# Gender asymmetry in selection tests at the pre-college level

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There has been an increasing concern regarding the under-representation of women in the Indian scientific workforce[1,2]. The issue of female representation in the competitive exams at the higher secondary school level has also been highlighted in various fora from time to time. However, a systematic study is lacking. In the present article, we present a comparison of gender representation in three national level exams. These exams are conducted at the Higher Secondary School (HSS) level (pre-college level). Two of these exams are extremely competitive, namely the Indian Institute of Technology-Joint Entrance Examination (IIT-JEE) and the Indian National Olympiad (INO) examinations in physics, chemistry and biology. The third is a compulsory examination, namely the Central Board of Secondary Education (CBSE) examination at HSS level, which a student has to clear in order to qualify for higher studies in the university and/or professional institutes.

Our attention was drawn to this issue while we were conducting a comparative study of the student's performance on research-based tests in physics from different countries. One of our aims was to understand how an average group and a high achieving group of Indian students performed on the research-based multiple-choice test compared to the US students[3]. In this context, we uncovered a disturbing but perhaps not so surprising data on female under-representations at the HSS level. There are routine reports of how girls perform better than boys in the State Board and CBSE at the HSS level examinations. We ask ourselves the following question: 'How well are girls represented in the more competitive and coveted examinations?'.

We focus on two prestigious exams as mentioned earlier. The IIT-JEE is the entry point to the prestigious science and technology programme of IIT. The INO examination constitutes the key stage of selection to the Indian team which represents India at the International Olympiad (IO).

Table 1 presents data for CBSE exam at the HSS level for three consecutive years. The raw data has been taken from the CBSE website (www.cbse.nic.in). We note that the total number of girls appearing on an average is approximately 44%. We examine in particular the data on high achieving students. This is because we would be comparing the CBSE performance with competitive exams like IIT and Olympiads. Columns 4 and 5 in Table 1 list the genderwise data for students who have scored more than 90%. This data is heartening. The percentage of girls in the top list is on an average 51 whereas the percentage appearing is 44. We can conclude that CBSE data suggests that girls are well represented in the merit lists. However, this trend is not reflected in the IIT-JEE or Olympiad selection tests.

Table 2 describes the genderwise distribution for IIT-JEE exam. The raw data has been taken from the IIT-JEE website (www.iitb.ac.in). The second column in Table 2 tells us that on an average, 24% of the candidates appearing are girls. However, only 9% of girls are able to make it to the final selection list of IIT. There appears to be a small increase in the percentage of girls appearing (22–26%) and girls selected (8–10%) over the last three years. However at this slow rate, it would take several decades for girls to catch up with boys.

Before proceeding, we acquaint the reader with the elaborate selection procedure to the science Olympiad team in India. This is a three-tier process. We illustrate the process by taking an example of a subject, viz. physics.

1. Stage I: National Standard Examination in Physics (NSEP). This is the first stage of selection of students in the Physics Olympiad programme which is organized by the Indian Association of Physics Teachers (IAPT). Approximately 40,000 students enrol for this stage. We emphasize that the outreach is very large with over 900 centres in the country which includes Andaman and Nicobar islands. The student has to spend Rs 75 (less than two dollars) only.
2. Stage II: Indian National Physics Olympiad (INPhO). The top 300 students selected from NSEP are eligible to appear for this stage. This is conducted by the Homi Bhabha Centre for Science Education (HBCSE) at 15 centres in the country. There is

**Table 1.** Number of CBSE students who appeared and secured 90% and above

| | Appeared | | 90% and above | |
|---|---|---|---|---|
| Year | Total | Females (%) | Total | Females (%) |
| 2007 | 555,965 | 48 | 8,120 | 52 |
| 2008 | 530,199 | 42 | 8,253 | 51 |
| 2009 | 612,102 | 42 | 15,839 | 51 |

The percentage in columns 3 and 5 indicates a fraction of the total number. Percentage is rounded off to the nearest integer.

**Table 2.** Number of students who appeared and were selected for IIT-JEE exam

| | Appeared | | Selected | |
|---|---|---|---|---|
| Year | Total | Females (%) | Total | Females (%) |
| 2007 | 243,029 | 22 | 7209 | 8 |
| 2008 | 311,258 | 25 | 8652 | 10 |
| 2009 | 384,000 | 26 | 9048 | 10 |

The percentage in columns 3 and 5 indicates a fraction of the total number. Percentage is rounded off to the nearest integer.

**Table 3.** Genderwise distribution for Olympiad exam

| | | Exam stages | | | |
|---|---|---|---|---|---|
| | | NSE | | INO | |
| Year | Subject | Total | Girls (%) | Total | Number of girls |
| 2007 | Physics | 33,158 | 37 | 301 | 14 |
| | Chemistry | 13,848 | 31 | 299 | 27 |
| 2008 | Physics | 25,708 | 31 | 318 | 23 |
| | Chemistry | 19,058 | 32 | 351 | 31 |
| 2009 | Physics | 27,288 | 28 | 311 | 20 |
| | Chemistry | 20,537 | 31 | 313 | 39 |

Note that column 4 implies percentage of total number. However, column 6 indicates the actual number. (Courtesy; Office, National Coordinator, Science Olympiads.)

**Table 4.** Gender representation in some of the coaching institutes in cities

| Coaching class city | Total students | Females (%) |
|---|---|---|
| Jaipur | 887 | 24 |
| Mumbai | 1101 | 17 |
| Delhi | 4650 | 24 |
| Hyderabad | 8000 | 23 |
| Tirupathi | 134 | 23 |

The above number is obtained through personal correspondence. Hence, total number may increase if we include all the coaching institutes.

no expenditure to the student at this stage.

3. Stage III: Orientation cum Selection Camp (OCSC) in physics. The top 35 students selected from INPhO are invited for this two-week camp held at HBCSE. Five students from this camp are selected to represent India in the International Physics Olympiad. There is no expenditure to the student at this stage also.

Table 3 presents the genderwise distribution data for physics and chemistry Olympiads. We remind the reader that every student aspiring to go through successive stages of the programme must enrol for National Standard Examination (NSE). Except this stage (NSE), subsequent stages are selection stages. Column 3 of Table 3 shows that on an average 32% girls enrol to appear for NSE in physics (NSEP). Only 6% girls are eligible to take part in the next stage, viz. INPhO. The situation worsens when we select top 35 candidates for OCSC camp (data not presented here). Not surprisingly since 1998, when we started sending Indian teams to Olympiads, only one girl and 59 boys had represented India at the International Physics Olympiads. Chemistry data given in Table 3 tells the same story.

We also note that almost all the students who did well in IIT and Olympiad examination went to coaching classes. The coaching institutes are privately owned and operated. They charge a fee which is significantly higher than the school fee. These institutes are found in all urban centres of India and constitute a parallel education system. Mark Bray of the UNESCO International Institute of Educational Planning has found that this phenomenon is now universal and terms it as 'shadow education' system[4]. The enormous presence of these institutes and their growth in the last two decades reflects a lack of faith in the mainstream high school education system in India. In the coaching classes, the focus is on problem solving. One could attribute under-representation of girls to parents who may be unwilling to spend money to send their daughters to the coaching classes. We carried out an informal survey with three well-known engineering entrance coaching classes in some of the cities and found out that this is only partly true. Table 4 lists the data. Except Mumbai, in other cities about a fourth of the students in coaching institutes are girls; one sixth of a Mumbai coaching centre's students are girls.

The fact that girls performing better than boys in CBSE exams and at the same time, are not able to secure admissions in top level engineering colleges in India raises many questions. In any case it is not a healthy sign for any academic institute.

The Olympiad exams present a bleaker picture than the JEE. Both together, they present a scene which is nowhere as rosy as the CBSE data. This needs reflections. The training and skills required to do well in CBSE appear to be largely irrelevant for JEE and Olympiads.

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