

ORIGINAL RESEARCH—INTERSEX AND GENDER IDENTITY DISORDERS

The Relationship Between Second-to-Fourth Digit Ratio and Female Gender Identity

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ABSTRACT

Introduction. Gender identity and the second-to-fourth finger length ratio (2D : 4D) are discriminative between the sexes. However, the relationship between 2D : 4D and gender identity disorder (GID) is still controversial.

Aim. The aim of this study is to investigate the relationship between 2D : 4D and score on the Gender Identity Scale (GIS) in female-to-male (FtM) GID subjects.

Methods. Thirty-seven GID-FtM with testosterone replacement therapy from our clinic were included in this study. As controls, 20 male and 20 female volunteers participated from our institution (medical doctors and nurses). We photocopied left and right hands of the participants and measured the second and fourth finger lengths. Gender identity was measured with the GIS.

Main Outcome Measures. 2D : 4D digit ratio and GIS in male, female, and GID-FtM subjects.

Results. The 2D : 4D (mean $\pm$ standard deviation) in male, female, and GID-FtM were 0.945 ± 0.029 , 0.999 ± 0.035 , and 0.955 ± 0.029 in right hand and 0.941 ± 0.024 , 0.979 ± 0.040 , and 0.954 ± 0.036 in left hand, respectively. The 2D : 4D was significantly lower in male controls in both hands and GID-FtM in the right hand than in female controls ($P < 0.05$, analysis of variance). Multiple linear regression analysis revealed that “consistent gender identity” score in the higher domain in GIS and “persistent gender identity” score in the lower domain are statistically significant variables correlating with 2D : 4D in the right hands among biological females.

Conclusions. The finger length ratio 2D : 4D in GID-FtM was significantly lower than in female controls in the right hand in this study. 2D : 4D showed a positive correlation with GIS score. Because 2D : 4D influences are assumed to be established in early life and to reflect testosterone exposure, our results suggest a relationship between GID-FtM and perinatal testosterone. **Hisasue S, Sasaki S, Tsukamoto T, and Horie S. The relationship between second-to-fourth digit ratio and female gender identity. J Sex Med 2012;9:2903–2910.**

Key Words. Digit Ratio; Gender Identity; Prenatal Testosterone; 2D : 4D

Introduction

Gender identity disorder (GID) is defined as a condition in which there is a strong and persistent cross gender identification and discomfort with one's own sex [1]. The mechanism of sexual differentiation of the brain is still controversial; however, perinatal testosterone plays an important

role in rodents [2]. For example, perinatal testosterone alters the size of the bed nucleus of the stria terminalis in rats and mice [3], a region linked to gender identity in humans [4]. There are several human studies investigating sex differences of the brain histologically [5,6]. However, the mechanism of sexual differentiation of the human brain is still unclear due to the difficulties associated

with studies requiring invasive procedures (blood samples) in fetuses or babies and the long developmental period between birth and the establishment of gender identity [7]. Therefore, an indirect marker of perinatal testosterone exposure was sought.

Manning et al. introduced such a retrospective marker in 1998: the ratio of the length of the index finger (2D) to that of the ring finger (4D). The 2D : 4D ratio is greater in females than in males [8] and several pieces of evidence support the hypothesis that 2D : 4D is an indicator for early life exposure to androgen [7]. Zheng and Cohn recently reported in their animal study that mouse digit ratios showed a significant difference between the male and female 2D : 4D ratios as early as embryonic day 17 [9]. They also provided direct evidence that sexually dimorphic digit ratios are caused by androgen and estrogen signaling and the fourth digit has higher levels of androgen receptor (AR) and estrogen receptor than the second digit. Therefore, 2D : 4D is determined not by prenatal testosterone alone but by the balance of testosterone to estrogen signaling in a narrow time window of fetal digit development [9].

Previous clinical studies have indicated a relationship between 2D : 4D and human pathology/physiology, such as sperm count [8], metabolic syndrome [10], autism [11], depression [12], sexual orientation [13], and GID [14–16]. The relationship between 2D : 4D and GID is still controversial, and there is no study investigating the potential of 2D : 4D ratio on the gender identity quantitatively. In this study, we investigated the relationship between 2D : 4D and gender identity in the GID-female-to-male (FtM) population using a new assessment tool for GID.

Materials and Methods

Thirty-seven GID-FtM with testosterone replacement therapy in our clinic were included in this study. As controls, 20 male and 20 female volunteers participated from our institution. All participants of this study were East-Asian origin. We took photocopies of bilateral hands of the participants, and a single investigator measured the second and fourth finger lengths in a blind manner. Finger length was measured by one author (S.H.) twice to confirm the reproducibility of the data. We investigated gender identity with the Gender Identity Scale (GIS). The study was approved by our institutional review board (No. 22-3016) and written informed consent was taken from all participants.

GIS is a questionnaire for gender identity assessment developed and validated in Japanese by Sasaki and Ozaki (see Appendix) [17]. It consists of 15 items and was designed to set his/her gender identity as “one gender” according to the concept conforming to Erikson’s identity theory [18]. The features of GIS consist of the following: (i) it does not measure the specific gender role and is asking one’s gender in general terms; (ii) even if the biological sex is different from gender identity or one has homosexual orientation, it can assess the gender; and (iii) it is based on the Erikson’s identity theory (the awareness of the fact that there is a self-sameness and continuity to the ego’s synthesizing methods and a continuity of one’s meaning for others) [18]. It is constructed by the higher domain with two factors (“reality prospective gender identity” and “consistent gender identity”) and the lower domain with detailed four factors (“prospective gender identity,” “socially real gender identity,” “persistent gender identity,” and “perceived gender identity”). In the current study, multiple linear regression analysis revealed that “consistent gender identity” in the higher domain and “persistent gender identity” in the lower domain were the variables that positively correlated with 2D : 4D.

In addition to comparing group means by analysis of variance (ANOVA), we carried out multiple linear regression analysis for the contributors to the 2D : 4D in the right hand of biological female ($N = 57$). We utilized the two models with variables including age and two factors in the higher domain (“reality prospective gender identity” score and “consistent gender identity” score) and with variables including age and four factors in the lower domain (“prospective gender identity,” “socially real gender identity,” “persistent gender identity,” and “perceived gender identity”) from GIS (Table 1).

Statistical comparisons were made using one-way ANOVA (Scheffé) for the comparison of the parameters: multiple linear regression analysis for the multivariate analysis and linear regression analysis for the correlation between 2D : 4D and GIS score. $P < 0.05$ was considered to be statistically significant.

Results

In four factors in the lower domain of GIS, GID-FtM showed significantly lower score than male in “socially real gender identity” score and lower than both female and male in “persistent gender

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