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Introduction

Elite rugby has one of the highest reported injury incidences of any professional sport (Brooks and Kemp, 2008). Some of the most severe injuries are those affecting tendon and ligament (Brazier et al., 2019), and therefore potentially the most debilitating to a player and playing squad. Tendon and ligament injuries are multifactorial conditions. The aetiology of these injuries involve a number of intrinsic and extrinsic factors, with a growing body of evidence suggesting that some inter-individual variability in injury susceptibility may be due to genetic variation (September et al., 2006). Elite rugby athletes (RA) might benefit from superior ability to recover from or withstand performance limiting or career-ending soft tissue injury to achieve their elite status. Thus, it was hypothesised that RA would possess genotypes associated with reduced soft tissue injury compared to a non-athlete control population.

Method

Participants from the RugbyGene project were elite Caucasian male RA (n = 636; mean (standard deviation) height 1.85 (0.07) m, mass 101 (12) kg, age 28 (7) yr), including 535 rugby union athletes and 104 rugby league athletes. Non-athletes (NA) were 722 Caucasian men and women (58% female; height 1.69 (0.10) m, mass 72 (14) kg, age 41 (23) yr). PCR of genomic DNA was used to determine genotypes using TaqMan probes, then groups were compared using χ^2 and odds ratio (OR) statistics, with alpha set at $P < 0.05$.

Results

COLGALT1 rs8090 AA genotype was more frequent in RA (27%) than NA (23%) ($\chi^2 = 12.6$, $P = 0.002$; OR = 1.48, 95% confidence intervals (CI) = 1.1-2.0; Figure 1). The *COL3A1* rs1800255 A-allele was more frequent in RA (26%) than NA (23%) due to more GA genotypes (39% v 33%, respectively; $\chi^2 = 9.0$, $P = 0.011$; OR = 1.1, 95% CI = 0.7-1.7). *MIR608* rs4919510 CC genotype was more frequent in RA (63%) than NA (56%; $\chi^2 = 16.4$, $P = 0.0003$; OR = 1.7, 95% CI = 1.1-2.6; Figure 2). *MMP3* rs591058 TT genotype was less frequent in RA (25%) than NA (31%; $\chi^2 = 10.8$, $P = 0.005$; OR = 1.33, 95% CI = 1.0-1.8), while *MMP3* rs679620 TT genotype was less frequent in RA (24%) than NA (29%; OR = 1.3, 95% CI = 1.0-1.7). *NID1* rs4660148 TT genotype was more frequent in RA (10%) than NA (6%; $\chi^2 = 14.5$, $P = 0.001$; OR = 1.6, 95% CI = 1.1-2.4; Figure 3), with *VEGFA* rs699947 AA genotype less frequent in RA (24%) than NA (29%; OR = 1.3, 95% CI = 1.0-1.8). There were no genotype differences between RA and NA for *COL1A1* rs1800012, *KDR* rs1870377, *MMP3* rs650108 or *TIMP2* rs4789932 variants.

Conclusion

We provide evidence for elite RA possessing a possible protective genetic profile regarding tendon and ligament injury risk. Notably, there was approximately 1.7 times the odds of RA possessing the CC genotype of *MIR608* rs4919510 than NA and 1.6 times the odds of RA possessing the TT genotype of *NID1* rs4660148 than NA. Additionally, more frequent *COLGALT1* AA, *NID1* TT, *MIR608* CC and *COL3A1* GA genotypes in RA, as well as less frequent *MMP3* rs591058 TT, *MMP3* rs679620 and *VEGFA* rs699947 genotypes in RA suggest a lower genetic risk of injury could enhance career success in rugby. Future research should focus on establishing how gene variants affect the collagen and extracellular matrix structures, as this may help develop more individualised injury prevention and management plans.

Results

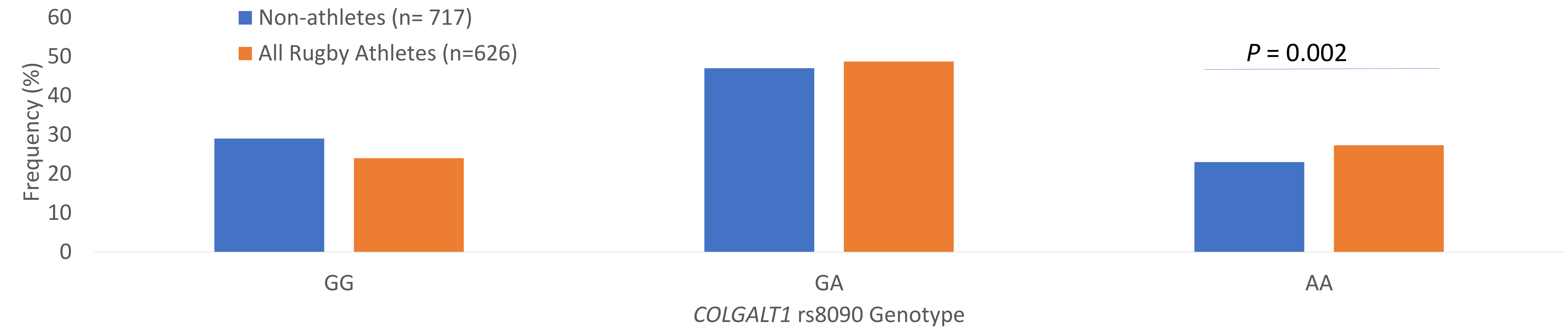


Figure 1. *COLGALT1* rs8090 genotype frequencies of all rugby athletes and non-athletes. AA genotype more common in RA than NA ($P < 0.01$).

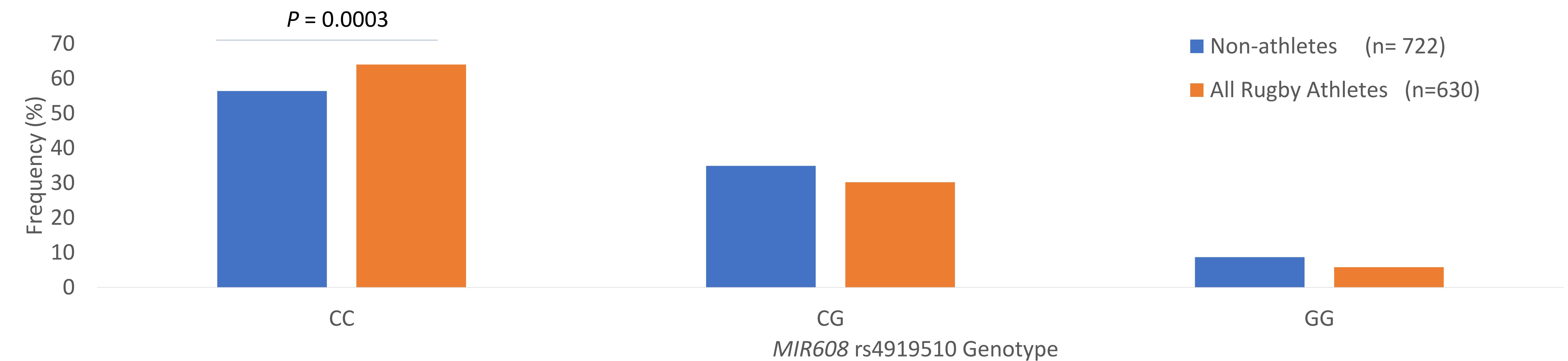


Figure 2. *MIR608* rs4919510 genotype frequencies of all rugby athletes and non-athletes. CC genotype more common in RA than NA ($P < 0.01$).

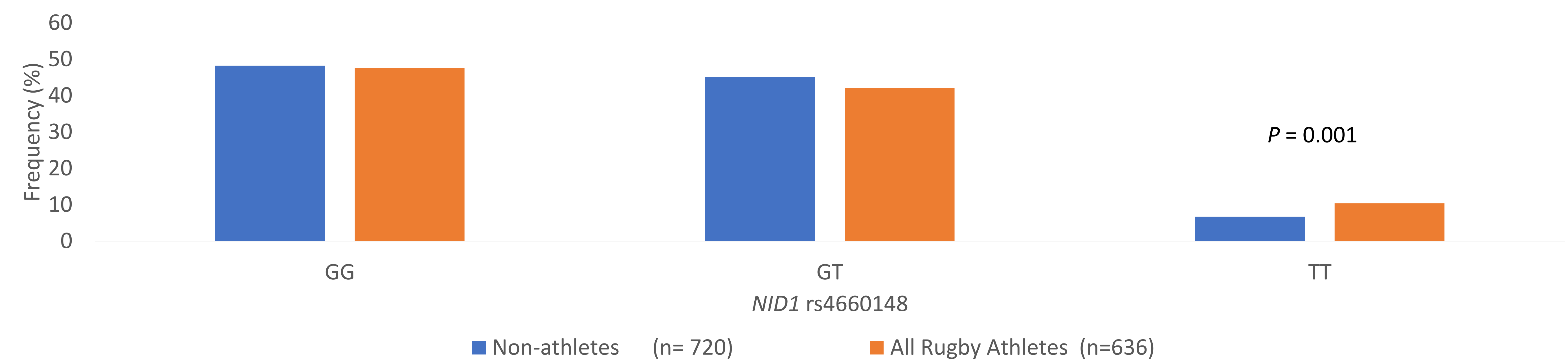


Figure 3. *NID1* rs4660148 genotype frequencies of all rugby athletes and non-athletes. TT genotype more common in RA than NA ($P < 0.01$).

References

Brooks and Kemp (2008) Clin Sports Med. 27, 51-73;
Brazier et al. (2019) Sports. 7, 138;
September et al. (2006) Int J Sports Med. 7, 201-215

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