Sex selective termination of pregnancy: an underestimated problem

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Declaration of Interest

• Professor emeritus at Maastricht University
• Editor-in-Chief, Human Reproduction: honorarium

• No payment or services from a third party (government, commercial, private foundation) for any aspect of the presented work (including but not limited to grants, data monitoring board, study design, manuscript preparation, statistical analysis)
• No financial relationships (regardless of amount of compensation) for any aspect outside the presented work with a third party during the 36 months prior to this presentation.
“The birth of a son enhances my status, that of a girl lowers my head”

Indian father, quoted in Dagar (2007)
2 remarkably consistent and poorly understood features of human biology

1. Male-biased sex ratio at birth
2. Female survival advantage throughout life

Austad: The human prenatal sex ratio: A major surprise. PNAS 2015;112:4839-4840
Harbin, China, 2014

Class of 36 children
- 15 girls
- 21 boys

N.S.

Sex ratio 1.40
Overview

• **Sex selection, the facts**

• **Tradition**
  • Male preference

• **Decreasing fertility**
  • Sociocultural determinants: male inheritance
  • Political determinants: one-child policy
  • Developmental determinants: older mothers

• **Opportunity**
  • Laid-back attitude towards abortion

• **Medical feasibility**
  • Easy access to diagnosis (U/S, fetal DNA)
  • Easy access to therapy (abortion; misoprostol/mifepristone)
Overview

• **Sex selection, the facts**
  • Tradition
    • Male preference
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    • Developmental determinants: older mothers
  • Opportunity
    • Laid-back attitude towards abortion
  • Medical feasibility
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# Definitions

<table>
<thead>
<tr>
<th>Type</th>
<th>Ratio</th>
<th>Point in time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Primary sex ratio</td>
<td>1.07-1.70</td>
<td>Conception</td>
</tr>
<tr>
<td>2 Secondary sex ratio</td>
<td>1.05</td>
<td>Birth</td>
</tr>
<tr>
<td>3 Tertiary sex ratio</td>
<td>1.01</td>
<td>Adult</td>
</tr>
<tr>
<td>4 Quarternary sex ratio</td>
<td>0.80</td>
<td>Post-reproductive period</td>
</tr>
<tr>
<td>5 Quinternary sex ratio</td>
<td>0.20</td>
<td>Centigenarians</td>
</tr>
</tbody>
</table>

Sex ratio: \[
\frac{n \text{ males}}{n \text{ females}}
\]
Table S6. Birth sex ratios for ART conceptions and for natural conceptions in Australia and New Zealand between 1979 and 2011

<table>
<thead>
<tr>
<th>Year</th>
<th>ART Sex ratio</th>
<th>Males</th>
<th>Females</th>
<th>Natural Sex ratio</th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>1991</td>
<td>0.516*</td>
<td>3,554</td>
<td>3,329</td>
<td>0.516</td>
<td>128,738</td>
<td>120,972</td>
</tr>
<tr>
<td>1992</td>
<td>0.528</td>
<td>702</td>
<td>628</td>
<td>0.514</td>
<td>134,317</td>
<td>126,961</td>
</tr>
<tr>
<td>1993</td>
<td>0.529</td>
<td>807</td>
<td>719</td>
<td>0.515</td>
<td>133,289</td>
<td>125,480</td>
</tr>
<tr>
<td>1994</td>
<td>0.515</td>
<td>1,029</td>
<td>968</td>
<td>0.515</td>
<td>133,525</td>
<td>125,583</td>
</tr>
<tr>
<td>1995</td>
<td>0.498</td>
<td>1,216</td>
<td>1,226</td>
<td>0.514</td>
<td>132,492</td>
<td>125,031</td>
</tr>
<tr>
<td>1996</td>
<td>0.514</td>
<td>1,416</td>
<td>1,340</td>
<td>0.515</td>
<td>130,367</td>
<td>123,279</td>
</tr>
<tr>
<td>1997</td>
<td>0.523</td>
<td>1,993</td>
<td>1,815</td>
<td>0.514</td>
<td>129,514</td>
<td>122,708</td>
</tr>
<tr>
<td>1998</td>
<td>0.521</td>
<td>2,174</td>
<td>1,999</td>
<td>0.513</td>
<td>128,928</td>
<td>122,340</td>
</tr>
<tr>
<td>1999</td>
<td>0.516</td>
<td>2,443</td>
<td>2,287</td>
<td>0.513</td>
<td>129,714</td>
<td>122,913</td>
</tr>
<tr>
<td>2000</td>
<td>0.512</td>
<td>2,699</td>
<td>2,571</td>
<td>0.514</td>
<td>129,407</td>
<td>122,502</td>
</tr>
<tr>
<td>2001</td>
<td>0.511</td>
<td>3,543</td>
<td>3,386</td>
<td>0.514</td>
<td>130,647</td>
<td>123,581</td>
</tr>
<tr>
<td>2002</td>
<td>0.506</td>
<td>3,836</td>
<td>3,739</td>
<td>0.513</td>
<td>127,263</td>
<td>120,788</td>
</tr>
<tr>
<td>2003</td>
<td>0.509</td>
<td>4,022</td>
<td>3,887</td>
<td>0.515</td>
<td>128,375</td>
<td>120,867</td>
</tr>
<tr>
<td>2004</td>
<td>0.512</td>
<td>4,745</td>
<td>4,515</td>
<td>0.513</td>
<td>134,047</td>
<td>127,035</td>
</tr>
<tr>
<td>2005</td>
<td>0.507</td>
<td>5,091</td>
<td>4,942</td>
<td>0.516</td>
<td>139,208</td>
<td>130,733</td>
</tr>
<tr>
<td>2006</td>
<td>0.510</td>
<td>5,580</td>
<td>5,362</td>
<td>0.514</td>
<td>144,397</td>
<td>136,630</td>
</tr>
<tr>
<td>2007</td>
<td>0.513</td>
<td>5,952</td>
<td>5,661</td>
<td>0.514</td>
<td>145,444</td>
<td>137,641</td>
</tr>
<tr>
<td>2008</td>
<td>0.521</td>
<td>6,814</td>
<td>6,256</td>
<td>0.514</td>
<td>145,786</td>
<td>137,705</td>
</tr>
<tr>
<td>2009</td>
<td>0.521</td>
<td>6,263</td>
<td>5,756</td>
<td>0.511</td>
<td>145,807</td>
<td>139,401</td>
</tr>
<tr>
<td>2010</td>
<td>0.521</td>
<td>6,446</td>
<td>5,936</td>
<td>0.514</td>
<td>147,489</td>
<td>139,638</td>
</tr>
<tr>
<td>Total</td>
<td>0.515</td>
<td>70,325</td>
<td>66,322</td>
<td>0.514</td>
<td>2,827,761</td>
<td>2,672,706</td>
</tr>
</tbody>
</table>


**Sex Ratio at Birth after ART**

# Sex ratio at birth

<table>
<thead>
<tr>
<th>Fertilization</th>
<th>Ratio</th>
<th>Moment of transfer</th>
</tr>
</thead>
<tbody>
<tr>
<td>IVF</td>
<td>1.03</td>
<td>Cleavage stage transfer</td>
</tr>
<tr>
<td>IVF</td>
<td>1.25</td>
<td>Blastocyst stage transfer</td>
</tr>
<tr>
<td>ICSI</td>
<td>0.95</td>
<td>Cleavage stage transfer</td>
</tr>
<tr>
<td>ICSI</td>
<td>1.04</td>
<td>Blastocyst stage transfer</td>
</tr>
<tr>
<td>Natural</td>
<td>1.05</td>
<td>-</td>
</tr>
</tbody>
</table>

Sex ratio: $\frac{n_{males}}{n_{females}}$

Johann Peter Süßmilch (1741)

“The extra percentage of boys compensates for:

• Higher losses due to recklessness
• Exhaustion
• Dangerous tasks
• War
• Sailing
• Emigration

..... thus maintaining the balance between sexes so that everyone can find a spouse at the appropriate time for marriage”
History of the Financial Crisis: Mid-2007 to 2010

- **Dec. 12, 2007**: Fed establishes first liquidity facility and first currency swap lines with other central banks.
- **Sept. 2008**: Fannie Mae and Freddie Mac conservatorship, Lehman Bros. bankruptcy, AIG stabilization effort, Treasury guarantees money market mutual funds.
- **Jan. 20, 2009**: President Obama takes office.
- **Mar. 3, 2009**: TALF program launched to help revive credit markets.
- **Mar. 23, 2009**: PPIP program announced to help revive mortgage finance market.
- **Jun. 2009**: First large banks repay TARP funds, GM and Chrysler complete restructuring.
- **Sep. 27, 2010**: Small Business Jobs Act enacted, creating the Small Business Lending Fund (SBLF) and State Small Business Credit Initiative (SSBCI).
- **Oct. 3, 2010**: Authority to make new commitments under TARP ends.

Monthly M/F for the United States in 2007, as well as the first and second halves of 2007.
Sex ratio at birth

<table>
<thead>
<tr>
<th>Country/region</th>
<th>at birth (CIA estimate)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liechtenstein</td>
<td>1.26</td>
</tr>
<tr>
<td>Azerbaijan</td>
<td>1.13</td>
</tr>
<tr>
<td>Armenia</td>
<td>1.124</td>
</tr>
<tr>
<td>China</td>
<td>1.12</td>
</tr>
<tr>
<td>India</td>
<td>1.12</td>
</tr>
<tr>
<td>Vietnam</td>
<td>1.12</td>
</tr>
<tr>
<td>Albania</td>
<td>1.118</td>
</tr>
<tr>
<td>Georgia</td>
<td>1.113</td>
</tr>
<tr>
<td>Grenada</td>
<td>1.098</td>
</tr>
<tr>
<td>San Marino</td>
<td>1.09</td>
</tr>
<tr>
<td>Taiwan</td>
<td>1.09</td>
</tr>
<tr>
<td>Jersey</td>
<td>1.08</td>
</tr>
<tr>
<td>Macedonia</td>
<td>1.08</td>
</tr>
<tr>
<td>Singapore</td>
<td>1.08</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>1.075</td>
</tr>
<tr>
<td>Bosnia and Herzegovina</td>
<td>1.074</td>
</tr>
<tr>
<td>Montenegro</td>
<td>1.072</td>
</tr>
<tr>
<td>Faroe Islands</td>
<td>1.071</td>
</tr>
<tr>
<td>World</td>
<td>1.07</td>
</tr>
</tbody>
</table>
3 Preconditions for sex selective abortion

**Sex selection should be:**

1. **Advantageous:**
   - having boys beneficial.

2. **Necessary:**
   - small-family size mandatory. If not, additional births achieve gender objective.

3. **Feasible:**
   - easy access to acceptable and efficient methods

(UNFPA, 2012)
1981-2015
One child policy
Birth sex ratios in China since the One-Child Policy.

Poston, D.L., Jr., et al - "China's unbalanced sex ratio at birth, millions of excess bachelors and societal implications"
Sex selection

• Female infanticide
• Late pregnancy termination
• Early pregnancy termination
• Pre-implantation selection
Advantages

• Single child policy has prevented over 400 million births.
• It has been proven successful in cities and has provided a better education for many children
• It allows parents to spend much more time and energy on their child.
• Families that have supported the family planning policy will receive benefits from the Chinese Government such as health care and education.
Disadvantages

• Many reported stolen children: over 70,000 children are kidnapped every year.
• Single children: difficult to make friends, feel lonely because they have no brother or sisters.
• Government Officials lose their job if they have more than one child.
• Chinese culture traditionally prefers boys
• Sex selective abortion - significantly more men than women.
• Baby girls being killed, sold, or put up for adoption.
• China’s population is living longer. The first children born under the one-child policy face the prospect of caring for an increasing number of pensioners.
• Men who can’t find wives due to gender imbalance.
Why Chinese men are the most single in the world
Overview

• Sex selection, the facts
• **Tradition**
  • Male preference
• Decreasing fertility
  • Sociocultural determinants: male inheritance
  • Political determinants: one-child policy
  • Developmental determinants: older mothers
• Opportunity
  • Laid-back attitude towards abortion
• Medical feasibility
  • Easy access to diagnosis (U/S, fetal DNA)
  • Easy access to therapy (abortion; misoprostol/mifepristone)
In *traditional* societies there is a strong male child preference. Or is it?
How much more likely is it that parents of solely girls will have another child than parents of solely boys?

By family size:

0% more likely for parents of 1 girl vs. 1 boy
2% more likely for parents of 2 girls vs. 2 boys
3% more likely for parents of 3 girls vs. 3 boys
5% more likely for parents of 4 girls vs. 4 boys
Suppose you could have only one child. Would you prefer it to be a boy or a girl?

<table>
<thead>
<tr>
<th>Preference</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>Girl</td>
<td>19 %</td>
<td>35 %</td>
</tr>
<tr>
<td>Boy</td>
<td>48 %</td>
<td>30 %</td>
</tr>
<tr>
<td>No preference</td>
<td>33 %</td>
<td>35 %</td>
</tr>
</tbody>
</table>

Gallup Poll in 2000 and 2003
Suppose you could only have one child. Would you prefer that it be a boy or a girl?

<table>
<thead>
<tr>
<th>Year</th>
<th>Boy</th>
<th>Girl</th>
<th>Either/Doesn't Matter (vol.)</th>
<th>Not Sure</th>
<th>No Opinion</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011 Jun 9-12</td>
<td>40</td>
<td>28</td>
<td>26</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2007 Jun 11-14</td>
<td>37</td>
<td>28</td>
<td>26</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>2003 Jul 18-20</td>
<td>38</td>
<td>28</td>
<td>27</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>2000 Dec 2-4</td>
<td>42</td>
<td>27</td>
<td>25</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>1997 May 6-7</td>
<td>36</td>
<td>23</td>
<td>38</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>1997 Feb 24-26 ^</td>
<td>41</td>
<td>29</td>
<td>25</td>
<td>--</td>
<td>5</td>
</tr>
<tr>
<td>1996 Feb 23-25 ^</td>
<td>41</td>
<td>31</td>
<td>25</td>
<td>--</td>
<td>3</td>
</tr>
<tr>
<td>1990 Apr 19-22 †</td>
<td>38</td>
<td>34</td>
<td>24</td>
<td>--</td>
<td>4</td>
</tr>
<tr>
<td>1947 Sep 12-17 †</td>
<td>40</td>
<td>25</td>
<td>27</td>
<td>--</td>
<td>8</td>
</tr>
<tr>
<td>1941 Mar 21-26 ‡</td>
<td>38</td>
<td>24</td>
<td>23</td>
<td>--</td>
<td>15</td>
</tr>
</tbody>
</table>

(vol.) = Volunteered response

^ If you were to have a child right now, would you rather have a boy or a girl?
† If you had another child would you rather have a boy or a girl?
‡ If you could have only one (one more) child, which would you prefer to have -- a boy, or a girl?
U.S. Census, 1940 - 2000

How much more likely is it that parents of all girls will have another child than parents of all boys?

By ethnicity:
- **2%** for Whites
- **1%** for Blacks
- **17%** for Asian-Americans
- **1%** other ethnicities
India's Sex Ratio at Birth

Boys per 100 Girls

- 1990
- 2005

- 1st child: 106, 104
- 2nd child, after 1 girl: 110, 120
- 3rd child, after 2 girls: 113, 130
Overview

• Sex selection, the facts
• Tradition
  • Male preference

**Decreasing fertility**
  • Sociocultural determinants: male inheritance
  • Political determinants: one-child policy
  • Societal determinants: older mothers

• Opportunity
  • Laid-back attitude towards abortion

• Medical feasibility
  • Easy access to diagnosis (U/S, fetal DNA)
  • Easy access to therapy (abortion; misoprostol/mifepristone)
“Sex selective abortion serves as a quiet way to deal with overpopulation”

The Conflict

• State: Do not reproduce
• Family: Produce a son

The Solution

• Woman: Sex selective abortion
China’s National Population and Family Planning Commission:

“Better to let blood flow like a river than to have one more than allowed”

“You can beat it out, you can make it fall out, you can abort it, but you cannot give birth to it”

“If you can have only one, it better be the right one”

Overview

• Sex selection, the facts
• Tradition
  • Male preference
• Decreasing fertility
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  • Easy access to therapy (abortion; misoprostol/mifepristone)
BOY-GIRL RATIO AT BIRTH & FERTILITY RATE

TRENDS IN THE SEX RATIO AT BIRTH AND THE TOTAL FERTILITY RATE IN ARMENIA

Data shows the boy-girl ratio at birth has been increasing since the early 1990s, just as the fertility rate declined.

Note: Sex ratio at birth (SRB) = number of boys born / number of girls born
Overview

- Sex selection, the facts
- Tradition
  - Male preference
- Decreasing fertility
  - Sociocultural determinants: male inheritance
  - Political determinants: one-child policy
  - Developmental determinants: older mothers
- Opportunity
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- **Medical feasibility**
  - Easy access to diagnosis (U/S, fetal DNA)
  - Easy access to therapy (abortion; misoprostol/mifepristone)
Non-Invasive Prenatal Testing (NIPT)

Cell-free fetal DNA in maternal blood
20 ml blood from week 10
1981 China one-child policy

1991 Collapse Soviet Union
TRADITION
Male child preference

DECREASED FERTILITY
- One-child policy
- Economic reasons
- Older mothers

OPPORTUNITY
Laid-back attitude towards abortion

MEDICAL FEASIBILITY
- Cheap U/S
- Fetal DNA
- Mife/Miso
One lucky guy:

Shanghai marriage market at people’s square
The risks

• Major disruptions traditional family structure
• Shortage of young nubile women
• Increased violence against women
• Increased prostitution
• Increasing number of sexual assaults and rapes
• More aggressive males; fighting clubs (fenquing)
• More risky behaviour of men
• Women trafficking
• Social turmoil
Guang-gun (bare branches at the family tree)
Malang (aloof and loopy)
135 million *missing women* in 2010

<table>
<thead>
<tr>
<th>Women in</th>
<th>If SRB 1.05</th>
<th>Factual</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>735</td>
<td>655</td>
<td>80 million women</td>
</tr>
<tr>
<td>India</td>
<td>626</td>
<td>571</td>
<td>55 million women</td>
</tr>
</tbody>
</table>

*135 million women*

After: UN Population Fund, 2012
The marriage squeeze: Sex ratio of those wanting to marry

Number of men expected to want to marry per 100 women expected to want to marry, forecast

Worst case*:
- India
- China

Best case†:
- 160 million missing women

Sex ratio at birth: *stays at 120 for China, 113 for India
†returns to 105 in 2020

Sources: Christophe Guilmoto; National Bureau of Statistics; Census of India

†Five-year moving average
§Three-year moving average from 2001
In Conclusion

• Male preference in (traditional) society
• Natural sex ratio at birth (SRB) is 1.05
• Worldwide SRB 1.07
• SRB over 1.10 is artificial (Sex selective procedures)
• Far East, Caucasus, Balkan, US Orientals
• Tradition + Decreased Fertility + Opportunity + Medical Feasibility
• 160 – 190 million missing women
• Social crisis scenario
Social crisis scenario

- Education of society: accept women as equals
- Remove cultural & religious barriers (involve men)
- Teaching & training of women
- Making women economically empowered and independent in society
- Change in mentality and attitude regarding male child preference
- Outlaw sex selective abortion
- Fischer principle: self-correction, girls in higher demand
“It’s no problem to have fewer children, as long as you have at least a son”

American Population Council, 1972

2017: no problem? We will see.