How Stereotypes Underpin Inequities for Women in Academic STEMM and Advancements in Women’s Health

Molly Carnes, MD, MS
Virginia Valian Professor of Medicine, Psychiatry, and Industrial & Systems Engineering
University of Wisconsin-Madison
October 20, 2021
Acknowledgements

• **NIH**: K07 AG00744; T32 AG00265; R01 GM088477; DP4 GM096822; R01 GM111002; R35 GM122557

• **NSF**: ADVANCE Institutional Transformation Award 0213666; Partnership for Adaptation, Implementation, and Dissemination SBE-0619979

• **University of Wisconsin-Madison**: Department of Medicine, School of Medicine and Public Health, College of Engineering, School of Education, and Office of the Vice Chancellor for Research and Graduate Education
Many other students and staff

Molly Carnes, MD, MS
Eve Fine, PhD
Anna Kaatz, MA, MPH, PhD
Wairimu Magua, PhD

Angela Byars-Winston, PhD
Amy Filut, PhD
Christine Kolehmainen, MD, MS
Jennifer Sheridan, PhD

Alayna Bonnette
Cecilia Ford, PhD
You-Geon Lee, PhD
Jennifer Summ

Patricia Devine, PhD
Carol Isaac, PhD
Vicki Leatherberry
Sharon Topp
1. Our knowledge of gender stereotypes (even if we don’t believe them) gives rise to overt and unintentional (“implicit”) gender bias.

2. The conflation of gender and status predicts that health conditions unique to or more common in women would be seen as less important.

3. Women in STEMM are more likely to study issues that affect the health of women, but gender bias may impede publication, research funding, willingness to resubmit, and attainment of leadership.

4. Individuals at all levels of STEMM must work hard to break their own bias habits because policy is not sufficient to overcome gender bias.
We know common stereotypes even if we don’t believe them

We know common stereotypes even if we don’t believe them

Men\(^1\)

- Strong
- Decisive
- Stubborn
- Competitive
- Ambitious
- Risk-taking
- Assertive
- Logical
- Authoritative
- Independent

We know common stereotypes even if we don’t believe them

Men\(^1\)

- Strong
- Decisive
- Stubborn
- Competitive
- Ambitious
- Risk-taking
- Assertive
- Logical
- Authoritative
- Independent

We know common stereotypes even if we don’t believe them

<table>
<thead>
<tr>
<th>Men¹</th>
<th>Women¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Strong</td>
<td>• Caring</td>
</tr>
<tr>
<td>• Decisive</td>
<td>• Nurturing</td>
</tr>
<tr>
<td>• Stubborn</td>
<td>• Family-oriented</td>
</tr>
<tr>
<td>• Competitive</td>
<td>• Emotional</td>
</tr>
<tr>
<td>• Ambitious</td>
<td>• Supportive</td>
</tr>
<tr>
<td>• Risk-taking</td>
<td>• Sympathetic</td>
</tr>
<tr>
<td>• Assertive</td>
<td>• Nice</td>
</tr>
<tr>
<td>• Logical</td>
<td>• Helpful</td>
</tr>
<tr>
<td>• Authoritative</td>
<td>• Dependent</td>
</tr>
<tr>
<td>• Independent</td>
<td></td>
</tr>
</tbody>
</table>

We know common stereotypes even if we don’t believe them

<table>
<thead>
<tr>
<th>Men¹</th>
<th>Women¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Strong</td>
<td></td>
</tr>
<tr>
<td>• Decisive</td>
<td></td>
</tr>
<tr>
<td>• Stubborn</td>
<td></td>
</tr>
<tr>
<td>• Competitive</td>
<td></td>
</tr>
<tr>
<td>• Ambitious</td>
<td></td>
</tr>
<tr>
<td>• Risk-taking</td>
<td></td>
</tr>
<tr>
<td>• Assertive</td>
<td></td>
</tr>
<tr>
<td>• Logical</td>
<td></td>
</tr>
<tr>
<td>• Authoritative</td>
<td></td>
</tr>
<tr>
<td>• Independent</td>
<td></td>
</tr>
<tr>
<td>• Caring</td>
<td></td>
</tr>
<tr>
<td>• Nurturing</td>
<td></td>
</tr>
<tr>
<td>• Family-oriented</td>
<td></td>
</tr>
<tr>
<td>• Emotional</td>
<td></td>
</tr>
<tr>
<td>• Supportive</td>
<td></td>
</tr>
<tr>
<td>• Sympathetic</td>
<td></td>
</tr>
<tr>
<td>• Nice</td>
<td></td>
</tr>
<tr>
<td>• Helpful</td>
<td></td>
</tr>
<tr>
<td>• Dependent</td>
<td></td>
</tr>
</tbody>
</table>

We know common stereotypes even if we don’t believe them

<table>
<thead>
<tr>
<th>Men¹</th>
<th>Women¹</th>
<th>White²</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Strong</td>
<td>• Caring</td>
<td>• High status</td>
</tr>
<tr>
<td>• Decisive</td>
<td>• Nurturing</td>
<td>• Rich</td>
</tr>
<tr>
<td>• Stubborn</td>
<td>• Family-oriented</td>
<td>• Intelligent</td>
</tr>
<tr>
<td>• Competitive</td>
<td>• Emotional</td>
<td>• Arrogant</td>
</tr>
<tr>
<td>• Ambitious</td>
<td>• Supportive</td>
<td>• Privileged</td>
</tr>
<tr>
<td>• Risk-taking</td>
<td>• Sympathetic</td>
<td>• Blonde</td>
</tr>
<tr>
<td>• Assertive</td>
<td>• Nice</td>
<td>• Racist</td>
</tr>
<tr>
<td>• Logical</td>
<td>• Helpful</td>
<td>• All-American</td>
</tr>
<tr>
<td>• Authoritative</td>
<td>• Dependent</td>
<td>• Ignorant</td>
</tr>
<tr>
<td>• Independent</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

We know common stereotypes even if we don’t believe them

<table>
<thead>
<tr>
<th>Men¹</th>
<th>Women¹</th>
<th>White²</th>
<th>Asian²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strong • Decisive • Stubborn • Competitive • Ambitious • Risk-taking • Assertive • Logical • Authoritative • Independent</td>
<td>Caring • Nurturing • Family-oriented • Emotional • Supportive • Sympathetic • Nice • Helpful • Dependent</td>
<td>High status • Rich • Intelligent • Arrogant • Privileged • Blonde • Racist • All-American • Ignorant</td>
<td>Intelligent • Bad drivers • Good at math • Nerdy • Shy • Skinny • Educated • Quiet • Passive</td>
</tr>
</tbody>
</table>

We know common stereotypes even if we don’t believe them

<table>
<thead>
<tr>
<th>Men&lt;sup&gt;1&lt;/sup&gt;</th>
<th>Women&lt;sup&gt;1&lt;/sup&gt;</th>
<th>White&lt;sup&gt;2&lt;/sup&gt;</th>
<th>Asian&lt;sup&gt;2&lt;/sup&gt;</th>
<th>Black&lt;sup&gt;2&lt;/sup&gt;</th>
<th>Latino&lt;sup&gt;2&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strong</td>
<td>Caring</td>
<td>High status</td>
<td>Intelligent</td>
<td>Ghetto or unrefined</td>
<td>Poor</td>
</tr>
<tr>
<td>Decisive</td>
<td>Nurturing</td>
<td>Rich</td>
<td>Bad drivers</td>
<td>Illegal immigrant</td>
<td>Illegal immigrant</td>
</tr>
<tr>
<td>Stubborn</td>
<td>Family-oriented</td>
<td>Intelligent</td>
<td>Good at math</td>
<td>Criminal</td>
<td>Uneducated</td>
</tr>
<tr>
<td>Competitive</td>
<td>Emotional</td>
<td>Arrogant</td>
<td>Nerdy</td>
<td>Athletic</td>
<td>Family-oriented</td>
</tr>
<tr>
<td>Ambitious</td>
<td>Supportive</td>
<td>Privileged</td>
<td>Shy</td>
<td>Loud</td>
<td>Lazy</td>
</tr>
<tr>
<td>Risk-taking</td>
<td>Sympathetic</td>
<td>Blonde</td>
<td>Skinny</td>
<td>Gangsters</td>
<td>Unintelligent</td>
</tr>
<tr>
<td>Assertive</td>
<td>Nice</td>
<td>Racist</td>
<td>Educated</td>
<td>Poor</td>
<td>Unintelligent</td>
</tr>
<tr>
<td>Logical</td>
<td>Helpful</td>
<td>All-American</td>
<td>Quiet</td>
<td>Uneducated</td>
<td>Loud</td>
</tr>
<tr>
<td>Authoritative</td>
<td>Dependent</td>
<td>Ignorant</td>
<td>Passive</td>
<td>Lazy</td>
<td>Gangsters</td>
</tr>
<tr>
<td>Independent</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Cultural stereotypes are responsible for overt discrimination and implicit bias against minoritized groups

- **Institutional**
  - Women paid less than men
  - Men penalized for taking family leave
  - Funds allocated for research to improve the health of women vs. men

- **Interpersonal**
  - Sexual harassment
  - Microaggressions
  - Decisions about who to hire, mentor, sponsor, reward, publish, and fund

- **Internalized**
  - Imposter syndrome
  - Stereotype threat
  - Decision about “fit” in career decisions
  - Resubmission of grants after rejection
Stereotypes of leaders

- Competitive
- Self-confident
- Aggressive
- Ambitious
- Powerful
- Decisive

Eagly & Carli 2007; Schein 1973
Who “fits”

Men = Agentic
- Strong
- Authoritative
- Risk-Taking
- Logical
- Assertive
- Decisive
- Independent

Women = Communal
- Caring
- Nurturing
- Supportive
- Nice
- Helpful
- Dependent
- Emotional

LEADER?
Gender and Leadership IAT Scores

Filut et al, 2017
There are penalties for breaking gender “rules”

Men = Agentic
- Caring
- Nurturing
- Supportive
- Nice
- Helpful
- Dependent
- Emotional

Women = Communal
- Strong
- Authoritative
- Risk-Taking
- Logical
- Assertive
- Decisive
- Independent

SOCIAL PENALTIES

Lack of fit could lead to bias in grant peer review

• Participants’ selection of traits for “average man” but not “average woman” strongly overlapped with traits for a successful scientist Carli et al. 2016

• Creativity and innovation were more strongly associated with male than female-gendered stereotypes Proudfoot et al. 2015; Elmore & Luna-Lucero 2017
Lack of fit could lead to bias in grant peer review

- Participants’ selection of traits for “average man” but not “average woman” strongly overlapped with traits for a successful scientist Carli et al. 2016

- Creativity and innovation were more strongly associated with male than female-gendered stereotypes Proudfoot et al. 2015; Elmore & Luna-Lucero 2017

- When grant awards were made on basis of research, no gender difference in award rate; when made on basis of scientist applying for the grant, women were less likely to be funded Witteman et al., 2019

- New NIH R01 (Type 1) award rate same for male and female applicants, but for renewals (Type 2) when applicants are both scientists and leaders female success rates consistently lower for women Kaatz et al. 2016; Kolehmainen et al. 2018; Erosheva et al. 2020; Chaudhary et al 2021
Lack of fit could lead to bias in grant peer review

- Participants’ selection of traits for “average man” but not “average woman” strongly overlapped with traits for a successful scientist *Carli et al. 2016*

- Creativity and innovation were more strongly associated with male than female-gendered stereotypes *Proudfoot et al. 2015; Elmore & Luna-Lucero 2017*

- When grant awards were made on basis of *research*, no gender difference in award rate; when made on basis of *scientist* applying for the grant, women were less likely to be funded *Witteman et al., 2019*

- New NIH R01 (Type 1) award rate same for male and female applicants, but for renewals (Type 2) when applicants are both *scientists* and *leaders* female success rates consistently lower for women - until 2020! *Kaatz et al. 2016; Kolehmainen et al. 2018; Erosheva et al. 2020; Chaudhary et al 2021*
Dozens of experimental studies document that women and non-White individuals are rated lower on performance and employment related variables (vs. men and White individuals) even when the work or application is identical.
Race and gender influence rating of identical postdoctoral candidates

Eaton et al., 2020
Race and gender influence rating of identical postdoctoral candidates

- 94 physics and 157 biological sciences faculty
- 8 U.S. public research universities
- Cover story:
  - Hypothetical CV from real postdocs
  - Studying CV formatting
- Evaluate:
  - Hireability
  - Competence

Eaton et al., 2020
Race and gender influence rating of identical postdoctoral candidates

- 94 physics and 157 biological sciences faculty
- 8 U.S. public research universities

Cover story:
- Hypothetical CV from real postdocs
- Studying CV formatting

Evaluate:
- Hireability
- Competence

Gender/race signaled with pre-tested names:
- White
  - Bradley Miller
  - Claire Miller
- Asian
  - Zhang Wei [David]
  - Wang Li [Lily]
- Black
  - Jamal Banks
  - Shanice Banks
- Latinx
  - José Rodriguez
  - Maria Rodriguez

Eaton et al., 2020
Race and gender influence rating of identical postdoctoral candidates

- Male more competent and hireable than female
- White, Asian more competent and hireable than Black, Latinx
- Women deemed more likeable

Eaton et al., 2020
Race and gender influence rating of identical postdoctoral candidates

• Male more competent and hireable than female*
• White, Asian more competent and hireable than Black, Latinx*
Race and gender influence rating of identical postdoctoral candidates

- Male more competent and hireable than female*
- White, Asian more competent and hireable than Black, Latinx*
Race and gender influence rating of identical postdoctoral candidates

- Male more competent and hireable than female*
- White, Asian more competent and hireable than Black, Latinx*

* $p < .05$

Eaton et al., 2020
Race and gender influence rating of identical postdoctoral candidates

Interaction of Race & Gender

- **Competence:** no significant differences

- **Hireability:** Black and Latina females and Latino males less hireable than all others (in physics, only)*

  * $p < .05$

* Eaton et al., 2020
Abundant evidence affirms a lower societal value placed on women, roles predominantly occupied by women, and work performed by women than men, roles predominantly occupied by men, and work performed by men.
Abundant evidence affirms a lower societal value placed on women, roles predominantly occupied by women, and work performed by women than men, roles predominantly occupied by men, and work performed by men.

- A man was worth 50 shekels of silver and a woman was worth 30; and a boy was worth 5 shekels and a girl was worth 3 shekels [Leviticus 24:3-7]

- Exclusion of women from early cardiovascular prevention studies and Baltimore Longitudinal Study of Normal Human Aging; need for this conference

- Reimbursement for 42/50 surgical procedures performed in men (usually by male urologists) higher than pair matched procedures performed in women (usually by female gynecologists) [Benoit et al. 2017]

- “Goldberg” designs indicate that work performed by women is rated of lower quality than the work performed by men regardless of the gender of the rater [Isaac et al. Acad Med, 2009]

- Women work at the lower echelons of all organizations and there is a strong correlation between percentage of women in a medical field and salary [Pelley and Carnes, 2020]
Abundant evidence affirms a lower societal value placed on women, roles predominantly occupied by women, and work performed by women than men, roles predominantly occupied by men, and work performed by men

• A man was worth 50 shekels of silver and a woman was worth 30; and a boy was worth 5 shekels and a girl was worth 3 shekels *Leviticus 24:3-7*

• Reimbursement for 42/50 surgical procedures performed in men (usually by male urologists) higher than pair matched procedures performed in women (usually by female gynecologists) *Benoit et al. 2017*
Abundant evidence affirms a lower societal value placed on women, roles predominantly occupied by women, and work performed by women than men, roles predominantly occupied by men, and work performed by men

- A man was worth 50 shekels of silver and a woman was worth 30; and a boy was worth 5 shekels and a girl was worth 3 shekels *Leviticus 24:3-7*

- Reimbursement for 42/50 surgical procedures performed in men (usually by male urologists) higher than pair matched procedures performed in women (usually by female gynecologists) *Benoit et al. 2017*

- Exclusion of women from early cardiovascular prevention studies and Baltimore Longitudinal Study of Normal Human Aging; need for this conference *Pelley and Carnes, 2020*
Abundant evidence affirms a lower societal value placed on women, roles predominantly occupied by women, and work performed by women than men, roles predominantly occupied by men, and work performed by men

- A man was worth 50 shekels of silver and a woman was worth 30; and a boy was worth 5 shekels and a girl was worth 3 shekels *Leviticus 24:3-7*

- Reimbursement for 42/50 surgical procedures performed in men (usually by male urologists) higher than pair matched procedures performed in women (usually by female gynecologists) *Benoit et al. 2017*

- Exclusion of women from early cardiovascular prevention studies and Baltimore Longitudinal Study of Normal Human Aging; need for this conference

- Women work at the lower echelons of all organizations and there is a strong correlation between percentage of women in a medical field and salary *Pelley and Carnes, 2020*
Gender bias can reduce investment in research to improve the health of women directly and also by impeding women’s career advancement in STEM.

Women physicians, scientists, and engineers are more likely than men to:

- Study or invent things to improve the health of women
  \( \text{Koning et al., 2019} \)

- Report sex-differences in their research
  \( \text{Nielsen et al., 2017; Sugimoto et al., 2019} \)

- Provide and lead women’s health care
  \( \text{Carnes et al., 2008, 2017} \)

- Have better patient outcomes
  \( \text{Tsugawa et al., 2017; Wallis et al., 2017; Greenwood et al., 2018} \)
Factors affecting sex-related reporting in medical research: a cross-disciplinary bibliometric analysis

Cassidy R Supinore, Yong-Yed Ahn, Eliza Smith, Bernad MacKuska, Vincent Lavrile

Summary

Background Clinical and preclinical studies have shown that there are sex-based differences at the genetic, cellular, biochemical, and physiological level. Despite this, numerous studies have shown poor levels of inclusion of female populations into medical research. These disparities in sex inclusion in research are further complicated by the absence of sufficient reporting and analysis by sex of study populations. Disparities in the inclusion of the sexes in medical research substantially reduce the utility of the results of such research for the entire population. The absence of sex-related reporting are problematical for the translation of research from the preclinical to clinical and applied health settings. Large-scale studies are needed to identify the extent of sex-related reporting and where disparities are more prevalent. In addition, while several studies have shown the dearth of female researchers in science, few have explored whether a scarcity of women in science might be related to disparities in sex inclusion and reporting. We aimed to do a cross-disciplinary analysis of the degree of sex-related reporting across the health sciences—from biomedical, to clinical, and public health research—and the role of author gender in sex-related reporting.

Methods This bibliometric analysis examined sex-related reporting in medical research examining more than 11.5 million papers indexed in Web of Science and PubMed between 1940 and 2016 and using sex-related Medical Subject Headings as a proxy for sex reporting. For papers that were published between 2009 and 2016 and could be matched with PubMed, we assigned a gender to first and last authors on the basis of their names, according to our gender assignment algorithm. We removed papers for which we could not determine the gender of either the first or last author. We grouped papers into three disciplinary categories (biomedical research, clinical medicine, and public health). We used descriptive statistics and regression analyses (controlling for the number of authors and representation of women in specific diseases, countries, continents, year, and specialty areas) to study associations between the gender of the authors and sex-related reporting.

Findings Between Jan 1, 1980, and Dec 31, 2016, sex-related reporting increased from 59% to 67% in clinical medicine and from 36% to 69% in public health research. But for biomedical research, sex remains largely under-reported (31% in 2016). Papers with female first and last authors had an increased probability of reporting sex, with an odds ratio of 1.26 (95% CI 1.24 to 1.27), and sex-related reporting was associated with publications in journals with low journal impact factors. For publications in 2016, sex-related reporting of both male and female is associated with a reduction of -0.51 (95% CI -0.54 to -0.47) in journal impact factors.

Interpretation Gender disparities in the scientific workforce and scarcity of policies on sex-related reporting at the journal and institutional level could inhibit effective research translation from bench to clinical studies. Diversification in the scientific workforce and in the research populations—from cell lines, to rodents, to humans—is essential to produce the most rigorous and effective medical research.
Factors affecting sex-related reporting in medical research: a cross-disciplinary bibliometric analysis

Cassidy R, Sugimoto C, Yoon-Hee Ahn, Elise Smith, Bertrand MacKinnon, Vincent Landrieu

Summary

**Background** Clinical and preclinical studies have shown that there are sex-based differences at the genetic, cellular, biochemical, and physiological levels. Despite this, numerous studies have shown poor levels of inclusion of female populations into medical research. These disparities in sex inclusion in research are further complicated by the absence of sufficient reporting and analysis by sex of study populations. Disparities in the inclusion of the sexes in medical research substantially reduce the utility of the results of such research for the entire population. The absence of sex-related reporting are problematical for the translation of research from the preclinical to clinical and applied health settings. Large-scale studies are needed to identify the extent of sex-related reporting and where disparities are more prevalent. In addition, while several studies have shown the dearth of female researchers in science, few have explored whether a scarcity of women in science might be related to disparities in sex inclusion and reporting. We aimed to do a cross-disciplinary analysis of the degree of sex-related reporting across the health sciences—from biomedical, to clinical, and public health research—and the role of author gender in sex-related reporting.

**Methods** This bibliometric analysis examined sex-related reporting in medical research examining more than 11.5 million papers indexed in Web of Science and PubMed between 1940 and 2016 and using sex-related Medical Subject Headings as a proxy for sex reporting. For papers that were published between 2005 and 2016 and could be matched with PubMed, we assigned a gender to first and last authors on the basis of their names, according to our gender assignment algorithm. We reviewed papers for which we could not determine the gender of either the first or last author. We grouped papers into three disciplinary categories (biomedical research, clinical medicine, and public health). We used descriptive statistics and regression analyses (controlling for the number of authors and representation of women in specific diseases, countries, continents, years, and specialty areas) to study associations between the gender of the authors and sex-related reporting.

**Findings** Between Jan 1, 1980, and Dec 31, 2016, sex-related reporting increased from 59% to 67% in clinical medicine and from 36% to 69% in public health research. But for biomedical research, sex remains largely under-reported (51% in 2016). Papers with female first and last authors had an increased probability of reporting sex, with an odds ratio of 1.26 (95% CI 1.24 to 1.27), and sex-related reporting was associated with publications in journals with low journal impact factors. For publications in 2016, sex-related reporting of both male and female is associated with a reduction of -0.54 (95% CI -0.54 to -0.47) in journal impact factors.

**Interpretation** Gender disparities in the scientific workforce and scarcity of policies on sex-related reporting at the journal and institutional level could inhibit effective research translation from bench to clinical studies. Diversification in the scientific workforce and in the research populations—from cell lines, to rodents, to humans—is essential to produce the most rigorous and effective medical research.

Lancet 2019; 393: 550-59
Factors affecting sex-related reporting in medical research: a cross-disciplinary bibliometric analysis

Cassidy R, Supimoto P, Yong-Yed Ahn, Elise Smith I, Bernt MacLand, Vincent Laroche

Summary

Background. Clinical and preclinical studies have shown that there are sex-based differences at the genetic, cellular, biochemical, and physiological levels. Despite this, numerous studies have shown poor levels of inclusion of female populations into medical research. These disparities in sex inclusion in research are further complicated by the absence of sufficient reporting and analysis by sex of study populations. Disparities in the inclusion of the sexes in medical research substantially reduce the utility of the results of such research for the entire population. The absence of sex-related reporting is problematical for the translation of research from the preclinical to clinical and applied health settings. Large-scale studies are needed to identify the extent of sex-related reporting and where disparities are more prevalent. In addition, while several studies have shown the dearth of female researchers in scientific fields, few have evaluated whether a scarcity of women in science might be related to disparities in sex inclusion and reporting. We aimed to do a cross-disciplinary analysis of the degree of sex-related reporting across the health sciences—from biomedical, to clinical, and public health research—and the role of author gender in sex-related reporting.

Method. We used bibliometric analysis to assess sex-related reporting in medical research examining more than 11.5 million papers indexed in Web of Science and PubMed between 1980 and 2016 using sex-related Medical Subject Headings as a proxy for sex reporting. For papers that were published between 2005 and 2016 and could be matched with PubMed, we assigned a gender to first and last authors on the basis of their names, according to our gender classification algorithm. We tested papers for which we could not determine the gender of either the first or last author. We grouped papers into three disciplinary categories (biomedical research, clinical medicine, and public health). We used descriptive statistics and regression analyses (controlling for the number of authors and representation of women in specific diseases, countries, continents, years and specialty areas) to study associations between the gender of the authors and sex-related reporting.

Findings. Between Jan 1, 1980, and Dec 31, 2016, sex-related reporting increased from 59% to 67% in clinical medicine and from 36% to 59% in public health research. But for biomedical research, sex remains largely under-reported (31% in 2016). Papers with female first and last authors had an increased probability of reporting sex, with an odds ratio of 1:26 (95% CI 1.24 to 1.27), and sex-related reporting was associated with publications in journals with low journal impact factors. For publications in 2016, sex-related reporting of both male and female is associated with a reduction of −0.01 (95% CI −0.04 to −0.07) in journal impact factors.

Interpretation. Gender disparities in the scientific workforce and scarcity of policies on sex-related reporting at the journal and institutional level could inhibit effective research translation from bench to clinical studies. Diversification in the scientific workforce and in the research populations—from cell lines, to rodents, to humans—is essential to produce the most rigorous and effective medical research.

Lancet 2019; 393: 550-59
Factors affecting sex-related reporting in medical research: a cross-disciplinary bibliometric analysis

Cecily R Sugimoto, Yong-Jeol Ahn, Elvis Smith, Bernad MacKinnon, Vincent Larivière

Summary
Background Clinical and preclinical studies have shown that there are sex-based differences at the genetic, cellular, biochemical, and physiological levels. Despite this, numerous studies have shown poor levels of inclusion of female populations into medical research. These disparities in sex inclusion in research are further complicated by the absence of sufficient reporting and analysis by sex of study populations. Disparities in the inclusion of the sexes in medical research substantially reduce the utility of the results of such research for the entire population. The absence of sex-related reporting are problematical for the translation of research from the preclinical to clinical and applied health settings. Large-scale studies are needed to identify the extent of sex-related reporting and where disparities are more prevalent. In addition, while several studies have shown the dearth of female researchers in science, few have explored whether a scarcity of women in science might be related to disparities in sex inclusion and reporting. We aimed to do a cross-disciplinary analysis of the degree of sex-related reporting across the health sciences—from biomedical, to clinical, and public health research—and the role of author gender in sex-related reporting.

Methods This bibliometric analysis analyzed sex-related reporting in medical research examining more than 11.5 million papers indexed in Web of Science and PubMed between 1940 and 2016 and using sex-related Medical Subject Headings as a proxy for sex reporting. For papers that were published between 2009 and 2016 and could be matched with PubMed, we assigned a gender to first and last authors on the basis of their names. According to our gender assignment algorithm, we determined the gender of either the first or last author. We grouped papers into three disciplinary categories (biomedical research, clinical medicine, and public health). We used descriptive statistics and regression analyses (controlling for the number of authors and representation of women in specific diseases, countries, continents, year, and specialty areas) to study associations between the gender of the authors and sex-related reporting.

Findings Between Jan 1, 1980, and Dec 31, 2016, sex-related reporting increased from 59% to 67% in clinical medicine and from 36% to 59% in public health research. But for biomedical research, sex remains largely under-reported (51% in 2016). Papers with female first and last authors had an increased probability of reporting sex, with an odds ratio of 1.26 (95% CI 1.24 to 1.27), and sex-related reporting was associated with publications in journals with low journal impact factors. For publications in 2016, sex-related reporting of both male and female is associated with a reduction of 0.53 (95% CI 0.54 to 0.47) in journal impact factors.

Interpretation Gender disparities in the scientific workforce and scarcity of policies on sex-related reporting at the journal and institutional level could inhibit effective research translation from bench to clinical studies. Diversification in the scientific workforce and in the research populations—from cell lines, to rodents, to humans—is essential to produce the most rigorous and effective medical research.

Lancet 2019; 393: 550-59
Factors affecting sex-related reporting in medical research: a cross-disciplinary bibliometric analysis

Cascioy R, Supimato A, Yong-Yed Ahn, Else Smith H, Benoit Macleod, Vincent Launère

Summary
Background Clinical and preclinical studies have shown that there are sex-based differences at the genetic, cellular, biochemical, and physiological levels. Despite this, numerous studies have shown poor levels of inclusion of female populations into medical research. These disparities in sex inclusion in research are further complicated by the absence of sufficient reporting and analysis by sex of study populations. Disparities in the inclusion of the sexes in medical research substantially reduce the utility of the results of such research for the entire population. The absence of sex-related reporting are problematic for the translation of research from the preclinical to clinical and applied health settings. Large-scale studies are needed to identify the extent of sex-related reporting and where disparities are more prevalent. In addition, while several studies have shown the dearth of female in biomedical sciences, few have explored whether a scarcity of women in science might be related to disparities in sex inclusion and reporting. We aimed to do a cross-disciplinary analysis of the degree of sex-related reporting across the health sciences—from biomedical, clinical, and public health research—and the role of author gender in sex-related reporting.

Methods This bibliometric analysis examined sex-related reporting in medical research examining more than 11.5 million papers indexed in Web of Science and PubMed between 1980 and 2016 and using sex-related Medical Subject Headings as a proxy for sex reporting. For papers that were published between 2005 and 2016 and could be matched with PubMed, we assigned a gender to first and last authors on the basis of their names, according to our gender assignment algorithm. We reviewed papers for which we could not determine the gender of either the first or last author. We grouped papers into three disciplinary categories (biomedical research, clinical medicine, and public health). We used descriptive statistics and regression analyses (controlling for the number of authors and representation of women in specific diseases, countries, continents, year, and specialty areas) to study associations among the gender of the authors and sex-related reporting.

Findings Between Jan 1, 1980, and Dec 31, 2016, sex-related reporting increased from 59% to 67% in clinical medicine and from 36% to 59% in public health research. But for biomedical research, sex remains largely underreported (51% in 2016). Papers with female first and last authors had an increased probability of reporting sex, with an odds ratio of 1.26 (95% CI 1.24 to 1.27), and sex-related reporting was associated with publications in journals with low journal impact factors. For publications in 2016, sex-related reporting of both male and female is associated with a reduction of 0.05 (95% CI 0.54 to −0.47) in journal impact factors.

Interpretation Gender disparities in the scientific workforce and scarcity of policies on sex-related reporting at the journal and institutional level could inhibit effective research translation from bench to clinical studies. Diversification in the scientific workforce and in the research populations—from cell lines, to rodents, to humans—is essential to produce the most rigorous and effective medical research.
Publication bias against research conducted in women?

- Cover story about developing a new journal and testing whether a review could be done from an abstract alone and with blinding to authors identity
- Sent to R01 grantees from 2010-2014 retrieved from RePORTER
- Randomly assigned one of 3 versions of the abstract: conducted in women, men, or individuals
- Reviewers evaluated scientific rigor, contribution to medical science, recommendation to publish
- Debriefed at end of survey
Research conducted in women was deemed more impactful but less publishable than the same research conducted in men

- Research in women greater contribution to science ($p=0.030$)
- No difference in perceived rigor
- Almost twice as likely to recommend publishing research when conducted in men than women ($p<0.001$)
Research conducted in women was deemed more impactful but less publishable than the same research conducted in men.

- Research in women greater contribution to science ($p=0.030$)
- No difference in perceived rigor
- Almost twice as likely to recommend publishing research when conducted in men than women ($p<0.001$)

*Murrar et al. 2021*
To be clear: Negative performance expectations are not born out by actual performance

- Patient satisfaction scores in a large HMO were significantly more negative for female and non-White physicians than male and White physicians with the same objective quality metrics. (Hekman et al., 2010)
To be clear: Negative performance expectations are not born out by actual performance

- Patient satisfaction scores in a large HMO were significantly more negative for female and non-White physicians than male and White physicians with the same objective quality metrics Hekman et al., 2010
- Natural language processing of ~1.2 million dissertations found those from women and non-White men had less future impact on science despite having more novel ideas Hofstra et al. 2020
To be clear: Negative performance expectations are not born out by actual performance

- Patient satisfaction scores in a large HMO were significantly more negative for female and non-White physicians than male and White physicians with the same objective quality metrics. (*Hekman et al., 2010*)

- Natural language processing of ~1.2 million dissertations found those from women and non-White men had less future impact on science despite having more novel ideas. (*Hofstra et al., 2020*)

- Women received lower scores than men on a research proposal but out-performed men in securing NIH grants and publishing in top journals after receiving the grant. (*Kolev et al., 2019*)
How the lower value of women vs. men and work performed by women vs. men simultaneously impede advancement of women in academic STEMM and women’s health

Murrar et al., 2021

16Blumenthal et al. 2017, 17Carnes et al. 2017
Female investigators more likely to conduct research in women\textsuperscript{1,2} 

How the lower value of women vs. men and work performed by women vs. men simultaneously impede advancement of women in academic STEMM and women's health \textit{Murrar et al., 2021}

\textsuperscript{1}Nielsen et al. 2017, \textsuperscript{2}Sugimoto et al. 2019, \textsuperscript{3}Spencer et al. 2019, \textsuperscript{4}Head et al.2013, \textsuperscript{5}Magua et al.2017, \textsuperscript{6}Witteeman et al. 2019, \textsuperscript{7}Kolehmainen & Carnes 2018, \textsuperscript{8}Chaudhary et al.2021; \textsuperscript{9}Murrar et al. 2021; \textsuperscript{10}Hengel 2020, \textsuperscript{11}Knobloch-Westerwick et al. 2013, \textsuperscript{12}Silbiger and Stubler 2019; \textsuperscript{13}Hoffer et al. 2016, \textsuperscript{14}Spector et al. 2019, \textsuperscript{15}Carr et al. 2018, \textsuperscript{16}Blumenthal et al. 2017, \textsuperscript{17}Carnes et al. 2017
Female investigators more likely to conduct research in women\textsuperscript{1,2}

Some areas of research on diseases in women underfunded relative to lethality compared to diseases in men\textsuperscript{3}

How the lower value of women vs. men and work performed by women vs. men simultaneously impede advancement of women in academic STEMM and women's health

\textit{Murrar et al., 2021}

\textsuperscript{1}Nielson et al. 2017, \textsuperscript{2}Sugimoto et al. 2019; \textsuperscript{3}Spencer et al. 2019; \textsuperscript{4}Head et al.2013, \textsuperscript{5}Magua et al.2017, \textsuperscript{6}Witteman et al. 2019; \textsuperscript{7}Kolehmainen & Cames 2018, \textsuperscript{8}Chaudhary et al.2021; \textsuperscript{9}Murrar et al. 2021; \textsuperscript{10}Hengel 2020, \textsuperscript{11}Knobloch-Westerwick et al. 2013, \textsuperscript{12}Silbiger and Stabler 2019; \textsuperscript{13}Hoffer et al. 2016, \textsuperscript{14}Spector et al. 2019, \textsuperscript{15}Carr et al. 2018, \textsuperscript{16}Blumenthal et al. 2017, \textsuperscript{17}Cames et al. 2017
Female investigators more likely to conduct research in women\(^1,2\)

Some areas of research on diseases in women underfunded relative to lethality compared to diseases in men\(^3\)

Bias against women investigators in grant peer review\(^4-6\)

How the lower value of women vs. men and work performed by women vs. men simultaneously impede advancement of women in academic STEMM and women’s health

\textit{Murrar et al., 2021}

---

\(^1\)Nielson et al. 2017; \(^2\)Sugimoto et al. 2019; \(^3\)Spencer et al. 2019; \(^4\)Head et al. 2013; \(^5\)Magua et al. 2017; \(^6\)Witterman et al. 2019; \(^7\)Kolehmainen & Carnes 2018; \(^8\)Chaudhary et al. 2021; \(^9\)Murrar et al. 2021; \(^10\)Hengel 2020; \(^11\)Knobloch-Westerwick et al. 2013; \(^12\)Silbiger and Stabler 2019; \(^13\)Hoffler et al. 2016; \(^14\)Spector et al. 2019; \(^15\)Carr et al. 2018; \(^16\)Blumenthal et al. 2017; \(^17\)Carnes et al. 2017
Some areas of research on diseases in women underfunded relative to lethality compared to diseases in men

Women less likely than men to have NIH R01 renewed

Bias against women investigators in grant peer review

Female investigators more likely to conduct research in women

How the lower value of women vs. men and work performed by women vs. men simultaneously impede advancement of women in academic STEMM and women’s health

Murrar et al., 2021

How the lower value of women vs. men and work performed by women vs. men simultaneously impede advancement of women in academic STEM and women’s health

- Female investigators more likely to conduct research in women
- Some areas of research on diseases in women underfunded relative to lethality compared to diseases in men
- Women less likely than men to have NIH R01 renewed
- Manuscripts describing research conducted in women less likely to be recommended for publication
- Bias against women as authors
- Bias against women investigators in grant peer review

References:

How the lower value of women vs. men and work performed by women vs. men simultaneously impede advancement of women in academic STEMM and women’s health  

Murrar et al., 2021

Women less likely than men to have NIH R01 renewed\(^7,8\)

Manuscripts describing research conducted in women less likely to be recommended for publication\(^9\)

Female investigators more likely to conduct research in women\(^{1,2}\)

Female faculty have lower research productivity and visibility in the scientific community than male faculty

Some areas of research on diseases in women underfunded relative to lethality compared to diseases in men\(^3\)

Bias against women as authors\(^{10-12}\)

Bias against women investigators in grant peer review\(^4-6\)

Women less likely than men to have NIH R01 renewed\(^7,8\)

Women less likely than men to have NIH R01 renewed\textsuperscript{7,8}

Manuscripts describing research conducted in women less likely to be recommended for publication\textsuperscript{9}

Less research conducted to improve the health of women

Female faculty less likely to be promoted to leadership in academic medicine where they can advance women's health research, education, and clinical care\textsuperscript{13-17}

Female faculty have lower research productivity and visibility in the scientific community than male faculty

Bias against women as authors\textsuperscript{10-12}

Female investigators more likely to conduct research in women\textsuperscript{1,2}

Some areas of research on diseases in women underfunded relative to lethality compared to diseases in men\textsuperscript{3}

Women less likely than men to have NIH R01 renewed\textsuperscript{7,8}

Bias against women investigators in grant peer review\textsuperscript{4-6}

How the lower value of women vs. men and work performed by women vs. men simultaneously impede advancement of women in academic STEMM and women's health \textsuperscript{Murrar et al., 2021}

\textsuperscript{1}Nielsen et al. 2017, \textsuperscript{2}Sugimoto et al. 2019; \textsuperscript{3}Spencer et al. 2019; \textsuperscript{4}Head et al. 2013, \textsuperscript{5}Magua et al. 2017, \textsuperscript{6}Witterman et al. 2019; \textsuperscript{7}Kolehmainen & Carnes 2018, \textsuperscript{8}Chaudhary et al. 2021; \textsuperscript{9}Murrar et al. 2021; \textsuperscript{10}Hengel 2020, \textsuperscript{11}Knobloch-Westerwick et al. 2013, \textsuperscript{12}Silbiger and Stubler 2019; \textsuperscript{13}Hofler et al. 2016, \textsuperscript{14}Spector et al. 2019, \textsuperscript{15}Carr et al. 2018, \textsuperscript{16}Blumenthal et al. 2017, \textsuperscript{17}Carnes et al. 2017
Bias is a habit that can be broken
We are focusing on helping STEMM faculty break the bias habit because policy alone does not change behavioral norms

- Equal pay for equal work has been law for almost 50 years *Equal Pay Act, 1963; Title VII of the Civil Rights Act, 1964*

- Multiple studies affirm gender pay inequity in academic science and medicine including chairs *Butkus et al. American College of Physicians position statement 2018; Mensah et al. 2020*

- For organizational culture to change, the individuals who create the culture must intentionally change their behavior *Rogers 1962; Nonaka 1994; Simpson 2002*
One of few strategies proven effective in helping change *behavior* in response to stereotype-based bias

- “Motivated self-regulation” – social psychology
- “Intuitive override” – judicial reasoning
- “Forward-looking tuneability by reasons” - philosophy
- “Breaking the bias habit” – our research team

*Monteith et al., 2016; Guthrie et al., 2009; Toribio, 2021; Carnes et al., 2015; Devine et al., 2017*
Breaking the bias habit takes *more than good intentions*

Changing any habit is a multistep process:

- Awareness
- Motivation
- Self-efficacy
- Positive outcome expectations
- Deliberate practice

Cluster randomized trial of gender bias habit-reducing intervention (R01 GM088477)

92 STEMM depts. 2,290 faculty

46 experimental
1,137 faculty
Attendance/dept 31% ± 21
Overall 310 = 26%

Baseline, 3 d & 3 months
Survey response: 587 (52%)

46 control
1,153 faculty

Baseline, 3 d & 3 months
Survey response: 567 (49%)

Differences Between Experimental and Control Departments Compared With Difference at Baseline

(IAT in D-scores; others on 7-point Likert scales)

N = 92 departments; 1154 faculty (50.4% response rate)
IAT= Implicit Association Test (standardized D-score)
*P < 0.05; models adjusted for faculty gender and rank
‡ P < 0.05 for action at 3 months when comparing only experimental depts with ≥25% attendance

Differences Between Experimental & Control Departments

Study of Faculty Worklife 2010 and 2012

N = 92 departments; 671 faculty for response rate 48% (2010) and 43% (2012).
* Indicates significant difference between experimental and control depts. compared with differences at baseline at $p<.05$. 

Diversity of New Faculty Hires, Experimental vs. Control Departments in Bias Literacy Workshop Study

Does this approach work beyond one institution and beyond gender bias? (R35 GM122557)

**Bias Reduction in Internal Medicine (BRIM)**

- Cluster randomized study of 3-hour bias habit-reducing workshop
- 19 departments of Medicine
- Divisions randomly assigned to receive workshop early (Group 1) or later (Group 2)
- Outcome measures: self-reported equity-promoting behaviors, perceptions of department climate, burnout
Q10-5

Intervene if I witness a student, resident, fellow, or colleague being treated in a biased way...

I engage in this action on a regular basis

N=3383, b=0.217(SE=0.106), p=0.04
Q10-5

Intervene if I witness a student, resident, fellow, or colleague being treated in a biased way...

I engage in this action on a regular basis

N=3383, b=0.217(SE=0.106), p=0.04

Social desirability?
Q10-5

Intervene if I witness a student, resident, fellow, or colleague being treated in a biased way...

I engage in this action on a regular basis.
Challenge a personnel decision if I think it has been influenced by stereotypes

Q8-2

I am confident that I can do this

I engage in this on a regular basis
Why do we think this approach worked?

- Engaged those responsible for organizational norms
- Incorporated strategies shown to be effective in fostering sustained intentional behavioral change
- Participation was voluntary
- Enabled social diffusion by targeting the entire dept/division
2 strategies to practice to break your own bias habits

• **Growth mindset**: e.g., “with *hard work* I can overcome the influence of stereotypes on my judgment and decision-making” *(based on studies in Carr et al., 2012)*

• **Perceiving variability**: Whenever you hear someone say [members of some group] are...., respond with “some are ____, some are ____, some others are____...” *(based on studies in Er-rafiy & Brauer, 2012)*
Summary & Conclusions

• Gender stereotypes are deeply entrenched in habitual patterns of thinking and behaving

• The conflation of gender and status negatively impacts the value placed on studying conditions prevalent in women and advancement of women in STEMM

• Breaking the bias habit should benefit both women in STEMM and women’s health but it requires hard work
Questions?