

Original Article

# The influence of the Chinese zodiac on the male-to-female ratio at birth in Hong Kong

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## Abstract

**Background:** Secular trends have been found in the male–female ratio at birth (M/F: male births divided by total births) in various countries, and this ratio is anticipated to approximate 0.515. Births in Dragon years are considered auspicious. Fertility is known to have increased in Dragon years in Hong Kong. This study analyzed M/F with reference to Dragon years.

**Methods:** Annual national data for male and female live births in Hong Kong were obtained from the World Health Organization and analyzed with contingency Tables.

**Results:** There were 3,827,347 live births (1960–2009). Births declined steadily, then increased from 2004 in association with M/F. M/F was stable prior to this time, with spikes in 1975–1976, 1988, and 2000, associated with increases in births for these same years.

**Conclusion:** M/F follows a U-shaped regression on cycle day of insemination. Families attempting to conceive children during Dragon years may have increased coital rates, inadvertently skewing M/F in favor of a male excess.

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**Keywords:** birth rate/trends; Hong Kong; infant; newborn; sex ratio

## 1. Introduction

In humans, sex is determined at conception. Males occur slightly in excess in a ratio that approximates 515 males to 485 females.<sup>1,2</sup> 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 uncertain but a large number of factors have been proposed.<sup>3</sup> These include stress, which decreases M/F,<sup>4</sup> and long-duration warfare (e.g., the World Wars), which increases M/F.<sup>5</sup> The ratio may also exhibit slow secular changes.<sup>6</sup>

The Chinese zodiac (Shēngxiào, Chinese: 生肖) is annually related to different animals on the basis of a 12-year

cycle. These animals are the Dog, Dragon, Goat, Horse, Monkey, Ox, Pig, Rabbit, Rat, Rooster, Snake, and Tiger. Each animal has specific attributes, some of which may be desirable while some are not. The Chinese zodiac retains its popularity in various East Asian countries, including not only China and the Hong Kong Special Administrative Region of the People's Republic of China (henceforth referred to as Hong Kong) but also Vietnam, Korea, Taiwan, and Japan.<sup>7</sup>

This study identified secular trends in M/F in Hong Kong from a World Health Organization dataset that includes the past 50 years, with particular attention to the effect of the Chinese Zodiac on M/F in Hong Kong.

## 2. Methods

Annual male and female live births were obtained directly from the World Health Organization.

Conflicts of interest: The author declares that there are no conflicts of interest related to the subject matter or materials discussed in this article.

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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.<sup>8</sup> 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.<sup>9</sup> This add-in is based on the original work by Cochran and Armitage (Dr. Peter Slezák, Institute of Normal and Pathological Physiology, Slovak Academy of Sciences, personal communication).<sup>10,11</sup>

Years of interest were compared with years in close proximity in order to avoid the confounding effects of secular shifts in M/F that are known to occur over long time periods.<sup>6</sup>

SPSS version 22 (SPSS Inc., Chicago, IL, USA) was used to calculate Pearson correlations. A  $p$  value  $\leq 0.05$  was taken to represent a statistically significant result.

### 3. Results

There were 3,827,347 live births available for analysis over the period 1960–2009 (1,982,156 boys and 1,845,191 girls), with an overall M/F of 0.5184 [95% confidence limits (CL) 0.5179–0.5174].

Five-year live births and corresponding M/F are summarized in Table 1. M/F remained overall stable within a relatively narrow range except for a rise commencing in 2004. Similarly, there was a slow decline in the total number of births, which was reversed in 2004.

Inspection of annual data shows peaks in M/F in the years 1975–76, 1988, and 2000 (Fig. 1). These years exhibit the highest M/F in their respective preceding and following 5-year periods. M/F for the sum of 1975–76 was significantly higher than that for 1973–4 (Table 2). For 1988 and 2000, these M/F peaks were smaller, and when compared to adjacent years, were not higher at statistically significant levels. However, when the sum of these years was compared to the sums of their preceding and following years, a significantly higher M/F was found (Table 2). The peak M/F was associated with a rise in total births (Table 3).

The rise in M/F from 2003 to 2009 was statistically significant ( $x$  trend 57.0,  $p < 0.001$ ). M/F prior to this period (1960–2003) was 0.5167 (95% CL 0.5172–0.5161).

For the period 1960–2009, there was a significant negative correlation between M/F and total births ( $r = -0.31$ ,  $p = 0.02$ ). When the period after the sharp rise in 2003 was eliminated, the correlation was even more significant

(excluding 2004–2009,  $r = -0.51$ ,  $p < 0.0001$ ; Fig. 1). For the period 2004–2009, M/F and total births paralleled each other.

### 4. Discussion

The Hong Kong dataset may be divided into two eras, with a watershed occurring around the year 2003. This is because after this period, M/F is skewed due an influx of mainland Chinese mothers and provides a clear example of how sex preference and national legislation may impact not only on countries in which such preferences exist and such legislation is enacted, but also on neighboring countries.

The increase in M/F in Hong Kong since 2003 has been linked to an increase in births due to mothers moving to Hong Kong from Mainland China in order to give birth, since this confers a variety of advantages.<sup>12</sup> This trend was encouraged by the *Right to Abode* legislation enacted that same year in Hong Kong, giving children born in Hong Kong an automatic right to live in Hong Kong.<sup>13,14</sup>

The phenomenon is nontrivial and is so overwhelming that it almost precludes additional analyses. Indeed, the increase in Mainland Chinese mothers climbed from 16.2% in 2000 to 45.4 in 2009.<sup>13</sup> This influx was of sufficient magnitude to reverse a previously declining trend in total births in Hong Kong, which had declined from 68,615 to 46,962 between 1995 and 2003, steeply climbing thereafter and exceeding 82,095 in 2009 (Fig. 1).<sup>12</sup> Mainland Chinese mothers delivering in Hong Kong were noted to have increased in all categories, including mothers residing legally in Hong Kong and those recorded as transient or illegal immigrants.<sup>12</sup> Interestingly, all the while, total births to Hong Kong mothers continued to decline.<sup>12</sup> It is for this reason that, for the period 2004–2009, M/F and total births paralleled each other.

Sex analysis of these births reinforces the contention that these trends are driven by extant family planning restrictions in Mainland China. For the period 2003–2007, M/F was significantly higher at all parities for Mainland Chinese mothers than for Hong Kong resident mothers.<sup>12</sup>

For the period 1960–2009, there was a significant negative correlation between M/F and total births, and this correlation was even stronger when the analysis was restricted to the era prior to 2003. This is an unexplained finding as extant studies have failed to reveal such a correlation.<sup>1,2</sup>

Table 1  
Five-year total live births and M/F for Hong Kong, 1960–2009.

|       | 1960–1964 | 1965–1969 | 1970–1974 | 1975–1979 | 1980–1984 | 1985–1989 | 1990–1994 | 1995–1999 | 2000–2001 | 2005–2009 |
|-------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| M     | 286,425   | 229,641   | 203,664   | 204,279   | 215,423   | 187,811   | 184,183   | 154,251   | 100,603   | 187,690   |
| F     | 268,655   | 215,521   | 191,698   | 190,400   | 202,847   | 176,171   | 171,453   | 142,971   | 93,261    | 166,680   |
| Total | 555,080   | 445,162   | 395,362   | 394,679   | 418,270   | 363,982   | 355,636   | 297,222   | 193,864   | 354,370   |
| UCI   | 0.51732   | 0.51733   | 0.51669   | 0.51914   | 0.51655   | 0.51761   | 0.51954   | 0.52077   | 0.52116   | 0.53129   |
| M/F   | 0.51601   | 0.51586   | 0.51513   | 0.51758   | 0.51503   | 0.51599   | 0.51790   | 0.51898   | 0.51894   | 0.52964   |
| LCI   | 0.51469   | 0.51439   | 0.51357   | 0.51602   | 0.51352   | 0.51436   | 0.51625   | 0.51718   | 0.51671   | 0.52800   |

F = female; LCI = lower confidence interval; M = male; UCI = upper confidence interval.

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