

**Title: AGE DIFFERENCES AMONG THE CROATIAN FEMALE YOUNG PIVOTS
IN THE INDICATORS OF BASIC AND HANDBALL-SPECIFIC PHYSICAL
FITNESS**

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ABSTRACT

PURPOSE: The aim of the research was to determine and analyse differences among the Croatian female pivots of a younger-cadet, cadet and junior age (U14, U16, U18) in several basic and handball-specific physical fitness indicators.

METHODS: The sample of 23 participants, female circle runners or pivots was drawn out of the population of members of the Croatian handball clubs recognized as promising players within their respective age group. Eighteen tests, defining four latent dimensions: agility, power, dynamic strength, flexibility, were chosen to assess basic and handball-specific motor abilities of the young pivots. Univariate analysis of variance (ANOVA) was used to establish global and individual differences among the age groups.

RESULTS: The significant global age differences were established in three variables: at the level of $p < 0.01$, in two variables assessing power of throwing and dynamic relative strength of arms, and at the level of $p < 0.05$ in the variable assessing dynamic relative strength of legs. Significant differences were established only between junior and younger cadet pivots since no significant difference was observed between cadets and younger cadets.

Only one variable differed junior pivots from their cadet colleagues ($p = 0.01$): bench press with 50% BW (MRSBP5).

CONCLUSIONS: The significant global age differences were obtained only in the 3 indicators of arm and leg strength (explosive and dynamic), primarily due to the differences between juniors and younger cadets. The differences originated from different growth and maturation stages.

Keywords: FEMALE YOUNG PIVOTS, CROATIAN, PHYSICAL FITNESS, AGE DIFFERENCES

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1. INTRODUCTION

Handball pertains to a group of complex team activities with the ball due to its structural characteristics and physical fitness requirements. A high level of motor and functional abilities of handballers is needed for top-level performance. All the mentioned causes a rather high complexity of training procedures and programmes (Vuleta, Milanović, et al., 2004). For a long time, handball experts, both researchers and practitioners, have been in a search for performance criteria (Vuleta et al., 2003), that is, they have been trying to determine performance relevance of individual abilities and skills for particular playing positions. Information on their performance relevance facilitates the design of training plans and programmes helping coaches with the creation of a stimulating training environment the main target of which is sport achievement. The information also represents a guideline in the processes of talent identification in general and for specific playing position. Čavala et al. (2002), Ohnjec and Gruić (2008), and Bojić-Ćaćić et al. (2015) determined positional differences in the basic and handball-specific motor abilities of women players. Bojić-Ćaćić et al. (2016) established, with the sample of 56 women juniors, and in 2017 with the sample of 48 women younger cadets, significant positional differences in the basic and specific motor abilities between wingers and backs as well as between wingers and pivots. Available literature search indicates few research studies have been published on age and positional differences among women handballers, especially of a younger age.

The aim of the research was to determine and analyse differences among the Croatian female pivots of younger-cadet, cadet and junior age (U14, U16, U18) in several basic and handball-specific physical fitness indicators.

We hypothesised that there were statistically significant global and individual age differences among young female pivots (younger cadets, cadets, juniors) in the indicators of basic and handball-specific physical fitness.

2. METHODS

2.1. Sample of Participants

Twenty-three female circle runners or pivots participated in the investigation, out of which three subsamples were formed: juniors (U18, $n=6$; age 18.43 ± 0.80 years, body height 171.28 ± 6.51 cm, body weight 71.78 ± 4.19 kg, average BMI about 25 kg/m^2), cadets (U16, $n=7$; age 15.94 ± 1.16 years, body height 174.97 ± 2.88 cm, body weight 70.93 ± 5.14 kg, average BMI about 23 kg/m^2), and younger cadets (U14, $n=10$; age 13.88 ± 0.46 years, body height 170.06 ± 5.83 cm, body weight 62.02 ± 6.02 kg, average BMI closer to 22 kg/m^2). The sample

of participants was drawn out of the population of the Croatian handball clubs' players who had beforehand been evaluated by their coaches and the Croatian Handball Federation selectors as promising players within their respective age group according to their handball skills and experience.

2.2. Sample of Variables

Eighteen tests, defining four latent dimensions: agility, power, dynamic strength, flexibility, were chosen to assess basic and handball-specific motor abilities of the young pivots (Vuleta et al., 2006).

Table 1. Variables obtained by the measurements and assessments of the participants' motor abilities using basic and handball-specific motor tests

	Variables	Acronyms	Intentional object of measurement
1.	Two triangles/star agility – seconds	MAG2TR	Agility
2.	Agility 96369 OK – seconds	MAG9OK	Agility
3.	Side steps – seconds	MAGKUS	Agility
4.	Maximal movement speed over 5 m – seconds	MES5m	Power – explosive strength of sprinting
5.	Maximal movement speed over 10 m – seconds	MES10m	Power – explosive strength of sprinting
6.	Maximal movement speed over 20 m – seconds	MES20m	Power – explosive strength of sprinting
7.	One-handed handball throwing while sitting – dm	MESB4S	Power – explosive strength of throwing
8.	Basic ground throw from 9 m with approach – dm	MESB9T	Power – explosive strength of throwing
9.	Basic jump throw from 9 m with approach – dm	MESB9S	Power – explosive strength of throwing
10.	CMJ with arm swing – cm	MESCMJ	Power – explosive strength of jumping
11.	Standing vertical jump – dominant, take-off leg – cm	MESMAX	Power – explosive strength of jumping
12.	Standing broad jump – cm	MESSDM	Power – explosive strength of jumping
13.	Sit-ups in 30 seconds – repetitions	MRSPTL	Dynamic repetitive-relative strength
14.	Squatting in 30 seconds – repetitions	MRSČUČ	Dynamic repetitive-relative strength
15.	Bench press 50% body weight – repetitions	MRSBP5	Dynamic repetitive-relative strength
16.	Shoulder rotation test with a stick – cm	MFLISP	Flexibility
17.	Straddle (V) sit forward bent – cm	MFLPRR	Flexibility
18.	Leg raise from supine position – cm	MFLPRL	Flexibility

2.3. Statistical Analysis

Basic descriptive statistical procedures were applied to determine central and dispersive parameters of the variables. Univariate analysis of variance (ANOVA) was used to establish global and individual differences among the age groups. The number of participants ensured the enough number of degrees of freedom thus enabling the power of statistical inference at the level of 95% reliability.

3. RESULTS

In Table 2 results of ANOVA are presented. The significant global age differences were established in three variables: at the level of $p<0.01$ in two variables assessing power of throwing dynamic relative strength of arms, and at the level of $p<0.05$ in the variable assessing dynamic relative strength of legs. Analytically speaking, the significant differences were established only between junior and younger cadet pivots since no significant difference was observed between cadets and younger cadets.

Only one variable differed junior pivots from their cadet colleagues ($p=0.01$): bench press with 50% BW (MRSBP5). The variable assessed players' dynamic strength of arms and shoulder gird: junior pivots completed 20.00 repetitions, whereas cadets completed only 8.57 repetitions. Juniors are two years on average older than cadets and have a longer training experience (eight years vs. six years). In the future, the cadets will, hopefully, catch up with the juniors' performance if they will involve in a more intensive resistance training and if they will improve their ball technique. Although the other differences between juniors and cadets were statistically insignificant, they must not be completely neglected in further analyses and comparisons in women handball since they can highlight certain aspects of sport fitness.

Three significant differences between junior and younger-cadet pivots were obtained in the following variables: one-handed handball throwing while sitting on the 4-metre line (MESBR4S), bench press 50% BW (MRSBP5), at the level of $p<0.01$, and squats in 30 s ($p<0.05$; MRSCUC).

Table 2. Basic descriptive parameters of the variables and analysis of the age differences among female pivots in their basic and handball-specific motor abilities

PIVOTS/ CIRCLE RUNNERS	Means			Standard deviations			Total		JU-CAD	JU-YC	CAD-YC
	JU=6	CAD=7	YC=10	JU=6	CAD=7	YC=10	F	p	p	p	p
MAG2TR	7.23	7.64	7.52	0.35	0.82	0.54	0.78	0.47	0.49	0.64	0.93
MAG9OK	8.29	8.66	8.84	0.44	0.32	0.51	2.97	0.07	0.34	0.07	0.71
MAGKUS	8.29	8.41	8.29	0.56	0.66	0.50	0.11	0.89	0.93	1.00	0.91
MEKS5m	1.68	1.65	1.71	0.05	0.09	0.10	0.83	0.45	0.91	0.77	0.46
MEKS10m	2.62	2.53	2.64	0.18	0.12	0.33	0.47	0.63	0.79	0.99	0.64
MEKS20m	3.98	4.05	4.13	0.14	0.27	0.19	1.00	0.39	0.83	0.40	0.74
MESBR4S	52.63	47.70	43.03	2.24	6.13	3.32	10.04	0.00	0.13	0.00	0.10

MESBR9T	75.24	73.39	67.70	3.89	12.29	6.17	1.91	0.17	0.92	0.22	0.38
MESBR9S	73.19	71.98	65.70	5.52	12.31	4.99	2.10	0.15	0.96	0.22	0.30
MESCMJ	34.59	35.71	35.22	3.18	5.72	2.00	0.14	0.87	0.87	0.95	0.97
MESMAX	36.78	37.52	35.40	4.01	9.63	3.86	0.26	0.78	0.98	0.91	0.79
MESSDM	197.56	193.43	182.23	14.21	23.01	12.55	1.83	0.19	0.91	0.23	0.41
MFLISP	71.61	73.33	67.23	10.12	8.25	15.62	0.54	0.59	0.97	0.80	0.62
MFLPRL	105.83	103.93	106.50	12.52	8.64	10.29	0.13	0.88	0.95	0.99	0.88
MFLPRR	77.72	81.86	75.00	12.71	6.60	8.11	1.17	0.33	0.72	0.85	0.33
MRSBP5	20.00	8.57	4.90	3.03	7.14	5.65	13.69	0.00	0.01	0.00	0.43
MRSCUC	28.50	26.29	23.40	0.84	3.45	3.98	4.70	0.02	0.49	0.02	0.23
MRSPTR	50.00	49.00	45.00	8.53	6.35	6.48	1.18	0.33	0.97	0.40	0.52

Legend: **MAG2TR** – two triangles/star agility, **MAG9OK** – agility 96369 with turns, **MAGKUS** – side steps, **MEKS5m** – maximal movement speed (sprinting) over 5 m, **MEKS10m** – maximal movement speed over 10 m, **MEKS20m** – maximal movement speed over 20 m, **MESBR4S** – one-handed handball throwing while sitting, **MESBR9T** – basic ground throw from 9 m with approach, **MESBR9S** – basic jump throw from 9 m with approach, **MESCMJ** – countermovement jump, **MESMAX** – standing vertical jump, **MESSDM** – standing broad jump, **MFLISP** – shoulder rotation test with a stick, **MFLPRL** – leg raise from supine position, **MFLPRR** – straddle (V) sit forward bent, **MRSBP5** – bench press 50% body weight, **MRSCUC** – squatting in 30 seconds, **MRSPTR** – sit-ups in 30 s.

DISCUSSION

Juniors demonstrated better power of throwing type – an average speed of ball juniors achieved was 52.63 km/h, whereas younger cadets achieved throwing speed of 43.03 km/h. This difference may be explained by a better quality of throwing/shooting skills in juniors and, if the performance in bench press 50% BW and squats in 30 seconds, by far more developed dynamic strength of arms, shoulders and legs. Junior pivots were able to complete 20.00 repetitions of bench press, whereas younger cadets performed only 4.90 repetitions.

Chronological age of younger cadets is four years less than the age of junior pivots. Therefore, the younger cadets will, hopefully, catch up with the juniors' performance in the future if they will commit themselves to a more intensive resistance training and if their ball technique will be improved. Certain strength exercises can be applied early in training, but load/resistance must not be too heavy since overloading in weight training may cause chronic damages or injuries of the musculoskeletal system of prepubertal children, especially of the epiphysis (round ends of long bones), or of the joints' soft tissues or cartilage (Mišigoj-Duraković, 2008).

The last difference in dynamic strength of legs between juniors and younger cadets was expected – juniors managed to complete 28.50 squats, whereas younger cadets executed only

23.40 repetitions. Namely, an ascending curve of strength development has been noticed in girls until the age of 15 years, when it starts to show stagnation (L. Milanović et al., 2003). Therefore, resistance training and strength development programmes, aimed at developing static and dynamic strength of legs, may be introduced in the process of sport preparation only after 15 years of age. Before that age, dynamic strength can be addressed/developed by the application of low-load dynamic exercises and methods (L. Milanović et al., 2003): method of low resistance load-many repetitions (30 repetitions), method of circular training using moderate resistance loads (10 drills, 20 repetitions) and moderate to high resistance load (8-10 drills, 10 repetitions).

Juniors from our study had been involved in various specific resistance training programmes aimed at strengthening their leg muscles, whereas younger cadets, due to the phase of intensive growth, could develop their dynamic leg strength only by low (minimal) load-high repetition method.

Playing position of a pivot is highly demanding as regards leg and the whole-body strength – it is characterised by a myriad of physical body contacts in struggle for the front position, both in attack and defence.

Therefore, in the process of sports preparation, much time and attention is dedicated to resistance training under simulated game conditions – junior pivots execute many technical-tactical exercises wearing weight vests and/or weight bracelets around ankles, for example, to increase dynamic leg strength and improve their performance.

In the training of younger cadets such loads are not allowed due to injury risks and because their technical-tactical skills have not been perfected yet.

The findings confirmed the hypothesis about the significant age differences among female pivots of different ages in some indicators of basic and handball-specific motor abilities or physical fitness.

4. CONCLUSION

The aim was to determine age differences among 23 young pivots (U14, U16, U18) in certain indicators of basic and handball-specific motor abilities. ANOVA revealed significant global age differences in power/explosive strength of throwing while sitting and dynamic repetitive-relative strength of arms ($p < .01$), and in dynamic repetitive-relative strength of legs ($p < .05$).

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