Effect of force training on flexibility

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ABSTRACT: The purpose of this study is to establish the possible variation between the gain rate in muscular strength and flexibility due to force training. The research was carried out with a sample of 31 men, users of Rio Sport Center, within age bracket of 20 to 30 years. Inclusion factors were: having been working out at least three months; being users of Rio Sport Center. The measuring made was: 1RM test for bending and supine and hip and knee goniometry, using the CARCI plastic goniometer. Descriptive Statistics techniques were fundamentally used in relation to statistical treatment. The results found, according to basic statistical data of description of mean values of the variables age, height, body mass, cutaneous fold and perimeter, presented a homogenous behavior, indicating normal distributions. Thus, we could treat the sample as a whole and not in a subdivided form. In synthesis, there was homogeneity in the population observed. The results of the mean values of the independent variables, dynamic force of bending and supine, presented a value corresponding to 35.70% and 43.08%, respectively, of the world record (Leighton, 1987), what characterized the assessed group as having a good strength level. The results found, according to basic statistical data of description of mean values of dependent variables, assessed joints flexibility, presented a maximum value, higher in all assessed movements, than those presented by the literature (American Academy of Orthopaedic Surgeons, 1965; American Medical Association, 1990 and Kapandji, 1990), what demonstrated a group with good flexibility. The results led to the conclusion that, for the studied group, with their respective characteristics, there is no correlation between dynamic force and flexibility.

Keywords: dynamic force and flexibility

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It was believed, due to lots of reasons, yet in this century, that when people trained using weight they tend to be extremely sinewy, slow and, due to the flexibility decrease it caused, coaches and fitness instructors used to advise their athletes to avoid this kind of training. Although there were some articles published in specialized magazines showing the opposite, this thought prosecuted. On the other hand, there were some athletes who combined weight training and sports, and they achieved good results. (Leighton, 1987). In the 40’s ending, when the best results belonged to the ones who practiced force training, the fitness instructors, coaches and doctors noticed that there were a new training methodology. A study published by Chui (1950), mentioned by Pearl and Moran (1993, p.414), “…stated that a training weight program increased more the athletic power level than an ordinary physical shape program”. Another study that helped to undo the myth of the weight training as a factor of velocity, flexibility and agility lost in the physical training for practicing sports, was the one by Zorbas and Karpovich (1951), mentioned by Pearl and Col. (1993, p. 415), that concluded people who practiced weight training weren’t slower than the other ones, but faster.

Nowadays, the force training is one of the most practiced training kind by people, and may have, as a competition purpose, Body building, Olympics and basic lifting, and in addition the rehabilitation use, sports training use, body shape, leisure and prophylactic treatment development, intending well-being. (Rodrigues and Rocha, 1985).

The American College of Sports Medicine (1999) placed force and flexibility together with aerobics capacity and body composition, as the fourth most important ones for physical fitness.

Nieman (1999) recognized flexibility as an important parameter of the physical fitness. Flexibility may be important in Therapy and prophylaxes, in cases like lombalgia and neuromuscular tensions (Badley and Wood, 1982; Suzuki and Endo, 1983).

The efficacy of the human beings movements depends on flexibility (Cornelius and Hinson, 1980), and there is an inverse relation between the amplitude of the articular movement and the energy spent for a certain movement (Johnson, 1982). A certain flexibility degree is necessary to make harmonious body movements (Rapoport, 1984), but it is unknown how desired it is (Lawther, 1956). Yessis (1986) states that flexibility can’t be seen or taken as enough amount or a little more for the every day activities.

Humphery (1981) suggests that certain sporting gestures need great flexibility and that the flexibility increase may, eventually, prevent sporting damage. However, Corbin and Noble (1980) related the damage possibilities on sporting performances and

**INTRODUCTION**

**Efeito do treinamento de força sobre a flexibilidade**

O presente estudo tem como objetivo estabelecer a possível variação entre a taxa de ganho em força muscular e flexibilidade, devido ao treinamento de força. A pesquisa foi realizada com uma amostra de 31 homens, clientes da Rio Sport Center, que estavam dentro da faixa etária de 20 a 30 anos. Os fatores de inclusão foram: pertencerem à faixa etária indicada; estarem treinando musculação há, no mínimo, três meses; serem frequentadores da Rio Sport Center. As medidas aferidas foram: teste de 1RM para o agachamento e o supino e a goniometria de quadril e joelho, utilizando-se o Goniómetro plástico da CARCI. Quanto ao tratamento estatístico, utilizou-se, fundamentalmente, as técnicas da Estatística Descritiva. Os resultados encontrados, segundo os dados estatísticos básicos de descrição dos valores médios das variáveis idade, estatura, massa, dobra cutânea, perímetro, apresentaram um comportamento homogêneo, indicando distribuições normais. Desta forma, foi possível tratarmos a amostra de modo conjunto e não subdividido. Em síntese, existiu homogeneidade na população observada. Os resultados dos valores médios das variáveis independentes, da força dinâmica do agachamento e do supino, apresentaram valores correspondentes a 35,70% e a 43,08%, respectivamente, do recorde mundial (Leighton, 1987), o que caracterizou o grupo avaliado como possuidor de um bom nível de força. Os resultados encontrados, segundo os dados estatísticos básicos de descrição dos valores médios das variáveis dependentes, e da flexibilidade das articulações avaliadas, apresentaram um valor máximo, superior, em todos os movimentos avaliados, aos apresentados pela literatura (American Academy of Orthopaedic Surgeons, 1965; American Medical Association, 1990 e Kapandji, 1990), o que demonstrou se tratar de um grupo com boa flexibilidade. Os resultados permitiram concluir que não existe correlação para o grupo investigado, com suas respectivas características entre força dinâmica e flexibilidade.

**Palavras-chave:** força dinâmica e flexibilidade

**RESUMO**

Efeito del entrenamiento de fuerza sobre la flexibilidad

El estudio presente tiene por objetivo establecer la posible variación entre la tasa de la ganancia de fuerza muscular y la flexibilidad, debido al entrenamiento de fuerza. El estudio de investigación fue realizado con una muestra de 31 hombres, clientes de la Rio Sport Center, que contaban entre 20 y 30 años de edad. Los factores de inclusión fueron: el hecho de pertenecer a la edad indicada anteriormente; de estar entrenando musculación desde por lo menos tres meses; de ser alumnos del gimnasio supra mencionado. Se tomaron las siguientes medidas: test de 1RM para agacharse y el supino y la goniometría de la cadera y de la rodilla, siendo utilizado el goniómetro plástico de la CARCI. Con respecto al tratamiento estadístico fueron utilizadas, fundamentalmente, las técnicas de la estadística descriptiva. Los resultados encontrados, según los datos estadísticos básicos de la descripción de los valores medios de las variables de edad, estatura, masa, doblé cutánea, perímetro, presentaron un comportamiento homogéneo, indicando distribuciones normales. Esta forma nos disponibilizó que tratásemos toda la muestra en conjunto y no subdividida. En síntesis, existió homogeneidad en la población observada. Los resultados promedios observados en las variables independientes, fuerza dinámica de agacharse y de supino, presentó un promedio correspondiente al 35,70% y al 43,08%, respectivamente, del record mundial (Leighton, 1987), o que caracterizó el grupo evaluado como poseedor de un buen nivel de fuerza. Los resultados encontrados, según los datos estadísticos básicos de descripción de los promedios de las variables dependientes de la flexibilidad de las articulaciones evaluadas, presentó un promedio máximo superior; en todos los movimientos evaluados, a los presentados por la literatura (American Academy of Orthopaedic Surgeons, 1965; American Medical Association, 1990 e Kapandji, 1990), lo que demostró que se trata de un grupo con buena flexibilidad. Los resultados permitieron concluir que no existe correlación para el grupo investigado, con sus respectivas característica entre la fuerza dinámica y la flexibilidad.

**Palabras clave:** fuerza dinámica y flexibilidad
the increase of the damage risk in the presence of over-moving articulations. Farinatti (1991), reviewing this subject, suggested that the flexibility need for each sporting kind is unknown.

This study aims to investigate the flexibility degree changing in groups that raise the force level due to force training, providing better tools for those professionals who work in this area, so that they can improve together two important physical qualities for the physical fitness and health.

**Purpose of this study**

This study’s purpose is to verify the existence of the mutual influence in the dynamic force and flexibility level, observed in non-athlete young adults.

**METHODOLOGY**

**Population and Sample**

The research was carried out with a sample of 31 men, users of Rio Sport Center, within the age bracket of 20 to 30 years old, and it was considered intentional “…When a research purpose need its guinea pigs to have specific characteristics…” (Flegner and Dias, 1995, p.48).

Inclusion factors were: having been working out for at least three months, and within this period, carrying out bending and supine exercises. Those ones who ad orthopedic and neurological disorders were excluded, mentioned during the anamneses process.

**Measurement**

The measures needed for this study were acquired through the following tools:

- To measure height, it was used a German stadiometer from the trademark SOEHNLE, in a scale of 0.1 cm, from 50 to 100 cm; and 1 cm for 1 to 3 m. Working through supersonic vibrations, using an ordinary 9-volts battery;
- The current weight was acquired due to a digital balance from the trademark FILIZOLA, with a precision of 100 grams and a scale varying from 0 to 140 kg;
- The skinfold was obtained through a compasses from the trademark Lange Skinfold Caliper, from Cambridge Scientific Industries, Inc. Cambridge, Maryland, USA;
- To measure perimeter, it was used a metallic flexible tape measure, 2 meters long and 6mm large, with a precision of 1 mm, from the trademark LUFKIN;
- To flexibility, it was used the CARCI plastic goniometer (180º - 35 cm);
- To measure force, it was used a Smith machine (Techinogym) for bending and supine: 1, 2, 3, 4, 5, 10, 15, 20 and 25 kg bell weight were used to regulate the extra weight. A tape measure was placed on the rod sustaining, which is after the sliding bar. The bar bell and its support weighed 15.1 kg.

**Protocol**

So that it could be determined the maximum thighs and back dynamic forces, it was used bending, executed in a Smith machine. The evaluated man, when getting close to the bar bell, should place it on the shoulders and back on the neck. His feet should be in strolled position and a two-shoulder distance apart. The position should provide comfort when the movement was executed. The evaluated should hold the bar bell tight, crouching, until his thighs were parallel to the ground and, then, it would be used a rope to demarcate the amplitude of the movements. The distance between the feet (cm), the acquired angle on the knees bending limit and the linear sliding of the bar bell were observed and reported. After that, he came back to the first position. A previous limber was made, from five to ten repetitions only with the bar bell’s weight. Five tries could be done and the weight was adapted before each one of them. The recovering time between the tries was around five minutes. The punctuation was taken from the full lifted charge on the last try (Maximum repetition number), according to ACSM (2000).

To figure out the maximum dynamic force of the thorax, shoulder and arm, it was used straight supine, that was executed using a bench and a Smith machine (Techinogym). The evaluated man should lay back down on the bench, placing the bar on the messternum point, with the shoulder in abduction of 70º. The distance of the hands, holding the bar, should match the position in which the forearms were perpendicular to the ground and the shoulder 20º of horizontal extension. This was the boundary position this study acquired, and it was reported and observed during the tries, so that it could be maintained a pattern. His feet should be on the ground. The bell weight was placed on the bar bell and the evaluated man, holding it tight, started the try, with the ceding work and finished it with the dominant work. It was made a previous limber with the bar bell’s weight. Five tries could be done and the weight was adjusted before each one. The recovering time between these tries were 3 minutes. The punctuation was acquired from the total lifted charge in the maximum repetitions, according to ACSM (2000).

In the hip flexibility test, it was measured bending, being the evaluated man back down, with his hip in abduction, adduction and zero degree spinning, and his knees extent. His hip bending was executed with the pelvis stabilized, avoiding the spinning or the post-balancing (Norkin and White, 1997). The goniometer was placed in the central axle on the trunk, with one of the rods fixed on the side of the trunk, along the amplit line, and, the other one, on the mean line of the extern part of the hip. Then, it was executed the hip articulation bending. (Dantas and cols., 1997).

To measure the hip extension, the evaluated man was placed back up, with his hip in abduction, adduction and zero degree spinning, with his knees extent. The pelvis was stabilized, avoiding the spinning or the ante-balancing (Norkin and White, 1997). The
goniometer was used with its central axle on the tibia side point, with one of the rods placed on the line from the trunk point to the tibia point, the extern part of the hip, and the other one placed from the tibia point to the sphirion point, the extern part of the leg. Then, his knees articulation bending movement was executed. (Dantas and cols., 1997).

To measure the horizontal shoulder articulation bending, the man was sit with his knees extent, his spine straight, the arm abducted 90° with the trunk, the elbows extent and the palm leafs down (Fernandes Filho, 1999). The goniometer was used with its central axle on the acromial point, being one of the rods on the imaginary line between the acromial points, and the other one, on the extern part of the arm, together with the line between the acromial point and the radial point. After that, the horizontal shoulder articulation bending was executed. (Fernandes Filho, 1999).

The evaluated man’s position and the techniques for the horizontal shoulder articulation extension were the same used in the horizontal shoulder articulation bending.

To determine the perimeters, it was observed the techniques precognized by the International Committee for the measure patronization in Physical Education, mentioned by Rizzo (1997) and by Lohman (1998).

**Thigh Perimeter**
The evaluated man stood up, opposite the evaluator, with his legs a little apart, distributing equally his weight between both legs. Then, the measurement was obtained, placing the tape measure on the femoral mean point (mean point between the trocanterical and the tibia points), according to Rizzo (1997).

**Hip Perimeter**
The measurement was obtained on the right and left trocanterical point level. The tape measure was placed in parallel with the ground, being the evaluated man with his feet together. (Rizzo, 1977)

**Thorax Perimeter**
The measurement was obtained on the meso-sternum point, on an horizontal place (Rizzo, 1977). The sternum mean point is related to the fourth spinal arch; and the Louis angle (Manubrio-body) comes up to the second rib, what makes it easy to find it. (Rizzo, 1977).

According to this same author, the concerns observed in the perimeter measurement determination were:

1. The measure points were marked by dermgraphic pencil;
2. The perimeters were measured on naked skin;
3. It was used metallic and flexible tape measure;
4. Caring about not leaving a finger between the tape measure and the skin;
5. There was neither overpression on the tape, nor lack of it.

6. The perimeters were measured before any physical activity

To determine the skinfold measurements, the following steps were used, according to Pollock and Wilmore (1993).

**Chest**
The evaluated man stood up, opposite the evaluator, and the measure was obtained on the mean point between the armpit foreline and the nipple. The skinfold was taken in diagonal position.

**Abdomen**
The evaluated man stood up, opposite the evaluator, and the measure was obtained 2 cm from the navel scar. The skinfold was taken in longitudinal position.

**Thigh**
The evaluated man stood up, opposite the evaluator, and the measure was obtained on the thigh foreface, on the femur mean point elevation. The skinfold was taken in longitudinal position.

**Triceps**
The evaluated man stood up, opposite the evaluator, and the skinfold measure was obtained on the meso-humerus projection point (Half the distance between the acromion and the olecranon process), on the arm post-face. The skinfold was taken in longitudinal position.

**Sub-scapular**
The evaluated man stood up, opposite the evaluator, and the measure was obtained on the scapular inferior angle, on its vertebral maple axle.

**Supra-iliac**
The evaluated man stood up, side to side with the evaluator, and the measure was obtained above the iliac ridge, in a coinciding point where an imaginary line comes from the mean armpit line. The skinfold was taken in diagonal position.

**Calf**
The evaluated man sat down, with his knees in 90° angle and the evaluator in front of him. The measure was obtained on the bigger muscular mass point of the leg median face. The skinfold was taken in longitudinal position. (Rocha, 1995).

Some linear measures were taken:

**Height**
The evaluated man stood up, with his feet together and to the front, relaxed shoulders, arms along the body, with the Frankfurt plan precisely in horizontal position. The stadiometer was placed on the vertex, strictly in parallel with the ground. The evaluated man was unshod and the measure was taken during inspiration. (Rizzo, 1977)
Statistical Treatment

Descriptive statistical techniques were utilized to characterize the mean data from the respective possibilities, using the main patterns, mean, pattern deflection, and the inferential statistical techniques, from the asymmetry and Curtose tests. The first one, to evaluate intra-group homogeneity, and the second one to evaluate dispersion degree of the distribution.

The hypothesis test was also used, which is the Pearson correlation test, between the score tables, structured according to the point values from each element in the respective experimental possibility.

This second part is relative to the inferential statistics, in which are presented hypothesis test's analytical results, based on the Pearson correlation test.

In the hypothesis test, the significant level = $p < 0.05$ was used, in other words, 95% certainty for the statement the study might have denoted.

According to the current experimental pattern, “the priori”, taking into consideration that people from the group showed regular distributed values, it can be considered that the intervening possibilities, as the training time, are not significantly implying that they are needed to be divided into age groups, so that it can be analyzed the results.

The analytical pattern first observed the element’s order, obtained from scores and standardized values, according to the formula:

\[
\text{Score}(i) = \frac{(\text{Obs. Val.} - \text{Min. Obs. Val.})}{(\text{Max. Obs. Val.} - \text{Min. Obs. Val.})}
\]

Once the respective scores were calculated, the score ranking was created from the experimental possibility combined with the observed man’s indexer number, correlating with the other experimental possibilities.

If there were the correlation, the existence of the functional relation between the respective experimental possibilities would be understood, according to the alternative hypothesis of this study.

PRESENTATION AND DISCUSSION OF THE RESULTS

Sample’s characteristics

The sample used in this study was characterized as intentional and it was selected among the Rio Sport Center users.

Sample Homogeneity Analysis

The acquired results, following the basic statistical results for mean age, height and mass values description (chart 1) were:

- Mean values of 23.32 years and a pattern deflection of 2.98 were found in Age; mean values of 177.3 cm and a pattern deflection of 6.47 were found in Height; mean values of 78.32 kg and a pattern deflection of 10.58 were found in Mass.

The results acquired, following the basic statistics mean values of the chest, subscapular, suprailiac, abdomen (chart 2) and Triceps, thigh, calf (chart 3) skinfold were:

- In the chest skinfold, mean values of 6.71 mm and a pattern deflection of 2.47 were found; in the subscapular skinfold, mean values of 12.77 mm and a pattern deflection of 4.23 were found; in the suprailiac skinfold, mean values of 12.68 mm and a pattern deflection of 6.38 were found; in the abdomen skinfold, mean values of 16.26 mm and a pattern deflection of 8.91 were found.

- In the Triceps skinfold, mean values of 7.84 mm and a pattern deflection of 3.47 were found; in the thigh skinfold, mean values of 12.29 mm and a pattern deflection of 4.48 were found; and in the calf skinfold, mean values of 9.16 mm and a pattern deflection of 4.18 were found.

The results acquired, following the basic statistics mean values of the Thorax, Hip, thigh and arm (chart 4) were:

- In the Thorax perimeter, mean values of 100.40 cm and a pattern deflection of 8.50; in the hip perimeter, mean values of 96.12 cm and a pattern deflection of 10.31; in the thigh perimeter, mean values of 56.44 cm and a pattern deflection of 4.94 and in the arm perimeter, mean values of 33.70 cm and a pattern deflection of 2.73.

Based on this study’s results, it can be denoted that in all observed aspects, every topic, but the thigh showed a homogeneous behavior, indicating normal distribution. Due to this, it was possible to treat the sample as a group and not subdivided. Abstractly, there was homogeneity in the observed population.

PRESENTATION OF THE TEST’S RESULTS (DEPENDENT AND INDEPENDENT VARIABLES)

Flexibility Degree Study

The results acquired, following the basic statistics mean values of the dependent variables, Flexibility of the Hip extension, Hip bending, knee bending, Horizontal shoulder bending and Horizontal shoulder extension (Chart 5) were:

- In the Flexibility of the Hip Extension, mean values of 36.65 degrees and a pattern deflection of 9.06 were found; in the flexibility of the Hip bending, mean values of 81.90 degrees and a pattern deflection of 15.08 were found; In the Flexibility of the knee bending, mean values of 143.33 degrees and a pattern deflection of 10.56 were found; and In the Flexibility of the Horizontal...
Shoulder Extension, mean values of 80.90 degrees and a pattern deflection of 16.51 were found.

**Force Level Study**

The results acquired, following the basic statistics mean values of the Independent variables, Maximum Dynamic Force of Supine and Bending (Chart 6) were:

In the Maximum Dynamic Force of Supine variable, mean values of 93.69 kg and a pattern deflection of 17.44 were found; In the Maximum Dynamic Force of Bending variable, mean values of 116.90 kg and a pattern deflection of 21.76 were found.

The results obtained, following the basic statistical mean values of the number of tries topic and the linear sliding bar elevation topic (1 and 2) on the Maximum Dynamic of Supine (Chart 7) were:

In the number of tries topic, mean values of 2.93 and a pattern deflection of 1.31 were found; in the elevation of the Linear bar sliding 1, mean values of 87.68 and a pattern deflection of 9.35 were found; in the elevation of the Linear bar sliding 2, mean values of 124.58 and a pattern deflection of 7.60 were found.

The results obtained, following the basic statistical mean values for the number of tries topic, Distance between heels, angle of the knees and Linear sliding bar elevation (1 and 2) on the Maximum dynamic force of bending (Chart 8) were:

In the Number of tries, mean values of 3.55 and a pattern deflection of 1.12 were found; in the distance between the heels, mean values of 26.28 cm and a pattern deflection of 6.49 were found; in the angle of the knees, mean values of 107.93 and a pattern deflection of 6.36 were found; in the elevation of the linear bar sliding 1, mean values of 43.90 cm and a pattern deflection of 10.67 were found; in the elevation of the linear bar sliding 2, mean values of 85.77 and a pattern deflection of 10.70 were found.

**Presentation and Discussion of the Answers and Questions to be investigated**

Two questions were created to be investigated, which will be answered as follows:

**Dynamic Force Level Determination on Non-athlete young adults, under Force Training**

The Maximum dynamic force test result (1RM), from non-athlete young adult under Force Training was around 116.90 (±21.76 kg).
kg on Bending, and 93.69 (± 17.44)kg on Supine, proving a good strength level in this evaluated group.

**Flexibility Degree Determination on Non-athlete young adults under Force Training**

It was used to measure the flexibility degree on non-athlete young adults, under Force Training, the Goniometry test result, which shows that the evaluated group presented, in the flexibility degree aspect, comparing with different sources, great variations among the mean values (Chart 9).

According Komi (1991), mentioned by Fleck and Figueira Junior (1997), “…The Neural adaptation is the main responsible for the force increment in the first 10 weeks of Training”. As the evaluated group’s mean time for Training is 24.3 months, the Chest muscles Hypertrophy may be the lower flexibility degree cause on the horizontal shoulder bending, when compared with other works.

**Presentation and Discussion about the Statistical Hypothesis Tests**

Pearson’s correlation test was used, resulting that the correlation degrees do not have significant importance between the force representative element as an independent variable, defined by the maximum dynamic force of bending (charge1), and the dependent variables, related to the Goniometry values of the Hip bending, Hip extension and knee bending (Chart 10).

It was used Pearson’s correlation test, leading to the result that the correlation degrees are not significant between the force representative element as an independent variable, defined by the maximum dynamic force of Supine (charge2) and dependent variables related to the Goniometry values of the Horizontal shoulder bending and Horizontal shoulder extension. (Chart 11).

The acquired results denote that the correlation degrees are not significant between the force representative element as an independent variable, defined by weight used on the Force test of Bending (charge1) and Supine (charge2) and the dependent variables related to Goniometry of the Hip bending, Hip extension,
Knee bending, Horizontal shoulder bending and Horizontal shoulder extension. This result implies the acceptance of the Force and Flexibility crossing hypothesis, in other words, the non-existence of a functional relation between the observed data amount. In synthesis, the force values for the observed population do not depend from their flexibility valences.

**Presentation and Discussion about the Specific Aims Achievement**

Two specific aims were established in this present study, that are describe as follows:

**Verification of the Dynamic Force in trained Non-athlete young adults**

The world records in basic lifting from athletes with 75 kg mass, in bending and supine exercises are: 327.5 kg and 217.5 kg, respectively (Leighton, 1987, p.264).

As the evaluated group was composed by non-athlete men, and with mean mass of 78.32kg, weight of 116.90 kg in bending (35.70% from the record) and weight of 93.69 kg in Supine (43.08% from the record), it can be said that the presented Force Level is good.

**Evaluation of the Flexibility degree in trained non-athlete young adults**

As it was said in 4.4.2 item, flexibility mean values were presented, however, the normality charts are presented in the maximum degree (chart 11).

The Hip bending movement, observed in this study’s sample, presented a lower amplitude degree than the ones observed in the literature. In relation to AAOS (1965), there was 31-degree decrease; to AMA (1990), a decrease of 18.1 degrees, and in relation to Kapandji (1990, p.14), a 8.1-degree decrease, presenting, then, a mean decrease of 21.43 degrees in relation to what is presented in the literature.

The Hip Extension movement, observed in this study’s sample, presented a higher degree than the ones observed in the literature. In relation to the AAOS (1965), there was a 6.7-degree increase, to AMA (1990) a 6.7-degree increase, and in relation to Kapandji (1990) a 6.7-degree increase, presenting, then, a mean increase of 6.7 degrees in relation to what is presented in the literature.

The Knee bending movement, observed in this study’s sample, presented a higher degree than the ones observed in the literature, in relation to the AAOS (1965), there was a 8.3-degree increase;

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**Chart 7 - Basic statistics mean values of the Number, Supine 1 and Supine 2 variables**

<table>
<thead>
<tr>
<th></th>
<th>Number (Number of times)</th>
<th>Supine 1 (cm)</th>
<th>Supine 2 (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>31</td>
<td>31</td>
<td>31</td>
</tr>
<tr>
<td>Mean</td>
<td>2.93</td>
<td>87.68</td>
<td>124.58</td>
</tr>
<tr>
<td>Pattern Deflection</td>
<td>1.31</td>
<td>9.35</td>
<td>7.60</td>
</tr>
<tr>
<td>Minimum</td>
<td>1</td>
<td>79</td>
<td>90</td>
</tr>
<tr>
<td>Maximum</td>
<td>5</td>
<td>128</td>
<td>132</td>
</tr>
<tr>
<td>Amplitude</td>
<td>4</td>
<td>49</td>
<td>42</td>
</tr>
<tr>
<td>Curtose</td>
<td>-0.89</td>
<td>11.08</td>
<td>14.37</td>
</tr>
<tr>
<td>Result</td>
<td>Homo</td>
<td>Homo</td>
<td>Homo</td>
</tr>
</tbody>
</table>

Number = Number of tries; Supine1 = Linear Supine Bar sliding 1, inferior position; Supine 2 = Linear Supine Bar sliding 2, superior position.

**Chart 8 - Basic statistics mean values of the Tries 1, Heel, Angle, Sliding 1 and Sliding 2**

<table>
<thead>
<tr>
<th></th>
<th>Tries 1 (Times)</th>
<th>Heel (cm)</th>
<th>Angle (Degree)</th>
<th>Sliding 1 (cm)</th>
<th>Sliding 2 (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>31</td>
<td>31</td>
<td>31</td>
<td>31</td>
<td>31</td>
</tr>
<tr>
<td>Mean</td>
<td>3.55</td>
<td>26.28</td>
<td>107.93</td>
<td>43.90</td>
<td>85.77</td>
</tr>
<tr>
<td>P.D</td>
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<td>6.49</td>
<td>6.36</td>
<td>10.67</td>
<td>10.70</td>
</tr>
<tr>
<td>Minimum</td>
<td>1</td>
<td>15.7</td>
<td>100</td>
<td>29</td>
<td>36</td>
</tr>
<tr>
<td>Maximum</td>
<td>5</td>
<td>39</td>
<td>120</td>
<td>91</td>
<td>97</td>
</tr>
<tr>
<td>Amplitude</td>
<td>4</td>
<td>23.3</td>
<td>20</td>
<td>62</td>
<td>61</td>
</tr>
<tr>
<td>Curtose</td>
<td>-0.69</td>
<td>-1.10</td>
<td>-0.81</td>
<td>12.65</td>
<td>15.99</td>
</tr>
<tr>
<td>Result</td>
<td>Homo</td>
<td>Hetero</td>
<td>Homo</td>
<td>Homo</td>
<td>Homo</td>
</tr>
</tbody>
</table>

Tries 1 = Number of tries; Heel = Distance between the heels; Angle = Angle of the knees on the inferior bending limit; Sliding 1 = Linear sliding bar of bending, inferior position; Sliding 2 = Linear sliding bar of bending, superior position.

**Chart 9 - Mean Flexibility Values Variations from the evaluated group, comparing with different sources**

<table>
<thead>
<tr>
<th>Articulation</th>
<th>Movement</th>
<th>Cassenza (2002)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hip</td>
<td>Bending</td>
<td>81.90 ± 15.08</td>
</tr>
<tr>
<td>Knee</td>
<td>Extension</td>
<td>36.65 ± 9.06</td>
</tr>
<tr>
<td>Shoulder</td>
<td>Bending</td>
<td>143.33 ± 8.24</td>
</tr>
<tr>
<td></td>
<td>Horizontal Bending</td>
<td>126.58 ± 10.56</td>
</tr>
<tr>
<td></td>
<td>Horizontal Extension</td>
<td>80.90 ± 16.51</td>
</tr>
</tbody>
</table>
to AMA (1990) a 6.7-degree decrease and to Kapandji (1990, p.80), a 3.3-degree increase, presenting, then, a 1.6-mean degree increase in relation to what is presented in the literature.

The Horizontal shoulder bending, observed in this study’s sample, presented a lower degree in relation to what is observed in the literature. In relation to Kanpandji (1990), a decrease of 13.42 degrees.

The horizontal shoulder extension movement, observed in this study’s sample, presented a higher degree than the ones observed in the literature: in relation to Kapandji (1990), a 50-degree increase.

In Chart 13, the maximum flexibility values are presented, observed among this study’s samples, and the maximum degree of the normality tables.

The Hip bending movement, presents 6.7º overpassing what is presented in the literature; the hip extension movement, 26º overpassing what is presented in the literature; the knee bending movement, 23º overpassing what is presented in the literature; the horizontal shoulder bending presents 11º overpassing what is presented in the literature; and the horizontal shoulder extension, 76º overpassing what is presented in the literature.

The maximum results obtained allowed the conclusion that the strong man may present a high flexibility degree. Orzolin (1988) stated that only the Force and Flexibility parallel training achieves the best results.

Conclusions and Recommendations

The acquired results allowed to conclude that there is no correlation for the investigated group, with their respective characteristics between Dynamic Force and Flexibility. It is supported by the literature, specially Kos (1988), mentioned by Weineck (1999), Ozolin (1995), Trash and Kelli (1987), and Girouard and Hurley (1995), when announcing not having found significant flexibility variation due to Force increase.

We conclude then, that the general purpose of this presented study was achieved in the investigation of the existent relations between Force and Flexibility.

RECOMMENDATIONS

Recommendations to this Study Improvement

There is a need to explicate the problems which must be discovered by those who intend to go on with this study.

**Chart 10 - Pearson’s Correlation Test on the Inferior Limb**

<table>
<thead>
<tr>
<th></th>
<th>Charge 1</th>
<th>Hipbend</th>
<th>Hipext</th>
<th>Kneebend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charge 1</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hipbend</td>
<td>0.23</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hipext</td>
<td>0.20</td>
<td>0.33</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Kneebend</td>
<td>0.02</td>
<td>-0.44</td>
<td>-0.04</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Charge 1 = Bending Force; Hipbend = Hip bending, Hipext = Hip extension; Kneebend = Knee bending

**Chart 11 - Pearson’s Correlation Test on the Superior Limb**

<table>
<thead>
<tr>
<th></th>
<th>Charge 2</th>
<th>Shoulderbend</th>
<th>Shoulderext</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charge 2</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shoulderbend</td>
<td>0.31</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Shoulderext</td>
<td>-0.09</td>
<td>-0.01</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Charge 2 = Supine Force; Shoulderbend = Shoulder bending; Shoulderext = shoulder extension

**Chart 12 - Maximum Flexibility Degree Mean Values within Normality**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Hip</td>
<td>Bending</td>
<td>120</td>
<td>100</td>
<td>90</td>
</tr>
<tr>
<td></td>
<td>Extension</td>
<td>30</td>
<td>30</td>
<td>20 to 30</td>
</tr>
<tr>
<td>Knee</td>
<td>Bending</td>
<td>135</td>
<td>150</td>
<td>120</td>
</tr>
<tr>
<td></td>
<td>Hor. Bending</td>
<td>-</td>
<td></td>
<td>140</td>
</tr>
<tr>
<td></td>
<td>Hor. Extension</td>
<td>-</td>
<td></td>
<td>30 to 40</td>
</tr>
</tbody>
</table>

**Chart 13 - Maximum Flexibility Values, observed in this present study, and the Maximum degree within the Normality charts**

<table>
<thead>
<tr>
<th>Articulation</th>
<th>Movement</th>
<th>Maximum Values Found in this study</th>
<th>Maximum (mean) Values found in the Literature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hip</td>
<td>Bending</td>
<td>110</td>
<td>103.3</td>
</tr>
<tr>
<td></td>
<td>Extension</td>
<td>56</td>
<td>30</td>
</tr>
<tr>
<td>Knee</td>
<td>Bending</td>
<td>158</td>
<td>135</td>
</tr>
<tr>
<td></td>
<td>Hor. Bending</td>
<td>154</td>
<td>140</td>
</tr>
<tr>
<td>Shoulder</td>
<td>Hor. Extension</td>
<td>111</td>
<td>35</td>
</tr>
</tbody>
</table>
According to Archour Junior (1999), “Flexibility increases during childhood till they became teenagers and decreases during lifetime”, what denotes the need to find out if this variation is due to age, due to Flexibility training absence or both.

There is a need to know the Hypertrophy degree that may interfere in the flexibility degree.

As the muscle-articulators Proprioceptors interfere in Flexibility, we conclude, then, that it is necessary to do a research about the interference caused due to partial execution, in Force exercises.

**Recommendations to this Study Applicability**

This study showed that there is no need to worry about losing Flexibility during Force Training. Neither Force decreases the Flexibility degree, nor Flexibility the Force degree.

We may conclude then, that the trained one achieves Force and Flexibility degree, nor Force decreases the Flexibility degree.

This study showed that there is no need to worry about losing Flexibility, due to Flexibility training absence or both.

We conclude then, that it is necessary to do a research about the interference caused due to partial execution, in Force exercises.

**REFERENCES**


