Gender inequality among medical, pharmaceutical and dental practitioners in French hospitals: Where have we been and where are we now?

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Abstract

Introduction
Women are under-represented in senior academic and hospital positions in many countries. The authors aim to assess the place and the evolution of all appointed female and male health practitioners’ working in French public Hospitals.

Materials and methods
Data of this observational study were collected from the National Management Centre (Centre National de Gestion) from 2015 up to January 1, 2020. First, the authors described demographic characteristics and specialties of all appointed medicine, pharmacy, and dentistry doctors’ working as Hospital Practitioners, Associate Professors, and Full Professors in French General and University-affiliated Hospitals in 2020. Then, they retrospectively reported the annual incidence of new entrance according to gender and professional status from 1999 to 2019 thanks to the appointment date of all practitioners in activity between 2015 and 2020.

Results
In 2020, 51 401 appointed practitioners (49.7% of female) were in activity in French public hospitals with a large majority being medical doctors (92.4%) compared to pharmacists (6%) and dentists (1.6%). Women represented 52.5% of the Hospital Practitioners, 48.6%...
of the Associate Professors, and 22.0% of the Full Professors (p < 0.001). There were disparities between the rates of female Full Professors in medicine (20.6%), pharmacy (36.1%), and dentistry (44.3%, p < 0.001). Women were appointed Hospital Practitioners and Associate Professors earlier than men (respectively 37.1 versus 38.8 years, p < 0.001 and 36.1 versus 36.5 years, p = 0.04), and at a later age among Full Professors (43.7 versus 41.9 years, p < 0.001). Compared to men, the annual proportion of appointed women varied significantly between 1999 and 2019 from 47.6% to 60.4% for Hospital Practitioners, from 50.0% to 44.6% for Associate Professors, and from 11.2% to 33.3% for Full Professors (p < 0.001 for trend).

Conclusions

Although more and more women occupy positions in French hospitals, there is still a gender gap regarding access to Full Professor status in medicine and pharmacy, but not in dentistry. The disparity in numbers makes comparison difficult. Despite a trend towards gender equality during the last twenty years, it has not yet been achieved regarding access to the highest positions.

Introduction

Gender inequality is a universal issue that has recently and increasingly been addressed in public debate. These inequalities affect the functioning of society and may concern various societal areas such as fundamental rights, access to education, wage differences, and access to high professional positions [1–4]. In this context of increased awareness of gender inequalities, the under-representation of women in senior academic positions has been pointed out in the literature [5–10]. In the medical field, which is perceived as an elitist professional sector, a demographic transition "in favour" of women is globally happening [11]. However, these worldwide progressist trends should not mask the fact that male doctors still massively dominate leadership roles [12–14]. Despite more women working in the health system, female health practitioners still hit the glass ceiling regarding access to upper-level management positions. Similar findings are observed in pharmacy and dentistry [15,16].

In France, qualification as a medical doctor, pharmacist and dentist requires a specific doctorate. Apart from the first common year, training is separate for each discipline. The growing proportion of women in medical practice began in the seventies thanks to the increasing rate of women attending university [17]. In 2019, 64% of medical, pharmaceutical, and dental students were women [18]. French medical practitioners, pharmacists, and dentists can work in the private or in the public sector. The French public healthcare system includes General Hospitals and University-affiliated Hospitals. Doctors of medicine, pharmacy, and dental surgery working in public hospitals have the “Hospital Practitioner” status. This status is obtained after completion of the National public health practitioner competition. Hospital Practitioners can both work in General and University-affiliated Hospitals. They are only employed by the Hospital. For those who additionally want to pursue a university career, University-affiliated Hospitals, created in 1958, gave them access to two tenured academic positions: “Associate Professor–Hospital Practitioner” and “Full Professor–Hospital Practitioner” respectively referred to as Associate Professors and Full Professors for the rest of the article [19]. Associate and Full Professors have a triple mission of teaching, care, and research. Both Hospital and
University employ them. Some can firstly become Associate Professors then Full Professors. However, many of them can be appointed Full professors at the outset. To achieve this highest academic position, Full Professors must justify many abilities like accreditation to supervise research (habilitation), overseas elective period, and publication of numerous international scientific articles in medical journals. Funders play no role in appointing Professors. The dean of their University and the National Universities Council (Conseil National des Universités, CNU) must approve their tenure. Dean is the traditional name given to the director of the Training and Research Units (Unités de Formation et de Recherche–UFR) in Universities. There is one dean for each UFR of Medicine, Pharmacy or Dentistry. The CNU is a French advisory and decision-making institution in charge of the careers of Full and Associate professors.

Although the general proportion of women in medical practice is already well documented, to this date there are few data regarding female representation and evolution of gender equality over time in medicine, pharmacy, and dentistry in France. Such granularity would be a valuable contribution to describing potential persisting areas of disparity between women and men. The primary objective of the study was to describe medicine, pharmacy, and dentistry practitioners’ gender representation in French General Hospitals and University-affiliated Hospitals as Hospital Practitioners, Associate Professors, and Full Professors in 2020. The secondary objectives were to report gender distribution according to both medical speciality and academic status in 2020 and describe the incidence of hospital and academic status appointments according to gender over the last twenty years, from 1999 to 2019.

Materials and methods

This is an observational retrospective study based on data collected up to January 1, 2020.

Data source

We obtained exhaustive anonymised data from the charts of personnel statistics (French Hospital Practitioners, Associate Professors, and Full Professors) from the National Management Centre (Centre National de Gestion: CNG). The CNG was created in 2007 and is in charge of the management of all appointed French doctors of medicine, pharmacy, and dental surgery working in the public healthcare sector. It is a public institution which carries out administrative duties under the authority of the French Ministry of Health. The database provided the history of each of the Hospital Practitioners, Associate Professors, and Full Professors in activity in General or University-affiliated Hospitals between 2015 and January 1, 2020. Basic socio-demographic data, gender, appointment date (or tenure), administrative status, type of workplace, discipline and medical specialty were all documented. Three main disciplines were categorized: medicine, pharmacy, and dentistry. Dentistry included oral surgery. Data concerning Associate and Full Professors in pharmacy began in 2006, the year of the legislative decree connecting their university and hospital careers [20]. In France, biology as a specialty can be practiced through both medical and pharmaceutical training. Data did not allow for the differentiation between medical doctors and pharmacists specialized in biology. We decided to categorise this specialty within the medical disciplines. On top of the medical specialties, Associate, and Full Professors have a particular university specialty under the aegis of the CNU. Specialities are slightly different between hospital practitioners and professors and do not allow for direct comparisons.
Statistical methods

First, we described the population of practitioners’ working in French public Hospitals according to gender (especially women representation) and academic status, as of January 1, 2020. Second, we reported gender distribution according to both medical specialty and academic status in 2020. Then, we retrospectively described the gender distribution from 1999 to 2019 based on the appointment date (or tenure) of each practitioner. Descriptive and bivariate analyses of the data were performed using 3.4.2 R version R. Quantitative variables are expressed as mean (standard deviation) and categorical variables as number (percentage). Quantitative variables are compared using the Student’s t-test. Categorical variables are compared using Chi square test. Evolution of the rate of female appointments over time was investigated using a Chi squared test for trend. For all analyses, a p-value < 0.05 was considered significant. Missing data were not imputed.

Results

As of January 1, 2020, 25 560 (49.7%) female and 25 841 (50.3%) male Health Practitioners were active in French public hospitals. A large majority of these are medical doctors (92.4%) compared to pharmacists (6.0%) and dentists (1.6%). There were 45 007 (87.6%) Hospital Practitioners, 2 022 (3.9%) Associate Professors, and 4 372 (8.5%) Full Professors. Among all of them, 20755 (40.4%) were working in University-affiliated Hospitals. Demographic characteristics of French public hospital doctors in 2020 are detailed in Table 1. All disciplines together, women represent 52.5% of the Hospital Practitioners, 48.6% of the Associate Professors, and only 22.0% of the Full Professors (p < 0.001). We represent gender and age

Table 1. Demographic characteristics of French public hospital doctors in 2020.

|                          | Female       | Male        | Total  |
|--------------------------|--------------|-------------|--------|
| **Hospital Practitioners, n (%)** | 23613 (52.5%) | 21394 (47.5%) | 45007  |
| Age, years (SD)          | 47.6 (9.4)   | 51.6 (9.6)  | 49.5 (9.7) |
| Age of appointment, years (SD) | 37.1 (5.8)  | 38.8 (6.5)  | 37.9 (6.2)  |
| Discipline, n (%)        |              |             | P<0.001 |
| Medicine                 | 21493 (51.2%)| 20495 (48.8%)| 41988  |
| Pharmacy                 | 2010 (73.5%) | 726 (26.5%) | 2736   |
| Dentistry                | 110 (38.9%)  | 173 (61.1%) | 283    |
| **Associate professors, n (%)** | 983 (48.6%)  | 1039 (51.4%)| 2022   |
| Age, years (SD)          | 45.1 (8.5)   | 46.0 (10.0) | 45.5 (9.3) |
| Age of appointment, years (SD) | 36.1 (3.9)  | 36.5 (4.0)  | 36.3 (4.0)  |
| Discipline, n (%)        |              |             | P = 0.04  |
| Medicine                 | 735 (49.7%)  | 744 (50.3%) | 1479   |
| Pharmacy                 | 102 (58.3%)  | 73 (41.7%)  | 175    |
| Dentistry                | 146 (39.7%)  | 222 (60.3%) | 368    |
| **Full professors, n (%)** | 964 (22%)    | 3408 (78%)  | 4372   |
| Age, years (SD)          | 52.6 (6.8)   | 54.0 (7.4)  | 53.7 (7.3) |
| Age of appointment, years (SD) | 43.7 (5.0)  | 41.9 (4.6)  | 42.3 (4.8)  |
| Discipline, n (%)        |              |             | P<0.001  |
| Medicine                 | 833 (20.6%)  | 3210 (79.4%)| 4043   |
| Pharmacy                 | 65 (36.1%)   | 115 (63.9%) | 180    |
| Dentistry                | 66 (44.3%)   | 83 (55.7%)  | 149    |

Abbreviation: SD = standard deviation.

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distribution according to these statuses in Fig 1. In medicine, women represent 51.2% of Hospital Practitioners, 49.7% of Associate Professors, and 20.6% of Full Professors ($p < 0.001$). In pharmacy, women represent 73.5% of Hospital Practitioners, 58.0% of Associate Professors, and 36.1% of Full Professors ($p < 0.001$). These percentages are respectively for female dentists of 38.9%, 40.0%, and 44.3% ($p = 0.49$). Regarding the age of appointments, women were appointed Hospital Practitioners or Associate Professor earlier than men and at a later age among Full Professors (Table 1).

Tables 2 and 3 describe gender distribution for each medical specialty, according to the professional status in 2020. Among hospital practitioners, there are large disparities in the proportion of male and female depending on the specialty. For example, there are 19% of female in neurosurgery, while 59% of the psychiatrist are female. Among full professor, there is always a majority of male except for the Pathology specialty (56.3% of female). Urology is the only specialty with no female among the 69 French Full Professors.

As shown in Fig 2, the number of newly appointed female doctors increased between 1999 and 2019, from 457 (47.6% compared to male) to 1474 (60.4%) per year for Hospital Practitioners ($p < 0.001$ for trend), and from 17 (11.2%) to 55 (33.3%) per year for Full Professors ($p < 0.001$). Even if the absolute number of female Associate Professors increase during the same period, the relative proportion decreased compare to male from 50.0% to 44.6% per year ($p < 0.001$ for trend). Since 2005, there have been more female appointed as Hospital Practitioners annually than male. This reversal takes place in 2012 for Associate Professors. By contrast, the number of female appointed Full Professor has been consistently lower than male.
Table 2. Distribution of French medical doctors working as Hospital Practitioners according to specialty and gender in 2020.

| Specialty                                      | Female       | Male         | Total   |
|------------------------------------------------|--------------|--------------|---------|
| Anaesthesiology                                | 1724 (46.8%) | 1962 (53.2%) | 3686    |
| Biology                                        | 1392 (67.6%) | 668 (32.4%)  | 2060    |
| Cardiovascular medicine and vascular medicine  | 403 (29.6%)  | 957 (70.4%)  | 1360    |
| Clinical pharmacology                          | 60 (71.4%)   | 24 (28.6%)   | 84      |
| Dermatology and venereology                    | 181 (70.2%)  | 77 (29.8%)   | 258     |
| Digestive surgery                              | 125 (19.2%)  | 525 (80.8%)  | 650     |
| Emergency medicine                             | 1893 (39.5%) | 2902 (60.5%) | 4795    |
| Endocrinology, diabetology, and nutrition      | 450 (81.8%)  | 100 (18.2%)  | 550     |
| Forensic medicine                              | 52 (45.2%)   | 63 (54.8%)   | 115     |
| Functional explorations                        | 24 (53.3%)   | 21 (46.7%)   | 45      |
| Gastroenterology and hepatology                | 414 (44.2%)  | 522 (55.8%)  | 936     |
| General medicine                               | 2057 (57.1%) | 1543 (42.9%) | 3600    |
| General surgery                                | 78 (24.5%)   | 240 (75.5%)  | 318     |
| Geriatric                                      | 1588 (66.1%) | 815 (33.9%)  | 2403    |
| Gynaecology and obstetrics                     | 825 (50.2%)  | 818 (49.8%)  | 1643    |
| Haemobiology and transfusion                   | 74 (69.2%)   | 33 (30.8%)   | 107     |
| Haematology                                    | 209 (59.9%)  | 140 (40.1%)  | 349     |
| Hospital hygiene                               | 159 (74.0%)  | 56 (26.0%)   | 215     |
| Infectious and tropical diseases               | 167 (56.6%)  | 128 (43.4%)  | 295     |
| Intensive care medicine                        | 153 (26.7%)  | 421 (73.3%)  | 574     |
| Internal medicine and clinical immunology      | 336 (53.4%)  | 293 (46.6%)  | 629     |
| Maxillofacial surgery                          | 41 (45.6%)   | 49 (54.4%)   | 90      |
| Medical genetics                               | 71 (77.2%)   | 21 (22.8%)   | 92      |
| Medical gynaecology                            | 58 (93.5%)   | 4 (6.5%)     | 62      |
| Nephrology                                     | 271 (49.8%)  | 273 (50.2%)  | 544     |
| Neurology                                      | 531 (55.6%)  | 424 (44.4%)  | 955     |
| Neurosurgery                                   | 30 (19.0%)   | 128 (81.0%)  | 158     |
| Nuclear medicine                               | 97 (48.7%)   | 102 (51.3%)  | 199     |
| Occupational medicine                          | 58 (66.7%)   | 29 (33.3%)   | 87      |
| Oncology                                       | 173 (61.1%)  | 110 (38.9%)  | 283     |
| Oncology-radiotherapy                          | 63 (47.7%)   | 69 (52.3%)   | 132     |
| Ophthalmology                                  | 185 (48.3%)  | 198 (51.7%)  | 383     |
| Orthopaedic surgery                            | 77 (8.3%)    | 848 (91.7%)  | 925     |
| Otorhinolaryngology                            | 182 (34.7%)  | 342 (65.3%)  | 524     |
| Paediatrics                                    | 1856 (68.9%) | 838 (31.1%)  | 2694    |
| Paediatric surgery                             | 96 (49.2%)   | 99 (50.8%)   | 195     |
| Pathology                                      | 256 (70.3%)  | 108 (29.7%)  | 364     |
| Physical medicine and rehabilitation           | 255 (62.0%)  | 156 (38.0%)  | 411     |
| Plastic surgery                                | 31 (34.8%)   | 58 (65.2%)   | 89      |
| Pneumology                                     | 435 (50.6%)  | 424 (49.4%)  | 859     |
| Psychiatry                                     | 3134 (59.0%) | 2181 (41.0%) | 5315    |
| Public health                                  | 250 (54.9%)  | 205 (45.1%)  | 455     |
| Radiology                                      | 680 (47.2%)  | 762 (52.8%)  | 1442    |
| Rheumatology                                   | 208 (57.8%)  | 152 (42.2%)  | 360     |
| Thoracic surgery                               | 31 (15.7%)   | 167 (84.3%)  | 198     |
| Urology                                        | 30 (8.4%)    | 326 (91.6%)  | 356     |
| Vascular surgery                               | 30 (20.8%)   | 114 (79.2%)  | 144     |

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Table 3. Distribution of French Associate and Full Professors according to discipline, CNU-section, and gender in 2020.

| Discipline                      | Associate Professors | Full Professors |
|---------------------------------|----------------------|-----------------|
|                                 | Female | Male | Total | Female | Male | Total |
| Anatomy                         | 9 (36.0%) | 16 (64.0%) | 25 | 6 (9.4%) | 58 (90.6%) | 64 |
| Anaesthesiology                 | 2 (8.7%) | 21 (91.3%) | 23 | 13 (10.7%) | 109 (89.3%) | 122 |
| Bacteriology                    | 76 (58.0%) | 55 (42.0%) | 131 | 35 (35.0%) | 65 (65.0%) | 100 |
| Biochemistry                     | 67 (60.4%) | 44 (39.6%) | 111 | 18 (24.3%) | 56 (75.7%) | 74 |
| Biostatistics                   | 12 (35.3%) | 22 (64.7%) | 34 | 13 (26.5%) | 37 (73.5%) | 49 |
| Cardiology                      | 6 (35.3%) | 11 (64.7%) | 17 | 10 (7.2%) | 128 (92.8%) | 138 |
| Cellular biology                | 23 (51.1%) | 22 (48.9%) | 45 | 17 (37.8%) | 28 (62.2%) | 45 |
| Child psychiatry                | 4 (44.4%) | 5 (55.6%) | 9 | 13 (36.1%) | 23 (63.9%) | 36 |
| Dermatology                     | 8 (66.7%) | 4 (33.3%) | 12 | 25 (37.9%) | 41 (62.1%) | 66 |
| Digestive surgery               | 10 (40.0%) | 15 (60.0%) | 25 | 12 (9.7%) | 112 (90.3%) | 124 |
| Emergency medicine              | 1 (12.5%) | 7 (87.5%) | 8 | 2 (5.0%) | 38 (95.0%) | 40 |
| Endocrinology                   | 10 (58.8%) | 7 (41.2%) | 17 | 21 (30.9%) | 47 (69.1%) | 68 |
| Epidemiology                    | 18 (48.6%) | 37 (51.4%) | 55 | 34 (26.6%) | 94 (73.4%) | 128 |
| Forensic medicine               | 7 (35.0%) | 13 (65.0%) | 20 | 11 (34.4%) | 21 (65.6%) | 32 |
| Gastroenterology and hepatology | 5 (35.7%) | 9 (64.3%) | 14 | 14 (10.9%) | 115 (89.1%) | 129 |
| General surgery                 | 0 (0%) | 0 (0%) | 0 | 0 (0.0%) | 3 (100.0%) | 3 |
| Genetics                        | 34 (66.7%) | 17 (33.3%) | 51 | 26 (38.2%) | 42 (61.8%) | 68 |
| Gynaecology and obstetrics      | 4 (33.3%) | 8 (66.7%) | 12 | 17 (13.5%) | 109 (86.5%) | 126 |
| Haematology and transfusion     | 38 (50.7%) | 37 (49.3%) | 75 | 34 (26.6%) | 94 (73.4%) | 128 |
| Histology                       | 36 (70.6%) | 15 (29.4%) | 51 | 12 (25.5%) | 35 (74.5%) | 47 |
| Immunology                      | 36 (60.0%) | 24 (40.0%) | 60 | 23 (28.4%) | 58 (71.6%) | 81 |
| Infectious disease              | 7 (41.2%) | 10 (58.8%) | 17 | 19 (25.3%) | 56 (74.7%) | 75 |
| Intensive care medicine         | 1 (8.3%) | 11 (91.7%) | 12 | 8 (6.8%) | 83 (91.2%) | 91 |
| Internal medicine and geriatrics| 11 (44.0%) | 14 (56.0%) | 25 | 33 (21.6%) | 120 (78.4%) | 153 |
| Maxillofacial surgery           | 1 (11.1%) | 8 (88.9%) | 9 | 5 (51.9%) | 4 (48.1%) | 9 |
| Medical gynaecology             | 15 (55.6%) | 12 (44.4%) | 27 | 16 (43.2%) | 21 (56.8%) | 37 |
| Nephrology                      | 5 (45.5%) | 6 (54.5%) | 11 | 19 (24.1%) | 70 (75.9%) | 89 |
| Neurology                       | 12 (54.5%) | 10 (45.5%) | 22 | 22 (18.0%) | 100 (82.0%) | 122 |
| Neurosurgery                    | 2 (18.2%) | 9 (81.8%) | 11 | 4 (6.5%) | 58 (93.5%) | 62 |
| Nuclear medicine                | 17 (31.5%) | 37 (68.5%) | 54 | 14 (20.6%) | 54 (79.4%) | 68 |
| Nutrition                       | 17 (81.0%) | 4 (19.0%) | 21 | 10 (25.0%) | 30 (75.0%) | 40 |
| Occupational medicine           | 11 (55.0%) | 9 (45.0%) | 20 | 9 (37.5%) | 15 (62.5%) | 24 |
| Oncology and radiotherapy       | 11 (42.3%) | 15 (57.7%) | 26 | 22 (17.3%) | 105 (82.7%) | 127 |
| Ophthalmology                   | 4 (44.4%) | 5 (55.6%) | 9 | 14 (21.5%) | 51 (78.5%) | 65 |
| Orthopaedic surgery             | 2 (22.2%) | 7 (77.8%) | 9 | 3 (3.4%) | 84 (96.6%) | 87 |
| Otorhinolaryngology             | 1 (10.0%) | 9 (90.0%) | 10 | 10 (10.0%) | 67 (90.0%) | 77 |
| Parasitology                    | 32 (61.5%) | 20 (38.5%) | 52 | 12 (38.7%) | 19 (61.3%) | 31 |
| Pathology                       | 40 (69.0%) | 18 (31.0%) | 58 | 49 (56.3%) | 38 (43.7%) | 87 |
| Paediatric surgery              | 9 (60.0%) | 6 (40.0%) | 15 | 10 (66.7%) | 4 (33.3%) | 60 |
| Paediatrics                     | 25 (64.1%) | 14 (35.9%) | 39 | 47 (27.0%) | 127 (73.0%) | 174 |
| Pharmacology                    | 24 (43.6%) | 31 (56.4%) | 55 | 14 (23.7%) | 45 (76.3%) | 59 |
| Physical medicine and rehabilitation | 6 (66.7%) | 3 (33.3%) | 9 | 8 (88.9%) | 5 (11.1%) | 48 |
| Physiology                      | 36 (41.4%) | 51 (58.6%) | 87 | 26 (29.9%) | 61 (70.1%) | 87 |
| Plastic surgery                 | 3 (33.3%) | 6 (66.7%) | 9 | 5 (55.6%) | 4 (44.4%) | 9 |
| Pneumology                      | 7 (46.7%) | 8 (53.3%) | 15 | 12 (80.0%) | 3 (20.0%) | 15 |
| Psychiatry                      | 5 (23.8%) | 16 (76.2%) | 21 | 20 (22.0%) | 71 (78.0%) | 91 |
appointments every year since 1999. A figure showing the evolution of newly appointed full professors according to gender and discipline between 1999 and 2019 is available in a supplemental appendix (S1 Fig).

**Discussion**

Data from this study show that the representation of women in the medical field in French public hospitals varies according to academic status. We show that the gender distribution is rather balanced for Hospital Practitioners (52.5% of female) and Associate Professors (48.6%). On the other hand, less than one Full Professor in four is female in France in 2020. In addition, the percentage of female French deans is 16.2% in medicine, 16.7% in pharmacy and 43.7% in dentistry in 2020 [21–23]. This reflects a glass ceiling which excludes women only from the highest academic levels and leadership roles [24,25]. The gender distribution evolution among newly appointed Full Professors between 1999 and 2019 does not indicate enough improvement of this tendency.

Although there is clear evidence of progress, the rate of advancement of women into leadership positions in academic medicine is slower than what would be predicted by their numbers.
for the past twenty years in France. Several explanations could be advanced to explain this gender inequality in the Full Professor career. Many authors have already identified obstacles to the promotion of women, mainly in English or American publications. There are well-documented gender gaps in publications [26–28], peer review processes [29], grant supports [30–35], recognition awards [36–39], speaker invitations [39–42], composition of editorial boards [43–46], and leadership positions [47–50].

We also found that French women are generally appointed Full Professor at a later age than men (43.7 versus 41.9 years old). This differs from the appointment of Hospital Practitioners and Associate Professor. One could argue that the overseas elective period is mandatory to become Full Professor and may be conflicting with maternity. Medical and research training frequently coincide with childbearing and early child-rearing years.

Generally speaking, a loss of wage income is seen for French women who have children compared to women not having children. In contrast, the arrival of a child has almost no impact on men, except for men in higher paid positions who increase their activity [51].

We also cannot rule out a form of discrimination. Strong evidence suggests that the gender disparity could be due to gender differences in promotional rates [52]. In addition, tacit biases have been shown to favour men over women in science and leadership, and may affect the promotion of women in academia [52–56]. Familial factors are also obviously worth noting since women tend to be the main caregiver and time investment required for promotion, tenure, and acquisition of leadership roles is not necessarily compatible with domestic and family life. Cultural factors such as a lack of women role models, a negative gender climate sustained by a male dominated institutional environment might also be part of the equation. Indeed, mentorship is associated with increased career satisfaction, productivity, and promotion of medical faculty [13,57]. Basically, gender disparity has many roots and is most likely multifactorial. In a recent review, Edmunds, et al. [58] found that there was supportive evidence for many of these points: some women might be more interested in teaching than in research, women lack adequate mentors and role models, and women experience gender discrimination and bias. Conversely, evidence was discordant for other reasons such as the concern of work-life balance [58]. Some practical solutions may be proposed to reach a better and equitable state: mentoring programs, conferences for only female practitioners, conferences about gender equity, establishment of quotas in publications, and of course denunciation in journals with high impact factors [5,13,59–61]. If the establishment of fixed quotas in committees and boards is not an end in itself, it can be a good start.

One more interesting finding also emerges from our study. We note equivalent rates of female Dentists among Hospital Practitioners (38.9%), Associate Professors (40.0%), and Full Professors (44.3%) compared to medical doctors and pharmacists in 2020. Parity in dentistry is long standing, stable over twenty years but has never been promoted by a voluntarist policy. Comparison with medicine and pharmacy is not simple for many reasons. First, the number of dentists working in Public Hospitals is very low (1.6%) compared to medical doctors (92.4%) and pharmacists (6%). In addition, the dual “hospital” and “university” affiliation was not created at the same time in medicine (1958), dentistry (1990), and pharmacy (2006). In the same way, there are great disparities between disciplines and specialties. For example, surgery is largely male while pharmacy and pathology are predominantly female. These differences imply a cautious interpretation and do not allow direct comparisons. Comparison with other academic fields is also difficult because of large disparities in the proportion of female professors in France: engineering science (19%), physics (23%), chemistry (38%), law and political science (45%), language and literature (63%) [62]. Our results are therefore limited in scope and cannot be generalised to all academic fields. However, our results are consistent with worldwide studies [10,15,61,63–66]. Gender gap in high academic positions is concerning.
If the data from our study could be considered qualitatively accurate, it is not excluded that the incidence data might be slightly underestimated or even biased due to the retrospective nature of the study. Indeed, physicians appointed between 1999 and 2014 may have ceased all hospital activity before 2015 and are therefore not accounted for in our data. The proportion of these cases, which are likely to be marginal, might differ by gender and bias the incidence differences in one direction or another. Our data do not contain any other characteristics that might play a positive or negative role in academic promotion such as ethnicity, number of children, religion, political opinion or sexuality. Further research is needed to obtain a better overview of French discriminations, not limited to gender. However, based on exhaustive national data, this work is a high-quality contribution to highlight gender disparity in the medical academic world. We hope that a better overview of these realities can help to create a favourable environment to support women’s participation to take on academic and hospital leadership positions in medicine, pharmacy, and dentistry. Women in leadership positions are key to achieving gender parity in the academic field. Diversifying all levels of academic Medicine, Pharmacy, and Dentistry in terms of gender is a way to make our institutions better by enabling varied perspectives to be shared. Change will not happen without decision-makers’ involvement. Gender parity should be treated as a priority and sufficient resources should be allocated to make it happen.

**Supporting information**

S1 Fig. Newly appointed Full Professors in medicine (A), in pharmacy (B), in dentistry (C), and proportion of female Full Professors in the three disciplines (D) between 1999 and 2019. (PDF)

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References

1. Hay K, McDougall L, Percival V, Henry S, Klugman J, Wurie H, et al. Disrupting gender norms in health systems: making the case for change. Lancet. 2019; 393: 2535–2549. https://doi.org/10.1016/S0140-6736(19)30648-8 PMID: 31155270

2. Uberoi D, de Bruyn M. Human rights versus legal control over women’s reproductive self-determination. Health Hum Rights. 2013; 15: E161–174. PMID: 25006084

3. Appleby J. Is there equal pay in healthcare? Not if you are a doctor. BMJ. 2012; 345: e6191. https://doi.org/10.1136/bmj.e6191 PMID: 22990103

4. Ganguli I, Sheridan B, Gray J, Chernew M, Rosenthal MB, Neprash H. Physician Work Hours and the Gender Pay Gap—Evidence from Primary Care. N Engl J Med. 2020; 383: 1349–1357. https://doi.org/10.1056/NEJMsa2013804 PMID: 32997909

5. Boylan J, Dacre J, Gordon H. Addressing women’s under-representation in medical leadership. The Lancet. 2019; 393: e14. https://doi.org/10.1016/S0140-6736(18)32110-X PMID: 30739700

6. Battaglia F, Farhan SA, Narmeen M, Karimuddin AA, Jalal S, Tse M, et al. Does gender influence leadership roles in academic surgery in the United States of America? A cross-sectional study. Int J Surg. 2020; 83: 67–74. https://doi.org/10.1016/j.ijssu.2020.08.029 PMID: 32871272

7. Bennett CL, Salinas RY, Locascio JJ, Boyer EW. Two decades of little change: An analysis of U.S. medical school basic science faculty by sex, race/ethnicity, and academic rank. PLoS One. 2020; 15: e0235190. https://doi.org/10.1371/journal.pone.0235190 PMID: 32755939

8. Aggarwal A, Rosen CB, Nehemiah A, Maina I, Kelz RR, Aaronson CB, et al. Is There Color or Gender Behind the Mask and Sterile Blue? Examining Gender and Racial Demographics within Academic Surgery. Ann Surg. 2020. https://doi.org/10.1097/SLA.0000000000004461 PMID: 32956175

9. Chen S-YT, Jalal S, Ahmadi M, Khurshid K, Bhulani N, Rehman AU, et al. Influences for Gender Disparity in Academic Family Medicine in North American Medical Schools. Cureus. 2020; 12: e8368. https://doi.org/10.7759/cureus.8368 PMID: 32617239

10. Richter KP, Clark L, Wick JA, Cruvinel E, Durham D, Shaw P, et al. Women Physicians and Promotion in Academic Medicine. N Engl J Med. 2020; 383: 2148–2157. https://doi.org/10.1056/NEJMsa1916935 PMID: 33252871

11. Shannon G, Jansen M, Williams K, Cáceres C, Motta A, Odihambo A, et al. Gender equality in science, medicine, and global health: where are we at and why does it matter? The Lancet. 2019; 393: 560–569. https://doi.org/10.1016/S0140-6736(18)33135-0

12. Human Resources for Health Global Resource Center. Gender and health workforce statistics. Accessed 7 May 2021. https://www.hhrresourcecenter.org/gender_stats.html.

13. Laver KE, Prichard IJ, Cations M, Osenik I, Govin K, Coveney JD. A systematic review of interventions to support the careers of women in academic medicine and other disciplines. BMJ Open. 2018; 8: e020380. https://doi.org/10.1136/bmjopen-2017-020380 PMID: 29572397

14. Abelson JS, Chartrand G, Moo T-A, Moore M, Yeo H. The climb to break the glass ceiling in surgery: trends in women progressing from medical school to surgical training and academic leadership from 1994 to 2015. Am J Surg. 2016; 212: 566–572.e1. https://doi.org/10.1016/j.amjsurg.2016.06.012 PMID: 27649976

15. Martin A, Naunton M, Peterson GM. Gender balance in pharmacy leadership: Are we making progress? Res Soc Adm Pharm. 2020. https://doi.org/10.1016/j.sapharm.2020.05.031 PMID: 32527465

16. Tiwari T, Randall CL, Cohen L, Holtzmann J, Webster-Cyriaque J, Ajiboye S, et al. Gender Inequalities in the Dental Workforce: Global Perspectives. Adv Dent Res. 2019; 30: 60–68. https://doi.org/10.1177/0022034519877398 PMID: 31746651

17. Lapeyre N, Feuvre NL. Féminisation du corps médical et dynamiques professionnelles dans le champ de la santé. Revue française des affaires sociales. 2005; 59–81.

18. Ministère de l’Enseignement supérieur, de la Recherche et de l’Innovation. La parité dans l’enseignement supérieur - État de l’Enseignement supérieur, de la Recherche et de l’Innovation en France n°12. Accessed 7 May 2021. https://publication.enseignementsup-recherche.gouv.fr/rees/FR/EEESR12_ES_12/la_parite_dans_l_enseignement_superieur/.

19. Centre National de Gestion | Statuts et textes de référence. Accessed 7 May 2021. https://www.cng.sante.fr/personnels-enseignants-et-hospitaliers/statuts-et-textes-de-reference.

20. Legifrance. Décret n°2006–593 du 23 mai 2006 modifiant le décret n°84–135 du 24 février 1984 portant statut des personnels enseignants et hospitaliers des centres hospitaliers et universitaires. Accessed 7 May 2021. https://www.legifrance.gouv.fr/affichTexte.do?cidTexte=LEGITEXT000006053748.
21. Conférences des doyens de Médecine. Accessed 7 May 2021. https://conferencesdesdoyensdemedicine.org/conferencesdesdoyensdemedicinorg-ethique-et-deontologie/doyens-faculte-de-medecine/

22. Conférences des doyens de Pharmacie. Accessed 7 May 2021. https://www.conference-doyens-pharmacie.fr/les-24-facultes/

23. Conférence des doyens des facultés d’Ondotologie. Accessed 7 May 2021. http://cdo.unistra.fr/

24. Carnes M, Morrissey C, Geller SE. Women’s health and women’s leadership in academic medicine: hitting the same glass ceiling? J Womens Health (Larchmt). 2008; 17: 1453–1462. https://doi.org/10.1089/jwh.2007.0688 PMID: 18954235

25. Bunton SA, Sass P, Sloane RA, Grigsby PK. Characteristics of Interim Deans at U.S. Medical Schools: Implications for Institutions and Individuals. Acad Med. 2018; 93: 241–245. https://doi.org/10.1097/ACM.0000000000001920 PMID: 28906262

26. Jagsi R, Guancial EA, Worobey CC, Renaut LE, Chang Y, Starr R, et al. The “gender gap” in authorship of academic medical literature—a 35-year perspective. N Engl J Med. 2006; 355: 281–287. https://doi.org/10.1056/NEJMoa053910 PMID: 16855268

27. Wu C, Fuller S, Shi Z, Wilkes R. The gender gap in commenting: Women are less likely than men to comment on (men’s) published research. PLoS ONE. 2020; 15: e0230043. https://doi.org/10.1371/journal.pone.0230043 PMID: 32236109

28. Dalal NH, Chino F, Williamson H, Beasley GM, Salama AKS, Palta M. Mind the gap: Gendered publication trends in oncology. Cancer. 2020; 126: 2859–2865. https://doi.org/10.1002/cncr.32818 PMID: 32212334

29. Steinberg JJ, Skae C, Sampson B. Gender gap, disparity, and inequality in peer review. Lancet. 2018; 391: 2602–2603. https://doi.org/10.1016/S0140-6736(18)31141-3 PMID: 30070217

30. Bedi G, Van Dam NT, Munafò M. Gender inequality in awarded research grants. Lancet. 2012; 380: 474. https://doi.org/10.1016/S0140-6736(12)61292-6 PMID: 22863053

31. Burns KEA, Straus SE, Liu K, Rizvi L, Guyatt G. Gender differences in grant and personnel award funding rates at the Canadian Institutes of Health Research based on research content area: A retrospective analysis. PLoS Med. 2019; 16: e1002935. https://doi.org/10.1371/journal.pmed.1002935 PMID: 31613898

32. Witteman HO, Hendricks M, Straus S, Tannenbaum C. Are gender gaps due to evaluations of the applicant or the science? A natural experiment at a national funding agency. Lancet. 2019; 393: 531–540. https://doi.org/10.1016/S0140-6736(18)32611-4 PMID: 30739688

33. Waisbren SE, Bowles H, Hasan T, Zou KH, Emans SJ, Goldberg C, et al. Gender differences in research grant applications and funding outcomes for medical school faculty. J Womens Health (Larchmt). 2008; 17: 207–214. https://doi.org/10.1089/jwh.2007.0412 PMID: 18321172

34. Head MG, Fitchett JR, Cooke MK, Wurie FB, Atun R. Differences in research funding for women scientists: a systematic comparison of UK investments in global infectious disease research during 1997–2010. BMJ Open. 2013; 3: e003362. https://doi.org/10.1136/bmjopen-2013-003362 PMID: 24327360

35. Svider PF, D’Aquillo CM, White PE, Pashkov a AA, Bhagat N, Langer PD, et al. Gender differences in successful National Institutes of Health funding in ophthalmology. J Surg Educ. 2014; 71: 680–688. https://doi.org/10.1016/j.jsurg.2014.01.020 PMID: 24776863

36. Lincoln AE, Pincus S, Koster JB, Leboy PS. The matilda effect in science: awards and prizes in the US, 1990s and 2000s. Soc Stud Sci. 2012; 42: 307–320. https://doi.org/10.1177/0306312711435830 PMID: 22849001

37. Gerull KM, Holten A, Rhea L, Cipriano C. Is the Distribution of Awards Gender-Balanced in Orthopaedic Surgery Societies? Clin Orthop Relat Res. 2020. https://doi.org/10.1097/CORR.0000000000001364 PMID: 32555007

38. Atkinson R, Lu P, Cho NL, Melnitchouk N, Kuo LE. Gender disparities in award recipients from surgical specialty societies. Surgery. 2019; 166: 423–428. https://doi.org/10.1016/j.surg.2019.04.021 PMID: 31229313

39. Ibrahim H, Abdel-Razig S, Stadler DJ, Cofrancesco J, Archuleta S. Assessment of Gender Equity Among Invited Speakers and Award Recipients at US Annual Medical Education Conferences. JAMA Network Open. 2019; 2: e1916222. https://doi.org/10.1001/jamanetworkopen.2019.16222 PMID: 31774518

40. Partiali B, Oska S, Touriel RB, Delise A, Barbat A, Folbe A. Gender disparity in speakers at a major academic emergency medicine conference. Emerg Med J. 2020. https://doi.org/10.1136/emermed-2019-208865 PMID: 31992568

41. Oska S, Touriel R, Partiali B, Delise A, Barbat A, Folbe A. Women’s representation at an academic dermatology conference: trending upwards, but not equal yet. Dermatol Online J. 2020; 26.
42. Fournier LE, Hopping GC, Zhu L, Perez-Pinzon MA, McCullough LD, et al. Females Are Less Likely Invited Speakers to the International Stroke Conference: Time’s Up to Address Sex Disparity. Stroke. 2020; 51: 674–678. https://doi.org/10.1161/STROKEAHA.119.027016 PMID: 31902331

43. Harris CA, Banerjee T, Cramer M, Manz S, Ward ST, Dimick J, et al. Editorial (Spring) Board? Gender Composition in High-impact General Surgery Journals Over 20 Years. Ann Surg. 2019; 269: 582–588. https://doi.org/10.1097/SLA.0000000000002667 PMID: 29342020

44. Amrein K, Langmann A, Fahrleitner-Pammer A, Pieber TR, Zollner-Schwetz I. Women underrepresented on editorial boards of 60 major medical journals. Gend Med. 2011; 8: 378–387. https://doi.org/10.1016/j.genm.2011.10.007 PMID: 22153882

45. Ioannidou E, Rosania A. Under-representation of women on dental journal editorial boards. PLoS ONE. 2015; 10: e0116630. https://doi.org/10.1371/journal.pone.0116630 PMID: 25635691

46. Jalilianhasanpour R, Charkhchi P, Mirbolouk M, Yousem DM. Underrepresentation of Women on Radiology Editorial Boards. J Am Coll Radiol. 2019; 16: 115–120. https://doi.org/10.1016/j.jacr.2018.08.017 PMID: 30340997

47. Godier A, Nouet-Gaulin K, Cittanova M-L, Beloeil H, Paugam-Bur tz C, Lukaszewicz A-C. Women in Anaesthesia and Intensive Care Medicine in France: are we making any progress? Anaesth Crit Care Pain Med. 2020. https://doi.org/10.1016/j.accpm.2020.04.019 PMID: 32650127

48. Larson AR, Kan CK, Silver JK. Representation of Women Physician Deans in U.S. Medical Schools. J Womens Health (Larchmt). 2019; 28: 600–605. https://doi.org/10.1089/jwh.2018.7448 PMID: 30920332

49. Schor NF. The Decanal Divide: Women in Decanal Roles at U.S. Medical Schools. Acad Med. 2018; 93: 237–240. https://doi.org/10.1097/ACM.0000000000001863 PMID: 28834842

50. Silver JK, Ghalib R, Poorman JA, Al-Assi D, Parangi S, Bhargava H, et al. Analysis of Gender Equity in Leadership of Physician-Focused Medical Specialty Societies, 2008–2017. JAMA Intern Med. 2019; 179: 433–435. https://doi.org/10.1001/jamainternmed.2018.5303 PMID: 30615072

51. Pora P, Wilner L. Les trajectoires professionnelles des femmes les moins bien rémunérées sont les plus affectées par l’arrivée d’un enfant. INSEE— Institut National de la Statistique et des Etudes Economiques; 2019. Accessed 7 May 2021 https://www.insee.fr/fr/statistiques/4226475.

52. Nocco SE, Larson AR. Promotion of Women Physicians in Academic Medicine. J Womens Health (Larchmt). 2020. https://doi.org/10.1089/jwh.2019.7992 PMID: 32407186

53. Derks B, Van Laar C, Ellemers N. The queen bee phenomenon: Why women leaders distance themselves from junior women. The Leadership Quarterly. 2016; 27: 456–469. https://doi.org/10.1016/j.leaqua.2015.12.007

54. Girod S, Fassiotto M, Grewal D, Ku MC, Sriram N, Nosek BA, et al. Reducing Implicit Gender Leadership Bias in Academic Medicine With an Educational Intervention. Acad Med. 2016; 91: 1143–1150. https://doi.org/10.1097/ACM.00000000000001099 PMID: 26826068

55. Ellemers N, van den Heuvel H, de Gilder D, Maass A, Bonvini A. The underrepresentation of women in science: differential commitment or the queen bee syndrome? Br J Soc Psychol. 2004; 43: 315–338. https://doi.org/10.1348/0144666042037999 PMID: 15479533

56. Steinpreis RE, Anders KA, Ritzke D. The Impact of Gender on the Review of the Curricula Vitae of Job Applicants and Tenure Candidates: A National Empirical Study. Sex Roles. 1999; 41: 509–528. https://doi.org/10.1023/A:1018839203698

57. Sambunjak D, Straus SE, Marusic A. Mentoring in academic medicine: a systematic review. JAMA. 2006; 296: 1103–1115. https://doi.org/10.1001/jama.296.9.1103 PMID: 16954490

58. Edmunds LD, Ovaieiko PV, Shepperd S, Greenhalgh T, Frith P, Roberts NW, et al. Why do women choose or reject careers in academic medicine? A narrative review of empirical evidence. The Lancet. 2016; 388: 2948–2958. https://doi.org/10.1016/S0140-6736(15)01091-0 PMID: 27105721

59. Davis T, Goldstein H, Hall D, Lawton B, Leo GSY, Yoshida R, et al. Women and children first? Gender equity in paediatric medicine. Arch Dis Child. 2019. https://doi.org/10.1136/archdischild-2018-316586 PMID: 31005893

60. Halley MC, Rustagi AS, Torres JS, Linos E, Plaut V, Mangurian C, et al. Physician mothers’ experience of workplace discrimination: a qualitative analysis. BMJ. 2018; 363: k4926. https://doi.org/10.1136/bmj.k4926 PMID: 30541926

61. Jena AB, Khullar D, Ho O, Olenski AR, Blumenthal DM. Sex Differences in Academic Rank in US Medical Schools in 2014. JAMA. 2015; 314: 1149–1158. https://doi.org/10.1001/jama.2015.10680 PMID: 26372584

62. Ministère de l’enseignement supérieur, de la recherche et de l’innovation. Enseignement supérieur et recherche—vers l’égalité Femmes-Hommes? Chiffres clés. 2021. Accessed 7 May 2021.
63. Wu B, Bhulani N, Jalal S, Ding J, Khosa F. Gender Disparity in Leadership Positions of General Surgical Societies in North America, Europe, and Oceania. Cureus. 2019; 11: e6285. https://doi.org/10.7759/cureus.6285 PMID: 31911877

64. Waseem Y, Mahmood S, Siddiqi R, Usman MS, Fatima K, Acob C, et al. Gender differences amongst board members of endocrinology and diabetes societies. Endocrine. 2019; 64: 496–499. https://doi.org/10.1007/s12020-019-01861-9 PMID: 30788668

65. Tomizawa Y. Gender gap in medicine: only one woman councilor in the Japan Surgical Society. Tohoku J Exp Med. 2015; 235: 97–102. https://doi.org/10.1620/tjem.235.97 PMID: 25749180

66. League Of European Research Universities. Implicit bias in academia: a challenge to the meritocratic principle and to women's careers—and what to do about it. January, 2018. 7 May 2021. https://www.leru.org/files/Publications/Implicit-bias-in-academia-Full-Paper.pdf.