

Gender, women and scientific research

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Citation Vargas C, Lutz M, Papuzinski C, Arancibia M.
Gender, women and scientific research. *Medwave*
2020;20(2):e7857

Doi 10.5867/medwave.2020.01.7857

Submission date 13/2/2020

Acceptance date 13/3/2020

Publication date 31/3/2020

Origin This article is one of several “Methodological notes” prepared by the course on Research Methodology of the School of Medicine of the University of Valparaíso.

Type of review Externally peer-reviewed by three reviewers, double-blind

Keywords gender identity, women, research, bias

Abstract

Gender is a psychosocial construct referring to the socially built roles, behaviors, expressions and identities of girls, women, boys, men and people with gender diversity, while sex is related to the biological attributes of a woman or a man. Even though the terms “sex” and “gender” are often used in a binary way, there is considerable diversity in the way individuals and groups understand, experiment and express them. This narrative review describes some relevant aspects of the subjective difference that exists and favors men over women in the fields of sciences and research, starting from a historical perspective in the light of feminist movements. In particular, women are described as researchers - creators of scientific knowledge, as well as the subjects of analysis. Some conflicts arising from sex bias, applied to biomedical research, are also analyzed, and cases are delivered that exemplify the disparity that has historically accompanied the female gender in this area, its ignorance and little cultural recognition. This review is the last article in a methodological series on general concepts in biostatistics and clinical epidemiology developed by the Chair of Methodology of Scientific Research of the School of Medicine of the Universidad de Valparaíso, Chile, which aims to address a contingent and cross-cutting theme to all scientific research.

Key ideas

- Gender and sex influence scientific research.
- For historical, cultural, political, economic and social reasons, women have been underrepresented in scientific research, as creators of knowledge and as subjects of analysis.
- The scarce presence of women in scientific research affects the research results.
- Gender perspective must be included in public policies of scientific research and in the guidelines of study reports.

Introduction

Unlike sex, identified as a set of biological attributes^{1,2}, gender derives from a psychosocial construction, and refers to the socially-built roles, behaviors, expressions, and identities of girls, women, boys, men and people with gender diversity within the historical context of any given society^{2,3}. This influences self-perception, conduct and interpersonal relationships, as well as the distribution of power and resources in society. However, the terms “sex” and “gender” are

often used interchangeably, conceptualized in a binary way, even though there is considerable diversity in the way individuals and groups understand, experiment, and express them^{4,5}.

Simone de Beauvoir’s clarifying observation “one is not born, but rather becomes, a woman”⁶, represents the difference in the nature of gender and sex concepts, which has materialized in the huge demands placed by sociocultural and political manifestations, increasing since the second half of the 20th century. This highlights the subjective difference that favors men over women, a phenomenon

that is addressed by the feminist movements. The underrepresentation and discrimination of women in areas of power and leadership does not exempt the academic-scientific field, a context in which it has been well documented that women have lower salaries, less allocation of funds for research, and even their publications are less cited than those of male peers, all of which accounts for gender-based violence⁷⁻⁹. In her essay *A Room of One's Own* (1929), the British writer and feminist Virginia Woolf (1882-1941) reflects on a series of lectures given in female divisions at the University of Cambridge, narrating fiction. In it, a series of male voices express “give her a room of her own and five hundred pounds a year, let her speak her mind and leave out half that she now puts in, and she will write a better book one of these days.” To be able to write, a woman needed her own room and the minimum allowance to support herself, two unusual concepts for this time¹⁰.

On the other hand, the sexist characteristics of the predominant culture have determined that gender bias is present in human and animal research¹¹⁻¹³, systematically generating equivocal assumptions and a misunderstanding of human health. The Canadian Institutes of Health Research¹⁴ established a conceptual framework for understanding gender, represented by four dimensions: gender roles (child care, domestic work), gender identity (personality traits, caring about the needs of others, leadership skills), gender relationships (social support), and institutionalized gender (career opportunities, economic income, educational training)¹⁵. However, as gender is a complex concept and difficult to quantify, which is further modified over time according to culture, it has been underestimated in scientific research¹⁶. To improve this circumstance, a number of recommendations¹⁷ and guidelines^{14,18} have been established. Nevertheless, since the productive function has been culturally given to men and the reproductive function to women, gender perspective-based studies still seem to have a long way to go.

In this review, we address the issues surrounding gender and women's concepts in science and research, as the creators of scientific knowledge and as subjects of analysis, pointing to a series of examples of women who contributed significantly to knowledge from a female perspective. We discuss some conflicts arising from sex bias in biomedical research. The article corresponds to the last installment of a methodological series of six narrative reviews on general topics in biostatistics and clinical epidemiology, which explore published articles available in major databases and specialized reference texts. The series, conducted by the Chair of Methodology of Scientific Research at the School of Medicine of the Universidad de Valparaíso, Chile, is oriented to undergraduate and graduate students of health sciences. We hope that this critical review will contribute to individual and collective reflection on women's work in scientific research.

Historical context: The feminist movements

The idea transversally laying under feminism is the recognition of a sociocultural conflict between the possibilities of vital development for women against the case of men. Under this perspective, each person recognizing this conflict and acting in consequence could be a participant of feminism.

The “first wave of feminism,” a designation that has been given in retrospective, started in the mid-19th century, along with the enlightened, socialist and anti-slavery ideals, as a combination of separate

groups who worked independently for women's rights, with an emphasis on equality between men and women in terms of access to education, work, control of owned money and, importantly, the right to vote. This is linked to the suffragist movement: Women who fought for the right to vote and the improvement of civil rights given to them by manifestation and civil unrest, and by lobby and publications. An outstanding role was played by the Czech lawyer and politician Milada Horáková (1901-1950)^{19,20}, one of the most relevant European feminists of the 20th century who defended democracy, and actively fought for women's social and political rights. Being a prisoner in the concentration camp of Terezín towards the end of World War II, she belonged to the resistance against the Nazi occupation of Czechoslovakia. After liberation, she was elected as a member of the Czech parliament. However, as a communist objector, she resigned when the communist government was installed in 1948. Due to being charged with conspiracy against the government, Horáková was arrested, tortured, and sentenced to death unless she recognized the legality of the government. She did not. Despite a series of letters asking to change the Czechoslovakian government's decision, and others sent by personalities such as Albert Einstein, Winston Churchill, Eleanor Roosevelt and Bertrand Russell, she was executed by hanging in 1950.

The first wave of feminism was criticized for focusing on the demands of the middle class. However, it made substantive progress related to its purposes²¹⁻²³. After World War II, there was significant popular desire to return to “normality” and the conventional, thus presenting a phenomenon of “over-correcting” gender roles, which experienced a rigid redefinition. The so-called second wave of feminism (1960s), known as the “women's liberation movement” reacted against it. This movement claimed women's sexuality, law, and management over the female body (along with the emergence of contraceptive drugs and ideas regarding abortion), policies on workplace sexual harassment and unequal payment between men and women for the same job.

The French philosopher Simone de Beauvoir wrote one of the founding texts on feminism: “The second sex”²⁶, in which she explores the biological, social, psychological and historical dimensions of “being a woman,” therefore unfolding the theoretical step from the first to the second wave of feminism (Example 1). During this movement, the phrase “the personal is political” was popularized, which is to say, personal experience has roots and political solutions. The second wave has been criticized for the emergence of polarized and radical feminist visions, which detract from the space of intermediate reflections and nuances. Similarly, while it would have given space to the homosexual cause, it would not have given greater importance to the emerging transgender cause²¹⁻²³.

Example 1. Simone de Beauvoir (1908-1986). Philosopher, writer, feminist teacher, and French existentialist. She was born in Paris in a well-to-do and traditional family, who advocated for a conservative and Catholic upbringing. However, from a profound reflection on the existence of God, de Beauvoir defined herself as an atheist from the age of 14. She studied philosophy at La Sorbonne in Paris, where she met the man who would accompany her during her lifetime, the philosopher Jean Paul Sartre. Both, in their work, defended philosophical reflection on freedom. While she has been recognized on multiple occasions as “Jean Paul Sartre's partner,” Simone was outstanding in her own

ideas. As a writer she excelled in the novelistic, essayistic, and autobiographical aspects. The work that consecrates and contributes substantively to feminist thought, *The Second Sex* (1949), recounts a journey from the question, “What is the problem of being a woman?” In *Destination*, she addresses biological, psychoanalytic, and political perspectives (historical materialism) of being a woman. For its part, *History, Myths and Formation* addresses the historical and individual life development of women. In *Situation*, she reflects about women’s social issues; in *Justifications*, she analyzes socio-historical prototypes of women (“the narcissistic,” “the in-love”, “the mystic”), and finally, in *Towards liberation*, she refers to the new social pact of women in contemporary society and the place that they must occupy. In her existentialist analysis of the status of “the feminine,” de Beauvoir is remembered by the phrase that synthesizes the notion of her feminist work: “One is not born, but rather becomes, a woman. No biological, psychic, or economic destiny defines the figure that the human female takes on in society.” Research into feminism could not be thought of in the same way without this philosopher’s work^{6,24-27}.

Since the 1990s, a third wave of feminism has been recognized, paying attention to small-scale social changes, the so-called “micro-politics,” and individual feminine expression of all ethnicities, religions, occupations, and sexualities. It discusses policies against sexual abuse, domestic violence, representation of women on social media, forms of language use, and the emergence of stereotypes. This third wave of feminism welcomes demands of transgender people and coincides with theories that understand sexuality more broadly, such as queer theory. However, here is also one of its main criticisms, as some point out that it constitutes a feminism without a clear goal and is rather an extension of the second wave. Some perspectives have even addressed a fourth wave of feminism, although the most developed theoretical lines are the three presented^{21,22}.

Women as scientific researchers

The bias of seeing women as “default men” can be traced back to Ancient Greece, in which the female body was seen as that of a “mutilated male and turned inward”²⁸. Since classical philosophy, the ontological difference between soul and body has had cultural implications regarding sex, having the mind associated as masculine while the body as feminine. Historically, women have been built as a source of reference to the body, but not a spiritual one. According to Butler²⁹, this vision raises relationships of subordination, as well as political and psychic hierarchy. Women are relegated to reproductive functions and men are relegated to intellectuality, hierarchically superior to the body plane. The mind as an active entity is the engine of subjectivity and transcendence, contributing to an underestimation and rejection towards the female anatomy³⁰.

An example of the theoretical and conceptual implications of the historical construction of being a woman is the development of the psychoanalytic theory, which in its beginnings was structured based strongly on manly concepts. In practice, adult psychoanalysis was reserved for men, while women could engage in child psychoanalysis, observed at the time as a minor practice. Because of this inequality, child psychoanalysis was initially developed (fortunately) by great women, such as Anna Freud, Melanie Klein, Margaret Mahler, Sabina Spielrein, and Alice Miller. The male psychoanalytic vision marked much of the theoretical and conceptual practice, as well as

the research and development of 20th-century psychology and psychiatry^{6,31}.

In the social sciences, the research contribution of women has been essential. The case of Hannah Arendt (1906-1974), a German philosopher, is paradigmatic, as she contributed significantly to the development of 20th-century political theory, an area historically linked to the male field. Her contributions were not only related to the conception of totalitarianism but also to the ethical and philosophical analysis of human nature and evil. As a Jew, she was confined to the Gurs concentration camp, then took refuge in the United States, where she served as an academic at Princeton, Chicago, and the New York School for Social Research. In 1961, she was a reporter for the *New Yorker* magazine for the trial of Adolf Eichmann, one of the senior Nazi officials responsible for the “final solution.” Taking inspiration from the trial in Jerusalem that ended with Eichmann’s execution, Arendt built a philosophical reflection that she termed the “banality of evil,” where she defined the phenomenon with brilliant rationality and great attachment to logic, discussing the concepts that define the essence of a person. Her analysis of Eichmann’s trial led her to denounce Jewish leaders for their role in the Holocaust. This action cost her to be widely rejected by the Jewish community and was a great misunderstanding of the time, yet she opened the debate around the Holocaust and analyzed deep concepts underlying phenomena as complex as war crimes, positioning herself as one of the more distinguished thinkers of the 20th century³²⁻³⁴.

The distortion of the vision of “the feminine” has a historical root in scientific development³⁵. Margaret Rossiter³⁶ describes the “Matilda effect,” honoring Matilda Joslyn Gage, an American suffragette and writer who worked fervently for women’s rights, showing the inequality between men and women. This phenomenon is understood as the invisibility of women both in the development of research and in the recognition of their achievements, which may be null, expropriated, and sometimes even delivered posthumously. This is a corollary of the “Matthew Effect”³⁷, given by a lower appreciation of the works of unknown writers, scientists or artists compared to the works, similar in importance, of others already consecrated or famous, due to structural relationships imposed on the work or research teams. The study of this phenomenon was conducted by the sociologist Harriet Zuckerman and published by her colleague and later husband Robert K. Merton, who paradoxically mentioned Zuckerman in his footnotes. Below the case of Rosalind Franklin, a scientist responsible for the bases that determined the structure of DNA, is illustrated. Franklin was left in the background by the sexism of the time (Example 2).

Example 2. Rosalind Franklin (1920-1958). The British chemist Rosalind Franklin was born into a Jewish family in England and studied chemistry at the University of Cambridge. In her scientific career, she developed crystallography extensively, including the study of the structure of some viruses and minerals. Yet Rosalind is best known for obtaining images of DNA structure through X-ray diffraction, a technique that she learned in Paris, during a time when the English scientific community favored her male peers in every way. Her findings were given to Watson and Crick by Rosalind’s partner, Maurice Wilkins, who had a poor relationship with her. Thus, Watson and Crick published a proposal for the double-helix DNA model in *Nature*, an article in which they thank the female scientist scantily for their “unpublished experimental results and ideas.” In 1958, she died of ovarian cancer

at age 37, perhaps from excessive radiation exposure during her scientific career. Four years later, Watson and Crick received the Nobel Prize in Physiology and Medicine for their discoveries in the structure of DNA and, on the occasion, Rosalind Franklin was not mentioned in the acceptance speech. However, the scientific world has recognized her in recent years, founding universities, scholarships, societies and even space exploration vehicles with her name and, in more equitable fashion, recognizing her substantive contribution to molecular biology. In Franklin's words, "science and everyday life cannot and should not be separated"³⁸⁻⁴⁰.

As has been noted, ignorance and poor cultural recognition of the female gender in scientific research has occurred throughout history. In research, this reality has been reflected by the weak position of women in the fields of science, technology, engineering, and mathematics (STEM)^{41,42}. A key aspect is the evaluation of women's performance in science. When women apply for research grants, scholarships, awards or positions, bias happens, often unconscious and ingrained, leaving women in the background. An example is the underrepresentation of women as leading authors of manuscripts published in high-impact journals, which is largely attributed to their higher dedication to tasks associated with teaching, management, and institutional service than men, who can be devoted mostly to research⁴³. In a recent study, Lerchenmueller and colleagues⁹ demonstrated that in scientific publications in which the first or last author is female, it is less common to use positive terms to describe the findings, such as "novel," "original," "relevant," and/or "unique," compared to those in which the authors are men. This difference is accentuated in mainstream journals. Perhaps this fact is explained by the traditional women's education due to a hegemonic expression of masculinity: Women are taught to behave modestly in order to maintain or move up in their professional careers⁴⁴.

The low retention and advancement of women in scientific research can also be explained by motherhood. The hard compatibility between motherhood and work, the non-compliance of a woman's pre and post-natal period, and the demerit in women's curricula contribute to great disadvantages compared to their male colleagues, having to choose in most cases between being a scientist or a mother. In addition, situations of sexual harassment are also an important factor in the desertion of women in science, for which public and private institutions have established protocols of reporting, investigating and punishing these behaviors from their workers⁴⁵ (Example 3).

Since October 2019, as part of the so-called "Social Outburst" in Chile⁴⁶, the questioning of the roles of women in society has been one of the main complaints addressed. As part of this movement, women have played the role defined by Marcuse⁴⁷ as an "anticipator group." That is, acting as a catalyzer group in a moment of disruption, since women, in spite of being a demographic majority, are at the same time a minority in formal and absolute terms⁴⁸. This new national sociopolitical scenario should lead to an improvement in the opportunities of development for women in scientific research.

Example 3. Marie Curie (1867-1934). Maria Salomea Skłodowska Curie was a Polish-French chemist and physicist born in Warsaw. During her youth in Warsaw, she took part in the Polish enlightened feminist movement. As women were banned from attending university in Poland, she worked as a governess to pay

for her studies at La Sorbonne, Paris, in an effort to resist prejudice. In 1893, she earned a bachelor's degree in physical sciences, and in 1894 she graduated in mathematics and met Pierre Curie, whom she married. She became the first female lecturer at La Sorbonne. Pierre Curie's director agreed that Maria should create a laboratory in a warehouse. At the warehouse she began her research of the electrometer, invented by Pierre, to measure the intensity of the current caused by uranium and thorium compounds. She later described the existence of the element Pierre and Marie called "radium." In 1903, she was recognized with the Nobel Prize in Physics, an award she shared with her husband and the physicist Henri Becquerel, although the Academy had initially awarded the prize to the two males only for the discovery of radioactivity, unaware of Marie's work. In 1910, the year in which she published the "Treatment on Radioactivity," her life changed: She was widowed (Pierre had a sudden and tragic death) and, after a period of mourning, she acknowledged publicly her relationship to Paul Langevin, a scientist disciple of her husband. She was then punished socially and, as a foreigner, was required to return to Poland with the heavy burden of conservatism, as Marie embodied the image of women, atheists, and the political left. Returning to Paris from a congress in Brussels, a mob threw stones at her house and insulted her with vitriol. To protect herself, Marie took refuge in the home of the mathematician Emile Borel, who was pressured by the French government to not accept her. In 1911, the Swedish Academy awarded Marie a second Nobel Prize, now in Chemistry, for the discovery of radium and polonium. Svante Arrhenius, a member of the Academy, encouraged her to travel to Sweden but soon after, in another letter, pointed out that it was safer for her to stay in France, sacrificing her meeting with Swedish royalty. Despite this rejection, Marie's friend Albert Einstein supported her, stating that she was the only scientist that fame had not corrupted, and advised her to attend the award ceremony in Stockholm. Marie noted: "The prize has been awarded to me for the discovery of radium and polonium. There is no relationship between my scientific work and the facts of my private life that are intended to invoke against me in low-skilled publications [...] In principle, I cannot accept that the appreciation of the merit of scientific work can be influenced by slander and insults in relation to my private life." Thus, Marie separates the professional from the personal sphere and claims the scientific-academic merits, a subject of total validity in our day. With a life devoted to scientific research, radioactivity caused irreversible damage to her body, and leukemia was determined as her cause of death⁴⁹⁻⁵¹.

In 2013, the Chilean National Commission for Scientific and Technological Research (CONICYT), currently the National Innovation and Development Agency (ANID), elaborated the Institutional Policy on Gender Equality, with actions aimed at granting equal opportunities for women in the fields of research, science, technology, education and innovation. Currently, the country has an Institutional Policy on Gender Equality in Science and Technology, which considers many recommendations at a global level, including the Sustainable Development Goal set by the United Nations N°5: "[Achieving gender equality and empowering all women and girls](#)". In particular, the National Innovation and Development Agency has established a roadmap with various aims oriented to recognize and visualize the work of Chilean female researchers, detecting gender bias in project evaluations and research protocols, and applying equality

gender in all available instruments. It also envisages reaching a consensus in protocols of good practice for women in the academy and enhancing women's associative thematic networks, among other measures that promote research in an appropriate work environment (Example 4).

Example 4. Adriana Hoffmann (1940-). A Chilean botanist, daughter of the physiologist and psychiatrist Helena Jacoby, known as Lola Hoffmann, and the physiologist Franz Hoffmann, who inculcated in their daughter “the feeling that flora and fauna should be preserved forever” from an early age. She started studying agricultural engineering at the Universidad de Chile, however, she quit these studies determining that such a technical career did not fulfill her passion for nature. She travelled to Germany with her mother, who practiced psychiatry, while Adriana focused on botanic studies. She went on a series of expeditions throughout Chile to register natural species. She is the author of a series of books on botany and the environment, such as “How Margarita Flores can take care of her health and help the planet” (1990), “The tragedy of Chilean forests” (1998), “Encyclopedia of Chilean forests: conservation, biodiversity, sustainability” (2000), among others, being a pioneer in the documentation of native species as well as environmental activism, in a period in which the preservation and care for the environment was not relevant. She took part in the non-governmental organization Chilean Forests Defenders, and in 1997 the United Nations recognized her as one of the 25 global environmental leaders of the decade. In 1999, she received the *Premio Nacional de Medio Ambiente* (Chile) and in 2015 the *Ministerio de Medio Ambiente de Chile* created the *Academia de Formación Ambiental Adriana Hoffmann* (Adriana Hoffmann Environmental Academy). Recently, in 2018, one of Adriana's great ideas materialized: The creation of a Center for Environmental Education in Cantalao Park (Pre-Andean area of Santiago, Chile). Hoffmann has stood out for her great environmental work understanding the science of nature, pointing to future generations: “Respect nature, try to learn as much as possible from it, because the person who knows it takes better care of it”⁵²⁻⁵⁴.

Including the female sex in biomedical research

Despite differences according to sex at the biochemical, genetic, cellular and physiological levels, many studies show null or low inclusion of female populations in biomedical research, which brings into question the external validity of these results⁵⁵. For example, pharmacokinetic and pharmacodynamic studies, which are part of the essential objectives of early stage clinical trials, are difficult to extrapolate from one sex to another sex, as these parameters exhibit differential behaviors in women and in men⁵⁶. A particular case is the drug zolpidem, a hypnotic reaction that increased significantly the number of adverse cases after its incorporation into the market, which was attributed to the fact that in women this drug has a reduced clearance compared to what occurs in men. This case led the U.S. Food and Drug Administration (FDA) to create the first indication of labeling that the recommended a lower dose for women⁵⁷.

There is a clear sexual dimorphism in a series of pathologies: Cardiovascular, neoplastic, autoimmune, respiratory, nephrological,

among others⁵⁸⁻⁶¹, which have been recognized through sex and gender analysis. Although including women in scientific research protocols seems logical, it does not always occur. Johnson and colleagues⁶² evaluated the sex analysis in primary studies analyzed by Cochrane systematic reviews related to the treatment of cardiovascular diseases. Results showed that 27% of the population in 258 randomized clinical trials were women and, of all these trials, 33% conducted a gender-based analysis. These differences are also present in preclinical studies using animal models⁶³. However, in basic science studies a higher use of male animals has been justified due to the influence of the menstrual cycle, which introduces confounding and interaction factors that are difficult to control. While the selection of individuals in research may be influenced a priori by information such as incidence, risk factors, or other variables (male participants would probably not be included in ovarian cancer studies, or female participants in prostate cancer studies), sex representativeness should be proportional and explicit in the research protocols⁶⁴, avoiding biases that can affect the validity of the findings and, ultimately, the health of the population.

From another perspective, gender analysis provides a broader view of the factors that can influence individuals. Although there is no a clear consensus of its definition^{64,65}, sex and gender analysis have made it possible to understand how self-perception, ethnicity, geographical location, public policies, and other factors, impact the risk of certain diseases, their diagnosis, and their treatment⁶⁶.

Recommendations and guidelines on gender and sex in scientific research

Various institutions have developed recommendations for gender evaluation and information in research. The U.S. National Institutes of Health (NIH) stipulate that women and minorities (ethnic, racial and/or cultural) must be included in phase III clinical trials to accurately analyze differences in the effects of tested interventions⁶⁷. The regulation expressly states that if men and women respond differently to a pharmacological intervention, phase III clinical trials should be designed in such a way as to separate the basic research questions into two: one for men and one for women, with adequate sampling for each situation.

In 1997, the Canadian government developed guidelines and policies for gender-based analysis, developing the Canadian Guidelines on the Inclusion of Women in Clinical Trials⁶⁸. In 2009, the Canadian health research agencies created the Institute of Gender and Health, which aims to promote excellence in research on the influence of sex and gender throughout life and to apply findings to identify and address urgent health challenges⁶⁹. Since then, all clinical trial grants must ensure that research designs include the sex and gender perspective. The strategic plan 2018-2023 called Science is better implements sex and gender, with strategies for integration, innovation, and impact on the research of the sex and gender perspective⁷⁰.

Simultaneously, the U.S. Institute of Medicine published the Sex-Specific Reporting of Scientific Research, recommending that the International Committee of Medical Journal Editors (ICMJE) adopt the guideline so that all articles reporting results from clinical trials analyze the data separately for men and women. A comprehensive guideline on sex and gender reports is available, recommending that researchers include representative populations in all types of studies, provide descriptive data on sex and other demographic variables relevant, and stratify reports by sex⁷¹.

Similarly, the European Association of Science Editors (EASE) established a gender policy committee in 2012 to develop a set of guidelines for reporting on sex and gender equality in research. This is how the SAGER (Sex and Gender Equity in Research) guidelines emerged¹⁸, designed to promote the systematic approach to research by sex and gender, providing researchers and authors with a tool to standardize information by these variables in scientific publications. SAGER guidelines are considered relevant for the object of study, provided that the guidelines apply to human beings, animals or any derived material (cells, tissues and organs), as well as in other disciplines whose results apply to humans. Even though in Latin America public state policies have been established pursuing the inclusion of women in scientific research, no guidelines have been elaborated that specify the inclusion of the gender perspective in biomedical research.

Final remarks

For historical, political, economic, social, cultural, and religious reasons, women's scientific work is in detriment in relation to male's participation in scientific research. This situation has resulted in a lower inclusion of women as researchers and as research subjects, even in studies with animal models, which biases the results obtained transversally in the research. In addition, female underrepresentation disincentivizes new generations of female researchers to join the scientific ranks, not to mention the still frequent phenomena like sexual harassment that marginalizes women. Although various countries possess guidelines for biomedical research that include the gender perspective, Latin America has not yet developed similar instruments, so it would be desirable to develop guidelines that reflect the local situation.

In this revision, we cover the contributions to scientific, natural, and social research of different women who at some point of their careers were affected by gender bias, and whose contribution to western development is significant. It would be impossible to include in one article the contributions of all women who have gone through similar experiences. The existence of female models and gender perspective in research allows, from the academic formation standpoint, more interest, participation, and validity of the results obtained.

Notes

Roles and contributions from authors

ML, CP and MA are scholars of the Chair of Methodology of Scientific Research, in which the development of this methodological series is circumscribed as a research activity of the teaching assistants of the course. All authors contributed to the planning and writing of the original manuscript, as well as in the writing of the Introduction and the Final considerations. CP and MA developed the section Historical context and Examples 1 and 2. CV, ML and MA elaborated the section Woman as a scientific researcher. CV and ML developed Including female sex in biomedical research and Recommendations and guidelines on gender and sex in scientific research. ML developed Example 3. CV developed Example 4.

Acknowledgments

We thank Fernanda Vargas, a Bachelor of Science student at Universidad de Valparaíso, who designed the images of Hannah Arendt, Marie Curie, Simone de Beauvoir, Rosalind Franklin, Adriana Hoffmann, Milada Horáková and Virginia Woolf found in Figure 1.

Funding

The authors state that there were no external sources of funding.

Competing interests

The authors completed ICMJE's conflicts of interest statement and stated that they received no funds for the completion of this article; they do not have financial relationships with organizations that may have an interest in the article published within the past three years and have no other relationships or activities that may influence the publication of the article. Forms can be requested by contacting the author responsible or the Editorial Committee of the Magazine.

Ethical aspects

This study did not require evaluation by an ethics-scientific committee.

From the editors

The original version of this manuscript was submitted in Spanish. This English version was submitted by the authors and has been lightly copyediting by the Journal.

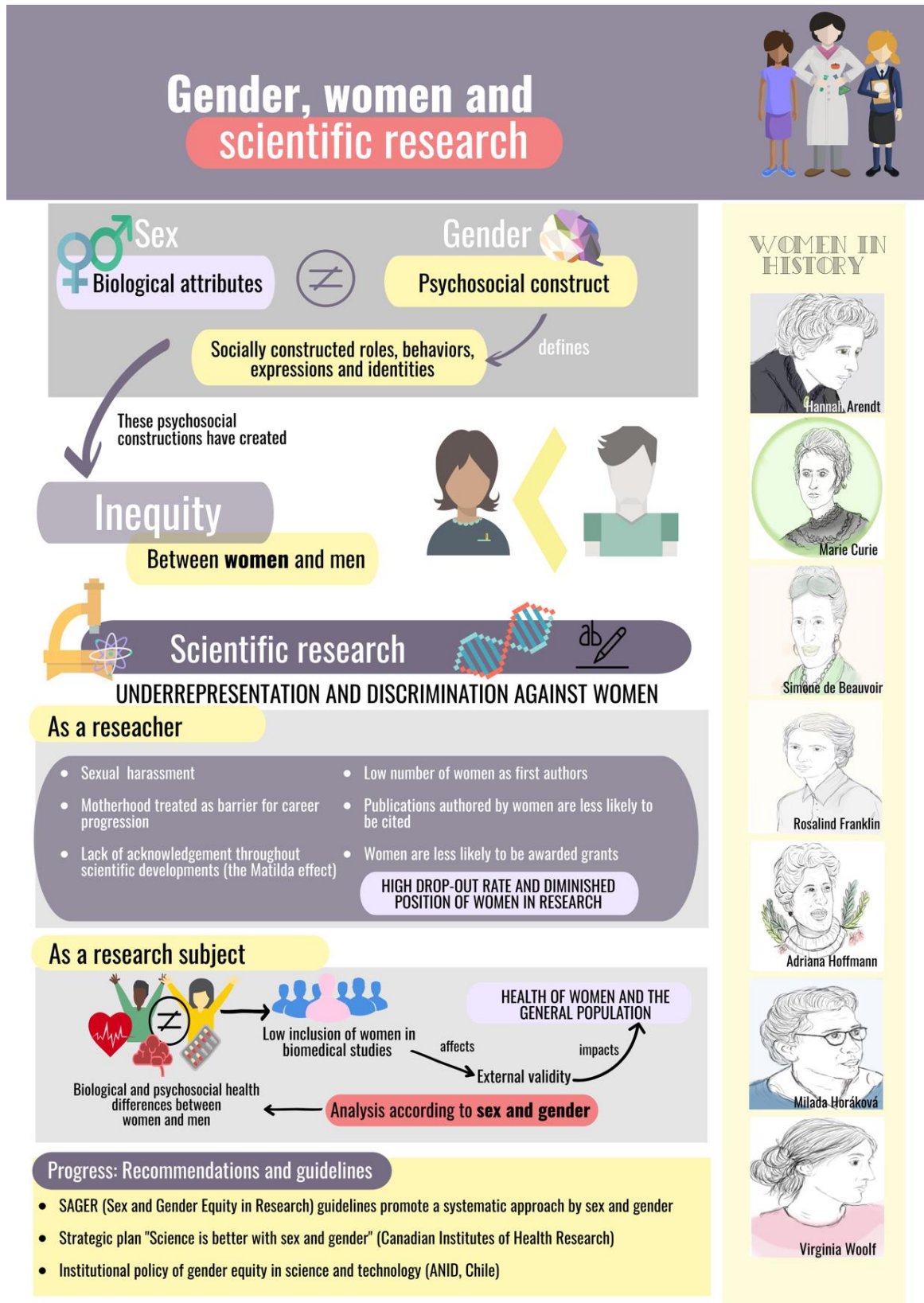
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Figure 1. Infographic of gender, women and scientific research.



Source: designed by the authors.

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