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Variation in biological status among Polish males and underlying socio-economic factors

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ABSTRACT The main purpose of this study was to evaluate the socio-economic and lifestyle factors associated with biological status of Polish men. Data were collected during a cross-sectional survey carried out in Poznań and several localities in Western Poland, between 2000 and 2002. The sample consisted of 2509 men ranging from 30 to 90 years of age. Biological status was expressed in terms of functional-biological age (BA) computed as a composite z-score of 11 biomarkers according to the method proposed by Borkan and Norris [1980*a*], and physiological reserve index (PR) developed by Goffaux *et al.* [2005]. The average biological age profiles (BAP) were compared in several subgroups of participants. The subgroups were categorized based on demographic, socio-economic and lifestyle characteristics. It was found that values of systolic and diastolic blood pressure, BMI, physical and emotional aging indicators and perceived satisfaction with life were significantly associated with most of the study factors, except for smoking habit and education level. The multivariate logistic regression models revealed that two factors, financial situation and physical activity, were significantly associated with the physiological reserve index estimation. The study confirmed the role of the socio-economic and lifestyle factors likely to play in men's biological status and aging rates.

KEY WORDS: biological age, physiological reserve, biomarkers, socio-economic status, lifestyle

The age-specific decline in physiological functions, though similar in general pattern, shows large inter-individual variation. It may be attributed to biological and environmental causes such as differential rate of age-related functional decline of specific organ systems, health-risk behaviours, and chronic degenerative disorders related to physiological aging [ŹIVIĆNJAK *et al*. 1997, RAUTIO *et al*. 2001, GOFFAUX *et al*. 2005]. For this reason, the assessment of aging *per se* becomes difficult. Many attempts to measure the aging rate have been made during the past decades. In most cases, the researchers attempted to find physiological or biochemical variables correlated with chronological age,

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a set (battery) of markers, which would enable the detection of subtle changes in the aging rate [BORKAN and NORRIS 1980*a*, NAKAMURA 1982, REFF and SCHNEIDER 1982, SZKLARSKA and ROGUCKA 2001]. GOFFAUX *et al*. [2005] proposed a concept of physiological reserve defined as "the outcome of the interaction of aging, lifestyle, and disease" and "the key to estimating biological age since the loss of reserve is the hallmark of aging". The concept of physiological reserve index is shown in Figure 1. Test batteries have been used to determine biological age also referred to as physiological age or functional age. Individuals with scores above the mean for their age group are likely to be biologically older than those below the mean [BORKAN and NORRIS 1980*a*]. Age-related traits, which develop on the base of a complex genetically regulated process such as aging, can be decomposed to its genetic and environmental components [CRAWFORD 2005] with heritability estimates ranging from 27% to 57% [KARASIK *et al.* 2005]. Environmental factors include the individual's socio-economic status, defined by education, income, social isolation, lifestyle factors such as smoking, drinking, exercising, marital status and others [BORKAN and NORRIS 1980*b*, FACCHINI *et al*. 1989, LAWLOR *et al*. 2003, KARASIK *et al*. 2005, GOGGINS *et al*. 2005, KACZMAREK and LASIK 2006].

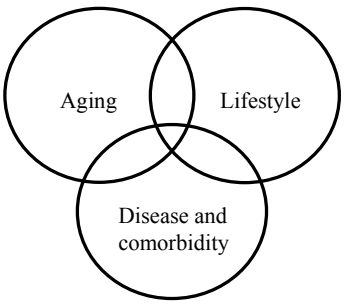


Fig. 1. Venn diagram demonstrating an individual's physiological reserve [Goffaux *et al.* 2005]

Socio-economic factors associated with biological status are of special interest because of the social and economic situation of Polish men after the political transformation of the 1990s [*Report of National Census* 2002, *Report of CBOS* 2006]. In terms of life expectancy, Poland ranks only 25th in Europe, although data of Central Statistical Office show a clear increasing trend in the lifespan of both men and women. Currently (the 2004 data), life expectancy at birth (e_0) for Polish males is 74.1 years. Owing to demographic trends currently prevailing in the developed countries, including Poland, as early as after 2010 most of these populations will be classified as aging populations [KACZMAREK and SKRZYPCZAK 2002]. At the beginning of the 21st century Poland is a country of high unemployment rate (21%), a country of contrasts and contradictions resulting from the transformations, with well educated people having problems in finding a job and managing a financial situation often not corresponding to educational level. Moreover, it is better material status, and not higher education, that gives a better chance for a "healthy lifestyle". The socio-economic changes have also brought about an increased level of social stress.

In light of the above-mentioned facts, the present study attempts to evaluate the socio-economic and lifestyle factors associated with the biological status of Polish men. The question posed in this paper is whether men coming from a low social stratum are biologically older than their peers from better-off conditions?

Materials and Methods

For purposes of the present study, data from the cross-sectional survey carried out between 2000 and 2002 in Poznań and several other localities in Western Poland were used. The study was approved by the Bioethics Committee of the University of Medical Sciences in Poznań.

The aim of the survey was to obtain a sample that meets quality requirements. Out of 4000 individuals enrolled for the study, replies were received from 2509. This gives a final response rate of 62.7%. It is far from satisfactory, but men, unlike women, are very difficult subjects for scientific purposes. Thus, the study sample consisted of 2509 men ranging from 30 to 90 years of age.

The data were collected from interviews carried out in private homes, institutions, and industrial places by graduate students specially trained for this inquiry. The Polish version of the Andropause-Specific Quality of Life Questionnaire (AQOL) was used to collect demographic, socio-economic and lifestyle data, subjective perception of one's quality of life (QoL), and health-related QoL indicators [KACZMAREK 2000]. Eleven variables were chosen for computing biological age.

The studied men were divided in two groups of chronological age: younger than 50 years of age, and equal to and older than 50 years of age. The following socio-economic, demographic and lifestyle factors, each divided into two categories, were included in analyses: marital status classed as (1) single (including bachelors, divorced, widowers) and (2) living with a partner (married/informal relationship); education level classed as (1) low (primary/vocational) and (2) high (secondary/university); place of residence categorized as (1) village/small town and (2) medium-sized town/large city; financial situation, based on answer to the question: *Is your income sufficient to afford the necessities of life?*, distinguished as (1) poor or (2) good; physical activity classed as (1) not physically active and (2) physically activity for more than 4 hours a week; smoking habit classed as (1) currently smoking less than and $\geq$10 cigarettes per day and (2) never smoked and past smoker.

The test battery included 11 biomarkers, known to have a positive or negative linear correlation with chronological age, characterizing the male physical and mental condition. These were as follows: anthropometric measurements (body mass index BMI kg/m^2 – calculated as body weight in kg divided by the square of standing height; weight and height measured with GPM anthropometric instruments); cardiovascular characteristics (systolic blood pressure SBP mmHg and diastolic blood pressure DBP mmHg measured on the left arm, after a sufficient sedentary period, using a sphygmomanometer); pulse pressure PP mmHg calculated as the difference between SBP and DBP, used as a measure of arterial stiffness; biochemical characters such as total cholesterol TCH, cholesterol fractions HDL and LDL, triglicerydes TRIGL sourced from medical records or measured from blood serum, and health-related indicators of the aging male.

Health-related indicators of the aging male's quality of life were self-estimated using the aging male specific questionnaire. The authors prepared and verified the questionnaire as detailed in a previous publication [KACZMAREK and SKRZYPCZAK 2002]. The scoring proce-

dure was based on each man's "yes" or "no" to questions about physical (PSAM), and emotional (ESAM) health complaints occurring within the previous three months. Physical complaints included hot flashes, night sweats, weakness, fatigue, and somatic pain. Emotional complaints included depression, irritation, feeling down or "blue", loss of memory and lack of concentration. A detailed explanation of the scoring procedure is shown in Figure 2.

The quality of life (QoL) was self-estimated and included a subjective feeling of well-being with life and particular life domains as proposed by CAMPBELL [1976]. The following life domains were evaluated: marriage, family, health, friends, job, home, leisure time, living standard, education, economic status and the quality of life in Poland. The degree of satisfaction in each area was scored from 1 to 7. An overall index of life quality for all the 11 areas ranged from 11 to 77, indicating high dissatisfaction within range 11-33, moderate dissatisfaction/satisfaction – scores within range 34-55, and high satisfaction – scores within range 56-77.

Distributions of test battery traits proved not to be normal; therefore, the median and quartile range (Q_1–Q_3) were used for the analysis. Biological age was calculated according to the method proposed by BORKAN and NORRIS [1980*a*] as a composite z-score. The z-score was calculated separately for each of the variables using the formula: [(observed value - median)/the Q_1–Q_3 quartile range]. Differences between z-scores for subgroups based on social status and lifestyle in two age groups were compared using the Mann-Whitney U test. Differences between z-scores for biological age indicators in age groups were compared by means of the Kruskal-Wallis test. Negative scores referred to younger biological age, and positive ones to older biological age. The majority of parameters, such as blood pressure, showed positive sloping, but for two parameters, namely the quality of life and the cholesterol fraction HDL, negative scores were associated with older biological age. To standardize interpretation of results, scores of negatively sloped variables were multiplied by –1.

A graphic representation of results was prepared in the form of a coordinate system, as proposed by BORKAN and NORRIS [1980a], with the biological age indicators

EMOTIONAL			**PHYSICAL**		
Scores	**Yes**	**No**	**Scores**	**Yes**	**No**
•I feel depressed	2	1	•I have hot flashes	2	1
•I feel anxious or nervous	2	1	•I suffer from sweats	2	1
•I prefer loneliness	2	1	•I have a headache	2	1
•I feel down or blue	2	1	•I feel dizzy spells	2	1
•I lost my memory	2	1	•I feel swarming in hands and foots	2	1
•I lost my concentration	2	1	•I have a spine ache	2	1
•I feel fear	2	1	•I have a muscle ache	2	1
			•I feel tired or worn out	2	1
Total scores: Min: 7 Max: 14			**Total scores: Min: 8 Max: 16**		

Fig. 2. Diagrammatic representation of scoring procedure for an aging male's complaints [Kaczmarek and Skrzypczak 2002]

situated on the X-axis and the z-scores for those indicators, on the Y-axis.

The physiologic reserve index (PR index) was used to express the biological status of the aging male. It was calculated as the sum of the test scores expressed in z-scores, each coming from the median and the interquartile range Q_1–Q_3 [GOFFAUX *et al*. 2005]. Values of the PR index below zero indicated biologically younger status whereas those equal to or above zero indicated biologically older status. Odds ratios of being biologically older for particular socio-economic and lifestyle factors were then assessed using logistic regression models (Logit).

The studied men were divided in two groups, one including men younger than 50 years of age and the other including men equal to or older than 50 years of age. The percentage distribution of men to the given age groups was 42%, and 58%, respectively.

Computations were performed using the package of statistical programmes Statistica, StatSoft, Inc. (2005). STATISTICA (data analysis software system), version 7.1. Statistical decisions were taken with a 5% error probability.

Results

Selected socio-economic and lifestyle characteristics for the two studied groups of men are presented in Table 1. The percentage distribution of men by marital status revealed that 85.8% of men were living with a partner (in marriage or informal relationship) and 14.2% were single (bachelors, widowers or divorced). The number of widowers significantly were increased in the older group of men making up 7.8% of this sample compared with 1% in the younger group of men. This confirms the cohort effect. The number of bachelors and divorced men remained similar in both groups at around 8% of the entire sample.

The great majority of studied men came from urban areas (80.6%) and were physically non-active (84%). Those having an academic level of education consisted of 22.7% of the total sample.

The cohort effect was also found with the smoking habit with significantly larger number of currently smoking men in the group aged below 50 years (44% vs 33%).

Values of the z-score for 11 indicators of the BA in the two groups of men are shown in Figure 3. Results of the Kruskal-Wallis test revealed significant differences in all but the LDL, triglicerydes and quality of life indicators for the BA between the study cohorts of men. Overall, chronologically younger men were likely to be biologically younger than their chronologically older peers ($p<0.05$).

The results of univariate analyses using the Mann-Whitney U test are shown in Table 2. The findings revealed that values of systolic and diastolic blood pressure, BMI, indicators of male's physical and emotional aging and perceived satisfaction with life were significantly associated with most of the study factors, except for smoking and educational level. The bivariate relations were likely to be stronger within the group of younger men compared to their older peers.

Figure 4 presents a set of average biological age profiles plotted for socio-economic and lifestyle factors in two chronological groups of men. The findings showed that married/partnered men were likely to be biologically younger than their single peers in relation to

Table 1. Selected characteristics of the sample for two chronological age groups (percentages)

Characteristic	Age group (in years) <50	≥50
Marital status		
Married/ Informal Relationship	90.3	84.2
Divorced/Separated	3.1	3.7
Never Married	5.6	4.2
Widowed	1.0	7.8
	χ^2 =62.6	p<0.01
	Spearman R=0.1	p<0.01
Educational level		
Primary	4.8	10.1
Vocational	35.8	33.0
Secondary	37.6	33.4
Academic	21.8	23.5
	χ^2 =27.5	p<0.01
	Spearman R=-0.3	p=0.17
Residence		
Village	22.0	17.9
Small city	31.0	26.5
Medium city	15.4	14.3
Large city	31.6	41.3
	χ^2 =25.0	p<0.01
	Spearman R=0.09	p<0.01
Financial condition		
Poor	47.4	39.6
Good	52.6	60.4
	χ^2 =14.6	p<0.01
	Spearman R=0.08	p<0.01
Physical Activity		
Non-Active	81.9	84.1
Active>4h weekly	18.1	15.9
	χ^2 =2.25	p=0.13
	Spearman R=-0.03	p=0.13
Smoking		
Current smoker ≥10 cigarettes/daily	27.8	18.2
<10 cigarettes/daily	17.1	15.0
Past smoker	24.9	33.6
Never smoked	30.2	33.2
	χ^2 =42.6	p<0.01
	Spearman R=0.10	p<0.01

emotional well-being (ESAM and QoL). Physiological indicators of BA revealed that single men were likely to be biologically younger than their married/partnered counterparts in the group of men younger than 50 years of age. In the group of men aged 50 years and older, single men were likely to be biologically older than their married/partnered counterparts (Fig. 4A). Profiles of BA shown in Fig. 4B revealed that men with higher education level were likely to be biologically younger than their peers having low educational attainment. Men from rural/ small city areas were likely to be biologically younger in terms of physiological

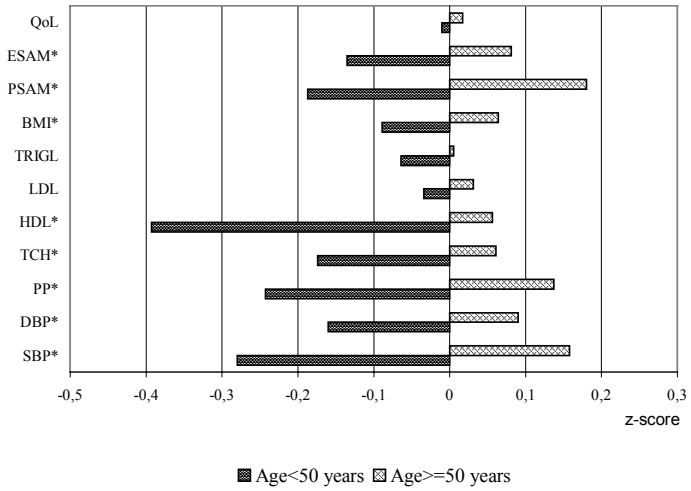


Fig. 3. Z-scores for biological age indicators significantly differentiated by chronological age (results of the Kruskal-Wallis test, * $p<0.05$)

Table 2. Results of the Mann-Whitney U test for indicators of biological age (BA) significantly associated with socio-economic and lifestyle factors in two chronological age groups.

BA Indicator	Age group (in years)							
	<50		≥50		<50		≥50	
	Z	*p*	*Z*	*p*	*Z*	*p*	*Z*	*p*
	Marital status				Education level			
SBP	-2.2	0.028						
PP			-2.7	0.007				
BMI	-2.6	0.009	3.2	0.001				
PSAM			-2.6	0.010				
ESAM	2.9	0.004	-4.5	0.001				
QoL	3.8	0.000	-5.8	0.001	6.6	0.001	3.5	0.001
	Residence				Financial condition			
TCH			-3.8	0.001				
BMI	3.3	0.001	2.1	0.032				
LDL	-2.1	0.032						
PSAM	-2.6	0.009	-2.6	0.006			-2.9	0.004
ESAM	-2.9	0.004	-2.8	0.006	3.4	0.000	-2.2	0.026
QoL			3.7	0.001	11.0	0.000	-11.2	0.001
	Smoking habits				Physical activity			
SBP					3.0	0.023		
DBP					2.8	0.005		
PP					2.0	0.039		
HDL					2.6	0.009		
BMI					5.2	0.001	2.3	0.023
PSAM	2.1	0.036			2.9	0.003	2.2	0.025
ESAM	2.9	0.003	-2.6	0.011	2.4	0.015	2.1	0.033
QoL	2.9	0.001	-2.2	0.026	5.8	0.000	5.1	0.001

Figure 4A – Marital Status

< 50 years ≥ 50 years

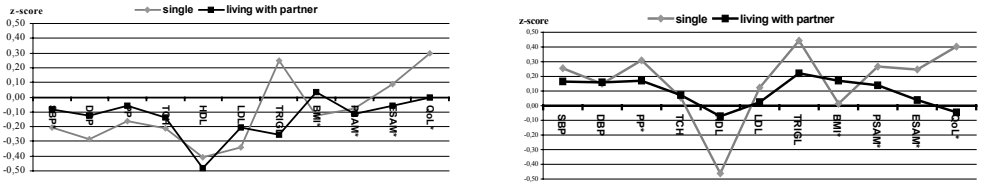


Figure 4B – Education Level

< 50 years ≥ 50 years

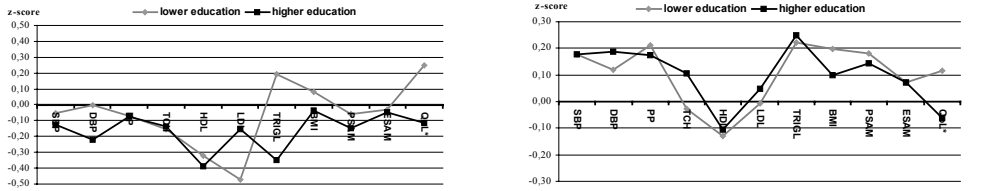


Figure 4C – Place of Residence

< 50 years ≥ 50 years

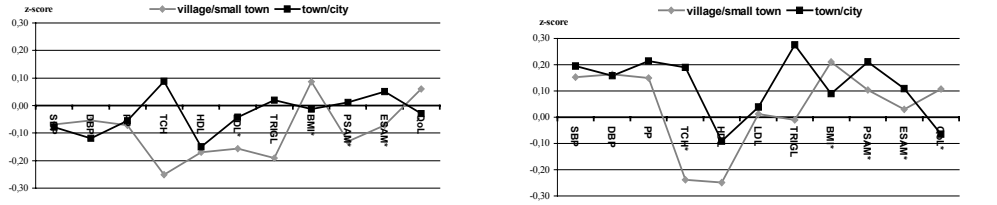


Figure 4D – Financial Situation

< 50 years ≥ 50 years

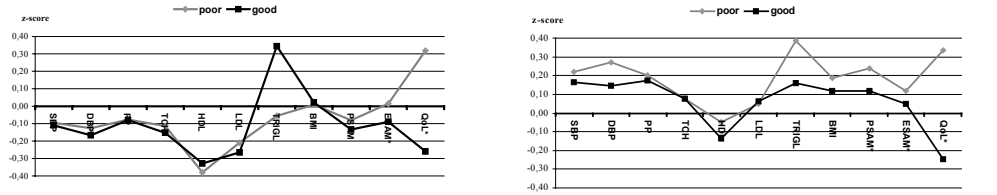


Figure 4E – Physical Activity

< 50 years ≥ 50 years

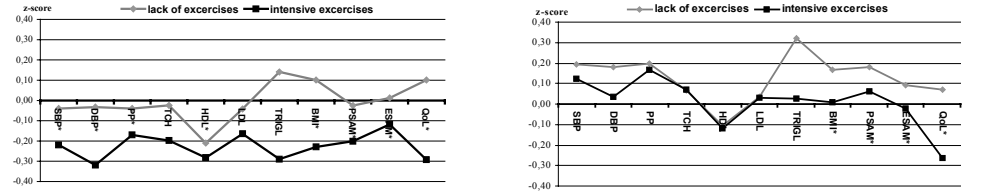
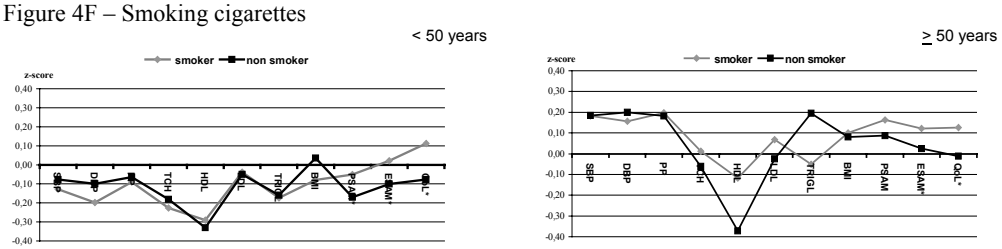


Fig. 4. Median biological age profiles for several SES-based subgroups of participants (significant values of Mann-Whitney U test indicated by asterisks); (A)-marital status; (B)-education level; (C)-place of residence; (D)-financial situation; (E)-physical activity; (F)-smoking habits

Figure 4F – Smoking cigarettes



traits than their counterparts from large cities, while they were older in terms of subjective well-being (Fig. 4C). It was also found that men from better-off life conditions were likely to be biologically younger than their poorer counterparts (Fig. 4D). Physically active men were likely to be biologically younger than their non-active peers (Fig. 4E). Smoking did not differentiate physiological traits in either studied cohort of men. But currently smoking men were likely to be biologically older than their never-smoked peers when quality of life and indicators of emotional aging were considered (Fig. 4F). The abovementioned relations were true for both studied groups of men.

The distribution of physiologic reserve index scores [(Me=0; $\overline{X}$=0.29; Q_1–Q_3 (-1.3–1.6); min-max (-11.5–13.8)] showed significant abnormality (Kolmogorov-Smirnov D=0.07 p<0.01), with skewing towards older biological age (skew=0.74). Therefore, the median values and interquartile range were used for further computations instead of arithmetic means. Of all factors included in Logit analyses, physical activity and financial situation were significantly associated with biological age estimation based on PR index (Table 3). The findings showed that physical activity significantly decreased the probability of being biologically older with OR=0.4 in the group of men aged under 50 years and OR=0.7 in men aged 50 years and above. In both groups of men, the better financial situation increased the probability of being biologically younger by~60% compared to those living under poor financial conditions (OR=0.6, and OR=0.7).

Table 3. Socio-economic and lifestyle variables significantly associated with the physiological reserve index in two age groups – results of Logit regression (OR – odds ratio, +95% CI- confidence interval)

Variables	β	SE	Wald chi^2	p	OR (±95% CI)
	Age <50 years	χ^2=44.1	p<0.01		
Constant value	2.6	0.7	15.2	0.001	13.9 (3.7 – 52.5)
Physical activity	-0.9	0.2	14.8	0.001	0.4 (0.3 – 0.6)
Financial situation	-0.6	0.2	13.3	0.001	0.6 (0.4 – 0.8)
	Age ≥ 50 years	χ^2=19.9	p<0.01		
Constant value	1.8	0.5	12.1	0.001	6.1 (2.2 – 16.9)
Physical activity	-0.4	0.2	4.9	0.027	0.7 (0.4 – 0.9)
Financial situation	-0.4	0.1	8.0	0.005	0.7 (0.5 – 0.9)

Discussion

Socio-economic and lifestyle characteristics of the sample were compared with data for the entire population of Polish males [*Report of National Census* 2002, *Report of CBOS* 2006, WHO 2003*a*]. Results of this comparison confirmed that the sample under study might be representative for Polish males.

Concerning marital status, the sample reflects the general structure of marital status in Poland with evidence for the cohort effect. This is not true for educational level. The structure of education for the sample and the entire Polish population differed significantly ($p<0.05$) on account of the larger number of well educated men in the sample. Indeed, the majority of study participants came from urban communities, were better educated than their rural counterparts, and more willing to participate in the study and comprehend its importance. The urbanization gradient of education, mirrored in the sample, is a well documented phenomenon in Poland.

A sedentary or physically inactive lifestyle is very common among Polish men. Almost 33% of Polish men, aged 30-45 are estimated to spend time mainly in the sitting position and exercising only occasionally if ever. The prevalence of physically inactive men in the older age group increases to 37% in the 45-59 and 60-74 ranges, and to about 46% in the group of men aged over 75. About 84% of all studied men reported inactive forms of leisure time, mainly in the sitting position, watching TV or reading.

Prevalence of smoking cigarettes was similar for the sample and the entire Polish population. Non-smokers were mostly represented by well educated, financially better-off residents of large cities.

The main purpose of this study was to solve the question as to whether men coming from lower social strata are subject to more rapid biological aging than their chronological peers living in privileged social and economic conditions.

A number of definitions describe biological aging. It has been defined as 'the progressive loss of function accompanied by decreasing fertility and increasing mortality [that occurs] with advancing age' [KIRKWOOD and AUSTAD 2000]. It is universal and progressive and represents the steady decrease in physiological ability to meet demands that occurs with increasing chronological age [BOND *et al*. 1993].

Biological aging includes all time dependent changes in structure and function of the organism that eventually contribute to diminished efficiency and increased vulnerability to disease and death. The meaning of biological aging is therefore often explained as "a quantity expressing the 'true global state' of the aging organism better than the corresponding

chronological age" or as "age corresponding better to 'true life expectancy' of the individual than his or her chronological age" [KLEMERA and DOUBAL 2006: 240].

ADAMS and WHITE [2004] regard biological aging as the progressive decline in physiological ability to meet demands that occurs over time. They claim that organism ages due to the accumulation of damage at the cellular level and the rate of this process is determined by both environmental and genetic factors.

CRAWFORD [2005], after reviewing definitions of biological aging, summa-

rized: "(1) aging is part of the life cycle, but is associated with post-developmental features, (2) there is physiological deterioration, and (3) an increased probability of death". His own definition considered biological aging as the "sum total of physiological, morphological, and behavioural characteristics observed after the age of reproduction and correlated with increases in chronological age" [CRAWFORD 2005: 4].

Much of the controversy regarding the assessment of differential rate of biological aging stems from a common problem with either the univariate or the multivariate approach for computing the outcome biological age. UTTLEY and CRAWFORD [1994] claim that two approaches referred to above "provide measures of age status relative to one's chronological peers". However, the methods are quite different. The advantages of the multivariate analyses are that only with this approach might the interactions within a group of independent variables be considered, whereas the univariate approach might lead to overestimating the importance of either component of the entire battery of tests. Although different, these methods provide similar results as was shown in Uttley's 1991 study on variables related to survival [cited after UTTLEY and CRAWFORD 1994]. Moreover, interactions among independent variables can complicate the interpretation of results. Therefore, in this study the battery of 11 tests, including physiological, functional and psychological measures, was transformed into biological age scores reflecting the individual's rate of aging. Median biological age profiles were plotted for several subgroups of participants based on socio-economic and lifestyle variables. These profiles were compared using the univariate approach. The overall measure of biological age, expressed in terms of physiologic reserve index, was then included in Logit model. Odds ratios were estimated for being biologically older compared to chronological age peers.

A number of studies have shown that socio-economic factor is significantly associated with biological status in respect of physiological, psychological and functional characteristics of adult individuals [RAUTIO *et al*. 2001, SZKLARSKA and ROGUCKA 2001, ADAMS and WHITE 2004]. It is claimed that poor people usually age more quickly than rich people due to the unhealthy environments to which they are exposed. They usually lack the internal and external resources needed to prevent the transformation of impairments and functional limitations into disability [SHUMWAY-COOK *et al*. 2002, HEIKKINEN 2006]. In contrast, the permissive social background is claimed to warrant easier access to resources, health and medical care. Positive lifestyle behaviors are considered to favour "good old age" [UTTLEY and CRAWFORD 1994].

People from the higher socio-economic class are likely to be biologically younger than their chronological age peers from the lower status group [KARASIK *et al*. 2004].

The statistical analyses showed that all studied variables, except for LDL, TRIGL and QoL, revealed a clear progressive decline with age, indicating that older biological age was associated with older chronological age. Involution changes in the androgenic activity of the male body usually occur gradually and display large intra- and interindividual variation. They may on average be pro-

nounced at 50 years of age and older [ŻIVIĆNJAK *et al*. 1997; BRIBIESCAS 2001, 2005; BATES *et al*. 2005; KACZMAREK *et al*. 2005]. For example, the same biological status of "younger" and "older" men in terms of LDL and triglicerydes could be the result of andropausal changes as well as socio-economic conditions.

Several epidemiological studies have shown evidence for the association of low social class or low education level with increased morbidity and mortality [CHEN *et al*. 1999, WELON *et al*. 1999, NILSSON *et al*. 2003], but the significance of this relationship decreases with chronological age above 50 years. The same tendency was found in the present work. In the group of men aged below 50, the biological age calculated for physical, physiological and psychological traits, was significantly associated with socio-economic and lifestyle variables such as marital status, education, residence, financial situation, physical activity, and smoking. In the group of men aged 50 and above, the social and lifestyle factors were differently associated with markers of biological aging, particularly with psychological well-being (ESAM, QoL).

Of all the variables, education level, marital status, and physical activity revealed greatest influence on the biological status of aging men. This finding corresponds well with BORKAN and NORRIS [1980*b*], KARASIK *et al.* [2004], FACCHINI *et al.* [1992]. However, it should be noted that the present study did not show unequivocally the significance of educational level for biological aging. The subgroup of men with higher education level was likely to be biologically younger than their poorly educated counterparts with regard to quality of life. This result could be explained by the lack of difference in healthy lifestyle between Poles of different education level, as presented in the introduction to this study. In spite of the highly stressful situation of highly educated Polish men at productive age, they are biologically younger in the emotional sphere. This may be accounted for by social support, membership in various types of groups or associations, and a cooperative network of social relationships. As emphasized by DERGANCE *et al.* [2003], cultural factors, such as beliefs, motivations, and availability of services influence individual behavior. Furthermore, the results of the present study show, that it is not better education, but better financial situation, that is likely to give better possibilities for a healthy lifestyle and a younger biological age. Financial income appeared to be the second most predictive factor for the physiologic reserve index of complex biological age. As RAUTIO *et al.* [2001] emphasized, "in persons over 65, higher incomes are associated with better physical and cognitive capacity".

A comparative analysis of the marital status subgroups provided interesting results, being similar for both age groups: single men were biologically younger considering their physiological status and biologically older as regards their emotional well-being. This finding corresponds well with many other studies. BEN-SHLOMO *et al.* [1993] and GLIKSMAN *et al.* [1995] found that married/partnered men were more advanced in decline in such parameters as BMI, blood pressure, and lipid levels than their single counterparts. Both, thisstudy and the abovementioned, found marriage likely to be protective for men's psychological well-being. It should be added,

however, that the significance of marital status and its protective function for aging men remains inconclusive.

Place of residence was another social variable prominently associated with biological age in both studied groups of men. Men living in urban areas were likely to be biologically younger than their rural counterparts, however this was true only for BMI and quality of life scores. Some other physiological traits put urban men among the biologically older compared to the rural counterparts. This finding is in good agreement with results obtained by FACCHINI *et al.* [1989].

Concerning cigarette smoking it should be noted that over the past 20 years Poland has been the country with the highest cigarette consumption in the world. About 70% of Polish men have smoked for more than 10 years and about 40% smoke more than 20 cigarettes a day [BALCZEWSKA 2004]. The risk of death caused by smoking constitutes of 18-19% of all death causes [WHO 2003*a*]. Fortunately, in the 2000s the prevalence of smoking among men was "only" 40% (as compared with 64% in the 1970s) [WHO 2003*b*]. The finding of this study, showing lower figures of physiological traits indicative of younger biological age and higher figures for psychological traits indicative of older biological age, compared to chronological age peers, may be explained by the specific situation for Polish men, who have difficulty with employment and financial standing – and for whom smoking of cigarettes might be considered a form of stress reaction/realese.

The physical activity of the men studied didn't change across age groups, with only about 17% of men in each age group exercising at least 4 hours per week. Comparing this finding with data collected in other countries (in the USA only 12% of adults aged 75 reported moderate physical activity: in the Nordic community about 25% are physically active [HEIKKINEN 2006]), the physical activity of Polish males does not appear too bad.

Logistic regression models of the physiological reserve index revealed that of all the studied socio-economic and lifestyle factors, physical activity had the greatest influence on biological age in the group of men aged below 50. It is generally assumed that physical activity is one of the most effective ways for older people to reduce the risk of mortality, hospitalization, incidence of various diseases, particularly cardiovascular and metabolic, and to increase functional capacity and quality of life [LAWLOR *et al.* 2003, CRESS *et al.* 2006, HEIKKINEN 2006].

In conclusion it might be said that biological status of Polish adult males is associated with financial life conditions and lifestyle behaviours, with physical activity topping the list. The adverse effects of low socio-economic status manifest in faster aging.

The study confirmed the leading role of socio-economic and lifestyle factors in the biological status of aging males and the need for study of the conditions under which successful aging may occur.

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Streszczenie

Celem pracy była ocena wybranych czynników społeczno-ekonomicznych oraz elementów stylu życia wywierających wpływ na stan biologiczny mężczyzn. Badaną grupę stanowiło 2509 mężczyzn w wieku od 30 do 90 lat, pochodzących z różnych warstw społeczno-ekonomicznych. Badania, przeprowadzone w latach 2000-2002 na terenie Poznania oraz zachodniej Polski, miały charakter przekrojowy. Stan biologiczny określano posługując się koncepcją wieku biologicznego zaproponowaną przez BORKANA i NORRISA [1980*a*] oraz metodą wyznaczania wskaźnika rezerwy fizjologicznej (PR) opracowaną przez GOFFAUX *et al*. [2005] (ryc. 1). Wiek biologiczny określano na podstawie 11 biomarkerów obejmujących pomiary antropometryczne, charakterystyki układu krążenia i biochemiczne, jakość życia oraz emocjonalne i fizyczne objawy towarzyszące starzeniu się mężczyzn (ryc. 2). Posługując się formułą [(wartość obserwowana – mediana)/odległość kwartylowa], uzyskiwano wartości *z*, które przypisywano do kategorii wieku biologicznego: młodszy (ujemne wartości) i starszy (dodatnie wartości) od przeciętnego. Następnie wykreślano profile wieku biologicznego, odrębnie w grupie mężczyzn

młodszych (mniej niż 50 lat) oraz starszych (50 lat i więcej), kategoryzowanych w zależności od czynników społeczno-ekonomicznych oraz określających styl życia. Wartość wskaźnika PR uzyskano sumując wszystkie wartości *z* dla każdego osobnika.

Charakterystykę próby przedstawiono w tabeli 1. Wykazano, że mężczyźni chronologicznie młodsi byli również biologicznie młodsi w porównaniu z mężczyznami chronologicznie starszymi (ryc. 3). Stwierdzono, że w obu grupach wieku parametrami najczęściej istotnie różniącymi się pomiędzy grupami o odmiennym statusie społecznym oraz stylu życia były parametry określające ciśnienie krwi, BMI, fizyczne i emocjonalne objawy towarzyszące starzeniu się oraz jakość życia. Poziom wykształcenia oraz palenie papierosów najsłabiej różnicowały wiek biologiczny mężczyzn w obu grupach wieku (tab. 2). Na ryc. 4 przedstawiono profile wieku biologicznego wyznaczone dla mężczyzn kategoryzowanych w zależności od stanu cywilnego, poziomu wykształcenia, miejsca zamieszkania, sytuacji finansowej, aktywności fizycznej oraz palenia papierosów. Analiza regresji logistycznej wykazała, że sytuacja finansowa oraz aktywność fizyczna, były istotnie powiązane z wskaźnikiem rezerwy fizjologicznej PR, kompleksowo oceniającym wiek biologiczny badanych mężczyzn (tab. 3). Wyniki uzyskane w pracy potwierdzają wpływ czynników społeczno-ekonomicznych oraz stylu życia na zróżnicowanie stanu biologicznego oraz wskaźników starzenia się mężczyzn.