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University School of Physical Education, Poznań, Poland
Akademia Wychowania Fizycznego w Poznaniu

KRZYSZTOF KUSY, JACEK ZIELIŃSKI, MAGDALENA KRÓL-ZIELIŃSKA

Seasonal variation of some indicators of health-related fitness in middle-aged women participating in recreational training

Sezonowe zmiany niektórych wskaźników sprawności fizycznej związanej ze zdrowiem u kobiet w średnim wieku uczestniczących w treningu rekreacyjnym

The health-related fitness (H-RF) concept encompasses a set of morphological, muscular, motor, cardio-respiratory and metabolic components (Bouchard, Shepard 1994) that influence our health positively and can be improved by regular physical activity.

Very little is known about seasonal variations of H-RF in middle-aged women from urban populations. On the basis of former Polish research on motor fitness (Kwilecka 1976, Prywer 1979) we suppose that seasonal fluctuations may occur also in case of H-RF. Moreover, it is interesting if structural changes are synchronized with functional variation.

METHODS

Ten women aged 40-56, inhabitants of the city of Poznań, participated in the study. Their health status was generally good. Six of them were obese (body fat ≥ 32%).

The examined women showed a moderate level of their habitual physical activity. Total amount from 2,33 to 3,00 points on the scale of 1 to 5 point of Baecke questionnaire was calculated. They did professionally mental work and participated in recreational training for several years. The main accent of the organized exercise was on muscle endurance, dynamic and static strength, also on flexibility and aerobic endurance. Each session lasted for 45-50 minutes, two times a week, every year in the period of 9 months (October – June). Various accessories and exercise forms were used. Six females were seasonally or yearlong going in for bicycling or swimming about one hour a week.

For this research one-year period was chosen. During this time 62 sessions took place, each female was present on average at 47 sessions (about 35 hours of organized exercise). The examination was made four times: in October 2002 (E1), in February 2003 (E2), in June 2003 (E3) and in October 2003 (E4). Following morphological components were included in the analysis: percent body fat (%BF), percent fat-free mass (%FFM), percent total body water (%TBW) by means of bioimpedance method (apparatus Spectrum Lightweight 2, Bodygram® software by Ackern S.r.l.), as well as body mass index (BMI) and FFM to BF ratio (FFM/BF). Following functional fitness tests were taken into consideration, according to „Eurofit for adults": dynamic sit-ups (DSU), vertical jump (VJ), hand grip (HGR) and relative strength (RES) as musculoskeletal fitness tests; sit-and-reach test (SAR) as flexibility test; plate tapping (PLT) as motor fitness test. To compare the results of the four examinations Friedman's ANOVA and Wilcoxon test were used.

RESULTS

The level of somatic and functional characteristics are shown in Fig. 1 A) and B). Morphological traits fluctuated within the year on average between: 68,5-71,8 kg body mass, 26,1-27,4 kg/m2 BMI,

47,6-51,4% total body water, 29,8-34,9% body fat, 65,1-70,2% fat-free mass and 1,9-2,4 FFM/BF. The results of functional tests changed seasonally on average as follows: dynamic sit-ups 16-21 repetitions, seat-and-reach 33-37 cm, vertical jump 26-33 cm, hand grip 30-34 kG, relative strength 4,18-4,79 N/kg and plate tapping 11,2- 12,7 sec.

Statistical significance of seasonal morphological and functional changes are shown in Table 1. Highly significant within-year variation (Mean ± SD) of %BF (5,1±1,8; p=0,001***), %TBW (3,7±1,2; p=0,003**), FFM (5,1±1,8; p=0,002**) and FFM/ BF (0,5±0,2; p=0,002**) was found. All these characteristics showed valid differences between Feb '03 and June '03, between June '03 and Oct '03 as well as between Oct '02 and June '03. Values from Oct '02 and Oct '03 (the beginning and the end of the one-year period) did not differ significantly. Body mass (3,3±1,6 kg; p=0,658) and BMI (1,3±0,7 kg/m2; p=0,431) kept similar level during the whole year.

In four functional tests significant seasonal variation has been revealed (Mean±SD): the highest changeability in sit-ups (4,9±1,9 rep.; p=0,0001***) and in plate tapping (1,5±0,6 sek.; p=0,0002***). Somewhat weaker but still valid fluctuations in seat-and-reach test (3,8±2,4 cm; p=0,013*) and vertical jump (7,5±3,5 cm; p=0,019*) could be observed. Hand grip (3,9±1,9 kG; p=0,527) and its derivative, relative strength (0,3±0,2 N/kg; p=0,669), did not change significantly. The pattern of functional changes was dissimilar to morphological variation and different for each test. Sit-ups results improved continuously over the four examinations and were much better at the end of the study (Oct '03) than at the beginning (Oct '02). Plate tapping results did not change from Oct '02 to Feb '03 but increased strongly from Feb '03 to June '03. Similarly to sit-ups, tapping outcomes were better at the end than at the beginning of the study. Significant tapping time improvement between Oct '02 and June '03 as well as between Feb '03 and Oct '03 was also noticed. Seat-and-reach results improved significantly between Feb '03 and June '03 as well between Feb '03 and Oct '03 returning finally to the initial mean values. Jump height increased significantly in the first period of the study (Oct '02 – Feb '03) and then decreased (Feb '03 – Oct '03) reaching the level slightly above the initial values in the end.

DISCUSSION

Although general morphological characteristics – body weight and body mass index – were not changing in the analyzed period, clear seasonality of body composition (%BF, % TBW, %FFM) in middle-aged women were observed in this study. Most health-desirable somatic parameters were found in June. It is interesting that the initial and final outcomes did not differ significantly. It indicates that the fluctuations of body composition described a "circle" returning to the starting point. Such a regular changes are most probably result of recurrent physiological processes in the human body. Other researchers observed noticeable circannual fluctuations of hormones, vitamin D, bone mineral density, bone turnover markers, cholesterol, hemoglobin, albumin and other variables in middle-aged and elderly women (e.g. Garden et al. 2000, Rapuri et al. 2002). Moreover, level of the daily physical activity, the way of earning the livelihood (e.g. farming vs office work), nutrition and the resultant morphological modifications seem to be strictly connected with general living conditions (including climate, urbanization, social roles, local tradition, religion). Striking seasonal changes in activity patterns, daily energy expenditure/intake, body weight, body fat and fat-free mass were found in adult women in rural communities of developing countries (Roberts et al. 1982, Ategbo et al. 1995). In industrialized countries, not being subject to natural factors to such a large extent, within-year hormonal, morphological, dietary and activity variation is not so powerful in adult women but the fluctuations did not disappear entirely (Staveren et al. 1986, Kivelä et al. 1988). This suggests that seasonally changing physical factors, e.g. sunlight (duration of daily photoperiod, ultraviolet solar radiation), temperature and humidity, atmospheric pressure, wind intensity or geomagnetic field, influence the human organism in spite of the "cultural shield".

Indicators of musculoskeletal fitness, flexibility and motor fitness also changed significantly but in a quite different way: independently of morphological variation. Results in seat-and-reach test, dynamic sit-ups and plate tapping increased continuously and hand grip results remained constant during one year in spite of morphological two-directional fluctuations. The height of vertical jump improved initially and than decreased while body fat maintained its level and than decreased at the same time. One should rather expect that the best results in jump test would be achieved at the smallest percent

body fat. It seems that the regular physical activity and the resultant adaptation to the increased physical effort is the factor modifying the course of functional changes "in defiance" of somatic variation.

Functional within-year changes may be different depending on forms, duration, intensity and frequency of physical activity. In a 3-year study, J. Prywer (1979) showed that the physical fitness decreased every time in October compared with May in active urban women aged 40-59, contrary to this study (best results usually in October). The reason may be the way how (actively or not) the women spent their holidays. In inactive working women, in turn, the results in vertical jump were worse in May than in October (Kwilecka 1976). For lack of a somatic data in both cited works no appropriate interpretation can be made.

The next research task is to monitor the changes in H-RF during several years to get information on (ir)regularity of seasonal variation. Besides, it is interesting what level of physical activity would bring about a disruption of the observed regularity of morphological changes. In this study, women finally returned to their initial somatic constitution. It seems that the question of food intake and energy balance should be taken into consideration.

CONCLUSIONS

Morphological and functional indicators of health-related fitness undergo seasonal changes in physically active middle-aged women from urban population.

Patterns of seasonal variation of morphological and functional characteristics are different. Body composition fluctuates consistently with a natural circannual rhythm whereas functional fitness may improve or maintain its level independently of changes in body composition.

Recreational physical activity may be considered as a factor modifying the natural seasonal rhythm of musculoskeletal fitness, flexibility and motor fitness in middle-aged urban women in a positive, health-supporting way.

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STRESZCZENIE

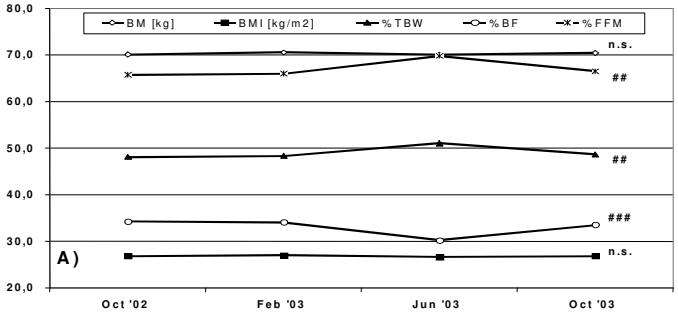
Zbadano 10 kobiet w średnim wieku, mieszkanek Poznania regularnie ćwiczących na średnim poziomie. Cztery razy w ciągu jednego roku mierzono poziom wskaźników morfologicznych i funkcjonalnych sprawności fizycznej związanej ze zdrowiem (H-RF). Stwierdzono okołoroczną zmienność (M±SD) masy tłuszczu (5,1±1,8%; p=0,001), wody całkowitej (3,7±1,2%; p=0,003), masy beztłuszczowej (5,1±1,8%; p=0,002), proporcji masy beztłuszczowej do masy tłuszczu (0,5±0,2; p=0,002), siadów z leżenia (4,9±1,9 powt., p=0,0001), skoku dosiężnego (7,5±3,5 cm; p=0,019), tappingu (1,5±0,6 s; p=0,0002) i gibkości (3,8±2,4 cm; p=0,013). Masa ciała (3,3±1,6 kg; p=0,658), BMI (1,3±0,7 kg/m2; p=0,431) i siła ręki (3,9±1,9 kG; p=0,527) nie zmieniały się znacząco. Zmienność morfologiczna i funkcjonalna nie były zsynchronizowane – sprawność ruchowa zmieniała się niezależnie od składu ciała. Wnioskowano, że rekreacyjna aktywność fizyczna może być czynnikiem pozytywnie modyfikującym naturalny sezonowy rytm sprawności funkcjonalnej.

ABSTRACT

This study was performed on 10 middle-aged women, inhabitants of city of Poznań, exercising regularly at moderate level. Seasonal changes in morphological and functional indicators of health-related fitness (H-RF) were examined four times during one year. Within-year significant fluctuations (Mean±SD) of percent body fat (5,1±1,8%; p=0,001), total body water (3,7±1,2%; p=0,003), fat-free mass (5,1±1,8%; p=0,002), FFM to BF ratio (0,5±0,2; p=0,002), dynamic sit-ups (4,9±1,9 rep., p=0,0001), vertical jump (7,5±3,5 cm; p=0,019), plate tapping (1,5±0,6 sek.; p=0,0002) and flexibility (3,8±2,4 cm; p=0,013) were observed. Body mass (3,3±1,6 kg; p=0,658), BMI (1,3±0,7 kg/m2; p=0,431) and hand grip test (3,9±1,9 kG; p=0,527) did not revealed any valid variation. Changes of morphological and functional characteristics were not synchronized, i.e. functional fitness changed independently of body composition. Conclusion was drawn that recreational physical activity may be considered as a factor modifying natural seasonal rhythm of H-RF in middle-aged women in a positive way.

Tab.1. Statistical significance of differences between four examinations of somatic and motoric characteristics obtained in women aged 40-56 during one-year cycle of recreational training (n=10). E1-E2, E2-E3 etc. – comparison of given examinations; Friedman's ANOVA: # p< 0,05 ## p<0,01 ### p<0,001; Wilcoxon test: * p< 0,05 ** p<0,01 *** p<0,001

			Wilcoxon test											
	Friedman's ANOVA	p-level	E1-E2 Z	p-level	E2-E3 Z	p-level	E3-E4 Z	p-level	E1-E4 Z	p-level	E1-E3 Z	p-level	E2-E4 Z	p-level
BM	0,05	0,658	13	0,139	16	0,407	15,5	0,407	22,0	0,575	27	0,959	18,5	0,636
BMI	2,76	0,431	14	0,169	12	0,114	14	0,314	23,0	0,646	21	0,508	23	0,646
%TBW	14,28	0,003##	19	0,386	0	0,005**	3	0,013*	20,0	0,445	1	0,007**	25	0,799
%BF	15,48	0,001###	20	0,445	0	0,005**	3	0,013*	17,5	0,308	1	0,007**	20	0,445
%FFM	14,46	0,002##	19	0,386	0	0,005**	3	0,013*	18	0,333	1	0,007**	25	0,799
FFM/BF	15,00	0,002##	23	0,646	0	0,005**	2	0,009**	18	0,333	1	0,007**	21	0,508
DSU	21,1	0,0001###	2	0,025*	3	0,030*	2	0,043*	0	0,008**	0	0,005**	4	0,017*
SAR	10,75	0,013#	8	0,600	0	0,028*	10	0,263	9	0,110	7,5	0,272	5	0,038*
VJ	9,97	0,019#	1	0,007**	6	0,051	20	0,767	12	0,103	10,5	0,155	3,5	0,024*
HGR	2,23	0,527	21	0,508	19	0,678	7,5	0,141	19	0,678	17,5	0,554	14,5	0,624
RES	1,56	0,669	22	0,575	20	0,445	14	0,169	19	0,386	23	0,646	21	0,508
PLT	19,91	0,0002###	14,5	0,343	0	0,005**	24	0,721	0	0,005**	1	0,007**	1,5	0,008**



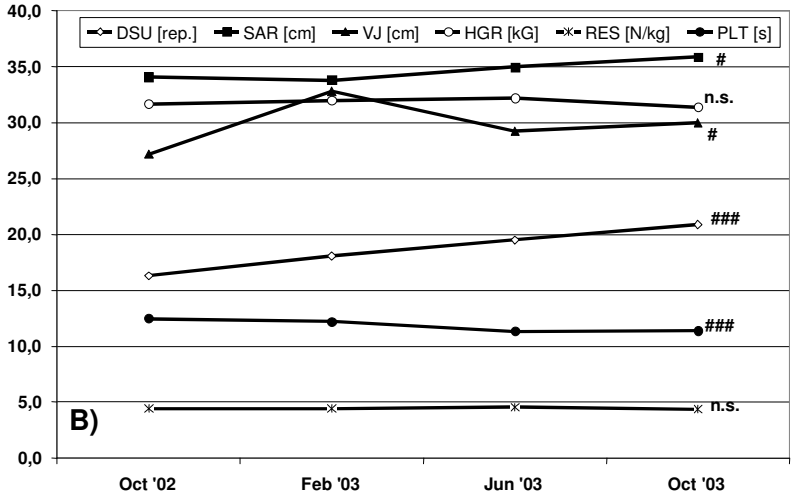


Fig.1. Seasonal changes in somatic (A) and functional (B) characteristics. Results of four examinations on women aged 40-56, involved in recreational training (n=10). Friedman's ANOVA: # p< 0,05 ## p<0,01 ### p<0,001, n.s. – not significant