Testicular ultrasound to stratify gonadal hormone references in a Norwegian study of male puberty

André Madsen1,2,3,*, Ninnie Helén Bakken Oehme1,2, Ingvild Særvold Bruserud1,2, Mathieu Roelants4, Geir Egil Eide5,6, Kristin Viste1,1, Jørn V. Sagen1,2,3, Gunnar Melgren1,2,3 and Petur B. Julliumson1,3

1Department of Clinical Science, University of Bergen, N-5020 Bergen, Norway, 2Department of Pediatrics, Haukeland University Hospital, Bergen, Norway 3Hormone Laboratory, Haukeland University Hospital, Bergen, Norway, 4*Department of Public Health and Primary Care, University of Leuven, Belgium, 5Centre for Clinical Research, Haukeland University Hospital, Bergen, Norway, 6Department of Global Public Health and Primary Care, University of Bergen, Norway, *correspondence to andre.madsen@uib.no.

BACKGROUND

Puberty in boys is associated with pituitary release of follicle-stimulating hormone (FSH) and luteinizing hormone (LH) which stimulate gonadal production of sperm and testosterone, respectively (Fig. 1). Pubertal development in boys is traditionally classified using Tanner stages I-V based on clinical inspection of genitalia (Tanner G), pubic hair (Tanner P) and testicle size. Ultrasound-based references of testicular growth in Norwegian boys are now available and this technique may provide more reliable data than Frader orchidometry1 (Fig. 2).

Altered timing of puberty may have profound implications for public health2. Although data on Norwegian children are currently lacking, others have demonstrated a secular trend towards earlier puberty timing in Western girls3. Epidemiological research suggest that an early onset of puberty in boys is associated with a higher risk of developing testicular cancer, adiposity, cardiovascular disease and diabetes in adult life4,5,6.

Improved and up-to-date references for pubertal development are needed to monitor timing of puberty and to identify children with an abnormally early or late start of puberty.

OBJECTIVES

Main project «Bergen Growth Study 2» aims to thoroughly describe pubertal development in Norwegian children.

In this study, we establish references for key puberty hormones LH, FSH, SHBG and testosterone based on (i) age, (ii) ultrasound-determined testicular volume and (iii) Tanner P stages.

RESULTS

Figure 3. Generalized additive models describing hormone levels varying with (i) age and (ii) ultrasound testicular volume throughout puberty for n=420-451 boys. Continuous reference intervals are specified by median (black line) and 2.5 – 97.5 percentiles (gray lines). A cut-off of 12 years of age or pubertal-stage testicle volume 22.73 ml was used to fit models where indicated.

CONCLUSIONS

Updated hormone reference intervals are an important tool to assess children during pubertal development.

Biochemical analytes, endocrine profiles and ultrasound assessments of testicular volume are objective markers of puberty status and allow for better evaluation and clinical follow-up of children with developing...