

Age-stratified EUROFIT scores and differences of rural and urban male children in Kosovo

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Abstract

Background and Study Aim Since its inception in 1988, the EUROFIT database network has expanded significantly. This expansion has facilitated the use of standardized test batteries to evaluate physical fitness across diverse groups. This study therefore aimed to determine possible differences in EUROFIT scores between rural and urban male children in Kosovo aged 7 to 11 years and to suggest the underlying factors besides the differences.

Material and Methods The study involved 500 schoolchildren from Kosovo, both rural and urban, aged between 7 and 11 years. They were equally distributed within the total sample. Measurements were conducted using EUROFIT and anthropometric tests. The results were subsequently analyzed and compared using a Student's t-test.

Results The data revealed that urban children have a better starting point, benefiting from greater access to organized physical activities. Their diets, while less healthy, may enhance physical power. The rural environment fosters healthier growth and skill development in boys, particularly before and during the onset of puberty.

Conclusions Urban children should maintain their regular organized physical activities throughout the school period. This will help them match their rural peers in terms of motor and functional abilities. However, morphological traits are becoming more similar between these groups as they enter the prepubertal stage. Future studies should investigate potential differences in female samples. They should also extend to other countries and regions to provide a broader perspective.

Keywords: EUROFIT, boys, reference values, kids, physical fitness

Introduction

The persistent challenge in assessing physical fitness results among children necessitates a standardized reference system for accurate evaluations. As societies evolve, discrepancies in physical activity levels and access among urban and rural children have become more pronounced, raising questions about the adequacy of current fitness benchmarks. To correctly evaluate or compare a certain physical fitness result, a reference system is essential. Reference values databases are crucial, serving professionals to evaluate and track progress in children and practitioners more precisely. Profiling is a method for standardization of motor ability (reference) values, and such values are valuable data for further evaluations and comparisons of the next generations [1]. The usefulness of these databases depends on the

sample, which should possess characteristics similar to the comparing group.

Stratification of samples can be achieved based on characteristics such as sex, age, environment, activity level, sport, sports group, and workplace. However, there is no ideal 'twin' group or database for any group, as each cohort exhibits unique variability. The EUROFIT test battery is considered the best solution for the standardized network of databases due to its cost-effectiveness and broad applicability. Its use across various age groups aids in assessing general health, evaluating and fostering regular exercise habits and sports participation, providing physical education teachers and coaches with insights into the structural and functional characteristics of children, developing national norms, and shaping national policies concerning children [2, 3, 4, 5].

Regarding EUROFIT, the most extensive study to date that involved EUROFIT testing in children was a systematic review conducted by Tomkinson et al. [6]. This study compiled results from EUROFIT analyses

on children across 30 European countries, excluding Kosovo. The analysis revealed that boys consistently outperformed girls in tests of muscular strength, power, endurance, speed-agility, and cardio-metabolic fitness, but lagged behind in flexibility. Additionally, physical fitness improvements were more rapid in boys than in girls, particularly during their teenage years. While there exists a study on youth performance with EUROFIT in Kosovo focusing on the pubertal age group (11-17) [7], it indicated not only the expected sex differences and age-growth correlations but also highlighted that Kosovar students outperformed their peers in other countries in terms of anthropometric characteristics and speed/agility of limbs. However, they fell short in flexibility and endurance compared to peers from other countries. No studies have yet explored the potential differences in EUROFIT scores between rural and urban children in Kosovo across generations, especially among males and younger age groups.

This study aims to determine possible differences in EUROFIT scores between rural and urban male children in Kosovo, separately by age (7-11), and to suggest the underlying factors besides the differences.

Material and Methods

Participants

This study was conducted with a sample of 500 male schoolchildren from both rural and urban areas. The participants were divided by age into ten groups: 7, 8, 9, 10, and 11 years old. The sample comprised students from various primary schools, and the selection was based on a simple random sampling method. Participants were initially invited to join the study via the institution's communication channels, and parental written consent was obtained. Ethical approval was secured from the Governing Council of the University of Prishtina 'Hasan Prishtina' in Prishtina (Kosovo), under protocol number 677 dated 24.03.2023, as approved by the University's Ethics Committee. The research adhered to the principles of the Declaration of Helsinki.

Study Design

The project was conducted from April 2023 to June 2023 within the standard school environment, specifically during regular physical education and health classes. Measurements were performed by professionals in the fields of kinesiology and medicine, who had undergone prior training in anthropometric and motor measurements. Motor skills were assessed using the EUROFIT battery tests, a standardized test suite developed by the Council of Europe for primary school children [8]. Measuring instruments were selected to align with these tests.

The test battery consisted of the following assessments: Flamingo balance test (static body balance), Plate tapping (movement frequency), Sit-and-reach, Standing broad jump (explosive strength), Sit-ups in 30 seconds (repetitive abdominal strength), Bent arm hang (isometric static strength of upper body), 10x5 Shuttle run (running velocity), and 20m Beep test (cardio-respiratory fitness). Anthropometric measurements followed the protocols of the International Biological Program (IBP). According to this program, although there are 39 linear measures, only seven were used in this research: body height, length of the sitting trunk, arms length open, triceps skinfold, abdominal skinfold, subscapular skinfold, and body weight. Body height, length of the sitting trunk, and arms length open were measured using the *Martin Anthropometer* with a precision of ± 0.01 kg scale. Skinfolds were measured using an *Accu-Measure Body Fat Caliper*, and body weight was assessed using a *TANITA diagnostic scale (BC 418)*.

Statistical Analysis

Statistical analysis was conducted using two PC programs: Statistica 14 by TIBCO Software Inc., and Microsoft Excel for Mac OS Version 16.43. Descriptive statistics were calculated for all subgroups, and T-tests were performed to determine differences between groups. The significance level for this study was set at 0.05.

Results

The authors investigated potential differences in EUROFIT test results between urban and rural male children according to their age through T-test analysis. The data are presented below (Tables 1-5).

Examining the results of seven-year-old boys (Table 1), significant differences were observed in only two EUROFIT variables: the Standing broad jump, where urban boys outperformed, and the 10x5 Shuttle run, where rural boys excelled. These findings suggest that younger children in Kosovo generally possess similar motor and functional abilities, as well as comparable anthropometric measures, regardless of their living area. However, urban boys tend to be slightly taller, heavier, and have longer arms and trunks, with less body fat compared to their rural peers. Conversely, rural boys demonstrated slightly better results in balance, repetitive abdominal and static arm strength, as well as aerobic power.

Eight-year-old boys show significant differences in longitudinal anthropometric measures, specifically body height and length of the sitting trunk (Table 2). Similar to the seven-year-olds (Table 1), there is also a difference between the groups in the 10x5 Shuttle run. Beyond these morphological measurements, urban boys are slightly heavier, this time with a greater fat mass compared to rural boys.

Table 1. T-test results between urban and rural, seven-year-old boys.

Variables	Urban		Rural		t-Value	p-Value
	Mean	SD	Mean	SD		
Body weight (kg)	27,13	14,39	25,50	7,16	0,720	0,476
Body height (cm)	124,94	5,24	124,00	6,57	0,792	0,431
The length of the sitting trunk (cm)	68,44	3,16	67,40	3,90	1,461	0,146
Arms length open (cm)	122,88	6,45	122,52	6,62	0,284	0,783
The triceps skinfold (mm)	8,90	3,56	8,90	5,08	0,000	1,000
Abdominal skinfold (mm)	6,88	4,91	9,22	9,56	-1,543	0,127
Subscapular skinfold (mm)	5,44	2,48	6,32	5,35	-1,057	0,294
Flamingo balance (sec)	11,46	8,35	11,70	8,39	-0,146	0,886
Plate tapping (n of taps)	20,01	3,34	55,79	25,52	-0,984	0,329
Sit-and-reach (n of repetitions)	36,10	5,93	36,24	5,22	-0,131	0,900
Standing broad jump (cm)	102,78	20,03	92,02	25,35	2,354	0,021*
Sit-ups in 30sc (n of repetitions)	14,48	3,33	14,36	4,88	0,142	0,886
Bent arm hang (sec)	8,11	8,06	9,48	10,80	-0,721	0,473
10x5 Shuttle run (sec)	21,38	1,26	20,36	2,73	2,401	0,018*
20m Beep test (level)	3,08	1,69	3,24	1,22	-0,522	0,603

Values are expressed as means and standard deviations (SD). An asterisk (*) indicates a significant difference.

Table 2. T-test results between urban and rural, eight-year-old boys.

Variables	Urban		Rural		t-Value	p-Value
	Mean	SD	Mean	SD		
Body weight (kg)	28,68	7,54	26,15	5,20	1,950	0,054
Body height (cm)	131,16	5,81	127,90	4,86	3,049	0,003*
The length of the sitting trunk (cm)	70,98	3,19	69,22	2,37	3,136	0,002*
Arms length open (cm)	126,88	6,53	125,32	5,50	1,291	0,199
The triceps skinfold (mm)	8,78	3,10	8,02	3,30	1,192	0,238
Abdominal skinfold (mm)	7,02	5,42	8,92	7,41	-1,463	0,146
Subscapular skinfold (mm)	5,84	3,82	5,36	2,16	0,775	0,442
Flamingo balance (sec)	9,22	8,27	9,22	6,49	0,000	1,000
Plate tapping (n of taps)	18,07	2,53	18,48	3,18	-0,711	0,480
Sit-and-reach (n of repetitions)	35,74	6,95	33,62	7,76	1,441	0,153
Standing broad jump (cm)	100,72	19,72	123,50	130,47	-1,222	0,225
Sit-ups in 30sc (n of repetitions)	12,96	3,65	11,90	3,95	1,393	0,166
Bent arm hang (sec)	15,29	15,87	11,54	11,16	1,374	0,174
10x5 Shuttle run (sec)	21,61	1,68	20,38	1,42	3,961	0,000*
20m Beep test (level)	2,86	0,95	3,10	0,89	-1,300	0,196

In terms of motor abilities, they excel in repetitive (legs and abdomen) and static arm strength. However, rural boys achieve better scores in aerobic and anaerobic power.

Further analysis of nine-year-old boys, as shown in Table 3, revealed significant differences in several variables: body weight, body height, sit-ups in 30 seconds, the 10x5 Shuttle run, and the 20m Beep test. As with younger age groups, rural boys displayed superior aerobic and anaerobic power. In this age

category, rural boys outperformed their urban peers in almost all motor tests, with the exception of the Sit-and-reach. They also carried more fat mass compared to their urban counterparts. Urban boys, however, excelled in absolute morphological measures.

Slight indications of the prepubertal stage may be observed in Table 4, where rural boys appear to enter this phase slightly earlier. This is evidenced by noticeable weight gains, alignment of longitudinal

Table 3. T-test results between urban and rural, nine-year-old boys.

Variables	Urban		Rural		t-Value	p-Value
	Mean	SD	Mean	SD		
Body weight (kg)	36,26	10,33	30,48	8,15	3,111	0,002*
Body height (cm)	138,64	6,45	135,40	6,33	2,542	0,013*
The length of the sitting trunk (cm)	74,26	3,77	72,78	3,79	1,961	0,053
Arms length open (cm)	134,18	7,02	133,38	7,96	0,533	0,595
The triceps skinfold (mm)	9,58	4,95	9,66	5,02	-0,084	0,936
Abdominal skinfold (mm)	11,00	9,59	12,58	9,98	-0,815	0,422
Subscapular skinfold (mm)	6,46	4,17	7,18	5,95	-0,706	0,485
Flamingo balance (sec)	9,18	7,45	9,90	6,19	-0,537	0,600
Plate tapping (n of taps)	14,72	1,84	15,10	2,21	-0,939	0,356
Sit-and-reach (n of repetitions)	33,90	7,93	32,62	9,38	0,740	0,463
Standing broad jump (cm)	113,62	28,53	116,80	22,47	-0,620	0,537
Sit-ups in 30sc (n of repetitions)	12,78	5,33	15,26	4,07	-2,611	0,010*
Bent arm hang (sec)	11,57	12,47	15,74	32,08	-0,860	0,394
10x5 Shuttle run (sec)	20,37	1,89	19,49	1,67	2,480	0,015*
20m Beep test (level)	3,27	1,19	3,97	1,75	-2,342	0,021*

Table 4. T-test results between urban and rural, ten-year-old boys.

Variables	Urban		Rural		t-Value	p-Value
	Mean	SD	Mean	SD		
Body weight (kg)	27,59	6,08	37,48	12,69	-4,970	0,000*
Body height (cm)	140,36	6,18	140,78	6,43	-0,330	0,740
The length of the sitting trunk (cm)	75,46	4,02	74,52	3,96	1,188	0,241
Arms length open (cm)	135,68	6,99	140,12	8,06	-2,946	0,004*
The triceps skinfold (mm)	8,36	3,67	11,42	7,55	-2,585	0,011*
Abdominal skinfold (mm)	10,30	8,64	17,28	16,11	-2,704	0,008*
Subscapular skinfold (mm)	6,50	4,23	10,16	11,44	-2,122	0,036*
Flamingo balance (sec)	8,28	5,42	9,60	7,79	-0,981	0,328
Plate tapping (n of taps)	13,89	2,36	14,60	2,54	-1,445	0,152
Sit-and-reach (n of repetitions)	28,24	8,27	34,14	6,00	-4,089	0,000*
Standing broad jump (cm)	136,62	21,95	113,18	20,88	5,470	0,000*
Sit-ups in 30sc (n of repetitions)	14,12	5,02	15,14	5,81	-0,940	0,350
Bent arm hang (sec)	18,06	16,78	15,50	15,38	0,790	0,429
10x5 Shuttle run (sec)	19,31	1,20	19,19	1,70	0,410	0,685
20m Beep test (level)	3,90	1,10	3,67	1,42	0,880	0,379

morphological measures with those of the urban group, and significantly higher fat mass levels, characteristic of the prepubertal stage in the rural group. Rural boys exhibited a significantly greater arm span, although their trunks were slightly shorter. Motor abilities varied, but significant differences were observed in the Sit-and-reach, with the rural group performing better, and in the Standing broad jump, where the urban group excelled. Urban boys demonstrated better aerobic results and relative static strength, likely due to their lighter body weight.

Results from Table 5 suggest the possible onset of the prepubertal stage among urban boys, as anthropometric differences have largely diminished, except for the abdominal skinfold. Significant differences were noted in motor variables: the urban group again scored higher in the Standing broad jump, while the rural group excelled in balance and repetitive strength exercises for the abdomen and legs. Additionally, rural boys demonstrated significantly greater aerobic capacities. This is the first instance where the urban group exhibited

Table 5. T-test results between urban and rural, eleven-year-old boys.

Variables	Urban		Rural		t-Value	p-Value
	Mean	SD	Mean	SD		
Body weight (kg)	41,63	11,03	40,16	10,79	0,681	0,501
Body height (cm)	147,26	5,72	144,86	7,03	1,876	0,064
The length of the sitting trunk (cm)	77,80	3,25	76,56	3,96	1,715	0,090
Arms length open (cm)	145,08	7,45	144,20	7,38	0,594	0,554
The triceps skinfold (mm)	11,12	4,78	11,34	6,96	-0,187	0,854
Abdominal skinfold (mm)	12,82	8,61	20,40	15,52	-3,029	0,003*
Subscapular skinfold (mm)	7,52	4,51	9,84	7,94	-1,800	0,075
Flamingo balance (sec)	7,18	5,73	10,24	7,06	-2,380	0,019*
Plate tapping (n of taps)	13,32	2,64	14,03	2,06	-1,500	0,137
Sit-and-reach (n of repetitions)	30,94	8,35	34,62	7,10	-2,379	0,020*
Standing broad jump (cm)	123,84	15,89	112,62	26,80	2,558	0,012*
Sit-ups in 30sc (n of repetitions)	14,60	5,23	16,58	3,56	-2,211	0,029*
Bent arm hang (sec)	15,06	18,15	15,89	17,12	-0,242	0,814
10x5 Shuttle run (sec)	19,09	1,39	19,13	1,81	-0,111	0,912
20m Beep test (level)	3,43	1,21	4,24	1,66	-2,811	0,006*

superior anaerobic power.

Discussion

This study aimed to determine possible differences in EUROFIT scores between rural and urban male children in Kosovo aged 7 to 11 years and to identify underlying factors beyond these differences. Initial findings reveal that while some motor and anthropometric measures showed significant differences, others did not, indicating a complex interaction of environmental and other factors. Furthermore, differences in specific tests like the Standing broad jump and 10x5 Shuttle run suggest varying developmental trends between the two groups.

The related study [9] conducted on schoolchildren aged 8-11 in two different environments in Turkey, although not age-stratified, found significant differences only in basic anthropometry and certain fitness tests (Sit-ups in 30sec and Bent arm hang). Compared to their Turkish peers, children in Kosovo show partial similarities, especially in the variability of height-related measures and the absence of differences in certain motor skills, while other data differ across generations.

The study with a protocol similar to ours [10] was previously conducted in North Macedonian schools, involving over 5,000 participants (average age 9.94 ± 2.41 years). It revealed that children from rural environments outperformed their urban peers in cardiorespiratory fitness, muscle fitness of the upper and lower extremities, and displayed better coordination, speed, and agility. Although such results might be expected, our findings confirm them only partially—specifically in the prepubertal

stage, but not during the middle childhood phase. These differences may be attributed to the distinct environments experienced by younger children in North Macedonia compared to Kosovo. Additionally, an analysis [11] of 11 and 12-year-old schoolchildren in Albania, a neighboring country, revealed similar trends in physical fitness and anthropometric characteristics among prepubertal children.

This study provides better insight into the generational changes among male children in different environments. As noted in the results, urban children during middle childhood tend to be slightly taller, heavier, and longer, possibly due to easier access to various kinds of processed and unprocessed food, which boosts their growth from an early age. Urban children are also slightly stronger at these ages, which could be attributed to more frequent participation in organized activities under professional supervision, as well as their diet. An interesting study [12] examined the impact of family background on physical health in rural areas, finding that lower educational levels of parents and the professional occupation of the mother were correlated with higher body mass index in children. Physical condition appears to be influenced by the educational level and professional occupation of the family, particularly the mother. These factors may also contribute to the lack of organized supervision and training of children through their early and middle childhood in rural areas of Kosovo. It is important to note the earlier entry of rural boys into the prepubertal stage, which could be explained by their continuous physical activity and better access to nature, whereas urban boys tend to become more sedentary as they age. Many factors may influence

such behavior, primarily video games, uncontrolled internet access, increasing school activities, overly protective parents, and more. Rural boys not only maintain their physical activity levels over the years but also enhance them as they grow older and begin assisting in various rural activities, which often require different forms of strength. Therefore, the observed differences in motor abilities in older rural-urban groups are expected. However, these differences seem to be even more pronounced in highly developed societies, as evidenced in Australia [13].

Researchers in Scotland [14] found that rural children spent an average of 14 minutes less being sedentary and 13 minutes more engaging in light-intensity activity per day. These figures are significant when considered cumulatively. However, in some instances, urban preadolescent children exhibit better levels of physical fitness than their rural peers, as seen in Croatia [15], and urban children in the US have a lower risk of obesity [16]. This indicates that such trends vary across nations, and each country and region must be evaluated independently. Furthermore, cardio-metabolic variables tend to increase with age. For example, during puberty, boys experience accelerated skeletal growth and muscle mass increases, which enhance maximum oxygen supply and improve endurance and sports performance [17]. As both groups enter puberty (Table 5), anthropometric differences gradually diminish, yet the rural group continues to excel in motor and functional abilities. There is an increasing concern for the physical fitness of urban prepubertal and pubertal children. One potential solution is school-based sports activities, which can significantly boost daily physical activity in urban settings [18]. Other strategies include ongoing education for parents and children about the importance of physical health and its impact on quality of life.»

The limitations of this study include its focus on a specific sample of participants, as it exclusively encompasses male children from Kosovo and does not include females. Future research should explore

the trends in EUROFIT testing across generations in rural and urban areas for female samples, as well as similar samples in other regions and countries.

Conclusions

This study explores differences in growth and abilities between rural and urban male children, focusing on age-stratified analysis. The results suggest that urban children initially have better access to organized physical activities and varied diets, which may enhance physical power, although these diets might be less healthy. As schooling begins, the rural environment seems more conducive to healthy growth and the development of abilities in boys. Thus, it is important for urban children to maintain regular organized physical activities throughout their schooling to match the motor and functional abilities of their rural peers. Over time, morphological traits tend to equalize between these groups as they approach the prepubertal stage.

Highlights

- Urban children display slightly better physical fitness during middle childhood, whereas rural children excel as they approach the prepubertal stages.
- Despite fewer opportunities for organized sports and access to less-caloric but healthier diets, rural children tend to demonstrate superior motor abilities compared to their urban peers.
- Skeletal growth in the studied age groups is influenced by factors unrelated to their rural or urban environments as they near puberty.

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