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Genetic influences on variation in female orgasmic function: a twin study

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Orgasmic dysfunction in females is commonly reported in the general population with little consensus on its aetiology. We performed a classical twin study to explore whether there were observable genetic influences on female orgasmic dysfunction. Adult females from the TwinsUK register were sent a confidential survey including questions on sexual problems. Complete responses to the questions on orgasmic dysfunction were obtained from 4037 women consisting of 683 monozygotic and 714 dizygotic pairs of female twins aged between 19 and 83 years. One in three women (32%) reported never or infrequently achieving orgasm during intercourse, with a corresponding figure of 21% during masturbation. A significant genetic influence was seen with an estimated heritability for difficulty reaching orgasm during intercourse of 34% (95% confidence interval 27–40%) and 45% (95% confidence interval 38–52%) for orgasm during masturbation. These results show that the wide variation in orgasmic dysfunction in females has a genetic basis and cannot be attributed solely to cultural influences. These results should stimulate further research into the biological and perhaps evolutionary processes governing female sexual function.

Keywords: twin studies; sexual dysfunction; epidemiology; genetic; orgasm

1. INTRODUCTION

Until recently, little research has explored female sexual function (Berman *et al.* 1999), and yet women commonly report sexual dysfunction. For example, over 50% of women in the UK report at least one sexual problem lasting a month or more during the previous year (Mercer *et al.* 2003), and around a quarter have never or rarely achieved orgasm during the previous three months (Dunn *et al.* 2002). There is controversy over whether the problem has a real medical basis, or whether it has partly been created by the media, pharmaceutical advertising and cultural expectations (Moynihan 2003). Whereas studying male sexual function is widely accepted (with a recent increase following the release of drugs like Viagra), the female orgasm is less well studied. This lack of scientific interest may be partly attributable to the previous consensus that the female orgasm has no clear role in reproduction. This view was challenged by research showing that the orgasm helped facilitate sperm retention (Morris 1967; Fox *et al.* 1970). Further evidence for the orgasm's reproductive role comes from studies linking it with the menstrual cycle (Matteo & Rissman 1984; Baker & Bellis 1995). More recently, this was corroborated in other studies showing that desire for pregnancy subconsciously predicted timing of the female orgasm to be just after that of the male (Singh *et al.* 1998). Studies such as these are obviously difficult to conduct, and there is still a lack of agreement among experts about the role of the female orgasm in humans.

While differences in sexual function between women were known to exist, these have been largely attributed to cultural, religious and psychological factors. No study has explored family history or genetic factors—which might indicate or refute a biological or evolutionary basis for the variation. We therefore performed a classical twin study comparing the similarities in identical and non-identical twins to explore whether there were observable genetic influences on variation in female orgasmic function.

2. METHODS

Subjects for this study were monozygotic (MZ) and dizygotic (DZ) twins enlisted from the TwinsUK registry—the largest adult twin registry in the UK (Spector & MacGregor 2002). This twin population has been involved in a wide range of studies on common traits and diseases (www.twin-research.ac.uk) ranging from cataracts and blood clotting to musical ability (Hammond *et al.* 2000; De Lange *et al.* 2001; Drayna *et al.* 2001). Moreover, twins from this registry have been shown to be comparable to the age-matched general population for a broad variety of medical and behavioural traits (Andrew *et al.* 2001). After obtaining ethical approval from the St Thomas' Hospital ethics committee, a postal self-completion questionnaire was sent to 3654 pairs of female twins aged between 19 and 83 years including questions relating to sexual behaviour. Complete confidentiality was assured and the twins were unaware of any specific hypotheses. Zygosity was established by using standardized questions that have over 95% accuracy (Sarna *et al.* 1978), and further confirmed in 54% of the pairs by multiplex DNA fingerprinting.

Orgasmic dysfunction was defined primarily using two questions on frequency of orgasm during intercourse and masturbation. The questions were, 'Overall, how frequently do you experience an orgasm during intercourse?' and 'Overall, how frequently do you experience an orgasm during masturbation by yourself or a partner?' Responses were on a seven-point scale labelled as in table 2.

An individual's phenotype is the result of the effects of both genotype and environment. To study the sources of individual differences (i.e. the variance) in a phenotype, genetically related subjects are required, and twins are ideal. MZ twin pairs share all of their genes and DZ twin pairs share, on average, 50% of their segregating genes. Assuming that both types of twins share equally similar family environments, one can assert that any greater similarity between MZ twins than between DZ twins is a result of genetic influences. The similarities are estimated using the intraclass correlation coefficient (ICC). Standard variance components model fitting was used to quantify the influences, and is based on comparison of the covariance (or correlation) of a trait between MZ and DZ twins (Neale & Cardon 1992). This permits separation of the observed phenotypic variance into additive and dominant genetic effects, and shared and unique environmental effects. The significance of genetic and environmental factors as components of the observed variance is assessed by removing each sequentially from the full model and testing the deterioration in fit of the various sub-models by hierarchic χ^2-tests. A heritability estimate can be generated, defined as the proportion of total variation that can be explained by genetic variance. Details of the analytical methods used are discussed in more detail in a paper by

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Table 1. Details of twins studied by zygosity.

characteristics of sample	monozygotic twins ($n=683$ pairs)	dizygotic twins ($n=714$ pairs)	p-value[a]
mean age (years)	49.3 (19–78)[b]	50.5 (21–83)[b]	0.07
ever sexually active	98%	99%	0.58
ever divorced	26%	25%	0.40
mean lifetime number of partners	4.98 (0–68)[b]	4.88 (0–99)[b]	0.72

[a] p-values corrected for the relatedness of twins.
[b] Range.

Table 2. Reported frequency (%) of experiencing orgasm per sexual act.

	during intercourse ($n=2749$)[a]	during masturbation ($n=2664$)[b]
unsure/never	16	14
less than 25%	16	7
25–49%	8	5
about 50%	13	7
51–75%	11	8
more than 75%	23	25
always	14	34

[a] Excludes those not sexually active and missing responses.
[b] Excludes missing responses.

Drayna *et al.* (2001). Preliminary analyses were carried out with STATA software, while all genetic modelling was carried out with the variance components program MX GUI v. 1.4.06 (http://www.vcu.edu/mx).

3. RESULTS

The questionnaire was returned by 4037 women, comprising 1697 complete pairs (and 643 whose co-twin did not reply). A subset of 683 MZ pairs and 714 DZ twin pairs responded fully to the orgasmic dysfunction questions, with no difference in respondents between the groups. Details of the sample are compared by zygosity in table 1. The MZ and DZ twin groups were similar in terms of divorce (26% and 25%, respectively), number of sexual partners (means of between 4 and 5) and age (49 and 50 years, respectively). The sample of respondents did not appear to be biased towards younger subjects; the average age of respondents was 50 years, the same as for all the twins to whom the questionnaire was sent. Of the sample, 98% sample reported being heterosexual and sexually active at some point.

The reported frequencies of experiencing orgasm through intercourse and masturbation are shown in table 2. The table shows that 32% of women were unable to achieve orgasm during intercourse more than a quarter of the time, and half of these women (16% overall) never reached orgasm during intercourse. Conversely, 14% of women always experienced orgasms during intercourse. More women were able to orgasm during masturbation, with 34% always reaching orgasm. However, 21% were still unable to orgasm more than a quarter of the time, two-thirds of whom never achieved orgasm during masturbation. There was no difference in the proportion of MZ and DZ twins who never or infrequently reached orgasm by either method (12% and 13%, respectively; $p=0.53$).

The ICCs for frequency of orgasm during intercourse and masturbation were higher for MZ pairs (31% and 39%, respectively) than for DZ pairs (10% and 17%; $p=0.0001$), suggesting a clear genetic influence for both. Variance components modelling revealed that the effects of the shared environment and dominant genetic effects could be dropped from the model without significant loss of fit, and provided a quantitative estimate of additive genetic variance (heritability) of 34% (95% confidence interval 27–40%) for orgasm during intercourse and 45% (95% confidence interval 38–52%) for orgasm during masturbation (see table 3). The remainder of the variance was a result of random error and non-shared environmental factors. There was no significant effect of adding age to the model.

4. DISCUSSION

This study shows that there is a significant genetic component to variation in female orgasmic function that has not been reported previously. We believe our results to be generalizable to singletons based on the nature and size of our sample (Spector & MacGregor 2002) and previous comparison studies of twins and singletons (Andrew *et al.* 2001). The response of 46% for complete pairs is comparable with the typical response for medically oriented twin surveys, and there was no evidence for an age bias. Further evidence for the generalizability of the findings comes from the similarities in prevalence figures reported here and elsewhere (Dunn *et al.* 2002).

We found that between 34% and 45% of the variation in ability to orgasm can be explained by underlying genetic variation, with little or no role for the shared environment (e.g. family environment, religion, social class or early education). These heritability findings are in a similar range (35–60%) to other behavioural and complex traits such as migraine, blood pressure, anxiety or depression and age at menarche and menopause (MacGregor *et al.* 2000). This is despite the greater difficulty in obtaining information on aspects of sexual relationships compared with obtaining data, for example, on migraine or hypertension (Johnson & DeLamater 1976). Our data lend support to the idea that variation in female orgasmic ability has a biological basis.

As in all studies of this nature, there are limitations to our study. There is potential for recall bias—but this would only have affected the results if there were

Table 3. Genetic modelling and estimates of heritabilities (given as additive genetic effects with 95% CI).
(A, additive genetic effects; C, common environmental effects; E, unique environmental effects; D, dominant genetic effects. Bold indicates best-fitting model and principal result.)

model	A (95% CI)	C/D (95% CI)	χ^2 (d.f.)	*p*-value
orgasm during intercourse				
ACE	0.33 (0.20–0.40)	0.00 (0.00–0.10)	101.98 (88)	0.15
CE	—	0.24 (0.18–0.29)	117.09 (89)	0.03
AE	**0.34 (0.27–0.40)**	—	**101.97 (89)**	**0.16**
ADE	0.08 (0.00–0.37)	0.29 (0.00–0.43)	102.32 (88)	0.14
orgasm during masturbation				
ACE	0.45 (0.33–0.52)	0.00 (0.00–0.09)	97.96 (88)	0.22
CE	—	0.32 (0.26–0.38)	123.74 (89)	0.01
AE	**0.45 (0.38–0.52)**	—	**97.96 (89)**	**0.24**
ADE	0.23 (0.00–0.50)	0.25 (0.00–0.53)	96.14 (88)	0.26

a systematic bias; for example, if MZ twins who replied were more likely to show similar direction of recall bias to their co-twin than DZ pairs. There was no evidence of this, nor was there evidence of a response difference in MZ or DZ twins, and the subjects were not aware of any specific hypotheses. Ideally, we would have used a more standardized detailed questionnaire such as the GRISS (Rust & Golombok 1985), and incorporated information on intercourse frequency and sexual satisfaction. Use of a questionnaire like this may have provided more specific answers. However, such instruments and investigations are lengthy, and inclusion may have reduced the response and hence the number of participants (Pfeiffer *et al.* 1972). Moreover, any errors resulting from the method of classification in this study are unlikely to be different among MZ and DZ twins. Such errors would result in an underestimate of the genetic component, and the heritable component may have been higher with more precise instruments.

There is poor understanding of the physiology of sexual function and the microanatomy of female sexual organs. Proposed biological influences include anatomical variations such as the controversial presence of Skene's glands (G-spot) in the vaginal wall. Recent work has found that nitric oxide type 5 phosphodiesterase pathways involved in male sexual excitement are also present in women and may function similarly (D'Amati *et al.* 2002, 2003). This is partly supported by the partial success of clinical trials in women of Viagra—a phosphodiesterase inhibitor (Caruso *et al.* 2001). Other potentially important biological factors include androgen levels or receptors, or natural variations in pleasure centres in the brain, resulting from dopamine or other psychological mood effects (Walsh & Berman 2004). All of these processes are probably mediated to some extent by genetic variations. Other associated factors, such as differences between individuals in anxiety and depression (Dunn *et al.* 1999), also have heritable components (Rijsdijk *et al.* 2003) and may partly contribute to the genetic component of orgasmic ability reported here.

The physiological and evolutionary role of the female orgasm is highly speculative and controversial, particularly its role in increasing fertility (Singh *et al.* 1998) and even in selecting sexually proficient mates (Baker & Bellis 1995). However, the present results showing that genetic factors are the predominant measurable influence on female orgasmic function will perhaps stimulate more research into understanding the underlying biological basis of the female orgasm and sexual dysfunction. This will become increasingly important, particularly as hormonal therapies for women (such as testosterone patches) may be licensed shortly for a condition we know little about (Shifren *et al.* 2000; Davis 2004).

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