Reduced Male:Female Ratio at Birth in Small Islands

V Grech

ABSTRACT

Background: *The male:female ratio at birth (M/F: male births divided by total births) is anticipated to approximate 0.515. The M/F in Micronesia in the Pacific Ocean has been noted to be higher than anticipated. This study analysed M/F in island populations available from a World Health Organization dataset.*
Methods: *The following islands were identified from the dataset as being sufficiently complete for analysis: Bahamas, Barbados, Puerto Rico, Trinidad and Tobago, and Mauritius.*
Results: *There were 540 8629 live births available for analysis over the period 1960–2009 with an overall M/F of 0.5106 (95% CL 0.5101, 0.5110). There were no secular trends in M/F.*
Conclusion: *The M/F in these equatorial islands is lower than anticipated, and the reason for this is unknown.*

Keywords: Birth rate, birth trends, infant, newborn, sex ratio

Reducción de la Razón Hombre:Mujer en los Nacimientos en las Islas Pequeñas

V Grech

RESUMEN

Antecedentes: *Se prevé que la razón hombre:mujer en los nacimientos (H/M; nacimiento de varones divididos por el total de nacimientos) se aproxime a 0.515. Se observa que la razón H/M en Micronesia en el Océano Pacífico es más alta de lo esperado. Este estudio analizó la razón H/M en las poblaciones insulares de una base de datos de la Organización Mundial de la Salud.*
Métodos: *Del conjunto de datos, las siguientes islas fueron identificadas como suficientemente completas para el análisis: Bahamas, Barbados, Puerto Rico, Trinidad y Tobago, y Mauricio.*
Resultados: *Hubo 540 8629 nacidos vivos disponibles para el análisis durante el período 1960–2009 con un H/M general de 0.5106 (95% CL 0.5101, 0.5110). No hubo tendencias seculares en H/M.*
Conclusión: *La razón H/M en estas islas ecuatoriales es más baja de lo esperado, y no se sabe la causa para que esto sea así.*

Palabras claves: Tasa de natalidad, tendencias en el nacimiento, infante, recién nacido, razón de sexo

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INTRODUCTION

Gender is determined at conception in humans. Males occur slightly in excess in a ratio that approximates 515 males to 485 females (1). This ratio is conventionally expressed as the ratio of male live births divided by total live births (M/F).

The reason for this discrepancy is undecided, but a very wide number of factors have been shown to influence this ratio (2). These include stress which decreases M/F (3) and long-duration warfare (*eg* the World Wars) which increases M/F (4). The ratio may also exhibit slow secular changes (5).

Micronesia (from Greek *mikrós*, "small" and *nēsos*, "island") is a subregion of Oceania that comprises thousands of small islands in the western Pacific Ocean. Some studies have shown that M/F in the Micronesian islands exceeds 0.521. (6, 7) and this was attributed to habitually increased coital activity even for couples with high birth orders and parental ages. This study identifies secular trends in M/F in available small islands from a World Health Organization (WHO) dataset that includes the past fifty years.

From: Department of Paediatrics, Mater Dei Hospital, Malta.

Correspondence: Professor V Grech, Department of Paediatrics, Mater Dei Hospital, Malta. E-mail: victor.e.grech@gov.mt

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SUBJECTS AND METHODS

Annual male and female live births were obtained directly from the WHO. The following islands were identified from the dataset as being sufficiently complete for analysis: Bahamas (1961–87), Barbados (1955–95), Puerto Rico (1955–92), Trinidad and Tobago (1950–94) and Mauritius (1952–2008).

The MF for these countries was also compared with the adjacent countries of Australia and New Zealand, which had totalled 874 5183 male and 829 0142 female births between them for the period 1950–2009 [M/F 0.5134; 95% CI: 0.5131, 0.5136] (8).

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 (9). Chi tests as contingency tables and Chi tests for trend were used for annual male and female births. These were performed using the Bio-Med-Stat Excel add-in for contingency tables. This add-in is based on the original work by Cochran and Armitage personal communcatin [Dr Peter Slezák, Institute of Normal and Pathological Physiology, Slovak Academy of Sciences] (10,11). Mater Dei Hospital and the Malta Medical School do not have an Institutional Review Board (IRB), so approval could not be sought from said board. Ethical approval was not required as this study analysed a large and anonymous WHO database.

RESULTS

There were 540 8629 live births available for analysis over the period 1960–2009 (276 1476 boys and 264 7153 girls), with an overall M/F of 0.5106 (95% CL 0.510, 10.5110).

Five-year live births and corresponding M/F are summarized in Table 1. The M/F remained relatively low (< 0.515) throughout and was significantly lower than that of Australia and New Zealand ($x = 127.6$, $p < 0.0001$).

There were no significant secular trends in M/F (Table 2). Based on an anticipated M/F of 0.515, the expected number of males was 278 5444, implying a deficit of 23 968 male births.

Table 2: Chi tests for secular trends in M/F.

	x	p
Bahamas	0.1	0.8
Barbados	1.9	0.2
Puerto Rico	0.2	0.6
Trinidad and Tobago	0.2	0.6
Mauritius	0.7	0.4

DISCUSSION

Earlier studies have shown that in Micronesia, M/F is significantly greater than the anticipated rate of 0.515. It is known that M/F follows a U-shaped regression on cycle day of insemination, such that female conceptions result most often from conceptions that occur around ovulation, while male conceptions occur more frequently at the beginning and end of the menstrual cycle (12, 13). These findings have been confirmed by recent meta-analyses (14, 15).

This U-shaped regression is further confirmed by the higher M/F that is found after the failure of rhythm methods of

Table 1: Five-year total live births and M/F for the Bahamas, Barbados, Puerto Rico, Trinidad and Tobago, and Mauritius, 1950–2009

		1950–54	1955–59	1960–64	1965–69	1970–74	1975–79	1980–84	1985–89	1990–94	1995–99	2000–04	2005–09	Total
Bahamas	**M**			8429	11098	11183	11856	13218	7354					63138
	F			8162	10770	11033	11514	12664	7306					61449
25°4′N	**Total**			16591	21868	22216	23370	25882	14660					124587
77°20′W	**UCI**			0.5157	0.5141	0.5100	0.5137	0.5168	0.5098					0.5096
Atlantic	**M/F**			0.5080	0.5075	0.5034	0.5073	0.5107	0.5016					0.5068
Ocean	**LCI**			0.5004	0.5008	0.4968	0.5009	0.5046	0.4935					0.5040
Barbados	**M**		18221	17703	14684	12756	11308	11381	10295	10295	1806			108449
	F		17993	17027	14152	12503	10957	11032	9892	9892	1736			105184
13°06′N	**Total**		36214	34730	28836	25259	22265	22413	20187	20187	3542			213633
59°37′W	**UCI**		0.5083	0.5150	0.5150	0.5112	0.5145	0.5144	0.5169	0.5169	0.5265			0.5098
Atlantic	**M/F**		0.5031	0.5097	0.5092	0.5050	0.5079	0.5078	0.5100	0.5100	0.5099			0.5076
Ocean	**LCI**		0.4980	0.5045	0.5034	0.4988	0.5013	0.5012	0.5031	0.5031	0.4933			0.5055
Puerto	**M**		196318	197062	184282	179576	189333	167410	166814	32885				1313680
Rico	**F**		187256	187662	175085	170815	179317	158161	159344	31596				1249236
18°27′N	**Total**		383574	384724	359367	350391	368650	325571	326158	64481				2562916
66°6′W	**UCI**		0.5134	0.5138	0.5144	0.5142	0.5152	0.5159	0.5132	0.5139				0.5132
Atlantic	**M/F**		0.5118	0.5122	0.5128	0.5125	0.5136	0.5142	0.5115	0.5100				0.5126
Ocean	**LCI**		0.5102	0.5106	0.5112	0.5108	0.5120	0.5125	0.5097	0.5061				0.5120
Trinidad and	**M**	63554	75025	84602	73005	66921	70139	81262	74690	55905				645103
Tobago	**F**	61712	71745	81096	70726	64626	67174	78128	72137	54263				621607
10°40′N	**Total**	125266	146770	165698	143731	131547	137313	159390	146827	110168				1266710
61°31′W	**UCI**	0.5101	0.5137	0.5130	0.5105	0.5114	0.5134	0.5123	0.5113	0.5104				0.5101
Atlantic	**M/F**	0.5074	0.5112	0.5106	0.5079	0.5087	0.5108	0.5098	0.5087	0.5075				0.5093
Ocean	**LCI**	0.5046	0.5086	0.5082	0.5053	0.5060	0.5081	0.5074	0.5061	0.5045				0.5084
Mauritius	**M**	35291	61827	67653	62478	53464	58893	55464	49362	54945	49866	48025	33838	631106
	F	34651	59849	65156	60249	51401	56885	53606	47546	53177	48339	46229	32589	609677
20°10′S	**Total**	69942	121676	132809	122727	104865	115778	109070	96908	108122	98205	94254	66427	1240783
57°31′E	**UCI**	0.5083	0.5109	0.5121	0.5119	0.5129	0.5116	0.5115	0.5125	0.5112	0.5109	0.5127	0.5132	0.5095
Indian	**M/F**	0.5046	0.5081	0.5094	0.5091	0.5098	0.5087	0.5085	0.5094	0.5082	0.5078	0.5095	0.5094	0.5086
Ocean	**LCI**	0.5009	0.5053	0.5067	0.5063	0.5068	0.5058	0.5055	0.5062	0.5052	0.5046	0.5063	0.5056	0.5078

M/F – male: female ratio at birth; UCI – upper confidence interval; LCI – lower confidence interval

birth control, since such failures would theoretically, on average, occur earlier or later in the menstrual cycle (16).

Thus, couples with increased coital rates inadvertently skew M/F in favour of a male excess. This was proposed as the reason for the increased M/F noted in Micronesia, and is contrary to the situation found in Europe and North America where a decline in M/F has been noted with marriage duration and spousal age, implicating a reduction in coital frequency as the cause of the M/F reduction (6, 7).

The high M/F noted in Micronesia is also consistent with studies from Europe that have shown that this ratio increases the closer the location studied is to the equator (17).

The converse was found in the islands analysed in this paper. All, bar one (Bahamas, Barbados, Puerto Rico, Trinidad and Tobago), are located in the western Atlantic Ocean close to the Americas, and span a latitude range of 10–25 °N. Mauritius also lies close to the equator at around 20 °S in the Indian Ocean. The M/F noted in this study is more consistent with the pattern noted in the Americas, where for both the North American and South American continent, M/F was lower as the equator was approached (17, 18).

In conclusion, the small islands analysed in this paper tend to produce lower M/F than anticipated and the reason for this is unknown.

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