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CORRELATIONS BETWEEN HABITUAL PHYSICAL ACTIVITY AND SELF-PERCEIVED FUNCTIONAL FITNESS, SELF-SUFFICIENCY FITNESS AND HEALTH AMONG MEN OVER 60 YEARS OLD

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ABSTRACT
Purpose. The study examined whether increased levels of habitual physical activity (HPA) in men over 60, expressed by the volume of energy expenditure in relation to PA, is significantly related to a higher self-assessment of functional fitness, self-dependency fitness and health. **Methods.** One hundred and sixty six men over 60 (60–88 years of age) living in Poznań (a large city in Poland) participated in the study. In order to measure actual HPA, a Caltrac accelerometer was used. The results were analysed according to weekly physical activity energy expenditure (PA-EE) values and PA-EE values per kilogram of body weight (PA-EE/kg). A questionnaire was used to estimate self-perceived functional fitness, self-sufficiency fitness and health. **Results.** The study noted higher values of PA-EE and PA-EE/kg in men who positively perceived their functional fitness, self-sufficiency fitness and health. **Conclusions.** Increasing the range of everyday activities is one of the potential directions for the development of health prophylaxis.

Key words: elderly men, accelerometer, energy expenditure, questionnaire

Introduction

Initiatives aimed at creating transnational strategies promoting physical activity (PA) in the elderly have been undertaken for several years under the auspices of the World Health Organization [1, 2]. Programs aimed at increasing PA amongst the elderly organised by large institutions and organisations are also good examples of such initiatives [3]. However, low activity levels in the elderly population can still be noted, including the elderly population of Poland [4]. In terms of organised PA (the most effective form of PA), problems in encouraging elderly people to undertake PA and maintaining constant participation for extended periods of time can be noted. Such problems may in fact be the reason why organised PA is not so commonly offered to the elderly population, as compared to the possibilities of organised PA offered to younger individuals. Habitual physical activity (HPA), related to performing daily, ordinary activities and duties is therefore of interest and its potential benefits should be recognised [5]. It turns out that the ability to perform everyday simple activities such as walking 400 meters, lifting a 10 pound weight, climbing 10 stairs without stopping, kneeling down and crouching down, is noticeably linked to a reduction in the risk of death and a decreased probability of hospital admission [6]. In their study of elderly women aged 60 to 70 years, Hamdorf et al. [7] observed that women who walked at a moderately intensive pace twice a week over a period of six months exhibited positive changes in certain physiological parameters. The authors emphasised the beneficial role that HPA had on functional fitness, lifestyle and independence. Low levels of HPA were considered important risk factors for limitations in locomotive abilities in a four year long continuous study of men and women over the age of 65 in the USA carried out by LaCroix et al. [8].

Even as late as 1996, DiPietro [9] wrote about how little was known about the relationship between HPA (in particular HPA of low and moderate intensities) and its effect on maintaining appropriate levels of physiological functioning in elderly people. Additionally, detailed results of studies trying to outline the relationship between HPA and health were inconclusive and, as such, the benefits resulting from this type of activity were often neglected and underestimated [10]. Since then, a few studies have been conducted verifying possible relationships between HPA and health. Laukkanen, Kaupinen and Heikkinen [11], demonstrated the significant positive effects of HPA on the quality of everyday activities in a five-year longitudinal study of 75- and 80-year-old men and women. Elderly men and women (aged 50–80) who maintained higher levels of HPA during a period of ten years were observed to have a slower rate of bone mass loss along with a beneficial improvement in their body balance, with no changes in their level of muscular strength, speed of walking or frequency of fractures [12]. A year-long study on the effects of HPA showed that maintaining good levels of physical fitness in men and women (aged 65 to 84) could be achieved in participants who walked 7–8 thousand steps a day and spent at least 15–20 minutes every day performing an

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activity of an intensity higher than 3 MET [13]. The authors of the study cautioned, however, that it was difficult to implicate a single factor in this correlation. The beneficial relationship between HPA and functional fitness and health can also be found in younger populations. The beneficial role of increased HPA and physical fitness in decreasing functional limitations was noted by Huang et al. [14] in a five-and-a-half year long continuous study of men and women aged over 40. In women 50 to 60 years of age, higher levels of HPA were noted to improve general well-being and health in a four-year continuous study carried out by Netz et al. [15].

The health of a particular population is often measured on the basis of death rates and incidence of disease. Conversely, subjective studies are very important when it comes to measuring positive health indicators such as a population's quality of life. In particular, at an older age health is determined by many factors and varies individually. Basing the general health status of an individual on the basis of clinical test results leaves much to be desired. Thus, epidemiological studies often employ questionnaire surveys and self-assessment tools which allow participants to assess their own health on the basis of one or more questions. The reliability of such self-assessment was described as satisfactory by various studies [16]. Subjective health assessment may therefore be an accurate indicator of health and thus is recommended for use in population studies as explored by a ten-year-long Finnish study of 1340 men aged 35–63 years [17].

In studies of HPA, various questionnaires have been used and found to be sufficiently useful (e.g. with respect to Baeck's questionnaire). Questionnaire methods have been shown to exhibit satisfactory reliability in the assessment of recreational PA, which is usually more intensive than HPA and thus easier to recall [18]. Objective methods of HPA assessment, for example using accelerometers, are sought after. The use of accelerometers, apart from some limitations [19], makes measuring HPA more objective, precise and reliable [20] with the results expressed in terms of energy expenditure. Accelerometers are best suited (because of their high accuracy of measurement) for locomotive HPA studies [21]. This form of locomotive PA (in particular marching) dominates in the elderly population [22]. Early studies highlighted the adapted usefulness of accelerometers in measuring energy expenditures related to PA. The Caltrac accelerometer in particular demonstrated an appropriate level of accuracy and reliability in measuring PA, both in tests on children, teenagers and adults [23].

The aim of this study was to examine whether increased levels of HPA in men over 60, expressed by the volume of energy expenditure in relation to PA, is significantly related to a higher self-assessment of functional fitness, self-dependency fitness and health.

Material and methods

The study included 166 men over 60 (60–88 years of age, $\bar{x}$ = 72.4 ± 5.7) living in Poznań (Poland), and not professionally active, i.e. retired or receiving a disability pension. Permission for the carrying out the study was obtained from the Local Research Ethics Committee at Karol Marcinkowski Medical Academy in Poznań.

In order to measure actual habitual physical activity (HPA), a Caltrac accelerometer (Muscle Dynamics Fitness Network, USA) was used. The testing took place on seven consecutive days in the spring. Measurements were obtained with the Caltrac device placed on the left side of the body, near the hip, on a trouser belt. The device did not interfere with everyday activities and functioning of the participants. The participants took off the device for bathing and sleeping. The resting energy expenditure and physical activity energy expenditure (PA-EE) were established (in kcal) after individually calibrating the device for age, sex, height and body mass. The results were analysed according to weekly PA-EE values and PA-EE values per kilogram of body weight (PA-EE/kg).

A portion of the "Interview questionnaire for the study of social positions of the oldest residents of Poznań" was used (with its author's agreement) for self-assessment purposes pertaining to a few selected factors. The questionnaire was used by the Municipal Office in Poznań and the Social Work Department at the Institute of Sociology of the Adam Mickiewicz University in Poznań, during their study of Poznań's senior citizens [24]. The questionnaire was completed by participants during individual direct interviews.

The participants carried out a general self-assessment of their own health and also assessed their own health in comparison to their contemporaries. The questionnaire used made it possible to assess functional fitness and self-sufficiency fitness using a points-based grading system. Information on functional fitness (mainly of the locomotive type) was gathered by allowing the participants to self-assess the degree of difficulty in performing seven activities. In describing self-sufficiency fitness, the degree of difficulty in performing ten activities was also self-assessed. For each activity, the participant specified whether performing the activity was done without difficulty, with difficulty or if the activity could not be performed unaided. Points were assigned to the answers according to the following guidelines: no difficulty – 3 points, with difficulty – 2 points, activity could not be performed unaided – 1 point. By summing the points, scales of functional fitness assessment and self-sufficiency fitness were obtained. Higher values (a maximum number of points was 21 and 30, respectively) corresponded to a higher levels of functional and self-sufficiency fitness.

In this study, the term 'functional fitness' replaced the term 'motor fitness', which was used in the original interview questionnaire. It seems that the seven activities considered in this respect are characteristic rather for 'functional fitness', which is defined by Rikli and Jones [25] as: "having physical abilities to perform normal everyday activities safely and without excessive fatigue".

The interdependences were calculated using Spearman's rank correlation (rho). In order to determine the significance of the degree of differences in mean values of the quantitative variables, the ANOVA Kruskal-Wallis test was used to compare many independent groups (samples), where H is the value of the test. For comparing two independent groups (samples), the Mann-Whitney test was used (where Z is the value of the test). Statistical significance was accepted at the $p \leq 0.05$.

Results

Table 1 presents the mean values of physical activity energy expenditures reflecting the HPA of participants during discrete periods of time. In a further analysis of the results, PA-EE values per kilogram of body weight (PA-EE/kg) were also used.

The rank order correlation between age and PA-EE was weak (rho = 0.26) but statistically significant ($p < 0.05$). This correlation with age was no longer significant when PA-EE/kg was included. It is an additional reason why researchers should pay more attention to values of energy expenditure related with physical activity (PA-EE) divided by weight.

The participants assessed their functional fitness by determining the degree of difficulty in performing seven activities, mainly of the locomotive type. Mean values of awarded points (Tab. 2) of individual activities indicate that participants found performing activities in a bent position and those involving standing for a long period of time to be the most difficult. Participants had the least amount of difficulty with unaided movement around the house. In further analyses, the arithmetic mean of the total of points awarded for seven activities was used.

Self-assessment of self-sufficiency fitness involved specifying the degree of difficulty in performing ten activities unaided. The arithmetic means presented in Table 3 indicate the minor difficulty participants had performing self-sufficiency activities. Participants had the most difficulty with performing heavy house work and the least difficulty with eating and using the toilet. In further analyses, the arithmetic mean of the total of points obtained for the ten activities was used.

Table 1. Basic characteristics of HPA in men aged over 60 (N = 166)

Variable	$\bar{x}$ ± SD	Min	Max
PA-EE [kcal/week]	2240.2 ± 1197.3	275.0	8613.0
PA-EE/d [kcal/day]	310.3 ± 177.2	39.3	1230.4
PA-EE/kg [kcal/kg]	28.0 ± 14.9	4.2	116.4
PA-EE/d/kg [kcal/day/kg]	4.0 ± 2.1	0.6	16.6

Table 2. Mean values ($\bar{x}$) and standard deviations (SD) of self-perceived functional fitness tested by specifying the degree of difficulty in performing seven activities (N = 166)

Activity	$\bar{x}$ ± SD
Movement inside the house	2.9 ± 0.3
Movement outside the house	2.8 ± 0.4
Climbing stairs	2.7 ± 0.4
Sitting for extended periods of time	2.8 ± 0.4
Standing for extended periods of time	2.6 ± 0.6
Standing from the seated position	2.8 ± 0.4
Activities with participant bent over	2.5 ± 0.7
Functional activity (total points)	19.2 ± 2.2

Table 3. Mean values ($\bar{x}$) and standard deviations (SD) of self-perceived self-sufficiency fitness tested by specifying the degree of difficulty in performing ten activities (N = 166)

Activity	$\bar{x}$ ± SD
Shopping for critical supplies	2.9 ± 0.3
Preparing meals	2.9 ± 0.4
Eating meals	3.0 ± 0.1
Lighter household work	2.9 ± 0.3
Harder household work	2.4 ± 0.8
Washing	2.9 ± 0.3
Bathing	2.9 ± 0.4
Using the toilet	3.0 ± 0.2
Grasping objects, doing up buttons	2.8 ± 0.4
Dressing	2.9 ± 0.2
Self-sufficiency (total points)	28.7 ± 1.9

Statistically significant positive relations were noted (Fig. 1) between the level of functional fitness and PA-EE (rho = 0.37; $p < 0.001$) or PA-EE/kg (rho = 0.43; $p < 0.001$). In men partaking in higher HPA, a higher self-perceived functional fitness was noted. Since functional fitness and PA decline with age, the partial correlation adjusted for age was also calculated. Coefficients of correlation were only slightly lower and still statistically significant (respectively 0.31 and 0.35; $p < 0.001$).

Self-perceived self-sufficiency fitness was also shown to be related to PA-EE and PA-EE/kg (Fig. 2) with correlation coefficients rho = 0.55 ($p < 0.001$) and rho = 0.58 ($p < 0.001$), respectively. Higher self-perceived self-sufficiency fitness was noted in those men who partook in a higher level of HPA. In addition, here the partial correlation calculated were adjusted for age. Self-perceived self-sufficiency fitness in comparison to self-perceived functional fitness seems to be strongely determi-

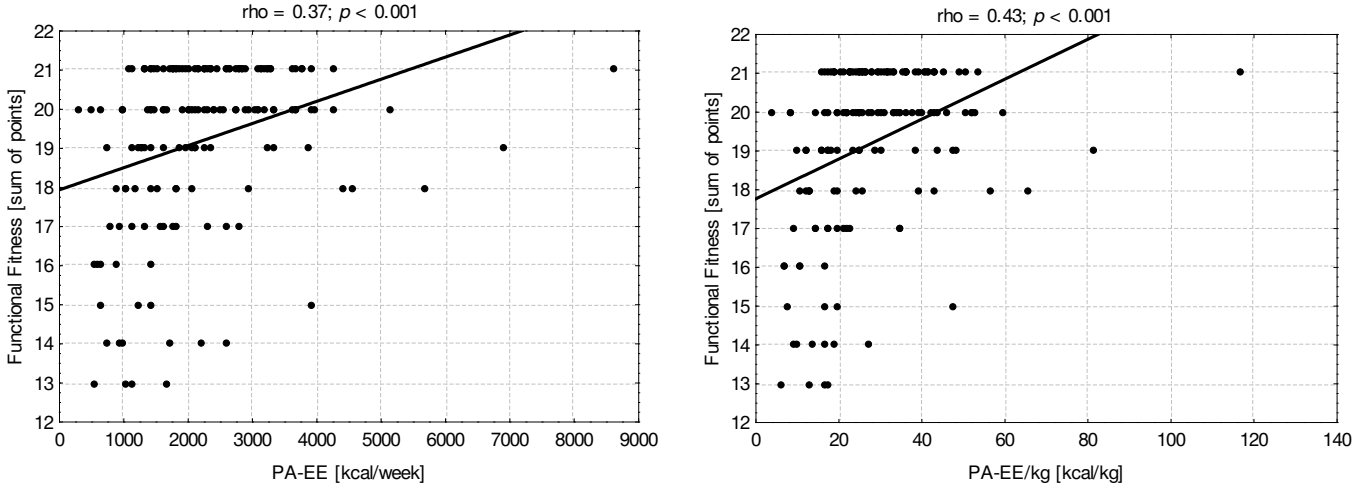

Figure 1. Physical activity energy expenditure (PA-EE) and physical activity energy expenditure per kilogram of body weight (PA-EE/kg) and self-perceived functional fitness in men aged over 60 (N = 166)

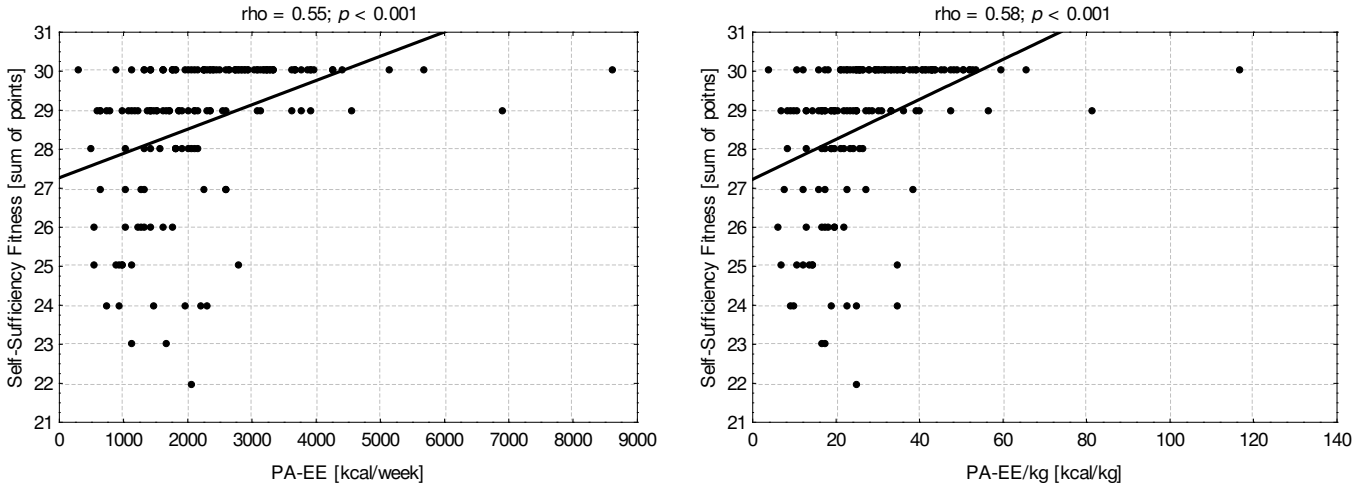

Figure 2. Physical activity energy expenditure (PA-EE) and physical activity energy expenditure per kilogram of body weight (PA-EE/kg) and self-perceived self-sufficiency fitness in men over 60 (N = 166)

Table 3. Self-perceived health of men aged over 60 (N = 166)

	Self-assessment of health		
	good	small ailments	serious ailments
number	38	64	64
%	22.8	38.6	38.6

Table 4. Self-perceived health of men aged over 60 in comparison with the health of their contemporaries (N = 166)

	Self-assessed health status as compared to contemporaries		
	same as contemporary	better than contemporary	worse than contemporary
number	50	99	17
%	30.1	59.7	10.2

nated by age, because values of correlation coefficients decrease to 0.36 (p < 0.001) and 0.40 (p < 0.001), respectively.

The participants assessed their health in two ways. First, they assessed their health in a general manner by describing it as positive or indicating the level of their complaints. Second, the participants assessed their health by comparing it to the health status of their contemporaries. The frequency of obtained answers is presented in Tables 3 and 4.

Statistically significant differences in PA-EE (H = 15.4; p < 0.001) and PA-EE/kg (H = 18.6; p < 0.001) were noted between subgroups in the general self-assessment of health (Fig. 3). Men whose self-perception of health was lowest showed statistically lower levels of PA-EE in comparison to those who assessed their health as good (Z = 3.08; p < 0.01) and those who only had minor complaints (Z = 3.49; p < 0.001). Similarly, in the case of PA-EE per kilogram of body weight, statistically significant differences were noted between the third

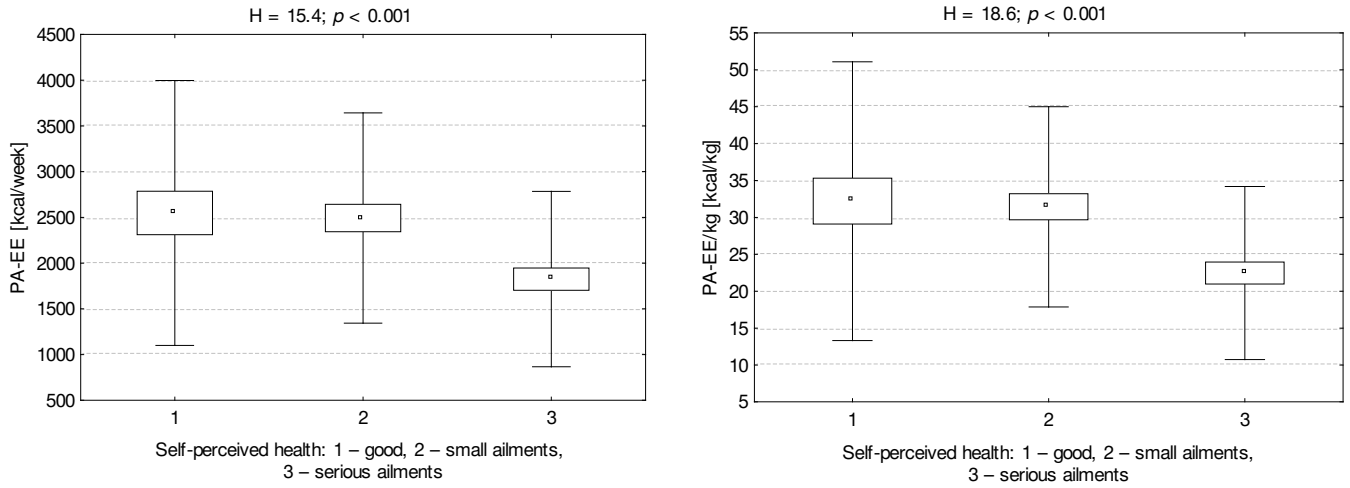

Figure 3. Mean values (also SD and min – max) of physical activity energy expenditure (PA-EE) and physical activity energy expenditure per kilogram of body weight (PA-EE/kg) in three subgroups of self-perceived health of men aged over 60 (N = 166)

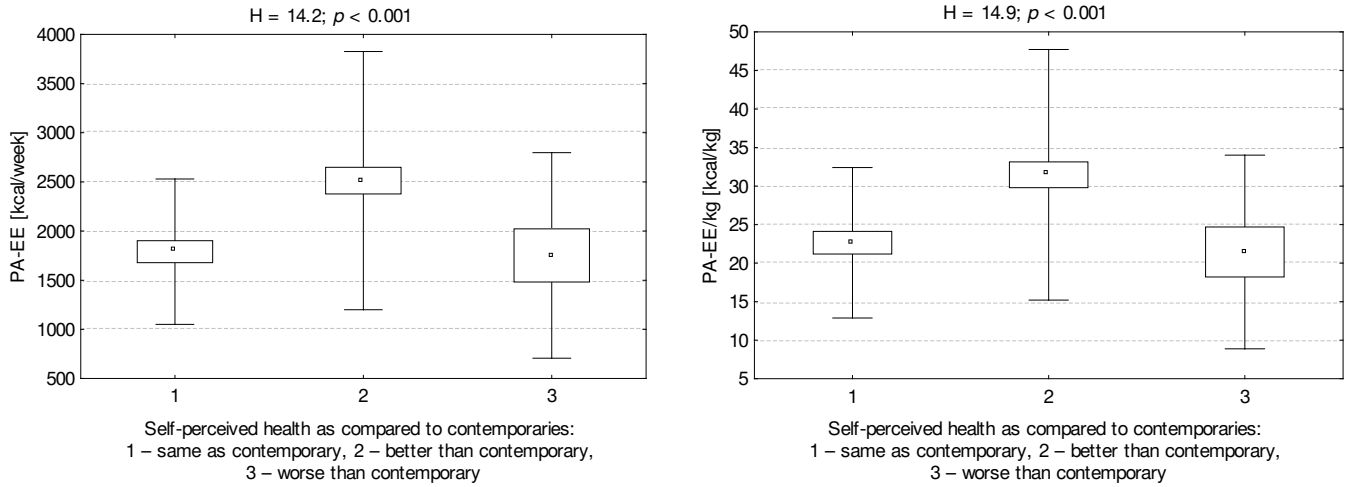

Figure 4. Mean values (also SD and min – max) of physical activity energy expenditure (PA-EE) and physical activity energy expenditure per kilogram of body weight (PA-EE/kg) in three subgroups of self-perceived health in comparison with the health of their contemporaries in men aged over 60 (N = 166)

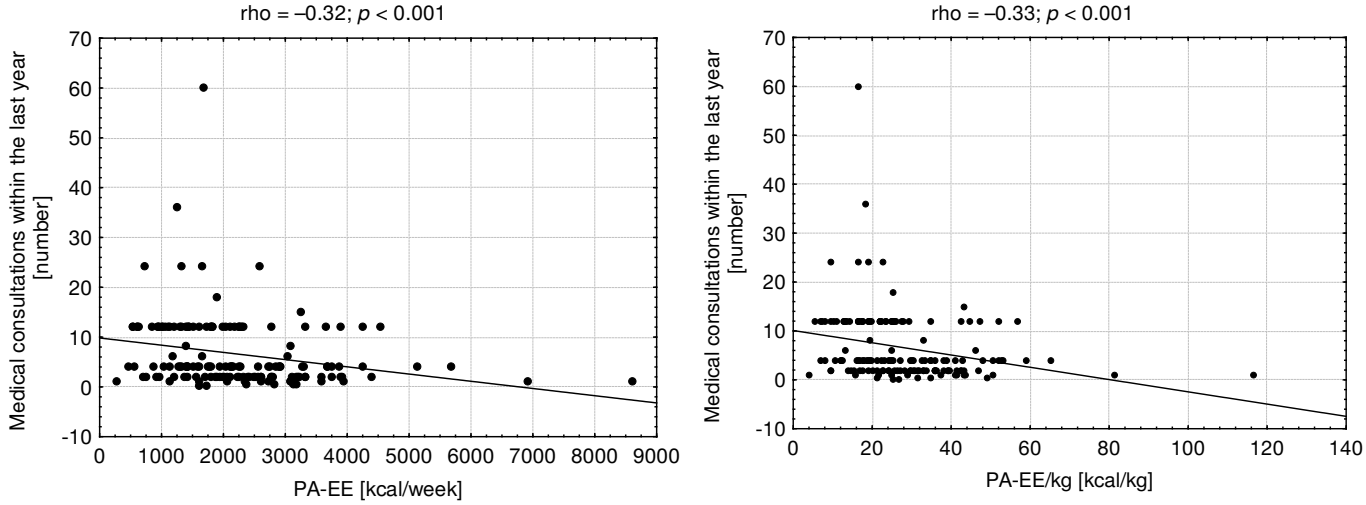

Figure 5. Physical activity energy expenditure (PA-EE) and physical activity energy expenditure per kilogram of body weight (PA-EE/kg) and the number of medical consultations within the last year in men aged over 60 (N = 166)

subgroup and the first subgroup (Z = 3.38; p = < 0.001) and the third subgroup and the second subgroup (Z = 3.86; p < 0.001). Self-perceived health and PA decrease with age, but comparison of age between three groups of such health status assessment showed no statistically significant differentiation (H = 0.39; p = 0.82).

Also, when comparing their own health with that of their contemporaries, (Fig. 4) significant differences in terms of PA-EE (H = 14.2; p < 0.001) and PA-EE/kg (H = 14.9; p < 0.001) were noted between the subgroups. The highest levels of PA-EE and PA-EE/kg were noted in participants who perceived their health as better compared to their contemporaries. These participants presented with a significantly higher level of PA-EE both in comparison to those perceiving their health as similar to the health of their contemporaries (Z = 3.32; p < 0.001), and those who assessed their health as worse compared to their contemporaries (Z = 2.41; p < 0.05). This pattern was also noted in PA-EE per kilogram of body weight, with the values of the U test being Z = 3.28 (p < 0.001) and Z = 2.63 (p < 0.01), respectively. The comparison of age between groups of different self-perceived health in comparison to contemporaries did not show any statistically significant differences (H = 2.32; p = 0.31).

Data about the number of medical consultations within the last year was also used as one of the criteria to assess health status. These values were compared to the levels of PA-EE and PA-EE/kg (Fig. 5). A statistically significant tendency was noted between lower numbers of medical consultations and higher values of both PA-EE (rho = –0.32; p < 0.001), and PA-EE/kg (rho = –0.33; p < 0.001).

Discussion

The aim of comparing HPAs depending on self-perceived levels of functional fitness, self-sufficiency fitness and health, was to assess the relationship between HPA and those factors which strongly determine quality of life [26]. The current study noted higher values of PA-EE and PA-EE/kg in men who perceived their functional fitness, self-sufficiency fitness and health as better. Like in the cross-sectional studies of Aoyagi et al. [13], the relationships we noted cannot be fully considered as matters of cause-and-effect. An interesting congruence should also be examined: higher values of HPA favour a higher self-assessment of health and fitness while at the same time increased levels of health and fitness allow for undertaking more extensive HPA. It is also possible that the interdependencies noted, relating HPA and the self-assessment carried out by our participants, were/are influenced by other factors above and beyond those which have been mentioned in our study. We have, therefore, adopted the stance of considering the noted relationships based on the effects that HPA has on health, functional fitness and self-sufficiency fitness. This stance is also favoured by the results of experimental studies carried out by Hamdorf et al. [7], Huang et al. [14], LaCroix et al. [8], and Laukkanen, Kauppinen and Heikkinen [11]. Harris et al. [6] noted a similar relationship concerning individuals with higher levels of education, further confirmed by Szeklicki [27], who found that higher levels of education coincide with higher levels of PA-EE and PA-EE/kg. These relationships were also noted in participants who were very old, irrespective of whether they suffered from chronic diseases or not [28].

A high level of PA in childhood and youth does not necessarily determine whether a high level of physical fitness will be undertaken during adulthood [29, 30]. Hillsdon et al. [26], in a study of over six thousand men and women living in London (mean age of 50), demonstrated that appropriate PA undertaken during middle age is of greater significance for functional fitness during old age. The almost nine-year-long study concluded that appropriate PA (a minimum 2.5 hours of moderate PA per week or a minimum of 1 hour of intensive PA per week) undertaken during middle age contributed to a much higher self-perceived functional fitness after nine years compared with participants with lower levels of PA. The above mentioned functional fitness included ten activities ranging from running intensively, lifting heavy objects and participating in tiring sports to bathing and getting dressed. These activities, as well as the three point scale used to score the responses, were very similar to those used in the present study. According to Becket et al. [31], levels of functional fitness fell with age contributing to a significant lowering of quality of life. Wong et al. [32] noted the beneficial effect of HPA (walking) on levels of functional fitness and its significant role in the prevention of disabilities in people over 50 years of age. A higher functional independence, as said before, contributes to increased HPA. This in turn implies positive health consequences, which manifest by decreasing the risk of cardiovascular diseases, among other things.

The results of the current study also point to relatively high levels of functional and self-sufficiency fitness in men aged over 60. Undoubtedly, the selection of participants was of importance since participants had to be capable of moving independently and were living in a large city. In Poland, residents of cities are generally of better health and fitness than people living in the countryside [33]. Demonstrating the positive effect of HPA in men with a relatively high level of functional and self-sufficiency fitness emphasises the significance of HPA for maintaining functional independence.

The obtained results, in terms of general self-perceived health, do not vary much from the results obtained by Bień and Synak [33] during a nationwide study of people aged over 65 asked to self-assess their health using a three point scale. Bień and Synak [33] grouped the results of men and women together, dividing the participants according to those living in the countryside versus those living in cities. The authors demonstrated that among

city dwellers, 21.2% perceived their health as good, 31.9% as average and 46.9% as bad. In the current study, the percentage of answers (with answer categories formulated in a slightly different manner) was 22.8%, 38.6% and 38.6%, respectively.

Both self-perceived levels of health and self-perceived levels of health in comparison to contemporaries are reflected in varying levels of PA-EE and PA-EE/kg. In both cases, participants who assessed their health as being better were characterised by significantly higher levels of HPA. Similarly, in a study of 1885 adult men living in Barcelona, non-working participants who perceived their health as being better noted higher levels of HPA [34]. A higher general self-assessment of health was also noted in elderly participants (mean age 61.2 years) with an increased level of HPA (i.e. of greater than moderate intensity) in the study of Buchheit et al. [35].

The number of medical consultations sought by participants can also be an indirect indicator of their health. It is worth noting that a higher number of medical consultations were noted in participants who demonstrated lower levels of PA-EE and PA-EE/kg. Similar results were reported in a 16-year-long study of men ($N = 2534$, 19 to 63 years old) in Finland which found that men with the lowest PA-EE in their leisure time ended up spending 36% more days in hospital (for various reasons) than those who were more physically active [36].

The health of elderly people along with an appropriate quality of life level which includes the ability to maintain functional self-sufficiency is important medical and social problems. The pertinence of these problems and the number of scientific studies pertaining to these issues has increased in recent years, in part due to the growing proportion of society entering this age group. The positive relationship demonstrated between HPA and functional fitness, self-sufficiency fitness and health, indicates a potential direction for the development of health prophylaxis. Increasing the range of everyday activities does not have to be based on complicated and very intensive programmes of controlled physical activity. Attention should be paid to PA of appropriate duration. Aerobic physical exertion is related to improved health and functional fitness (which has been demonstrated in the studies quoted above) and general well-being [37]. The aim of using PA as a means of prophylaxis and as therapy for diseases affecting the elderly is based mainly on effectively slowing progressive involutional changes, maintaining functional independence and ensuring optimal quality of life [38]. In this respect ensuring increased levels of HPA seems quite beneficial.

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