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# Women in science: Under-represented and under-measured

*This issue of the UNESCO Institute for Statistics (UIS) Bulletin on Science and Technology Statistics examines women's participation in the research profession and different stages of higher education. It draws on data from the UIS database and is published in collaboration with the Institut National de la Recherche Scientifique (INRS, Montreal, Canada).*

Despite the growing demand for cross-nationally comparable statistics on "women in science", national data and their use in policymaking often remain limited.

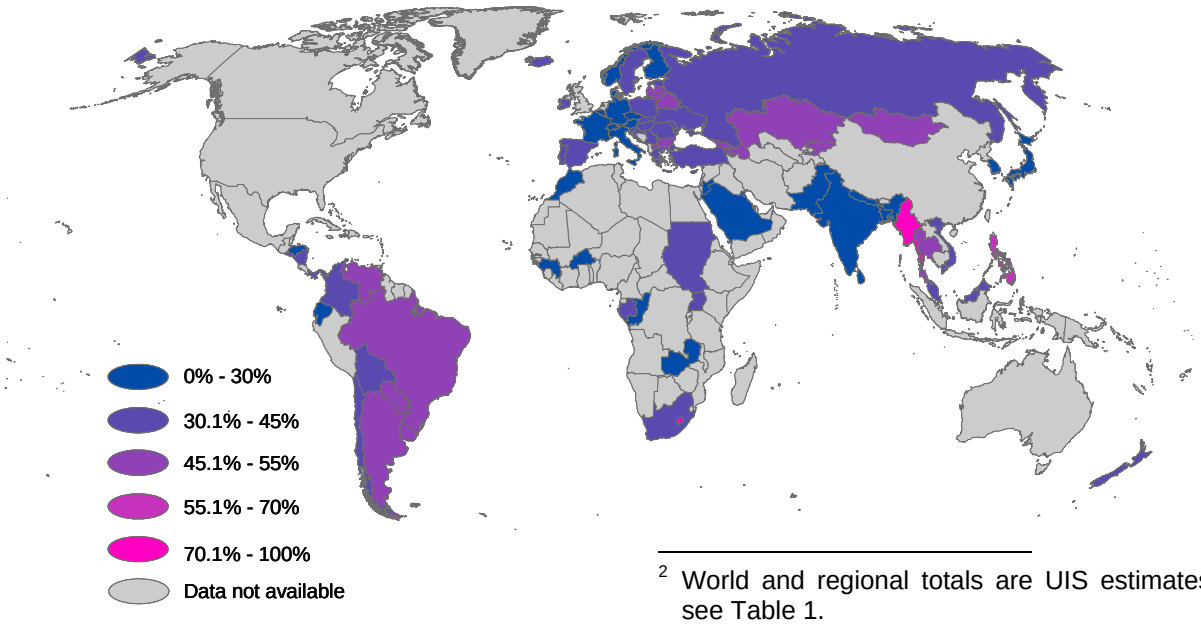
Available information shows clearly that women and men move along different career paths through higher education and research.

Indeed the UNESCO Education for All (EFA) Global Monitoring Report 2003/4[1] has shown the extent of gender differences in primary and secondary education, which can ultimately hinder equal participation in higher education and equal access to opportunities later in life.

## Women in research and development

It is estimated that women constitute only slightly more than one-quarter of the world's researchers,[2] although there are many countries for which data are lacking.[3] In 34

**Figure 1. Women as a share of the total number of researchers (headcount), 2003**




**Source:** UNESCO Institute for Statistics, May 2006

[1] Available at www.efareport.unesco.org.

[2] World and regional totals are UIS estimates, see Table 1.

[3] This includes countries with a significant number of researchers, such as Australia, Canada, China, Mexico, the United Kingdom and the United States of America.

of the 89 countries with available data,[4] women represent less than 30% of researchers. In 69 countries, women represent less than 45% of researchers. Only 17 – or 18% of countries - have achieved gender parity.[5] However, significantly more women than men are working as researchers in three countries (*see* ***Figure 1 and Table 1***).

In Latin America and the Caribbean, 46% of researchers are women, exceeding the world average. One-third of the countries have achieved gender parity. This includes Argentina, Brazil and Venezuela, which are among the most populous in the region and have the largest numbers of researchers. One-half of the countries in the region present a moderate male predominance (30% to 45% of researchers are women). Men account for more than 70% of researchers only in countries with significantly smaller research communities, namely Ecuador, Honduras and the U.S. Virgin Islands.

In Asia, on the other hand, women constitute only 15% of researchers.[6] While 28% of countries achieved gender parity in 2003, a markedly heterogeneous picture emerges across the continent. Less than 30% of researchers are female in all countries with available data in South Asia, the region's Arab States as well as Japan and R. of Korea. South Asia in particular has the lowest rate of 12%, mostly due to India, where only 10% of researchers are women.

In contrast, all Central Asian countries with data report gender parity, which is well above the global average. In South East Asia, the total share is 42%, ranging from 11% in Macao (China) to 55% in the Philippines and 85% in Myanmar, which has the world's highest proportion of women researchers.

In Europe, 32% of researchers are women, with only five countries reaching gender parity. In particular, in Western and Central Europe[7] only two countries –- Latvia and Lithuania – report gender parity. Overall more than 70% of researches are male in 11 countries of this region, out of the 25 with available data. A more balanced situation is found in the remaining (Southeast and East) European countries, where women account for 43% of researchers. Gender parity has been reported in Belarus, Bulgaria and the Former Yugoslav Republic of Macedonia, highlighting a trend found in many formerly socialist states. In the Commonwealth of Independent States (CIS), women's participation in research is significantly higher (44%) than that of the world average.

In Africa, it is estimated that about 29% of researchers are women. In just over one-half of countries with available data, they represent less than 30% of researchers. Cape Verde is the only country in the region to report gender parity. In contrast, Lesotho has the second highest share (76%) of female researchers in the world.

### Women in private sector research

Studies have found that women are less likely than men to be employed in the private sector (business enterprise) of research and experimental development (R&D) than the public sector. Some have concluded that the significant share of business enterprise in R&D may explain the relatively low percentages of female researchers. For example, women account for 28% of all researchers in the EU. However, this share rises to 34% for R&D undertaken by government and higher education.

[4] Figures in this bulletin are based on the number of countries with available data (amounting to 89 for "researchers" and a varying number for the other indicators presented). This discrepancy may limit the level of interpretation, which highlights the need for more data from more countries.

[5] As defined here, gender parity ranges from 45% to 55% for either sex.

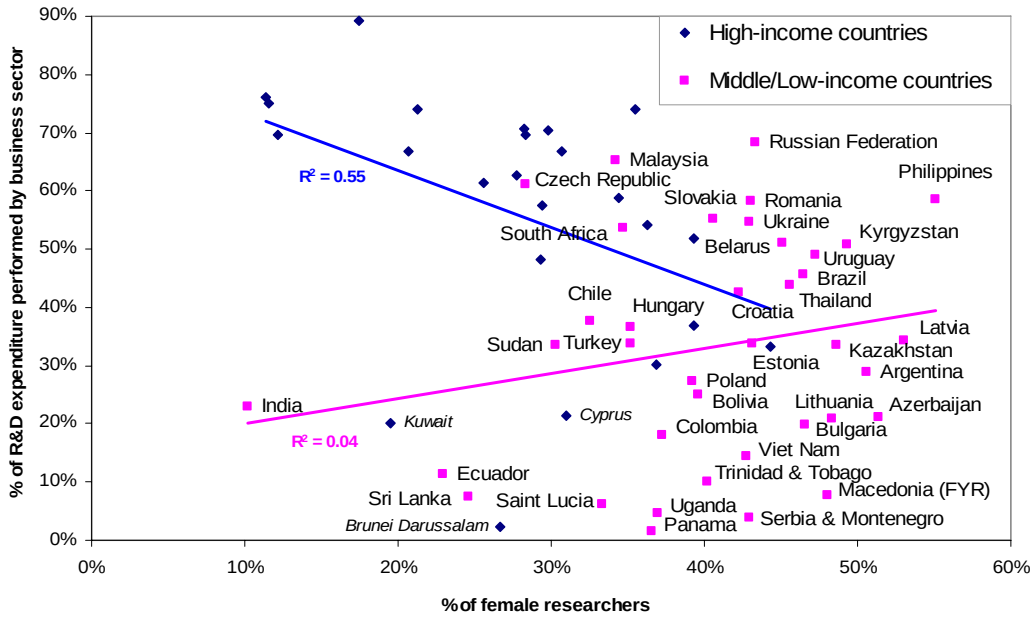
[6] No data are available for China.

[7] European Union (EU) and European Free Trade Agreement (EFTA) countries.

This share is nearly twice that of business enterprise R&D (18%).[8]

**Figure 2** shows that this hypothesis seems to be accurate for high-income countries. However, middle and low-income countries present a more scattered pattern, with little correlation between female participation and the scale of business enterprise research. It is important to note that the variable coverage of private sector R&D statistics in developing countries might be influencing these results. Further studies in this area are clearly needed.

**Figure 2. Relationship between the % of women researchers and business enterprise performed R&D expenditure (as a % of total R&D expenditure), 2003**




**Source:** UNESCO Institute for Statistics, 2006

## Divergent paths through higher education[9]

Analysis of the stock and breakdown by sex of researchers raises questions concerning future trends. The current stock of researchers is the result of the accumulated flow of graduates and variations in the labour market over the last four decades.

To gain insight into the potential flow of highly-qualified people into research, this section will analyse current higher education statistics (given that a higher education qualification normally forms the basis for a research career). The evidence presented can be seen as a sign of the future evolution of the gender-balance in the research profession. The divergent paths discussed below may raise concern as many countries aim to substantially increase the participation of women in research and development.

In 2003, less than one-third of countries reported gender parity among university students enrolled in **first degree courses**[10] (leading to a Bachelor's degree or similar qualifications). The remaining countries are split almost evenly into two groups favouring either women or men in terms of enrolment at this level. Yet, when looking specifically at enrolment in science and engineering (S&E)[11] fields, only three out of 47 countries

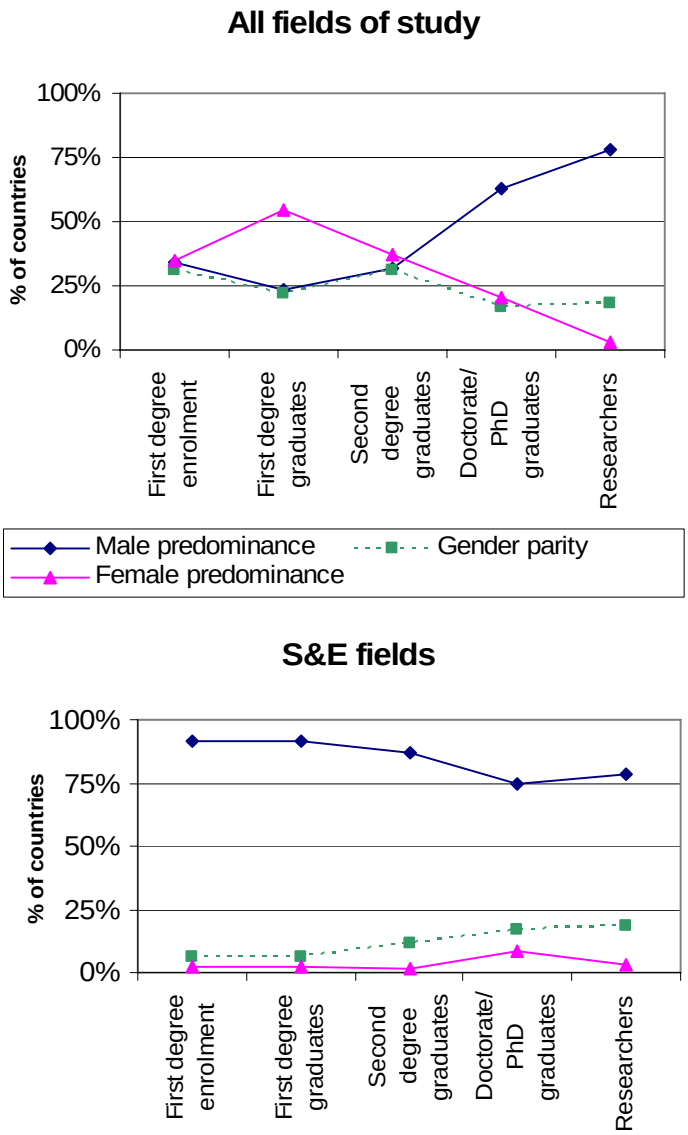
[8] However, growth rates during 1999-2003 were generally higher for women than for men, particularly in industrial research.

[9] This section is based on a chapter drafted for UNESCO's *International Report on Science, Technology and Gender* (2006). Levels of education described are based on the International Standard Classification of Education 1997 (ISCED97), available at www.uis.unesco.org/publications/ISCED97.

[10] Corresponding to ISCED97 level 5A, first degree.

[11] S&E includes the following ISCED97 fields of education: *science* (life sciences, physical sciences, mathematics and statistics, computing), and *engineering, manufacturing and construction* (engineering and engineering trades, manufacturing and processing, architecture and building).

**Figure 3. "Scissors diagram": percentage of countries with gender parity[5] or disparities by level of education, 2003**




**Source:** UNESCO Institute for Statistics, 2005

with available data for this breakdown attained gender parity. In 43 countries (91%), men clearly outnumber women in these fields of study.

In terms of first degree graduates, almost one-quarter (22%) of the countries report gender parity. In more than one-half of the countries (54%), women represent over 55% of the total graduates at this level. These shares are higher than those for enrolment. Yet, when the analysis is limited to S&E fields, men once again outnumber women in terms of graduates.

At the next stage of higher education, gender parity is reported among **second degree graduates**[12] (e.g. Master's degree) in almost one-third of the countries. There are therefore fewer countries in which female graduates predominate than at the first degree level.

In **S&E fields**, however, similar patterns are found for first and second degree graduates (women are slightly better represented among the latter in more countries). This is not surprising because second degrees appear to be increasingly important in S&E careers. At the same time, the fact that in many countries there are proportionally more female second degree graduates than at the first degree level seems to strengthen the hypothesis that women still perform better and drop out less than men, particularly in the early stages of higher education.

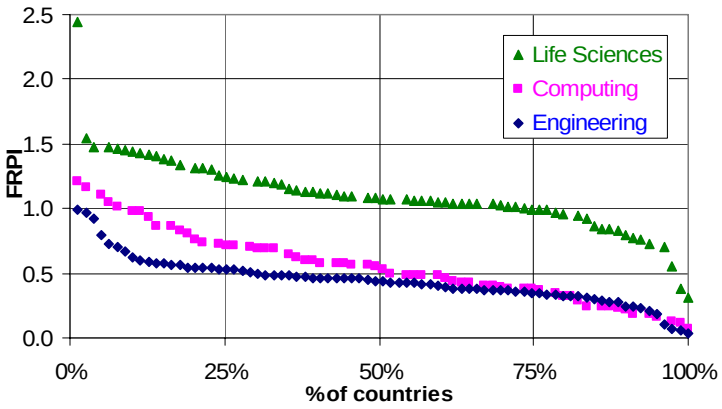
The downward trend in the share of women graduating from the previously discussed levels of education clearly results in male predominance at the level of **doctorates, PhDs or other advanced research degrees**.[13] Only 20% of countries have significantly more women than men graduating from doctorate programmes. This is the case for just 8% of countries, when looking specifically at S&E fields. Overall, 17% of countries have reached gender parity at this level, with no significant variations reported between S&E or all fields of study.

[12] Corresponding to ISCED97 level 5A, second degree.
[13] Corresponding to ISCED97 level 6.

All available evidence shows that the gender gap intensifies at the advanced levels of higher education, following a "scissors diagram" type of pattern (*see **Figure 3***). Yet the gaps are so wide in S&E fields that this pattern fades altogether.

It is important to note that, when running linear regression to the available data on graduates of the various levels, the data presented do not provide a statistically significant predictor of the percentage of women in research in a given country. However, a longer time series on higher education statistics may shed light on the relevance of the gender structure in higher education vis-à-vis the characteristics of the stock of researchers.

**Figure 4: Field Relative Parity Indices (FRPI) for first degree graduates in engineering, computing & life sciences, 2003**




**Source:** UNESCO Institute for Statistics, 2004

***Field Relative Parity Index (FRPI) for field X =***

$$\frac{\text{share (\%) of female graduates in field X}}{\text{share (\%) of female graduates in all fields}}$$

| | |
|---|---|
| *FRPI > 1* | *field X has a higher proportion of female graduates than the total for all fields.* |
| *FRPI < 1* | *field X has a lower proportion of female graduates than the total for all fields.* |
| *FRPI ~= 1* | *field X has a similar proportion of female graduates to the total for all fields.* |

## Gender gaps by field of study

To analyse women's participation by field of science, this section will examine Field Relative Parity Indices (FRPI). These indices reflect female participation in a specific field compared to the national average for all fields at a given level of education. Participation above or below the national average is indicated by an FRPI>1 or FRPI<1.[14]

**Figure 4** presents the comparative FRPIs for all available countries for first degree graduates (ISCED97 5A) in the fields of engineering, computing and life sciences, which were chosen for their gender profile and their key role in R&D. The indices did not reveal any surprising results.

To begin with, the indices for **engineering** graduates do not reveal any surprises: the overwhelming majority of graduates are men. All of the countries with available data[15] report an FRPI below one, with an average of just 0.44. Therefore, female participation in engineering studies is, on average, less than one-half of the total female participation in first degrees across all fields.

In the case of computing, it is fair to say that universities are still 'manning' the information society. FRPI for **computing** is higher or equal to one in only 8% of the countries but lower than 0.25 in 18%. The average of 0.55 is slightly higher than that for engineering, but still shows a high predominance of men in this field.

A different panorama arises in the case of **life sciences**. Almost three-quarters of countries (73%) report an FRPI higher or equal to one, with an average of 1.1. Female graduates are therefore clearly predominant in this field, which includes medicine.[16]

[14] FRPIs applied to the analysis of single countries should not be used independently from the national averages to make national comparisons meaningful.

[15] Please see footnote 4.

[16] The UIS *Global Education Digest 2006* (pp. 19-20) found mixed results for graduates in health welfare and education. (http://www.uis.unesco.org/publications/GED2006).

## Conclusions

Women account for a minority of the world's researchers. This is particularly the case in higher-income countries. The higher percentage of industrial research in these countries provides only a partial explanation of the low degree of women's participation in research. A more gender-balanced workforce is found in Eastern Europe and the CIS, Latin America and the Caribbean, as well as some South East Asian countries.

Overall, the under-representation of women in research activities can be traced back to education systems, particularly at the higher levels. Although female participation in higher education has increased globally over the last decade,[17] it remains weak in the most advanced degree programmes.

It is therefore of foremost importance to further analyse other aspects hindering women's access to, continuity and advancement in research positions. This involves issues related to stereotyping, working conditions (the "work/life" balance), labour market conditions, governance and the role of researchers in society.[18]

The information presented in this bulletin provides an overwhelming case for the importance of the gender dimension in science and technology. Decision-makers in the field of higher education and S&T policy cannot ignore this issue at any level.

This issue of the UIS Bulletin on Science and Technology Statistics has been prepared by the UIS S&T Statistics team, with the collaboration of Benoit Godin (INRS) and Camilla Gidlöf-Regnier (Women & Science Unit, European Commission - DG Research). The authors acknowledge the valuable input of other UIS colleagues.

All issues of the Bulletin on S&T Statistics are available on the UIS website at www.uis.unesco.org.

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[17] UIS *Global Education Digest 2006*, pp. 27-30, see note 14.

[18] For further discussion, please see the *International Report on Science, Technology and Gender*, published by UNESCO in 2006.

## Table 1. Women's share of the total number of researchers (headcount), 2003

| Region/country or territory | Women's share of the total number of researchers (headcount) | | Region/country or territory | Women's share of the total number of researchers (headcount) | | Region/country or territory | Women's share of the total number of researchers (headcount) | |
|---|---|---|---|---|---|---|---|---|
| Argentina | 51% | | Ireland | 31% | | Saudi Arabia | 17% | *2* |
| Armenia | 46% | | Italy | 29% | | Serbia and Montenegro | 43% | *2* |
| Austria | 21% | *2* | Japan | 12% | | Singapore | 26% | *2* |
| Azerbaijan | 51% | *2* | Jordan | 18% | *F, 8* | Slovakia | 41% | |
| Bangladesh | 14% | *U, 7* | Kazakhstan | 49% | *F, 2* | Slovenia | 34% | |
| Belarus | 45% | *2* | Korea (Republic of) | 11% | | South Africa | 35% | *F, 1* |
| Belgium | 28% | | Kuwait | 20% | *2* | Spain | 36% | |
| Bolivia | 40% | *1* | Kyrgyzstan | 49% | *2* | Sri Lanka | 25% | *U, 0* |
| Brazil | 46% | *U, 4* | Latvia | 53% | | Sudan | 30% | *4* |
| Brunei Darussalam | 27% | | Lesotho | 76% | *U, 2* | Sweden | 35% | |
| Bulgaria | 47% | | Lithuania | 48% | | Switzerland | 21% | *0* |
| Burkina Faso | 19% | *F, 7* | Luxembourg | 17% | | Thailand | 46% | |
| Cape Verde | 52% | *2* | Macau (China) | 11% | *F, 0* | Trinidad and Tobago | 40% | |
| Chile | 33% | | Macedonia (FYR) | 48% | *F, 2* | Turkey | 36% | *2* |
| Colombia | 37% | | Malaysia | 34% | *F, 2* | Uganda | 37% | *U, 1* |
| Congo | 13% | *F, 0* | Mauritius | 20% | *7* | Ukraine | 43% | *2* |
| Croatia | 42% | | Moldova (Republic of) | 30% | *2* | Uruguay | 47% | *2* |
| Cyprus | 31% | | Mongolia | 52% | *6* | Viet Nam | 43% | *2* |
| Czech Republic | 28% | | Morocco | 27% | *U, 2* | Virgin Islands (U.S.) | 17% | *2* |
| Denmark | 28% | | Myanmar | 85% | *U, 2* | Venezuela | 46% | |
| Ecuador | 29% | | Nepal | 15% | *2* | Zambia | 14% | *F, 9* |
| El Salvador | 37% | *0* | New Zealand | 39% | *1* | | | |
| Estonia | 43% | | Nicaragua | 42% | *2* | **Regional averages** | | |
| Finland | 30% | | Norway | 29% | | Latin America & Caribbean | 46% | *U* |
| France | 28% | | Pakistan | 18% | *U, 2* | Europe | 32% | *U* |
| Gabon | 31% | *4* | Panama | 37% | | EU/EFTA | 27% | *U* |
| Georgia | 51% | *2* | Paraguay | 50% | *2* | Other Europe | 42% | *U* |
| Germany | 12% | | Philippines | 55% | *2* | Asia | 15% | *U* |
| Greece | 37% | | Poland | 39% | | Central Asia | 50% | *U* |
| Guinea | 6% | *0* | Portugal | 44% | | Arab states in Asia | 18% | *U* |
| Honduras | 27% | | Romania | 43% | | South Asia | 12% | *U* |
| Hungary | 35% | | Russian Federation | 43% | | South East Asia | 42% | *U* |
| Iceland | 39% | | Saint Helena (U.K.) | 25% | *F, 9* | Africa | 29% | *U* |
| India | 10% | *U,F,8* | Saint Lucia | 33% | *U, 9* | World total | 27% | *U* |

Source: UNESCO Institute for Statistics, May 2006. Regional averages are previously unpublished UIS estimates.

Notes:
The reference year is 2003 unless otherwise specified:
4: 2004 2: 2002 1: 2001 0: 2000 9: 1999 8: 1998 7: 1997 6: 1996
F: Full-time equivalent (FTE) instead of headcounts U: UIS estimation
Data are unavailable for countries not presented in this table.