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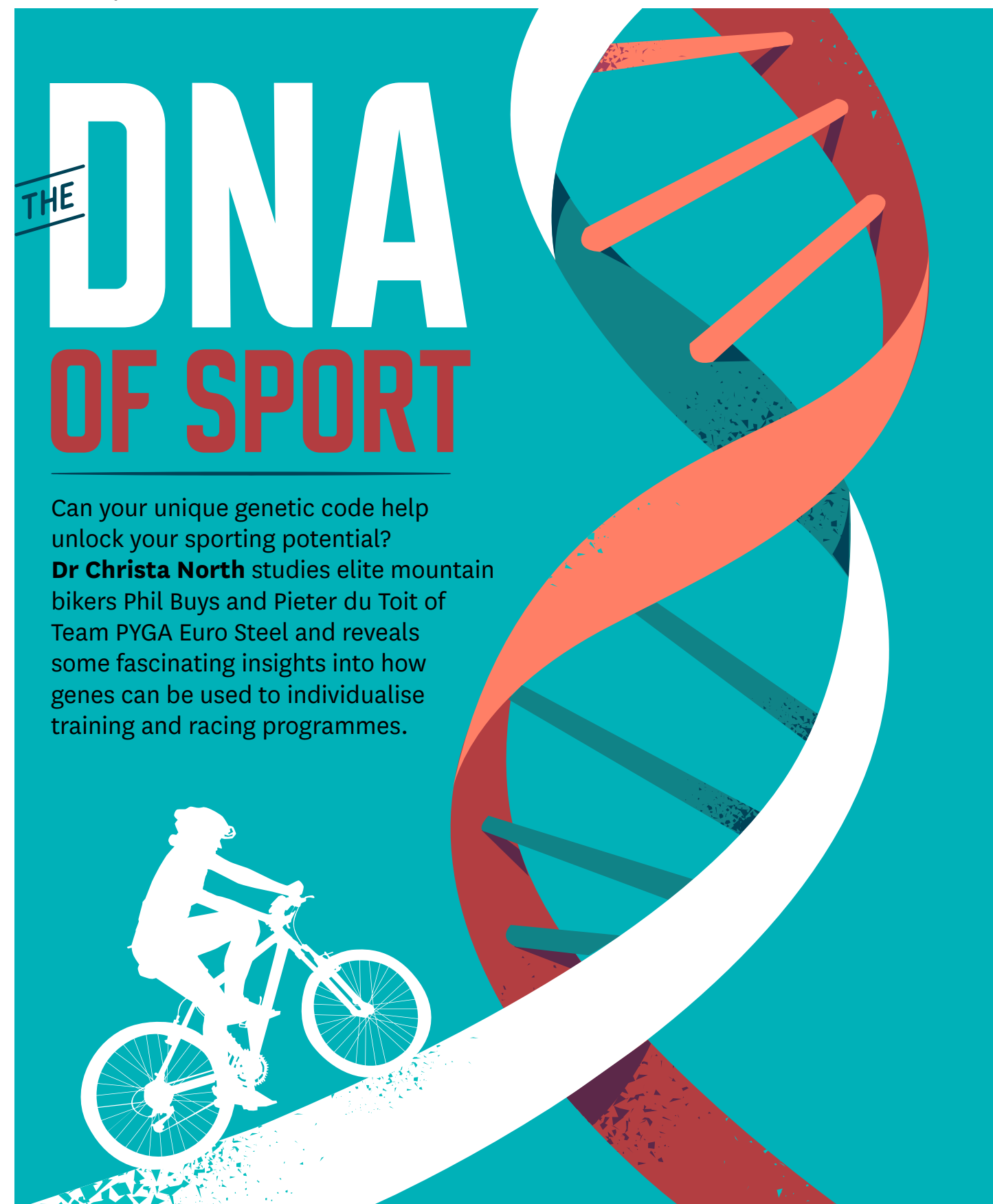
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THE DNA OF SPORT

Can your unique genetic code help unlock your sporting potential? **Dr Christa North** studies elite mountain bikers Phil Buys and Pieter du Toit of Team PYGA Euro Steel and reveals some fascinating insights into how genes can be used to individualise training and racing programmes.

Over the years, many athletes have wondered how they can identify unique things about their bodies that they can leverage to optimise their sporting potential. The question is not “how did he or she do it”, but rather, “how can I do it?” What can I do to reach that extra speed, clock that extra distance, or achieve my personal best? What is unique about me?

Now, a genetic test can be done to determine which unique factors lie in your DNA that you can leverage to achieve exactly that. While DNA testing used to be expensive and accessible to only an elite few, the technology is proliferating fast, costs are decreasing and you now have multiple options to choose from to explore this avenue. The result is that a new generation of athletes is embracing the opportunity to learn more about their bodies, and subsequently using this data to their advantage.

DNA BASICS

Before we get into the detail, let’s cover a few basics of DNA testing. Firstly, your DNA never changes. Therefore, regardless of what age you are, your DNA will be the same. However, with the technology expanding the way it is, local laboratories can test a lot more SNPs (single nucleotide polymorphisms) or genetic points than they could 10 years ago, yielding more detailed results. No two people’s DNA is the same (except for identical twins), so your results will be unique to you. There need not be any blood involved. Your DNA can be extracted from a simple cheek swab. Hence, there is no need for your DNA to leave the country. Testing is confidential.

While many people are under the misconception that your DNA is a predictor of certain traits, this is not entirely true. Your DNA works like a trigger. Different genes connect to different parts of the body and these genes get switched on and switched off. Some of your genes will work well, or optimally, while others won’t work well, and this is where it gets interesting. Your exposure to certain elements, environmental factors or behaviours will determine the reactions that those genes trigger, and therefore your body’s response. This is why DNA should not be viewed as your destiny, but rather a road map or recipe from which to live and act, so that you can achieve optimal health, and in the case of athletes, optimal results.

An example that makes this easy to understand is the ANKK1 gene, which is well studied in relation to addiction and weight gain, but also effects motivation to exercise. This dopamine-related variant is involved in the reinforcement value of addiction. Recently, researchers found that this same gene variant also relates to an ‘addiction for exercise’ — or, whether people felt that the reward of exercising was greater than doing other non-physical activities such as watching TV, playing video games, etc.

This is the fundamental principle of precision medicine, a field that is rapidly growing today as it enables each person to manage their health according to their unique needs. Additionally, the field emphasises prevention, rather than cure, when it comes to illnesses.

DNA testing has evolved to the point that there are now various types of genetic tests that you can do, each testing specific

CASE STUDY



Philip Buys (32) and Pieter du Toit (22) of Team PYGA Euro Steel were second overall at this year’s KAP sani2c. Part of their success, they say, was testing their DNA using the Geneway GeneSport test and training accordingly.

No two people are the same, and testing your DNA is an insightful way to determine exactly what your body needs to perform at its best. The genes tested help outline your genetic potential, show your body’s preferred fuel and energy source during exercise, your response to caffeine, your risk for inflammation and injury, your ability to deal with oxidative stress, your endurance and power potential, your susceptibility to injury as it relates to muscle and bone health, your ability to perform at high altitudes and the recovery time required after intense exercise.

Buys says he found his DNA test results beneficial as he now knows at which time of day he performs at his best (afternoons), and how to time his caffeine intake to get the best effect, with a cup of coffee ideally an hour before a workout. He is also able to address his weaker points, such as focusing on doing more endurance training, and capitalize on his stronger points, such as his short-term power acceleration. “I learned many things in a very short time, some of which would have taken me years to figure out,” he says. “It has also been a great confidence booster.”

Du Toit says the test enabled him to make small changes that have made a big difference. His test showed he is predisposed to become Vitamin D deficient, and now that he has started supplementing this nutrient, his recovery time has improved significantly. His test results recommended that he focus more on short explosive and slow-twitch muscle training. He has also made changes to what he eats, after the test suggested he incorporate more natural foods into his diet, which too has made a difference.



PHOTOGRAPHS SANI2C

genetic markers related to aspects such as your diet, your skin, your mind, your fertility, and your sporting potential. These tests scrutinize different groups of genes that play a role in these aspects of your health.

DNA TESTING FOR SPORTS

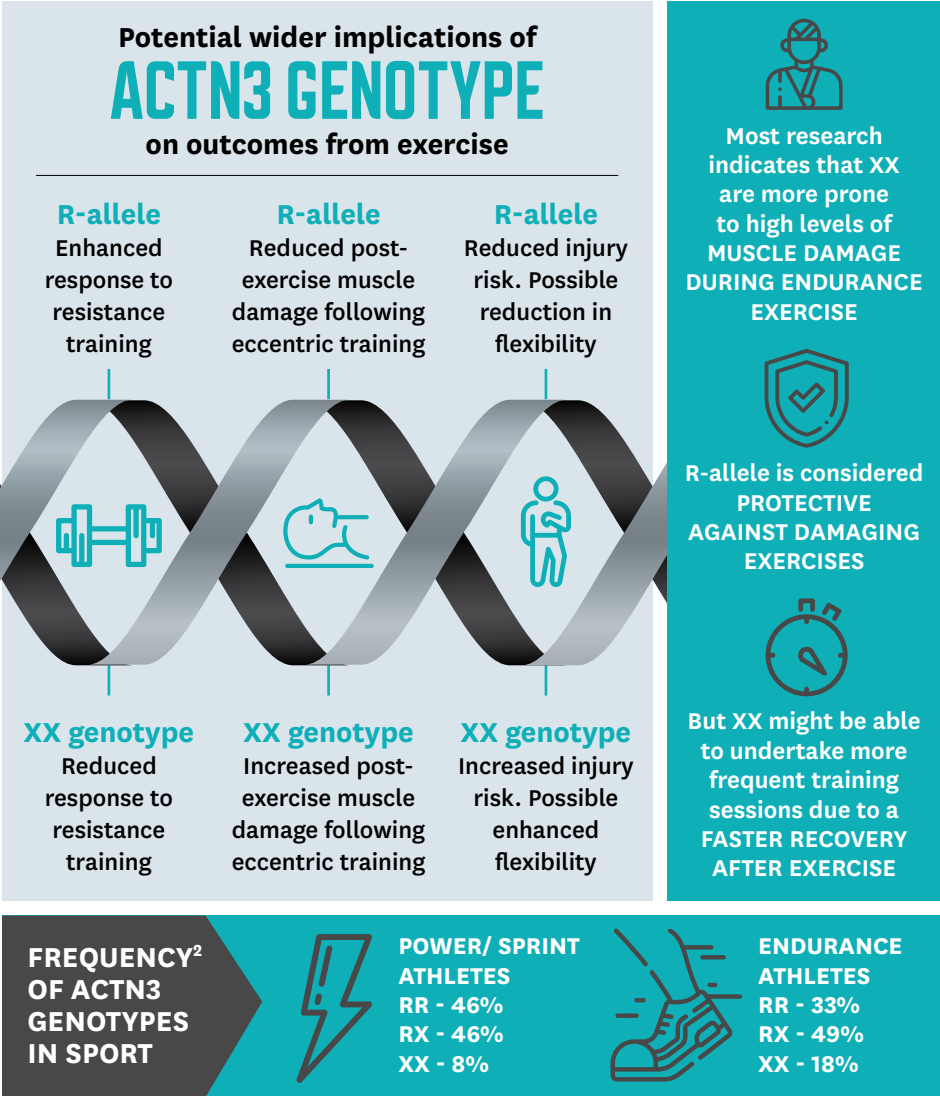
In 2018, the Chinese Ministry of Science and Technology revealed that China would use genetic testing on its athletes ahead of the 2022 Winter Olympics, incorporating it into the official athlete selection process. Other countries that support genetic testing include Uzbekistan, Brazil and Australia. South Africa participates in the RugbyGene project.

The debate over whether genetic testing of athletes actually works has been around for some time, especially regarding recruitment and selection programmes. I believe that genetic testing should not be used as means of talent identification since sport performance is complex. However, it holds utility within the athlete preparation process, providing information on exercise response, recovery speed and injury risk, to name a few.

It’s possible understanding the relationships between genes and individual training responses can be used to better individualise athlete training programmes. For example, a recent paper published reported those with particular gene variants linked to aerobic training adaptations showed greater training responsiveness after eight weeks of targeted training.

HOW GENETIC TESTING CAN HELP COACHES

Coaching encompasses both art and science. The science describes known facts about human anatomy, physiology and the way humans respond and adapt to exercise. Traditionally, during the coaching process many decisions are based on “lagging indicators”, meaning we have to wait to see how you responded to a



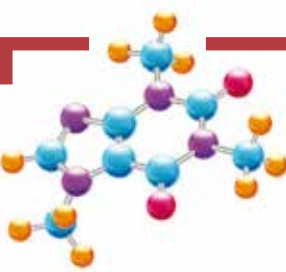
previous decision in order to decide what to do next. Genetic testing enables you to take a bigger picture approach and incorporate more “leading indicators” into coaching decisions, which could help athletes make faster progress, identify competitive advantages and reduce injury risk.

Doing a genetic test can tell you:

- Whether to focus on aerobic or strength training – which type is best for you.
- What time of day is best for your training, or at what time are you at your strongest.
- Guidelines to maximize your

supplementation, for example, should you be taking more iron or zinc.

- Your ideal fuel and energy source during exercise.
- Your response to caffeine – should you have 1, 2 or 3 cups of coffee prior to training, or rather none at all.
- Your ability to deal with oxidative stress and whether you need to add an antioxidant to your supplementation or not.
- Your muscle and bone composition and how you need to support this, for example supplement with vitamin D.



GENES AND CAFFEINE

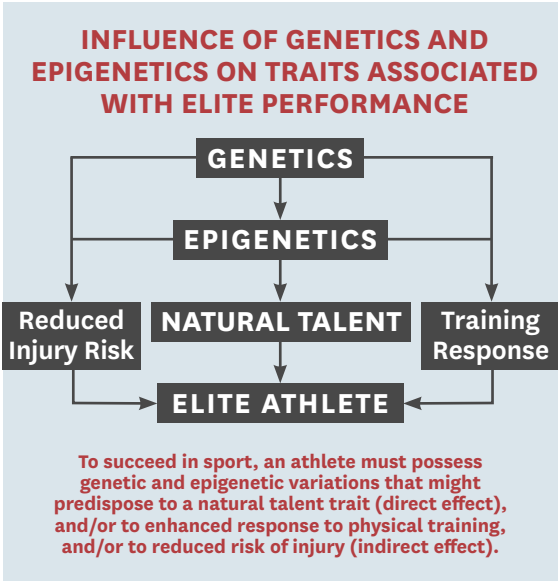
Caffeine is a popular and well-utilised ergogenic aid across a broad range of exercise modalities. Knowledge of the differences in CYP1A2 gene may inform pre-competition caffeine strategies. For example, CYP1A2 AA genotypes appear to experience greater ergogenic effects following caffeine ingestion than C allele carriers, indeed, CC genotypes may even find some doses of caffeine ergolytic. Your genetic results will determine whether or not you should ingest caffeine, and if so, how much should you ingest to benefit from its ergogenic effects.

- Your susceptibility to injury and your recovery time, such as how long do you need to set aside after your workout for recovery.
- Your natural response to running at altitude with recommendations on adapting to it.
- Your genetic lactate threshold and how you need to manage this. Lactate threshold is defined as the intensity of exercise at which lactate begins to accumulate in the blood at a faster rate than it can be removed.
- Your ‘built-in’ motivation to exercise and exercise tolerance perception

FAST OR SLOW?

Many physical traits help determine an individual’s athletic ability, primarily the strength of muscles used for movement and the predominant type of fibres that compose them. Skeletal muscles are made up of slow-twitch fibres and fast-twitch fibres. Slow-twitch muscle fibres contract slowly but can work for a long time without tiring; these fibres enable endurance activities like long-distance running. Fast-twitch muscle fibres contract quickly but tire rapidly; these fibres are good for sprinting and other activities that require power or strength.

The best-studied genes associated with athletic performance are ACTN3 and ACE. These genes influence the fibre type that makes up muscles,



and they have been linked to strength and endurance. The ACTN3 gene provides instructions for making a protein called alpha-actinin-3, which is predominantly found in fast-twitch muscle fibres. A variant in this gene, called R577X, leads to production of an abnormally short alpha-actinin-3 protein. Some people have this variant, which appears to reduce the proportion of fast-twitch muscle fibres and increase the proportion of slow-twitch fibres in the body, and is more common among high-performing endurance athletes than in the general population. On the other hand, carrying the rare “R” variation of the ACTN3 gene gives you an advantage in sprinting, due to the amount of fast-twitch muscle fibres. Usain Bolt carries the ACTN3 R allele, giving him, to say the least, a considerable edge in feats of strength and speed.

The ACE gene provides instructions for making a protein called angiotensin-converting enzyme. Individuals who have two copies of a version called the D allele, have the highest levels of angiotensin-converting enzyme. The DD pattern is thought to be related to a higher proportion of fast-twitch muscle fibres and greater speed.

Whatever your goal – get fit, lose weight, build muscle – and training experience, to maximize your results you need a workout plan that’s personalised to you – and genetic testing can certainly help to personalise your plan in a more targeted way. 🌀

THE GENEWAY GENESPORT

There are 43 genes tested by the GeneSport test offered by Geneway. The objectives of this test are to help athletes, runners, cyclists and weekend warriors to maximise their potential and performance in their respective fields by providing a blueprint of unique genetic factors that can be leveraged. The test is offered by qualified and trained practitioners, such as biokineticists, who are trained in the interpretation of genetic test results.

While some DNA testing companies are willing to test your DNA and simply email you a report, it is recommended that you get an HPCSA-accredited professional to explain your results to you. This is because the information is very detailed, and it is unlikely that the average person will be able to apply all of it without a professional level of expertise. To find a Geneway practitioner, go to www.geneway.co.za.

Some of the genes tested for:

- ACE A gene for endurance
- ACTN3 A gene for speed
- COL1A1 A gene for collagen

- CYP1A2 A gene for caffeine metabolism
- MCM A gene for lactose tolerance
- PGC1A A gene for aerobic capacity
- PPARA A gene for fat burning
- ADRB2 A gene for adrenaline signalling
- AGT A gene for blood pressure regulation
- AMPD1 A gene for energy production
- BDKRB2 A gene for vascular function
- CLOCK A gene affecting sleep cycle
- IL6 A gene for inflammation and recovery
- NOS3 A gene for blood flow
- PPARG A gene associated with fat and carb processing
- VDR A gene for vitamin D processing/activation
- VEGFA A gene for blood vessel formation