ORIGINAL RESEARCH PAPER

THE LEVEL OF STRENGTH AND ENDURANCE-STRENGTH ABILITIES OF THE FEMALE EARLY EDUCATION TEACHERS AS EXAMINED BY THE MEDICINE BALL FORWARD THROW AND THE 3 MIN. BURPEE TEST: A COMPARATIVE ANALYSIS

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Abstract

Aim: The aim of the study is to assess strength and endurance-strength abilities of selected female early education teachers (EET) against classification norms, and subsequently compare the level of these abilities to that of pre-school and early school children and female university students. Methods: The research comprised: 700 pre-school children, 1306 early school children, 303 female university students and 217 EET. In order to determine the research participants' level of motor abilities, two motor tests, i.e. the medicine ball forward throw and the 3-min. Burpee Test were applied. Results: Based on the classification norms, the EET obtained an average level of strength and endurance-strength abilities. Moreover, in the medicine ball (2 and 4kg) forward throw trial, the EET achieved significantly worse results than the 1st year female university students (p = 0.0000), yet significantly better results than the examined pre-school and early school children (p = 0.0000). On the other hand, in the 3 min. Burpee Test, the EET gained significantly worse results than the 2nd (p = 0.0000) and 3rd (p = 0.0000) year girls and boys and the 1st year female university

students (p = 0.0000), but significantly better results than the pre-school children (girls: p = 0.0000, boys: p = 0.0166) and the 1st year boys (p = 0.0000). Conclusions: Since motor fitness is important in EET's everyday work, it is worrisome that the teachers under study attained an average level of strength and endurance – strength abilities. There were also many teachers who were exempted from any form of physical exercise for health reasons, which may be a consequence of their poor eating habits or/and an insufficient amount of daily physical activity. It seems to be reasonable, thus, to design and implement new enrollment criteria for admission to early education studies including fitness tests, and to expand the curriculum of early education studies by increasing the number of practical P.E. classes.

Key words: *early education teachers, female students, 6 – 9-years-old children, motor abilities, classification norms*

Introduction

Motor fitness (MF), as one of the main indicators of a person's biological development (including physical health), has been the subject of numerous research works in the field of physical culture. Although this term has been defined and assessed differently over the last two decades (Raczek, 2010; Szopa, Chwała, & Ruchlewicz, 1998), currently the concept of Health-Related Fitness (H-RF) has become the most preferable and widely recognized approach worldwide. In the light of this theory, a physically fit person is characterized by: an adequate level of cardio-respiratory endurance, a vigor of life, positive relationships with other people, an appropriate level of body fat, a desirable level of strength and flexibility, and a healthy lower (lumbar-sacral) spine (Howley & Franks, 1997). Irrespective of the approach preferred, determining the level of motor fitness is still an important link when controlling motor development in the field of physical culture (Lovecchio, Merati, Guasti, Casolo, & Eid, 2013; Podstawski & Borysławski, 2012; Tudor, Ružic, Sestan, Sirola, & Prpic, 2009), physical recreation (Strydom, 2013), rehabilitation (McMurray et al., 2000), as well as in the sports training (Gabbett, 2009; Mikulić & Ružic, 2008).

Strength and endurance-strength abilities are thought to be basic elements of a person's motor potential. As for strength abilities, some scientists believe strength to be the fundamental motor ability as it is necessary to initiate, continue and stop the movement, as well as essential to set in motion one body by another. Therefore, it can be assumed, that

strength constitutes a primary substrate in relation to other abilities, one that conditions a person's mobility (Podstawski & Borowska, 2011). An adequate level of strength abilities has a decisive influence on a person's overall health and his/her being active in everyday life, especially in the aspect of a sports training (Kreamer, 1992; Sallis, Hovell, & Bouno, 1992). A decline in the muscle strength can cause adverse changes, which markedly diminish a person's motor fitness and consequently deteriorate the health quality of his/her life (Podstawski, Skibniewska, & Paradowska, 2011).

Endurance abilities, on the other hand, are closely linked with physical efficiency. In the main, endurance can be defined as an ability of a body to sustain a long physical effort of a given intensity and to maintain increased resistance to tiredness under the conditions of the surrounding environment (Szopa, 1998). Apart from a high aerobic efficiency in endurance efforts, anaerobic potential bears a special significance, which is linked with glycolytic processes of an acidosis phase resulting directly from the time and intensity of a physical effort (Szopa, Chwała, & Ruchlewicz, 1998). A biological substrate of endurance abilities is made up of energy predispositions, namely maximal oxygen uptake ability VO_2max (maximal aerobic power – aerobic potential), largely affecting two integral factors: cardio-respiratory endurance and body resistance to acidification (Brooks, Fahey, White, & Baldwin, 2000).

The above information indicates clearly that the research on the level of strength and endurance abilities is of great importance, and so far has been viewed in many different aspects. However, there is a group of professional people whose strength and endurance abilities have been examined in a limited range, which seems to contradict the main principles underlying their work. The professionals in question are early education teachers (EET), who no doubt substantially contribute to shaping a positive attitude in relation to body and physical activity (PA) of pre-school and early school children, and by this having an influence on their level of MF. A thorough penetration of the literature on the comparison of EET's strength and endurance-strength abilities to those of children and adolescents resulted in finding no data on this subject. There is also a marginal number of research works on testing EET's MF.

Therefore, assessing the level of the EET's strength and endurance-strength abilities against classification norms, and comparing this level to that of pre-school and early school children and university female students deserves attention and may help solve the problem of continuously

decreasing PA of children and youth (Ara, Moreno, Leiva, Gutin, & Casajŭs, 2007; Monyeki & Kemper, 2007).

The aim of this research is to assess the level of EET's strength and endurance-strength abilities against classification norms, and compare this level to that of pre-school and early school children and first-year female university students enrolled at the University of Warmia & Mazury in Olsztyn (UWM), Poland. In order to determine the level of strength (the medicine balls forward throw) and endurance-strength (the 3 min. Burpee Test) abilities, classification norms were devised according to T- score scale.

Materials and Methods

Participants. The research on the level of strength and endurance – strength abilities of the pre-school and early school children was carried out in 12 preschools and 14 elementary schools. The 1st-year female students participating in the research attended the UWM, whereas the EET under study were examined at their workplace (40 preschools and 50 elementary schools). In order to provide a broad spectrum of the children's socioeconomic backgrounds, the schools and preschools situated in villages, small, medium-size and big towns were selected for the purpose of the study. All the preschools and schools were situated in the area of the voivodeship of Warmia & Mazury, north-eastern Poland, and all the research participants were inhabitants of this region.

The research comprised: 700 pre-school children (mean age 6.3 years old) (367 girls, 333 boys), 1306 elementary school pupils aged 7-9 (225 first-year girls, 219 second-year girls, 233 third-year girls, 201 first-year boys, 213 second-year boys, 215 third-year boys) (mean age 8.3 years old), 303 first-year female full-time students enrolled at UWM (mean age 19,6 years old) and 217 certified, professionally active EET (mean age 26.24 years old). In all the preschools and schools under investigation, 96% of all the children took part in the tests, except for those who were absent on the day of the examination. In the case of the EET, the women who were either exempted from the examination on health grounds or unwilling to participate in the tests were excluded from the research. Of 721 women who had been asked to participate in the research, as many as 167 (23.16%) refused to be involved for health reasons (permanent damage to their locomotive apparatus confirmed by a medical certificate), and the other teachers (337 women) refused to be engaged giving no particular reason. The children involved in the research attended obligatory P.E. classes a total of 3 lesson units a week 45 min. each, providing they did not practice any other sports discipline, as any involvement in out-of-school sports activities

would significantly distort the obtained results. The UWM students attended compulsory P.E. classes a total of 2 lesson units a week, 45min each. Taking into consideration a vast number of the research participants, the obtained data can be representative for this type of research.

Procedures. The research program was approved by the UWM Bioethical Committee as well as the principals of the schools under study, and the students and teachers themselves. It is also in accordance with the Helsinki Human Rights Declaration.

Instruments. All the research participants' height and body mass were measured, on the basis of which the values of their BMI were calculated. The BMI values of the adults were subsequently assessed according to WHO norms (WHO, 2000), whereas the BMI values of the pre-school and early school children were calculated on the basis of the international norms devised by Cole, Flegal, Nicholls, & Jackson (2007). The results obtained by the children, female students, and the EET in the individual motor tests constituted dependent variables. Two motor tests were applied to accurately assess the participants' strength and endurance-strength abilities, namely the medicine ball (4 kg for the EET and the female students, and 2 kg for the 6-9-year-old children) forward throw [cm], and the 3 min. Burpee Test [number of cycles]. The accuracy and reliability of the above motor tests has been confirmed by numerous studies on the topic (Pilicz, 1997).

The description of the applied motor tests:

Medicine ball (4 kg) forward throw (Fig. 1): the participant stands at a line with the feet slightly apart facing the throw-in area, then he or she vigorously throws the ball forward with both hands over the head; the participant is not permitted to step forward over the line after the ball is released. Two attempts are allowed and the score is obtained by recording a better throw measured in the straight line from the nearest trace of the ball to the inner edge of the throw line exact to 1cm (Pilicz, 1997).

Figure 1. 3 min. Burpee Test

3min. Burpee Test (Fig. 2): From the upright standing position, the participant assumes a supported squat with both hands on the ground, then thrusts his or her feet backwards into a push-up position with straightened arms (body trunk and legs form one line); from this position the participant once again returns to the supported squat and the whole cycle is completed by the participant returning to the upright position and simultaneously clapping his or her hands over the head, making sure the arms remain extended. The cycle is performed as many times as possible in the given time limit (3 minutes). The number of cycles executed within 3 minutes constitutes the result of the test (Podstawski, Kasietczuk, Boraczyński, Boraczyński, & Choszcz, 2013).

Figure 2. Medicine ball forward throw

The level of strength and endurance-strength abilities was assessed on the basis of the EET and university students' results based on a derived 5-point scale. It was assumed that both study groups fell into the range of the same developmental stage in terms of their morph-functionality. All the children and the university students were instructed on the proper technique of executing the motor tasks during the lessons preceding the actual tests and given ample time to practice them. The EET learnt how to perform each motor test during the meeting with the research director, who thoroughly demonstrated the proper technique of executing each test. Afterwards, the teachers were given enough time to practice the tasks on their own. Prior to performing the actual tests the participants took part in a 10-minute warm-up. The study was conducted during the period from March to May in the summer semester of the academic year 2011/2012.

Statistics. Statistical analysis of the research data was performed using Statistica PL v. 10 software, applying descriptive statistics and the Mann-Whitney *U* nonparametric test for two groups. The calculations were made assuming the significance level $\alpha = 0.05$. If the probability of exceeding the calculated value was less than the adopted significance level ($p < \alpha$), the differences between the analyzed groups for a given motor test were

accepted as significant. In order to transform individual results obtained in the motor tests into a uniform scale for both EET and university students, „3 sigm" rule was applied (Rabiej, 2012), on the basis of which T-score scale for the medicine ball (4 kg) forward throw and the 3 min. Burpee Test was devised (Tab. 1).

Table 1

The range of different levels of motor fitness

The level of MF	Standard results	Scores in T* scale
Very good	$> \bar{X} + 2SD$	80 ÷ 100
Good	$> \bar{X} + SD \div < \bar{X} + 2SD$	60 ÷ 80
Average	$\bar{X} - SD \div \bar{X} + SD$	40 ÷ 60
Poor	$\bar{X} - 2SD \div < \bar{X} - SD$	20 ÷ 40
Very poor	$< \bar{X} - 2SD$	0 ÷ 20

Notes: $\bar{X}$ - average test results obtained in the reference group, SD – standard deviation of the overall test results in the reference group. * - Point intervals in T-score scale are right-closed (left-open).

Results

The description and interpretation of the results have been narrowed to the EET so as to reduce the amount of information considered irrelevant to the aim of the work. Table 2 shows the results of the measurements of the teachers' height and body mass as well as the calculated BMI. Due to a slight sexual dimorphism of 6-9 aged children (Osiński, 2003; Podstawski & Borysławski, 2014; Raczek, 2010), the results of the anthropometric features of the examined children (both girls and boys) from each class are presented as one.

Table 2

Characteristics of the study group in terms of their body mass, height, and BMI

Group	*Research participants*	*[No]*	*Age [years]*	*Body mass [kg]*	*Body height [cm]*	*BMI [kg/m^2]*
			Mean ± stand. dev.(max÷ min)			
a	Preschool girls and boys	700	6.09 ± 0.279	20.64 ± 2.862	118 ± 4.011	14.75 ± 1.736
b	1st-year girls and boys	426	6.98 ± 0.158	25.91 ± 5.803	125 ± 7.723	16.59 ± 2.588
c	2nd-year girls and boys	432	7.99 ± 0.196	29.34 ± 6.704	132 ± 6.137	16.65 ± 2.993
d	3rd-year girls and boys	448	9.01 ± 0.188	32.74 ± 6.364	136 ± 6.154	17.66 ± 2.658
e	1st-year female students	303	19.01 ± 0.244	61.33 ± 6.501	160 ± 8.130	24.18 ± 3.575
f	EET	217	26.24 ± 1.679	68.22 ± 9.330	164 ± 7.654	25.16 ± 2.465

Significance of result differences (the Mann-Whitney *U* Test):
– for body mass: f > a, b, c, d, e, **
– for body height: f > a, b, c, d, e, **
– for BMI: f > a, b, c, d, e, **

Notes: differences statistically significant * – at the level $\alpha = 0.05$, ** – at the level $\alpha = 0.01$.

As can be seen in table 2, the values of the EET's body mass and height as well as their BMI were significantly higher than the values of the pre-school and early school children, and the first-year students. In addition, the average BMI values of the examined teachers (25.16 kg/m^2) point to overweight (Tab. 2).

Table 3 presents the assessment of the teachers' motor abilities based on T-score scale.

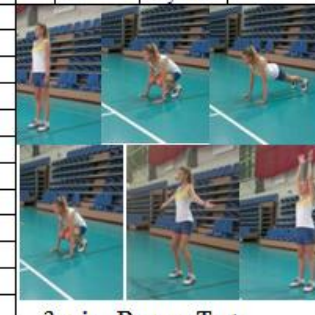
Table 3

T-score scale of EET's physical fitness in the 3 min. Burpee Test and the medicine ball (4 kg) forward throw

Level	*T scale*	*3 min. Burpee Test*	*Medicine ball forward throw*	Level	*T Scale*	*3 min. Burpee Test*	*Medicine ball forward throw*	*Level*	*T Scale*	*3 min. Burpee test*	*Medicine ball forward throw*
	points	No of cycles	cm		points	No of cycles	cm		points	No of cycles	cm
Very good	100	-	760	Good	80	56	-	Average	60	50	595
	99	-	-		79	-	660		59	49	590
	98	-	-		78	-	-		58	-	580, 585
	97	-	-		77	-	650		57	48	567, 569, 570, 573
	96	-	-		76	-	645		56	47	558, 560, 561, 563
	95	-	-		75	-	640		55	-	550, 551, 554, 555
	94	-	740		74	-	635		54	46	544, 545, 548, 549
	93	-	-		73	54	630		53	45	538, 540, 542, 543
	92	-	-		72	-	625		52	-	531, 532, 535, 537
	91	-	-		71	-	-		51	44	521, 525, 528, 530
	90	-	-		70	-	623		50	43	515, 517, 518, 520
	89	-	-		69	-	621		49	42	510, 512, 513, 514
	88	-	-		68	53	620		48	-	503, 505, 508
	87	-	-		67	-	-		47	41	498, 500, 501
	86	-	-		66	-	616		46	40	490, 493, 495
	85	-	-		65	-	615		45	39	480, 485, 488
	84	-	690		64	52	613		44	-	470, 475, 479
	83	-	-		63	-	610		43	38	458, 460, 465, 468
	82	-	680		62	-	600		42	37	440, 445, 450, 455

Table 3 (continued)

T-score scale of EET's physical fitness in the 3 min. Burpee Test and the medicine ball (4 kg) forward throw

Level	*T scale*	*3 min. Burpee Test*	*Medicine ball forward throw*	Level	*T Scale*	*3 min. Burpee Test*	*Medicine ball forward throw*	*Level*	*T Scale*	*3 min. Burpee test*	*Medicine ball forward throw*
	points	No of cycles	cm		points	No of cycles	cm		points	No of cycles	cm
Poor	40	35	435					Very poor	20	29	-
	39	-	-						19	-	-
	38	-	428						18	28	345
	37	-	-						17	-	-
	36	34	425						16	-	-
	35	-	-						15	27	323
	34	-	420						14	-	-
	33	-	-						13	-	-
	32	33	400						12	-	300
	31	-	-						11	-	-
	30	-	398						10	-	-
	29	-	-	3 min. Burpee Test					9	-	290
	28	32	390						8	-	-
	27	-	-						7	-	-
	26	-	385						6	22	270
	25	-	380						5	-	-
	24	31	375						4	-	250
	23	-	370						3	-	-
	22	-	360						2	-	-
	21	30	-	Medicine ball forward throw					1	20	200

The score tables presented in Table 3 enable to assess the endurance-strength abilities (the 3 min. Burpee Test) and strength abilities (the medicine ball (4 kg) forward throw) of the women between 18 and 30 years old (Osiński, 2003). The results obtained by the EET and first-year students were calculated into the points between 1 and 100 in order to determine the level of the EET's motor abilities examined in the applied motor tests (Tab. 3). Based on the obtained results and relevant points, a 5-point scale (very poor, poor, average, good, very good) was created, which is shown in Table 4

Table 4

The level of EET's motor abilities according to the 5-point scale for the 3 min. Burpee Test and the medicine ball (4 kg) forward throw

3 min. Burpee Test						
Level of MF	*Tolerance range*		N	%	*Average total*	
	Cycles	Points			Cycles	Points
Very poor	below 30	1 ÷ 20	9	4.14	26	13
Poor	30 ÷ 35	21÷ 40	23	10.59	33	33
Average	36 ÷ 50	41÷ 60	159	73.27	44	52
Good	51 ÷ 56	61÷ 80	26	11.98	52	65
Very good	above 57	81÷ 100	0	0	0	0
Medicine ball (4 kg) forward throw						
Level of MF	*Tolerance range*		N	%	*Average total*	
	Result [cm]	Points			Result [cm]	Points
Very poor	below 356	1 ÷ 20	7	3.22	283	9
Poor	356 ÷ 435	21÷ 40	18	8.29	400	31
Average	436 ÷ 595	41÷ 60	162	74.65	516	50
Good	596 ÷ 674	61÷ 80	26	11.98	625	70
Very good	above 675	81÷ 100	4	1.84	718	90
Motor test		*Result*			*Assessment*	
					Points	*Level*
3 min. Burpee Test [No of cycles]		43.26 ± 6.760 (20 ÷ 56)			50	Average
Medicine ball forward throw [cm]		515.40 ± 79.717 (200 ÷ 760)			50	Average

The results in Table 4 show that both in the 3 min. Burpee Test and in the medicine ball (4 kg) forward throw the EET who achieved an average result (73.27% and 74.65% respectively) constituted the highest percentage. Precisely, the average results in the 3 min. Burpee Test was obtained by the women who performed about 44 cycles (52 points), whereas in the medicine ball forward throw by the women who threw a 4 kg medicine ball as far as 516 cm (50 points). In the 3 min. Burpee Test none of the women received a very good result, whereas in the medicine ball (4 kg) forward throw – only 4 (1.84%). A distinct percentage of the examined EET gained very poor and poor results in both tests (the 3 min. Burpee Test: 4.14% and 10.59%; the medicine ball (4 kg) forward throw: 3.22% and 8.29%). In general, all the tested women obtained an average level of endurance-strength and strength abilities (50 points respectively) (Tab. 4).

Table 5 presents the results of the variance analysis for the applied motor tests comparing the results of the EET to those of the pre-school and early school children.

Table 5

The variance analysis of the results obtained in the 3min. Burpee Test and the medicine ball (4 kg) forward throw

3 min. Burpee Test [number of cycles]			
Groups under study	*Mean ± stand. dev. (min. ÷ max.)*	*Tests results*	
EET	43.26 ± 6.760 (20 ÷ 56)	*z*	p
Pre-school girls	36.85 ± 9.530 (14 ÷ 67)	9.2109	0.0000
Pre-school boys	41.67 ± 9.792 (15 ÷ 66)	2.3961	0.0166
1st-year girls	42.28 ± 10.246 (12 ÷ 65)	0.6756	0.4993
1st-year boys	39.56 ± 12.720 (12 ÷ 66)	3.1902	0.0000
2nd-year girls	50.90 ± 9.554 (19 ÷ 70)	-9.7896	0.0000
2nd-year boys	52.23 ± 12.143 (18 ÷ 70)	-8.9678	0.0000
3rd-year girls	50.43 ± 11.492 (22 ÷ 72)	-8.3979	0.0000
3rd-year boys	54.97 ± 9.850 (26 ÷ 71)	-12.5026	0.0000
1st-year female students	48.94 ± 7.958 (16 ÷ 64)	-8.4823	0.0000
Medicine ball (4 kg) forward throw [cm]			
EET	515.40 ± 79.717 (200 ÷ 760)	*z*	p
Pre-school girls	130.53 ± 33.096 (74 ÷ 230)	20.1981	0.0000
Pre-school boys	157.92 ± 38.888 (80 ÷ 290	19.8031	0.0000
1st-year girls	167.03 ± 69.650 (60 ÷ 390)	18.0667	0.0000
1st-year boys	208.97 ± 60.233 (80 ÷ 490)	17.4340	0.0000
2nd-year girls	243.78 ± 48.196 (145 ÷ 375)	17.7445	0.0000
2nd-year boys	283.61 ± 73.568 (110 ÷ 470)	17.0794	0.0000
3rd-year girls	246.80 ± 71.996 (100 ÷ 480)	17.8017	0.0000
3rd-year boys	333.76 ± 69.325 (130 ÷ 551)	16.2052	0.0000
1st-year female students	588.23 ± 100.599 (330 ÷ 890)	-8.0837	0.0000

***Notes**: z* – value of statistics, p – probability of exceeding the calculated value

Based on the statistical analysis of the 3min. Burpee Test it was observed that the EET obtained significantly worse results than the second-year ($p = 0.0000$) and third-year ($p = 0.0000$) girls and boys, and the first-year university students ($p = 0.0000$). However, their results were significantly better than those of the pre-school children (girls: $p = 0.0000$, boys: $p = 0.0166$), and the first-year boys ($p = 0.0000$). No significant differences in the 3 min. Burpee Test were observed only between the EET and the first-year pre-school girls ($p = 0.4993$). In the case of the medicine ball forward throw trial, the EET obtained significantly worse results than the first-year students ($p = 0.0000$), whereas significantly better results than the examined pre-school and early school children ($p = 0.0000$).

Discussion

According to candidates who intend to study physical education, a P.E. teacher should be characterized most of all by a love of sport and physical activity, (Dodds et al., 1992; Smith, 1993), professional expertise, and ought to display an adequate level of motor fitness in order to serve as a role model to their students (Melville & Cardinal, 1997; Pagnano & Langley, 2001). In view of the above, theoretical knowledge and motor skills acquired by EET during their university education are insufficient to properly conduct P.E. lessons with children. Early education graduates are, in fact, inadequately prepared both theoretically and practically to teach physical activities. Their contact with physical culture is more often than not limited to compulsory P.E. classes at university. Moreover, they might be even physically impaired or/and exempted from any forms of physical exercise for health reasons during their university education (Podstawski & Borysławski, 2014). The lack of adequate criteria for admission to early education studies as well as a limited scope of physical education in the teaching program result in a low level of EET's competence, which also manifests itself in a low level of their motor fitness.

Such assumptions have been confirmed by the results presented in this work, which clearly indicates that the level of strength and endurance-strength abilities in the women under investigation proved to be average or in some cases (the 3 min. Burpee Test) significantly worse than that of early school, 2nd and 3rd-year children and 1st-year female students (in both motor tests). In addition, of 721 women asked to participate in the experiment, as many as 167 (23.16%) were unable to perform any exercises due to permanent damage to their locomotive apparatus confirmed by medical certificates. Such results would have considerably lowered the level of the EET's strength and endurance-strength abilities. A similar percentage of women (25%) with a certified permanent disability was observed in the preliminary studies, which showed that in the vast majority of trials in the applied motor tests the EET displayed the lowest (very poor) level of motor abilities and motor skills (Podstawski, Górnik, & Romańczuk, 2013).

Some of the differences in the applied motor tests between the results obtained by the EET and the children can be logically explained. The EET were expected to perform significantly better than the pre-school and early school children in the medicine ball (2 kg – children and 4 kg EET and university students) forward throw, since in such motor tasks great values of anthropometric features such as body height and mass play a major role, as it is in the case of pitchers, discus and javelin throwers and other related sports disciplines (Mondal, Majumdar, & Pal, 2011; Thorland, Johnson,

Tharp, & Hammer, 1981). A negative influence of the EET's body mass and height on their level of endurance-strength abilities was clearly noticeable in the 3 min. Burpee Test. In endurance-strength efforts the ability to overcome resistance largely depends on the level of organism's cardio-respiratory fitness (Ramsbottom, Currie, & Gilder, 2010; Sands, Irvin, & Major, 1995).

The age between 20 and 30 is marked by the greatest potential in terms of human motor skills (Leversen, Haga, & Sigmundsson, 2012; Wilmore, Costill, & Kenney, 2008). Thus, the EET should have possessed a significantly higher level of strength and endurance-strength abilities than the pre-school and early school children, and similar to that of the 1st-year students. Since the results obtained by the EET in both motor tests were significantly worse than those of the 1st-year students, it can be assumed that the level of endurance-strength and strength abilities of the female postgraduates declines considerably as a result of a decreased amount of PA oriented at endurance and strength exercises. The fact that some EET proved to be overweight, apparently as a consequence of their poor eating habits, might have enlarged the regress in the level of their endurance-strength abilities.

Because the lack of endurance and strength abilities greatly impairs the EET's motor skills, it is highly likely that the investigated teachers will be unable to properly demonstrate a wide range of physical exercises. Teachers without required motor skills perform their duties in a dull and ineffective way (Podstawski & Borysławski, 2014), having little influence on positive changes in the motor development of children (Melville & Cardinal, 1997; Pagnano & Langley, 2001), whose PA nowadays is generally restricted to participating in the obligatory P.E. classes.

At present, in Poland physical education in early education (as a component of integrated teaching) is conducted by EET, a vast majority of whom (99%) are female, but merely 9% of them are fully qualified to teach physical education (SIO, 2009). Meanwhile, in Poland there is an excessive number of graduates in physical education who are not employed to teach early school children as this work is assigned to EET (Jaworski, 2012).

Limitations and practical aplications

One of shortcomings relating to the issue of EET's MF is a total lack of publications in this field, preventing appropriate comparisons. Our research was conducted only in one voivodeship in Poland (Warmia & Mazury). For the above reasons, the research should be continued and its scope expanded into other regions of Poland and abroad. The results of our research and the classification norms based on the results enable to assess

and compare the level of endurance-strength and strength abilities of women aged 18-30. The classification norms that we constructed constitute a reference system determining the level of women's endurance-strength and strength abilities as compared to their peers in a given age group (Pilich, Przewęda, Dobosz, & Nowacka-Dobosz, 2002). Such norms also complement fitness trials included in Podstawski's Test, designed in order to determine students' motor fitness (Podstawski, 2006).

Conclusions

For the reason that motor fitness is important in EET's everyday work, it is worrisome that the teachers under investigation were proved to be at an average level of MF in the range of strength and endurance strength abilities. There was also a relatively big number of teachers who were exempted from physical exercise on health grounds, which may suggest an urgent need for changes in the teacher's lifestyle concerning their daily PA and proper nutrition. Furthermore, it is necessary to outline and implement new enrolment criteria for admission to early education studies including fitness tests, and to expand the curriculum of early education studies by increasing the number of practical P.E. classes.

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