

Abstract

Muscle Fiber Typologies in Elite Cycling Disciplines

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1. Introduction

Classical muscle biopsy studies demonstrated that elite endurance athletes exhibit a slower muscle typology, while elite athletes who excel in explosive disciplines, have a predominant fast muscle typology¹. Muscle carnosine quantification by proton magnetic resonance spectroscopy (1H-MRS) was developed as a non-invasive alternative to estimate muscle typology. The validity of this technique was initially demonstrated in track-and-field, where muscle carnosine levels in elite athletes gradually decrease with increasing running distance². In cycling, solid data on muscle typology are scarce and therefore the aim of this study was to compare muscle carnosine levels between elite cyclists excelling in different disciplines.

2. Methods

The muscle carnosine content of 61 male and 23 female elite cyclists (37 track riders, 4 BMX riders, 23 road cyclists, 11 mountain bikers and 9 cyclo-crossers) was measured in the soleus and gastrocnemius medialis muscle by 1H-MRS on a 3T whole body MRI scanner (Siemens Trio - Belgium; Philips Medical Systems - Australia). Based on the UCI points and the rider profiles on ProCyclingStats, the track riders were further divided into "track-sprint athletes" (n=9) and

"track endurance riders" (n= 28) and the road riders were split up into "one day racers" (n=14), "general classification riders" (n=7) and "time-trial specialists" (n=2). Z-scores of muscle carnosine were calculated for each cyclist relative to a reference population with same age and sex. One-way anova and independent samples t-tests were used to compare the carnosine levels between the different cycling disciplines.

3. Results

Looking at the 5 main disciplines, BMX riders (Z= 1.47; range: 0.79 to 2.43) are characterized by higher carnosine levels compared to the other disciplines which is indicative for a fast muscle typology. Mountain bikers (Z= -0.99; range: -1.94 to -0.06), road riders (Z= -1.00; range: -2.22 to 0.61) and cyclo-crossers (Z= -0.81; range: -1.45 to -0.10) exhibit significantly (p <0.001) lower carnosine levels suggesting a slow muscle typology. Track riders (Z= 0.11; range: -1.41 to 3.62) also dispose of higher carnosine levels compared to mountain bikers (p=0.028) and road riders (p<0.001). As we observed broad carnosine ranges in the track and road riders, we further divided these riders into specific disciplines with different characteristics. Track-sprinters show a significant faster muscle typology (Z= 1.40; range: 0.55 to 3.62) compared to track endurance riders (Z= -0.31; range: -1.41 to 1.11) (p<0.001). Where, one day road racers



($Z = -0.79$; range: -1.94 to 0.61) ($p = 0.043$) and time-trial specialists ($Z = -0.06$; range: -0.43 to 0.41) ($p = 0.031$) demonstrate higher carnosine levels compared to general classification riders ($Z = -1.67$; range: -2.22 to -0.96).

4. Conclusion

Prominent differences in muscle carnosine levels exist between elite cyclists of various disciplines, in line with their respective functional demands. The non-invasive character and the high intra-individual stability of the technique open opportunities for application in transfer and talent orientation in cycling.

References

1. Gollnick, P. (1972). *J. Appl. Physiol*, 33, 312-319;
2. Baguet, A. (2011). *PLoS One*, 6, 1-6.