimentally-derived $ED_{50\text{ exp}}$ value was 140.49 ± 11.09 mg/kg (Figure 2A). In contrast, the theoretically calculated $ED_{50\text{ add}}$ value was 106.71 ± 5.05 mg/kg (Figure 2A). With isobolography, it was found that the three-drug mixture at the fixed-ratio of 1:1:1 exerted an infra-additive (antagonistic) interaction ($P < 0.05$) in the tonic-clonic seizure model in mice (Figure 2A-2C). Moreover, the evaluation of potential acute adverse effects produced by the three AED mixture (at doses reflecting the $ED_{50\text{ exp}}$ from the tonic-clonic seizure model) in three behavioral tests revealed that the mixture did not disturb long-term memory and learning or skeletal muscular strength in the experimental animals (Table 1). Motor coordination in mice subjected to the chimney test was the only behavior that was slightly affected. One out of eight mice displayed impairment in motor coordination (12.5%, Table 1). However, the observed coordination deficits were not statistically significant (Table 1).

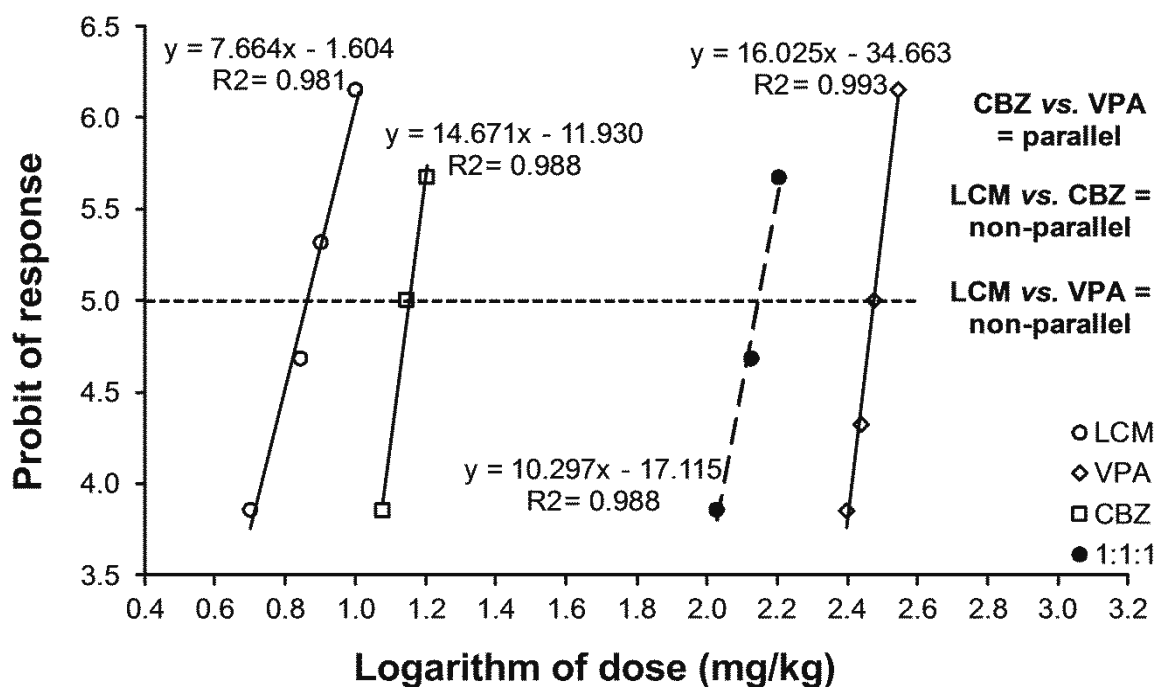


Figure 1. Dose-response functions for lacosamide (LCM), carbamazepine (CBZ), and valproate (VPA) when injected alone and in combination for the fixed-ratio of 1:1:1 in the mouse tonic-clonic seizure model

Doses of AEDs were transformed to logarithms, while their anticonvulsant effects from tonic-clonic seizures in mice were transformed to probits according to the log-probit method [21]. Linear regression functions for CBZ, LCM and VPA administered separately and in combination at the fixed-ratio of 1:1:1 are presented on the graph.

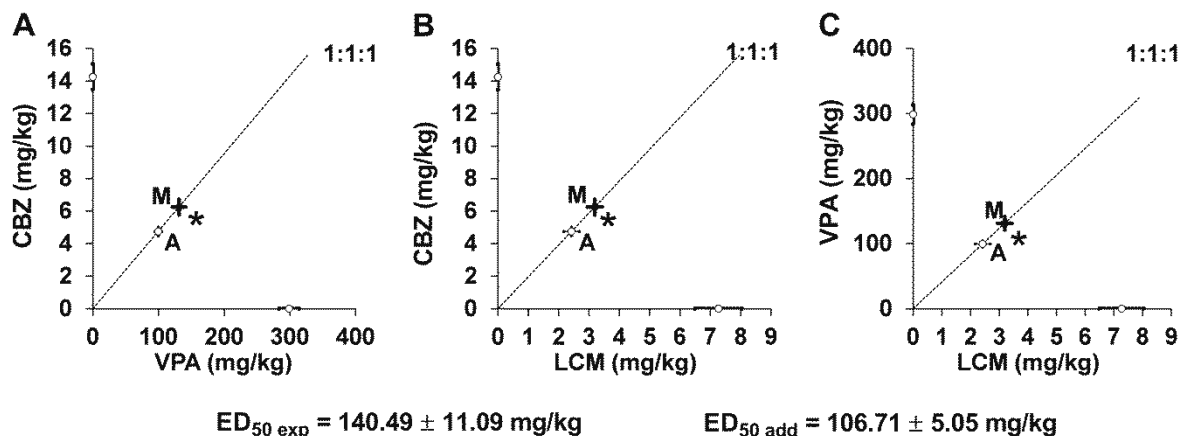


Figure 2. Isobolograms illustrating antagonistic (infra-additive) interaction among carbamazepine (CBZ), lacosamide (LCM) and valproate (VPA) in tonic-clonic seizures in mice

The ED_{50} values (\pm S.E.M.) of LCM, CBZ and VPA are plotted on X- and Y-axes, respectively. Point M depicts the experimentally-derived $ED_{50\text{ exp}}$ (\pm S.E.M.) value, whereas point A indicates the theoretically calculated $ED_{50\text{ add}}$ (\pm S.E.M.) value, corresponding to doses of AEDs in combination that protected 50% of the mice from tonic-clonic seizures. The dotted line starting from the point (0, 0) and crossing through the points M and A reflects the fixed-ratio of 1:1:1 for the three-drug combination. The experimental $ED_{50\text{ exp}}$ value of the three-drug mixture is placed significantly above the theoretically calculated $ED_{50\text{ add}}$ value ($*P < 0.05$), indicating the infra-additive (antagonistic) interaction. Statistical comparison of $ED_{50\text{ add}}$ and $ED_{50\text{ exp}}$ values was performed by using the unpaired Student's *t*-test.

Table 1. Influence of the three-drug mixture of lacosamide (LCM), carbamazepine (CBZ) and valproate (VPA) on skeletal muscular strength, long-term memory and motor coordination in mice

Treatment (mg/kg)	Muscular strength (N)	Retention time (s)	Motor coordination deficits (%)
Vehicle + vehicle + vehicle	0.926 ± 0.081	180 (180; 180)	0
LCM (3.19) + CBZ (6.25) + VPA (131.05)	0.919 ± 0.074	175.5 (155.7; 180)	12.5

The 1st column lists doses of the studied drugs corresponding to their ED_{50 exp} value in the tonic-clonic seizure model. The 2nd column indicates mean muscular strengths (in newtons [N] ± S.E.M.) in mice from the grip-strength test. The 3rd column represents median retention times (with 25th and 75th percentiles in parentheses) of the mice in the passive avoidance task. The 4th column indicates percentage of animals with impairment of motor coordination during the chimney test.

Discussion

In this study we found that the combination of LCM with CBZ and VPA produced antagonistic (infra-additive) interaction in the mouse tonic-clonic seizure model. Unfortunately, the antagonistic interaction entirely disqualified this combination from clinical use so as not to expose patients to ineffective treatment options. The utmost caution is therefore advised for patients receiving this combination of LCM, CBZ and VPA.

Previously, it was reported that the two-drug combination of CBZ with VPA produced an additive interaction in the mouse tonic-clonic seizure model [23]. Unfortunately, at present, there is no available information regarding the type of interaction resulting from the two-drug combinations of LCM with CBZ or VPA in the mouse tonic-clonic seizure model. Although it has been reported that the combinations of LCM with VPA and LCM with CBZ in the mouse 6 Hz-induced seizure model were additive and synergistic, respectively [24]. The 6 Hz model is thought to be an experimental model of limbic refractory seizures, while in this study we used a model reflecting tonic-clonic seizures in humans. Despite the clear difference in experimental seizure models, the above-mentioned facts allowed us to theoretically expect a favorable combination when combining the three AEDs together (LCM with CBZ and VPA). Unfortunately, instead of expected synergy, an antagonistic interaction occurred among these three AEDs.

To explain the observed antagonistic interaction in the mouse tonic-clonic seizure model, the molecular mechanisms of action of all three drugs should be considered. It can be hypothesized that LCM competitively blocks the anticonvulsant effects produced by CBZ due to the effects of both AEDs on sodium channels or due to a, highly likely, paradoxical effect upon combination of CBZ and LCM, as observed for CBZ and phenytoin [25]. Thus, higher doses of both AEDs are required to provide the same anticonvulsant effects in the mouse tonic-clonic seizure model.

On the other hand, we have previously documented that several three-drug combinations, LCM with CBZ and LTG, LCM with CBZ and PB, and LCM with LTG and PB, exerted additive interactions in the mouse tonic-clonic seizure model [6-8]. Since the above-mentioned three-drug combinations were additive in preclinical studies, we determined the magnitude and strength of these combinations by calculating interaction index values. This index, a ratio of ED_{50 exp} and ED_{50 add} values, allows one to measure the strength of interaction by classifying the combinations as beneficial, neutral and unfavorable [26]. It is widely accepted that interaction index values equal to or lower than 0.7 indicate synergistic interaction, whereas interaction index values equal to or higher than 1.3 reflect infra-additive (antagonistic) interaction. Only values ranging between 0.7 and 1.3 are indicative of additivity [27-29]. In this study, the interaction index value for the combination of LCM with CBZ and VPA was 1.32, whereas the interaction index values for the three-drug combinations ranged from 0.46 to 1.18 in our previously published studies (Table 2). Thus, the interaction index value of 1.32 confirmed that the combination of LCM with CBZ and VPA exerted antagonistic interaction in the mouse tonic-clonic seizure model.

Table 2. Interaction index values for the studied three-drug combinations

Combination	Type of interaction	Interaction index	References
LCM + CBZ + VPA	infra-additive	1.32	[the present study]
LCM + CBZ + LTG	additive	1.05	[8]
LCM + CBZ + PB	additive	1.18	[6]
LCM + LTG + PB	additive	1.07	[7]
CBZ + PB + TPM	supra-additive	0.46	[9]
PB + PHT + PGB	supra-additive	0.53	[22]

In this study we also evaluated acute adverse effect potentials of the AEDs in combination. It was found that the combination of LCM, CBZ and VPA produced no acute adverse effects in three behavioral tests (grip-strength, chimney and passive avoidance) used in our study.

An antagonistic interaction between LCM, CBZ and VPA in the mouse tonic-clonic seizure model was observed for the first time and necessitates a warning for patients receiving such a combination due to the fact that a similar interaction may occur in clinical settings. For instance, it has been found isobolographically that the combination of CBZ with LTG was antagonistic in the mouse tonic-clonic seizure model [30], and simultaneously, this combination was highly toxic in patients [31]. Moreover, caution is specifically advised to patients that receive VPA and CBZ and intend to replace one of these AEDs with LCM (as the add-on drug). When replacing one ineffective AED in epileptic patients, there is a general rule that the replaced drug is co-administered with the new one. In such a situation a transient triple therapy (three AEDs) is administered to patients. All three drugs are administered together until the newly introduced AED reaches a steady-state and then the ineffective drug is removed [32].

Conclusions

1. The mixture of LCM, CBZ and VPA produced an antagonistic (infra-additive) interaction in the tonic-clonic seizure model; therefore, it should not be recommended for further clinical trials.
2. A specific warning is required for physicians if they are considering treating epilepsy patients with LCM, CBZ and VPA in combination.
3. LCM should be avoided as a third AED when added to the combination of CBZ and VPA.

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- Journal *Health Problems of Civilization*

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Wszystkie obrazki, zarówno fotografie, wykresy, jak i diagramy, powinny być ponumerowane kolejno, zgodnie z pojawieniem się w tekście.

Cytaty i bibliografia

Pozycje literatury powinny być cytowane w nawiasach kwadratowych w kolejności cytowania.

Bibliografia powinna być ułożona w kolejności cytowania w tekście. Jeżeli liczba autorów przekracza 6, po 6 nazwisku należy dopisać „et al.”.

Cytowanie czasopisma:

Tomao P, Ciceroni L, D'Ovidio MC, De Rosa M, Vonesch N, Iavicoli S, et al. Prevalence and incidence of antibodies to *Borrelia burgdorferi* and to tick-borne encephalitis virus in agricultural and forestry workers from Tuscany, Italy. *Eur J Clin Microbiol Infect Dis*. 2005; 24(7): 457–463.

Czasopismo – suplement:

Kalman M, Inchley J, Sigmundova D, Iannotti RJ, Tynjälä JA, Hamrik Z, et al. Secular trends in moderate-to-vigorous physical activity in 32 countries from 2002 to 2010: a cross-national perspective. *The European Journal of Public Health*. 2015; 25(Suppl. 2): 37-40.

Tom czasopisma z numerem części:

Abend SM, Kulish N. The psychoanalytic method from an epistemological viewpoint. *Int J Psychoanal*. 2002; 83(Pt 2): 491-5.

Cytat z czasopisma online:

Zhang M, Holman CD, Price SD, Sanfilippo FM, Preen DB, Bulsara MK. Comorbidity and repeat admission to hospital for adverse drug reactions in older adults: retrospective cohort study. *BMJ*. 2009 Jan 7; 338: a2752. <https://doi.org/10.1136/bmj.a2752>

Publikacja elektroniczna przed drukowaną:

Yu WM, Hawley TS, Hawley RG, Qu CK. Immortalization of yolk sac-derived precursor cells. *Blood*. 2002 Nov 15; 100(10): 3828-31. Epub 2002 Jul 5.

Książka:

Biddle SJ, Mutrie N. Psychology of physical activity: determinants, well-being, and interventions. 2th edition. London: Routledge; 2008.

Rozdział z książki:

Hung Chih Yu A. Exploring motivation for leisure-based physical activity: a case study of college students. In: Burns R, Robinson K., editors. *Proceedings of the 2006 Northeastern Recreation Research Symposium*. Newtown Square: Department of Agriculture, Forest Service, Northern Research Station; 2006. p. 342-349.

Zapowiedzi/w druku:

Tian D, Araki H, Stahl E, Bergelson J, Kreitman M. Signature of balancing selection in *Arabidopsis*. *Proc Natl Acad Sci U S A*. Forthcoming 2002.

Materiały opublikowane online nieposiadające numeru DOI:

Aboud S. Quality improvement initiative in nursing homes: the ANA acts in an advisory role. *Am J Nurs [Internet]*. 2002 Jun [cited 2002 Aug 12]; 102(6): [about 1 p.]. Available from: <http://www.nursingworld.org/AJN/2002/june/Wawatch.htmArticle>

Materiały opublikowane w języku innym niż angielski:

Wielkoszyński T. [Modified, spectrophotometric method of silicon determination in biological material]. *Diagn Lab*. 2000; 36(3): 377–385 (in Polish).

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