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Research paper

Behavioral components of pro-healthy lifestyle and bioelectrical impedance body composition in Polish young adults: Preliminary results

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Article info

ABSTRACT

Introduction: Adverse health behaviors changes are reported during emerging adulthood, inter alia the reduced level of physical activity (PA), worse diet quality etc. There are only very few studies concerned with the relationship between health behaviors and body composition in healthy young adults.

Aim: The aim was to investigate the relationship between behavioral components of prohealthy lifestyle and body composition assessed by bioelectrical impedance (BIA) in the cohort of Polish young adults.

Material and methods: A cross-sectional observational study of health behaviors, anthropometric indices and BIA body composition was conducted in Polish young adults (n = 92) aged 18–24 (mean 19.33, SD 0.915), 71 females. Behavioral variables included: general health behaviors, PA, eating behaviors and nutritional knowledge. Body composition was analyzed by means of the BIA phase-sensitive 8-electrode medical SECA mBCA 525 device.

Results and discussion: A higher level of PA was associated with a lower volume of visceral adipose tissue in females (r = –0.27; P < 0.05). In the males, the intensification of unhealthy diet was negatively correlated with the muscle mass (r = 0.65; P < 0.01), and the higher level of nutritional knowledge resulted in a smaller waist circumference (r = –0.45; P < 0.05). Behavioral components of pro-healthy lifestyle were not significant predictors of body composition/anthropometric indices such as waist circumference, fat mass index, fat free mass index and body mass index.

Conclusions: The reported studies provide an important insight into the sex--specific correlations between the behavioral components of the pro-healthy lifestyle and body composition in healthy young adults.

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1. INTRODUCTION

A number of studies have demonstrated adverse changes in health behaviors during emerging adulthood, involving a reduced level of physical activity (PA), and a worse quality of diet, which implies an increased risk of body mass gain.[1–5] These changes are connected with identity discontinuity and formation processes[6] and the changes of the environmental context that shape behaviors.[2] The relationship between health behaviors and body composition has been the subject of a number of investigations in diverse healthy populations, inter alia in Spain,[7] in Italy,[8] in women,[9,10] in Polish children,[11] as well as in groups of ill persons, e.g. in women with polycystic ovary syndrome (PCOS).[12] The behavioral predictors of bioimpedance phase angle (PhA) have been analyzed in Polish young adults.[13]

2. AIM

In view of the small number of studies on the relationship between health behaviors and body composition in young adults,[4,14] research was undertaken to investigate the relationship between selected behavioral indicators of prohealthy lifestyle and body composition assessed by bioelectrical impedance (BIA) in the cohort of Polish young adults.

3. MATERIAL AND METHODS

3.1. Study population

From 1 October 2017 to 30 October 2018 a cross-sectional study was carried out of 92 young adults aged 18–24 (M 19.33, SD 0.886), including 71 females. The studies were carried out in the autumn months to avoid seasonal PA determinants. The purposively selected subjects were first-year dietetics (61.96%) and physiotherapy (38.04%) students at the Medical University of Lublin, Poland. In total, 47.83% of the subjects listed the countryside as their permanent residence, 7.61% – a town of under 20 000 inhabitants, 16.30% – a town of 20 000 to 100 000 inhabitants, and 28.26% – a city of over 100 000 inhabitants. 2.17% of the subjects rated their financial situation as below average, 83.7% – as average, 14.13% – as over average. The majority of subjects combined employment with college studies.[13]

3.2. Anthropometric measurements

Anthropometric measurements were carried out in accordance with the WHO standards, taking into account the body mass measurement to the nearest 0.1 kg and height to the nearest 0.5 cm.[15] The measurements were obtained using the measuring station SECA with stadiometer model No. 7997021289. The waist circumference (WC) was measured using the anthropometric tape to the nearest 1 cm. The body mass index (BMI) was calculated as body weight divided by the square of height (in kg/m^2).

3.3. Bioelectrical impedance

The non-invasive analysis of body composition was carried out by means of a phase-sensitive, multi-frequency 8 electrode SECA medical Body Composition Analysis 525 device (SECA, Hamburg, Deutschland). BIA enables a non-invasive and reliable assessment of body composition and is widely used to assess the nutritional status.[16–19]

3.4. Behavioral variables

The survey technique by means of standardized questionnaires was used to assess selected behavioral components of pro-healthy lifestyle.

The level of PA was assessed using the long version of the International Physical Activity Questionnaire (IPAQ).[20]

Eating behaviors and nutritional knowledge were assessed by the standardized Dietary Habits and Nutrition Beliefs Questionnaire, self-administered version No 1.2.[21,22] Eating behaviors were assessed using closed-ended questions, which concerned the frequency of consumption of specific products, drinks, and dishes. The prohealthy-diet-index-10 (pHDI-10) and non-healthy-diet-index-14 (nHDI-14) were calculated.[13] The values of both indices in points were used for statistical analyses (the range 0–100 points). Nutritional knowledge was assessed using statements that the respondents qualified as true or false. Each correct answer was awarded 1 point (the range 0–25 points)[21].

General health behaviors were assessed using health behavior inventory (HBI). The questionnaire contains 24 statements that describe health-related behaviors. The subjects mark on a 5-degree scale how often they engage in the listed behaviors (the range 24–120 points).[23]

3.5. Statistical analysis

The statistical analysis was carried out using the Statistica v. 13.3; TIBCO Software Inc. 2017 (Table 1) and IMB SPSS Statistics v. 25 (Tables 2–4). The data were expressed as mean values (M) and standard deviation (SD). In order to calculate the intergroup sex-dependent differences, the non-parametric Mann-Whitney U-test was applied because of significant differences in the number of females and males ($\chi^2 = 27.17$ $P < 0.001$). Correlations between variables were calculated using the r-Pearson correlation coefficient. In order to assess the relationship between lifestyle elements and the anthropometric and body composition parameters, the linear regression analysis was used with the enter method. The results of regression analysis were presented in standardized units of beta (β) coefficients as well as coefficients of correlation (R) and coefficients of determination (R^2) in order to establish what percentage of dependent variable variance (body composition parameters) is explained by the package of independent (behavioral) variables. The values of $P < 0.05$ were recognized as statistically significant.

Table 1. Characteristics of the studied participants ($n = 92$).

Anthropometric indices		Bioimpedance body composition		Behavioral components of pro-healthy lifestyle	
Weight, kg	63.0 ± 10.8	Fat mass absolute value, kg	15.30 ± 5.82	Summary intensity of health behaviors HBI, total score	79.71 ± 12.99
		Fat mass index, kg/m^2	5.31 ± 1.96		
Height, cm	1.71 ± 0.074	Fat free mass absolute value, kg	48.33 ± 9.54	Summary energy expenditure, MET-min/week.	7322.29 ± 7797.03
		Fat free mass index, kg/m^2	16.55 ± 2.05		
BMI, kg/cm^2	21.80 ± 2.57	Visceral adipose tissue, L	0.5319 ± 0.57	pHDI, total score	33.57 ± 5.55
		Skeletal muscle mass, kg	22.80 ± 5.65	nHDI, total score	38.13 ± 6.24
		Phase angle, °	6.38 ± 0.75	Level of nutritional knowledge, total score	14.72 ± 3.40
WC, cm	75.30 ± 9.18	Total body water, L	35.67 ± 6.92		
		Extracellular body water, L	15.23 ± 2.46		

Abbreviations: MET – metabolic equivalent; pHDI-10 – Prohealthy-Diet-Index; nHDI-14 – Non-Healthy-Diet-Index.[13]

4. RESULTS

The results concerning anthropometric measurements, body composition, and behavioral variables obtained in the studied group are presented in Table 1.

On account of separate norms of the WC in males and females, mean values of WC for gender groups were additionally calculated, these being 72.87 ± 7.44 cm and 83.52 ± 9.88 cm respectively ($Z = -4.36$; $P = 0.001$). Similarly, because of different reference values for gender groups, mean values for fat mass index (FMI) and fat free mass index (FFMI) were additionally calculated for women and men. FMI was 5.71 ± 1.75 kg/m^2 in the females, and 3.94 ± 2.07 kg/m^2 in the males ($Z = 3.85$; $P = 0.001$), while FFMI was: 15.68 ± 1.18 kg/m^2 and 19.50 ± 1.56 kg/m^2, respectively ($Z = 6.58$; $P = 0.001$). Different reference values in gender groups are also reported for phase angle (PhA). In the present study, the mean PhA was 7.220 ± 0.720 for men, and 6.130 ± 0.570 for women ($Z = -5.25$; $P = 0.001$).

Table 2 presents the relationship between selected anthropometric variables (WC, BMI) as well as body composition parameters (FM, FFM, SMM, VAT, PhA) and the health behaviors intensity (HBI), physical activity (PA), diet quality indices (pHDI, nHDI) and the level of nutritional knowledge. The analysis of correlations between body composition / anthropometric parameters, and indices describing the elements of pro-healthy lifestyle revealed a negative correlation between the PA level and the volume of VAT, but only in females. The PA level was not correlated with the other indices of body composition. There is no relationship between PA assessed by the IPAQ and SMM as well as FM.

The analysis of the relationship between the quality of diet and body composition parameters made it possible to reveal a negative correlation between nHDI and SMM in males, demonstrating a relationship between a higher frequency of unhealthy food consumption and smaller SMM. No relationship was, however, shown between pHDI and SMM in any of the gender groups. The frequency of healthy or unhealthy food consumption was not related to the other indices of body composition.

Greater nutritional knowledge was associated only with lower PhA values in women (this relationship should be rec-

ognized as paradoxical) and with lower WC values in males. No connection between the level of nutritional knowledge and the other parameters of body composition was reported.

Health behaviors assessed by the health behavior inventory scale were not related to any of the anthropometric indices or to body composition.

In order to evaluate the relationship between lifestyle and anthropometric parameters as well as body composition, the linear regression analysis with the enter method was carried out (all independent variables were simultaneously entered into analysis). On account of the inappropriate relation between the numerical strength of the male group ($n = 21$) and the number of independent variables, analyses in this group were abandoned. Analysis was carried out in the entire studied cohort ($n = 92$) and in the female group ($n = 71$). Regression models taking account of behavioral variables

Table 2. Correlations r between behavioral, anthropometric and body composition variables stratified by gender.

	Gender	HBI	PA	pHDI	nHDI	Nutritional knowledge
FM	Male	–0.157	–0.038	–0.336	–0.008	–0.100
	Female	–0.010	–0.119	0.154	–0.091	0.082
FFM	Male	0.225	–0.056	0.264	–0.667	–0.287
	Female	0.029	0.022	–0.052	–0.049	–0.086
SMM	Male	0.250	–0.027	0.264	–0.647**	–0.276
	Female	0.037	0.047	–0.046	–0.022	–0.138
VAT	Male	0.110	0.013	–0.309	–0.061	–0.416
	Female	–0.035	–0.267*	0.045	0.040	0.203
PhA	Male	0.425	–0.060	0.385	–0.313	–0.031
	Female	0.039	0.228	–0.051	0.050	–0.314**
WC	Male	0.163	0.119	–0.190	–0.165	–0.454*
	Female	–0.113	–0.026	0.039	–0.008	–0.092
BMI	Male	0.004	0.028	–0.045	–0.297	–0.185
	Female	0.029	0.045	0.081	–0.121	–0.114

Comments: * $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$; HBI – health behavior inventory; PA – physical activity; pHDI – prohealthy-diet-index; nHDI – non-healthy-diet-index; FM – absolute fat mass value; FFM – fat-free mass value; SMM – skeletal muscle mass value, VAT – visceral adipose tissue value; PhA – phase angle; WC – waist circumference; BMI – body mass index; r – correlation coefficient.

(health behaviors, PA, nHDI, pHDI and the level of nutritional knowledge) proved statistically insignificant in the whole studied group (Table 3) and in the females (Table 4).

5. DISCUSSION

The mean BMI in the studied group was within the range of normal values.[24] In light of the guidelines of the International Diabetes Federation 2006, mean WC was within the normal range for both gender groups.[25] In both gender groups the FFMI value approximated the values of 50 centile for FFMI estimated in a population of young adult European Caucasians (age group 18–34 years; 50c for women = 15.4 kg/m², for men = 18.9 kg/m²).[26] Both in females (5.71 ± 1.75 kg/m²), and in males (3.94 ± 2.07 kg/m²) the FMI values corresponded to the values of 50 centile, which, according to Schutz et al., are 5.5 kg/m² for women, and for men – 4.0 kg/m².[26] Mean values of FM and FFM in the studied group were 15.3 kg and 48.33 kg respectively (Table 1). Referring to similar studies by Bajerska-Jarzębowska et al.[27] among students aged 19–26 years, the FM values in own research were lower than in the cited investigation (in which they were 19.7 kg), whereas the FFM values were lower in the authors' own sample than in those investigations (in which they were 60.1 kg). The cited studies showed a relationship between physical efficiency – a function of PA level – and the FFM.[27] No such relationship was found in the reported study (Table 2).

The PhA values, which were 6.380 ± 0.750 in the entire studied group (Table 1), should be regarded as normal in view of the studies by Selberg et al.,[19] who suggest that values lower than 4.40 should be treated as incorrect, those in the 4.40–5.40 range as borderline ones, and above 5.40 as normal.

The literature enables comparison of the PA level (Table 1) with the results obtained by means of the same tool in other similar groups of subjects. The mean results expressed in MET-min/week were in the high PA range, exceeding the cut-off point of 3000 MET-min/week.[20] The studies by Kościuczuk et al.[28] carried out using the same tool in a similar group of dietetics and physiotherapy students showed that the summary PA was on average 3014.5 MET-min/week (±1564.8), being therefore far lower than the mean value obtained in the reported study (which was 7322.29 MET-min/week). In contrast, the result obtained in the present study is closer to the findings by Górski et al.[29] in a group of Polish and Irish physical education students, in which the total PA level was 11477 (±6331) and 7205 (±4787) MET-min/week respectively. The PA level was not correlated, nor was it a predictor of the majority of the assessed body composition parameters, except the volume of VAT in women (Table 2) (the correlation coefficient –0.27, hence clear but low linear dependence; the number of women ($n = 71$) guarantees the significance of the correlation coefficient).[30] Studies by Lovro et al.[4] in Croatia in a group of young adults ($n = 271$) showed significant correlations between lifestyle factors and body composition, and demonstrated a strong inverse relationship between PA and weight, BMI, FM percentage, as well as a strong

Table 3. Multiple regression analysis between behavioral factors and anthropometric/body composition variables in the whole studied group.★

	WC	VAT	BMI	FMI	FFMI
			β Coefficient		
HBI	–0.66	0.022	–0.043	–0.066	0.012
PA	0.045	-0.051	0.070	-0.083	0.168
pHDI	–0.032	–0.159	–0.018	0.049	–0.070
nHDI	0.057	0.133	–0.059	-0.173	0.101
Nutritional knowledge	–0.127	0.011	–0.112	0.009	–0.148
			R Coefficient		
	0.213	0.229	0.162	0.206	0.308
			R^2 Coefficient		
	0.045	0.053	0.026	0.042	0.095

Comments: ★All correlations insignificant.; HBI – health behavior inventory ; PA – physical activity; pHDI – prohealthy-diet-index; nHDI – non-healthy-diet-index; WC – waist circumference; VAT – visceral adipose tissue; BMI – body mass index; FMI – fat mass index; FFMI – fat-free mass index; R – coefficient of correlation; R^2 – coefficient of determination.

Table 4. Multiple regression analysis between behavioral factors and anthropometric/body composition variables in females.★

	WC	VAT	BMI	FMI	FFMI
			β Coefficient		
HBI	–0.155	–0.164	0.010	–0.123	0.176
PA	–0.084	–0.250	0.012	–0.095	0.141
pHDI	0.095	0.091	0.063	0.171	–0.117
nHDI	–0.048	0.053	–0.124	–0.085	–0.094
Nutritional knowledge	–0.089	0.173	–0.144	0.013	–0.261
			R Coefficient		
	0.179	0.337	0.193	0.208	0.336
			R^2 Coefficient		
	0.032	0.114	0.037	0.043	0.113

Comments: ★All correlations insignificant.; HBI – health behavior inventory ; PA – physical activity; pHDI – prohealthy-diet-index; nHDI – non-healthy-diet-index; WC – waist circumference; VAT – visceral adipose tissue; BMI – body mass index; FMI – fat mass index; FFMI – fat-free mass index; R – coefficient of correlation; R^2 – coefficient of determination.

positive association between PA and muscle-mass percentage. The meta-analysis by Mundstock et al.[31] shows that PhA is significantly higher in physically active people ($P < 0.001$, 95% CI: 0.48, 0.92), the two variables being positively correlated.

The studies by Naliwajko et al.[32] in young males aged 21–30 years in turn show that persons who systematically practice PA are characterized by a significantly lower percentage of FM (15.1 vs. 17.1; $P < 0.01$), and by a higher SMM (40.7 vs. 35.8; P

< 0.001). In our studies, PA was inversely correlated with VAT volume but only in the females, without however being connected with other body composition parameters (Table 2). In the context of WHO's theses pointing out the pro-health values of PA ('every move counts'), with emphasis on favorable changes in body composition,[33,34] the results of the reported studies showing only the connection between PA and VAT should be regarded as an unexpected finding that requires verification by means of an objectified PA measurement.

The absence of a relationship was demonstrated between health behaviors assessed with the HBI scale and anthropometric parameters as well as body composition. This result is understandable in light of the content of this tool, which encompasses the behavioral aspects of health care loosely connected with body composition, and, in addition, the tool items are formulated in highly general terms (e.g. 'I care about proper diet'). When referring the obtained HBI score to the provisional Polish norms the average result both in women (74.10) and in men (81.37) was in the region of 5 sten and should be interpreted as average.[35]

The connection between diet quality and body composition in a similar sample was evaluated in Croatian studies[4]. That research took into account the Mediterranean Diet Quality Index (KIDMED), based on 16 questions about pro-health or unhealthy eating behaviors. The stricter following of the rules of the Mediterranean diet was conducive to lower body mass in both sexes, smaller BMI, lower FM, and higher FFM. In the present study, only nHDI was negatively correlated with SMM in men (correlation coefficient –0.65, the sample size of the male group $n = 21$ was a sufficient guarantee of its significance).[30] The other parameters of body composition were not related to diet quality (Table 2). pHDI was not correlated with any anthropometric or body composition parameters, only nHDI was negatively correlated with SMM in men (Table 2). When discussing this result, attention should be drawn to the studies by Barrea et al.,[8] which proved the importance of the Mediterranean diet adherence as a PhA predictor in the Italian population, explaining the considerable percentage of PhA variation (44.5% in men and 47.3% in women). In contrast, the Turkish studies[10] did not show PhA correlation with health behaviors in women. These results are consistent with the results of the reported studies in that the dietary predictors of the vast majority of anthropometric parameters and body composition were not identified (Tables 3 and 4). The assessment of behavioral variables by means of self-reported questionnaires is burdened with the risk of a number of errors influencing the reliability of the data obtained, including inter alia the recall bias.[36]. The Food Frequency Questionnaire (FFQ) used in the present study should be classified as FFQs with shorter food lists, which are a less reliable source of data on consumption frequency compared with FFQs with longer food lists, which contain over 200 items. Moreover the questionnaires analyze behavioral variables within a specific time range, depending on reporting the remembered behaviors while body composition remains impacted by long-term influences.

The level of nutritional knowledge was negatively correlated with the WC in men (moderate linear relationship) while in the females the greater level of nutritional knowledge was associated with lower PhA values, which should be recognized as a paradoxical finding. Low PhA values are regarded as a pathology marker and a predictor of worse health outcomes as well as mortality,[12] while higher diet quality is associated with larger PhA values.[8]

6. CONCLUSIONS

(1) In the studied group a higher PA level is correlated with a lower VAT volume in women.
(2) The nHDI is negatively correlated with SMM in men.
(3) A higher level of nutritional knowledge is linked with the lower WC in men.
(4) The behavioral components of pro-healthy lifestyle are not significant predictors of body composition/anthropometric indices such as WC, VAT, FMI, FFMI and BMI.

Ethics
Informed consent was obtained from all subjects before they participated in the study. Consent for the conduct of studies was obtained from the Bioethical Commission of the Medical University of Lublin, Poland (resolutions KE-0254/248/2017 and KE-0254/263/2018).

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