

RELATIONSHIP BETWEEN OVER-ARM THROWING PATTERN AND THROWING PERFORMANCE

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Throwing is a common movement among the upper extremities activities. This study examined the relationship between throwing patterns and throwing distance. Eighty-five age 21 years old students (m = 29, F = 56) voluntarily participated in the study. Each subject threw a tennis ball as hard as they could straightforward for three trials. A video camera at subjects' right hand side was used to record the subjects' motion. The Burton's (1992) amendment of DSOT table was used to quantify the throwing patterns. Data collected was examined by Pearson correlation ($p < .05$). The results were as follows: 1. the trunk rotation was found to associated with throwing distance for the male subject, 2. the backswing and trunk rotation were associated with throwing distance for the female subject.

KEY WORDS: throwing pattern, throwing distance, over-arm throw

INTRODUCTION: Throwing is perhaps the most complex basic fundamental movement discussed among researches. Robertson (1984) described the throwing stages as a uniform sequence of structural or functional neural changes, which produce sequential changes in body movement. Wild (1938) is generally credited as setting the standards for the study of developmental throwing stages. Her classical study over a half-century ago attempted to uncover age and sex characteristics of throwing in 32 boys and girls, 2 to 12 years old and she described the over-arm throw into four developmental stages. Langendorfer (1980) studied age-related changes in the arm action components during the preparatory phase of a forceful over-arm throw. Using over 1000 trials recorded on 16mm film from a body of cross-sectional and longitudinal data, he also proposed a motor development sequence consisting of four steps. Haubenstricker (1983) and Seefeldt (1972) adapted the total-body approach and divided the over-arm throw into five development stages. Robertson (1984) measured throwing patterns and classified them into five components: the Backswing, Humerus, Forearm, Trunk, and the Foot. Gallahue and Ozmun (1998) divided the development of over-arm throw into three stages: the Initial, Elementary and mature stages. Stodden et al (2001) divided a mature over-arm throw movement into six phases: the wind-up, stride, arm-cocking, arm-acceleration, arm-deceleration and the follow-through.

There were two major approaches in analyzing the throwing movement patterns; the component approach (Payne & Isaacs, 1991; Robertson, 1977) and the total-body approach (Seefeldt & Haubenstricker, 1982). The former inspect minor changes of the motion and the latter aimed at evaluating the movement's fluency. Early researches preferred the total-body approach (Seefeldt & Haubenstricker, 1982; Wild, 1938); recently, the component approach (Robertson, 1984; Burton, 1992; Gallahue and Ozmun, 1998) was favored. The purpose of this study was to understand the relationship between throwing patterns and throwing distance, in the aim to provide insight of the effectiveness of patterns of throwing. It was hypothesized that higher grades of components is associate with further distance.

METHODS: Eighty-five students (M = 29, F = 56) aged 21 year-old, voluntarily participated in the study and no previous injuries in their eyes, ears or body parts. The participants were all right-handed, and none had received formal over-arm throwing training. A survey completed by the parent before the testing determined each subject's training experience and his/her dominate throwing hand. All participants were recruited from local public parks. The Tennis ball (mass: 56 g, diameter: 6.00 cm) were used as the throwing object. A Panasonic AG-450 camcorder was used to record the throwing performance on tape. The camera was fixed to record the right side view of each subject's throwing. To reduce the chance for injury and to increase the participants' comfort in the testing environment, four easy effort practice trials

and two medium effort trials were conducted as warm-up prior to the testing. When the subject was ready, each of them was asked to throw the ball as hard as he/she could to the forward area. Three maximal effort trials were recorded on videotape for each subject. Data were analyzed for the movement patterns. This study used the Burtons' amendment(1992) of Development Sequences for Overhand Throwing from Roberton (1984) which measured throwing patterns and classified into five components, including: Humerus (step 1-3), Forearm (step 1-3), Backswing (step 1-4), Foot Action (step 1-3) and Trunk (step 1-3). The observation and analysis of Videotapes was made by two trained judges. If the subject's movement matched the characters of level 1, he/she would get 1 point. If the subject's movement matched the characters of level 2, he/she would get 2 points. A higher point represent the movement pattern is more mature. To enhance the reliability of the judging, the two judges would first analyzed five of these children's throwing patterns. The correlation between the two judges were examined by Pearson correlation ($\alpha = .05$) as the interrater reliability. It was showed the reliability is .90. One week later, the same judges were asked to analyze the same children's throwing patterns again. The intrarater reliability of the two judges is .93. The relationship between the developmental skill patterns of children's throwing and throwing distance was examined by Pearson correlation ($\alpha = .05$).

Table 1 Throwing pattern scores.

		Backswing	Humerus	forearm	Trunk rotation	Foot Action	Sum
Male (29)	mean	3.89	2.10	2.10	2.06	3.00	13.21
	± SD	0.30	0.30	0.30	0.25	0.00	0.90
Female (56)	mean	3.63	2.04	2.04	2.02	2.95	17.26
	± SD	0.49	0.18	0.19	0.13	0.22	3.36

RESULTS: The Mean values for total developmental pattern and five components of the male students were shown in Table 1.

In Table 2, we could find that the trunk rotation skill was associated with throwing distance in male subject. As to female, the backswing and trunk rotation skill were associated with throwing distance.

Table 2 The correlation between throwing patterns and throwing distance (N=85).

Variable	male (N=29)	female (N=46)
	P	P
Total developmental pattern	.288*	.442*
Backswing Action	.019	.336*
Humerus Action	.219	.217
Forearm Action	.219	.217
Trunk Action	.382*	.388*
Foot Action	----	.104

CONCLUSIONS: The average point of the total developmental pattern in this study was comparable to study done by Roberton (1984) for both male and female subjects. The Foot action had achieved the mature movement pattern, whereas the Forearm, trunk, humerus and trunk didn't for both gender too. In this study. The other results showed that the subjects in this study didn't achieve the highest mature throwing developmental pattern yet. A mature throwing pattern could result in further throwing distance.

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