EFFECT OF STATIC STRETCHING OF WRIST FLEXORS ON HANDGRIP STRENGTH AND ENDURANCE OF APPARENTLY HEALTHY INDIVIDUALS

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ABSTRACT

Background/ Objective: Stretching exercise has been considered an essential component in warm up for decades. However, the benefit of stretching exercise in performance enhancement is now being questioned. This study investigated the effects of static stretching of the wrist flexors on the handgrip strength and endurance of apparently healthy individuals.

Method: Seventy five (75) registered students (36 males and 39 females) of the College of Medicine in the University whose ages ranged from 18 years to 35 years were recruited for this study. They were randomly assigned to 3 groups (Group A, B and C). Groups A, B and C performed the static stretching to the their wrist flexors for 30, 45, and 60 seconds respectively. The handgrip strength and endurance were measured before and after stretching. Data was analyed using Statistical Package for Social Sciences (SPSS) version 22.0.

Result: Static stretching had no significant effect on handgrip strength of Groups A (p = 0.70), B (p = 0.27) and C (p = 0.84) as well as handgrip endurance of Groups B (p = 0.71) and C (p = 0.72). However, it brought about a significant decrease on handgrip endurance of Group A (p = 0.02). There was no significant difference between the effects of static stretching on handgrip strength (p = 0.37) and handgrip endurance (p = 0.97) of male and female subjects. There was a positive relationship on the effect of static stretching on handgrip strength and endurance (p = 0.01).

Conclusion: Static stretching of wrist flexors had no significant effect on handgrip strength despite the duration of stretch. Static stretching of 30 seconds brought about a significant reduction in handgrip endurance but those of 45 and 60 seconds had no significant effect. There was a low positive correlation between the effect of static stretching of wrist flexors on handgrip strength and endurance.

Keywords: Static stretching, Wrist flexors, Handgrip strength, Handgrip endurance, Apparently healthy

INTRODUCTION

Many daily functions and sporting events require high activity levels of the flexor musculature of the forearms and hands. These are muscles involved in grip strength. Sports like wrestling, football, and basketball as well as performing daily activities such as carrying laundry and turning a door knob, require some degree of grip strength to be successful (Budoff, 2004; Fry, Ciroslan and Fry, 2006).

Often overlooked or taken for granted, handgrip strength plays a key role in injury prevention and overall strength development (Smith et al., 2006). It is widely used for estimating upper limb strength and as an indicator of general health status (Nicolay and Walker, 2005; Schlüssel, Angos and Vasconcellos, 2008). Grip strength has been shown to be a predictor of general body strength, postoperative conditions, mortality and functional decline (Massey-Westrop et al., 2004; Bohannon, 2009). Evaluation of this parameter is considered to be very important when assessing performance in some sporting activities (Visnapuu and Jurimae, 2007). This is because muscle strength and endurance are important aspects of physical performance and need to be considered when assessing musculoskeletal function (White et al.,...
Physical strength is one of the major components of fitness and health and can be evaluated by different protocols and in diverse body segments (American College of Sports Medicine, 2011). Enhancement of physical performance in exercise and sports has been of optimal importance to sports men and women. Throughout history there are several myths and nonscientific postulates on the activities involving stretching especially its application before and during warm-up or cool down as a contributing factor for physical performance and reduced risks of injury during exercise training (Andersen, 2005; Jantvedt et al., 2010; Sekir et al., 2010). Stretching exercise is a form of therapeutic exercise in which a specific skeletal muscle (or muscle group) is deliberately elongated, in order to improve the muscle’s felt elasticity and reaffirm comfortable muscle tone (Weerapong, Patria and Gregory, 2004). It involves elongating a muscle passively to the point of mild discomfort and holding it for an extended length of time (Donche, 2007). It results in increased muscle control and flexibility as well as increased range of motion of the joints of the body (Corbin et al., 2001; Weerapong, Patria and Gregory, 2004).

According to Haff (2006), there are 4 different protocols in practice for flexibility training – static, ballistic, dynamic stretching and proprioceptive neuromuscular facilitation (PNF). Static stretching is perhaps the most popular, or at least the most well-known method of stretching. It has been promoted as the safest and best method of stretching (Synder, 2004).

Extensive research done in sports medicine to examine the role of stretching exercise in injury prevention, post exercise muscle soreness reduction and performance enhancement reported conflicting results (Murphy 2008; Trajano, Franco and Oliveira, 2011; Shier and McHugh, 2012). Systematic reviews of these studies revealed that it had insignificant effects on injury prevention and post exercise muscle soreness (Herbert and Gabriel, 2002; Andersen, 2005). Also, the benefit of stretching on performance enhancement is now being questioned (Weerapong, 2007). Marek et al (2005) reported that limited and inconclusive data are available regarding the effects of static and PNF stretching on muscle strength and power output. It has also been reported that the conflicting results may be as a result of differences among static stretching protocols, types of tests performed (Marek et al., 2005) and differences in the durations of stretch imposed across studies (Kay and Blazevich, 2012). This study therefore investigated the effects of different durations of static stretching of the wrist flexors on handgrip strength and endurance of apparently healthy individuals.

MATERIALS AND METHODS

Subject Selection
Seventy-five (75) registered students (36 males and 39 females) of the College of Medicine in the University were recruited for this study using a sample of convenience. The inclusion criteria for subjects in this study were as follows; they were students (both male and female) of the College of Medicine, University of Lagos whose ages ranged from 18 years to 35 years and had no recent or existing pathological or physical condition relating to the upper limb. They were randomly assigned to 3 groups (Groups A, B and C) using the fish bowl technique where the number the subjects picked determined their group. Ethical approval was obtained from the Health Research and Ethics Committee of the Teaching Hospital of the institution and written informed consent was obtained from each subject that participated prior to the commencement of the study.

Procedure for data collection
The weight and height of each subject were measured using a combined weighing scale and height meter (Model RGZ-160 (Leidal Medical LTD, UK) and recorded. Each subject was asked to perform hand warm up exercises (flexion and extension of the wrist and fingers and other free active exercises of the wrist and fingers) of the dominant hand for five minutes. The baseline measurement of the dominant handgrip strength and endurance was then taken and recorded.

Handgrip strength measurement protocol: A hydraulic hand dynamometer (XINJING SPORTS, WO LI BIA O Model) was used to measure the handgrip strength. The handling of the hand dynamometer for the measurement of handgrip strength was adapted from Costa e Silva et al (2014). In an upright sitting position, the subject held the hydraulic hand dynamometer with the dominant hand in a neutral position (mid pronation/supination position) with the elbow extended and the
shoulder flexed at 90 degrees. The subject was asked to squeeze the dynamometer with as much force as possible, being careful to squeeze only once for each measurement. Three trials were made with an interval of about 15 seconds inbetween two trials to avoid muscle fatigue. If the difference in scores was within 3 kg, the test was accepted but if the difference between any two readings was more than 3 kg, then, the test was repeated once more after a rest period. The average of the three highest readings was recorded (Centre for Drug Abuse and AIDS Research (CDAAR), 2003).

Handgrip endurance measurement protocol: The subjects had a break of at least 5 minutes after measuring the handgrip strength before measuring their handgrip endurance. They were asked to perform maximal handgrip using the hand dynameter and sustain the strength for as long as they could while the researcher measured how long they maintained the grip strength using a stop-watch (Swallow et al., 2007). Three trials were also made with an interval of about 15 seconds inbetween two trials to avoid muscle fatigue. After taking the baseline measurements of the dominant handgrip strength and endurance, static stretching of 30, 45, and 60 seconds duration were performed to the wrist flexors by Groups A, B and C respectively after a break of at least 5 minutes.

Static stretching protocol
The position adopted by the subjects when carrying out the static stretching was that in upright sitting, the subject placed the shoulder of the dominant upper limb at 90 degrees flexion. The elbow was placed in full extension with the forearm in pronation and the wrist in extension (Costa e Silva et al., 2014). The subjects were instructed to pull the fingers of the dominant hand in extension with the non-dominant hand to the point of discomfort and held for the duration of the stretch (30, 45, and 60 seconds) depending on the group (Weerapong, 2007; Costa e Silva et al., 2014). Groups A, B and C performed the stretching for 30, 45, and 60 seconds respectively. This was repeated 3 times with a 15 seconds interval between each stretch. A cool down period of one minute was given to subjects in Groups A, B and C before the handgrip strength and endurance were measured and recorded again.

Data Analysis
All statistical tests were done using Statistical Package for Social Sciences (SPSS) version 22 and summarized using descriptive statistics of mean and standard deviation. Data were presented on tables. Paired t-test was used to compare the pre and post intervention mean values of handgrip strength and endurance. Analysis of variance (ANOVA) was used to compare the mean changes in handgrip strength and endurance due to static stretching of the three groups. Paired t-test was also used to compare the mean changes in handgrip strength and endurance due to static stretching exercises in male subjects with those of the female subjects.

RESULT
Table 1 shows the demographic characteristics of subjects in Groups A, B and C and analysis of variance (ANOVA) showed that there was no significant difference in the demographic characteristics of subjects in the three groups (Age: p = 0.47; BMI: p = 0.77).

<table>
<thead>
<tr>
<th>STUDY GROUPS</th>
<th>AGE (YEARS) Mean±SD</th>
<th>HEIGHT (m) Mean±SD</th>
<th>WEIGHT(Kg) Mean±SD</th>
<th>BMI(Kg/m²) Mean±SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A</td>
<td>21.13±1.54</td>
<td>1.70±0.11</td>
<td>66.00±11.42</td>
<td>22.76±2.52</td>
</tr>
<tr>
<td>Group B</td>
<td>21.36±2.45</td>
<td>1.72±0.10</td>
<td>68.00±12.24</td>
<td>22.99±3.97</td>
</tr>
<tr>
<td>Group C</td>
<td>22.04±3.40</td>
<td>1.70±0.95</td>
<td>64.00±9.30</td>
<td>22.09±3.33</td>
</tr>
<tr>
<td>F – value</td>
<td>0.85</td>
<td>0.68</td>
<td>1.03</td>
<td>0.37</td>
</tr>
<tr>
<td>p-value</td>
<td>0.47</td>
<td>0.57</td>
<td>0.38</td>
<td>0.77</td>
</tr>
</tbody>
</table>

Significance at p<0.05

Paired t-test comparison of pre and post static stretch mean handgrip strength scores showed no statistically significant difference in Group A (p=0.70), Group B (p=0.27) and Group C (p=0.84) although individually, mean handgrip strength scores slightly increased in Groups A and C but decreased in Group B (Table 2). Handgrip endurance decreased in the three groups after static stretching but paired t-test comparison of pre and post static stretch mean handgrip endurance scores showed no statistically significant differences in Group B (p=0.71) and Group C (p=0.72) but statistically significant difference in Group A (p=0.02) (Table 2).
This study was aimed at determining the effect of static stretching on handgrip strength and endurance. Results obtained revealed that static stretching had no significant effect on handgrip strength and handgrip endurance. There was a low but significant positive relationship between the effect of static stretching on handgrip strength and endurance (p = 0.01) (Table 5).

DISCUSSION
This study was aimed at determining the effect of static stretching on handgrip strength and endurance. Results obtained revealed that static stretching had no significant effect on handgrip strength and handgrip endurance. There was a
weak but significant relationship between the effect of static stretching on handgrip strength and endurance. Also there was no significant difference on the effects of static stretching on handgrip strength and handgrip endurance between male and female participants.

The finding that static stretching of wrist flexors of the dominant hand had no significant effect on handgrip strength despite the three different durations of static stretching implies that carrying out static stretching of the wrist flexors for 30, 45 and 60 seconds did not increase handgrip strength. This is contrary to one of the principles of application of warm up exercise before the main exercise or sports which states that warm up exercise enhances physical performance (Sekir et al., 2010). Stretching exercise is an important component of warm up exercise. Egan et al (2006) reported that acute static stretching had no effect on muscle torque and power output during concentric isokinetic knee extension. Boscher-Torres et al (2009) and Costa e Silva et al (2014) concluded that static stretching resulted in a decrease in muscle strength. Two primary factors have been used to explain this stretching induced deficit. These are mechanical factors such as changes in muscle stiffness and neuromuscular factors such as altered motor control strategies (Cramer et al., 2000; Ebersole et al., 2000).

Kay and Blazevich (2012) stated that lack of concensus regarding the negative effects of stretching is partly attributable to differences in the duration of stretch imposed across studies. This present study compared the effects of three different durations of static stretching (30, 45 and 60 seconds) on handgrip strength and found out the duration of static stretching was not the issue as none of the durations of static stretching brought about any significant change in the handgrip strength. However, this finding differs from the results of the study of Shier and McHugh (2012) who reported that short durations of static stretch (<30 seconds) did not result in meaningful reductions in muscular performance but durations of stretches of 30 to 45 seconds reduced strength but not power. Durations of static stretching lasting 60 seconds or more reduced maximal performance on strength, power and speed dependent tasks. Kay and Blazevich (2012) reported similar finding with Shier and McHugh (2012) that stretching lasting for 60 seconds or more were more likely to cause a reduction in muscle performance. However, they differed in their opinion about stretching lasting for 30 to 45 seconds, stating that they can be used in preexercise routines without risk of significant decrease in strength performance. Murphy (2008) also reported that static and dynamic stretching for 20 seconds can improve muscular strength in a sample of recreotional athletes.

The finding that static stretching of wrist flexors brought about a significant reduction in handgrip endurance in subjects in Group A and insignificant reduction in handgrip endurance of subjects in Groups B and C implies that performing static stretching for 30 seconds caused a significant reduction in handgrip endurance while that for 45 and 60 seconds did not cause any significant reduction. It could be that the handgrip muscles got easily fatigued by 30 seconds of static stretching but gradually started recovering since the reductions in handgrip endurance by 45 and 60 seconds of static stretching were not significant. In a presentation at the American College of Sports Medicine Annual meeting (2001), Kokkonen, Velson and Arnall (2001) presented data showing a decline in muscle strength/endurance in the knee flexors following stretching. Nelson, Kokkonen and Arnall (2005) reported that an intense stretching protocol will reduce the endurance of muscles of the knee flexors. Trajano, Franco and Oliveira (2011) reported that static stretching may enhance the manifestation of fatigue and is mainly related to neuromuscular responses. White et al (2013) suggested that endurance protocols need to consider the make up of muscles and that it may not be valid to use the same protocol for muscles that have different contraction characteristics.

This study also observed that the handgrip strength and endurance of male subjects were higher than the female. Studies have shown that handgrip is both a highly sexual dimorphic and a lateralized anthropometric measurement (Kumarul, Ahmed and Loh, 2006; Dopsaj et al., 2007; De et al., 2011). Dopsaj et al (2007) reported that men showed significantly greater maximal hand grip force in both dominant and non-dominant hands than women. The two possible explanations for this were the difference in the type of activity of each gender (Men are more active and perform more physical work than women) and the difference in body composition (De et al., 2011). Jenssan et al (2000) explained that strength variations between men and women may be mainly related
to the smaller amount of muscle mass and a higher body fat percentage in women. This study also showed that after performing static stretching, a statistically non-significant decrease was observed for the handgrip endurance of both male and female and the handgrip strength of the male subjects. This is consistent with the findings of previous researches (Hunter et al., 2004; White et al., 2013). Hunter et al (2004) reported that men were more fatigable than women during both intermittent and sustained contractions. White et al (2013) observed that the male participants appeared to show greater fatigue in the quadriceps than the female participants. However, the numbers of subjects in their study were too small to draw a definitive conclusion on the effect of gender.

The low positive correlation between handgrip strength and endurance observed in this study implies that the effects of static stretching of wrist flexors on handgrip strength and endurance are positively related. This low positive correlation between the effect of static stretching on handgrip strength and endurance may be explained by the fact that static stretching brought about insignificant reduction in handgrip endurance of all the groups and handgrip strength of only the group that performed the static stretch for 45 minutes. Nelson, Kokkonen and Arnall (2005) stated that muscular strength and endurance are linked. They speculate that the inhibitory effect that prior stretching has on strength can also extend to reduction in endurance.

CONCLUSION
Static stretching of wrist flexors had no significant effect on handgrip strength despite the duration of stretch. Static stretching of wrist flexors for 30 seconds brought about a significant reduction in handgrip endurance but those of 45 and 60 seconds had no significant effect. There was no significant difference between the effect of static stretching on handgrip strength and endurance of males and females. There was a low positive correlation between the effect of static stretching of wrist flexors on handgrip strength and endurance.

RELEVANCE OF FINDINGS
The following deductions can be made on the basis of the findings of this study:
1. Static stretching may not be used as a means of increasing muscular strength or endurance (functional performance) among healthy individuals.
2. Gender may not influence the effect of static stretching on muscular strength and endurance.
3. The effect of static stretching on handgrip strength is positively related to handgrip endurance.
REFERENCES


