Strength and Anthropometric Measures in Identical and Fraternal Twins: No Evidence of Masculinization of Females with Male Co-Twins

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Sharing of intrauterine environment in twins of opposite sex has been hypothesized to result in masculinization of the female twin. We tested this hypothesis by comparing strength (maximum hand-grip pressure) and various anthropometric measures in a newly established survey panel comprising 4,314 middle-aged twins identified through a Danish population-based twin registry. Sex- and zygosity-specific mean values of handgrip strength, height, weight, body mass index, and waist circumference were highly comparable between fraternal twins of opposite sex and fraternal twins of same sex. Our results provide no support for the hypothesis of masculinization of female twins from opposite sex twin pairs. (Epidemiology 2000; 11:340-343)

Keywords: twins, gender, anthropometry, muscle strength, masculinization, phenotype.

In several species of litter-bearing mammals, intrauterine positioning predicts postnatal characteristics.1 Female animals gestated between two male fetuses are exposed to increased levels of androgens; this has been shown to result in masculinization of the female fetus with regard to a broad range of morphological and behavioral postnatal characteristics.2-5

Human twins can be identical (MZ), fraternal of the same sex (DZss), or fraternal of the opposite sex (DZos). Pregnancy with DZos is the human analogy to the intrauterine position phenomenon in litter-bearing animals. The female DZos fetus shares the intrauterine environment with a male fetus and is potentially exposed to higher androgen levels produced by the male co-twin. This exposure has been offered as an explanation for the higher degree of masculinization of female DZos observed in some studies.6-8

In the present twin study, we focused on strength and body composition measures, phenotypes that are known to depend on intrauterine positioning in animals,1,2,4 and that are also important predictors of human morbidity and disability.9,10 We used data from a large newly established panel of middle-aged identical and fraternal twins identified in a population-based registry.

Subjects and Methods
We identified pairs of twins born between 1931 and 1952 through the Danish Twin Registry.11 The twins had responded to a brief mailed questionnaire (response rate 77%) in 1997 and had declared their willingness to participate in future studies (90% of responders). This questionnaire included items on similarity of the twins, based on which we assigned zygosity, a method found to result in misclassification rates of less than 5%.12 Within each of the 22 birth cohorts, we randomly identified 40 pairs of each zygosity (MZ, DSS, and DZ). Half of the retrieved MZ and DZs twin pairs were female. Owing to insufficient numbers of MZ pairs in the birth cohorts of 1933, 1934, and 1936, we retrieved an additional 11 MZ pairs from the birth cohorts of 1931 and 1935. A total of 2,640 pairs were identified. Shortly before the survey we obtained demographic information on these twins from a continuously updated nation-wide population register, the Danish Civil Registration System. Ninety-one twins (1.7%) had died or emigrated in the 2-year period pre-
No evidence of masculinization of females with male co-twins

The Danish Twin Registry
5,280 twins born 1931-52
91 twins dead or emigrated during the year before the study
5,189 eligible twins

Intact twin pairs
MZ male 431
MZ female 427
DZss male 420
DZss female 427
DZos 846
All 2,551

Broken twin pairs*
MZ male 9
MZ female 12
DZss male 20
DZss female 13
DZos 33
All 87

Overall participation 83.1%

FIGURE 1. Eligibility and participation in the study of middle-aged Danish twins.

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were considered not possible to contact only when at least three unsuccessful attempts to contact them at their residence were made. To avoid interviewer bias, which would inflate twin similarity, twins from a pair were never interviewed by the same interviewer. A pilot study testing all procedures resulted in minor changes only.

We compared participants and non-participants with regard to age, gender, urban residency, and marital status using data from the Civil Registration System. Height in centimeters and weight in kilograms were self-reported and were used to calculate the body mass index (weight/height^2 kg/m^2). With a tape measure, the interviewers took two measurements of the subjects' waist circumference between the lowest rib margin and the iliac crest and recorded the values to the closest 0.1 cm. The average of the two measures was used in this analysis. For grip strength, we identified the maximum value among the recorded measurements (three for each hand for 97.8% of the sample).

Results
Eighty-five percent of male and 81.3% of female eligible twins participated (Figure 1). Compared with non-participants, participants were slightly younger, more frequently married, and lived less frequently in urban areas (Table 1). These differences remained when the sample was stratified by zygosity (results not shown). Pair-wise

<table>
<thead>
<tr>
<th>TABLE 1. Characteristics of Participants and Non-Participants in the Study of Middle-Aged Danish Twins (N = 5,189)</th>
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</thead>
<tbody>
<tr>
<td>Both Twins</td>
</tr>
<tr>
<td>Participants Non-Participants</td>
</tr>
<tr>
<td>Age, ‡ mean (SD)</td>
</tr>
<tr>
<td>Male, %</td>
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<tr>
<td>Urban residency, $ %</td>
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<tr>
<td>Married, %</td>
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</tbody>
</table>

* Includes 62 twins from twin pairs where only one twin was eligible for participation.
† Includes 25 twins from twin pairs where only one twin was eligible for participation.
‡ As of January 1, 1999.
§ Defined as residency in borough with 500 or more inhabitants per km².
participation was greater for MZ pairs (77%) than DZ pairs (72%).

After exclusion of twins with missing values on variables of interest, the sample was reduced to 4,223 twins (97.9%). The mean age of these subjects was 56.9 years (SD = 6.3) and varied 0.3 years or less in sex and urban area dwellers. Interestingly, males were more likely to participate in this as well as in previous Danish twin studies, a pattern opposite to what we expected from the literature.

In conclusion, the data of this large study of twins using both objective measurements and self-reported data provide no evidence of a more masculinized phenotype in female DZos.

References


IEA EUROPEAN REGIONAL MEETING

Satellite Seminar

Future of Epidemiology II

24 August 2000 at 09:00–16:00h

Kaunas University of Medicine, Central Building,
Mickeviciaus str. 9, LT-3000 Kaunas, Lithuania

Opening: (Prof. Jorn Olsen, Denmark)
Public Health Epidemiology: (Prof. Neil Pearce, New Zealand)
Ecosocial Science Perspective: (Prof. Nancy Krieger, United States of America)
Environmental/Occupational Epidemiology: (Dr. Timo Partanen, Finland)
Clinical Epidemiology: (open)
Molecular Epidemiology: (Prof. Paolo Vineis, Italy)
Genetic Epidemiology: (Prof. Kari Hemminki, Sweden)
Epidemiology in Central and Eastern Europe: (Prof. Vilius Grabauskas, Lithuania)
Epidemiology in Developing Countries: (Dr. Catharina Wesseling, Costa Rica)
Expectations of Young Epidemiologists: (Dr. Esther Welp, the Netherlands)
Equity and Ethics: (Prof. Rodolfo Saracci, Italy)
Round Table Discussion
WHO view
Comments and Questions from the Audience
Conclusion

IEA EUROPEAN REGIONAL MEETING

"From Molecules to Public Health"

25–26 August 2000 at 8:30–17:30h

Kaunas Vytautas Magnus University,
Daukanto str. 28, LT-3000 Kaunas, Lithuania

FRIDAY 25 AUGUST, 2000

Keynote lectures:
"Social inequalities and health in changing Europe" (open)
"Ageing processes in European populations"
(Prof. James W. Vaupel, Denmark)

SATURDAY 26 AUGUST, 2000

Keynote lectures:
"Monitoring requirements in disease surveillance system"
(Dr. Ruth Bonita, Switzerland)
"Community approaches in health promotion and disease prevention"
(Prof. Pekka Puska, Finland)

http://www.info.kma.lt/ EUROIEA2000