

159.8± 4.5 cm in GH-treated *vs.* untreated TS patients, respectively, $P=0.015$). More than half of the TS GH-treated patients reached normal adult height (equal or higher than 150.2 cm), whereas only 15.6% of GH-untreated patients reached it.

Conclusion: Despite the delayed diagnosis of TS patients in our cohort, GH treatment was associated with a significant height gain, and the TS GH-treated group was around 7 cm taller than the GH-untreated group.

Reproductive Endocrinology

CLINICAL STUDIES IN FEMALE REPRODUCTION I

Prevalence of Menstrual Disorders and Hormonal Control Use in Elite Female Athletes in New Zealand

Alison K. Heather, BSc PHD¹, Megan Ogilvie, MD², Sarah Beable, MD³, Lynne Coleman, MD⁴, Holly Thorpe, PhD⁵, Katie Schofield, PhD⁵, Stacy Sims, PhD⁵, Stella Ruth Milsom, FRACP², Bruce Hamilton, MD⁶.

¹University of Otago, Dunedin, New Zealand, ²Fertility Associates, Auckland, New Zealand, ³Axis Sports Medicine, Auckland, New Zealand, ⁴High Performance Sport New Zealand (HPSNZ), Auckland, New Zealand, ⁵University of Waikato, Hamilton, New Zealand, ⁶WHISPA group, High Performance Sport NZ, Auckland, New Zealand.

SAT-011

Menstrual disorders are frequent in female athletes, especially those participating at the elite level. Factors which may contribute to impaired ovarian function in athletes include high training volumes, eating disorders and/or low body weight, which in turn may interrupt GnRH signaling. Hormonal contraception may disguise underlying menstrual disorders, and athlete use of such approaches is common, despite limited data on whether hormonal control has positive, neutral or negative effects on athletic performance. To determine the prevalence of hormonal contraceptive use, as well as the prevalence of menstrual disorders, in New Zealand elite female athletes, we completed a national internet-based survey of 219 participants being supported by High Performance Sport New Zealand. The survey aimed to characterize the demographics, health and athletic performance history, the training load and contraceptive use. We found that athletes were training intensely, with 38% reporting training volumes of >70 hours/month. At the youngest age represented (15-19 years), 72% had been in competitive sports for more than 5 years, suggesting a young gynecological age is represented by the cohort. More than half (58%, 127/219) of the surveyed athletes reported diagnosed illness or injuries. Stress fractures (39% 50/127), concussion (31%, 39/127) and asthma (26%, 33/127) were the most common diagnoses, followed by oligo/amenorrhea (20%, 26/127), reduced energy deficit syndrome (9%, 17/194), endometriosis (8%, 16/194), and polycystic ovary syndrome (5%, 9/194). Oligomenorrhea was significantly associated with stress fracture ($p=0.018$) and disordered eating ($p=0.009$). More than 50% of athletes tracked their menstrual cycle, and self-reporting showed even higher rates of oligo/amenorrhea 37% (29/79) in athletes not using hormonal contraception. Self-reporting also indicated a high

prevalence of other menstrual disorders including delayed menarche (21%, 43/207), menorrhagia (30%, 60/203), and dysmenorrhea (32%, 66/203). In athletes reporting menorrhagia, there was a significant association with iron deficiency ($p=0.026$). Of the 219 athletes, 37% were currently using hormonal contraception, of which the oral combined pill was the most popular (64%). The most commonly cited reason for hormonal contraception was birth control, however athletes used hormonal control to manipulate either the frequency (38%) or the symptoms (29%) of menstruation, particularly around competition. The data clearly suggests that there is likely to be significant undiagnosed gynecological pathology in elite female athletes. Hormonal contraception can mask gynecological health issues and themselves can lead to side effects that affect performance. It remains that health issues, especially those related to gynecological health, need to be considered by athletes, their coaches and medical support staff.

Steroid Hormones and Receptors

STEROID AND NUCLEAR RECEPTORS

Mineralocorticoid and Glucocorticoid Receptors Adopt Distinct Quaternary Structures and Can Form Heteromultimers That Affect Chromatin-Binding Profiles

Diego Alvarez de la Rosa, PhD¹, Thomas A. Johnson, MS², Gregory Fettweis, PhD², Gordon L. Hager, PHD².

¹University of La Laguna, La Laguna, Spain, ²NATL CANCER INST, Bethesda, MD, USA.

OR12-03

The mineralocorticoid and glucocorticoid receptors (MR and GR) are evolutionarily related nuclear receptors with high sequence conservation and a shared hormone response element (HRE). Both receptors are activated by glucocorticoids, but MR can be selectively activated by aldosterone. Using the imaging technique Number & Brightness (N&B) it has recently been proposed that liganded GR dimers form tetramers upon binding to HREs in live cells. We now show that agonist-bound MR adopts a tetrameric organization in the nucleoplasm and forms complexes with an average of 7 receptor units upon binding an HRE. Interestingly, MR antagonists eplerenone and spironolactone induced intermediate oligomerization arrangements, strongly suggesting that higher order oligomerization is essential for receptor activity. Site-directed mutagenesis and deletion analysis suggest that the N-terminus of MR is a main determinant of higher order oligomerization. Both with corticosterone and aldosterone, GR can incorporate into MR complexes partially displacing MR monomers. Genome-wide chromatin binding studies suggest that the presence of GR in the same cells profoundly change MR interaction with distinct sets of enhancers in a ligand-dependent way, contributing to receptor-specific signaling. Certain genes respond to only one receptor while others respond to both receptors. The interaction of these two closely related receptors has important implications for the mechanisms for glucocorticoid signaling and transcription factors in general.