# Upper Body Range of Motion Correlation Toward Elementary School Students' Manipulative Skill

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**Abstract.** This study aimed to evaluate the correlation between upper body range of motion toward manipulative skills. The upper body range of motion variables was arm flexion, arm extension, arm abduction, and arm adduction. The manipulative skill variable was ball throwing velocity, measured by a speed gun. The research was conducted with a quantitative approach with correlational methods. One hundred twenty-six elementary students participated as research samples. The samples were selected by using a random sampling method. The correlation product moment test was performed by SPSS 26 Computer Software. The result showed a significant correlation between upper body range of motion toward manipulative skill (Sign. $<$ 0.05). In further detail, the significant correlation toward throwing velocity was arm flexion (0.04), arm extension (0.01), arm abduction (0.00), and arm adduction (0.007). In conclusion, these results indicate that the upper body range of motion correlates positively with manipulative skill, especially in throwing velocity.

**Keywords:** Gait Analysis · Biomechanics Analysis · Fundamental Movement · Physical Education

## 1 Introduction

### 1.1 Fundamental Movements

Fundamental movement is a foundation for advanced movement. Excellent fundamental movements could support children in performing complex movements [1]. Essential movement skills must be developed from childhood and then directed to specific abilities in sports [2, 3]. Fundamental movements are ideally taught in childhood by paying attention to the child's growth and development [4]. This is because fundamental movements help improve children's sensory-motor skills [5]. Every child can reach the stage


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of gross motor development, especially optimal movement abilities when getting the proper stimulation [6]. In addition, the Mastery of Fundamental movement has a role in children's cognitive, physical, and social development [7]. Fundamental movement is also considered the essential motivator for children to live active lives [2, 8]. Fundamental movements are divided into three categories, i.e., non-locomotor movement, locomotor movement, and manipulative movements.

Non-locomotor motion is a movement carried out in place and without any space for a movement that uses the ability of this movement to bend, push, pull, lift, lower, and so on [9]. The non-locomotor movements measured in this study included balance and range of motion. Locomotor movement is moving the body from one place to another [10]. Locomotor motion is the basis for developing coordination of movements involving gross muscles, muscle growth, endurance, and stamina [11]. The locomotor movements analyzed in this study were running and standing board jumps. Manipulative motion is related to the ability to control or play an instrument so that a movement skill is formed [12]. Manipulative movement skills are movements that require objects to be used as a medium of movement. Examples of manipulative movements include kicking, throwing, hitting, and so on. Manipulative motion can be improved by using traditional games. Siregar, Sari, Budiningsih, & Zulham (2021) said that the increase in manipulative movements from the initial test results was 19.7 to 22 in the final test. Manipulative movements in this study include throwing and kicking the ball. The most significant period for the development of the Fundamental movement is at the age of under seven years [14, 15]. Children's motor skills will develop along with biological maturity [16]. During physical activity and play, children learn to control their bodies. They consciously or not have done FMS, for example, running, jumping, crawling, throwing, and catching the ball [17, 18]. There is convergent evidence that physical play that requires high energy can improve children's cognitive abilities [19] and behavior [20].

### 1.2 Manipulative Skills

Alawiyah (2014) defined manipulative motion as a movement that uses an object or tool in its implementation. In line with this, manipulative motion is a skill that involves the control of an object, such as a ball, beanbag, ring, ribbon, or frisbee (Al Ardha et al., 2018). This means that manipulative movements cannot be separated from movements that use the hands and feet, although other body parts can also be used [23]. Manipulative movements that use the hands and feet as the dominant body parts, manipulative movements are certainly an ability that must be possessed by everyone, especially in early childhood in the process of growth and development. According to Yasbiati [23], manipulative motion is divided into two parts: receiving and pushing. Receiving movements, for example, are catching and controlling while trying movements, including throwing, hitting, and kicking.

Throwing is a movement to move an object away from the body through the medium of air by using the hands [24]. This means the arm plays an essential role in carrying out the movement. Several techniques are generally used in throwing, such as using one or two hands from above or below the head. Throwing motion has an essential role in daily activities, especially in sports. Some sports related to throwing moves include baseball, cricket, basketball, handball, petanque, and many more. In throwing motion, two things

need attention, namely accuracy and speed. These two things are essential components when doing sports that involve throwing movements. For example, in basketball, the accuracy component in this sport is necessary, where accuracy affects getting points when throwing a ball into the ring [25]. Another example is baseball. A pitcher/thrower in baseball makes speed a vital component when throwing so that it is not easily hit or obtained by the opponent [26].

### 1.3 Range of Motion (ROM)

Range of Motion (ROM) is a joint's maximum movement in any of the three body parts, namely sagittal, transverse, and frontal [27]. The sagittal section is a line that runs through the body from front to back, dividing the body into left and right halves. The frontal cut passes through the body side to side and divides the body into front-to-back sections. A transverse amount is a horizontal line that divides the body into upper and lower halves. Joint mobility in each cut is limited by ligament, muscle, and joint construction. Some joint motions are specific to each amount. In the sagittal section, the movements are flexion and extension (fingers and elbows) and hyperextension (hips). In the frontal passage, the movements are abduction and adduction (arms and legs) and eversion and inversion (legs). In the transverse section, the movements are pronation and supination (hand), internal and external rotation (knee), dorsiflexion, and plantarflexion (foot). Movement can be seen as the bones being moved by muscles or other external forces in their range of motion through the joints. When movement occurs, all the structures found in the joint will be affected.

Throwing motion can change bone and soft tissue development during the development of bone adaptation, and this is often seen in the larger humerus of the arm that is often used for throwing balls. The shoulder joint has a significant role in the throwing motion when throwing from above, below, or from the side of the head. In throwing movements from above and below the head, flexion and extension movements contribute to this movement (Vardakastani, 2018). Meanwhile, in the throwing motion from the side, the adduction and abduction movements are working. The overhead throw creates a unique glenohumeral ROM range. External rotation is more significant than Internal Rotation in the overall degree of motion retention [28]. This study aimed to evaluate the correlation of upper body ROM toward manipulative skill, particularly in throwing.

That uses or does not use tools spontaneously, is flexible, fun, not forced, and develops children's imagination power without considering the result. Thus, playing can be interpreted as an activity carried out either using tools or not using fun tools that help children's growth and development. That the world of children is the world of play, where playing for them can be said to be a core or main activity. Space has a vital role in the development of children in almost all areas of development, including physical-motor development, language, intellectual, moral, social, and emotional [15]. Traditional games are the nation's cultural heritage and heritage from their ancestors whose existence must be preserved. As a child of the government, it is an obligation to maintain the presence of these traditional games. Traditional games are not just games, and there are values and cultural elements inherent in them. Each region in all corners of Indonesia has classic games that characterize the area.

Traditional games have positive values that can be instilled in children. These values are all excellent and valuable in a child's life. The traditional game in this study is the ongsrotan game.

## 2 Method

### 2.1 Research Method

The research was conducted with a quantitative approach with comparative and correlational methods. One hundred twenty-six elementary students participated as research samples. The samples were selected by using a random sampling method (Table 1).

### 2.2 Research Procedure

The range of motion data was collected using an excellent human track (Figs. 1 and 2). The upper body range of motion variables was arm flexion, arm extension, arm abduction, and arm adduction. The manipulative skill variable was ball throwing velocity, measured by a speed gun. Each sample was trained in the manipulative skill before the test. Furthermore, the manipulative skill test was repeated three times, and selected the best result.

**Table 1.** Research Sample

| | First Grade | Second Grade | Third Grade | Fourth Grade | Sixth Grade | Total |
|---|---|---|---|---|---|---|
| Male | 7 | 8 | 18 | 21 | 12 | 66 |
| Female | 6 | 13 | 11 | 10 | 20 | 60 |
| Total | 13 | 21 | 29 | 31 | 32 | **126** |


**Fig. 1.** Arm Flexion and Extension

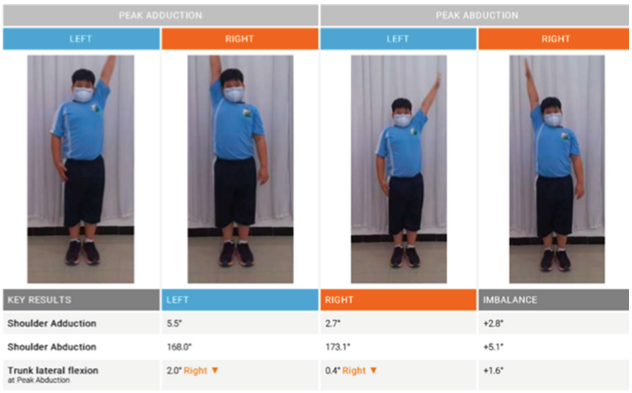


**Fig. 2.** Arm Abduction and Adduction

**Table 2.** Normality Test Result

| | Mean | SD | Sign |
|---|---|---|---|
| Age | 9,57 | 1,68 | 0,00 |
| Height | 133,54 | 11,11 | 0,18* |
| Arms Span | 136 | 11,51 | 0,18* |
| Arm Flexion | 186,28 | 22,04 | 0,06* |
| Arm Extension | 40,39 | 20,41 | 0,12* |
| Arm Abduction | 128,79 | 72,31 | 0,08* |
| Arm Adduction | 59,27 | 75,95 | 0,06* |
| Throwing Velocity | 8,4 | 2,1 | 0,13* |

* Data in the standard distribution (sign > 0.05)

## 3 Result and Discussion

### 3.1 Normality Test

The Kolmogorov-Smirnov normality test was applied to compare the data distribution with the usual distribution standard. As a result, arm span and flexion are in the standard distribution (sign > 0.05). However, the other variables are not in the standard distribution (sign < 0.05). The non-parametric test was conducted to evaluate further analysis, particularly the correlation between upper body range of motion toward manipulative skill (Table 2).

### 3.2 Correlation Test

The Pearson Product Moment test was applied to find a significant correlation between the upper body's range of motion toward manipulative skill (Table 3). The results show a

**Table 3.** Correlation Test Result

| | **Sign** |
|---|---|
| Arm Flexion - Throwing Velocity | 0,04* |
| Arm Extension - Throwing Velocity | 0,02* |
| Arm Abduction - Throwing Velocity | 0,00* |
| Arm Adduction - Throwing Velocity | 0,007* |

substantial correlation between upper body range of motion (ROM) toward manipulative skill (sig. $< 0.05$). The fundamental movement skill is essential to support the children in performing throwing skills [29]. The correct kinematic movement of the throwing will be beneficial to the throwing accuracy and velocity [30].

## 4 Conclusion

Based on the result of this study, it can be concluded that there are correlations between upper body range of motion (ROM) and manipulative skill, especially in throwing velocity. The ROM of the upper body supports the kinematic moment in throwing. Furthermore, students could perform throwing abilities effectively. Further study could be conducted to evaluate the kinematic mechanics of throwing.

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