



OPEN LETTER

REVISED **A PowerPack of SuperScientists: An innovative concept by African scientists to address gender bias and inequity in science [version 2; peer review: 1 approved, 1 approved with reservations]**

Maphe Mthembu ^{1,2}, Omolara Baiyegunhi ^{1,2}, Yanga Mdleleni^{2,3}, Lerato Ndlovu^{1,2}, Hannah Keal¹, Kim Waddilove¹, Justin C. Yarrow⁴, Victoria Kasproicz^{1,2,5}, Thumbi Ndung'u ^{1-3,5-7}, Emily B. Wong ^{1,8}

¹Africa Health Research Institute, Durban, 4001, South Africa

²University of KwaZulu-Natal, Nelson R. Mandela School of Medicine, Durban, 4001, South Africa

³HIV Pathogenesis Programme, The Doris Duke Medical Research Institute, University of KwaZulu-Natal, Durban, 4001, South Africa

⁴CodeMakers NPC - SuperScientists, Durban, 4001, South Africa

⁵Ragon Institute of MGH, MIT and Harvard, Cambridge, MA, 02139-3583, USA

⁶Harvard Medical School, Boston, MA, 02115, USA

⁷Division of Infection and Immunity, University College London, London, WC1E 6BT, UK

⁸Division of infectious Diseases, Heersink School of Medicine, University of Alabama at Birmingham, AL, 35294, USA

V2 **First published:** 11 Mar 2022, 7:87
<https://doi.org/10.12688/wellcomeopenres.17668.1>
Latest published: 24 Feb 2023, 7:87
<https://doi.org/10.12688/wellcomeopenres.17668.2>

Abstract

Underrepresentation of women in scientific leadership is a global problem. To understand and counter narratives that limit gender equity in African science, we conducted a public engagement campaign. Scientists representing six sub-Saharan African countries and multiple career stages used superhero imagery to create a diverse and unified team advocating for gender equity in science. In contrast to many traditional scientific environments and global campaigns, this "PowerPack of SuperScientists" was led by early-career Black female scientists whose perspectives are often under-represented in discussions about gender equity in science. The superhero imagery served as a powerful and fun antidote to imposter syndrome and helped to subvert traditional power structures based on age, race and sex. In an interactive social media campaign, the PowerPack developed insights into three themes: a) cultural stereotypes that limit women's scientific careers, b) the perception of a "conflict" between family and career responsibilities for women scientists, and c) solutions that can be adopted by key stakeholders to promote gender equity in African science. The PowerPack proposed solutions that could be undertaken by women working individually or collectively and interventions that require allyship from men,

Open Peer Review

Approval Status ? ✓

	1	2
version 2 (revision) 24 Feb 2023		✓ view
version 1 11 Mar 2022	? view	↑ ? view

- Faith Osier** , Imperial College London, London, UK
KEMRI-Wellcome Trust Research Programme, London, UK
- Millicent Liani** , International Institute of Tropical Agriculture, Oyo State, Nigeria

Any reports and responses or comments on the article can be found at the end of the article.

commitment from scientific institutions, and wider societal change. Further work is required to fully engage African scientists from even more diverse and disadvantaged backgrounds and institutions in these solutions and to enhance commitment by different stakeholders to achieving gender equity in science. Our experience suggests that creative tools should be used to subvert power dynamics and bring fresh perspectives and urgency to this topic.

Keywords

Gender equity, African science, Intersectionality, Bias, Early career scientists

This article is included in the [Africa Health](#)



[Research Institute \(AHRI\) gateway.](#)

Corresponding author: Emily B. Wong (emily.wong@ahri.org)

Author roles: **Mthembu M:** Conceptualization, Formal Analysis, Funding Acquisition, Methodology, Project Administration, Resources, Writing – Original Draft Preparation, Writing – Review & Editing; **Baiyegunhi O:** Conceptualization, Validation, Writing – Review & Editing; **Mdleleni Y:** Conceptualization, Validation, Writing – Review & Editing; **Ndlovu L:** Conceptualization, Validation, Writing – Review & Editing; **Keal H:** Conceptualization, Funding Acquisition, Methodology, Project Administration, Writing – Review & Editing; **Waddilove K:** Conceptualization, Funding Acquisition, Methodology, Project Administration, Writing – Review & Editing; **Yarrow JC:** Conceptualization, Funding Acquisition, Methodology, Project Administration, Writing – Review & Editing; **Kasprowicz V:** Conceptualization, Funding Acquisition, Methodology, Project Administration, Supervision, Writing – Review & Editing; **Ndung'u T:** Supervision, Validation, Writing – Review & Editing; **Wong EB:** Conceptualization, Funding Acquisition, Methodology, Project Administration, Supervision, Validation, Writing – Review & Editing

Competing interests: No competing interests were disclosed.

Grant information: This work was supported by the African Academy of Sciences (AAS) through a community and public engagement seed grant focusing on gender equity in science [CPE/GENDER/19/012] (to MM); and under a DELTAS Africa Initiative grant [DEL-15-006] as part of the Sub-Saharan African Network for TB/HIV Research Excellence (SANTHE). The DELTAS Africa Initiative is an independent funding scheme of the AAS's Alliance for Accelerating Excellence in Science in Africa (AESA) and supported by the New Partnership for Africa's Development Planning and Coordinating Agency (NEPAD Agency) with funding from the Wellcome Trust [107752] and the UK government. The views expressed in this publication are those of the author(s) and not necessarily those of AAS, NEPAD Agency, Wellcome Trust or the UK government.

The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Copyright: © 2023 Mthembu M *et al.* This is an open access article distributed under the terms of the [Creative Commons Attribution License](#), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

How to cite this article: Mthembu M, Baiyegunhi O, Mdleleni Y *et al.* **A PowerPack of SuperScientists: An innovative concept by African scientists to address gender bias and inequity in science [version 2; peer review: 1 approved, 1 approved with reservations]** Wellcome Open Research 2023, 7:87 <https://doi.org/10.12688/wellcomeopenres.17668.2>

First published: 11 Mar 2022, 7:87 <https://doi.org/10.12688/wellcomeopenres.17668.1>

REVISED Amendments from Version 1

The points below summarise amendments made from version 1 to address reviewers' comments:

1. The word "fighting" was replaced with "advocating" for gender equity in science throughout the paper as the term fighting has been labeled as being derogative.
2. "Internal" and "individual" were used interchangeably to describe the nature of narratives or solutions to gender equity in science and to remove any confusion that this may cause we now decided to use "individual" throughout the paper.
3. This version now highlights the weakness of the current work of not having included scientific institutions or people or voices from disadvantaged or not well-funded backgrounds as they might have added a different flavor to the current voices.
4. The current version also includes a few more added references from the Sub-Saharan African region since this work is reporting voices from the Sub-Saharan African region.
5. It is now also emphasized throughout the paper that we captured voices from only the Sub-Saharan region and not the whole of Africa.
6. It is now emphasized how language and geographic location influence cultural behaviors which then directly dictate where we find ourselves in science.
7. The importance of workshops and mentorship in improving women's scientific outputs is now emphasized.
8. We also emphasize the importance of having scientific donors or funders more intentional about funding and supporting women scientists as a straightforward way of regressing inequity.
9. It is now also emphasized that the gender equity issue is a matter of urgency to improve the quality and innovation of African science.

Any further responses from the reviewers can be found at the end of the article

Disclaimer

The views expressed in this article are those of the author(s). Publication in Wellcome Open Research does not imply endorsement by Wellcome.

Background

Throughout the world, and in Africa, women are under-represented in science¹. The well-worn analogy of the "leaky pipeline" illustrates that a great number of women scientists are "lost" to science at various points along their career, resulting in fewer women leading scientific publications, being awarded prestigious grants, faculty, and leadership positions².

Historical and systemic factors prevent women from pursuing and thriving in scientific careers³⁻⁵. Women occupy over 70% of global health positions but less than 25% of leadership positions⁶. Even in countries with highly diverse populations, gender and racial disparities interact to decrease diversity in the scientific workforce. In the USA, scientific faculty and leadership positions are dominated by men and white people while Black and Hispanic women are poorly represented in these ranks⁷. The sub-Saharan Africa (SSA) Science Granting Council (SGC) who are key players of African science innovation were also reported to have more men than women holding positions across most levels of employment especially leadership positions⁸. The underrepresentation of women, and in particular

Black women, in scientific leadership positions costs science and society. Limited representation of women in scientific leadership hampers the ambitions of girls seeking career role models and the practical advice and help available to women seeking to advance their scientific careers. The insights, voices and perspectives of women from diverse backgrounds are under-represented among circles of scientific influence. The overall quality of science is impacted because innovative ideas stem from teams that represent diverse perspectives⁹. The achievement of gender diversity in science has been linked to substantial increases in scientific outputs, creativity and innovation^{6,9}.

The coronavirus disease 2019 (COVID-19) pandemic has further exacerbated existing gender inequalities in science¹⁰. During the pandemic, women have experienced unique pressures and childcare demands on their time resulting in decreased scientific authorship by women^{11,12}. There is an urgent need for radical solutions to promote diversity in science, especially in scientific leadership.

We describe a project that was established to spark dialogue among scientists whose voices are often side-lined due to intersecting race and gender power dynamics. Our aim was to reframe narratives that contribute to gender inequity in science, by re-imagining African scientists at all career stages as superheroes working as a team to advocate for the idea of gender equity in science. Here, we provide details about our online campaign and its insights into potential solutions for achieving gender equity in African science.

Approach

We engaged in a collaborative project involving the Sub-Saharan African Network for TB and HIV Excellence (SANTHE) and Codemakers, a South African science education non-profit organization. Scientists from across the SANTHE network were invited to participate in the project and using intersectionality lens, we selected a group that represented diverse career-stages, gender and nationality (in the Sub-Saharan African region) while intentionally overrepresenting historically disempowered groups, like early-career Black female scientists. The selected group consisted of 24 scientists representing 6 Sub-Saharan African countries (South Africa, Kenya, Rwanda, Uganda, Botswana, and Zambia). Scientists were 79% female and 21% male (Figure 1A) and of diverse racial origin, with 80% Black, 8% Caucasian, 4% Asian and 8% multi-racial (Figure 1B). They represented multiple career levels, with 29% in faculty or leadership positions, 21% at the post-doctoral level, and 50% post-graduate students (master's and PhDs) (Figure 1C). Becoming a SuperScientist involved each scientist reflecting on their scientific "brand", identifying their strengths as scientists ('superpowers'), and designing a superhero persona complete with costumes and insignias. After being transformed into superheroes, the group of scientists were referred to as the 'PowerPack of SuperScientists' (Figure 2).

During a series of closed sessions, the PowerPack discussed their experiences with gendered narratives in science and co-created the themes of the campaign, deciding to focus on specific

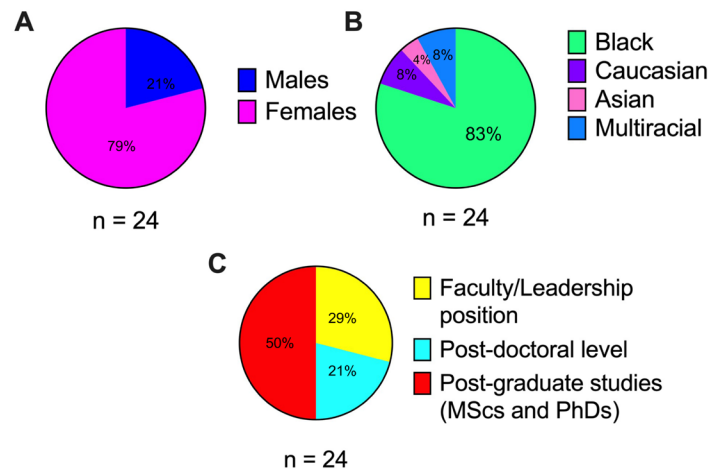


Figure 1. Characteristics of a group of scientists spearheading the gender equity public engagement campaign. (A) Gender distribution of this group; females (pink) and males (blue). **(B)** Racial distribution of this group; Black (green), Caucasian (purple), Asian (pink), Multiracial (blue). **(C)** Career-stage distribution of this group; faculty/leadership (yellow), postdoctoral trainee (turquoise), post-graduate student (red).



Figure 2. The PowerPack of SuperScientists in the fight for gender equity in science.

barriers and suggested solutions to achieving gender equity in science. The team then conducted a month-long social media and online campaign, “African Scientists for Gender Equity,” on Facebook (@GenderEquitySci), Twitter (@genderequitysci) and Zoom that introduced PowerPack members on social media using their SuperScientist imagery and quotations that encapsulated the campaign themes (Figure 3–Figure 6). The campaign also included two interactive webinars. *Surviving and Thriving in Science in 2020* targeted an audience of young African women in science and featured three female scientists who have negotiated barriers to gender equity to achieve successful careers. *Solutions for Gender Equity* targeted an audience across the African scientific community and featured 3 thought-leaders from the continent who discussed how gender equity in science could be promoted at the institutional level.

The month-long campaign yielded over 1,000 followers and 250,000 impressions from across the world.

African scientists for gender equity campaign themes

The campaign themes are summarized in Table 1. Discussions highlighted gender equity barriers and suggested solutions that could be applied at individual, environmental and institutional levels.

Barriers to gender equity in Sub-Saharan Africa science
Barriers to gender equity in science have been reviewed extensively and a comprehensive discussion is beyond the scope of this report^{5,13,14}. However, in reflecting on gender dynamics in African science, the SuperScientists drew on lived experiences and highlighted specific barriers relevant to the scientific context of Sub-Saharan Africa. These barriers can have negative impacts on women’s careers at multiple levels: individual, environmental and institutional.

a. Cultural stereotypes that limit women’s scientific careers. Culture encompasses customs, beliefs, attitudes, behaviors and traditions¹⁵. Cultures are specific to societies, and they manifest and influence how we understand ourselves and navigate the world around us¹⁵. Our SuperScientists came from diverse backgrounds and different countries, and therefore experienced different cultural norms in their upbringing and their current circumstances. Even though we had a diverse group, it is important to highlight that due to the scope of the current project we could only focus on the sub-Saharan African countries, excluding the North and West Africa. Due to their inclusion in the SANTHE network, the selected group of participants may be more privileged and better-funded than others from African scientific institutions outside of the network. We therefore acknowledge the gaps in our findings and may



Figure 3. Cultural stereotypes and problematic narratives that uphold gender inequity in science.

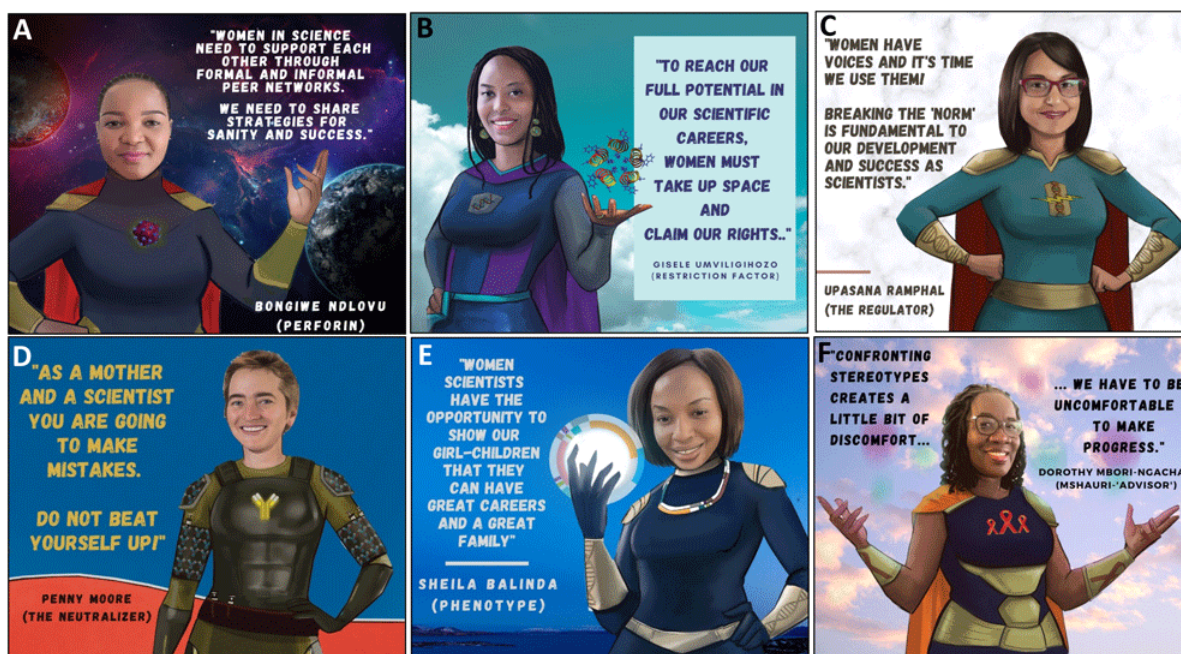


Figure 4. Tools that women can use to promote gender equity in science.

have missed important insights from unrepresented and less advantaged scientific institutions from across the continent. Nonetheless, from our group, many PowerPack members highlighted the multifaceted marginalization of African women that prohibits them from pursuing and thriving in science careers. Like many other cultures, most African societies are patriarchal; privileging and empowering boys and men over girls and women^{16,17}. A recurring theme from the PowerPack was that cultural stereotypes contribute to gender inequity in science. PowerPack members reported that in many of their cultures

of origin, women were traditionally associated with domestic rather than professional environments, resulting in scant experience or imagery to associate women with scientific careers (Figure 3A–B). PowerPack members reported being raised in cultures that subordinated young girls and women to boys and men and that these experiences caused stereotypes to become entrenched in their minds from a young age. For instance, in the context of the current COVID-19 pandemic, media coverage of mostly male scientists muted female scientists’ perspectives on the pandemic and furthered societal stereotypes (Figure 3C)¹⁸.

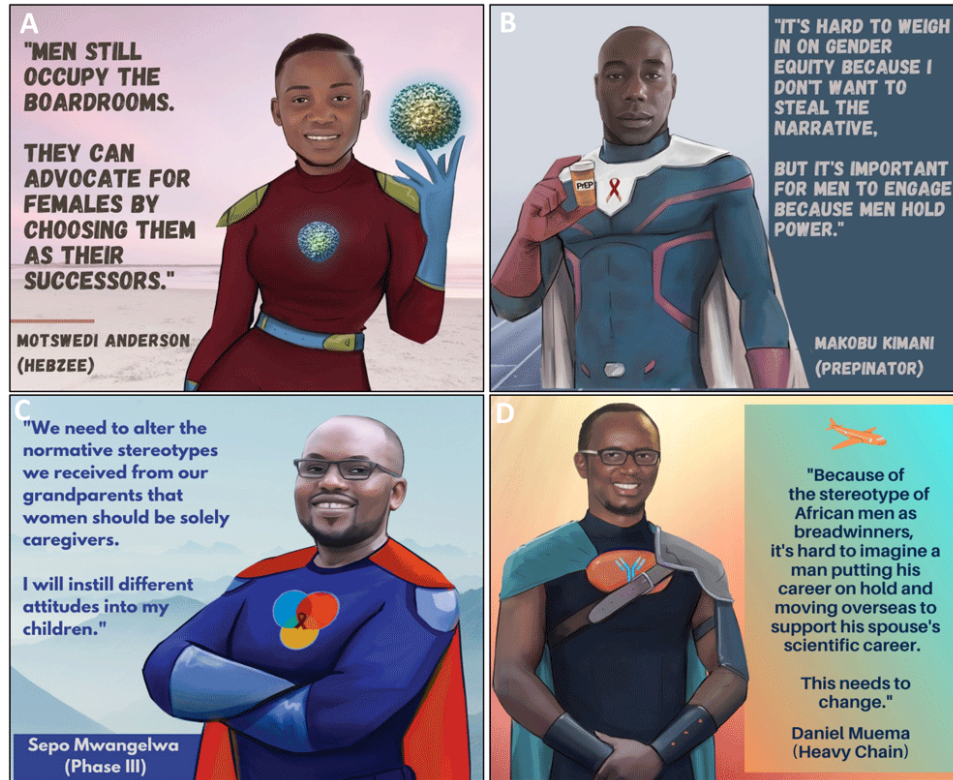


Figure 5. Tools that men can use to promote gender equity in science.



Figure 6. The role of scientific institutions in promoting gender equity in science.

Although the identified stereotypes have their origin in patriarchal and colonial society, many members of the campaign acknowledged some level of internalization of these biases. Language and geographical location influence cultural behaviors

and continue to dictate where we find ourselves in science and these colonial legacies continue to limit ambitions and opportunities especially for women. Women scientists from the PowerPack reported associating these internalized gender

Table 1. Barriers to gender equity in science and suggested solutions.

Levels	Identified barriers	Suggested solutions
Individual	<p>Internalized gendered cultural stereotypes Isolation within the scientific environment.</p> <p>Pressure to achieve scientific excellence and its impact on mental health</p> <p>Self-doubt and self-judgement about the ability to negotiate the “conflict” between motherhood and science</p>	<p>Learn to recognize and actively oppose negative scripts and judgements</p> <p>Female scientists must find their voice, take up space and seek peer support and mentorship.</p> <p>Recognize the impact of intersecting racial and gender identities on stress and seek mental health care.</p> <p>Mother scientists must expect imperfection in motherhood and their scientific career and accept help in both roles</p>
Environmental / Societal	<p>Limited representation of successful female scientists</p> <p>Societal expectations that women bear responsibility for the domestic sphere</p> <p>Patriarchy and post-colonial dynamics in the society</p>	<p>Science and the society should celebrate scientists of both genders and scientist-mothers</p> <p>Male scientists and the male partners of female scientists should embrace hands-on parenting, including paternity leave.</p> <p>Acknowledge these and their multiple impacts on gender inequity in science</p> <p>Scientific society and fellow women should promote women leaders</p>
Institutional	<p>Lack of support for the specific needs of scientist-mothers, especially those in vulnerable/early stages of their scientific careers</p> <p>Continued attrition of women scientists at all career levels (“leaky pipeline”)</p> <p>Gender equity in science perceived as the exclusive responsibility of women</p>	<p>Clear and publicized maternity leave policies for all career levels. Supplemental funds for continued productivity during maternity leave, extra childcare during travel. Clean and comfortable lactation facilities.</p> <p>Enact policies to promote equal pay, positions and funding for both genders. Track institutional performance outcomes. Promote women scientists to leadership.</p> <p>Men should embrace gender equity and participate in campaigns.</p>

stereotypes from their upbringing with current struggles to express their true feelings and discomforts in male dominated spaces. These dynamics limited their ability to address social ills and claim space in male dominated situations, including their scientific environments¹⁹. Thus, members of the PowerPack reported that cultural dynamics resulted in internalized stereotypes and barriers to the pursuit of gender equity in science. Upon reflection, PowerPack members recognized that gendered cultural expectations have become unconscious frames that shape their behaviors, plans and aspirations. Recent SSA based studies also highlighted socio-cultural behaviors as one of the major drivers of gender inequitable scientific career progression^{20,21}. Moreover, some of these stereotypes have power to create gender inequity in science because they are internalized and unconscious. The fact that they are often unrealized and unspoken, especially in scientific environments, makes it hard for them to be acknowledged and addressed.

b. Isolation, pressure and their combined impact on mental health. Another barrier to gender equity identified by the PowerPack was the pressure faced by Black women scientists to excel and to achieve success and recognition in the face of structural and cultural barriers (Figure 3D). PowerPack members reflected that this dynamic was strongly impacted by the intersection of race and gender. During colonization, Black Africans were not allowed to pursue scientific careers and only in recent generations have scientists of African origin been

accepted into scientific institutions. PowerPack members noted that historical roots of non-acceptance subconsciously affect some African scientists and induce imposter syndrome that is independent of but compounds feelings brought on by gender discrimination. The uncomfortable and isolating experience of being an “only” (e.g. the only Black woman in a laboratory or a speaking panel) compounds this pressure and makes it more difficult to relieve some of these feelings through regular discussion with peers facing shared pressures. These dynamics and intersecting racial and gender biases exact pressure on African women scientists to work harder in order to achieve status that is achieved by members of other race and gender groups at a lower emotional cost. PowerPack members acknowledged that feelings of pressure were universal in science but agreed that pressure is felt unequally and especially affects Black African women scientists. Being a member of an identity group with limited traditional or current power may encourage scientists to try to deal with this pressure without involving others, “making trouble” or drawing attention to themselves. Scientists who have additional intersecting minoritized identities (e.g. sexual-orientation, gender or disability) may experience further isolation without having access to peers or role models who share similar experiences. Importantly, these pressures were noted to eventually interfere with mental health of Black women scientists and to have the potential to negatively affect their performance as scientists (Figure 3D).

c. The perceived conflict between motherhood and science.

Another barrier to gender equity is the idea that there is a conflict between being a scientist and being a mother, which can lead to female scientists leaving the field after becoming mothers (Figure 3E–F). This barrier was noted to have effects at individual, environmental and institutional levels. Women PowerPack members reported often feeling pressure to conform to expectations to be constantly available for scientific work, to work extended hours, to travel, to compete for prestigious grants and faculty positions in order to maintain their professional identity, all while being fully present mothers. PowerPack members who had children or who wished to have children reported feeling that these twin ideals were unsustainable. PowerPack mothers reported that they struggled to request help from external sources for their childcare duties because asking for help prompted feelings of inadequacy within societies that exert unrealistic expectations upon women. Though the inability to cope with the combined pressures of motherhood and patriarchal institutional cultures can at times be perceived as an internal problem of the female scientist, external solutions are necessary. Lack of visibility of scientist mothers was noted to be an environmental barrier in scientific arenas and in the wider culture. At the institutional level, PowerPack members highlighted the lack of structural support for scientist-mothers at their institutions, and attributed lack of material support for mothers as one of the contributing factors to excellent female scientists exiting the field (Figure 3F&G). Specific impediments to gender equity in science included absence of clear maternity leave policies for scientific trainees and early career researchers and lack of facilities for lactation upon return to work. Labor laws that accommodate parenthood have been enacted in most countries around the world^{22,23}. However, PowerPack members reported that most of their scientific institutions are not structured to execute these policies.

Solutions for gender equity in science

After identifying these barriers to gender equity in science the PowerPack proposed possible solutions. Much has been written about policy-level solutions and a comprehensive review is beyond the scope of this project^{24–26}. Here we highlight particular solutions for pursuit of gender equity in African science that arose from the unique perspective of the PowerPack. Solutions included those that can be addressed by individuals, society and institutions.

a. Actions women can take at the individual and collective level.

Individuals have an important role in addressing gender inequity in science. Representation is one of most effective bridges to fight gender disparities, and can be achieved through peer support, mentorship, and public campaigns (Figure 4A). Women scientists need to overcome fear and negative internal scripts that contribute to feelings of inadequacy and imposter syndrome. This negative ‘voice’ is often the result of previous ill-treatment, past trauma, internalized societal pressures and culture (both scientific and non-scientific). Senior PowerPack members made it clear that it is critical for women to find and use their voices in the scientific sphere. They emphasized the need for women to recognize the value of their perspectives to the scientific community and to become comfortable taking up physical and theoretical space. Claiming a seat at the table and

giving voice to their perspectives will create a virtuous cycle that will change science and its gender norms (Figure 4B–C). The positive experience of the internal discussions among PowerPack members during the African Scientists for Gender Equity campaign highlighted the power of single- and multi-generational peer support groups as a strategy to enhance gender equity in science. PowerPack members realized that gendered biases internalized during childhood will not disappear overnight and will require affected individuals to be intentional in overcoming and unlearning these through regular conversations in a supportive environment (Figure 4A). Such discussion groups will also provide accountability and positive reinforcement of new thinking patterns. Multiple platforms have been established for African women, to encourage empowerment and accelerate women placement as directors and examples of those are Boardroom Africa, Gender Summit Africa etc.²⁷. Individual or groups sustainable mentorship programs through workshops and receiving professional guidance has been reported to improve women’s scientific outputs and should continue to be used as a tool to facilitate gender equity in science^{27,28}.

It is also critical for women to completely re-write their own narratives around motherhood and science. Not only is it possible to combine the two, but it is also wonderful to do so! Without “sugar-coating” the inherent difficulties in pursuing two time-intensive vocations simultaneously, SuperScientists who are also mothers highlighted these important lessons: 1) understand the truth of the proverb “it takes a village to raise a child” and learn to solicit and accept support from family, friends, colleagues, and childcare providers; 2) accept that your journey as a mother and scientist is never going to be perfect so expect mistakes and avoid negativity and shame when they occur in either realm, (Figure 4D); 3) encourage your children to understand the importance of your work so they will understand the reason why you are busy and respect your contributions to society; (Figure 4E) 4) re-frame the pleasures of motherhood experienced on evenings and weekends as the “reward” for the hard work and long hours put into science, and vice versa. Overall, in trying to take these suggestions into action, discomfort will be experienced but one should remember that we have to be uncomfortable to make progress (Figure 4F).

b. The role of men in improving gender equity in science.

The campaign identified environmental and institutional barriers to gender equity, which require advocacy and external engagement to address. For instance, while women must re-write the narrative of conflict between motherhood and science themselves, it is also critical for male scientists and the wider scientific culture to understand and promote the idea that women can pursue motherhood and science simultaneously and be successful in both realms. Male PowerPack members emphasized that gender equity in science was not just a problem for women but a concern for the entire scientific community. Due to the current underrepresentation of women in leadership positions, men currently hold the vast majority of power in African science and therefore must overcome feelings of awkwardness or defensiveness when addressing the issue and commit themselves and their institutions to improving gender

equity in science. Mentors (male and females) need to intentionally provide opportunities to female mentees and promote their progression into leadership positions by embracing “sponsorship” as an alternative to traditional mentorship²⁹. Given that science in Africa is largely funded by donors, their increased attention to intersectional gender and other inequities within African science, could result in significant shifts. We suggest that funders examine the insights raised in this manuscript and designate substantial funds to the advancement of women scientists at all career levels. Funders need to be intentional about providing more funding opportunities to women scientist and using their funds to redress inequity in straightforward and creative ways. Male leaders should intentionally promote female successors for their positions and ensure that opportunities are offered to women and not informally arranged through traditional male-dominated networks (“Boys Clubs”) (Figure 5A). Male scientists must also reflect on their actions outside of the scientific environment and actively help to subvert their culture’s gendered stereotypes (Figure 5B–D). Taking an active role in parenting, especially by taking paternity leave in the early newborn period, can be a powerful antidote to cultural beliefs about gendered roles in the domestic sphere^{23,30}.

c. The role of institutions in improving gender equity in science.

Institutions must be intentional about addressing gender inequity in science and produce comprehensive rubrics to improve salary and funding parity, female representation in leadership, and gender equity policies within their organizations (Figure 6A–B). Our campaign highlighted institutional solutions most relevant to Black women in the early stages of their scientific careers. The most critical policy improvements addressed the problematic idea of a conflict between motherhood and a successful scientific career. A very important recommendation was the need for scientific institutions to provide clear maternity leave policies, especially for trainees/post graduate students. There was also a need for providing child-care assistance for scientists traveling with their babies for scientific conferences or funds to cover extra childcare when children are left at home. In addition, the need for sanitary and comfortable lactation rooms in workplaces was highlighted. This is legislated in the labor laws of some countries, for instance the South African employment act legislates for breastfeeding/milk expression breaks for lactating mothers³¹. However, a major challenge is that many employers and employees are not aware of these policies or their rights³². In addition, although these suggested policies are very good, the lack of proper implementation, monitoring and tracking prevent success. Scientific institutions must implement progressive maternity and lactation policies and track their impact over time in order to retain women in the scientific career pipeline. Additionally, it is crucial for policy makers and institutions to (i) recognize intersectionality and its impact on power dynamics in scientific environments, (ii) be critical in examining internal biases and prejudices when leading institutions, and (iii) design and enact explicit policies to encourage and provide opportunities to people whose sex and race disadvantages them. Lastly institutions must provide opportunities to people according to merit and scientific capabilities and not according to their sex, pregnancy or motherhood status (Figure 6C–D).

Concluding remarks

This campaign harnessed creative and fun imagery to transform 24 African scientists into a PowerPack advocating for gender equity in science. By amplifying the voices of diverse scientists, particularly Black African female graduate students, who are often silenced by the culture of science, our campaign highlighted specific practices and policies that can be adopted to advance gender equity in science. The campaign highlighted the importance of including diverse groups of people in order to capture various perspectives when addressing equity issues. The PowerPack included scientists who were male and female, from diverse career stages, and from 6 sub-Saharan African countries. This diversity brought innovative ideas to our themed discussions and when combined with the superhero imagery resulted in a positive and empowered approach to topics which can often be heavy and difficult to discuss. This approach resulted in a number of insights that are immediately actionable by PowerPack members and their institutions. The campaign fostered a collaborative culture across race, gender and age lines and the PowerPack felt that such solidarity is imperative for true and lasting change to be implemented. The diversity of the group also allowed the PowerPack to appreciate the importance of conceptualizing solutions to gender equity that act at multiple levels. By listening attentively to the concerns articulated by the youngest and least systemically empowered members of the PowerPack, the group could strategically imagine those solutions that could be spearheaded by individual female scientists and those that would require advocacy by male allies to change scientific institutions. Identifying solutions at multiple levels gives a clear picture of what each stakeholder can contribute to advancing gender equity in science. This collaborative spirit, if adopted widely, has the potential to relieve female scientists of the pressure of advocating to pursue their careers against stark odds while also struggling to combat external factors that contribute to gender inequity in science.

This project formed a baseline for identifying and raising awareness on very important themes to promote gender equity in African science. We recognize that there are other barriers and challenges faced by women scientists and other marginalized groups, which may not necessarily be discussed in this work since we were unable to capture all geographic areas and cultures in Africa. Because this study was centered on the SANTHE network, its failure to include scientists from West and North African institutions, Francophone institutions and less well funded institutions limits the generalizability of the insights reported. More work needs to be done to develop viable interventions, while also identifying ways to implement all the recommended solutions identified from this campaign. Future work is also needed to investigate the effectiveness of interventions and how they promote women participation in science, technology, engineering and mathematics (STEM) and retention among women and girls.

African science is young and energetic and will substantially benefit from addressing the ills caused by gender inequity. Africa has the potential to leap-frog the rest of the world in its pursuit of a healthier, more diverse and innovative culture of science (Figure 7A&B). Now is the time to act to address the barriers and enact the solutions highlighted in this innovative



Figure 7. Key themes of the African Scientists for Gender Equity campaign.

campaign. We challenge every stakeholder to take substantive action in the pursuit of gender equity in African science (Figure 7C), as this is a matter of urgency to improve the quality and innovation of African science.

Data availability

No data are associated with this article.

Acknowledgements

We appreciatively acknowledge the following people:

Members of the PowerPack who, together, conceptualized the barriers and solutions of the campaign: Lenine Libenberg, Doty Ojwach, Mohlopheni Marakalala, Monkgomotsi Maseng, Rodah Kabuti, Jaclyn Mann, Bongive Ndlovu, Penny Moore, Gisele Umvilighozo, Sheila Balinda, Sepo Mwangelwa, Motswedi Anderson, Lucy Mupfumi, Daniel Muema, Upasana Ramphal, Anne Kapaata, Dorothy Mbori-Ngacha. Additionally, Catherine Kyobutungi, Kui Muraya and Tom Kariyuki shared their suggestions on solutions on gender inequity in science at institutional level during the second online webinar. Lastly, we would like to acknowledge Curtis Bonhomme, the artist who made all the conceptualized imagery artwork possible.

References

- Huang J, Gates AJ, Sinatra R, et al.: **Historical comparison of gender inequality in scientific careers across countries and disciplines.** *Proc Natl Acad Sci U S A.* 2020; **117**(9): 4609–4616. [PubMed Abstract](#) | [Publisher Full Text](#) | [Free Full Text](#)
- Huyer S: **Is the Gender Gap Narrowing in Science and Engineering?** 2018. [Reference Source](#)
- Bangani A, Vyas-Doorgapersad S: **The implementation of gender equality within the South African Public Service (1994–2019).** *Afr Public Serv Deliv Perform Rev.* 2020; **8**(1): a353. [Publisher Full Text](#)
- Charles M, Bradley K: **Indulging Our Gendered Selves? Sex Segregation by Field of Study in 44 Countries.** *AJS.* 2009; **114**(4): 924–76. [PubMed Abstract](#) | [Publisher Full Text](#)
- Makarova E, Aeschlimann B, Herzog W: **The Gender Gap in STEM Fields: The Impact of the Gender Stereotype of Math and Science on Secondary Students' Career Aspirations.** *Front Educ.* 2019; **4**(60): 60. [Publisher Full Text](#)
- Valantine HA, Collins FS: **National Institutes of Health addresses the science of diversity.** *Proc Natl Acad Sci U S A.* 2015; **112**(40): 12240–2. [PubMed Abstract](#) | [Publisher Full Text](#) | [Free Full Text](#)
- Iwasaki A: **Why we need to increase diversity in the immunology research community.** *Nat Immunol.* 2019; **20**(9): 1085–8. [PubMed Abstract](#) | [Publisher Full Text](#)
- Jackson JC, Payumo JG, Jamison AJ, et al.: **Perspectives on Gender in Science, Technology, and Innovation: A Review of Sub-Saharan Africa's Science Granting Councils and Achieving the Sustainable Development Goals.** *Front Res Metr Anal.* 2022; **7**: 814600. [PubMed Abstract](#) | [Publisher Full Text](#) | [Free Full Text](#)
- Nielsen MW, Alegria S, Börjeson L, et al.: **Opinion: Gender diversity leads to better science.** *Proc Natl Acad Sci U S A.* 2017; **114**(8): 1740–1742. [PubMed Abstract](#) | [Publisher Full Text](#) | [Free Full Text](#)
- Inno L, Rotundi A, Piccialli A: **COVID-19 lockdown effects on gender inequality.** *Nat Astron.* 2020; **4**(12): 1114. [Publisher Full Text](#)
- Fazackerley A: **Women's research plummets during lockdown - but articles from men increase.** *The Guardian.* 2020; 12 May 2020. [Reference Source](#)
- Gewin V: **The career cost of COVID-19 to female researchers, and how science should respond.** *Nature.* 2020; **583**(7818): 867–9. [PubMed Abstract](#) | [Publisher Full Text](#)
- Ceci SJ, Williams WM: **Understanding current causes of women's underrepresentation in science.** *Proc Natl Acad Sci U S A.* 2011; **108**(8): 3157–62. [PubMed Abstract](#) | [Publisher Full Text](#) | [Free Full Text](#)
- Schmidt EK, Cacace M: **Addressing gender inequality in science: the multifaceted challenge of assessing impact.** *Res Eval.* 2017; **26**(2): 102–14. [Publisher Full Text](#)
- Geert H, Hofstede GJ: **Cultures and Organizations. Software of the Mind.** 2004. [Reference Source](#)
- Parpart JL: **Gender, Patriarchy and Development in Africa: The Zimbabwean Case.** Women and International Development. 1995. [Reference Source](#)
- Sathiparsad R, Taylor M, Dlamini S: **Patriarchy and Family Life: Alternative Views of Male Youth in Rural South Africa.** *Agenda: Empowering Women for Gender Equity.* 2008; **22**(76): 4–16. [Reference Source](#)
- Adjin-Tettey TD: **The media have muted the voices of women during COVID-19: can the tide be turned?** *The Conversation;* 2020. [Reference Source](#)
- Wood W, Eagly AH: **Gender.** *Handbook of social psychology.* 5th ed. Hoboken, NJ,

- US: John Wiley & Sons, Inc.; 2010; **1**: 629–67.
[Publisher Full Text](#)
20. Liani ML, Nyamongo IK, Pulford J, *et al.*: **An intersectional gender analysis of familial and socio-cultural drivers of inequitable scientific career progression of researchers in Sub-Saharan Africa.** *Glob Health Res Policy.* 2021; **6**(1): 30.
[PubMed Abstract](#) | [Publisher Full Text](#) | [Free Full Text](#)
 21. Liani M, Nyamongo I, Tolhurst R: **Understanding intersecting gender inequities in academic scientific research career progression in sub-Saharan Africa.** 2020; **12**(2): 263.
[Reference Source](#)
 22. Behari A: **Lessons on parental leave: a comparative analysis of parental leave in South Africa and the United Kingdom.** *Obiter.* 2020; **41**(4): 787–805.
[Publisher Full Text](#)
 23. Duffy C, Rycroft A: **Parental rights: Progress but some puzzles.** 2019; **40**: 12–25.
[Reference Source](#)
 24. Casad BJ, Franks JE, Garasky CE, *et al.*: **Gender inequality in academia: Problems and solutions for women faculty in STEM.** *J Neurosci Res.* 2021; **99**(1): 13–23.
[PubMed Abstract](#) | [Publisher Full Text](#)
 25. Müller J, Collado C, González A, *et al.*: **Policy Towards Gender Equality in Science and Research.** *Bruss econ review.* 2011; **54**: 295–316.
[Reference Source](#)
 26. Sardelis S, Oester S, Liboiron M: **Ten Strategies to Reduce Gender Inequality at Scientific Conferences.** *Front Mar Sci.* 2017; **4**(231): 231.
[Publisher Full Text](#)
 27. Tiedeu BA, Para-Mallam OJ, Nyambi D: **Driving gender equity in African scientific institutions.** *Lancet.* 2019; **393**(10171): 504–6.
[PubMed Abstract](#) | [Publisher Full Text](#)
 28. Leke RGF, Nolna SK: **Health research: Mentoring female scientists in Africa.** *Nature.* 2016; **536**(7614): 30.
[PubMed Abstract](#) | [Publisher Full Text](#)
 29. Huston WM, Cranfield CG, Forbes SL, *et al.*: **A sponsorship action plan for increasing diversity in STEMM.** *Ecol Evol.* 2019; **9**(5): 2340–5.
[PubMed Abstract](#) | [Publisher Full Text](#) | [Free Full Text](#)
 30. Huerta MC, Adema W, Baxter J, *et al.*: **Fathers' Leave and Fathers' Involvement: Evidence from Four OECD Countries.** *Eur J Soc Secur.* 2014; **16**(4): 308–46.
[PubMed Abstract](#) | [Publisher Full Text](#) | [Free Full Text](#)
 31. **Basic Conditions of Employment Act.** (accessed 21 May 2019).
[Reference Source](#)
 32. Mabaso BP, Jaga A, Doherty T: **Experiences of workplace breastfeeding in a provincial government setting: a qualitative exploratory study among managers and mothers in South Africa.** *Int Breastfeed J.* 2020; **15**(1): 100.
[PubMed Abstract](#) | [Publisher Full Text](#) | [Free Full Text](#)

Open Peer Review

Current Peer Review Status: ? ✓

Version 2

Reviewer Report 24 March 2023

<https://doi.org/10.21956/wellcomeopenres.20687.r55208>

© 2023 Liani M. This is an open access peer review report distributed under the terms of the [Creative Commons Attribution License](#), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.



Millicent Liani 

International Institute of Tropical Agriculture, Oyo State, Nigeria

Many thanks for the opportunity to review this article. I hereby acknowledge that the authors have addressed all the comments based on my initial review. I, therefore, look forward to seeing this article indexed.

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Gender equitable scientific career pathways in Africa; research capacity strengthening; gender integration in research and development projects; intersectionality; gender-responsive and transformative 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.

Version 1

Reviewer Report 05 May 2022

<https://doi.org/10.21956/wellcomeopenres.19545.r49169>

© 2022 Liani M. This is an open access peer review report distributed under the terms of the [Creative Commons Attribution License](#), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.



Millicent Liani 

International Institute of Tropical Agriculture, Oyo State, Nigeria

Many thanks for the opportunity to review this article. It was a pleasurable experience reading it! Great efforts by the authors to unraveling practical advice and actions towards helping women seeking to advance their scientific careers in Africa, a research area that has been largely anecdotally explored. I have minor comments and suggestions that should be addressed to make the article scientifically sound:

1. Throughout the paper, the authors use the term 'fighting' for gender equity in science, which from the discourse of gender and development, this term sounds derogative. Instead, they could use a better term and tone such as 'advocating' for gender equity in science.
2. The term 'individual' interventions should be used consistently throughout the paper as opposed to using it interchangeably with 'internally' as it is appearing in the abstract.
3. Re: the approach – Need to add that 'Using an intersectionality lens' (as this is clearly spelled out as a keyword in the abstract), we selected a group that represented diverse career stages.... (see my edits on pg. 3). The countries outlined are all Sub-Saharan Africa (SSA) so it could be important if the authors explicitly state that the 24 scientists represented six SSA countries. Additional information on how the study participants were selected, as well as their distribution across various career stages by gender, would be useful to illuminate variations amongst the participants.
4. The opening statement on the theme about 'barriers to gender equity in science' (pg 4) is hanging as it is unclear whether this is in SSA or globally. The authors could also consider providing some further nuanced reflections on how the sub-themes on 'isolation, pressure and their combined impact on mental health'; 'The perceived conflict between motherhood and science'; and 'actions women can take at individual and collective level' relates to existing SSA literature. This would greatly strengthen the claims being made in the paper.
5. Going through the references, about 75% of the cited literature is from the global North yet the paper is amplifying the experiences of researchers in the SSA region. The author/s could strengthen the results & discussion section to include insights from SSA studies.
6. Need to proofread the paper for typos and grammatical errors.

I look forward to seeing this important piece of work published!

Is the rationale for the Open Letter provided in sufficient detail?

Yes

Does the article adequately reference differing views and opinions?

Partly

Are all factual statements correct, and are statements and arguments made adequately supported by citations?

Partly

Is the Open Letter written in accessible language?

Yes

Where applicable, are recommendations and next steps explained clearly for others to follow?

Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Gender equitable scientific career pathways in Africa; research capacity strengthening; gender integration in research and development projects; intersectionality; gender-responsive and transformative 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.

Reviewer Report 01 April 2022

<https://doi.org/10.21956/wellcomeopenres.19545.r49172>

© 2022 Osier F. This is an open access peer review report distributed under the terms of the [Creative Commons Attribution License](#), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.



Faith Osier 

¹ Faculty of Natural Sciences, Imperial College London, London, UK

² KEMRI-Wellcome Trust Research Programme, London, UK

This is a nicely written article that raises awareness on the issue of underrepresentation of women in scientific leadership from an African perspective. It describes a public engagement campaign led by early-career black female scientists fighting for gender equity in science. The PowerPack of SuperScientists utilizes superhero imagery to counter the imposter syndrome that is faced by many scientists, and particularly black females. It also served to subvert traditional power structures based on age, race and sex. Three themes were debated on social media i) women cultural stereotyping that limits women's careers ii) the perceived conflict between family and career for and iii) solutions that could be adapted by key stakeholders. The authors acknowledge the importance of engaging men to achieve wider societal change.

Creating awareness on the issues of gender and inclusivity in science, and particularly in scientific leadership is important and strongly appreciated. The comments raised below are efforts to encourage the authors and readers to broaden the diversity of dialogue across the richness of the African continent.

Geographical representation and religious orientation

The authors focused on members of the SANTHE network. This is a highly selected and privileged group and one questions how representative this is of science in Africa. While there was an effort

to include people at all career stages, there are glaring omissions in terms of geographical representation – notably West and North Africa. There is also a lack of representation of cultural and religious differences. For young girls growing up in Muslim countries where the tradition of covering up is the norm, seeing superhero Muslim women scientists would have a major impact. Similarly, unpacking cultural stereotypes across the breadth of the continent will be equally powerful and can only meaningfully be captured by the “wearer of the shoe”. Further collaboration across geographies in such initiatives would highly enrich debate and go further towards breaking down these stereotypes.

Francophone and Lusophone Africa...and others

Related to geography is language. Unfortunately, the experience of young girls aspiring to scientific leadership is to a large extent dictated by where they find themselves – and these colonial legacies continue to limit ambitions and opportunities. Career trajectories can be vastly different in the different settings and we need to be cognizant of this and work to address it. Funding opportunities are still dictated by colonial history and Africa needs to chart its own future in this regard and give equal opportunities to all its people.

Funded-researchers privilege

While we often discuss the “older white men” privilege in science, we are in danger of overlooking our own privilege as black African women, working in highly networked and well-funded research groups. Is this representative of science in Africa? For many striving female scientists across the continent, the main issue may be access to the basics, resources to undertake basic experiments, exposure to research infrastructure and mentorship that gives them a chance of realizing their ambitions. The societal system that created a lack of women in scientific leadership, is the same one that prevents many would-be scientists from seeing the light of day. The inequity of education, physical security and opportunities for women vary greatly across the continent and those of us in the countries that participated in this article often take this granted. Listening to the other voices will add richly to the debate in ways that we cannot even consider.

Superhero or teamwork?

Similarly, whilst I love and understand the desire to portray scientists as superhero’s – the concept of superhero’s generally speaks to particularly outgoing and highly visible personalities that singlehandedly “save the world”. This is more the realm of fiction than fact. Science is a collaborative endeavor that requires teamwork across diverse personalities. The role of the technician who performs a routine task every single day should not be considered less than that of the team leader that gets awarded the prize. Portraying images of teams and people working together is perhaps something that the authors could consider in future iterations. The issue of personalities is important in science. Like in many other areas, charismatic individuals that may not necessarily be the best scientists win the day and this perpetuates a lack of inclusion of different kinds of personalities that are equally vital to the scientific endeavor. How do we portray images of “strong silence” that nevertheless get the job done? How do we reach out to the different personalities that realistically reflect who we are?

Preaching to the converted and measuring impact

How do we bring about societal change? Who is responsible for bringing about change? Who decides who gets to sit at the leadership table? How does one engage institutional leaders? Are we talking just to ourselves? I commend the authors notes on actions that we can take as individuals – each one doing their part. Those in leadership positions must work to bring up more

women and to support them to remain. There is power in numbers. Whilst a fair amount was discussed about what institutions should do, little was said on how this could happen, who would hold institutions accountable and will force be required? Is this a top priority for institutions in Africa? What needs to happen to make it a top priority? Debate and papers such as this are a good way to start, but I felt more is needed to translate talk to action.

The role of funders

The authors should comment on the role that funders and funding organizations can play in promoting gender diversity and inclusivity. Given that science in Africa is largely funded by donors, they can insist on how the work they support is conducted.

Gender diversity and inclusivity: urgent?

The authors should also take a stand on whether there is any sense of urgency to the challenge of underrepresentation of women in scientific leadership. Is this “a good thing to do” or is there an urgency? Is this a good story to tell or is this change that we really believe is important, urgent and will have a major impact.

Is the rationale for the Open Letter provided in sufficient detail?

Yes

Does the article adequately reference differing views and opinions?

Partly

Are all factual statements correct, and are statements and arguments made adequately supported by citations?

Yes

Is the Open Letter written in accessible language?

Partly

Where applicable, are recommendations and next steps explained clearly for others to follow?

Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Parasitology, Immunology, Vaccines

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.
