

VELOCITY, AGILITY AND FLEXIBILITY PERFORMANCE AFTER HANDBALL TRAINING VERSUS PHYSICAL EDUCATION PROGRAM FOR PRE-ADOLESCENT CHILDREN

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Summary.- The performance on velocity, agility, and flexibility after six months of specific handball training or a mainstream physical education program was examined in participants (handball n=51; physical education, n=70) who engaged in 3 sessions per week (60 min./session) including ball-handling exercises, horizontal and vertical jump shots, fast-breaks, and several defensive skills. Statistically significant differences were observed between the two groups on velocity, agility, and flexibility with differences in favouring the handball group. Handball training could significantly improve preadolescents' physical performance.

Training in team sports during the period of puberty plays a significant role in athletic performance (Garl, Ring, & Bomba, 1988). Velocity, agility, and flexibility are ranked among the fundamental motor abilities, and not only because they contribute greatly to high performance in team sports to improve technical and tactical skills (Taborsky, 2001; Moscai, 2002). Papavasiliou (2003) studied the influence of a physical education program in combination with a 7-min. aerobic running task in the development of preadolescence's and adolescence's physical abilities and found that it improved all basic physical condition parameters such as endurance. Athletics (Birer & Levine, 1987), swimming (Bloomfield, Blanksby, Ackland, & Elliot, 1985), basketball (Bar-Or, 1989; Hoare, 2000), and football (Ramadan & Byrd, 1987) have been proven to contribute to speed improvement in children and teenagers practicing these sports. It was ascertained that by practicing gymnastics, volleyball, basketball and by participating in physical abilities development programs, athletes-adolescents improved upper and lower limb power, balance, and agility (Huff, 1972; Liemohn, 1983; Robertson & Elliot, 1996; Mills, Taunton, & Mills, 2005). Research on gymnastics (Pienaar & Van Der Walt, 1988), handball (Zakas & Geladas 2003), netball (Farrow, Younk & Bruce, 2005) and soccer (Moller, Oberg, & Gillquist, 1985), shows that these sport activities all improve flexibility.

Very few studies have examined the effect of a handball training program on motor abilities in young athletes. The aim of this study was to evaluate the influence of a 6-mo handball program, in velocity, agility and fle-

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xibility on 12 to 14 year old adolescents and to be compared with effectiveness of mainstream physical education program. It was hypothesised that handball group would affect greater velocity, agility, and flexibility than those attending physical education programs.

METHOD

Participants

Two groups of boys ($N = 121$) were formed, a Handball group ($n = 51$, M age = 13.6 yr., $SD = 0.8$) and a Physical Education group ($n = 70$, M age = 13.5 yr., $SD = 0.9$; height=163.39 cm, $SD=10.13$; weigh=57.34, $SD=11.13$). The handball group included children that were selected after evaluation and voluntarily participated in the sport schools' training program and so were more homogeneous in motor abilities than children participating in the physical education program. In the initial measurement were not found significant differences between groups in flexibility, while in velocity and agility there were differences in favor to handball group. Students who participated in sport schools were engaged only in handball game. All students were in good health, and their families signed an informed consent form prior to their inclusion in the study.

Training

The handball-training program was performed 3times/week for 60min (50 training sessions). Each session was divided into a warm-up (8-10 min), main training program (45 min.) and cool-down (5-7 min.). The main training program consisted of several exercises, including ball handling, medium and low dribbling at standing position while moving to all directions, holding, receiving and passing the ball with and without a jump, various shooting throws with horizontal and vertical jumps of different height, basic fakes against defense by opposing press, individual- and team- defensive skills, fast and breaks with and without press. Also students were engaged in scrimmages and games during training programs, but they did not participate in sport competitions.

The Physical Education group performed 50 sessions divided in a similar way (warm-up, main part, and cool-down, total duration 60 min.). The physical education program provided by the Ministry of Education included exercises from track and field (basic running technique, 50m running, long jump exercises, etc.), gymnastics and various team sports such as volleyball (passing, receiving, service, etc.), basketball (dribble, pass, shoot, etc.), and soccer (pass, dribbling, control, shoot the ball, etc.).

Measures

A decimal measurement tape (SECA-220), two electronic chronometers (Lafayette type, Goniometer Brodin, Goniometer Myrin 17183 SOLNA), and flexiometer sit-and-reach were used to evaluate performance in different field tests. Instructions and manuals were followed to evaluate the performance on the above tests and to classify individual scores (EUROFIT, 1986).

Testing Procedure

The subjects performed the following fitness tests: 10m and 30m sprints (sec), tapping hand (sec), running (10x5, 6x5 meters) and running across a center of parallelogram 5x3meters (sec), sit-and-reach, arm flexion (degrees), amplitude of wrist joint (degrees), wrist flexion (degrees), and wrist extension (degrees). The goniometer Myrin was used to evaluate the flexibility. Running performance of 10m and 30m sprint from standing position. The tapping hand, the back-to-front running 10x5m, front-lateral side running 6x5m and the sit-and-reach were conducted according to Eurofit instructions. Also running across a center of parallelogram 5X3m by changing angles-corners was used to evaluate agility.

Statistical Analysis

SPSS 10.0 was used to analyse all data. Analysis of Covariance (ANCOVA) was used to examine differences between the two groups for post training means of each motor test; pre training means were used as covariates. All data are presented as means and standard deviations, with a p value of <0.05 considered as statistically significant.

RESULTS AND DISCUSSION

From the analysis of covariance between the two groups, statistically significant differences appeared in all the variables. Effect sizes ranged from $n^2 = .04$ to $.50$. These differences were in favor of the Handball group. Table 1 presents descriptive statistics for all fitness measures and ANCOVA for the two groups.

The handball program contributed to improvement in all velocity measures, i.e. 10-m sprint, 30-m sprint and upper-limb repeated velocity. This is possibly due to the fact that handball is characterized by fast attack actions as well as by numerous counterattacks. Cardinale (2004) found that during a game, a handball player performs 485 high-impact movements (8 per min.), most of which are in the form of sprints. About 60% of movements during a game are of high impact and involve movements of 20 m or less.

Similar differences were observed in all variables which measured agility. This improvement is possibly attributable to the particular characteristics and requirements of handball in defending and the attacking roles of players. In the framework of these roles, players perform various types of penetration, feint, attack, and 3- to 4-m lateral movements (Birer & Levine, 1987; Seco, 1998).

In the present study significant differences were detected in upper body, shoulder, and wrist flexibility. Specific handball characteristics, such as the manner in which transfers, throws, feints, and maximum range defense actions are performed, contribute to the improvement of flexibility. In ball reception, the wrist joint has to perform extensions of great amplitude in order to absorb the ball's energy (Burton, Greer, & Wiese-Bjornstal, 1992). While performing throws and transfers, numerous flexions and turns of the wrist joint are required (Pappas, Morgan, Schulz, & Diana, 1995).

In addition, although not measured, the sport schools' training staff might have contributed to the above differences owing to the greater emphasis placed on training load in the handball training group. These differences may be associated with the volume and intensity of handball

TABLE 1

MEANS, STANDARD DEVIATIONS AND *F* RATIOS FOR HANDBALL AND PHYSICAL EDUCATION GROUPS ON VELOCITY, AGILITY, AND FLEXIBILITY TASKS.

Variables	Handball (<i>n</i> = 51)		Physical education (<i>n</i> =70)		<i>F</i>	Effect Size η^2
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
10-m running	2.15	0.16	2.30	0.19	3.75*	.06
30-m running	5.35	0.43	5.65	0.52	16.15‡	.15
Tapping hand	41.84	2.59	40.27	3.37	9.65‡	.09
Running 10x5m	17.30	1.25	20.03	1.40	69.44‡	.50
Running 6x5m	11.65	0.82	13.30	1.14	28.00‡	.04
Running across 5x3m	11.68	0.66	12.75	0.79	24.22‡	.11
Sit-and-reach	15.20	5.55	14.70	7.24	6.59†	.05
Arm flexion	0.48	9.72	0.44	9.63	11.65‡	.07
Amplitude of wrist joint	154.53	9.93	142.10	10.62	56.58‡	.34
Wrist flexion	85.20	4.40	75.62	5.93	68.24‡	.40
Wrist extension	70.00	10.04	66.64	7.94	35.77‡	.29

**p*<.05. †*p*<.01. ‡*p*<.001.

training, as well as to the peculiarities by which handball is characterized. Handball could be an important element of the physical education curriculum in primary and secondary physical education. Energy expenditure, ALT-PE, teacher effectiveness and motivation of students could be measured for future research so to have more thorough-detailed conclusions.

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