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Fitness Level of Adult Economically Active Population in the Republic of Croatia Estimated by EUROFIT System

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A B S T R A C T

The study presents the results of the EUROFIT CROATIA project that was conducted according to the instructions of Council of Europe. The aim of the study was evaluation of fitness level of the employed Croatian population. The measurements comprised EUROFIT battery of tests as well as Baecke's questionnaire for evaluation of habitual physical activity. The sample was comprised of 1628 active inhabitants, 18–60 years of age, all of who were employed and living in Croatia. The obtained results of functional, motor and morphological characteristics were presented according to the sex and age. The results shower poor aerobic capacity, high obesity indicators and low motor performance in both sexes, which pointed to the increased risk for developing many cardiovascular or musculo-skeletal diseases. The overall fitness level of Croatian population showed to be unsatisfactory and it should be improved by engagement in sports-recreational activities.

Key words: *Croatia, Eurofit, physical fitness, aerobic capacity*

Introduction

Scientific research in the field of recreational sport and active leisure time, and especially the research into the interrelationship between leisure-time sport and health, has a long and abundant past in Croatia.

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EUROFIT for Adults is based on the same scientific logic and principles that have been known to us much earlier. However, since the world today connects and accepts the appropriate common norms, the EUROFIT system was accepted by numerous European countries as a uniform procedure for the assessment of the health-related, functional and motor status of adults. It is directed to epidemiological research studies to be carried out on their populations and for the purpose of engaging the citizens in the programs of leisure-time sport. Therefore, it stands to reason that we may hope that this survey of population research into physical activity and the established norms will find in Croatia a wide public among people employed in health care services and recreational-sport agencies who will read this survey and apply its results. Likewise, we hope that this survey will be an encouragement for the engagement of these experts in fostering, organizing and implementing physical activity programs as an irreplaceable way of health preservation and improvement. Such engagement will definitely contribute to the affiliation of the Republic of Croatia to the European integration processes.

EUROFIT Croatia is a part of the European projects of the Council of Europe, whose goal is to identify national indicators of physical activity, the level of functional-motor (psycho-physical) abilities connected with health (health-related fitness). The first population research study of this type in Croatia, and the fourth research study of this type in Europe (after United Kingdom, Sweden and the Czech Republic), is aimed at helping the government and the non-government institutions to identify the issue. This study presents the starting point for further planning and programming the corresponding public-health-related and leisure-time-sport activities. As physical fitness is often related to slowing the ageing process and lowering the risks of many illnesses[1–4], we hope that the results of the study would contribute to the higher number of physically active Croatian citizens in the future.

Subjects and Methods

The total sample was comprised of 1,628 examinees. The population from which the sample for this research study had been extracted was defined as the economically active (employed) population 18 to 60 years of age from the northern, middle and eastern areas of Croatia. The subjects were sampled by general practitioners that were asked to send a letter of invitation to every registered employed patient between the ages 20 to 65. The letter comprised short description of the procedures and the time and the date of testing. The patients usually choose their general practitioner according to the vicinity of the practice to their home or place of work, which gave us the sample that was representative for the population. The subjects came from different educational backgrounds and were both smokers and non-smokers. One fifth (21%) of all contacted subjects showed up for testing, which was scheduled in the morning hours. Most of the invited subjects, who did not come, excused themselves by the previously scheduled obligations or current health problems. The measurements were conducted in 1997, 1998 and 1999.

The sample was comprised of examinees of different education levels, ranging from elementary school level to those who were highly educated. The precondition for the engagement in the testing program was a medical screening examination. Those who had any counter-indications for testing, that is, who had any acute disease that could at that moment be regarded as a risk for their health or

that would affect the testing results, were excluded from further research. The examinees suffering from any chronic disease that at that moment did not affect the efficiency with which they realized their jobs were included in the sample, because they also constitute a part of active population. The measurements were carried out in Zagreb, Middle and North Croatia and in Slavonia. Table 1 displays the number of examinees according to the geographical regions in which measurements were performed. Mean age of the male subjects was 39.27± 9.35 years, and the mean age of the female subjects was 39.75± 8.58 years.

TABLE 1
NUMBER OF EXAMINEES ACCORDING TO GEOGRAPHICAL REGION AND THE YEAR OF MEASUREMENT (TOTAL SAMPLE: 1628, 859 MALES AND 769 FEMALES)

Region	Year	N
Zagreb and surr.	1997	694
Varaždin and surr.	1998	153
West Slavonija	1998	183
Đurđevac and surr.	1998	162
Daruvar and surr.	1998	140
Kutina and surr.	1999	113
Osijek and surr.	1999	183

To be able to interpret the obtained results more easily, the questionnaire regarding physical activity was applied[5]. The Baecke's questionnaire was used because in previous studies[6–8] it showed high correlation with overall energy expenditure. Total sample was divided into four age groups (Table 2).

The variables were selected within the battery of tests 'EUROFIT' so that the research results could later be compared with the results of other research studies carried out in Europe[9]. All variables are strictly defined and were not influenced by the authors of this paper. The measuring instruments were either the same as or similar to, but of the same metric characteristics, those prescribed and described in the instructions for the realization of EUROFIT testing. In order for the tests to be correctly realized special attention was paid to the selection and training of people who carried out the measurements. The same was paid to a proper organization and distribution of tests, to maintenance and calibration of equipment, to accurate recording of data and to the environment in which a test was carried out (temperature between 15–25 °C, ideally 18 °C). Three medical doctors, five Kinesiology students and a laboratory technician performed the measurements. All of them participated in the educational course and performed a pilot-study, so they were enabled to conduct the EUROFIT battery of tests. Each test was always conducted by the same measurer. On the basis of the accepted hypotheses about the interrelationship between physical activity and health four basic sets of tests were established:

TABLE 2
NUMBER OF SUBJECTS ACCORDING TO AGE AND GENDER

Age group	Men	Women
<35	177	188
35–44	228	267
45–54	220	206
>55	143	118

1. morphological characteristics: Body Mass Index (BMI), Waist-to-Hip Ratio (WHR), body fat percentage;
2. musculoskeletal characteristics: sit-ups, vertical jump, flexibility, grip strength;
3. motor characteristics: one-foot balance, hand tapping;
4. aerobic (functional) characteristics: VO_2max.

The data were processed in program Statistic for Windows 6.0 licensed to the Faculty of Kinesiology. Descriptive statistics was used for describing the characteristics of the whole sample and the subgroups, as well as the mean values for each test. The norms were generated with aim to diagnostic motor performance, aerobic capacity and obesity indicators. We used the »classical« approach, based on the normality principle for tests that showed normal distribution, which included five categories of the assessment. The assessment of the achievement in each test was based on deviation from the mean values of the group (arithmetic mean lying on the 50th percentile, P_{50}) and characterized as significantly below average ($P_{0–10}$), below average ($P_{11–30}$), average ($P_{31–70}$), above average ($P_{71–90}$), and significantly above average ($P_{90–100}$). In tests, which did not show normal distribution, like balance and sit-ups, the derivation of the norms was determined by the empirical curves of cumulative frequencies, which enabled the conversion of the row scores into percentiles.

Results

The questionnaire that was filled out by the examinees provided us with an insight into the physical activity participation of the examined population. Out of the total sample of examinees 75% did not participate in any physical activity during leisure time whatsoever, not even long walks. The percentages of physically active examinees are displayed in Table 3.

The descriptive statistics was used in order to obtain the average values for all tested variables according to age and sex of the testing (Table 4a, 4b).

Normative values based on five categories were generated. These data are presented in Appendix and they represent the normative values for abilities and characteristics tested by EUROFIT system for the economically active population in the Republic of Croatia.

Discussion

Prior to the beginning of the study, and knowing the eating habits of Croatian rural population we expected higher average values of obesity indicators like BMI and WHR in all age groups, especially in women. Noticeable difference was found between men and women, pointing to the fact that men were slightly overweight even in the youngest age group while the women start to be slightly overweight around the age of forty. More alarming than the BMI values, were the high values of WHR in men even in younger age groups. It implied very large abdominal circumferences and consequen-

TABLE 3
NUMBER OF HOURS SPENT IN SPORTS AND RECREATIONAL ACTIVITIES PER WEEK ACCORDING TO GENDER

	Total sample (%)	Women (%)	Men (%)
Do not practice any sport or recreational activity	75	81	68
1–2 hours per week	8	5	10
2–3 hours per week	8	8	9
3–4 hours per week	4	3	5
> 4 hours per week	5	3	8
Total	100	100	100

TABLE 4a
MEN – MEANS AND STANDARD DEVIATIONS FOR EACH VARIABLE ACCORDING TO AGE

Age (yrs)	< 35	35–44	45–54	≥55
Fat tissue (%)	21.68 ± 6.24	22.91 ± 5.65	23.12 ± 5.59	22.71 ± 4.99
Body mass index (kg/m^2)	25.81 ± 3.45	27.40 ± 3.65	27.75 ± 3.57	28.59 ± 3.41
Waist-to-hip ratio	0.87 ± 0.06	0.91 ± 0.06	0.94 ± 0.07	0. 95 ± 0.07
Grip strength (kp)	59.03 ± 8.15	58.88 ± 8.74	54.37 ± 9.04	48.25 ± 9.50
Vertical jump (cm)	48.56 ± 8.46	44.40 ± 9.08	38.63 ± 9.32	33.81 ± 12.53
Sit & reach (cm)	5.68 ± 7.81	3.14 ± 9.22	0.36 ± 8.22	– 4.80 ± 10.51
Balance (n)	4.96 ± 8.59	6.58 ± 9.66	8.71 ± 10.58	10.00 ± 11.52
Sit ups (n)	14.67 ± 1.73	13.84 ± 3.24	11.73 ± 5.23	9.27 ± 6.44
Tapping (n)	31.51 ± 5.30	29.96 ± 5.99	27.73 ± 5.93	26.02 ± 8.05
VO_2max (ml/kg/min)	34.00 ± 7.31	27.01 ± 5.99	25.87± 6.66	24.48 ± 5.20

TABLE 4b
WOMEN – MEANS AND STANDARD DEVIATIONS FOR EACH VARIABLE ACCORDING TO AGE

Age (yrs)	< 35	35–44	45–54	≥55
Fat tissue (%)	21.03 ± 6.30	25.00 ± 6.36	26.98 ± 5.89	27.01 ± 6.38
Body mass index (kg/m^2)	23.55 ± 4.22	25.98 ± 4.85	26.99 ± 3.99	26.49 ± 3.54
Waist-to-hip ratio	0.76 ± 0.05	0.78 ± 0.07	0.81 ± 0.07	0.81 ± 0.07
Grip strength (kp)	37.98 ± 4.96	37.05 ± 5.80	34.46 ± 5.74	33.01 ± 9.50
Vertical jump (cm)	34.35 ± 7.82	32.08 ± 8.14	29.75 ± 8.92	28.45 ± 14.70
Sit & reach (cm)	8.68 ± 7.03	7.14 ± 7.88	5.21 ± 9.20	4.57 ± 6.57
Balance (n)	5.85 ± 8.98	6.15 ± 8.55	9.18 ± 10.70	8.11 ± 10.30
Sit ups (n)	13.86 ± 3.02	12.25 ± 4.71	10.42 ± 5.54	10.35 ± 6.78
Tapping (n)	27.26 ± 4.36	26.16 ± 4.99	24.066 ± 4.89	23.27 ± 7.43
VO_2max (ml/kg/min)	30.89 ± 6.56	26.19 ± 6.03	23.73 ± 5.81	21.85 ± 3.57

tly much higher risks for development of cardiovascular diseases[10–11], as well as diabetes mellitus[12]. In women, average values of WHR indices did not cross the 0.85 cut-off value in none of the age groups. It might be contributed to the prevalence of »southern« type of women in Croatian population, meaning more peripheral distribution of fat tissue.

The strength and explosive power (grip strength and vertical jump) declined with age, which was expected and coherent with previous findings, even though the grip strength values were somewhat higher when compared to UK and Swedish population[13–15]. That was probably due to the more manual work performed at job and at home[16]. We must stress the fact that vertical jump test was performed strictly according to the Eurofit battery instructions, so the results could not be compared to the results obtained during different vertical jump performances.

The results of the flexibility testing, performed at »Sit & Reach« bench showed poor performance in the oldest male group

which reported a lot of chronic lower back problems. As in recently published work, Katzmarzyk et al.[17] did not find any relation between flexibility and mortality the obtained values in other groups might be considered satisfactory. On the contrary, it was very disappointing that many subjects in both genders and in all age groups did not succeed to perform the sit up task as described in Eurofit system. As abdominal strength correlates strongly with high mortality risk, these results were disturbing.

Balance test results as well as tapping test results did not demonstrate any specificity. Unfortunately the data describing alcohol intake were not collected, which might be interesting in relation to the balance performance, especially in older male groups[18,19].

The maximal oxygen uptake declined with age as found in Toth study[20]. The overall aerobic capacity of Croatian population was very low in both genders and all age groups, which was understandable if we consider the physical activity data[21]. Aerobic capacity represented by maximal oxygen uptake can be improved only through participation in aerobic activity of adequate volume, duration and intensity, which was not a case in most of the subjects.

Conclusion

The EUROFIT battery of test is easily applied and the instruction provided by the Council of Europe were found to be extremely useful. The results obtained on Croatian population point to the fact that fitness level of economically active population is unsatisfactory. The fitness level of Croatian population is much lower than expected, especially concerning aerobic capacities. There is an obvious need for engagement of adult population into sports-recreational programs but the motivation programs should be established on higher levels, meaning Ministry of Health and Schools of Public Health. According to the present socio-economic situation, those programs should be co-financed by the state because current available programs (fitness centers and health clubs) are not reachable to everybody because of the prices and locations that are mainly in the larger cities.

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RAZINA FUNKCIONALNO-MOTORIČKIH I MORFOLOŠKIH SPOSOBNOSTI ZAPOSLENE HRVATSKE POPULACIJE MJERENA EUROFIT BATERIJOM TESTOVA

S A Ž E T A K

Istraživanje predstavlja rezultate projekta EUROFIT CROATIA koji je proveden prema uputama Vijeća Europe. Svrha rada bilo je utvrđivanje morfoloških i funkcionalno-motoričkih sposobnosti hrvatske populacije. Ispitanici su mjereni EUROFIT baterijom testova uz koju je primijenjen i Baecke-ov upitnik za utvrđivanje habitualne tjelesne aktivnosti. Uzorak je sačinjavala zaposlena hrvatska populacija u dobi od 18–60 godina života. U prikazu rezultata uzorak je podijeljen prema spolu i prema dobi. Rezultati su prikazani kao prosječne vrijednosti i kao normativne vrijednosti za hrvatsku populaciju. Uvidom u rezultate može se zaključiti da je hrvatska populacija povišenih pokazatelja pretilosti, loših aerobnih i motoričkih sposobnosti što predstavlja povećani rizik za razvoj bolesti lokomotornog i kardiovaskularnog sustava. Opća tjelesna pripremljenost hrvatske populacije nije zadovoljavajuća i neophodno je promocijom uključiti što veći broj građana u sportsko-rekreativne program kako bi se rizik od bolesti smanjio.

Appendix

Normative values for the economically active Croatian population (EUROFIT battery of tests)

TABLE A
PERCENTAGE OF FAT TISSUE DETERMINED FROM THREE SKINFOLDS

	Women				Men			
Age	< 35	35–44	45–54	≥ 55	< 35	35–44	45–54	≥ 55
Very low ($P_{0–10}$)	<14	<16	<17	<19	< 11	<13	<15	<15
Below average ($P_{11–30}$)	14–19	16– 23	17–23	19–24	11–17	13–18	15–19	15–19
Average ($P_{31–70}$)	20–24	23–28	24–30	25–30	18–23	19–24	20–25	20–25
Above average ($P_{71–90}$)	25–30	29–33	31–36	31–37	24–27	25–28	26–29	26–30
Much above average ($P_{90–100}$)	>30	>33	>36	>37	>27	>28	> 29	>30

TABLE B
BODY MASS INDEX (KG/M^2)

	Women				Men			
Age	< 35	35–44	45–54	≥ 55	< 35	35–44	45–54	≥ 55
Very low ($P_{0–10}$)	< 17	< 20	< 21	< 21	< 20	< 22	< 22	< 23
Below average ($P_{11–30}$)	17–19	20–23	21–24	21–24	20–23	22–25	22–26	23–26
Average ($P_{31–70}$)	20–22	24–26	25–28	25–28	24–26	26–29	27–29	27–30
Above average ($P_{71–90}$)	23–25	27–30	29–32	29–32	27–29	30–33	30–33	31–34
Much above average ($P_{90–100}$)	> 25	> 30	> 32	> 32	>29	> 33	> 33	>34

TABLE C
WAIST-TO-HIP RATIO

	Women				Men			
Age	< 35	35–44	45–54	≥ 55	< 35	35–44	45–54	≥ 55
Very low ($P_{0–10}$)	<0. 68	<0.68	<0.71	<0.72	< 0.79	< 0.81	< 0.82	<0.85
Below average ($P_{11–30}$)	0.68–0.73	0.69–0.74	0.72–0.78	0.73–0.78	0.79–0.84	0.81–0.87	0.82–0.90	0.85–0.91
Average ($P_{31–70}$)	0.74–0.78	0.75–0.81	0.79–0.82	0.79–0.82	0.85–0.90	0.88–0.93	0.91–0.96	0.92–0.97
Above average ($P_{71–90}$)	0.79–0.83	0.82–0.86	0.83–0.88	0.83–0.89	0.91–0.97	0.94–1.00	0.97–1.05	0.98–1.07
Much above average ($P_{90–100}$)	>0.83	>0.86	>0.88	>0.89	>0.97	>1.00	>1.05	>1.07

TABLE D
GRIP STRENGTH (KP)

	Women				Men			
Age	< 35	35–44	45–54	≥ 55	< 35	35–44	45–54	≥ 55
Poor ($P_{0–10}$)	<30	<26	<23	<20	<48	<45	<43	<36
Below average ($P_{11–30}$)	30–35	26–32	23–30	20–28	48–55	45 –54	43–50	36–43
Average ($P_{31–70}$)	36–41	33–39	30–37	29–35	56–64	55–63	51 –57	44–52
Above average ($P_{71–90}$)	42–50	40–48	41–46	36–42	65–74	64 –72	58–65	53–60
Very good ($P_{90–100}$)	>50	> 48	> 46	> 42	> 74	> 72	> 65	> 60

TABLE E
VERTICAL JUMP (CM)*

	Women				Men			
Age	< 35	35–44	45–54	≥ 55	< 35	35–44	45–54	≥ 55
Poor ($P_{0–10}$)	< 23	< 20	< 18	<16	< 34	< 30	< 27	< 22
Below average ($P_{11–30}$)	23–30	20–28	18–25	16–24	34–44	30–39	27–34	22–29
Average ($P_{31–70}$)	31–38	29–34	26–32	25–31	45–51	40–48	35–41	30–37
Above average ($P_{71–90}$)	39–47	35–42	33–39	32–37	52–60	49–55	42–51	38–46
Very good ($P_{90–100}$)	> 47	> 42	> 39	>37	> 60	> 55	> 51	> 46

* the obtained values could only be compared with the results of the high jump test performed as described in Eurofit battery of tests[9]

TABLE F
SIT AND REACH (CM)

	Women				Men			
Age	<35	35–44	45–54	≥55	<35	35–44	45–54	≥55
Poor ($P_{0–10}$)	<–3	<–5	<–8	<–13	<–5	<–8	<–11	<–13
Below average ($P_{11–30}$)	–3–4	–5–2	–8–0	–10 – –1	–5–1	–8 – –1	–11 – –2	–12 – –7
Average ($P_{31–70}$)	5–11	3–10	1–8	0–7	2–8	0–6	–3–4	–8 – –2
Above average ($P_{71–90}$)	12–20	11–18	9–14	8–12	9–17	7–14	5–11	–2–8
Very good ($P_{90–100}$)	> 20	> 18	>15	>13	>17	>14	>11	> 8

TABLE G
BALANCE TEST RESULTS (NUMBER OF TRIALS NEEDED TO REACH 30 SECONDS STANDING ON ONE FOOT WITH CLOSED EYES)

	Women				Men			
Age	< 35	35–44	45–54	≥ 55	< 35	35–44	45–54	≥ 55
Very good ($P_{0–10}$)	< 2	< 3	< 4	< 4	< 2	<3	<4	<4
Above average ($P_{11–30}$)	2–4	3–4	4–7	4–7	2–3	3–4	4–6	4–8
Average ($P_{31–70}$)	5–6	5–7	8–10	8–9	4–5	5–7	7–10	9–11
Below average ($P_{71–90}$)	7–8	8–9	11–12	10–12	6–7	8–9	11–14	11–15
Poor ($P_{90–100}$)	> 8	> 9	> 12	> 12	> 7	> 9	> 14	> 15

TABLE H
SIT UPS (NUMBER OF SUCCESSFULLY ACCOMPLISHED SIT UPS OUT OF POSSIBLE 15)*

	Women				Men			
Age	< 35	35–44	45–54	≥ 55	< 35	35–44	45–54	≥ 55
Poor ($P_{0–10}$)	<9	<7	<5	<5	<9	<7	<5	<5
Below average ($P_{11–30}$)	9–11	7–10	5–8	5–8	9–11	7–10	5–8	5–8
Average ($P_{31–70}$)	12–13	11–12	9–11	9–10	12–13	11–12	9–11	9–10
Above average ($P_{71–90}$)	14–15	13–14	12–13	11–12	14–15	13–14	12–13	11–12
Very good ($P_{90–100}$)	15	15	>13	>12	15	15	>13	>12

* The legs are bent at 90° in knee joints and the feet are fixed. The subject should try to accomplish all 15 sit-ups. During first five sit-ups the palms are placed on kneecaps, in second five the arms are crossed and the palms are placed on shoulders, and in last five the palms are placed on the ear lobes of the same boy side

TABLE I
TAPPING IN 20 SECONDS (N)

	Women				Men			
Age	< 35	35–44	45–54	≥ 55	< 35	35–44	45–54	≥ 55
Poor ($P_{0–10}$)	<20	<16	<15	<15	<23	<21	<18	<16
Below average ($P_{11–30}$)	20–23	16–21	15–20	15–20	23–27	21–26	18–24	16–22
Average ($P_{31–70}$)	24–30	22–28	21–26	21–25	28–34	27–32	25–30	23–28
Above average ($P_{71–90}$)	31–39	29–36	27–34	26–34	35–42	33–40	31–38	29–36
Very good ($P_{90–100}$)	>39	>36	>34	>33	>42	>40	> 38	>3 6

TABLE J
MAXIMAL OXYGEN UPTAKE (ML/ KG/ MIN)*

	Women				Men			
Age	< 35	35–44	45–54	≥ 55	< 35	35–44	45–54	≥ 55
Poor ($P_{0–10}$)	<22	<20	<18	<16	<26	<21	<18	<17
Below average ($P_{11–30}$)	22–26	20–23	18–21	16–19	26–31	21–24	18–22	17–20
Average ($P_{31–70}$)	27–33	24–30	22–27	20–24	32–37	25–31	23–28	21–26
Above average ($P_{71–90}$)	34–41	31–38	27–34	25–30	38–44	32–40	29–35	27–32
Very good ($P_{90–100}$)	>41	> 38	>34	>30	>44	>40	>35	>32

* the values were estimated by means of Astrand test