

The Association of Serum Testosterone Levels and Urinary Incontinence in Women



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Abbreviations and Acronyms

BMI = body mass index

MUI = mixed urinary incontinence

NHANES = National Health and Nutrition Examination Survey

SUI = stress urinary incontinence

UUI = urge urinary incontinence

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Purpose: Pelvic floor integrity is an important predictor of stress urinary incontinence. Androgen receptors have been found in the pelvic floor musculature and fascia, and testosterone administration has been shown to increase levator ani hypertrophy and improve stress incontinence in a rodent model. We examined the relationship between serum total testosterone levels and self-reported urinary incontinence in women.

Materials and Methods: We included women older than 20 years in the 2012 NHANES (National Health and Nutrition Examination Survey) cycle who underwent serum total testosterone measurement and answered self-reported urinary incontinence questions. A weighted, multivariate logistic regression model was used to determine the association between incontinence and serum testosterone levels after adjusting for age, body mass index, diabetes, race, parity, menopause and time of venipuncture.

Results: A total of 2,321 women were included in analysis, of whom 37.5% had stress incontinence, 29.8% had urge incontinence and 16.4% had mixed incontinence. Women in the lowest quartile of serum testosterone were more likely to complain of stress and mixed incontinence (OR 1.45, 95% CI 1.03–2.12 and OR 1.68, 95% CI 1.23–2.22, respectively). No association was noted between serum testosterone levels and urge incontinence.

Conclusions: Low serum testosterone is associated with an increased likelihood of stress and mixed incontinence in women. Given the role of pelvic musculature in maintaining urethral support and the anabolic effect of androgens on skeletal muscle, a physiological mechanism for this relationship can be proposed and further evaluated in prospective and translational studies.

Key Words: urethra; urinary incontinence; testosterone; pelvic floor; muscle, skeletal

STRESS urinary incontinence is a common problem among women. While the mechanism of SUI is multifactorial, pelvic floor integrity remains an important component of urethral competence. Urethral competence is facilitated by the interaction of the pubocervical fascia and skeletal muscles of the pelvis (levator ani and obturator internus), creating a supportive hammock and

ensuring adequate urethral closure with increases in abdominal pressure.¹ Disruption of this mechanism through traumatic injury, denervation or atrophy of the pelvic muscles impairs urethral support and increases the likelihood of urinary incontinence.

A number of studies have shown the presence of androgen receptors in the female levator ani and

pubocervical fascia as well as the anabolic effect of androgens on the pelvic floor.² In animal models testosterone supplementation resulted in hypertrophy and hyperplasia of levator ani myocytes.³ Specifically 1 study showed that testosterone administration after SUI induction in rats resulted in diminished levator ani atrophy and decreased Valsalva leak point pressure.⁴ However, few groups have explored the role of testosterone in women with SUI.

The objective of our study was to determine whether a relationship exists between serum testosterone levels and urinary incontinence complaints in a large, population based cohort of women. Because experimental evidence suggests that androgens may strengthen the pelvic floor musculature, we hypothesized that women with lower serum testosterone would be more predisposed to experience incontinence.

MATERIALS AND METHODS

Study Population

NHANES is a nationally representative, cross-sectional survey of the resident civilian, noninstitutionalized population of the United States performed at NCHS (National Center of Health Statistics), a division of CDC (Centers for Disease Control and Prevention). Participants are interviewed privately in the home or at a mobile examination center, where they also undergo physical examination and laboratory testing. The methodology of the survey and its primary results have been previously reported.⁵

We used data from the 2012 NHANES survey cycle, which is the only available cycle with female serum testosterone measurements. All female participants older than 20 years were included in the cohort. NHANES study protocols underwent institutional review board approval and included written informed consent from all participants.

Serum Testosterone Levels

Serum testosterone levels were measured in NHANES using validated isotope dilution liquid chromatography-tandem mass spectrometry.⁶ Serum specimens were processed, stored and shipped to the Division of Environmental Health Laboratory Sciences, NCEH (National Center for Environmental Health) at CDC for analysis.

While serum testosterone ranges are well-defined in males, the normal range of testosterone in women is less clear. Furthermore, precise measurement of testosterone in females remains difficult and testosterone levels that represent deficiency are particularly challenging to define. Therefore, serum testosterone concentrations were log transformed in the analysis to achieve a more linear relationship with the dependent variable and assigned to quartiles to simplify interpretation. We used the lowest quartile of testosterone as a marker of deficiency to determine the relationship between testosterone and urinary incontinence.

Incontinence Symptom Assessment

Incontinence during the 12 months prior to the interview was assessed by 2 questions, including question 1 for stress incontinence and question 2 for urge incontinence. 1) Have you leaked or lost control of even a small amount of urine with an activity like coughing, lifting or exercise? 2) Have you leaked or lost control of even a small amount of urine with an urge or pressure to urinate and you could not get to the toilet fast enough? Mixed incontinence was defined as endorsing stress and urge incontinence.

Demographics

Age and parity were analyzed as discrete variables. Parity was defined as the number of vaginal and cesarean deliveries. Ethnicity was categorized as Caucasian, African American, Hispanic and other. Because serum testosterone may have circadian variation, the time of venipuncture was categorized as morning, afternoon or evening. Participants were determined to have diabetes if they had ever been told by a doctor or another health care professional that they had diabetes outside of pregnancy. Participants were categorized as menopausal if they reported no menstrual periods because of menopause. All covariates were chosen a priori based on known or suspected confounders of the relationship between testosterone and incontinence.⁷⁻⁹

Statistical Analysis

Differences between categorical and continuous variables were assessed by the Pearson chi-square test and the Student t-test, respectively. The association between incontinence and the lowest quartile of serum testosterone was examined in a weighted, multivariate logistic regression model. ORs and 95% CIs were calculated for each outcome of interest, including stress, urge and mixed incontinence. All models were adjusted for age, BMI, diabetes, race, parity, menopausal status and time of venipuncture. Statistical significance was considered at 2-tailed $p < 0.05$. Sample weights specific to the cohort of women who had undergone laboratory testing were provided by NHANES and used to produce national population estimates considering oversampling, nonresponse and differences between demographic characteristics of the sample and the rest of the population of the United States. All analyses were calculated using Stata/SE™, version 12.0.

RESULTS

A total of 2,321 women were included in our study. Of these women 1,180 (50.9%) complained of urinary incontinence of any type, 870 (37.5%) complained of SUI, 692 (29.8%) complained of UUI and 380 (16.4%) complained of MUI (see table). Testosterone levels were highest at ages 20 to 29 years (see figure). After ages 20 to 29 years testosterone gradually decreased. Testosterone was also significantly higher when drawn in the morning compared to the afternoon or the evening. Women who endorsed stress, urge or mixed urinary incontinence

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