

Clinical Paper

The male to female ratio at birth in the Republic of Ireland and Northern Ireland: influence of societal stress.

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ABSTRACT

Introduction: Male live births occur slightly in excess of female births. The ratio of male divided by total births is referred to as M/F. Many factors reduce M/F including toxins, stress, and privation, with excess male foetal loss. “The Troubles” (1969-1998) of Northern Ireland (NI) and the economic downturn of Republic of Ireland (ROI) from 2007 posed stresses with corresponding controls. This study analysed M/F in NI and ROI.

Methods: Annual male and female live births in NI and the ROI were compared using chi tests.

Results: M/F was significantly higher in NI than in ROI. M/F in NI dropped after 1974. M/F rose in ROI up to 1994, then fell.

Discussion: Violence-related stress may have been the cause for the M/F drop in NI. Economic improvement followed by recession may have caused parallel M/F changes in ROI. These findings agree with the stress hypothesis of M/F.

INTRODUCTION

The ratio of male to female live births is expressed as the ratio of male live births divided by total live births. It almost invariably exceeds 0.5 and is conventionally referred to M/F.¹

In man, there is a slight excess of male live births (circa 3%). However, this ratio varies secularly,² and by region. For example, gendercide, the selective abortion of female infants in Asian societies that highly prize male offspring has resulted in a highly skewed ratio in China, Korea and India, with the ensuing loss of tens of millions of women.³

A huge number of additional factors have been implicated as affecting M/F.^{1,4} Most factors tend to reduce the ratio by inducing spontaneous abortions which affect male fetuses more than female fetuses. These influences include exposure to toxins,^{1,4} stress,⁵ and privation.⁶

Stress has been shown to be particularly important in reducing M/F. For example, after the September 11 2001 terrorist attacks on New York, M/F fell sharply just a few months later and recovered equally quickly.⁵ This effect was also noted on the other side of the continent in California which was not directly affected by the violence unleashed in the attack.⁷ A transient drop was also noted in the entire country with a corresponding male foetal loss.⁸

Similarly, the 10-day war in Slovenia in 1991 sufficed to transiently but significantly depress M/F,⁹ as did the economic turmoil and uncertainty in East Germany in 1991 following the reunification of Germany in 1990.¹⁰

Ireland provides an interesting location for the analysis of M/F since the country is divided into two: Republic of Ireland and Northern Ireland. Rising standards of living in Northern Ireland (NI) along with the flourishing of industry and manufacturing resulted in better economic conditions in NI than in The Republic of Ireland (ROI).¹¹ The situation was reversed with the onset of sectarian violence in NI and a booming economy in ROI.

NI has had a turbulent history, with a minority Catholic population at odds with the Protestant community.¹¹ In the early 20th century, the Protestant and Catholic communities became divided over the issue of home rule. Most Irish Catholics (republicans/separatists) desired complete independence from Britain as it was perceived that this would lead to more equal treatment and less discrimination in everyday life on the basis of religious belief, but Irish Protestants (loyalists/unionists) resisted.¹¹

Violence erupted in the late 1960s as the incumbent Protestant administration's attempts to resolve discrimination against the Catholic minority were perceived to be inadequate by the Catholic community and excessive by the Protestant majority.¹² “The Troubles” colloquially refers to these dark years of Irish history and are considered to have commenced in 1969 and ended in 1998.¹²

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TABLE 1:

M/F for the two Irelands, in 5-year intervals

	1950-54		1955-59		1960-64		1965-69		1970-74		1975-79		1980-84	
	NI	ROI	NI	ROI	NI	ROI	NI	ROI	NI	ROI	NI	ROI	NI	ROI
M	74244	162524	77252	155258	84761	158723	85954	159865	77741	173377	67824	178020	70433	179294
F	69574	153642	72420	148044	79467	150937	80180	151098	72464	163819	64521	168606	66690	168648
T	143818	316166	149672	303302	164228	309660	166134	310963	150205	337196	132345	346626	137123	347942
UCI	0.5188	0.5158	0.5187	0.5137	0.5185	0.5143	0.5198	0.5159	0.5201	0.5159	0.5152	0.5152	0.5163	0.5170
M/F	0.5162	0.5140	0.5161	0.5119	0.5161	0.5126	0.5174	0.5141	0.5176	0.5142	0.5125	0.5136	0.5136	0.5153
LCI	0.5136	0.5123	0.5136	0.5101	0.5137	0.5108	0.5150	0.5123	0.5150	0.5125	0.5098	0.5119	0.5110	0.5136
ch		1.9		7.2		5.4		4.7		4.8		0.5		1.1
p		0.168		0.007		0.020		0.031		0.029		0.496		0.300
	1985-89		1990-94		1995-99		2000-04		2005-09		2010-		Total	
	NI	ROI	NI	ROI	NI	ROI	NI	ROI	NI	ROI	NI	ROI	NI	ROI
M	70211	148592	64664	131325	61001	134229	56003	152144	61870	177303	25742	148775	877700	2059429
F	66189	140272	61789	123057	57786	125881	52822	144215	58722	169215	24846	141587	827470	1949021
T	136400	288864	126453	254382	118787	260110	108825	296359	120592	346518	50588	290362	1705170	4008450
UCI	0.5174	0.5162	0.5141	0.5182	0.5164	0.5180	0.5176	0.5152	0.5159	0.5133	0.5132	0.5142	0.5155	0.5143
M/F	0.5147	0.5144	0.5114	0.5163	0.5135	0.5160	0.5146	0.5134	0.5131	0.5117	0.5089	0.5124	0.5147	0.5138
LCI	0.5121	0.5126	0.5086	0.5143	0.5107	0.5141	0.5116	0.5116	0.5102	0.5100	0.5045	0.5106	0.5140	0.5133
ch		0.0		8.1		2.1		0.5		0.7		2.1		4.4
p		0.835		0.005		0.151		0.485		0.408		0.144		0.036

In economics, a recession is defined as a business cycle contraction with a slowdown in economic activity that produces negative gross domestic product values for at least two consecutive quarters. A depression is a sustained and severe recession accompanied by an increase in unemployment and bankruptcies and a decrease in the availability of credit and of all economic activities in general. Ireland was hard hit, commencing in 2007.¹³

The two parts of Ireland constitute parts of a relatively small island with very similar ethnic and racial mixes, and may be considered as controls for each other with regard to M/F. This study was carried out in order to compare M/F in the two parts during the Troubles and after the onset of the Irish economic recession.

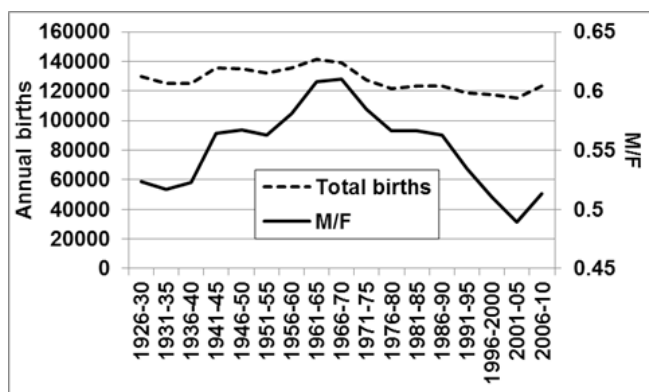


Fig 1. M/F in Northern Island, 1926-2010 and total births.

METHODS

For ROI, annual male and female live births were obtained

from a World Health Organisation Database (HFA (Health for All) Database) for the period 1950-2013.

For NI, the equivalent data was available from the Northern Ireland Statistics and Research Agency (NISRA) website, as well as data going back to 1926.

Data available relates to registered dates and not birth dates but this makes no practical difference for the purposes of this study.

Excel was used for data entry, overall analysis and charting. The quadratic equations of Fleiss were used for exact calculation of 95% confidence intervals for ratios.¹⁴ Chi tests and chi tests for trends for annual male and female births were used throughout using the Bio-Med-Stat Excel add-in for contingency tables.¹⁵ SPSS was used to perform Spearman correlation. A p value < 0.05 was taken to represent a statistically significant result.

RESULTS

Five year M/F and total M/F are depicted in table 1. For the period studied wherein overlap occurred (1950-2011), M/F was overall significantly higher in NI than in ROI.

NI

There was a rising trend in M/F ratios up to the early 1970s (figure 1). M/F dropped suddenly after 1974 (1970-74 vs. 1975-79; $\chi^2=7.2$, $p=0.007$ – figure 1) and this drop continued until the end of the study (χ^2 for trend=5.5, $p=0.02$). M/F fluctuations were closely paralleled by total births (figure 1) and correlated well ($\rho=0.69$, $p=0.002$).

ROI

M/F in ROI rose steadily between 1955 and 1994 (chi for trend=8.4, p=0.004 – figure 2), remained constant for the next five years then fell to the end of the study period (1995-2013; chi=8.9, p=0.003). Annual births increased until the early 1980s and then dropped markedly down to the year 2000, rising again to early 1980s levels.

Comparison

For 1955-1974, M/F in NI was significantly higher than in ROI (table 1). M/F in NI then dropped to levels below ROI up to 1994, but only to statistically significant levels for 1990-94. M/F continued to be higher (non-significantly) in ROI till 1999, dropped (non-significantly) to below ROI levels till 2009, then showed slight recovery.

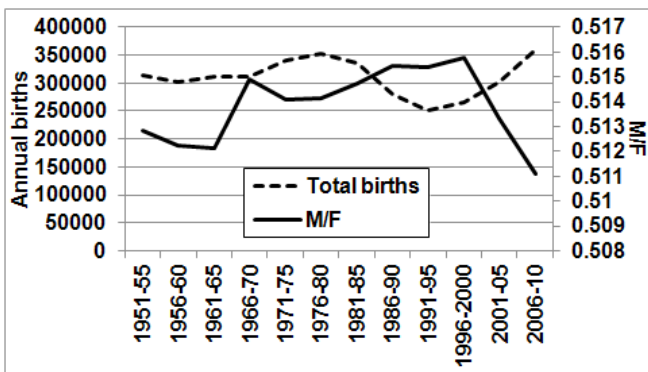


Fig 2. M/F in the Republic of Ireland, 1951-2010 and total births.

DISCUSSION

The overall higher M/F in NI when compared to the ROI agrees with the economic stress theory in that the less affluent south had a lower M/F than the more affluent north. The rise in M/F in ROI would suggest that if the economic stress hypothesis alone impinged on M/F, then the economy in NI was not very badly affected when compared with the ROI. However, the rise in M/F may also have been influenced by other factors that were not available for analysis.

The drop in M/F in NI commenced in the early 1970s some years after the onset of the Troubles in 1968/9. The Troubles brought years of bloody civil conflict. By 1997, 3600 deaths, 34000 shootings and 14000 bombings had been recorded and the majority of deaths were civilian.^{16,17} The population stress engendered in this period is evidenced by the residual psychological trauma. Indeed, Northern Ireland has the world's highest reported rates of post-traumatic stress disorder rates which per capita exceed that of war-torn regions such as Israel and Lebanon.¹⁸ It is estimated that the annual combined direct and indirect costs of treatment is around £175 million based on the year 2008 as a sample year.¹⁶ Progressively increasing levels of stress as The Troubles escalated may have therefore surpassed the level wherein M/F becomes negatively affected, resulting in a lowering of M/F several years into the this period.

The oral contraceptive pill was introduced in the early 1960s

and this may have been associated with the decline in births.¹⁹ However, this is probably not related to the decline in M/F in this period since effective contraception leads to higher maternal age which is in turn associated with an increase in M/F.¹ This is thought to be due to normal higher circulating levels of gonadotrophins in older women which is in turn associated with higher levels of M/F.¹

In contrast, the annual number of births in ROI continued to increase until the early 1980s and this may be related to the slower introduction of the oral contraceptive pill in this Catholic community. The increase in births from the early 1990s may be related to the influx of immigrants and asylum seekers that occurred around this time.¹⁹

The situation for the ROI was different and although The Troubles did not directly impinge on the Republic, the effects of the global economic depression was devastating.

The international financial crisis was precipitated on the 9th August 2007 when one of the world's largest banks (BNP Paribas) acknowledged a looming debt crisis by closing two funds. It was at this point that the world's financial services acknowledged that tens of trillions of dollars of financial derivatives were of doubtful security, leading to a convulsion in the global banking system.²⁰

Prior to 2007, the ROI economy was touted as one of the most successful models worldwide. Economic growth had commenced in the mid-1990s to the early 2000s due to catch-up expansion to reach levels attained by Europe's other economies. Growth was encouraged by favourable demographics which produced an increase in the total number of available workers who also had a high level of education. This precipitated a second and more treacherous growth period fuelled by credit expansion and an increase in individual personal indebtedness. This in turn caused property prices to soar to unsustainable levels, masked by unwise bank lending.^{21,22} It is perhaps for this reason that M/F rose continually up to the 1990s.

Irish banks were not immune to the problem and were highly vulnerable and exposed. Property prices fell and banks took huge losses.^{21,22} The economic recession may potentially have been responsible for the fall in M/F during this period.

Whatever the nature of stress, it appears capable of lowering M/F. It has been suggested that the process is via an excess of prenatal foetal losses which are skewed such that males are lost at a higher rate than females.^{5,8}

This is in agreement with the Trivers-Willard hypothesis (1973) which proposes that natural selection has favoured parents who bias offspring gender in favour of the sex with the best reproductive prospects in accordance with then extant peri-conceptual and gestational conditions.²³ Briefly, poor conditions may preclude successfully carrying a male baby to term since a male requires greater maternal gestational resources.^{24,25} Should such pregnancies go to term, a frail male may ensue who will compete unfavourably for mating

privileges with other stronger males. However, even under adverse circumstances, a female foetus may be successfully carried to term, survive, and eventually produce offspring of her own.

Conversely, under favourable conditions, carrying a male to term will result in a good quality male with far more reproductive opportunities than a good quality female who is hindered by a nine month gestational period and subsequent nursing. Thus, since resource abundance or scarcity affects reproductive success, the Trivers–Willard hypothesis predicts that natural selection will favour parents who tend to produce females under poor conditions and males in good circumstances.²³

Natural disasters have also been shown to lower M/F and these have included earthquakes,²⁶ floods and the Great Smog of London in 1952.²⁷ In conclusion, M/F was higher to be highest in NI and ROI stress-free times of affluence, and lower in economically depressed times and during periods of stress. Birth rates may also have played a role but this only appears to have influenced NI.

The overall findings of this study appear to be agreement with the Trivers-Willard hypothesis. M/F may provide a sensitive indicator of a population's stress, whether caused by economic hardship or internal violence.

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