PAPERS

Contribution of dihydrotestosterone to male sexual behaviour

Christos S Mantzoros, Emmanuel I Georgiadis, Dimitrios Trichopoulos

Abstract

Objective—To document the relative importance of endogenous sex steroids in modulating the frequency of orgasms, the dominant aspect of sexual behaviour in healthy eugonadal men.

Design—Measurement of adrenal and testicular sex steroids in a sample of army recruits and study of their relation to frequency of orgasms ascertained by questionnaire after potential confounding variables were controlled for.

Setting—Military campus and military hospital laboratories in Athens, Greece.

Subjects—92 consecutively enrolled healthy male recruits aged 18-22 years.

Main outcome measures—Weekly number of orgasms. Serum concentrations of testosterone, dehydroepiandrosterone sulphate, dihydrotestosterone, oestradiol, oestrone, Δ-4-androstenedione, and sex hormone binding globulin.

Results—Serum dihydrotestosterone concentration was the only independent hormonal predictor of the frequency of orgasms; an increase in concentration of 1·36 nmol/l (about 2 SD) corresponded to an average increase of one orgasm a week.

Conclusions—Differences in concentrations of circulating dihydrotestosterone within the normal range may represent a major predictor of sexual activity in healthy young men.

Introduction

Male sexual function is at least partially dependent on androgens in most species.[1] Evidence from non-human primates suggests that testosterone and its major metabolite dihydrotestosterone are essential for male sexuality.[1] Studies in humans indicate that subnormal libido and sexual function because of induced or spontaneous hypogonadism improve with testosterone treatment.[1,2] It remains unclear, however, whether the beneficial effect is because of testosterone itself or dihydrotestosterone. We have studied recruits to the Greek army to explore whether testosterone, dihydrotestosterone, or other sex steroid hormones are important determinants of sexual function as reflected in the frequency of orgasms.

Subjects and methods

Participants in the present study were 100 consecutively enrolled male army recruits aged 18-22 who consented to having a single blood sample drawn between 9 00 and 11 00 am during their first day in the army. Subjects were healthy and were taking no medication.

The participants responded to a questionnaire administered by an interviewer that covered basic demographic and lifestyle variables. Specifically, the participants were asked to indicate their age in completed years, height in centimetres, weight in kilograms, and educational level in years of schooling.

Quetelet's index (body mass index) was calculated as weight/height.[2] In addition, subjects were asked to indicate whether they were smokers and if so the daily number of cigarettes smoked. Information was also provided on the amount of coffee drunk in cups a day and usual alcohol intake in glasses a day. Greek (Turkish) coffee was the type consumed by nearly all subjects, whereas alcohol consumed in the standard measures of most drinks is about the same for wine, beer, and spirits. Voluntary physical activity was recorded in hours a day, but no attempt was made to weight it according to intensity. Finally, the participants were asked to indicate the average number of orgasms a week over the past month. Recalled number of orgasms a week has been previously shown to represent a major and reliable expression of male sexual behaviour.[3] It was made clear to the study participants collectively as well as individually that the object of the study was to assess the total number of events rather than the mode of their initiation in the context of sexual intercourse, masturbation, or spontaneous nocturnal orgasms. This approach was adopted to optimise the validity of the response since young men could be tempted to overreport orgasms during intercourse and underreport ones during masturbation.

Blood samples for the hormone determinations were centrifuged immediately, and serum was frozen at −34°C until determination. Serum hormone concentrations were determined by commercially available RIA kits (Coat-a-Count, DPC, Los Angeles, for testosterone and dehydroepiandrosterone sulphate; Amersham International for dihydrotestosterone; EIRRIA, Switzerland, for oestradiol and oestrone; Buhlman Lab, Italy, for Δ-4-androstenedione; and Biodata Spa, Switzerland, for sex hormone binding globulin). The sensitivity of the assays was as follows: testosterone 0·14 nmol/l, oestrone 30·0 pmol/l, oestradiol 22·8 pmol/l, Δ-4-androstenedione 0·07 nmol/l, dihydrotestosterone 17·34 pmol/l and dehydroepiandrosterone sulphate 0·06 μmol/l. The coefficients of variation in the range of values measured were 5·2% for dihydrotestosterone, 4·5-5·5% for dehydroepiandrosterone sulphate, 5·8% for testosterone, 5-8% for Δ-4-androstenedione, 5-6% for oestradiol and oestrone, and 2·8-6·9% for sex hormone binding globulin.

Statistical analysis was by modelling weekly number of orgasms as a function of demographic, lifestyle, and endocrine variables. Weekly number of orgasms was approximately normally distributed with a mean (SD) of 3·9 (1·9). For eight subjects one or more values were missing and these subjects were excluded from the analysis.

Results

Table I shows representative values of the demographic and lifestyle variables. The mean (SD) weekly number of orgasms was 3·9 (1·9), the median and the

401 Military Hospital, Athens, Greece
Christos Mantzoros, *resident in medicine*
Emmanuel I Georgiadis, *head, Endocrine Unit*

Department of Epidemiology, Harvard School of Public Health, Boston, Massachusetts 02215, USA
Dimitrios Trichopoulos, *professor and chief*

Correspondence to:
Dr Mantzoros, Department of Endocrinology, RN 324, Beth Israel Hospital, Harvard Medical School, 330 Brookline Avenue, Boston, Massachusetts 02115, USA.

Variable	Mean (SD)	Univariate regression coefficients	Partial regression coefficients (95% confidence interval[1])	Two tailed P value
Lifestyle variables:				
Age (years)	19·56 (0·81)	0·683	0·897 (0·363 to 1·434)	0·002
Height ((cm)	171·73 (0·75)	0·279	0·166 (−0·399 to 0·731)	0·565
Quetelet's index (kg/m²)	23·23 (2·62)	0·182	0·136 (−0·030 to 0·302)	0·116
Schooling (years)	8·95 (2·88)	−0·013	−0·380 (−1·158 to 0·398)	0·341
Physical activity (hours/day)	3·85 (2·35)	−0·049	−0·072 (−0·258 to 0·114)	0·450
Smoking (1/2 pack/day)	1·59 (1·46)	0·238	−0·034 (−0·404 to 0·336)	0·858
Coffee drinking (cups/day)	1·52 (1·46)	0·128	0·114 (−0·376 to 0·514)	0·568
Alcohol intake (glasses/day)	1·50 (1·84)	0·064	−0·033 (−0·307 to 0·241)	0·814
Endocrine variables:				
Dihydrotestosterone (nmol/l)	2·73 (0·72)	0·810	0·610 (0·052 to 1·168)	0·034
Testosterone (nmol/l)	34·01 (8·77)	0·006	−0·009 (−0·058 to 0·040)	0·665
Δ-4-Androstenedione (nmol/l)	11·10 (2·06)	0·221	0·184 (−0·008 to 1·376)	0·060
Dehydroepiandrosterone sulphate (μmol/l)	4·83 (1·25)	0·111	0·037 (−0·294 to 0·368)	0·685
Oestradiol (pmol/l)	276·57 (81·20)	0·004	0·004 (−0·0005 to 0·0085)	0·103
Oestrone (pmol/l)	115·67 (28·74)	−0·0011	−0·002 (−0·016 to 0·012)	0·793
Sex hormone binding globulin (μg/dl)	0·893 (0·205)	−1·0240	−1·025 (−2·945 to 0·900)	0·298

Variable	Partial regression coefficient (95% confidence interval)	Two tailed P value
Age (years)	0·695 (0·260 to 1·130)	0·002
Dihydrotestosterone)	0·733 (0·219 to 1·247)	0·006
Δ-4-Androstenedione (nmol/l)	0·147 (−0·029 to 1·323)	0·105

mode 3·5, the range 0 to 11, and the first and third quintiles 2·2 and 5·5, respectively. Table I also shows simple regression coefficients and those derived from multiple regression of the weekly number of orgasms, regressed on these variables. Only age was a significant predictor of the frequency of orgasms. Table I also gives representative values of the endocrine variables as well as regression coefficients of weekly number of orgasms regressed on these hormones. Only dihydrotestosterone and perhaps Δ-4-androstenedione seemed to be independent predictors of the weekly number of orgasms. By contrast, testosterone was unrelated to the frequency of the orgasms. There were no problems of colinearity in the statistical analysis. The highest value of the Pearson correlation coefficient between any two of the hormones studied was 0·27 for dihydrotestosterone with Δ-4-androstenedione.

In table II the weekly frequency of orgasms is regressed on age, dihydrotestosterone, and Δ-4-androstenedione—that is, the variables that seemed to be the important predictors of the frequency of orgasms on the basis of the models presented in tables I and II. Age and dihydrotestosterone remained significant and independent predictors of the frequency of orgasms, whereas the partial regression coefficient for Δ-4-androstenedione was reduced from 0·184 to 0·147 and the corresponding significance weakened from 0·063 to 0·105. The values of the Pearson correlation coefficients between the weekly frequency of orgasms on the one hand and dihydrotestosterone and age on the other were 0·28 and 0·30, respectively. Regressing the frequency of orgasms on free hormone indices (calculated as the ratio of testosterone, oestradiol, or oestrone over sex hormone binding globulin) generated essentially identical results; age (P=0·001) and dihydrotestosterone (P=0·006) remained the only significant predictors of the weekly frequency of orgasms.

Discussion

Among androgens, testosterone and dihydrotestosterone have been found to be important determinants of sexual function in rodents and non-human primates.[1] The effect of sex steroids other than testosterone has not been adequately studied in humans.[1 2 4] Men with hypogonadism because of pituitary or testicular failure have decreased libido and sexual activity that can be restored with testosterone replacement treatment.[4] It is not known whether supplementation with testosterone improves sexual activity by increasing concentrations of circulating testosterone or through conversion to the much more potent dihydrotestosterone.[4] In normal men, pronounced testosterone reduction because of spontaneous or induced hypogonadism by administration of luteinising hormone releasing hormone agonist[2] has been associated with impaired sexual behaviour, which was restored with testosterone treatment.[2] Concentrations of testosterone and any testosterone metabolite were not measured in these studies, making it difficult to identify the active androgenic compound.[2] In most cross sectional studies in eugonadal adult men no correlation has been found between sexual activity and circulating concentrations of testosterone,[4] although weak positive[5] and negative[6] correlations have also been reported in small studies. Therefore, at the time of our study there was equivocal evidence for the role of testosterone in determining sexual activity of healthy adults and virtually no evidence concerning the possible role of dihydrotestosterone.

Our results strongly support the hypothesis that dihydrotestosterone is the active hormone for male sexual function as reflected in the frequency of orgasms. An increase of dihydrotestosterone by about 2 SD (1·36 nmol/l) was associated with an increase of the weekly number of orgasms by at least one and conceivably more depending on the extent of biologically generated variation and consequent misclassification. Additionally, within the age range studied, a difference of three years corresponded to an increase of the weekly number of orgasms by about two; this increase is likely to reflect socially conditioned enhancement of opportunities with increasing age (possibly including marital status which was not ascertained in this study).

Only orgasms were evaluated in this investigation, and no attempt was made to ascertain other aspects of male sexual behaviour.[7] Previous studies, however, have found that self reported frequency of orgasms in men is a highly reliable method for the evaluation of the effects of androgens on sexual activity that tends to remain stable over time.[3 8] There is undoubtedly misclassification in the reporting of the frequency of orgasms as well as in the laboratory determinations of dihydrotestosterone and the other hormones. The corresponding errors, however, are clearly uncorrelated since laboratory tests were blindly performed and the staff concerned had no knowledge of the identity of the subjects or their questionnaire data. Non-differential misclassification can bias the regression coefficients towards the null values, but the extent of this misclassification was no smaller for dihydrotestosterone than for other hormones.

Key messages

- Androgens regulate male sexual behaviour in several species

- The hormone that determines sexual behavior has not yet been conclusively identified in healthy adults

- This study shows that dihydrotestosterone is the dominant hormonal determinant of the frequency of orgasms in young healthy adults

- The frequency of orgasms depends not only on psychosocial factors but on variation of dihydrotestosterone concentrations within the normal range

It seems that in normal young adults the potent testosterone metabolite dihydrotestosterone, which binds much more avidly with the androgen receptor,[9] is the most important and perhaps the only important androgen in determining male sexual behaviour as reflected in the frequency of orgasms, whereas physiological concentrations of serum oestrogen and adrenal steroids do not seem to play an independent part of comparable importance.

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Prevalence of knee problems in the population aged 55 years and over: identifying the need for knee arthroplasty

Alan Tennant, Jon Fear, Anne Pickering, Micky Hillman, Alison Cutts, M A Chamberlain

Abstract

Objective—To determine the prevalence of knee problems in people aged 55 years and over and identify those who should be considered for knee arthroplasty.

Design—Postal survey; questionnaires were sent to a multistage stratified probability sample of residents of North Yorkshire Health Authority aged 55 and over.

Setting—A health district with a population of 210 000 aged 55 and over.

Results—An initial four page postal questionnaire produced an 86% response rate among 18 827 eligible patients. A subsequent detailed questionnaire sent to 1277 patients with knee problems (with a response rate of 78%) then determined the prevalence of severe pain and severe disability. Pain and disability consistent with the need to consider arthroplasty was found in 20·4/1000 (95% confidence interval 18·0 to 23·1); of these, 4·1 (2·7 to 5·8)/1000 had extreme disability. Age and sex specific rates in men who might benefit from arthroplasty were, in those aged 55-64, 12·9 (8·4 to 19·0)/1000; aged 65-74, 12·1 (7·4 to 18·4)/1000; aged 75 and over, 20·3 (12·9 to 30·5)/1000. In women aged 55-64 the rates were 12·9 (8·6 to 18·7)/1000; aged 65-74, 19·6 (13·9 to 26·7)/1000; aged 75 years and over, 42·6 (34·3 to 52·4)/1000.

Conclusions—Total knee replacement has until recently been considered unreliable and often seen as a last resort for many with severe knee problems. Advances in prosthesis design and surgical and anaesthetic techniques have transformed this procedure into a reliable option with a potential for reducing disability and dependency in a large number of people in the community. Understandably, the prevalence pool of those who may benefit is large; health authorities and, increasingly, general practitioners should consider purchasing more total knee replacement surgery to offer real choice to those in need.

Introduction

In the United Kingdom it has been known for over 20 years that the prevalence of disability varies considerably by locality.[1,2] Given that musculoskeletal disorders cause about half of all disability,[3] it would not be surprising to find that severe disability associated with, for example, knee problems also varies within locality, despite the common prevalence of underlying disease. As well as variations by age and sex in disability,[3] other factors such as occupation can increase the risk of problems.[4,5] Disability levels are also likely to be affected by the historical quality of the management of disease from place to place as well as the success of past local surgical activity.[6]

The recent reforms within the NHS have placed an obligation on purchasing authorities to assess the health needs of their residents. This requires disability to be assessed locally, as national estimates may be of limited value.[7] We describe the results from a survey designed to enable a purchasing authority to determine the numbers of people aged 55 years or more who report problems with their knees such that they might benefit from knee arthroplasty.

Methods

QUESTIONNAIRES

A two stage random sample using postal questionnaires was commissioned by North Yorkshire Health. The initial questionnaire (phase 1) was posted at the beginning of June 1993. Non-respondents were sent a maximum of two further copies. The questionnaire asked about activities of daily living, dependency, and disability and asked respondents to indicate on a manikin which joints had caused problems for more than six weeks in the past three months.

A more detailed questionnaire (phase 2) was sent to all those who reported a problem with their knee and difficulties in daily living. This 12 page questionnaire included the index of severity of osteoarthritis of the hips and knees developed by Lequesne and colleagues to identify those in need of surgery.[8] This instrument gives a score of 0-24 points for each joint, with a threshold of 10-12 points for consideration for surgery. We set our threshold at 11 points, but after exploratory data analysis we decided to increase the threshold to 14 points (equivalent to Lequesne and colleagues' "extremely severe" group), as there was poor discriminant validity for pain and disability in the lower 11-13 point group compared with those not needing arthroplasty (10 points and below). In addition, on examining the distribution of scores we added an

Rheumatology and Rehabilitation Research Unit, Research School of Medicine, University of Leeds, Leeds LS2 9NZ
Alan Tennant, *Charterhouse principal research fellow*
Micky Hillman, *research fellow*
Alison Cutts, *senior research fellow*
M A Chamberlain, *Charterhouse professor of rheumatological rehabilitation*

North Yorkshire Health, York YO1 1PE
Jon Fear, *consultant in public health medicine*
Anne Pickering, *health research manager*

Correspondence to:
Mr Tennant.

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