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Editorial

The Scarcity of Professional Athletes with Type 2 Diabetes: A Predictive Genomics Approach

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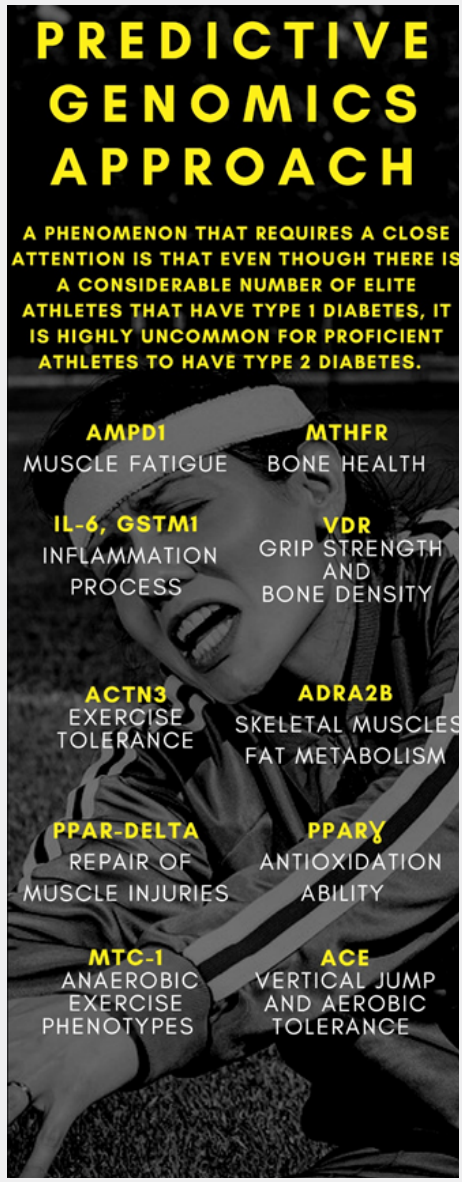
A phenomenon that requires close attention is that there are a considerable number of elite athletes who have type 1 diabetes, such as Gary Mabbutt, who played for the British football teams 'Tottenham' and 'Bristol Rovers' despite suffering from the condition. Incidentally, Mabutt was also the winner of the 1984 UEFA Cup and the 1991 FA Cup. It is highly uncommon for proficient athletes to have type 2 diabetes and enjoy a high-profile sporting career at the same time, however.

Predictive genomics combines multiple fields of specialties, such as predictive and personalized medicine, genomics, and bioinformatics. It is a novel discipline that deals with the imminent phenotypic outcomes, of complex human diseases, such as type-2 diabetes (T2D) and cancer via prediction. In addition, predictive genomics can also aid in envisaging the skills and behavior of certain individuals in different situations by analyzing their complex genetic architecture. One important benefit of predictive genomics is in deciphering human athletic performance, which is a highly complex multi-factorial polygenic trait. Several factors determine the physical fitness and performance phenotype of an athlete, such as the environment and various physiological and psychological factors; however, genetics is also a very important factor. Moreover, predictive genomics can aid in the understanding of abilities and weaknesses associated with sports performance.

It assesses disadvantageous genetic traits that can be modified through external factors, such as the environment and nutrition. Genetic studies have led to the discovery of DNA sequence/gene variations associated with athletic performance, such as endurance capacity, muscle performance, susceptibility to tendon and bone injuries, the effect of an individual's body mass index (BMI), and their psychological aptitude. Surprisingly, sequence variations in many of these genes are also associated with the development of T2D and/or its complications. For example, the genomic variants of *ace, bdkrb2, nos3, hif1,* and VEGF genes can affect the endurance capacity of athletes since they have been shown to influence maximal oxygen consumption as well as the energy supply involved in aerobic metabolism. They also enhance the oxygen supply to muscle tissues [1-4]. On the other hand, ace gene polymorphism is associated with T2D in Caucasians, Indian, Taiwanese, and several other populations [5]. Moreover, a single nucleotide polymorphism rs2069590 (T/A) in *bdkrb2* is associated with T2D in Han Chinese [6]. Incidentally, the nitric oxide synthase *nos3* gene (rs3918188) plays an important role in an individual's susceptibility to T2D [7]. Furthermore, it was found that the inhibition of HIF1, the product of the *hif1* gene, in adipose tissue ameliorates obesity and insulin resistance and thus may provide a potential therapeutic target for obesity and type 2 diabetes [8]. Lastly, it was found that certain genetic deletions/insertions in the VEGF gene play a key role in the pathogenesis of diabetic microvascular complications [9]. Similar patterns of genetic correspondence were also observed with the genes involved in muscle strength and performance, which are namely, the ACTN3, *ace, hif1,* and *nos3*. Genes that are involved in acute exercise tolerance (*ampd1*), muscle fatigue (*mtc-1*), anaerobic exercise phenotypes and muscular strength (*dio1*), number of slow twitch muscle fibers (*ppar*-delta), repair of Muscle Injuries (*igf-1*), heart health (*mthfr, sod3,* IL-6, TNF- α, APOC3, CETP, LPL, eNOS and *ace*), bone health (VDR, IL-6, TNF-a), Insulin resistance (VDR, *ace*, IL-6, TNF-a, PPARɣ), antioxidation ability anti-oxidant protection and detoxification (eNOS, *sod3,* MnSOD, GSTM1, GSTP1, GSTT1) and inflammation health (GSTM1, GSTP1, GSTT1, MnSOD, IL-6 and TNF-α) [10-12]. In fact, all the mentioned above genes are currently used in commercial kits to evaluate and enhance the performance and the physical capacity of many elite athletes and international teams all over the world. Enhanced physical performance can be achieved through the acquiring of optimal exercise responses, precise assessment of any injury and recovery profiles, the accurate evaluation of food sensitivities and intolerances, the personalization of nutrient needs, and the correct defining of optimal diet and macronutrient responses. The facts outlined in this paper raise two important issues; the first being that the phenomenon of the scarcity of professional athletes with type 2 diabetes could be due to certain genetic factors, which hinder individuals with an underlying genetic risk of T2D from being able to compete in different sorts of sports early in their life even before the development of T2D occurs. Secondly, the genetic risk of T2D, which may hinder the athletic abilities of certain individuals, who are at risk of developing T2D later in life, can be modified and even reversed at an early age. The genes in question play an important role in determining an individual's phenotype, which in this case, pertain to athletic performance.

However, this can be modified or significantly altered through environmental and nutritional intervention. Thus, a high degree of understanding and the profiling of the nutrigenomics of the athlete can help in improving his/her performance. This branch of predictive nutrigenomics is involved in folic acid metabolism, iron absorption, storage, inflammatory response, antioxidation ability as well as anti-oxidant protection, detoxification ability, salt-sensitive hypertension, alcohol metabolism, caffeine metabolism, and gluten intolerance. There is no doubt that this phenomenon requires further attention and the conducting of multiple studies in order to shed more light on the topic and help affected people to overcome their ordeal, especially in the early stages of their life.



Bibliography

1. Popadic Gacesa, J. Z., Momcilovic, M., Veselinovic, I., Brodie, D. A. & Grujic, N. G. (2012). Bradykinin type 2 receptor -9/-9 genotype is associated with triceps brachii muscle hypertrophy following strength training in young healthy men. *BMC Musculoskelet Disord., 13*(217).

2. Salles, J. I., Duarte, M. E. L., Guimarães, J. M., Lopes, L. R., Vilarinho Cardoso, J., *et al.* (2016). Vascular Endothelial Growth Factor Receptor-2 Polymorphisms Have Protective Effect against the Development of Tendinopathy in Volleyball Athletes. *PLoS ONE, 11,* e0167717.

3. Vancini, R. L., Pesquero, J. B., Fachina, R. J., Andrade, M. D. S., Borin, J. P., *et al.* (2014). Genetic aspects of athletic performance: the African runners phenomenon. *Open Access J Sports Med., 5,* 123-127.

4. Kambouris, M., Del Buono, A. & Maffulli, N. (2014). Genomics DNA profiling in elite professional soccer players: a pilot study. *Transl Med UniSa., 9,* 18-22.

5. Abbas, S., Raza, S. T., Ahmed, F., Ahmad, A., Rizvi, S. & Mahdi, F. (2013). Association of genetic polymorphism of PPARγ-2, ACE, MTHFR, FABP-2 and FTO genes in risk prediction of type 2 diabetes mellitus. *J. Biomed. Sci., 20*(1), 80.

6. Han, L., Xin, R., Sun, J., Hou, F., Li, C., *et al.* (2015). Association of single nucleotide polymorphisms of susceptibility genes of type 2 diabetes mellitus with liability to gout among ethnic Han Chinese males from coastal region of Shandong. *Zhonghua Yi Xue Yi Chuan Xue Za Zhi, 32*(5), 711-714.

7. Chen, F., Li, Y. M., Yang, L. Q., Zhong, C. G. & Zhuang, Z. X. (2016). Association of NOS2 and NOS3 gene polymorphisms with susceptibility to type 2 diabetes mellitus and diabetic nephropathy in the Chinese Han population. *IUBMB Life, 68*(7), 516-525.

8. Jiang, C., Qu, A., Matsubara, T., Chanturiya, T., Jou, W., *et al.* (2011). Disruption of hypoxia-inducible factor 1 in adipocytes improves insulin sensitivity and decreases adiposity in high-fat diet-fed mice. *Diabetes, 60*(10), 2484-2495.

9. Amle, D., Mir, R., Khaneja, A., Agarwal, S., Ahlawat, R., Ray, P. C. & Saxena, A. (2015). Association of 18bp insertion/deletion polymorphism, at -2549 position of VEGF gene, with diabetic nephropathy in type 2 diabetes mellitus patients of North Indian population. *J Diabetes Metab Disord., 14*(19).

10. Gineviciene, V., Jakaitiene, A., Aksenov, M. O., Aksenova, A. V., Druzhevskaya, A. M., *et al.* (2016). Association analysis of ACE, ACTN3 and PPARGC1A gene polymorphisms in two cohorts of European strength and power athletes. *Biol Sport., 33*(3), 199-206.

11. Szelid, Z., Lux, Á., Kolossváry, M., Tóth, A., Vágó, H., *et al.* (2015). Right Ventricular Adaptation Is Associated with the Glu298Asp Variant of the NOS3 Gene in Elite Athletes. *PLoS ONE, 10*(10), e0141680.

12. Massidda, M., Eynon, N., Bachis, V., Corrias, L., Culigioni, C., *et al.* (2015). Influence of the MCT1 rs1049434 on Indirect Muscle Disorders/Injuries in Elite Football Players. *Sports Med Open., 1,* 33.