EFFECT OF AGE ON INDIRECT SYMPTOMS OF MUSCLE DAMAGE AFTER FATIGUE EXERCISE

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1. General

The purpose of this study was to establish the main differences between men and prepubescents in muscle damage induced by exercise (EIMD) performed at maximal intensity and particularly to compare changes in the jump height and maximal voluntary contraction after a strenuous stretch shortening cycle exercise protocol (SSE). EIMD in humans frequently occurs after unaccustomed exercise, particularly if the exercise involves a large amount of eccentric contractions [1,2,3]. It is still not quite clear how age affects resistance to muscle damage and fatigue. There have been few studies on EIMD in children. Children often demonstrate lower fatigue rates and faster recovery than adults [4,5,6,7]. Therefore, we hypothesized that the severity of symptoms of EIMD after an initial bout of plyometric exercise would be milder in boys than in men. Among the numerous well documented direct symptoms of EIMD (disruption of intracellular muscle structure, sarcolema and extracellular matrix, protein leakage from injured muscle fibres), this study examined only the indirect symptoms of skeletal muscle damage such as impairment of muscle function measured during voluntary contractions, delayed-onset muscle soreness and changes in different jumping height tasks. These damage indicators were assessed pre-, immediately post-, 24, 48 and 72 hours post SSE.

Keywords: *muscle damage, prepubescent, vertical jump, stretch shortening cycle*

2. Methods-Procedure

Participants visited the data collection laboratory on five different occasions (familiarisation, pre-immediately after SSE, 24h, 48h and 72h after SSE).Twelve boys [age (mean $\pm$ SD)10,1$\pm$0,56 years] and 12 men (age 24,5 $\pm$ 2,54 years) gave written, informed consent and participated in this study.

The SSE protocol consisted of 100 maximal intensity jumps performed as 10 sets of 10 continuous maximal plyometric jumps. Participants stood with feet shoulder apart and hands on hips. Assuming this posture, they were asked to jump as high as possible on each jump after a preparatory downward eccentric movement, to a knee bend of 90˚, which was performed as fast as possible. Each set of 10 jumps was separated by a 30 seconds rest period.

For the evaluations of delayed onset muscle soreness (DOMS), each participant palpated his muscle belly and the distal region of the vastus medialis, vastus lateralis and rectus femoris in a seated position with the muscles relaxed. Perceived soreness was then rated on a scale ranging from 1 (normal) to 10 (very sore).

An isokinetic dynamometer (CYBEX NORM Lumex Inc., Ronkokoma, N.Y) was used to evaluate the performance of the knee extensors. Each participant performed three trials and the best one was selected as the representative. The parameter measured was isometric peak torque at 70^o knee flexion. There was a 3-minute rest between contraction modes.

All jumps of the protocol and the additional tested squat (SJ) and countermovement jumps (CMJ) were performed on a 0.6x0.6 Bertec force plate (Type 4060, Bertec Corporation, Columbus, OH) collecting at 1000 Hz, which served as a landing area. Each participant executed three SJ and three CMJ and the best one on the basis of jumping height was selected.

All the parameters mentioned were measured before exercise and immediately after, 24 h, 48 h and 72 h after the SSE.

3. Statistics

The Kolmogorov-Smirnov test of normality revealed that none of the studied variables required logarithmic transformation. Repeated measures one-way ANOVA with five levels (pre-exercise, immediately post exercise, 24, 48 and 72 hours post exercise) were utilised for indirect muscle indicators. When the ANOVA was significant, a Student's t-test was used to determine differences between the groups. The significance level was set at $P < 0.05$.

4. Results

All muscle damage indicators revealed significant changes post- compared to pre-exercise data ($P < 0.05$) confirming that muscle damage did occur. First of all, it was found that adults from the 1st to 10th set of consecutive jumps (protocol) presented drop in their jumping height (mean of 10 jumps) compared to children who did not alter their jumping score and in fact they improved it during the 6th and 7th set. As well as that, both groups revealed delayed muscle soreness and particularly adults reported high valued 48 hours after protocol and children 24 hours after it. In the meanwhile, across time (0,24,48 and 72 hours after protocol), adults presented statistical significant decrease in jumping height performance both in countermovent and squat jump and maximal isometric strength and in fact at a greater degree compared to children. In these parameters, children presented their peak drop about 24 hours after protocol and their values returned to the baseline values about 48 hours after the protocol, whereas adults presented a long-lasting (till 72 hours) drop in the values of the above mentioned parameters and of course a decrease at a greater extent compared to children.

5. Discussion and Conclusions

The first finding of this study was that during the SSE, the height of jumps from bout to bout (mean value of 10 consecutive jumps) was decreased more in adults compared to children SSE exercise resulted in less severe symptoms of exercise-induced muscle damage in boys than in men. This was true for perceived soreness and for measures of muscle function. Previous research has reported that squat jump height is affected to a greater extent than jump which involves the stretch shortening cycle after EIMD in adults [8,9]. Similarly, in the present study the decrement in performance was greater for the squat jump in men. The pattern of decline and recovery in squat and countermovement jump height in men concurs with these previous findings after a single bout of SSE protocol. In boys, both jumps appeared to be affected to a similar extent after SSE, although recovery was quicker for the squat jump. Neuromuscular fatigue which was seen during the SSE protocol and immediately after in both groups, could likely be attributed apart from muscle damage factors [10], to metabolic factors since the duration of the ten continuous jumps was long enough (0.25-0.30s.) for ATP and PCr to be decreased significantly. A lower glycolytic rate (as children adopt), which probably results in less marked lactate accumulation in skeletal muscles, is given as the major reason for high fatigue resistance and faster recovery in children compared to adults [11]. In addition to this, damage has been reported to occur predominantly in fast-twitch fibers [11,12]. Because fast-twitch fibers are more susceptible to damage, a lower proportion of these fibers in prepubescents may help explain the relatively milder symptoms of EIMD in this group. In conclusion, all functional measures and soreness were almost back to baseline 48h after the SSE in prepubescents. The same was not evident in adults. Future research including biochemical apart from functional measures both in adults and prepubescents would further shed light on the exact mechanisms that support the point of reduced severity of symptoms in prepubescents after a SSE protocol in contrast to adults.

5. References

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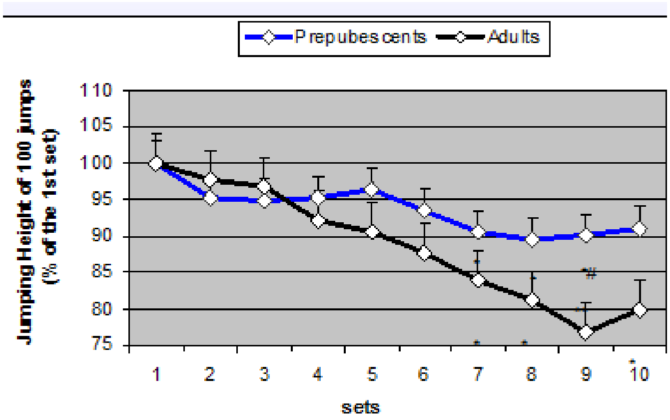

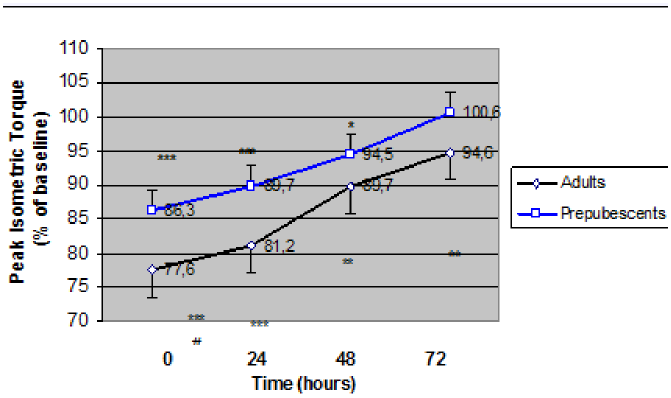

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