Published in final edited form as:

Epidemiology. 2009 January ; 20(1): 52–55. doi:10.1097/EDE.0b013e31818b47d1.

Handedness and time to pregnancy

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Abstract

Background—Non-right handedness, particularly mixed-handedness, has been associated with a number of medical conditions. We examined whether handedness was associated with fecundity, measured by time to pregnancy.

Methods—We used data on parental handedness and time to pregnancy from two regional birth cohorts in Denmark: the Aalborg-Odense Birth Cohort (1984–1987) and the Aarhus Birth Cohort (1990–1992) (N=5808 and 3426, respectively). We applied discrete-time survival analysis to assess fecundity in relation to handedness.

Results—In both cohorts, we saw a slightly lower fecundity in individuals who reported being mixed-handed. Left handedness was not significantly associated with fecundity.

Conclusions—Our data showed a modest association between mixed-handedness and subfecundity, which suggests that these traits may share a common prenatal etiology.

Keywords

handedness; fecundity; time to pregnancy

Although the etiology of handedness is unclear,^{1–4} brain lateralization is probably determined during embryogenesis,⁴ and more than 80% of fetuses show more right-arm than left-arm movements as early as at 10 gestational weeks.^{5,6} Non-right handedness is considered by some a marker of neurotoxic exposures during fetal life^{7,8} and has been associated with schizophrenia,^{9,10} autism,¹¹ homosexuality,¹² and asthma.¹³ Exposure to abnormal steroid levels during fetal life is a possible cause.^{12,14,15} In this study, we examined the association between handedness and fecundity measured by time to pregnancy.^{16–19}

Methods

Study population

We used data from two regional population-based birth cohorts in Denmark: the Aalborg-Odense Birth Cohort (1984–1987)^{20,21} and the Aarhus Birth Cohort (1990–1992).^{22,23} Both studies collected data on socio-demographic, environmental, and lifestyle factors during pregnancy through questionnaires, and the children were followed up since birth. Detailed information on the study populations is available on the journal's website.

Parents' handedness

In the follow-up questionnaires, we collected information on parents' handedness by asking the parent the following questions: "Which hand does your child's biological mother use the most?" and "Which hand does your child's biological father use the most?". The response categories were: (1) exclusively the right hand, (2) mostly the right hand, (3) both hands equally, (4) mostly the left hand, (5) exclusively the left hand. We defined parents as strong dextral, dextral, mixed-handed, sinistral, and strong sinistral, respectively.

Time to pregnancy

In the pregnancy questionnaires, women were asked if their pregnancy was planned (yes, no, don't know), if they had ever been examined or treated for infertility (yes, no), and for how long they had tried to become pregnant before succeeding (three categories for the Aalborg-Odense Birth Cohort: 0–6, 7–12, and more than 12 months – in order to facilitate valid recall in exchange for a loss of precision; and number of months for the Aarhus Birth Cohort). We restricted all analyses to planned pregnancies.

Statistical analysis

We calculated fecundity ratios (FR) by using discrete-time survival analysis with complementary log-log link, which has an interpretation in terms of hazard ratio (HR) and is more appropriate and robust to the choice of time to pregnancy categories than logit link,^{24–27} in STATA 9.1 (StataCorp, College Station, Texas, USA). Strong dextrals were used as the reference category. We defined fecundity as the probability to conceive in a given time to pregnancy category, conditionally on not having conceived in the previous interval. The discrete-time survival analysis with complementary log-log link expresses the hazard as a ratio of the incidence (conception) density to the survival function. In the Aarhus Birth Cohort, we additionally performed Cox regression by treating time to pregnancy (in months) as a continuous variable. Data were analysed separately for mothers and fathers, as well as for each birth cohort.

Reported handedness may correlate with age, especially in older parents, if they had been "corrected" as children. Different lateralization, perception of being different, or living in a world designed for right-handed people may result in different lifestyles, which could, in turn, affect fecundity. We thus examined whether including parents' age at the time of birth of the child (<25, 25–29, 30–34, 35+ years) and mother's smoking before pregnancy (yes, no) in the models for each cohort changed the estimates. We also examined our results in the Aalborg-Odense Birth cohort by further adjusting for alcohol intake, coffee consumption and body mass index before pregnancy in women, and for smoking and alcohol intake in men.

Results

In the Aalborg-Odense Birth Cohort we had 5808 couples for analysis, with 10.0% left or mixed-handed women and 12.5% left or mixed-handed men. In the Aarhus Birth Cohort we

had 3426 couples, with 9.2% left or mixed-handed women and 12.4% left or mixed-handed men (a table with time to pregnancy is available on the journal's website).

Mixed-handed individuals had a lower fecundity in the Aalborg-Odense Birth Cohort, regardless of adjustment. We saw similar estimates in the Aarhus Birth Cohort (Table 1). Estimates in the Aarhus Birth Cohort were unchanged when treating time to pregnancy as a continuous variable in Cox regression models [Adjusted HR 0.94 (95% confidence interval 0.74–1.19) for mixed-handed women and 0.87 (0.72–1.04) for mixed-handed men; a table with detailed information is available on the journal's website]. Further adjustment for alcohol intake, coffee consumption and body mass index before pregnancy in women and for smoking and alcohol intake in men in the Aalborg-Odense Birth Cohort did not change the results (data not shown).

Some types of handedness run in families,²⁸ and familial handedness may represent a distinct phenotype. Excluding mixed-handed women or men whose children were mixed-handed or left handed had no effect on the estimates in either cohort [Aalborg-Odense Birth Cohort: adjusted HR 0.85 (0.68–1.07) and 0.81 (0.69–0.96) for mixed-handed women and men, respectively; Aarhus Birth Cohort: adjusted HR 0.96 (0.64–1.43) and 0.87 (0.70–1.08) for mixed-handed women and men, respectively].

Discussion

We found a modest association between mixed-handedness and a longer time to pregnancy in two Danish birth cohorts. Our findings suggest that handedness and fecundity may share a common genetic background or common causes operating during fetal life.

Our study populations arose from parents enrolled in two birth cohorts (the Aalborg- Odense and the Aarhus birth cohorts). Participation at enrolment was high (87% and 95%, respectively), but moderate for the follow-up questionnaires (74% and 72%, respectively). However, it is unlikely that participation depended on both length of time to pregnancy and handedness. It is also highly unlikely that respondents reported handedness differentially depending on their time to pregnancy, since the information on time to pregnancy was provided at least a decade earlier. Information on time to pregnancy was obtained in the pregnancy questionnaires, and the recall period was less than one year in both cohorts. The distribution of handedness as well as that of time to pregnancy were comparable with results from other studies.^{22,29}

In most cases the mother reported handedness for herself and the child's father by answering one question for each, and the resulting distribution of handedness was close to the expected,²⁹ although we do not know whether those reporting equal use of both hands referred to the ability to perform the same task or different tasks. As expected, there were more non-right-handed or mixed-handed men than women, and the frequency of mixed-handedness was lower than what has been reported in more detailed assessments.^{30,31} We cannot, however, rule out that using a different set of questions would have yielded different results.³²

Besides psychopathological disorders,⁹ weak lateralization has been associated with a wide range of conditions, such as spatial performance, dyslexia, and even asthma.¹³ Prenatal stress has been studied as a potential cause of mixed-handedness.^{30,33,34} In line with these reports, we found an association of lower fecundity with mixed-handedness but not left-handedness. This may suggest that abnormal levels of steroids in fetal life lead to incomplete lateralization, manifested as mixed handedness. However, our and others' findings do not necessarily imply that mixed handedness is pathological. Some "corrected" left-handers could be among the right- and, more likely, mixed-handed individuals, and the stress of having to operate with the nonprimary hand may have resulted in compromised fertility or other adverse health

conditions. It is thus expected that mixed-handed individuals would appear to deviate from the statistical norm, while the influx of “corrected” left-handers into the group of right-handers would not be noticeable.³⁵

Our results suggest that mixed-handedness is associated with lower fecundity, perhaps because these two traits share a common etiology, but other explanations are also possible. Future studies should examine direct associations between hormonal levels during fetal life and subsequent handedness, as well as fecundity later in life.

Acknowledgment

The authors thank Drs Clarice R Weinberg and Freya Kamel for helpful comments on an earlier version of this manuscript. This work was supported by a grant from the Danish Medical Research Council (No. 271-05-0115) and, in part, by the Intramural Research Program of the NIH, National Institute of Environmental Health Sciences.

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Detailed information regarding the study population put on the journal's website

In the Aalborg-Odense Birth Cohort all pregnant women in Aalborg and Odense were invited to participate in a health campaign “Healthy Habits for Two” between April 1984 and April 1987. Midwives handed out a self-administered questionnaire at the routine antenatal visit in the 36th gestational week. A total of 11,980 women (87% of eligible) in the two regions took part in the study. In 2002, a follow-up questionnaire on health and development of the child, including his/her handedness as well as that of his/her biological parents, was mailed to 10,636

mother-child pairs who could be traced by means of the civil registration system (all children were singletons). A total of 7841 primary caregivers, usually the mothers, responded (74%). We excluded data for any pregnancy except the first during the recruitment period (N=248 dropped). We also excluded 169 records with no information on maternal or paternal handedness, and 29 records with more than one answer for maternal or paternal handedness. We further excluded unplanned pregnancies (N=1557) and pregnancies with no information on time to pregnancy (N=30), thus leaving 5808 pregnancies in the Aalborg-Odense Birth Cohort available for the final analysis.

The Aarhus Birth Cohort, established in 1989, is an ongoing longitudinal cohort that covers all births at the Department of Obstetrics, Aarhus University Hospital. The cohort is based on pregnant women who are consecutively recruited in early pregnancy through the antenatal health care service. The present study was based on children born between January 1990 and June 1992 and their parents. Prior to the routine antenatal visit at 16 gestational weeks, all Danish-speaking women were asked to complete a self-administrated questionnaire. Information about waiting time to pregnancy, medical and obstetric history, smoking, and alcohol consumption, was collected for the woman's hospital record with a response rate of 95%. In 2001, for children who were still alive (N=8244, traced by means of the civil registration system), their parents were asked to fill in a comprehensive questionnaire concerning child health as well as other factors, including the biological parents' handedness. A total of 5974 questionnaires were returned (72%). We kept only the first child of each woman in the study and thus dropped 154 children. We further excluded 186 records with no information on parental handedness. Unplanned pregnancies (N=2150) and pregnancies with no information on time to pregnancy (N=58) were also excluded, thus leaving 3426 pregnancies (3381 singleton pregnancies, 42 twins pregnancies and 3 triplets pregnancies) in the Aarhus Birth Cohort available for the final analysis.

Table 1
Fecundity ratio (FR) with 95% confidence interval (CI) according to handedness, Aalborg-Odense Birth Cohort (1984–1987) and Aarhus Birth Cohort (1990–1992)

	Aalborg-Odense Birth Cohort			Aarhus Birth Cohort		
	N	Crude FR	Adjusted FR (95% CI)	N	Crude FR	Adjusted FR (95% CI)
Handedness, women						
Exclusively the right hand	3050	1.00	reference	1822	1.00	reference
Mostly the right hand	2176	1.00	1.00 (0.93–1.06)	1289	1.01	1.01 (0.92–1.09)
Both hands equally	188	0.86	0.83 (0.70–1.00)	70	0.93	0.96 (0.71–1.28)
Mostly the left hand	246	0.97	0.97 (0.83–1.12)	136	0.97	0.93 (0.77–1.13)
Exclusively the left hand	148	1.00	0.99 (0.81–1.21)	109	1.21	1.14 (0.90–1.44)
Handedness, men						
Exclusively the right hand	2997	1.00	reference	1743	1.00	reference
Mostly the right hand	2086	0.96	0.95 (0.89–1.02)	1257	1.01	1.00 (0.92–1.09)
Both hands equally	294	0.84	0.81 (0.71–0.94)	124	0.86	0.85 (0.70–1.03)
Mostly the left hand	305	0.97	0.96 (0.83–1.11)	202	0.93	0.93 (0.79–1.10)
Exclusively the left hand	126	1.11	1.06 (0.87–1.30)	100	1.13	1.06 (0.84–1.32)

Discrete-time survival analysis. Adjusted for women’s age, women’s smoking before pregnancy, and men’s age.

Extra Table 1
Time to pregnancy (TTP) distribution according to handedness, Aalborg-Odense Birth Cohort (1984–1987) and Aarhus Birth Cohort (1990–1992)

	Aalborg-Odense Birth Cohort			Aarhus Birth Cohort			
	N	Percentage (%), TTP (months)		N	Percentage (%), TTP (months)		
		0–6	7–12		>12	0–6	7–12
Handedness, women							
Exclusively the right hand	3050	73.8	9.7	1822	73.4	11.6	15.0
Mostly the right hand	2176	73.7	10.2	1289	74.1	10.7	15.2
Both hands equally	188	69.1	9.0	70	72.9	8.6	18.6
Mostly the left hand	246	72.4	10.6	136	69.9	16.2	14.0
Exclusively the left hand	148	75.0	7.4	109	80.7	8.3	11.0
Handedness, men							
Exclusively the right hand	2997	74.6	9.2	1743	74.3	10.4	15.3
Mostly the right hand	2086	72.4	11.0	1257	74.3	11.1	14.6
Both hands equally	294	67.7	11.2	124	63.7	20.2	16.1
Mostly the left hand	305	74.8	7.2	202	70.3	13.4	16.3
Exclusively the left hand	126	77.8	9.5	100	76.0	14.0	10.0

Extra Table 2

Hazard ratio (HR) with 95% confidence interval (CI) according to handedness, Aarhus Birth Cohort (1990–1992)

	N	Crude HR	Adjusted HR (95% CI)
Handedness, women			
Exclusively the right hand	1822	1.00	reference
Mostly the right hand	1289	1.00	1.00 (0.93–1.07)
Both hands equally	70	0.91	0.94 (0.74–1.19)
Mostly the left hand	136	1.01	0.97 (0.81–1.15)
Exclusively the left hand	109	1.17	1.11 (0.91–1.34)
Handedness, men			
Exclusively the right hand	1743	1.00	reference
Mostly the right hand	1257	1.01	1.00 (0.93–1.08)
Both hands equally	124	0.88	0.87 (0.72–1.04)
Mostly the left hand	202	0.95	0.95 (0.82–1.10)
Exclusively the left hand	100	1.08	1.03 (0.84–1.27)

Cox regression. Adjusted for women's age, women's smoking before pregnancy, and men's age. In addition, censoring time to pregnancy at 13 months (excluding possible effects of medical treatment for infertility) did not change the estimates in the table.