52 - COMPARISON BETWEEN THE LEVEL OF FLEXIBILITY IN THE FOUR SWIMMING STYLES FOR FEMALE ATHLETES

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INTRODUCTION

Flexibility is an important physical quality of the neuromuscular function, responsible for maintaining a broad range of appropriate joint movements, providing individuals with an easier and more efficient motion. Also, it helps to refine sports techniques, increases the mechanic capacity of muscles and joints, allowing for a more economic use of energy. Besides that, it can act as a lesion inoculator, helping develop efficiency, speed and strength (LIMA & SILVA, 2006). Joint mobility is also related to reaction and resistance (GOMES & FRANCISCON, 2000).

Knowing the levels of flexibility in swimmers in their different styles is of great importance for Physical Education professionals to create action plans to improve the development of athletes, respecting their individual characteristics and how experienced they are (JEFFERSON apud ZOGAIB et al., 2005).

Studies are unknown that accurately establish the ideal or most suitable flexibility degree in terms of age, gender or race for swimmers specialized in one of the four styles. According to Silva et al (2006), flexibility is a specific physical capacity, i.e., a swimmer can have good mobility in the hip region and low mobility in the shoulder region, depending on the most demanded joint in his/her style of specialization.

In swimming, there are four styles of competition, whose performance can be improved or worsened depending on the levels of flexibility of the athletes. These include the butterfly, backstroke, breaststroke and crawl style.

In the butterfly style, where arms and legs make simultaneous movements in the vertical plane, two leg-strokes are performed per arm-stroke cycle, as described by Maglischo (1999). This leg-stroke is known as dolphin, consisting in an upward and subsequent downward leg-stroke, therefore helping the waving movement. In this style, the propulsion caused by the legs only corresponds to 40% of the total, while the arms account for the other 60%. The kind of breathing typically used is the frontal breathing.

The backstroke style is very similar to the crawl style, except for the fact that it is done in a supine position with “arms and legs making alternate movements with six leg-strokes per arm-stroke cycle” (MAGLISCHO, 1999). The backstroke style arm-stroke is less propelling than the crawl style's, and corresponds to 80% of the swimming propulsion as a result of the anatomic limitation of the shoulders in the backward rotational movements.

According to Maglischo (1999), the breaststroke style is the slowest of all competition modalities, since the arm and leg movements occur simultaneously and under water in a horizontal plane. Swimmers perform a short semicircular arm-stroke and a leg-stroke consisting of a flexion of the leg over the thigh followed by a stretching with leg adduction and the feet in dorsiflexion. The leg-stroke corresponds to 50% of the swimming style's total propulsion, the same percentage noticed for the arms. For each arm-stroke cycle there is a leg-stroke, and the frontal kind of breathing is used at each leg-stroke and arm-stroke cycle.

Finally, the crawl style “has evolved to become the fastest of all four styles of competition and its cycle consists of a rightward and leftward arm-stroke and of a variable number of leg-strokes” (MAGLISCHO, 1999), either with two, four or six times. The arm and leg movements are alternate as in the backstroke style. The arms perform 85%-90% of the propulsion while the legs account for 10%-15% only. Lateral breathing is used during the propelling phase of one of the arms. High-efficiency athletes breathe on the highest efficiency side.

OBJECTIVES

This study aims to assess the level of flexibility of swimmers specialized in one of the four swimming styles and, later, check in which part of the body each swimming style further develops flexibility.

RESEARCH METHODOLOGY

The sample was intentionally selected and comprised of 8 female individuals between 13-20 years old, with mean age of 17.62 years. Participation was voluntary under signed consent according to CNS Resolution 196/96.

Individuals who were assessed have practiced swimming specialized in one of the four styles for a minimum of 3 and a maximum of 13 years, with an average of 8.75 years of practice, at least five times a week for approximately 2 hours, divided into groups of two athletes per swimming style.

Twenty flexibility-testing procedures were applied in this study through the use of *Flexiteste* (ARAÚJO, 1987), whose aim is to measure ankle, knee, hip, trunk, wrist, elbow and shoulder flexibility.

According to Coelho & Araújo (2000), in *Flexiteste*, the movements to assess are performed by the researcher in different standardized positions and the range degree obtained is compared with those of maps predetermined by the test, by assigning progressive degrees in a discontinuous and ascending scale from 0 to 4 points, corresponding to low and high range of movement, respectively. The maximum score to achieve in the ankle/knee, hip and wrist/elbow regions is 16 points each. In the trunk region, twelve points can be achieved, and in the shoulder, a maximum of 20 points.

Besides analyzing the mobility of each joint movement specifically, *Flexiteste* allows the examiner to add up the values in each movement to find a global flexibility index, called *FlexIndex*, ranging from 0 to 80 points. Despite this, there are no clinically validated *FlexIndex* values which indicate clinical hypo and hyper-mobility features (ARAÚJO, 2000).

RESULTS AND DISCUSSIONS

Values obtained in *Flexiteste* were grouped together according to each swimmer's specific style and the body region being assessed. For each value determined, the average was calculated and the classification done, as shown in Table 01.

Table 01. Average of values obtained in *Flexiteste* (ARAÚJO, 1987).

Swim styles/Region	Ankle and Knee	Hip	Trunk	Wrist and Elbow	Shoulder	Overall
Butterfly	11	**14.5**	11.5	11	14	**62**
Backstroke	11.5	11	8.5	9.5	**15**	50.5
Breaststroke	10	12	10.5	10	**14.5**	57
Crawl	9.5	10.5	9	10.5	**11.5**	51
Possible total values	16	16	12	16	20	80

By looking at Table 01, we can see that the butterfly style shows a greater index in relation to hip movement (14 and 15).

The ankle/knee, wrist/elbow and shoulder regions were classified above the average whereas the hip and trunk region were classified well above the average. As described by Farinatti (2000) in his review article, good shoulder flexibility helps recover arm-stroke. Also, a great hip and trunk flexibility allows for broad waving movements which sustain the swimmer, especially during breathing. The other regions help propel and maintain the appropriate swimming technique.

In the backstroke style (Table 02), the greatest index obtained is related to shoulder movement (15). The wrist/elbow region fell in the average, whereas the other ones, i.e., ankle/knee, hip, trunk and shoulder fell above the average. According to Marino (1984), "good shoulder flexibility is crucial during the pull in backstroke", since the backward rotational movement is limited by the anatomic condition. This explains the high score achieved by the swimmers in this region.

In the breaststroke style, we could see that a greater index was achieved in the shoulder region (14.5 and 13) as shown in Table 03. The ankle/knee and wrist/elbow joints ranged within the average, while the hip and shoulder were above the average, and the trunk well above the average. According to Vervaecke & Persyn (1979), the best backstroke swimmers seem to have good flexibility, particularly developed in the ankle joints, together with the foot surface size, resulting in a great ability to perform technically efficient gestures.

In the crawl style, the greatest index found was related to shoulder movement (13 and 10). The ankle/knee, hip, wrist/elbow, and shoulder regions were classified within the average, whereas the trunk fell above the average, as seen in Table 04. Skipka, Rader & Wilke (1986) propose that asymmetries in performing the crawl style could originate from equally asymmetric levels of flexibility, since these patterns can influence the performance of different swimming styles among swimmers of the same style.

According to Farinatti (2000), a good technique to perform a certain style together with a good flexibility technique can result in great increase in propulsion, as is the case of the breaststroke style leg-stroke. Also, a great joint mobility in the shoulder, arms and trunk helps the performance of the movements required by each style, without changing the position of the body in water. As an example, he mentions the recovering of the arm-stroke in the crawl style, where it is necessary to run the arm over the water without touching the water in order to achieve a better body rotation.

By using the FlexIndex Classification Table (ARAÚJO, 1987), we conclude that in the butterfly style, an overall average of 62 is considered excellent. In the backstroke, the average was 50.5, classified as median. In the breaststroke and crawl styles, the values found were 57 and 51, respectively, and flexibility was classified as good.

CONCLUSION

It is very important that swimming coaches be able to differentiate the flexibility training aspects and how these should be applied in the preparation of their swimmers. During the physical preparation, we should focus on the muscle groups and on the joints used in the movements for each swimming style, although the ideal level of flexibility is still unknown for each athlete specialized in one of the four styles. However, it is possible to evolve and maintain the level of flexibility achieved at any age, regardless of gender (COELHO & ARAÚJO, 2000).

According to the results found in the study, we could see that the swimming style that requires the greatest flexibility is the butterfly, since, in the overall average of the *Flexiteste* accumulated score, joint mobility was classified as excellent. The backstroke swimmers' flexibility was classified as median, while the breaststroke and crawl reached good level.

We can see that the butterfly style swimmers must work hard to achieve good flexibility in the hip region, due to the waving movement this style requires to make the swimming more economic and efficient. In the backstroke, breaststroke and crawl styles, closer attention should be given to the shoulder region since this is where the propelling movements are largely concentrated for these swimming styles.

The female athletes assessed showed good level of flexibility since none of them had indexes below average. However, it is important to emphasize that the less flexible regions need to be worked so that the different swimming style techniques may be better performed, although the *FlexIndex* does not have its values clinically validated to indicate a joint hypo or hyper-mobility, as mentioned by Araújo (2000). According to Farinatti (2000), swim coaches "should consider age, gender, time of the day, local temperature and the individual training capacity, since these are aspects that determine the improvement of the flexibility capacity".

A greater sample study is suggested, including male athletes in order to check for potential differences between genders.

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COMPARISON BETWEEN THE LEVEL OF FLEXIBILITY IN THE FOUR SWIMMING STYLES FOR FEMALE ATHLETES

ABSTRACT

Flexibility is an important physical quality of the neuromuscular function and is of great importance for Physical Education professionals to create action plans to improve the development of athletes. It helps to refine sports techniques, increases muscle and joint mechanical capacity allowing for a more economical use of energy and can work as a lesion inoculator helping develop efficiency, speed and strength (LIMA & SILVA, 2006). In swimming, there are four styles of competition (butterfly, backstroke, breaststroke and crawl), which may have their performances improved or worsened depending on the level of flexibility of the athletes. To check the level of flexibility in each style, we compared eight swimmers aged 13-20 (mean 17.62 years) and the time of specialized practice between 3-13 years in each of the four styles (mean 8.75 years). To assess flexibility, *Flexiteste* by Araújo (1987) was used. This test involves 20 positions which allow us to assess flexibility in five different regions (ankle/knee; hip; trunk; wrist/elbow; shoulder). Through the test, we detected the highest flexibility region necessary in each style and made an analysis of the swim movement related to the most flexible region.

KEY-WORDS: flexibility, swimming, female

COMPARAISON ENTRE LE NIVEAU DE FLEXIBILITÉ DES QUATRE STYLES DE LA NATATION CHEZ LES ATHLÈTES FEMMES

RÉSUMÉ

La flexibilité est une qualité importante de la fonction neuromusculaire et a une grande importance afin que les professionnels de l'Éducation Physique puissent élaborer des plans d'action pour améliorer le développement de leurs athlètes, car cela rend plus facile le perfectionnement des techniques des sports ; cela augmente la capacité mécanique des muscles et des articulations, tout en permettant un profit plus économique d'énergie, et peut fonctionner comme un inoculateur de lésions, qui aide au développement de l'agilité, la vélocité et la force (LIMA et SILVA, 2006). Dans la natation, il y a quatre styles de nages de compétition (le papillon, le dos crawlé, la brasse et le crawl), qui pourront avoir leurs performances améliorées ou empirées d'après le niveau de flexibilité des athlètes. Pour vérifier le niveau de flexibilité dans chaque style, on a évalué 8 athlètes de natation, âgées de 13 à 20 ans, présentant une moyenne de 17,62 ans, et un temps de pratique spécialisée dans un des quatre styles compris entre 3 et 13 ans, avec une moyenne de 8,75 ans. Pour évaluer la flexibilité, on a utilisé le Flexiteste proposé par Araújo (1987), qui comprend 20 positions qui permettent d'évaluer la flexibilité dans cinq régions différentes (cheville/genous ; hanche ; tronc ; poing/coude ; épaule). À travers ce test, on a détecté la région avec plus de flexibilité nécessaire dans chaque style et une analyse du mouvement de la nage relié à la région la plus flexible.

MOTS-CLEFS: flexibilité, natation, femmes

COMPARACIÓN ENTRE EL NIVEL DE FLEXIBILIDAD DE LOS CUATRO ESTILOS DE NATACIÓN EN ATLETAS FEMENINAS

RESUMEN

La flexibilidad es una importante calidad física de la función neuromuscular y es de gran importancia para que los profesionales de Educación Física puedan elaborar planes de acción para mejorar el desarrollo de sus atletas. Esto facilita el perfeccionamiento de las técnicas de deportes, aumenta la capacidad mecánica de los músculos y articulaciones, permitiendo un aprovechamiento más económico de energía y puede funcionar como un inoculador de lesiones, ayudando el desarrollo de la agilidad, velocidad y fuerza (LIMA y SILVA, 2006). En natación, existen cuatro estilos de nados de competición (mariposa, de espalda, de pecho y crol), que podrán tener sus desempeños mejorados o empeorados dependiendo del nivel de flexibilidad de sus atletas. Para verificar el nivel de flexibilidad en cada estilo, fueron evaluadas ocho atletas de natación, con edades entre 13 y 20 años, presentando una media de 17,62 años, y tiempo de práctica especializada en uno de los cuatro estilos entre 3 y 13 años, con una media de 8,75 años. Para evaluar la flexibilidad, se utilizó el Flexiteste propuesto por Araújo (1987), que comprende 20 posiciones que permiten evaluar la flexibilidad en cinco regiones distintas (tobillo/rodilla; cadera; tronco; puño/codo; hombro). A través del examen, se detectó la región de mayor flexibilidad necesaria en cada estilo y un análisis del movimiento de nado relacionado a la región más flexible.

PALABRAS-CLAVES: flexibilidad, natación, femenino

COMPARAÇÃO ENTRE O NÍVEL DE FLEXIBILIDADE DOS QUATRO ESTILOS DA NATAÇÃO EM ATLETAS DO GÊNERO FEMININO

RESUMO

A flexibilidade é uma importante qualidade física da função neuro-muscular e é de grande importância para que os profissionais de Educação Física possam elaborar planos de ação para melhorar o desenvolvimento de seus atletas, pois facilita o aperfeiçoamento nas técnicas dos desportos; aumenta a capacidade mecânica dos músculos e articulações, permitindo um aproveitamento mais econômico de energia e pode funcionar como um inoculador de lesões, ajudando no desenvolvimento da agilidade, velocidade e força (LIMA e SILVA, 2006). Na natação, existem quatro estilos de nados de competição (borboleta, costas, peito e crawl), que poderão ter suas performances melhoradas ou pioradas dependendo do nível de flexibilidade de seus atletas. Para verificar o nível de flexibilidade em cada estilo, foram avaliadas 8 atletas de natação, com idades entre 13 e 20 anos, apresentando uma média de 17,62 anos, e tempo de prática especializada em um dos quatro estilos entre 3 e 13 anos, com uma média de 8,75 anos. Para avaliar a flexibilidade, foi utilizado o Flexiteste proposto por Araújo (1987), que compreende 20 posições que permitem avaliar a flexibilidade em cinco diferentes regiões (tornozelo/joelho; quadril; tronco; punho/cotovelo; ombro). Através do teste, foi detectada a região de maior flexibilidade necessária em cada estilo e uma análise do movimento do nado relacionado à região mais flexível.

PALAVRAS-CHAVES: flexibilidade, natação, gênero feminino.