Association of *PPARA* gene variant with sprint and power ability of Lithuanian elite athletes

Assoc. Prof. Dr. Valentina Ginevičienė¹, Roberta Žavoronkova¹, Prof. Dr. Habil. Kazys Milašius²

Institute of Biomedical science, Faculty of Medicine, Vilnius University¹, Vytautos Magnus University Education Academy²

**Introduction.** The elite athletic phenotype is a complex combination influenced by both multiple genes and environmental factors (Barh, Ahmetov, 2019; Leonska-Duniec, 2013). One of the genes of the sports-related phenotype is the *PPARA* encoding peroxisome proliferator activated receptor alpha that is a central regulator of expression of genes involved in energy homeostasis, in mitochondrial fatty acid oxidation, lipid and glucose metabolism (Eynon et al., 2010; Shreekrishna et al., 2018). This case-control study aims to examine the association between *PPARA* (G > C, rs4253778) genetic variant and physical performance phenotype in Lithuanian elite athletes.

**Method.** A total of 142 elite athletes (endurance-oriented (n = 41), sprint/power-oriented (n = 59) and team sports (mix) group (n = 42)) and 191 non-athlete controls (healthy unrelated Lithuanian citizens) were genotyped for *PPARA* G/C variants. Genotyping was performed by restriction fragment length polymorphism method. The measured phenotypic variables included: anthropometric measurements (height, body mass, fat mass, muscle mass, body mass index (BMI)); maximal isometric power of the forearm muscles (handgrip test (RGS, LGS)); short-term explosive muscle power (STEMP, vertical jump test), anaerobic alactic maximum power (AAMP, stair climbing test) and maximum oxygen uptake (VO₂max). The average differences for each genotype of athletes’ phenotypic indices were evaluated by using single factor dispersion analysis (ANOVA). Statistical analysis was performed using Rv3.2.

**Results.** Our study groups of athletes demonstrate unique and clearly distinctive phenotypes. Each group contains elite level athletes from a well-defined sports category that has known prime determinants for success. The phenotypic measurements were different and specific to each sports groups. Almost all phenotypic variables were significantly higher in males than females with exception of fat mass and STEMP (p < 0.05). The sprint/power-oriented athletes had significantly higher BMI, RGS, LGS, muscle mass, STEMP and AAMP than endurance-oriented athletes (p < 0.05). Whereas VO₂max was significantly higher in endurance-oriented than in sprint/power or mixed group athletes (p < 0.05). These results indicate that gender and sport specialization has an important influence on athletes physical characteristics.

The distribution of *PPARA* G/C polymorphism genotype and allele frequencies in 142 Lithuanian elite athletes were compared to 191 healthy untrained individuals. Significant different were determined for genotype distribution between sprint/power-oriented group and controls (GG/GC/CC: 50.8/40.7/8.5% vs 68.6/28.3/3.1%; p = 0.02). According our results, *PPARA* C allele was more frequent in the sprint/power group (28.8%) compared to other sports groups (endurance18.3%, mixed 13.1%) and the controls (17.3%) (p < 0.05). In addition, *PPARA* alleles/genotypes distribution significant differed between male sprint/power group and male controls (GG/GC/CC: 47.2/43.4/9.4% vs 74.8/23.4/1.8%; p=0.0007; [G/C] alleles: 68.8/31.2 vs 86.5/13.5%; p = 0.006). The odds ratio (OR) of sprint/power athletes harbouring *PPARA* GG genotype was 0.47 (95% CI: 0.26–0.85, p = 0.014) compared to controls. Regression analysis revealed that *PPARA* C/C genotype and sport category, gender, muscle mass determine the STEMP and AAMP. The athletes, carriers of the *PPARA* CC genotype...
in the sprint/power group had higher muscle mass, handgrip strength, AAMP and STEMP compared to the PARA GG genotype athletes.

**Conclusions.** Summarizing the results, we conclude that the athletes, carriers of the **PPARA** CC genotype have better ability to achieve high muscle capacity indexes when exercising short-term explosive muscle power tasks. Sprint/power-oriented athletes characterized by a higher frequency of **PPARA** C allele are prone to skeletal muscle hypertrophy and energy substrate switch resulting to anaerobic performance. Findings provide support for an association of **PPARA** (rs8192678) C allele with sprint and power ability in Lithuanian elite athletes. Molecular testing of genetic factors, such as **PPAR** genes variant, might be useful in optimizing training programs by indicating in which sport an elite athlete can compete successfully.

**Keywords:** PPAR gene, genotype, phenotype, elite athletes.

**REFERENCES**