Female Models in AI and the Fight Against COVID-19 [version 1; peer review: 1 approved, 2 approved with reservations, 1 not approved]

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Abstract
Gender imbalance has persisted over time and is well documented in the fields of science, technology, engineering and mathematics (STEM) and singularly in artificial intelligence (AI). In this article we emphasize the importance of increasing the visibility and recognition of women researchers to attract and retain women in the AI field. We review the ratio of women in STEM and AI, its evolution through time, and the differences among disciplines. Then, we discuss the main sources of this gender imbalance highlighting the lack of female role models and the problems which may arise; such as the so called Marie Curie complex, survivorship bias, and impostor syndrome. We also emphasize the importance of active participation of women researchers in conferences, providing statistics corresponding with the leading conferences. Finally, to support these views, we give examples of several prestigious female researchers in the field and we review their research work related to COVID-19 displayed in the workshop “Artificial Intelligence for the Fight Against COVID-19” (AI4FA COVID-19), which is an example of a more balanced participation between genders.

Keywords
Women, AI, STEM, COVID-19, AI4FA COVID-19
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Introduction
Throughout history, women have played a prominent role in science, technology, engineering and mathematics (STEM) disciplines, however, their work has not always been duly recognized. The ratio of women in STEM positions has grown in the last decades, but still they are underrepresented and growth rate has fallen in the last years (see Figure 1). Women constitute 47% of Europe workforce, but the percentage of women scientists and engineers employed in high-tech sectors is only 22%. The proportion of women also varies across STEM disciplines: in Europe the quota of women in tertiary education is 36% in physical sciences, 28% in mathematics and statistics, 21% in information and communication technology, and 27% in engineering.

In this opinion article, we review the ratio of women in artificial intelligence (AI), showing that the gender imbalance has decreased in the last years but progress is still too slow. We discuss the causes of gender imbalance in the field, placing special emphasis on the lack of female role models. We review related problems like the so-called Marie Curie complex, survivorship bias, and impostor syndrome. Furthermore, we emphasize the leaky pipeline of women in STEM, highlighting the significant drop-out rates. In our opinion, to tackle gender imbalance in STEM we need to attract women to science and to retain researchers already in the field.

Next, we describe the participation of female researchers in conferences and the importance of events in which both men and women participate actively. We expose the workshop AI4FA COVID-19 as an example to support this view.

We highlight the career of four outstanding women researchers in AI: Prof. Concha Bielza, Prof. Emilie Chouzenoux, Prof. Mihaela van der Schaar, and Prof. Laure Wynants. Then, we review the contributions of those researchers for the fight against COVID-19 displayed in the workshop “Artificial Intelligence for the Fight Against COVID-19” (AI4FA COVID-19) carried out at BCAM in April 2022. Finally, we conclude that the gradual increase of women in AI is still too slow. Emphasis is placed on raising awareness in the community and making women in AI more visible and recognized as a measure to close the gender gap.

Underrepresentation of women in AI
The gender gap remains in STEM disciplines, and is even more pronounced in AI and data analytics industry. According to Harnham diversity in data and analytics report, in the last year the percentage of women in data industry has stayed the same or even dropped. The percentage of professional women in data analytics is 22% in Europe (Figure 1) and 27% in the US and such inequality is accentuated in senior positions. Only 11% of leaders in the data industry in Europe are women and in Spain the ratio drops to 6%. The lack of female managers is reflected in a 13% pay gap with large fluctuations among countries. In the last year, France and Norway have reduced their pay gap to 5% and 7% while the Netherlands maintained a 24% gap and the UK doubled it from 7% to 13.5% in the last two years. AI research also presents little gender equality. In 2019, only 13.8% of the scientific papers in AI were authored by women and the ratio of female co-authors has not increased in over 30 years.

Underrepresentation of women continues in grants and scientific societies. Only 23 women have won a Nobel Prize in physics, chemistry, and medicine since Marie Curie in 1903, compared to 606 men. European Research Council (ERC)
Grants bestowed to women have grown by 3% over the past four years, reaching 35% of female grantees by 2021. However, the proportion of women is again significantly lower in the senior categories. For instance, in ERC Advanced Grants the rate of female grantees is only 25% (Figure 2). The percentage of women elevated to IEEE Fellow has slowly increased by 8% over the past two decades. In 2021 only 14% of IEEE Elevated Fellows were women (Figure 2).

We are of the opinion that the reason for gender gap in STEM disciplines is not unique, but rather a set of deep social conceptions and biases difficult to synthesize. Studies show that two decisive factors are a masculinized view of science and lack of a sense of belonging among women scientists to the intellectual community. Both situations can be improved by making women in STEM more visible and fostering collaboration both among women and among the intellectual community.

Lack of female visibility, in turn, is due not only to gender imbalance, but also to social biases. Female researchers denounce that their early works often only gain attention later in their careers, in stark contrast to their male peers. We consider that a system that only pays attention to female researchers when they are superlative talented is doomed to discourage present and future female researchers by fostering the Marie Curie complex. This term refers to the impact of highlighting exclusively exceptionally brilliant women scientists, such as the first women in earning a Nobel Prize, Marie Curie. It leads to believe that successful female STEM careers are exceptional and unattainable. Lack of attainable role-models might promote unrealistic high standards which may lead to frustration, lack of a sense of belonging, impostor syndrome and, ultimately, not to pursue a scientific career or give up on it.

Bringing more diversity and equality into STEM is crucial for three main reasons. First, the participation of women is always positive to bring different perspectives into the field, and can contribute to increase innovation. Second, according to the European Institute for Gender Equality, closing gender gap in STEM would increase overall productivity and labor market activity fostering economic growth. Last, it is already a fact that AI and technological advances are redefining our future as a society. If women do not participate in that transition, women’s perspectives in our collective future would be lost.

To achieve a more gender-balanced scenario in STEM, it is clear that a primary goal is to attract women to STEM disciplines, but the work does not stop there. To bring more gender equality into STEM, we need women to stay in science. The second goal is to avoid the leaky pipeline of women leaving STEM disciplines. The leak of women in STEM is confirmed by the gap between women studying STEM tertiary education in contrast to the percentage of women in the STEM workforce or in research. Furthermore, numerous studies find that women leave STEM significantly more than men. For example, in the US 24% of women leave full-time STEM employment in contrast to 16% of men, i.e., 50% more. When we focus on researchers who had become parents the figures increase to 23% for men and a devastating 43% for women.
We consider it critical to highlight the leaking of women in the STEM pipeline. This implies that while improving the visibility of women in the field is necessary, it is not sufficient. Focusing only on successful women who have been able to stay in science might spawn survivorship bias. This term refers to the logical error of concentrating on those that past some selection process and overlooking those that did not, which may lead to false conclusions. We want to emphasize the need to address gender gap in STEM as an structural problem that needs to be tackled from the root. We believe that the first step is to make the whole scientific community aware of the problem to be able to work on it collectively.

**Female models in AI**

Despite gender imbalance, there are many women pioneering AI research around the globe. There are organizations to support them and foster collaboration among women in the field. For example, the initiative Women in AI (WAI) seeks to bring awareness and knowledge through education, like the educational program for training and mentoring Wai2GO, events, like Women in AI Awards, and blogging. https://www.widsconference.org inspires and educates data scientists worldwide and supports women in the field by means of the annual https://www.widsconference.org/conference.html, annual datathons dedicated to different topics of social interest, podcasts, and an education outreach program. Women in Machine Learning (WiML) enhances the experience of women in machine learning by organizing an annual workshop co-located with NeurIPS, small events, a mentoring program for Ph.D. students and a directory and profiles of women in machine learning.21

We find these initiatives of great importance to support women in AI and improve their visibility. Nevertheless, we find a fundamental flaw that is repeated all over these kind of events and initiatives: the public is almost exclusively female. We think that fostering collaboration among women is vital, but we should be careful not to call for gender apartheid in the way. We believe that, ultimately, the only effective way to achieve gender balance is to approach the problem collectively. We cannot change how the STEM disciplines operate without more than half of the STEM community. For this reason we believe that promoting collaboration both among women and among each and every person in STEM regardless of gender is critical.

In our opinion, scientific conferences and workshops should include people of all genders as audience and speakers. It is this second part that, unfortunately, is most often neglected in non-exclusively female initiatives. A study conducted in 2018 showed that only 12% of researchers published in the leading AI conferences (Neural Information Processing Systems, International Conference on Machine Learning, and International Conference on Learning Representations) are women.22 This number contrasts with the 22% of women working in AI.

Next, we describe the workshop AI4FA COVID-19 as an example of a more gender-balance collaboration in AI events. This event counted with a 33% of female speakers and a 100% of female keynote speakers. The workshop received the participation of four women leading AI research for the fight against COVID-19 as keynote speakers: Prof. Concha Bielza, Prof. Emilie Chouzenoux, Prof. Mihaela van der Schaar, and Prof. Laure Wynants. These researchers, besides working on cutting-edge research on different collaborative projects, are pioneers in their fields. In addition, they are a cross-section of women’s leadership in AI, at different points in their careers and with varying degrees of experience and background. In the workshop they shared their work with a diverse audience of researchers. In what follows, we introduce them and the work they presented on this workshop.

Professor Bielza is Full Professor of Statistics and Operations Research in the AI Department at the Polytechnic University of Madrid. She has received multiple awards for her work, highlighting the Research Award for Significant Contribution in the Field of Machine Learning granted in 2020 by Amity University. In 2021 she was appointed Member of the Scientific Advisory Board of NorwAI (Norwegian Research Center for AI Innovation) and she is a Member of the Transfer Committee of the Spanish Royal Society of Mathematics and a Member of the Academic Council of ValgrAI (Valencian Graduate School and Research Network of Artificial Intelligence). Along her career, Concha has pointed out the importance of female participation in AI to define our own future. In addition, she emphasizes the importance of the participation of men in the joint responsibility in contributing to close the gender gap.23

Professor Chouzenoux is a Researcher at Inria Saclay within the project team OPIS (Optimization for large scale biomedical data), in the Center for Digital Vision of University Paris Saclay. She is the principal investigator of the ERC Starting Grant MAJORIS initiated in 2020. She is also an Associated Editor for the IEEE Transactions in Signal Processing, and SIAM Journal on Mathematics of Data Science. Regarding gender gap in STEM, Emilie spots that a major factor is lack of information and the impostor syndrome. She proposes introducing girls from an early age to the careers of successful researchers in order to broaden the options for the future they envision. She also emphasizes that the fight for women’s participation in science could benefit from being considered more widely. Therefore, it is important to educate young girls and boys in a joint dissemination of scientific culture, at school and family sphere.22
Professor van der Schaar is the John Humphrey Plummer Professor of Machine Learning, Artificial Intelligence and Medicine at the University of Cambridge and a Fellow at The Alan Turing Institute in London. In addition to leading van der Schaar Lab, she is the founder and director of the Cambridge Centre for AI in Medicine. She has received numerous international awards and recognition for her work, highlighting the Oon Prize on Preventative Medicine from the University of Cambridge, three IBM Faculty Awards, the IBM Exploratory Stream Analytics Innovation Award, the Philips Make a Difference Award, Star in Computer Networking and Communications by N2Women, Royal Society Wolfson Research Merit Award, and the IEEE Darlington Award. She was elected IEEE Fellow in 2009 and she is the most-cited female AI researcher in the U.K.5 During her career, Mihaela has organised several outreach activities dedicated to empowering women in engineering and computer science. To address gender imbalance among AI workers and researchers, Prof. van der Schaar proposes to show the creative and human aspect of AI and ML to the public, especially to women.25

Professor Laure Wynants is an Assistant Professor of Epidemiology at Maastricht University and KU Leuven. She is an Associate Editor for BMC Diagnostic and Prognostic Research, member of the International Society for Clinical Biostatistics, and member of STRATOS’ (STRengthening Analytical Thinking for Observational Studies) topic group on the evaluation of diagnostic tests and prediction models. She wrote one of the most read papers in Statistics in Medicine in 2019.26 In addition, she has received multiple awards including the Edmond Hustinx Prize for Science. Laure has pointed out often the need to increase the gender-balanced in science, for instance, she declared that, after more than 10 years in the field, she was glad to attend for the first time a completely female panel at the Winter School of the University of Padova.27

Workshop AI4FA COVID-19
As mentioned above, the workshop AI4FA COVID-19 is an example of a more gender-balance in AI events with a 33% of female speakers and a 100% of female keynote speakers.

There are indeed women doing cutting-edge AI research and it is vital to recognize their work and give them much more visibility at all career levels to bring more women into the field. The workshop AI4FA COVID-19 counted with the participation of four excellent female keynote speakers doing remarkable research.28,29 It was hosted by the Basque Center for Applied Mathematics (BCAM) in collaboration with AXA Research Fund and the Basque Government. The workshop was held from the 6th to the 8th of April 2022 and it was part of the project “Early prognosis of COVID-19 infections via machine learning” funded by AXA Research Fund under the Exceptional Flash Call “Mitigating risk in the wake of the COVID-19 pandemic”, and the project “Mathematical Modelling Applied to Health” funded by the Basque Government.

The workshop featured presentations by keynote speakers: Prof. Concha Bielza, Prof. Laure Wynants, Prof. Mihaela van der Schaar, and Prof. Emilie Chouzenoux (Figure 3). The four keynote speakers presented leading-edge investigation of AI techniques applied to the fight against COVID-19 pandemic. They are women pioneering in this area of research.

![Keynote speakers at AI4FA COVID-19 workshop.](image-url) From left to right: Prof. Mihaela van der Schaar, Prof. Emilie Chouzenoux, Prof. Laure Wynants and Prof. Concha Bielza.
Prof. Bielza opened the workshop with the session “Interpretable machine learning applied to COVID-19.” She presented her work and preliminary analyses with data from patients in hospitals of the six waves of the pandemic in Madrid. Her investigation puts a special spotlight on model interpretability and human-in-the-loop solutions by means of Bayesian networks and decision trees.

Prof. Wynants presented the talk “A journey through the disorderly world of diagnostic and prognostic models for COVID-19: a living systematic review.” She leads the international consortium conducting a living systematic review of diagnostic and prognostic models for COVID-19. They have screened over 126,000 records, 412 studies and 731 prediction models. It already has over 2000 citations, and has been picked up by policymakers, including the European Commission and the World Health Organization. She detected issues with applicability and methodological biases in the majority of models, and identified a small number of usable models.

Prof. van der Schaar presented her work “Covid and AI: Unexpected challenges and lessons.” She emphasized what she and her team learned from working with clinicians. She noted that explainability means something different for them than for AI professionals and that explainable AI is vital in clinical applications. Mihaela addressed the explainability problem by using symbolic metamodeling. It consists on finding a whitebox model, defined by an explicit function, for an input blackbox model.

Prof. Chouzenoux participated in the workshop with the session “Data Science and Artificial Intelligence for healthcare: COVID-19 use case.” She presented an AI model developed within the collaborative project ScanCovIA. The model gives accurate COVID-19 prognosis decision to help clinicians. It processes computerized tomography imaging features together with selected clinical and biological biomarkers.

The main conclusion of the workshop was that quality AI models for fight against COVID-19 need quality data. Therefore, AI work starts in health care services. It is key to work with clinicians, learn about their needs and explain them the data that will make it possible to meet those needs.

Projects like AI4FA COVID-19 workshop help in celebrating leading women researchers in AI, and in put a face on them. In this way, both the representation of women in the field and the disparity in the recognition they receive can be improved.

Conclusions
The number of women working and researching in AI is increasing, however, there is still much work to be done to achieve parity in representation and recognition. There is a clear need to take action to attract and retain women in artificial intelligence (AI) in order to close the actual gender gap. We believe that it is necessary to make women in the field more visible to address the problem. It is essential to give visibility to women researchers in AI, with special emphasis on the early career, as this is the period in which there has been the most inequality in public recognition. Providing spaces for female AI figures to speak up and disseminate their research and careers can be an important step in closing the gender gap.

Furthermore, we believe that the first step should be to raise awareness of the problem and its various manifestations among the entire scientific community working in AI. We propose to focus on the following issues: less recognition for female research, specially in early careers, higher female drop-out rates, Marie Curie complex, suvivorship bias, and impositor syndrome.

We look at the percentage of female researchers published in leading conferences as a measure of gender-balance in the field, finding that only 12% of authors are women. We insist on the importance of events that bring together men and women in AI to share their research with gender parity both among the audience and the speakers, and we present AI4FA COVID-19 workshop as an example of such an event.

The outstanding women researchers; Prof. Bielza, Prof. Chouzenoux, Prof. van der Schaar, and Prof. Wynants, provide a remarkable example of cutting-edge AI research lead by women. The AI4FA COVID-19 workshop was honored to have the participation of these four keynote speakers to present their work on AI for the fight against COVID-19. We highlight the workshop as an example of the kind of activities that can help attract and retain more female researchers to the field.

We maintain that raising awareness in the STEM community and improving visibility and recognition of female researchers at every career level are key aspects to attract more women into STEM and break the current cycle of women leaving the field.
Data availability
No data are associated with this article.

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This paper analyses the gender imbalance in the artificial intelligence (AI) field. It summarizes the ratio of data analytics industry in the last years, the evolution of AI women researches in international conferences, as a leaders, as authors of scientific papers, wining the Nobel Prize, in the European Research Council (ERC), etc. From this analysis, the authors try to explore the causes of the current gender gap in STEM disciplines and, specifically, in the AI field.

They conclude that the gender gap in STEM is a structural problem that needs to tackled from the root. They propose some initiative to make the whole scientific community aware of the problem in order to solve it.

One of this initiative is the organization of the workshop AI4FA COVID-19. This event counted with 33% of female speakers and 100% of female keynotes speakers (Dr. Concha Bielza, Emilie Chouzenoux, Mihaela van der Schaar and Laure Wynants), which are pioneers researchers in AI. With events like this, we can improve the visibility of women in the scientific community and in the society.

Although the authors describe an initiative to improve gender imbalance in AI, I think they can mention some strategies to attract female students to the high education in the STEM disciplines and how to promote female STEM vocation in the non-university students.

Is the topic of the opinion article discussed accurately in the context of the current literature?  
Yes

Are all factual statements correct and adequately supported by citations?  
Yes

Are arguments sufficiently supported by evidence from the published literature?
Yes

**Are the conclusions drawn balanced and justified on the basis of the presented arguments?**
Partly

**Competing Interests:** No competing interests were disclosed.

**Reviewer Expertise:** computer vision, machine learning, artificial intelligence, gender

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

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The aim of this article is to review the ratio of women in STEM and AI, its evolution through time, and the differences among disciplines and gender and an assessment of the sources of this gender imbalance. It makes suggestions on the importance of active participation of women researchers in conferences, providing statistics corresponding with the leading conferences. Overall, this is an interesting and timely opinion article given the heightened increase in both AI and the continued calls in policy and practice to increase the participation of females across a number of STEM related activities both in employment, in commercialising research and in the startup and entrepreneurship domains.

The following review provides feedback on the strengths of the paper and provides suggestions on areas of development in the editing of the piece. It is a challenge for authors to manage word count when they are so familiar with and passionate about sharing their learnings and suggestions for advancement on a topic and thus, I am sure the answers to the comments below are readily available to the authors.

The introduction section would benefit from including descriptors or the parameters for the key themes being investigated to ensure clarity and signalling to the reader as to the specifics of what are broad topics. For instance:
  - **AI** - as it is an ever-changing concrete and a term used interchangeably and multidimensional - so is it AI in general or AI as part of the researcher in general population as is AI more specifically relevant to certain cohorts.
  - **Researcher** - the researcher population is broad in nature - Is this paper examining researchers working in or within employment only or is the data relating to startup or the
commercialisation of research.

- Is the focus specifically on female researchers in AI or researchers in STEM – or a combination or AI is assumed as part of STEM? Clarification of this will highlight more explicitly the unit of analysis

**Literature Review**

The section titled *Underrepresentation of women in AI* is very effective in establishing a factual context and the identification of the characteristics of the underrepresentation which are consistent across females in paid employment and those in the researcher domain and highlights the continued gap between males and females.

The analysis on the challenges presents a good deeper level analysis of the less obvious factors and brings to the fore novel topics for consideration for females in AI. For instance, the discussion on issues and challenges relating to the lack of attainable role models is effective as it reduces the more general focus on having role models which may not be attainable – and thus have less impact.

Additionally, factors such as ‘survivorship bias’ – which is less mentioned in research is an important and value-added point in this research. Further the discussion and points made about the focus should not be solely on how to bring more people into STEM but also to develop them and broadening it beyond the female population provides a useful point for debate and consideration.

Some points to consider are as follows;

- Data and Statistics provided – are these specific to female researchers or females in general in research and non-research fields – while the general data is useful as a framing context if not specific or reflective AI researchers then commentary to this effect is important and assessment of the implications or learnings from the data for female researchers in AI.

- Figure 2. Women bestowed European Research Council Grants in Physical Sciences and Engineering and elevated to IEEE Fellow - is this in general across STEM or AI?
- Linkage of STEM initiatives and those in AI – are the two sets of intiaitves similar and can the synergies of both be aligned to reduce potential duplication or overlap.

- What is the rationale for introducing Marie Curie funding as opposed to similar research funding providers – why this source and is it more relevant or targeted to AI? Does it provide a fair or appropriate representation of women in broader arena of AI?

  More general points relate to metrics applied Metrics to measure and access impact – is it publications; working in AI; researching in AI and or commercialising research and why those?

**Methodology**

The methodology is not referred to in the article and this should be addressed and take into consideration the following points.

- What is the research approach or methodology adopted – is it the case study method where the cases are the workshops?. Details on the research approach adopted and the rationale for its choice requires consideration.
Was the workshop designed to investigate or explore the research aims of this paper or was it already available and used for this paper?

What was the aim and outcomes or learnings that guided the development of the workshop and how do these relate to providing insights into the research questions. These are important to establish the foundation on which to measure the impact or success of the workshop in delivering on the objectives.

In relation to measuring or assessing the impact of the workshop – how was the outcomes measured from the different perspectives- what criteria were applied and who undertook the assessment?

The workshop is presented as leading-edge investigations of AI techniques applied to the fight against COVID-19 pandemic – so was the dominant focus on the description of the projects and their use and benefits in Covid or did the speakers reflect and story tell their personal STEM journey in research and about bringing the research to reality or a finished product/service?

Reference is made that the AI4FA COVID-19 workshop ‘helps in celebrating leading women researchers in AI, and in put a face on them’ – was there a discussion on how the content addressed the personal challenges or the journey the female speakers navigated to– did they discuss or refer to the issues identified in the previous sections in the literature and did they speak to these to enable other females understand and identify ways of overcoming these challenges.

The discussion on the workshop is largely descriptive and lacks constructive critical analysis or critique to highlight the learnings both positive and negative and what they would do the next time around to add to it – the transferability of the learnings to enable readers to be in a position to develop similar workshops.

Was the evaluation of the workshop based on the organisers own views or did it engage with participants and speakers to ascertain their feedback – this would provide more objective ‘other and user’ party evaluation to determine where and how the workshop provided ways or mechanisms to address the challenges identified in the review of the literature?

What criteria or measures were used to determine the impact of the workshop, what were the reasons it was deemed impactful – more constructive critique of the event based on its objectives and in particular to the research questions of this piece.

What was the rationale for the selection of these speakers and were they considered attainable role models?’

**Conclusion**

In the discussion in the conclusion section reference is made to ‘number of females publishing’ but is this a fair or accurate measure/indicator of ‘gender imbalance in this field’ as the researchers may be productive in achieving outcomes in different areas?
Content in this section should more explicitly highlight the various contributions the research has made to practice, scholarly and if possible policy or educational domains given the nature of the research questions. The research should speak to those parties/stakeholders who have potential to remedy the challenges identified.

State future directions for research as these are not mentioned.

Is the topic of the opinion article discussed accurately in the context of the current literature?
Yes

Are all factual statements correct and adequately supported by citations?
Partly

Are arguments sufficiently supported by evidence from the published literature?
Yes

Are the conclusions drawn balanced and justified on the basis of the presented arguments?
Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Entrepreneurship, EntreSTEAM, Women in STEM, Commercialisation of Research

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.
not discuss the issue in a proper way.

In my opinion, there are several limitations that make the article not suitable for publication. First, the underrepresentation of women in AI, which should be the focus of the article, is very briefly presented, while more space is given to the gender gap in other scientific sectors.

Second, I think that the description of the four scientists mentioned in the paper does not contribute to the paper. Here, the discussion on the AI4FA COVID-19 conference is said to be an example of a more balanced participation between genders. However, I do not see how a lengthy description of this conference and its speakers can contribute to the understanding of the theme. I do understand the intent of the authors of providing positive examples, however this should have been included in a more rigorous discussion on the gender gap in AI, which in my opinion is missing.

A solid background and explanation of the motivations for the description of the conference is missing and, consequently, the conclusions drawn are not justified.

Is the topic of the opinion article discussed accurately in the context of the current literature?
No

Are all factual statements correct and adequately supported by citations?
Partly

Are arguments sufficiently supported by evidence from the published literature?
No

Are the conclusions drawn balanced and justified on the basis of the presented arguments?
No

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: STEM gender gap

I confirm that I have read this submission and believe that I have an appropriate level of expertise to state that I do not consider it to be of an acceptable scientific standard, for reasons outlined above.

Reviewer Report 04 September 2023

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Introduction: This article focuses on the crucial and pressing issue of gender imbalances within the AI ecosystem. The authors' primary objective is to emphasize the significance of enhancing the visibility and recognition of women researchers in the field. Within the article, various challenges that women face, such as the "Marie Curie complex," survivorship bias, and imposter syndrome, are briefly discussed. Additionally, the authors present a list of female researchers in AI in Europe and highlight their contributions to COVID-19 research to bolster their arguments.

Review and Comments:

1. Relevance and Scope: The article tackles a topic of great relevance within the STEM community. Nevertheless, there is a concern about potential bias within the article itself. While the authors commendably cite four notable female AI researchers involved in COVID-19 research, the omission of examples from North America and other regions is notable. It would strengthen the article's credibility to provide a broader international perspective on female role models in AI. I would like reference to a relevant article addressing gender parity in AI within the Canadian context, which is unmentioned in this piece (link provided: https://pubmed.ncbi.nlm.nih.gov/35865270/) \(^1\). (Conflict of Interest is declared by the reviewer). Therefore, it is recommended that the article be revised to explicitly state its regional context, specifically focusing on Europe.

2. Promotional Aspect: There appears to be a promotional undertone throughout the article, primarily for the Workshop AI4FA COVID-19 and its keynote speakers. To maintain a balanced and objective tone, it is advisable to minimize the detailed information about the workshop and the speakers. A brief mention and link to the workshop can suffice, ensuring that the primary focus remains on the broader issues of gender imbalances in AI.

3. Structural and Professionalism Improvements: Several structural and professionalism issues require attention. First, there are broken links within the article, which hinder the reader's experience and access to relevant resources. These should be promptly fixed to ensure a seamless reading experience. Furthermore, both the abstract and the article's content could benefit from a more professional and standard article format, enhancing the overall presentation.

4. Avoiding Bias: The central idea presented in the article, while important, carries the risk of inherent bias. It is crucial to present a balanced perspective and acknowledge the progress and initiatives addressing gender imbalances in AI alongside the challenges. Striving for objectivity and comprehensiveness will enhance the article's impact and credibility.

Conclusion:

In conclusion, the article addresses a significant and timely issue regarding gender imbalances in the AI ecosystem. However, it requires substantial revisions to ensure impartiality, broaden its geographical scope, improve its structure and professionalism, and mitigate potential biases. By taking these recommendations into account, the authors can create a more impactful and inclusive article that contributes effectively to the ongoing conversation on gender equity in AI.
References
1. Daraz L, Chang BS, Bouseh S: Inferior: The Challenges of Gender Parity in the Artificial Intelligence Ecosystem-A Case for Canada. Front Artif Intell. 2022; 5: 931182 PubMed Abstract | Publisher Full Text

Is the topic of the opinion article discussed accurately in the context of the current literature?
Partly

Are all factual statements correct and adequately supported by citations?
Yes

Are arguments sufficiently supported by evidence from the published literature?
Partly

Are the conclusions drawn balanced and justified on the basis of the presented arguments?
Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Implementation Science, Health Informatics, Health Literacy, Internet, Diverse populations, Social determinants of health, Health equity.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

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