

## Does Child have Muscle Pain after Enormous Exercise?

Eisuke Hiruma

Department of Sport and Medical Science, Teikyo University, 359 Otsuka, Japan

### Abstract

There are many researches of the effects of strenuous exercise on DOMS for adults have been presented. However, there are not many studies on children who have a lot of physical activity on a daily basis and are engaged in sports activities. In recent years, due to the younger age of sports competitions, practice specialized in specialized sports has been practiced since childhood. The practice in the children is similar to that of an adult, and there is a high opportunity that injury may occur. Therefore, the purpose of this study was to understand the effects of children after strenuous exercise on their bodies so that they can practice safely. Adults express DOMS regardless of gender in resistance training with eccentric muscle activity. However, even if boys and girls under the age of 15 in the developing stage perform resistance training with the same load, visual analog scale (VAS), which is an indirect index of DOMS, increases, but creatine kinase activity (CK), which is an index of muscle damage, does not increase. In addition, in uphill or downhill running due to its own weight, an increase in CK is observed in boys with high muscle mass, but not in girls with low muscle mass. Therefore, it was suggested that there may be a gender difference in the expression of DOMS that is not observed in adults, and a gender difference in the expression of DOMS in developing children.

### Introduction

Delayed onset muscle soreness (DOMS) is called muscle soreness caused by unfamiliar exercise or high-intensity and intense exercise [1]. In addition, it has been presented that eccentric muscle activity causes DOMS [2], and Hiruma et al. [3] present that DOMS is not expressed by resistance training with 50% of one repetition maximum (1RM) and slow eccentric muscle activity. DOMS is accompanied by muscle damage [4], pain, muscle weakness, decreased range of motion, edema, increased activity of creatine kinase activity (CK) and glutamine [5]. These physical damages may cause various symptoms of injuries. These symptoms are used as indirect indicators of DOMS. It has been presented that the peak of pain is 24-48 hours, the peak of CK is 48-72 hours later, and almost all symptoms disappear after 7 days [6].

Physical activity in children is important for promoting healthy growth and development, developing healthy habits, and improving sports performance. A safe and effective exercise program is important for children to practice exercise habitually. Since DOMS is accompanied by pain and edema, muscle fiber damage [7], fascia damage [8], and Z-band damage [4,9] have been presented. From this, it is important for children in the developing stage to understand the effects on muscles after physical activity and sports, and [2] the recovery status of DOMS and muscle damage. It is important to prevent the occurrence of adverse events.

Therefore, the purpose of this study was to review the studies related to the keywords "DOMS" and "children" and to examine them from the viewpoint of sex and exercise method.

### Method

10 original papers submitted to overseas specialized journals, PUBMED and CiNii, were extracted from 1989 to 2018. Table shows the subjects, loading methods, measurement items, and results of the five original papers extracted. These will be considered separately for sex and loading method.

### Publication History:

Received: September 28, 2020

Accepted: October 03, 2020

Published: October 05, 2020

### Keywords:

DOMS, Isometric maximum muscle strength, Creatine kinase, Resistance training, Contact sports

### Results and Discussion

The table shows the subjects, load methods, measurements, and results of the five extracted original Russian texts. The five papers extracted this time have a wide range of ages from 1989 to 2018. These will be considered separately for sex and loading method (Table 1).

### Resistance training and DOMS

In Fatoutos et al. [10], the effects of the resistance training of the lower limbs on range of motion (ROM), isometric muscle strength (IMS), CK and VAS in boys and male adults. ROM after resistance training was significantly reduced in both groups ( $p < 0.05$ ), but the rate of decrease in male adults was significantly greater than that in boys ( $p < 0.05$ ). In addition, VAS was significantly increased in both groups ( $p < 0.05$ ), but the rate of increase was significantly higher in male adults than in boys ( $p < 0.05$ ). There were no significant changes in IMS and CK in boys, but there was a significant decrease in IMS and an increase in CK in male adults ( $p < 0.05$ ). Similar results were found in a bench press study by Soares et al. [11]. From the above results, significant changes were observed in IMS and CK of male adults after the resistance training to the upper and lower body ( $p < 0.05$ ). However, boys under the age of 13 in the both studies had not the changes in IMS and CK which were the evaluation indicators of DOMS. Furthermore, there was a significant increase in VAS and a decrease in ROM in the male adults which are indicators of DOMS. The rate of change of VAS and ROM in children was significantly lower than in male adults ( $p < 0.05$ ). Webber et al. [12] present that male adults exert greater muscle activity and strength per unit area, resulting in greater muscle cell damage, increased CK, and decreased IMS. Therefore, boys

**Corresponding Author:** Prof. Eisuke Hiruma, Department of Sport and Medical Science, Teikyo University, 359 Otsuka, Hachioji, Tokyo 192-0395, Japan; E-mail: [hiruma@main.teikyo-u.ac.jp](mailto:hiruma@main.teikyo-u.ac.jp)

**Citation:** Hiruma E (2020) Does Child have Muscle Pain after Enormous Exercise?. Int J Phys Ther Rehab 6: 166. doi: <https://doi.org/10.15344/2455-7498/2020/166>

**Copyright:** © 2020 Hiruma. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

References	Subjects	Exercise loads	Measurements	Results
Fatouros et al. (2017)	10-12yrs Boys 15-45yrs Adults	Knee Extension (15 raps × 5 sets)	IMS CK VAS ROM	boys → < adult ↓ (p<0.05) boys → < adults ↑ (p<0.05) boys ↑ < adults ↑ (p<0.05) boys ↓ < adults ↓ (p<0.05)
Soares et al. (1996)	Boys (12.1±0.2yrs) men (28.3±3.5yrs)	Bench Press (80% 1 RM×5sets)	ISO CK VAS PAIN	boys → < Men ↓ (p<0.05) boys → < men ↑ (p<0.05) boys ↑ < men ↑ (p<0.05) boys ↑ < men ↑ (p<0.05)
Webber et al.(1989)	Chilren(10.4±0.3yrs) boys girls Adults (27.2±2.3yrs) men women	Downhill Running	VAS VAS CK CK	boys ↑ = men ↑ girls ↑ = women ↑ boys ↑ < men ↑ (p<0.05) girls → = women →
Elamaran et al. (2013)	14yrs boys Football players 14yrs boys 16yrs boys Football players 16yrs boys	Treadmill running with up-road	CK	Football player ↑ < boys ↑ (p<0.05)
Hughes et al. (2018)	Girls Football Players U13(12.2±0.6yrs) U15(13.8±0.6yrs) U17(15.8±0.4yrs)	Football Game	CK VAS	U13 ↑ > U15 ↑ = U17 ↑ (p<0.05) U13 ↑ = U15 ↑ < U17 ↑ (p<0.05)

Table 1: Studies of DOMS in children.

ROM: Range of motion, IMS: Isometric muscular strength, CK: Creatine Kinase, VAS: Visual analog Scale.

with relatively low muscle mass compared to adults have less muscle damage. The significant increased CK and decreased IMS (p<0.05), even when resistance training is performed with the same load as male adults. It is probable that it was not recognized. Furthermore, it is considered that the rate of change in ROM and VAS was significantly lower than that in male adults because of less muscle damage.

### Downhill running and DOMS

Webber et al. [12] compared the effects of downhill running on VAS and CK between boys and male adults and girls and male adults. VAS was significantly increased in all four groups after downhill running. There was also no significant increase in CK for girls and male adults. However, a significant increase in CK was observed in boys and male adults (p<0.05), but the rate of change was significantly higher in male adults (p<0.05). Again, as discussed in the resistance training and DOMS above, male adults are relatively heavier and stronger than boys, resulting in greater fall speed and greater muscle damage during downhill running. This is the reason for this muscle damage. The boys also tended to recover DOMS faster because of less muscle damage.

### Flatland running and DOMS

Elamaran et al. [13] compared the effects of treadmill running with Brunce protocol (uphill running with increasing running speed) on CK for 14- and 16-year-old soccer players and boys of the same age. As a result, CK after treadmill running was significantly increased in four groups (p<0.05). The rate of increase was also significantly higher in boys of the same age than in soccer players aged 14 and 16 (p<0.05). Hiruma et al. [14] presented that repeated high-intensity training with muscle damage for 7 consecutive days under the same load resulted in muscle adaptation and recovery of DOMS indicators after the 4th day. Therefore, it is probable that both soccer players practice on a daily basis had a lower increase in CK than the boys of the same age due to the muscle adaptation to DOMS.

### Soccer match and DOMS

Hughes et al. [15] compared the effects of female soccer players under the age of 13 (U13), under the age of 15 (U15), and under the age of 17 (U17) on CK and VAS, which are indicators of DOMS after the official match. As a result, a significant increase in CK and VAS was observed after the official match in all three groups (p<0.05). The increase in CK in U13 group also was more significant than in the U15 and U17 groups (p<0.05). However, VAS in U17 group showed significantly higher values than that in U13 and U15 groups (p<0.05). Due to daily training on the 3.5th and 5th days after the match, VAS and CK in the three groups did not recover to rest values on the 7th day. U13 and U15 groups had VAS immediately after the official match and on the 3.5th day. Despite showing the same value and lower than U17, CK value in U13 group was higher than that in U15 and U17 groups. In these three previous studies, boys and girls did not significantly increase in CK. It might be considered that the increase in the CK value of U13 group was due to contact or bruising in the match. CK presents intracellular changes. It leaked into the blood due to damage to the cell tissue and myocardium due to causes other than exercise.

### Conclusion

It was suggested that there may be a gender difference in the expression of DOMS that is not observed in adults, and a gender difference in the expression of DOMS in developing children. However, there are very few studies on children compared to studies on adults. Therefore, further research is needed to protect children from muscle injuries and injuries and to create an environment where they can safely engage in sports and physical activity.

### Competing Interests

The author declare that there is no competing interests regarding the publication of this article.

---

## References

1. Clarkson PM, Teemblay I (1988) Exercise-induced muscle damage, repair, and adaptation in humans. *J Appl Physiol* 65: 1-6.
2. O'Reilly K, Warhol M, Fielding R, Frontera W, Meredith C, et al. (1986) Eccentric exercise-induced muscle damage impairs muscle glycogen repletion. *J Appl Physiol* 63: 526-256.
3. Hiruma E, Katamaoto S, Nait H (2015) Effects of shortening and lengthening resistance exercise with low-intensity on physical fitness and muscular function in senior adults. *Medical Express* 2: 19-26.
4. Clarkson PM, Hubal MJ (2002) Exercise-induced muscle damage in humans. *Am J Phys Med Rehabil* 81: 52-69.
5. Low SY, Taylor PM, Rennie MJ (1996) Response of glutamine transport in cultured rat skeletal muscle to osmotically induced changes in cell volume. *J Physiol* 492: 877-885.
6. Nosaka K, Clarkson PM, McGuiggin ME, Byrne JM (1991) Time course of muscle adaptation after high force eccentric exercise. *Eur J Appl Physiol* 63: 70-77.
7. Newham DJ, Mills KR, Quigley BM, Edwards RH (1983) Pain and fatigue after concentric and eccentric muscle contractions. *Clin Sci* 64: 55-62.
8. Loverring RM, De Deyne PG (2004) Contractile function, sarcolemma integrity, and the loss of dystrophin after skeletal muscle eccentric contraction-induced injury. *Am J Physiol* 286: 230-238.
9. Thosten H, Matin W, Theo W (2000) Isoenzyme-specific interaction of muscle-type creatine kinase with sarcomeric M-Line is mediated by NH<sub>2</sub>-terminal lysine charge-clamps. *J Cell Bio* 149: 1225-1234.
10. Fatouros IG, Paschalis V, Georgakouli K, Zalavras A, Avloniti A, et al. (2017) A comparison of exercise-induced muscle damage following maximal eccentric contractions in men and boys. *Pediatr Exerc Sci* 29: 316-325.
11. Soares JMC, Mota P, Duarte JA, Appell HJ (1996) Children are less susceptible to exercise-induced muscle damage than adults: A preliminary investigation. *Pediatr Exerc Sci* 8: 361-367.
12. Elamaran M, Muhammed MM (2013) The changes on creatine kinase in response to aerobic exercise among novice and trained soccer players of different ages. *Int J Phys Ed Fit Sports* 2: 29-33.
13. Webber LM, Byrnes WC, Rowland TW, Foster VL (1989) Serum creatine kinase activity and delayed onset muscle soreness in prepubescent children: a preliminary study. *Pediatr Exercise Scie* 1: 351-359.
14. Hiruma E, Okamura T, Sasaki H, Umimura M, van Essen A, et al. (2001) Relationship between seven days of maximum endurance strength exercise delayed onset muscle soreness. *Med Sci in Sports Exer* 33: 69.
15. Hughes JD, Denton K, Lloyd RS, Oliver JL, Croix M De Ste, et al. (2018) The impact of soccer match play on the muscle damage response in youth female athletes. *Int J Sports Med* 39: 343-348.