Declining male births in Germany before and after reunification

Victor Grech

Department of Pediatrics, Mater Dei Hospital, Malta. E-mail: victor.e.grech@gov.mt

SUMMARY: Grech V. Declining male births in Germany before and after reunification. Turk J Pediatr 2013; 55: 300-303.

Male births occur 3% in excess of female births in mammals in a ratio (M/F) of 0.515. Many factors have been shown to influence this, including socioeconomic deprivation. This paper reviews live birth data for Germany over the period 1946-2009, and identifies secular trends in M/F pre- and post-reunification. The null hypothesis is that there were no differences between East and West Germany, geographically or temporally, before and after reunification.

Annual data on male and female live births were obtained from the Human Mortality Database and analyzed with contingency tables. These data were available separately for East and West Germany (1950-1989).

There was a significant decline in M/F in both German Republics overall and before reunification ($p<0.0001$). No decline was present after. Pre-reunification, West Germany had a lower overall M/F than East Germany ($p=0.001$).

In conclusion, a declining M/F has been shown in many countries over the past decades. The two German Republics' M/F fell prior to reunification and the economic collapse of East Germany. Contracting societies that offer poor socioeconomic conditions (such as the communist former East Germany) may result in a decrease in M/F, but this is not reflected in the data, which show that M/F in West Germany prior to reunification was lower than in East Germany. This is not explicable with the contracting economies hypothesis; other and as yet unknown influences may have modified M/F trends anticipated by known variables.

Key words: Germany, birth rate, trends, Europe, epidemiology, infant, newborn, sex ratio.

Male births occur slightly in excess of female births in mammals. The male to female ratio of live births is generally expressed as the ratio of male live births divided by total live births (M/F). Although this would be more accurately abbreviated as M/T (male births divided by total births), it is widely (albeit technically incorrectly) abbreviated as M/F, and this will be used throughout. This value is expected to approximate 0.515, with 1.5% more males born than females[1,2]. The reason for this discrepancy is multifactorial, and the factors that have been shown to influence this are legion[3].

In utero, the male fetus is more susceptible to morbidity and mortality from external influences than the female fetus, as well as being at higher risk for all obstetric complications[4]. Since M/F at birth still favors the male, even more male conceptuses must be produced than females in order to produce this male skew in live births.

It has therefore been proposed that M/F could serve as a surrogate health indicator[5], or an indicator of contracting economies in that secular trends in M/F that demonstrate a decline in the expected excess of male births may indicate adverse population condition(s). This theory is indirectly supported by studies that compare metropolitan vs. non-metropolitan areas. These assume that exposure to reproductive hazards occurs to a greater extent in major cities than in more rural areas. For example, in Italy, it has been shown that metropolitan areas have a higher male stillbirth rate and a concomitant decline in male births that are both significantly different from the lower male stillbirth rate and the contemporaneous increase in male births observed in non-metropolitan areas[6].

The formal unification of Germany into a nation state occurred in 1871 after the French

capitulation in the Franco-Prussian War (1870-1871). Germany was once again split following its surrender in 1945 after the Second World War, into an Eastern communist part (the Democratic Republic of Germany) and a Western part (the Federal Republic of Germany) with a free market economy.

A review of German birth trends in 2003 had shown that East Germany's economic collapse in 1991 (after formal reunification with West Germany in October 1990) resulted in the observed lowest M/F between 1946 and 2000 in this country[7].

The two Germanies constitute two very similar populations that were sharply separated by ideologies that severely affect economies: a Western capitalist and an Eastern communist society. It is well known that classical Marxist-Leninist economies, such as that of the former East Germany, do not thrive, and this may be reflected in a lower M/F than that which would be exhibited by a similar populace, such as West Germany. This paper reviews live birth data for Germany over the period 1946-2009, and further identifies secular trends in M/F pre- and post-reunification. The null hypothesis tested is that there were no differences between East and West Germany, geographically or temporally, before and after reunification.

Material and Methods

Annual data on male and female live births were obtained from the Human Mortality Database (University of California Berkeley and Max Plank Institute for Demographic Research) for 1946-2009. These data were available separately for East and West Germany for the entire period.

Contingency tables were analyzed for annual male and female live births using chi- squared and chi-squared for trend. 95% confidence intervals for ratios were obtained by using the quadratic equations of Fleiss equations[8]. Values of $p<0.05$ were taken as significant.

Results

Five-year totals for German live births are shown in Table I. Analysis of annual M/F shows a significant decline in M/F in both German Republics from 0.518 to 0.514-0.513 ($p<0.0001$, Table II). This decline was significant for the period before reunification ($p<0.0001$, Table III) but not for the period after.

A comparison of the two Republics for the pre-

Table I. Five-Year Totals for German Live Births, Before and After Unification

Five yr	period	1946-49	1950-54	1955-59	1960-64	1965-69	1970-74	1975-79	1980-84	1985-89	1990-94	1995-99	2000-04	2005-09
East	M	494365	782911	728897	764296	662030	530422	549866	608352	560244	273976	250099	278294	332421
Germany	F	458922	730379	682377	720828	623856	501283	517951	576316	530288	259819	236919	264344	315318
	Total	953287	1513290	1411274	1485124	1285886	1031705	1067817	1184668	1090532	533795	487018	542638	647739
	UCI	0.51959	0.51815	0.51731	0.51544	0.51571	0.51509	0.51589	0.51442	0.51467	0.51460	0.51494	0.51418	0.51442
	M/F	0.51859	0.51736	0.51648	0.51463	0.51484	0.51412	0.51494	0.51352	0.51373	0.51326	0.51353	0.51285	0.51320
	LCI	0.51759	0.51656	0.51566	0.51383	0.51398	0.51316	0.51400	0.51262	0.51280	0.51192	0.51213	0.51152	0.51198
West	M	1635199	2075619	2282822	2632364	2562688	1824742	1512778	1563781	1649213	1838248	1768010	1586618	1408110
Germany	F	1518097	1944028	2141828	2487064	2424725	1727812	1431381	1480940	1563711	1740815	1674157	1503811	1335188
	Total	3153296	4019647	4424650	5119428	4987413	3552554	2944159	3044721	3212924	3579063	3442167	3090429	2743298
	UCI	0.51912	0.51686	0.51640	0.51462	0.51427	0.51416	0.51439	0.51417	0.51385	0.51413	0.51416	0.51395	0.51388
	M/F	0.51857	0.51637	0.51593	0.51419	0.51383	0.51364	0.51382	0.51360	0.51331	0.51361	0.51363	0.51340	0.51329
	LCI	0.51802	0.51588	0.51547	0.51376	0.51339	0.51312	0.51325	0.51304	0.51276	0.51309	0.51310	0.51284	0.51270

Table II. Chi Tests for M/F Trends for the Two Germanies for the Periods 1946-2009 (Pre-Reunification), 1992-2009 (Post-Reunification) and for the Entire Period

1946-2009	East	West
chi	56.2	56.2
p	<0.0001	<0.0001
1946-91	East	West
chi	47.1	146.6
p	<0.0001	<0.0001
1992-2009	East	West
chi	1.3	0.4
p	ns	ns

Chi tests for trend were calculated using one-year intervals.

Table III. Chi Tests for M/F for the two Germanies for the periods 1946-2009 (Pre-Reunification) and 1992-2009 (Post-Reunification)

1946-91	East	West	Results
M	5828077	18483989	chi (Yates)
F	5481751	17424252	10.6
Total	11309828	35908241	p
UCI	0.51560	0.51492	0.001
M/F	0.51531	0.51476	
LCI	0.51502	0.51459	
1992-2009	East	West	Results
M	988096	5856203	chi (Yates)
F	936849	5549305	0.1
Total	1924945	11405508	p
UCI	0.51402	0.51374	ns
M/F	0.51331	0.51345	
LCI	0.51260	0.51316	

reunification period (1946-1991) showed that the M/F for West Germany was significantly less than that of East Germany (p=0.001, Table III). No such difference was present after reunification (1992-2009, Table III).

Discussion

Studies dealing with earlier periods in German history, such as 1787-1802 (the period of the French Revolutionary wars), have shown that war and its aftermath may decrease M/F9. More recently, other factors such as the nuclear disaster at Chernobyl and the subsequent radiation exposure have also been shown to reduce the M/F in Germany, as well as in other European countries[10]. However, no specific such events occurred selectively in East or West Germany, and these effects may be discounted.

Seasonal variation in M/F has also been demonstrated in Germany[11], and this has been shown to be associated with average monthly air temperature and monthly temperature deviations from the overall mean for the period 1946-1995[12]. Such variations would have affected both parts of Germany and may therefore also be discounted.

A survey in Germany has established that preconception sex selection for non-medical reasons is unlikely to cause gender imbalance, and this potential influence can therefore be discounted as well[13]. This is in contrast with countries such as India, where it has been estimated that the selective abortion of female fetuses results in approximately 0.5 million missing female births annually, translating to the abortion of over 10 million female fetuses over the past two and a half decades[14].

Studies from various countries have shown a decline in the M/F over the past three to six decades[15-18]. This study is in accordance with these findings, demonstrating a decline in M/F that preceded the reunification of Germany.

It has been shown that M/F declines not only in response to environmental stimuli, but also in stressed females, as these spontaneously abort more male than female fetuses[4]. The resultant shortfall in the expected male excess has been reported after warfare[19], earthquakes[20], and other environmental disasters[21]. This has been demonstrated throughout the world, not only in Europe, along with the finding that that there is an increase in male fetal loss occurring in tandem with a reduction in male births[22].

It has thus been proposed that contracting economies or stressed societies that offer poor overall socioeconomic conditions may result in a decrease in M/F7. Before reunification, the population of the communist-occupied East Germany faced economic privation and stress, and the economic deprivation/contracting economies hypothesis would therefore predict M/F favoring a higher proportion of male births in West Germany than in East Germany.

This is not reflected in the data, which appear to show that although M/F declined in both Germanies prior to reunification, M/F was overall lower in the Federal Republic than in the Democratic Republic (with a significant

decline in M/F in East Germany in 1991 (Fig. 1), thus rejecting the null hypothesis in an unanticipated direction.

Moreover, after reunification, former East German workers experienced the market forces of free competition, resulting in a 20% unemployment rate and another 20% reduced working days23. This failed to further reduce the overall M/F in the reunited Germany. However, this potential reduction in M/F may have been ameliorated by favorable economic conditions in the former West Germany with low unemployment and peak in production since the post-war period and with expansion and investment in the former East Germany (Fig. 1).

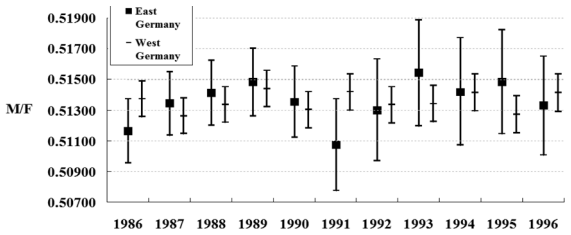

Fig. 1. M/F with 95% confidence interval for East and West Germany for 1986-1996.

While acknowledging the sharp M/F decline in East Germany in 1991, the economic deprivation/contracting economies hypothesis does not explain why M/F was lower in West Germany than in East Germany prior to reunification. It is therefore likely that other and as yet unexplained influences have modified M/F trends anticipated by known variables.

Acknowledgements

Human Mortality Database (University of California Berkeley and Max Plank Institute for Demographic Research).

REFERENCES

1. Grech V, Vassallo-Agius P, Savona-Ventura C. Declining male births with increasing geographical latitude in Europe. J Epidemiol Community Health 2000; 54: 244–246.
2. James WH. Evidence that mammalian sex ratios at birth are partially controlled by parental hormone levels around the time of conception. J Endocrinol 2008; 198: 3-15.
3. Grech V, Savona-Ventura C, Vassallo-Agius P. Unexplained differences in the sex ratio at birth in Europe and North America. Br Med J 2002; 324: 1010–1011.
4. Byrne J, Warburton D. Male excess among anatomically normal fetuses in spontaneous abortions. Am J Med Genet 1987; 26: 605-611.
5. Davis DL, Gottlieb MB, Stampnitzky JR. Reduced ratio of male to female births in several industrial countries: a sentinel health indicator? JAMA 1998; 279: 1018–1023.
6. Astolfi P, Zonta LA. Reduced male births in major Italian cities. Hum Reprod 1999; 14: 3116-3119.
7. Catalano RA. Sex ratios in the two Germanies: a test of the economic stress hypothesis. Hum Reprod 2003; 18: 1972-1975.
8. Fleiss JL. Statistical Methods for Rates and Proportions (2nd ed). New York: John Wiley; 1981: 14–15.
9. Kemkes A. Secondary sex ratio variation during stressful times: the impact of the French revolutionary wars on a German parish (1787-1802). Am J Hum Biol 2006; 18: 806-821.
10. Scherb H, Voigt K. Trends in the human sex odds at birth in Europe and the Chernobyl Nuclear Power Plant accident. Reprod Toxicol 2007; 23: 593-599.
11. Lerchl A. Seasonality of sex ratio in Germany. Hum Reprod 1998; 13: 1401-1402.
12. Lerchl A. Sex ratios at birth and environmental temperatures. Naturwissenschaften 1999; 86: 340-342.
13. Dahl E, Beutel M, Brosig B, Hinsch KD. Preconception sex selection for non-medical reasons: a representative survey from Germany. Hum Reprod 2003; 18: 2231-2234.
14. Jha P, Kumar R, Vasa P, Dhingra N, Thiruchelvam D, Moineddin R. Low female [corrected]-to-male [corrected] sex ratio of children born in India: national survey of 1.1 million households. Lancet 2006; 367: 211-218.
15. Moller H. Change in male-female ratio among newborn infants in Denmark. Lancet 1996; 348: 828–829.
16. Van der Pal-de Bruin KM, Verloove-Vanhorick SP, Roeleveld N. Change in male-female ratio among newborn infants in Netherlands. Lancet 1997; 349: 62.
17. Allan BB, Brant R, Seidel JE, et al. Declining sex ratios in Canada. Can Med Assoc J 1997; 156: 37–41.
18. Grech V, Vassallo-Agius P, Savona-Ventura C. Secular trends in sex ratios at birth in North America and Europe over the second half of the 20th century. J Epidemiol Community Health 2003; 57: 612-615.
19. Zorn B, Sucur V, Stare J, Meden-Vrtovec H. Decline in sex ratio at birth after 10-day war in Slovenia: brief communication. Hum Reprod 2002; 17: 3173-3177.
20. Fukuda M, Fukuda K, Shimizu T, Møller H. Decline in sex ratio at birth after Kobe earthquake. Hum Reprod 1998; 13: 2321-2322.
21. Lyster WR. Altered sex ratio after the London smog of 1952 and the Brisbane flood of 1965. J Obstet Gynaecol Br Commonw 1974; 81: 626-631.
22. Mizuno R. The male/female ratio of fetal deaths and births in Japan. Lancet 2000; 356: 738-739.
23. Neumann M. German unification: economic problems and consequences. Carnegie-Rochester Conference Series on Public Policy 1992; 36: 163-209.