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Range of motion of the upper limb among right and left-handed table tennis players aged 7-10

Zakres ruchomości kończyny górnej wśród praworęcznych i leworęcznych tenisistów i tenisistek

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Abstract

Aim of the study. the aim of the study was to assess the range of motion of the upper limb among right and left-handed table tennis players aged 7-10 years and to analyze the influence of the playing hand on the range of motion. Material and methods. the study covered 103 table tennis players who had a license in Silesian sports clubs for at least a year – 32 girls and 71 boys aged 7-10. One of the inclusion criteria for the study was participation in at least three training sessions per week. Among children, the range of motion of the upper limb was measured using the inertial GYKO device. Collected results were subjected to statistical analysis using a nonparametric U Mann Whitney test. Results. Right-handed children playing table tennis showed a significantly greater range of motion of the right upper limb both during flexion and abduction movements. In turn, among left-handed children, the range of motion during both movements was significantly greater in the left upper limb. Conclusions. Among the athletes, a relationship between the playing hand and the range of motion of the right and left upper limb both during flexion and abduction movements was found ($p < 0.05$). The participants had a significantly greater range of motion of the upper limb with which they played table tennis. Research has shown that among young table tennis players from the Silesian Voivodeship, therapeutic procedures are necessary to increase the range of motion of the non-playing hand.

Key words:

table tennis, sport, range of motion, children

Streszczenie

Cel pracy. Celem niniejszej pracy była ocena zakresu ruchomości kończyny górnej wśród praworęcznych i leworęcznych tenisistów i tenisistek stołowych w wieku 7–10 lat oraz analiza wpływu ręki grającej na badany zakres ruchomości. Materiał i metodyka. Badaniem zostało objętych 103 tenisistów i tenisistek stołowych posiadających od minimum roku licencję zawodniczą w śląskich klubach sportowych – 32 dziewczynki i 71 chłopców w wieku 7–10 lat. Warunkiem koniecznym uczestnictwa w badaniu był udział w minimum trzech treningach tygodniowo. Wśród dzieci wykonano pomiar zakresu ruchomości kończyny górnej za pomocą inercyjnego urządzenia GYKO. Zebrane wyniki poddano analizie statystycznej za pomocą nieparametrycznego testu U Manna Whitneya. Wyniki. Wśród praworęcznych dzieci grających w tenisa stołowego wykazano istotnie większy zakres ruchomości prawej kończyny górnej zarówno podczas ruchu zgięcia, jak i odwodzenia. Z kolei wśród leworęcznych dzieci zakres w trakcie wykonywania obu ruchów był istotnie większy w lewej kończynie górnej. Wnioski. Wśród badanych sportowców wykazano zależność między ręką grającą a zakresem ruchomości prawej i lewej kończyny górnej zarówno podczas ruchu zgięcia, jak i odwodzenia ($p < 0,05$). Badani charakteryzowali się istotnie większym zakresem ruchomości kończyny górnej, którą grali w tenisa stołowego. Badania wykazały, że wśród młodych tenisistów i tenisistek stołowych, grających na terenie województwa śląskiego konieczne jest postępowanie terapeutyczne mające na celu zwiększenie zakresu ruchomości ręki niegrającej.

Słowa kluczowe:

tenis stołowy, sport, zakres ruchomości, dzieci

Introduction

The problem of hypokinesia among children is becoming more and more common [1]. Physical activity undertaken regularly by children plays a positive role in their proper development [2, 3, 4]. The decision to engage in one sport until adulthood is often made when the child is only a few years old – so that it is possible to develop the correct technique during the period of life when the child learns most quickly and absorbs new patterns. Regular physical activity, including table tennis, allows to maintain the correct body mass composition – the normative content of fat and muscle tissue in the body, not only among children, but also among adults [5].

Table tennis is one of the Olympic disciplines that requires players' strength, speed, endurance, but also well-developed eye-hand coordination [6, 7]. It is a technical sport [8] and requires simultaneous work of the upper and lower limbs. Moreover, table tennis is considered one of the fastest sports in the world [9]. During an ongoing rally, a player has only a split of a second to react to the opponent's hit and then to decide how to hit and where to land a ball [10, 11].

Table tennis players tend to have a slim, athletic build, with stronger arms and thighs. The higher body mass of a table tennis player slows down his movement at the table, which makes it more difficult to achieve high sports results in this discipline.

The range of motion of the upper limb also plays a significant role in achieving high sports results in table tennis. Full mobility of the playing upper limb provides greater ease in hitting the ping-pong ball and allows you to receive the opponent's shots even with unfavorable positioning of the lower limbs, which would be impossible with limited mobility of the playing hand. Greater mobility also reduces the risk of injury during sudden movement of the upper limb. Among table tennis players, injuries of the upper limb related to its range of motion are the most common [12]. Injuries of the knee and ankle joint are equally common among male and female tennis players [13, 14]. Their stability plays an important role during rally. Table tennis is a sport in which quite often, during rallies with an opponent, the player is forced to take one or often both feet off the ground at the same time. A stable landing is particularly important to avoid injuries.

Equally important is the range of motion of the non-playing upper limb – it helps provide the player with stability during quick and often unexpected changes in the position of the lower limbs by the table.

Aim of the study

The aim of the study was to assess the range of motion of the right and left upper limb among right and left-handed table tennis players aged 7-10. The main research hypothesis was that among table tennis players aged 7-10, there is a relationship between the playing hand and the range of motion of the upper limb.

Material and methods

The research involved 103 table tennis players of both sexes, aged 7–10. The inclusion and exclusion criteria for the study are presented in Table 1.

Table 1. Inclusion and exclusion criteria for study

Inclusion criteria	Exclusion criteria
<ul style="list-style-type: none">• Age 7–10 years• Written consent of the players' parents or legal guardians• Participation in at least 3 training sessions per week• Competitive license for at least one year• No movement dysfunctions/disabilities	<ul style="list-style-type: none">• Age under 7 or over 10 years• Lack of written consent from the players' parents or legal guardians• Giving up on training• Lack of a competitive license or time of possession it for less than one year• Physical disability

The study group consisted of 32 girls and 71 boys. The population of children playing table tennis in Poland aged 7–10 in the Silesian Voivodeship in the 2022/2023 season included 153 players with a clear numerical predominance of boys (98 boys and 55 girls).

Each of the player declared their "playing hand" – right or left. The number of right-handed and left-handed table tennis players is presented in Table 2.

Table 2. Characteristics of the players according to the playing hand

Playing hand	Number of male players	Number of female players
Right	45 (63.38%)	21 (65.62%)
Left	26 (36.62%)	11 (34.38%)

The data from Table 2 indicate a clear predominance of right-handed people (over 60% of the surveyed players).

The research was conducted from September to December 2022 with the consent of the bioethics committee of the Medical University of Silesia in Katowice. Table tennis players were recruited for the study from professional table tennis clubs in the Silesian Voivodeship. Participation in the research was voluntary.

Among the athletes, the range of motion of the upper limb was analyzed using the inertial GYKO device – one of the

most modern measuring device, which is used both in sports and rehabilitation. Analysis of the range of motion using the GYKO device is a non-invasive method that allows immediate viewing of the results in the RePower software.

The research results were subjected to detailed statistical analysis using the Statistica StatSoft Polska program. Normality of distribution was checked using the Shapiro Wilk test. The results of the analysis of the range of motion were subjected to the non-parametric U Mann Whitney test. In this study, statistical significance was assumed at p value < 0.05 .

Results

Among the table tennis players, in the first stage of the study, the range of motion of the upper limb was analyzed during flexion and abduction movements with both the right and left upper limb. Table 3 shows the results for flexion movement among right- and left-handed children playing table tennis.

Table 3. Range of motion of the right and left upper limb during flexion among right- and left-handed children

	Right-handed children		Left-handed children	
	Right upper limb	Left upper limb	Right upper limb	Left upper limb
Mean	162.58°	153.82°	155.19°	164.57°
Minimum	128.00°	115.00°	132.00°	138.00°
Maximum	180.00°	177.00°	179.00°	180.00°
SD	± 12.13	± 13.02	± 13.16	± 11.94
Quartile range	19.00	17.00	20.00	19.00

The results from Table 3 indicate that during performing a flexion movement, right-handed children had a greater range of motion of the right upper limb, while among left-handed children this range was greater in the left upper limb. The data from Table 3 were statistically analyzed using the non-parametric U Mann Whitney test. The results of the analysis are presented in Table 4 and Figures 1 and 2.

Table 4. Playing hand and the range of motion of the right and left upper limb during flexion – U Mann Whitney test

Range of motion of the upper limb	Playing hand						p-value
	Right-handed children			Left-handed children			
	Mean	SD	Total rank	Mean	SD	Total rank	
Right upper limb	162,58°	± 12.13	1269.50	155.19°	± 13.15	500.50	0.040962
Left upper limb	153,82°	v13.02	968.50	164.57°	± 11.94	801.50	0.005921

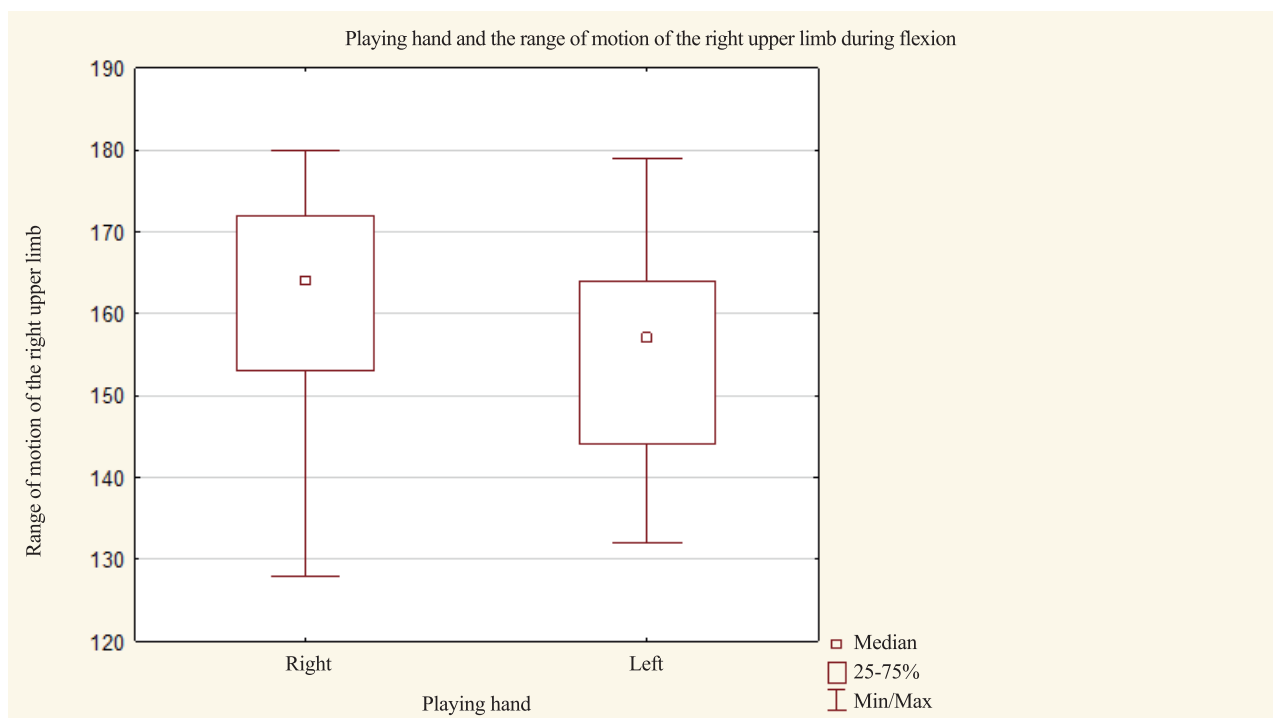


Fig. 1. Relationship between the playing hand and the range of motion of the right upper limb during flexion movement



Fig. 2. Relationship between the playing hand and the range of motion of the left upper limb during flexion movement

The results of the U Mann Whitney test ($p < 0.05$) allow the conclusion that the range of motion of the right upper limb during flexion among right-handed table tennis players is significantly greater than among left-handed table tennis players. In turn, the range of motion of the left upper limb during flexion among left-handed table tennis players is significantly greater than among right-handed table tennis players. Therefore, the relationship between the playing hand and the range of motion of the right upper limb during flexion is statistically significant (Figures 1 and 2).

Among the athletes, the range of motion of the right and left upper limb was analyzed, also during abduction movements. The results of this measurement are presented in Table 5.

Table 5 Range of motion of the right and left upper limb during abduction among right- and left-handed children

	Right-handed children		Left-handed children	
	Right upper limb	Left upper limb	Right upper limb	Left upper limb
Mean	163.92°	155.76°	156.81°	163.00°
Minimum	136.00°	125.00°	123.00°	144.00°
Maximum	180.00°	175.00°	177.00°	179.00°
SD	± 11.82	± 12.61	± 13.01	± 10.29
Quartile range	16.00	16.00	11.00	16.00

The data from Table 5 indicate, similarly to the case of flexion movement, that during the abduction movement, right-handed children had a greater range of motion of the right upper limb, and left-handed children had a greater range of motion of the left upper limb.

The data from Table 5 were statistically analyzed using the non-parametric U Mann Whitney test. The results of the analysis are presented in Table 6 and Figures 3 and 4.

Table 6. Playing hand and the range of motion of the right and left upper limb during abduction – U Mann Whitney test

Range of motion of the upper limb	Playing hand						p-value
	Right-handed children			Left-handed children			
	Mean	SD	Total rank	Mean	SD	Total rank	
Right upper limb	163.92°	± 11.82	1281.00	156.81°	± 13.01	489.00	0.025916
Left upper limb	155.76°	± 12.61	1008.50	163.00°	± 10.29	761.50	0.036603

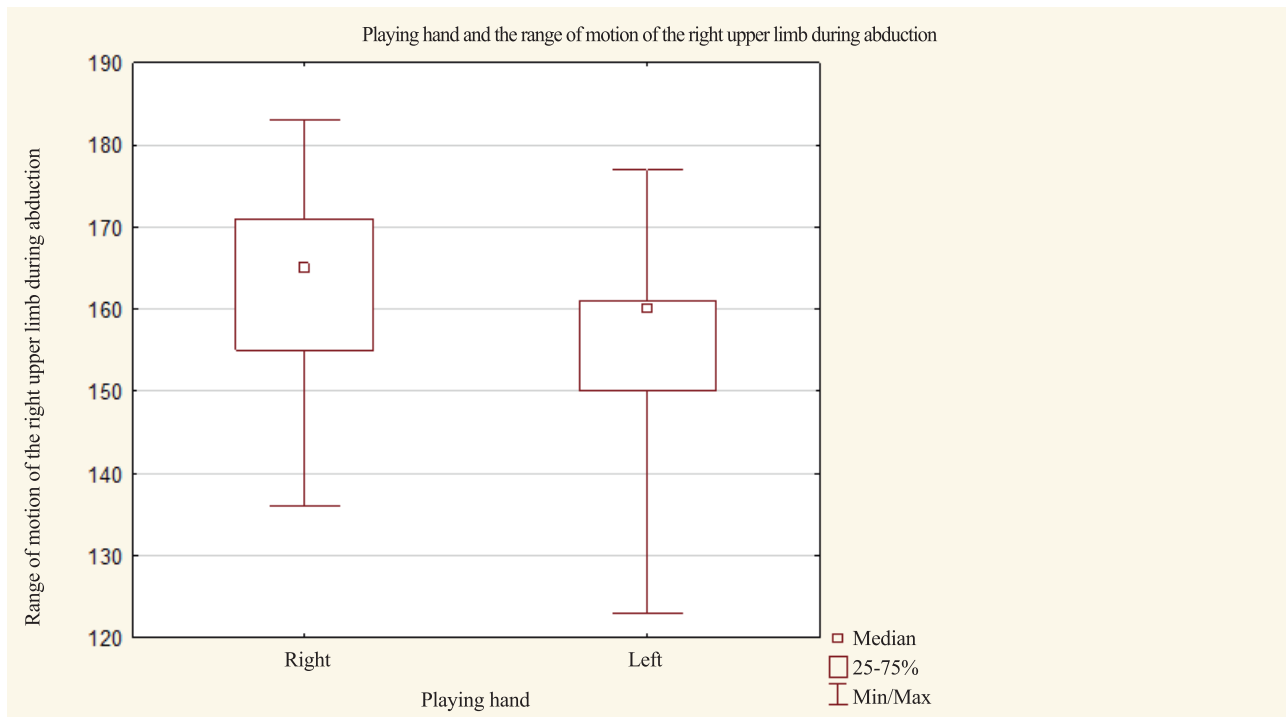


Fig. 3. Relationship between the playing hand and the range of motion of the right upper limb during abduction movement

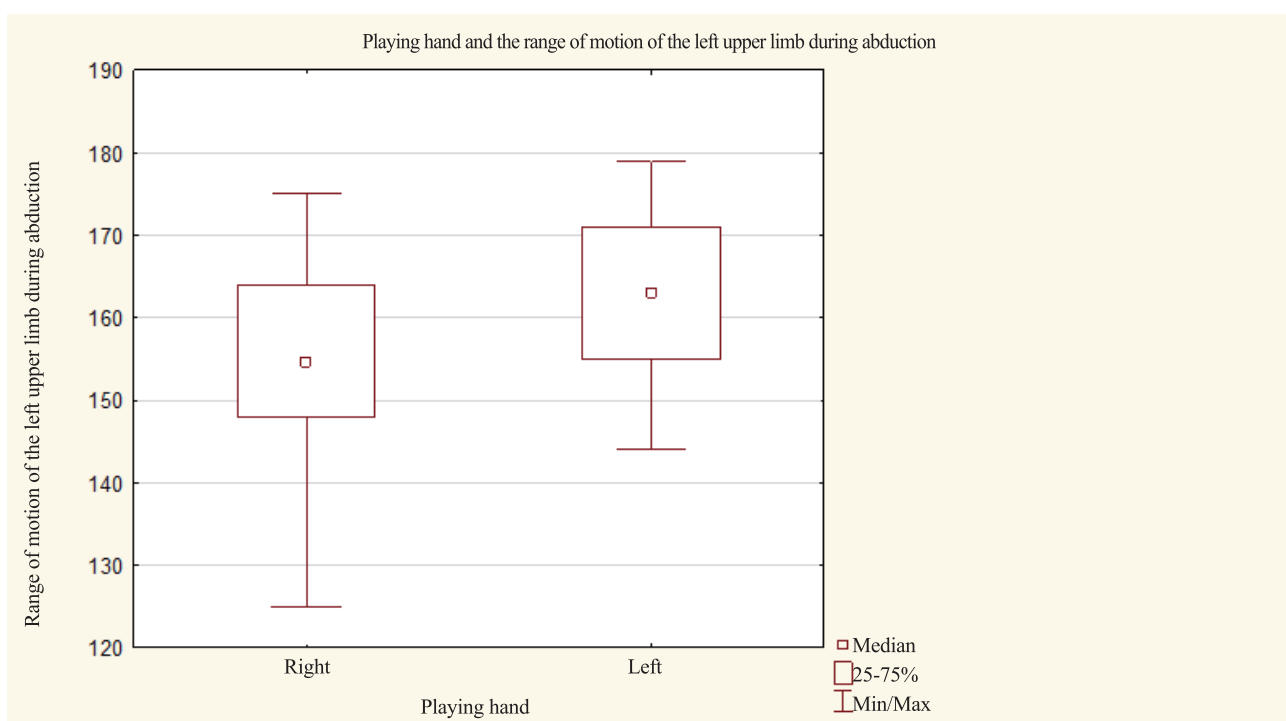


Fig. 4. Relationship between the playing hand and the range of motion of the left upper limb during abduction movement

The results of the U Mann Whitney test ($p < 0.05$) allow the conclusion that the range of motion of the right upper limb during abduction among right-handed table tennis players is significantly greater than among left-handed table tennis players. In turn, the range of motion of the left

upper limb during abduction among left-handed table tennis players is significantly greater than among right-handed table tennis players. Therefore, the relationship between the playing hand and the range of motion of the right and left upper limb during abduction is statistically significant (Figures 3 and 4).

Discussion

Measuring the range of motion may be subject to the risk of error [15], so it is necessary to use methods that will allow obtaining correct and reliable results. One of these methods may be measuring using a modern, inertial GYKO device, the result of which is immediately visible in the RePower software.

Table tennis is a technical sport in which the range of motion of the upper limb is very important. Research has shown that among the best players of various disciplines, the range of motion of the upper limb is greater than among those at a lower sports level [16].

Among athletes playing table tennis, researchers indicate that upper limb injuries are one of the most common [17]. The relationship between the range of motion of the upper limb in the pre-season and the risk of injury during the season was studied by Pozzi et al. It was showed that athletes practicing baseball and swimming are most at risk, while in the case of other athletes (handball, volleyball and tennis) pre-season range of motion screening tests were not sufficient to determine the risk of injury [18].

Tooth et al., in turn, concluded in their research that both the deficit in the range of motion of the upper limb and its excessive mobility may result in injury. They considered previously existing injuries to be another factor increasing the risk of injury [19]. Table tennis is a sport in which both the deficit of mobility and its excessive range may result in injury as a result of sudden movement of the upper limb. Moreover, a symmetrical range of motion in both upper limbs is important, because the non-playing hand (providing the player with stability) is as important during a rally with an opponent as the playing hand.

Cigercioglu et al. obtained similar results to the own research among 42 tennis players (average age was 11.3 and average BMI 18.3). The range of external range of motion of the upper limb was greater in the case of the dominant side, while the range of internal motion of the upper limb was greater in the non-dominant limb. Researchers showed that girls were more likely to have a greater range of motion of the dominant upper limb than boys. One of the conclusions of the indicated studies were significant statistical differences in the range of motion of the dominant and non-dominant upper limb [20]. Own research, conducted among table tennis players also showed statistically significant differences in the range of motion of the playing and non-playing hand ($p < 0.05$).

Cejudo also conducted research on the range of motion of the upper limb among athletes. In that research, authors tried find the ideal range of motion of the upper limb that CrossFit athletes should have. Studies have shown that

when performing a flexion movement, the optimal range will be 173° [21]. In own research, the average range of motion of the playing upper limb among young male and female table tennis players was almost 163° in right-handed children and almost 165° in left-handed children, respectively.

Research by Bullock et al. showed that a deficit in the range of motion of the upper limb may result in injuries among athletes - baseball players [22]. In own research, asymmetry in the range of motion of the playing and non-playing upper limb may contribute to the occurrence of an injury among young athletes, which may exclude the child from professional training for a long period of time.

In turn, Colomar et al. pointed out that the range of motion of the upper limb among tennis players may influence the speed of the serve [23]. Among the table tennis players - participants of own study, the range of motion of the upper limb may affect the quality of the forehand top spin hit - a wide range of motion is desirable when performing the movement.

Conclusions

Among the examined athletes, a relationship was found between the playing hand and the range of motion of the right and left upper limb both during flexion and abduction movements ($p < 0.05$).

Children had a significantly greater range of motion of the upper limb with which they played table tennis.

Research has shown that among young table tennis players playing in the Silesian Voivodeship, therapeutic procedures are necessary to increase the range of motion of the non-playing hand. Increasing the range of motion of the non-playing hand may contribute to the subjects' achieving higher sports results at a later stage of their professional career. It may also help to eliminate related pain with limited mobility of one of the upper limbs, which may appear in adulthood.

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