PLOS One

Measured treatment differences between sexes and genders: A scoping review

--Manuscript Draft--

Manuscript Number:	PONE-D-26-09728R2
Article Type:	Research Article
Full Title:	Measured treatment differences between sexes and genders: A scoping review
Short Title:	Measured treatment differences between sexes and genders: A scoping review
Corresponding Author:	Miriam Veenhuizen University of St Andrews St Andrews, UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND
Keywords:	bias; Discrimination; healthcare; Feminism
Abstract:	Background: Sex and gender-based inequality is found throughout medicine. Although there has been significant research in gender disparities affecting healthcare professionals, there is a lack of research into gender differences in the treatment of patients. Despite recognition of systemic issues, recent empirical evidence on how gender influences actual treatment decisions remains fragmented across specialties. A preliminary search of MEDLINE, the Cochrane Database of Systematic Reviews and JBI (Joanna Briggs institute) Evidence Synthesis was conducted and no current or underway systematic reviews or scoping reviews on the topic were identified. Methods: Studies in English published between 2018 and 2023 were included. Only research which studied measurable differences in the care received by patients of different sexes or genders was included. Both authors independently screened the literature against the a priori defined eligibility criteria. A thematic synthesis approach was used and results summarised qualitatively. Results: Forty-one papers were included in this review. Of the thirty-eight retrospective case series, thirty-three found a significant difference between the treatment of male and female patients. Of the twenty-nine case series using a multivariate analysis, twenty-five studies found a significant difference in treatment between male and female patients. Conclusions: The results of this review indicate that men and women are frequently treated differently by healthcare systems. During 2018-2023, five hundred and fifty-one papers were published which studied gender-based differences in opportunities given to healthcare professionals, but only forty-one studying the treatment given to patients. This highlights an area of unmet research need.
Order of Authors:	Miriam Veenhuizen
	Andrew O'Malley
Opposed Reviewers:	
Response to Reviewers:	We again thank the reviewer and editor for their time and effort invested into this submission. Below, we outline the reviewer's most recent comments and indicate our adjustments made to the paper. - Tables 1 and 2 should be removed. The contents of these tables could be moved to the main text. We have removed Tables 1 and 2, and moved the contents to the main text as suggested. - Table 3 and Figure 1 should be combined into a standard PRISMA flowchart. A standard flowchart would also need the exact number of records retrieved from each database. We have combined Table 3 (now removed) and Figure 1 into a standard PRISMA flowchart. We have also included the number of records retrieved from each database. - Tables 4, 5, and 6 need to be revised. For example, in Table 4, different procedures within the same study should be presented in separate rows. - Please apply the same format to Tables 5 and 6. Tables 4, 5, and 6 (now Tables 1 to 3) have been reformatted as suggested, with

	separate rows for different procedures within the same study. We have also added years of publication to all references in these tables. - Also, move the table legends to the top of each table. We have moved the table captions/legends to the top of each table. - Please provide the Embase search strategy. We have provided the Embase search strategy in the appendix. - Please provide the exact start and end dates of the literature search (e.g., 01/01/2018–31/12/2024). We have provided the exact start and end dates of the literature search in the Appendix. Kind regards, Andrew O'Malley and Miriam Veenhuizen
Additional Information:	
Question	Response
Competing Interests Use the instructions below to enter a competing interest statement for this submission. On behalf of all authors, disclose any competing interests that could be perceived to bias this work—acknowledging all financial support and any other relevant financial or non-financial competing interests. This statement is required for submission and **will appear in the published article** if the submission is accepted. Please make sure it is accurate and that any funding sources listed in your Funding Information later in the submission form are also declared in your Financial Disclosure statement. View published research articles from *PLOS ONE* for specific examples.	The authors have declared that no competing interests exist.

NO authors have competing interests Enter: *The authors have declared that no competing interests exist.* **Authors with competing interests** Enter competing interest details beginning with this statement: *I have read the journal's policy and the authors of this manuscript have the following competing interests: [insert competing interests here]* * typeset	
Data Availability Authors are required to make all data underlying the findings described fully available, without restriction, and from the time of publication. PLOS allows rare exceptions to address legal and ethical concerns. See the PLOS Data Policy and FAQ for detailed information. A Data Availability Statement describing where the data can be found is required at submission. Your answers to this question constitute the Data Availability Statement and **will be published in the article**, if accepted. **Important:** Stating 'data available on request from the author' is not sufficient. If your data are only available upon request, select 'No' for the first question and explain your exceptional situation in the text box. Do the authors confirm that all data underlying the findings described in their manuscript are fully available without restriction?	Yes - all data are fully available without restriction
Additional data availability information:	
Financial Disclosure Enter a financial disclosure statement that describes the sources of funding for the	The author(s) received no specific funding for this work.

work included in this submission. Review the submission guidelines for detailed requirements. View published research articles from *PLOS ONE* for specific examples. This statement is required for submission and **will appear in the published article** if the submission is accepted. Please make sure it is accurate. **Funded studies** Enter a statement with the following details: • Initials of the authors who received each award • Grant numbers awarded to each author • The full name of each funder • URL of each funder website • Did the sponsors or funders play any role in the study design, data collection and analysis, decision to publish, or preparation of the manuscript? Did you receive funding for this work?	
Ethics Statement Enter an ethics statement for this submission. This statement is required if the study involved: • Human participants • Human specimens or tissue • Vertebrate animals or cephalopods • Vertebrate embryos or tissues • Field research Write "N/A" if the submission does not require an ethics statement. General guidance is provided below. Consult the submission guidelines for detailed instructions. **Make sure that all information entered here is included in the Methods section of the manuscript.**	N/A

Format for specific study types **Human Subject Research (involving human participants and/or tissue)** • Give the name of the institutional review board or ethics committee that approved the study • Include the approval number and/or a statement indicating approval of this research • Indicate the form of consent obtained (written/oral) or the reason that consent was not obtained (e.g. the data were analyzed anonymously) **Animal Research (involving vertebrate animals, embryos or tissues)** • Provide the name of the Institutional Animal Care and Use Committee (IACUC) or other relevant ethics board that reviewed the study protocol, and indicate whether they approved this research or granted a formal waiver of ethical approval • Include an approval number if one was obtained • If the study involved *non-human primates*, add *additional details* about animal welfare and steps taken to ameliorate suffering • If anesthesia, euthanasia, or any kind of animal sacrifice is part of the study, include briefly which substances and/or methods were applied **Field Research** Include the following details if this study involves the collection of plant, animal, or other materials from a natural setting: • Field permit number • Name of the institution or relevant body that granted permission	
Data Availability Before publication, Authors are required to make fully available and without restriction all data underlying their findings. Sharing the data underlying your findings increases the visibility, credibility, and impact of your work, while supporting transparency and future scientific discovery. Please see our PLOS Data	All relevant data are within the manuscript and its Supporting Information files.

Policy page for detailed information on this policy. A **Data Availability Statement**, detailing where the data can be accessed, is required at first submission. Insert your Data Availability Statement in the box below. Please see the data reporting section of our submission guidelines for instructions on what you need to include in your Data Availability Statement. Examples of acceptable Data Availability Statements are included here for reference: 1. The minimal data set [and accompanying code, where generated] is available at [repository name] via [DOI hyperlink] 2. No data was generated by this study. The following existing data sources were used: [dataset name] from [dataset location] available via [web address or DOI hyperlink]. 3. For Study Protocols: No datasets were generated or analysed during the current study. All relevant data from this study will be made available upon study completion. *PLOS allows rare exemptions to address legal and ethical concerns. If you have legal or ethical restrictions, please use the box below to detail these in full sentences for the Journal team to consider.* This statement will be typeset if the manuscript is accepted for publication.	

Dr Andrew O'Malley
School of Medicine
University of St Andrews
North Haugh
St Andrews
KY16 9TF

25 February 2026

Dear Editorial Board,

We wish to submit an original research article entitled "Measured Inequalities in sex and gender in the Practice of Medicine: A Scoping Review" for consideration by the PLOS One journal. We confirm that this work is original and has not been published elsewhere, nor is it currently under consideration for publication elsewhere.

In this paper, we summarise recent literature which studied how people of different genders are treated by healthcare systems worldwide. During 2018-2023, five hundred and fifty-one papers were published which studied gender-based differences in opportunities given to healthcare professionals, but only forty-one studying the treatment given to patients. This highlights an area of unmet research need. This is significant because in order to improve inequity in the treatment of people of different genders, the scale of the problem must first be identified. We believe that this manuscript will interest the readership of PLOS One.

Here are suggested appropriate Academic Editors to handle your manuscript: Ayobami Precious Adekola, Emilia Aiello, Zelalem Nigussie Azene, Licy Yanes Cardozo, Natalie Hammond.

We have no conflicts of interest to disclose.

Please address all correspondence concerning this manuscript to me at aso2@st-andrews.ac.uk.

Thank you for your consideration of this manuscript.

Sincerely,

Dr Andrew O'Malley

Measured treatment differences between sexes and genders: A scoping review

Miriam Veenhuizen[1,2] and Andrew O'Malley[1]

[1] University of St Andrews, St Andrews, KY16 9AJ, United Kingdom

[2] University of Keele, Newcastle-under-Lyme, ST5 5BG, United Kingdom

Corresponding author: Andrew O'Malley (aso2@st-andrews.ac.uk)

1 Abstract

Background: Sex and gender-based inequality is found throughout medicine. Although there has been significant research in gender disparities affecting healthcare professionals, there is a lack of research into gender differences in the treatment of patients. Despite recognition of systemic issues, recent empirical evidence on how gender influences actual treatment decisions remains fragmented across specialties. A preliminary search of MEDLINE, the Cochrane Database of Systematic Reviews and JBI (Joanna Briggs institute) Evidence Synthesis was conducted and no current or underway systematic reviews or scoping reviews on the topic were identified.

Methods: Studies in English published between 2018 and 2023 were included. Only research which studied measurable differences in the care received by patients of different sexes or genders was included. Both authors independently screened the literature against the a priori defined eligibility criteria. A thematic synthesis approach was used and results summarised qualitatively.

Results: Forty-one papers were included in this review. Of the thirty-eight retrospective case series, thirty-three found a significant difference between the treatment of male and female patients. Of the twenty-nine case series using a multivariate analysis, twenty-five studies found a significant difference in treatment between male and female patients.

Conclusions: The results of this review indicate that men and women are frequently treated differently by healthcare systems. During 2018-2023, five hundred and fifty-one papers were published which studied gender-based differences in opportunities given to healthcare professionals, but only forty-one studying the treatment given to patients. This highlights an area of unmet research need.

Keywords: bias; discrimination; healthcare; feminism

2 Introduction

Sex inequities are evident throughout medicine. Women remain underrepresented in senior academic roles (1), conference presentations (2), and surgical careers where male-dominated culture and structural barriers persist (3). Harassment and discrimination during training further entrench disadvantage, with one study reporting that 87% of women in surgery experienced sex-based discrimination in medical school (4). These inequities extend into pay gaps (5), differential allocation of healthcare resources (6), and even patient interactions, where staff report gender- and race-based abuse (7, 8). Policy initiatives, such as commitments from the Medical Schools Council and General Medical Council (9, 10), signal recognition of the problem but persistent disparities remain.

Similar structural inequities also exist from a patient perspective. The field of women's health has developed considerably since the women's health movement of the 1960s and 1970s, which centred on reproductive rights and the exclusion of women from clinical research (11). While the term sex refers to a biological difference between females and males, gender refers to societal views and norms differentiating women from men (12). Over time, the scope has broadened to encompass sex- and gender-based differences across all populations, though significant challenges remain (11). Females are still underrepresented in clinical research trials; this results in clinical guidelines being based on data skewed towards male patients (13). However, some feel that knowledge of sex differences will not result in a reduction in gender discrimination in healthcare (12).

The term administrative sex refers to the classification of a person's sex on official documentation such as medical records (14). Current clinical databases have been criticised for failing to allow for recording of a patient's gender, or for intersex patients (14). The lack of information in medical databases can make research into sex and gender inequality challenging (14).

Within healthcare, sex plays a role in the diagnosis and management of patients (13). Research into this phenomenon began in the 1970s, with psychiatric and gynaecologic practise coming under scrutiny (15). In the 1990s, the concept of the Yentl Syndrome was published, describing poorer outcomes for women following myocardial infarction and differences in clinical presentation (16). This work helped to catalyse the field of gender medicine, which aims to research sex differences in disease and reduce gender-based management disparities (13, 17).

Cardiovascular medicine illustrates many of these ongoing disparities. Females remain substantially underrepresented in clinical trials of cardiovascular drugs, acute coronary syndromes, heart failure and interventional procedures (18). Similar gaps exist in authorship and leadership, with under-representation of women as investigators being associated with lower recruitment of women as participants (18). Despite decades of institutional efforts, including mandates from the National Institutes of Health and the FDA, females (particularly females from underrepresented minority groups) continue to be under-enrolled in cardiovascular research (19). This under-representation has clinical consequences, contributing to reduced efficacy and higher rates of adverse effects in females. These findings underscore the need for systematic approaches to embed gender-sensitive practice into both research and healthcare delivery (11, 20). These patterns may reflect wider systemic and societal issues.

The COVID-19 pandemic and contemporary social movements have significantly influenced discourse on gender inequities in healthcare and medical education. The pandemic threatened progress toward gender equity in academic medicine, as women faculty faced disproportionate challenges from unequal household labour division and may experience reduced academic productivity (21). Four key social movements (#MeToo, #NiUnaMenos, intersectional feminism, and the global trans rights movement) are transforming health sciences by forcing examination of gendered power relations (22). The pandemic revealed structural gendered racism as a root cause of health inequities, particularly women of colour who occupy disadvantaged positions in households, occupations, and healthcare institutions (23). Intersectionality provides a useful conceptual lens, recognising that gender interacts with other axes of identity such as race, class and age, compounding inequities (24, 25). In healthcare, this perspective is vital for understanding how treatment disparities may be shaped by multiple overlapping factors.

Research demonstrates that intersectionality significantly influences healthcare diagnosis, treatment, and outcomes, though this area remains understudied. A systematic review found that while implicit bias research in healthcare exists, studies examining multiple social identity domains (race, sex, class) typically analyse them separately rather than investigating their overlapping effects (26). In mental health, intersectional analysis reveals that sex, race, class, and ethnicity combine in mutually constitutive ways to explain variation in ADHD diagnosis patterns, demonstrating "paradoxical" stratification effects (27). Studies confirm that socioeconomic status measures cannot fully account for sex inequalities in health, and that both sex and class affect how risk factors translate into health outcomes through complex intersections (28). In cardiovascular care, intersectionality approaches are needed to understand how multiple factors interact to influence heart failure patients' behaviours and health outcomes (29).

Despite recognition of systemic issues, recent empirical evidence on how sex influences actual treatment decisions remains fragmented across specialties, with little synthesis of findings across healthcare systems. A preliminary search of MEDLINE, the Cochrane Database of Systematic Reviews and JBI Evidence Synthesis was conducted and no current or underway systematic reviews or scoping reviews on the topic were identified.

The aim of this scoping review is to synthesise recent evidence (2018–2023) on sex-based differences in the management of patients by healthcare systems, identifying where inequities in treatment provision are most evident.

3 Methods

The scoping review was informed by the JBI methodology for scoping reviews (30). A research question was developed using the PCC (Population, Concept, Context) framework: What recent evidence of measured inequalities in sex and gender are found in the practice of medicine? Key terms were identified, and a search was conducted using Ovid Embase and PubMed databases. MEDLINE (via PubMed) and Embase (via Ovid) were selected as the two principal biomedical databases indexing the clinical literature relevant to the review question (31). Key terms were adapted for the requirements of each database. The Population was defined as “Patients with any clinical condition or presentation receiving care within healthcare systems.”. The Concept was “Inequalities in the management or treatment of patients based on sex or gender (including differences in diagnosis, access to interventions, procedures, medications, or outcomes).”, with key terms: “sexism”, “gender bias”, “sex bias”, “gender roles”, “gender inequality”, “sex inequality”, “sex factors”, “gender factors”, “gender equity”, “sex equity”, “gender disparities”, “sex disparities”, “gender discordance”, “sex discordance”. The Context was defined as “Healthcare delivery and practice, across specialties and healthcare systems in Europe, the US, Australia, and New Zealand, with key terms: “healthcare”, “medicine”.

The results of both searches were collected, uploaded to and stored in the literature management software EndNote. This scoping review considered both experimental and quasi-experimental study designs including randomized controlled trials, non-randomized controlled trials, before and after studies and interrupted time-series studies. In addition, analytical observational studies including prospective and retrospective cohort studies, case-control studies and analytical cross-sectional studies were considered for inclusion. This review also considered descriptive observational study designs including case series, individual case reports and descriptive cross-sectional studies for inclusion. Qualitative studies were considered if they presented primary data. Grey literature, opinion and editorial articles, reviews and articles without primary data were not considered in this review. Full eligibility criteria were predetermined and used to screen the literature. The inclusion criteria were: written in English, published in or after 2018, published in peer reviewed journals and reporting primary data; address sex/gender differences affecting real patients; compares the healthcare received by patients of different genders. The exclusion criteria were: written in languages other than English, published before 2018, grey literature, opinion and editorial articles, reviews and articles without primary data; address sex/gender differences affecting virtual or simulated patients, healthcare professionals, or in authorship of academic publications; descriptions of differences in presentation between sex/gender without comment on the healthcare they receive, descriptions of the knowledge or attitudes of healthcare practitioners rather than their actions/the actions of systems towards patients, descriptions of patients' opinions on how healthcare should be apportioned, descriptions about barriers to access or lack of representation, only discussing interventions to previously identified inequalities, reviews the framing of disease in news articles, economic analysis.

Both authors independently screened the literature against the a priori defined eligibility criteria and disagreements were resolved through discussion between the authors. Quality appraisal of the included papers was undertaken using the JBI appraisal checklists (32). The JBI appraisal checklist is a widely-used method for assessing quality of evidence in healthcare research (33).

A spreadsheet with pre-determined columns was populated with information from each study, including year, authors, country of origin, participants, study type, outcomes measured, results, level of evidence and JBI checklist risk of bias results.

To identify themes and concepts across the included studies, a thematic synthesis approach was used (34). Quantitative and qualitative data from each study were compared and summarised qualitatively.

4 Results

The initial search of OVID Embase and PubMed after exclusion of duplicates returned 1,112 results. Title and abstract screening reduced this to fifty-seven results. Full text screening resulted in forty-one papers remaining for analysis (see Figure 1). The most common reason for non-inclusion of papers was that the study focused on differences in the treatment of healthcare professionals by gender rather than the treatment of patients. See Figure 1 for full information on reasons for exclusion.

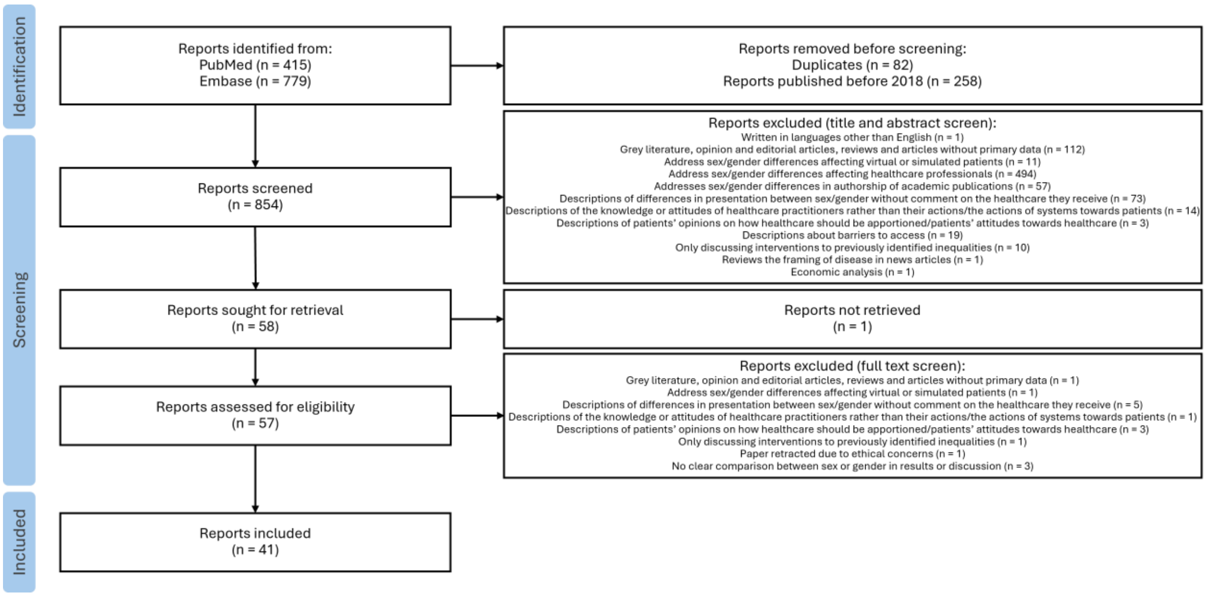


Figure 1: PRISMA flow chart

Of the forty-one papers included in this study, twenty-six were conducted in the United States (35-60), two in the United Kingdom (61, 62), one in Canada (63), one in China (64), two in Germany (65, 66), one in Portugal (67), one in the Netherlands (68), one in Norway (69), two in Sweden (70,71), one in Romania (72), one in Chile (73), one in Israel (74) and one across Europe (75). The studies were published in twenty-seven different journals between 2018 and 2023.

Thirty-eight were retrospective case series. One study combined retrospective case series with survey of participants, one combined retrospective case series with prospective case series and survey of participants and one study used mixed methods.

The papers were grouped by specialty area of medicine to aid the development of a synthesised narrative. Fifteen were from cardiovascular medicine (35, 36, 40-42, 49, 50, 52, 54, 57, 61, 65, 67, 71, 72), four from neurology (37, 44, 60, 69), one from renal medicine (38), four from surgical medicine (39, 56, 63, 66), three from transplant medicine (43, 59, 75), three from emergency medicine (45, 51, 55), three from endocrinology (46, 47, 68), three from psychiatry (48, 62, 70) two from medico-legal (58, 64), one from anaesthetics (53), one regarding waiting times across the health system (73) and one from primary care (74).

For the thirty-eight papers that used a retrospective case series, nine did not include multivariate analysis as part of their statistical analysis. Seventeen did not include the ethnicity of the participants. Thirteen did not include comorbid conditions in their description of the participants.

As all included papers were retrospective reviews of medical records, all results are assumed to be relating to the administrative sex of the patients. None of the included papers made any comment about the gender of patients, as opposed to sex. None of the reviews included any patients who were intersex.

Of the thirty-eight retrospective case series, thirty-three noted a statistically significant difference between the treatment of male and female patients. Of the twenty-nine case series using a multivariate analysis, twenty-five studies found a statistically significant difference in treatment between male and female patients.

4.1 Descriptive Results by Specialty

4.1.1 Cardiovascular

For cardiovascular conditions such as myocardial infarction, heart failure and supraventricular tachycardia, females are more likely to be managed conservatively with medication when compared to invasive procedures such as coronary artery bypass grafting, percutaneous coronary intervention or ablation therapy (41, 42, 50, 61, 67). One study showed that females had worse mortality when presenting with cardiovascular conditions (50), however the others that examined this found no significant difference in mortality (35, 61). In a Swedish study, the time from experiencing the first symptoms of a myocardial infarction to receiving a diagnostic electrocardiogram was longer for females (71). The discharge destination was examined in one study showing that females were more likely to be discharged to a skilled nursing facility after having a myocardial infarction, likely a marker of worse clinical outcomes (35). For patients with atherosclerosis of vessels, all studies found females were less likely than males to receive lipid lowering therapies (36, 40, 54, 65). In patients with diabetes, there was no statistically significant difference between the prescription of lipid-lowering therapies in males and females (72). During elective cardiovascular surgery females were more likely to receive allogeneic blood transfusion (which has a well-established link with poorer outcomes) (49). Post-aortic repair surgery, statistically significantly fewer females were discharged with optimal medical management (57).

The group-dynamics of the teams deciding on allocation of advanced heart-failure therapies (AHFT) affected the allocation process. Teams which functioned well were more likely to allocate AHFT to females than males, teams which functioned less well were more likely to allocate AHFT to men than women.

4.1.2 Neurology

For patients with Parkinson’s disease, men were more likely to be referred for consideration of deep brain stimulation devices, an implantable device to help manage symptoms of Parkinson’s disease. After referral, there was no statistically significant difference in whether males and females went on to have the procedure. For females who did not undergo surgery this was more likely than in males to be due to patient preference (37). For patients with dementia, females were more likely to receive treatment (44). For patients admitted to hospital with pneumonia, males were more likely to be screened for underlying neurological causes with a speech and language consult (60). In the data from a large trial of thrombolysis (an emergency treatment for stroke) no significant difference was found between the treatment of males and females (69).

4.1.3 Endocrinology and Diabetes

For patients with diabetes, studies found no difference in the management between males and females (47, 68). For children, a study found no difference in the number of males vs females who are overweight being screened for diabetes. Males who were obese were more likely than females to be screened for diabetes (46).

4.1.4 Renal and Transplant Medicine

For the papers that looked at likelihood of liver transplantation, both found that males were more likely to receive a liver transplant than females (43, 75). Females on the transplant list were more likely to be hospitalised and more likely to be transplanted from the intensive care unit (59).

For dialysis a permanent means of access is preferred to a central venous catheter, females who required dialysis were found to spend longer using a central venous catheter and were less likely to transition to a permanent means of access (38).

4.1.5 Surgery

Length of stay in hospital (a negative outcome) was longer for females than males in two of three surgical studies (39, 66). There was no difference in discharge destination found for males and females who had elective adult spinal deformity correction (39). Endovascular treatment is a preferred treatment option for hernia repair operations however females were more likely to receive open hernia repairs (66).

When older patients were studied in Canada, females were less likely to be offered an operation (63). The outcomes for males and females who had been offered an operation were not significantly different (63). Prior to surgical management for symptomatic spinal stenosis, females were advised to trial significantly more non-operative treatments (56).

4.1.6 Emergency Medicine

Females were less likely to receive treatment from prehospital emergency medical teams both with targeted temperature management for out of hospital cardiac arrests (45), and opioids for pain management (51). Bystanders were less likely to use a defibrillator on females in cardiac arrest (55). A decision to terminate resuscitation efforts was less likely in females in cardiac arrest compared with males. Females were more likely to survive to hospital admission compared with men (55).

4.1.7 Anaesthetics

Females were less likely to receive an appropriate size of endotracheal tube for their height, receiving on average tubes too large for them (53).

4.1.8 Psychiatry

Males were less likely to receive a diagnosis of bipolar disorder than females (48). Females were less likely to be treated with clozapine for treatment resistant schizophrenia (62). Males with depression are more likely to be prescribed medications (70) but after taking into account six month follow up, are equally likely to be sick-leave certified (70).

4.1.9 Waiting Times

In a comparison of waiting times between males and females in Chile, sixteen conditions were studied (73). After multivariate analysis, in nine there was no significant difference in waiting times between males and females. For two conditions males waited for significantly longer and in five females waited significantly longer than males (73).

4.1.10 Primary Care

In a review of primary care delivery to geriatric patients in Israel, females were vaccinated at a lower rate (74). Females were prescribed benzodiazepines at a higher rate than males (74).

4.1.11 Medico-legal

For drug adverse events that were documented by health-care professionals, more were documented for females. The adverse reactions documented for femaleswere less serious than the events documented for males (58). One of the most common adverse drug events for females listed was “feeling hot”, however for males one of the most common adverse drug events listed was “death” (58).

A Chinese study of medical errors in elderly patients found numerical differences in the rates of reported errors between males and females between specialties, however there was no statistical analysis of the cases (64). Females were more likely to report medical errors in nephrology, respiratory, oncology, primary care and internal medicine. Males were more likely to report medical errors in the emergency department, general surgery and medical technology departments. Incidence of errors in the orthopaedic department was the same between males and females (64).

4.2 Results of Thematic Analysis

4.2.1 Interventional procedures

A theme which emerged during the analysis was papers studying the likelihood of patients of different sex’s having interventional procedures. The ten papers which studied this question are summarised in Table 1 below. The effect direction and estimate refer to the likelihood of female patients receiving an interventional procedure as compared with male patients.

Table 1: Likelihood of interventional procedures. AOR = adjusted odds ratio, uOR = unadjusted odds ratio, NR = not recorded, asHR = adjusted subdistribution hazard ratio, uIRR = unadjusted incidence rate ratio.

Study	JBI bias risk	Level of evidence	Effect direction	Effect estimate (95% confidence interval)	p-value
Sacks, N.C. et al. (2020)					
Ablation for paroxysmal supra-ventricular tachycardia	Moderate	Level 4	▼ (decreased)	aOR 0.83 (0.70-0.98)	0.0278
Verghese, D. et al. (2022)					
Coronary angiography	Moderate	Level 4	▼ (decreased)	uOR 0.65 (0.64-0.66)	<0.001
Early angiography	Moderate	Level 4	▼ (decreased)	uOR 0.70 (0.69-0.71)	<0.001
Percutaneous coronary intervention	Moderate	Level 4	▼ (decreased)	aOR 0.69 (0.68-0.70)	<0.001
Jackson, A. M. et al. (2020)					
Coronary angiography	Low	Level 4	▼ (decreased)	aOR 0.66 (0.60 - 0.73)	<0.0001
Percutaneous coronary intervention	Low	Level 4	▼ (decreased)	aOR 0.60 (0.54-0.66)	<0.0001
Araujo, C. et al. (2018)					
Coronary angiography: STEMI group	Moderate	Level 4	▼ (decreased)	aOR 0.61 (0.41-0.90)	0.0138
Coronary angiography: NSTEMI group	Moderate	Level 4	— (no effect)	aOR 0.79 (0.62-1.01)	≥ 0.05
Shpiner, D. S. et al. (2019)					
Referral for DBS surgery	Moderate	Level 4	▼ (decreased)	uOR 0.51 (0.37-0.71)	<0.0001
Proceeding with DBS surgery after referral	Moderate	Level 4	— (no effect)	uOR 0.94 (0.52-1.68)	0.8220

Darden, M. et al. (2021)					
Liver transplant	Moderate	Level 4	▼ (decreased)	aOR 0.854 (NR)	0.002
Liver ablation	Moderate	Level 4	▲ (increased)	aOR 1.623 (NR)	0.000
Liver resection	Moderate	Level 4	▼ (decreased)	aOR 0.918 (NR)	0.021
Listabarth, S. et al. (2022)					
Liver transplant	Moderate	Level 4	▼ (decreased)	aOR 0.78 (0.73-0.82)	<0.0001
Arya, S. et al. (2020)					
Transition to permenent means of access for dialysis	Low	Level 4	▼ (decreased)	asHR 0.96(0.93-0.98)	<0.001
Rucker, D. et al. (2019)					
Operative management	Low	Level 4	▼ (decreased)	uOR 0.74 (0.56-0.97)	0.03
Tandon, V. et al. (2020)					
Number of procedures	Moderate	Level 4	▼ (decreased)	uIRR 0.84 m(NR)	<0.05
Breathett, K. et al. (2023)					
Allocated to advanced therapies	Moderate	Level 4	▲ (increased)	NR	NR

4.2.2 Guideline compliant care/ optimal medical management

Another theme which emerged during the analysis was papers studying the likelihood of patients of different sex’s having care which was compliant with guidelines. The seventeen papers which studied this question are summarised in Table 2 below. The effect direction and estimate refer to the likelihood of female patients receiving guideline-compliant care as compared with male patients.

Table 2: Likelihood of guideline compliant care. aOR = adjusted odds ratio, uOR = unadjusted odds ratio, aHR = adjusted hazard ratio, a% difference = adjusted percentage difference.

Study	**JBI bias risk**	**Level of evidence**	**Effect direction**	**Effect estimate (95% confidence interval)**	**p-value**
Shen, X. et al. (2019)					
Statin prescription from cardiologist: commercial insurance plan	Moderate	Level 4	▼ (decreased)	aOR 0.69 (0.65-0.74)	<0.0001
Statin prescription from cardiologist: Medicare Advantage insurance plan	Moderate	Level 4	▼ (decreased)	aOR 0.78 (0.76-0.79)	<0.0001
Podell, R. et al. (2018)					
Influenza vaccination	Moderate	Level 4	▼ (decreased)	uOR 0.83 (0.83-0.84)	<0.0001
Pneumococcal vaccination	Moderate	Level 4	▼ (decreased)	uOR 0.79 (0.78-0.80)	<0.0001
Mahtta, D. et al. (2020)					
Statin prescription	Moderate	Level 4	▼ (decreased)	aOR 0.68 (0.62-0.75)	<0.0001
Peters, F. et al. (2020)					
Optimal pharmacological treatment	Moderate	Level 4	▼ (decreased)	aOR 0.89 (0.86-0.92)	<0.0001
Găman, M. A. et al. (2020)					
Statin prescription	High	Level 4	— (no effect)	uOR 0.62 (0.36-1.08)	0.09
Ilyas, S. et al. (2022)					
Aspirin at discharge	Moderate	Level 4	▼ (decreased)	uOR 0.74 (0.63-0.86)	0.0001
Statin at discharge	Moderate	Level 4	▼ (decreased)	uOR 0.66 (0.56-0.76)	<0.0001

Lu, Z. K. et al. (2021)					
Anti-dementia medications	Moderate	Level 4	▲ (increased)	aOR 1.71(1.19-2.45)	0.0036
Stodolski, M. et al. (2020)					
Endoscopic hernia repair	Moderate	Level 4	▼ (decreased)	uOR 0.29 (0.19-0.46)	<0.0001
Morris, N. et al. (2021)					
Targeted temperature management	Moderate	Level 4	▼ (decreased)	aOR 0.90 (0.87-0.92)	<0.001
Wimbish, L. et al. (2022)					
Opioid administration	Low	Level 4	▼ (decreased)	aOR 0.90(NR)	0.004
Wesley, E. et al. (2021)					
Clozapine prescription	Low	Level 4	▼ (decreased)	aOR 0.66 (0.44-0.97)	<0.05
Ihle-Hansen, H. et al. (2022)					
Onset of symptoms to admission	Moderate	Level 4	— (no effect)	Mean 91.6 vs 95.3 min	0.2900
Door to needle time	Moderate	Level 4	— (no effect)	Mean 38.6 vs 37.0 min	0.3100
Ahmed, F. et al. (2022)					
Prescribed statin therapy	Low	Level 4	— (no effect)	uOR 1.14 (0.61-2.12)	0.682
Received appropriate intensity statin therapy	Low	Level 4	— (no effect)	uOR 1.14 (0.64-2.00)	0.658
Bak, L. et al. (2023)					
19 diabetes process measurements	Moderate	Level 4	— (no effect)	aORs ranged from 0.87-1.06	All >=0.06
Roberts, M. M. et al. (2023)					
Aspirin	Moderate	Level 4	▼ (decreased)	a% difference -	<0.001

				4.36 (-5.38--3.34)	
Cholesterol management	Moderate	Level 4	▼ (decreased)	a% difference -3.88 (-4.63--3.14)	<0.001
BP control	Moderate	Level 4	▲ (increased)	a% difference 1.80 (1.28-2.32)	<0.001
Smoking cessation counselling	Moderate	Level 4	▲ (increased)	a% difference 1.67 (0.95-2.38)	<0.001
Bolinger, C. et al. (2020)					
Speech and language consult	Moderate	Level 4	▼ (decreased)	uOR 0.73 (0.58-0.91)	0.0051
Vajravelu, M. E. et al. (2021)					
Diabetes screening in overweight patients	Moderate	Level 4	▲ (increased)	aHR 1.67 (1.43-2.00)	<0.0001
Diabetes screening in obese patients	Moderate	Level 4	▲ (increased)	aHR 1.43(1.43-1.67)	<0.0001

4.3 Analysis of intersectional identities

Out of the forty-one papers, twenty nine did not have result reporting for identities other than sex. Where results were reported for other identities such as age or ethnicity, these were presented separately in seven papers. Five papers gave results for intersectional identities, all of these reported the intersection between sex and ethnicity. See Table 3 below for a summary of these results.

Table 3: Intersectional identity results. aOR = adjusted odds ratio, uOR = unadjusted odds ratio, aHR = adjusted hazard ratio, a% difference = adjusted percentage difference, aCE = adjusted estimate of co-efficient, NR = not reported

Study	JBI bias risk	Level of evidence	Effect direction	Effect estimate (95% confidence interval)	p-value
Darden, M. et al. (2021)					
Caucasian Women transplant	Moderate	Level 4	(decreased)	0.82 (0.73-0.91) [aOR]	<0.001
African-American women transplant	Moderate	Level 4	(decreased)	0.42 (0.32-0.54) [aOR]	<0.001
Caucasian women resection	Moderate	Level 4	(increased)	1.597 (1.446-1.765) [aOR]	<0.001
African-American women resection	Moderate	Level 4	(increased)	1.579 (1.303-1.913) [aOR]	<0.001
Caucasian women ablation	Moderate	Level 4	(decreased)	0.918 (0.849-0.993) [aOR]	0.033
African-American women ablation	Moderate	Level 4	(decreased)	0.813 (0.684-0.967) [aOR]	0.020
Ahmed, F. et al. (2022)					
White males vs white female statin prescription	Low	Level 4	— (No Effect)	0.68 (0.25–1.90) [aOR]	0.4600
Non-white females vs white female statin prescription	Low	Level 4	— (No Effect)	Effect)0.36 (0.12–1.06) [aOR]	0.0600
Non white males vs white female	Low	Level 4	— (No Effect)	2.19 (0.53–8.98) [aOR]	0.2800

statin prescription					
Tandon, V. et al. (2020)					
Number of procedures	Moderate	Level 4	Native american women had the lowest average number of procedures, with asian men having the highest	NR	NR
Breathett, K. et al. (2023)					
Race x gender with group function score probability of allocation to advanced heart failure therapies	Moderate	Level 4	— (No Effect)	-0.37 (-3.453-2.713) [aCE]	0.815

5 Discussion

Gender based differences in the treatment of patients were unable to be studied in this scoping review due to the lack of research found containing information on the gender of patients. This is likely due to the reliance on electronic health records for the papers studied in this scoping review. The electronic health records contain information on the administrative sex of patients, rather than their gender. This issue could be addressed using prospective studies designed specifically to answer questions regarding gender- based inequality in the current healthcare system. The HL7 gender harmony model is a logical model which gives a framework for healthcare organisations to document additional information regarding a patient's sex and gender (14). If this model or similar were to be adopted into wide-spread use, research into gender inequality within healthcare could be undertaken at a larger scale.

The results of this scoping review indicate that males and females are frequently treated differently by healthcare systems, though the evidence does not consistently clarify whether such differences confer disadvantage to either sex. Many studies, excluded from the formal part of this review, did not directly measure patient care but instead examined professional attitudes or workforce equity, which fall outside the central focus here. The studies that did examine management revealed variation in treatment practices, raising questions about whether these reflect appropriate clinical considerations or systemic inequities. Notably, very few papers explicitly referenced clinical guidelines recommending sex-specific management, leaving uncertainty about the drivers of observed disparities. Observed differences in treatment practices may relate to patient choice or barriers to access treatment. These findings align with other adjacent reviews, which have synthesised evidence of gender inequities across multiple medical specialties, revealing persistent disparities in both clinical care delivery and professional representation. Grinberg & Sela (76) identified significant gender biases in pain management, with women receiving inadequate analgesia during medical procedures due to unconscious biases, lack of sex-specific protocols, and cultural stereotypes. Shaw et al. (77) examined cardiovascular medicine, emphasizing that achieving equitable care requires consideration of unique gendered structural determinants of health and development of women-optimised care pathways. Ros et al. (78) conducted a broader scoping review revealing substantial inequities in women's representation across medical professions, particularly in leadership positions and senior faculty roles, with only 13% of identified studies addressing potential interventions. Parsons Leigh et al. (79) focused on critical care medicine, noting it has among the lowest female representation and proposing comprehensive strategies to synthesise and implement solutions for improving gender equity.

Most included studies originated from the United States, limiting the generalisability of findings. This raises the need to examine evidence from other regions such as Europe, the UK, and Australasia, where healthcare systems and policy frameworks differ. Research evidence reveals significant sex inequities in healthcare delivery across the UK and Europe. In the UK's National Health Service, females and older people receive guideline-recommended cardiovascular treatments less frequently than malesand younger people, with limited research available on ethnic disparities (80). A broader European analysis found that after adjusting for healthcare needs, significant pro-rich inequity emerged in half of studied countries for physician contacts, primarily due to higher-income groups' greater use of specialist services while lower-income groups relied more on general practitioner care (81). Sex bias in healthcare manifests in two ways: assuming similarities between male's and female's health situations when differences exist, and assuming differences where similarities occur, both potentially leading to negative health outcomes for females (82). Despite equity being a central NHS objective since 1948, important inequities persist in UK healthcare access, though methodological limitations often prevent firm conclusions about underlying causes (83). This regional evidence reinforces the broader pattern identified in this review, showing that inequities in healthcare delivery are not confined to the US context but also persist across European systems.

A consistent trend was observed: females were statistically less likely than males with similar clinical characteristics to be offered invasive management, and when managed conservatively, females were statistically less likely to receive optimal pharmacological therapy. It is not possible to determine whether this was as a result of inequities or due to another cause. Breathett et al. studied how group dynamics may influence the allocation of treatment to patients and found that worse group dynamics resulted in females and patients of colour being less likely to be allocated intensive treatment options.

Much of the recent research on sex differences in management has been conducted in cardiovascular medicine, reflecting the historical prominence of this field since early studies on sex-based disparities (82). It remains unclear whether this concentration reflects a true predominance of inequities in cardiovascular care or simply research inertia building on prior work.

Research has identified several explanations for observed sex differences in healthcare delivery. Raine (84) found evidence of sex disparities across multiple conditions, with males more likely to receive certain procedures like renal transplantation and HIV treatments, while females were more likely to undergo liver transplantation and cataract surgery. The study attributed these differences to both demand factors (disease prevalence, severity, patient preferences) and supply factors (clinical judgment). With patient preference also being attributed to the reduced implantation of deep-brain stimulation devices in females in one study in this review (37). Elderkin-Thompson & Waitzkin (85) highlighted communication differences as a key factor, noting that physicians commonly attribute women's symptoms to "over anxiousness" and make more diagnostic errors with female patients, even when positive test results are present. These explanations provide possible mechanisms underlying the consistent trend observed in this review, where females are statistically less likely than males to receive invasive management or optimal pharmacological therapy.

Although thirteen studies reported results comparing outcomes for groups other than males and females, only four presented the results using intersectional identities. The results of these studies are summarised in Table 3, no clear conclusions could be drawn due to the lack of data. The reporting of results for different identities separately rather than in an intersectional manner has been noted in previous reviews (26).

The evidence base remains limited in quality. Many studies relied on retrospective analyses of medical records, with incomplete data limiting the strength of conclusions. Several did not perform multivariate analyses to adjust for potential confounders such as race, comorbidity, or socioeconomic status. Future research should prioritise prospective designs to establish whether differences are attributable to sex itself rather than intersecting factors.

Several major international funding agencies have implemented policies requiring or encouraging sex and gender analysis in health research. The National Institutes of Health (NIH) has instituted policies requiring researchers to include appropriate populations and analyse data accordingly, focusing on sex as a biological variable (SABV) to enhance reproducibility (86, 87). The Canadian Institutes of Health Research (CIHR) implemented a sex- and gender-based analysis (SGBA) policy, with mandatory questions introduced in 2010 showing increased compliance over time, though disparities across disciplines persist (87, 88). The European Commission requires integration of the "gender dimension," incorporating sex, gender, and intersectional analysis into research and innovation (87). A comprehensive analysis of 22 major national funding agencies across six continents reveals varying approaches to implementing sex, gender, and diversity analysis policies, highlighting opportunities for improved international collaboration and research excellence (89).

A limitation of this paper relates to the methodology employed. Scoping reviews in health research face several common methodological limitations that must be acknowledged when interpreting findings. Key limitations include a lack of prospective studies, non-representative samples that limit generalizability, and insufficient data on mediators and moderators of relationships between variables (90). The heterogeneous nature of literature in scoping reviews creates challenges in gathering, analysing, and interpreting information, with epistemological considerations significantly influencing methodological decisions (91). The search was restricted to two biomedical databases and did not include allied health or multidisciplinary indexes such as CINAHL, so relevant studies indexed solely in those sources may have been missed. Consistent with the mapping aim of a scoping review, the consistency of effect directions observed across specialties suggests the principal patterns are unlikely to be materially altered by a small number of additional records.

6 Conclusions

This review demonstrates that recent evidence points to persistent sex-based differences in the treatment of patients. Across multiple specialties, the most consistent finding was that females were statistically less likely than males with comparable clinical characteristics to receive invasive or intensive treatments, and when treated conservatively, were less likely to receive guideline compliant therapy. Important gaps in evidence quality exist, with many studies limited by retrospective designs, incomplete adjustment for confounders, and a predominance of US-based data. A gap in research investigating the gender of patients rather than administrative sex was evident. Future research must integrate equity considerations and intersectional analysis into study design, employ rigorous analytical methods, and extend to diverse healthcare systems. Addressing these gaps will be critical to determining whether observed differences represent appropriate clinical variation or systemic inequities, and to ensuring that practice reflects equitable standards of care.

Acknowledgements

None

Author Contributions

MV designed and performed the search. MV and AO reviewed results of search. Both authors contributed to, read and approved the final manuscript.

References

1. Richter KP, Clark L, Wick JA, Cruvinel E, Durham D, Shaw P, et al. Women Physicians and Promotion in Academic Medicine. N Engl J Med. 2020;383(22):2148-57.
2. Arora A, Kaur Y, Dossa F, Nisenbaum R, Little D, Baxter NN. Proportion of Female Speakers at Academic Medical Conferences Across Multiple Specialties and Regions. JAMA Netw Open. 2020;3(9):e2018127.
3. Lim WH, Wong C, Jain SR, Ng CH, Tai CH, Devi MK, et al. The unspoken reality of gender bias in surgery: A qualitative systematic review. PLoS One. 2021;16(2):e0246420.
4. Walton MM. Sexual equality, discrimination and harassment in medicine: it's time to act. Med J Aust. 2015;203(4):167-9.
5. Hoff T, Lee DR. The gender pay gap in medicine: A systematic review. Health Care Manage Rev. 2021;46(3):E37-E49.
6. Mondal B, Dubey JD. Gender discrimination in health-care expenditure: An analysis across the age-groups with special focus on the elderly. Soc Sci Med. 2020;258:113089.
7. Whitgob EE, Blankenburg RL, Bogetz AL. The Discriminatory Patient and Family: Strategies to Address Discrimination Towards Trainees. Acad Med. 2016;91(11 Association of American Medical Colleges Learn Serve Lead: Proceedings of the 55th Annual Research in Medical Education Sessions):S64-S9.
8. McKinley SK, Wang LJ, Gartland RM, Westfal ML, Costantino CL, Schwartz D, et al. "Yes, I'm the Doctor": One Department's Approach to Assessing and Addressing Gender-Based Discrimination in the Modern Medical Training Era. Acad Med. 2019;94(11):1691-8.
9. Active Inclusion: Challenging exclusions in medical education.: Medical Schools Council; 2021.
10. Corporate Strategy 2020-2025. General Medical Council; 2020.
11. Fuentes Artiles R, Gebhard CE, Gebhard C. Integrating gender medicine into modern healthcare: Progress and barriers. Eur J Clin Invest. 2025;55(10):e70089.

12. Risberg G, Johansson EE, Hamberg K. A theoretical model for analysing gender bias in medicine. International Journal for Equity in Health. 2009;8(1):28.

13. Lippi D, Bianucci R, Donell S. Gender medicine: its historical roots. Postgrad Med J. 2020;96(1138):480-6.

14. McClure RC, Macumber CL, Kronk C, Grasso C, Horn RJ, Queen R, Posnack S, Davison K. Gender harmony: improved standards to support affirmative care of gender-marginalized people through inclusive gender and sex representation. J Am Med Inform Assoc. 2022 Jan 12;29(2):354-363. doi: 10.1093/jamia/ocab196. Erratum in: J Am Med Inform Assoc. 2022 Jan 12;29(2):411. doi: 10.1093/jamia/ocab255. PMID: 34613410; PMCID: PMC8757317.

15. Levinson R. Sexism in Medicine. The American Journal of Nursing. 1976;76(3):426-31.

16. Healy B. The Yentl syndrome. N Engl J Med. 1991;325(4):274-6.

17. Machluf Y, Chaiter Y, Tal O. Gender medicine: Lessons from COVID-19 and other medical conditions for designing health policy. World J Clin Cases. 2020 Sep 6;8(17):3645-3668. doi: 10.12998/wjcc.v8.i17.3645. PMID: 32953842; PMCID: PMC7479575.

18. Burgess S, Zaman S, Towns C, Coylewright M, Cader FA. The under-representation of women in cardiovascular clinical trials: State-of-the-art review and ethical considerations. Am Heart J. 2025;282:81-92.

19. Cho L, Vest AR, O'Donoghue ML, Ogunniyi MO, Sarma AA, Denby KJ, et al. Increasing Participation of Women in Cardiovascular Trials: JACC Council Perspectives. J Am Coll Cardiol. 2021;78(7):737-51.

20. Sinha T, Bakht D, Bokhari SFH, Amir M, Fatima R, Bakht K, et al. Gender Matters: A Multidimensional Approach to Optimizing Cardiovascular Health in Women. Cureus. 2024;16(6):e61810.

21. Woitowich NC, Jain S, Arora VM, Joffe H. COVID-19 Threatens Progress Toward Gender Equity Within Academic Medicine. Acad Med. 2021;96(6):813-6.

22. Shannon G, Jansen M, Williams K, Caceres C, Motta A, Odhiambo A, et al. Gender Equality in Science, Medicine, and Global Health: Where Are We At and Why Does It Matter? In: Benatar S, Brock G, editors. Global Health: Ethical Challenges. 2 ed. Cambridge: Cambridge University Press; 2021. p. 76-85.

23. Laster Pirtle WN, Wright T. Structural Gendered Racism Revealed in Pandemic Times: Intersectional Approaches to Understanding Race and Gender Health Inequities in COVID-19. Gender & Society. 2021;35(2):168-79.

24. Crenshaw K. Mapping the Margins: Intersectionality, Identity Politics, and Violence against Women of Color. Stanford Law Review. 1991;43(6):1241-99.

25. The Oxford Handbook of Feminist Theory. Disch L, Hawkesworth M, editors: Oxford University Press; 2016 06 Jan 2015.

26. Roberts JK, Mitra AK, Ogungbe O. A systematic review of implicit bias in health care: A call for intersectionality. IMC Journal of Medical Science. 2019;13(1).

27. Bergey M, Chiri G, Freeman NLB, Mackie TI. Mapping mental health inequalities: The intersecting effects of gender, race, class, and ethnicity on ADHD diagnosis. Sociol Health Illn. 2022;44(3):604-23.

28. Iyer A, Sen G, Ostlin P. The intersections of gender and class in health status and health care. Glob Public Health. 2008;3 Suppl 1:13-24.

29. Allana S, Ski CF, Thompson DR, Clark AM. Intersectionality and heart failure: what clinicians and researchers should know and do. Curr Opin Support Palliat Care. 2021;15(2):141-6.

30. Peters MDJ GC, McInerney P, Munn Z, Tricco AC, Khalil, H. Scoping Reviews. Aromataris E LC, Porritt K, Pilla B, Jordan Z, editor: JBI; 2020.

31. Goossen K, Hess S, Lunny C, Pieper D. Database combinations to retrieve systematic reviews in overviews of reviews: a methodological study. BMC Med Res Methodol. 2020 Jun 1;20(1):138. doi: 10.1186/s12874-020-00983-3. PMID: 32487023; PMCID: PMC7268249.

32. Munn Z, Barker TH, Moola S, Tufanaru C, Stern C, McArthur A, et al. Methodological quality of case series studies: an introduction to the JBI critical appraisal tool. JBI evidence synthesis. 2020;18(10):2127-33.

33. Joanna Briggs Institute. Supporting document for the Joanna Briggs Institute levels of evidence and grades of recommendation. Adelaide: The Joanna Briggs Institute. 2014.

34. Thomas J, Harden A. Methods for the thematic synthesis of qualitative research in systematic reviews. BMC Med Res Methodol. 2008;8:45.

35. Perl L, Peiffer V, Fuhrer AE, D'Ascenzo F, Pietzsch JB. Sex differences in discharge destination following acute myocardial infarction. Coron Artery Dis. 2018;29(6):502-10.

36. Shen X, DiMario S, Philip K. Gender Disparities in Health Resource Utilization in Patients with Atherosclerotic Cardiovascular Disease: A Retrospective Cross-Sectional Study. Adv Ther. 2019;36(12):3424-34.

37. Shpiner DS, Di Luca DG, Cajigas I, Diaz JS, Margolesky J, Moore H, et al. Gender Disparities in Deep Brain Stimulation for Parkinson's Disease. Neuromodulation. 2019;22(4):484-8.

38. Arya S, Melanson TA, George EL, Rothenberg KA, Kurella Tamura M, Patzer RE, et al. Racial and Sex Disparities in Catheter Use and Dialysis Access in the United States Medicare Population. J Am Soc Nephrol. 2020;31(3):625-36.

39. Elsamadicy AA, Freedman IG, Koo AB, David WB, Lee M, Kundishora AJ, et al. Influence of gender on discharge disposition after spinal fusion for adult spine deformity correction. Clin Neurol Neurosurg. 2020;194:105875.

40. Mahtta D, Ahmed ST, Ramsey DJ, Akeroyd JM, Lee MT, Rodriguez F, et al. Statin Prescription Rates, Adherence, and Associated Clinical Outcomes Among Women with PAD and ICVD. Cardiovasc Drugs Ther. 2020;34(6):745-54.

41. Sacks NC, Everson K, Emden MR, Cyr PL, Wood DR, Raza S, et al. Disparities in the Management of Newly Diagnosed Paroxysmal Supraventricular Tachycardia for Women Versus Men in the United States. J Am Heart Assoc. 2020;9(19):e015910.

42. Tandon V, Stringer B, Conner C, Gabriel A, Tripathi B, Balakumaran K, et al. An Observation of Racial and Gender Disparities in Congestive Heart Failure Admissions Using the National Inpatient Sample. Cureus. 2020;12(10):e10914.

43. Darden M, Parker G, Monlezun D, Anderson E, Buell JF. Race and Gender Disparity in the Surgical Management of Hepatocellular Cancer: Analysis of the Surveillance, Epidemiology, and End Results (SEER) Program Registry. World J Surg. 2021;45(8):2538-45.

44. Lu ZK, Xiong X, Wang X, Wu J. Gender Disparities in Anti-dementia Medication Use among Older Adults: Health Equity Considerations and Management of Alzheimer's Disease and Related Dementias. Front Pharmacol. 2021;12:706762.

45. Morris NA, Mazzeffi M, McArdle P, May TL, Burke JF, Bradley SM, et al. Women receive less targeted temperature management than men following out-of-hospital cardiac arrest due to early care limitations - A study from the CARES Investigators. Resuscitation. 2021;169:97-104.

46. Vajravelu ME, Lee JM, Amaral S, Kelly A. Sex-based differences in screening and recognition of pre-diabetes and type 2 diabetes in pediatric primary care. Pediatr Obes. 2021;16(2):e12699.

47. Ahmed F, Lin J, Ahmed T, Siddiqui D, Nguyen J, Sarpong D. Health Disparities: Statin Prescribing Patterns Among Patients with Diabetes in a Family Medicine Clinic. Health Equity. 2022;6(1):291-7.

48. Liu G, Kong L, Baweja R, Ba D, Saunders EFH. Gender disparity in bipolar disorder diagnosis in the United States: A retrospective analysis of the 2005-2017 MarketScan Commercial Claims database. Bipolar Disord. 2022;24(1):48-58.

49. O'Shaughnessy S, Tangel V, Dzotsi S, Jiang S, White R, Hoyler M. Non-White Race/Ethnicity and Female Sex Are Associated with Increased Allogeneic Red Blood Cell Transfusion in Cardiac Surgery Patients: 2007-2018. J Cardiothorac Vasc Anesth. 2022;36(7):1908-18.

50. Verghese D, Patlolla SH, Cheungpasitporn W, Doshi R, Miller VM, Jentzer JC, et al. Sex disparities in management and outcomes of cardiac arrest complicating acute myocardial infarction in the United States. Resuscitation. 2022;172:92-100.

51. Wimbish LA, Simpson JR, Gilbert LR, Blackwood A, Grant EA. Examining Racial, Ethnic, and Gender Disparities in the Treatment of Pain and Injury Emergencies. HCA Healthc J Med. 2022;3(3):111-8.

52. Breathett K, Yee R, Pool N, Thomas Hebdon MC, Knapp SM, Herrera-Theut K, et al. Group Dynamics and Allocation of Advanced Heart Failure Therapies-Heart Transplants and Ventricular Assist Devices-By Gender, Racial, and Ethnic Group. J Am Heart Assoc. 2023;12(5):e027701.

53. De La Chapa JS, Webb K, Stadlin C, Reddy A, Schoeff SF, Reed R, et al. Evolving Endotracheal Tube Preferences and Practices: Intensivist Knowledge Gaps and Sex Disparities. Laryngoscope. 2023;133(11):3080-6.

54. Roberts MM, Marino M, Wells R, Atem FD, Balasubramanian BA. Differences in Use of Clinical Decision Support Tools and Implementation of Aspirin, Blood Pressure Control, Cholesterol Management, and Smoking Cessation Quality Metrics in Small Practices by Race and Sex. JAMA Netw Open. 2023;6(8):e2326905.

55. Chavez S, Huebinger R, Chan HK, Schulz K, Panczyk M, Villa N, et al. Racial/ethnic and gender disparities of the impact of the COVID-19 pandemic in out-of-hospital cardiac arrest (OHCA) in Texas. Resuscitation. 2022;179:29–35.

56. Davison MA, Lilly DT, Moreno J, Bagley C, Adogwa O. Gender differences in use of prolonged non-operative therapies prior to index ACDF surgery. J Clin Neurosci. 2020;78:228–35.

57. Ilyas S, Stone DH, Kang J, Cooper MA, Columbo JA, Huber TS, et al. Non-guideline-compliant endovascular abdominal aortic aneurysm repair in women is associated with increased mortality and reintervention compared with men. J Vasc Surg. 2022;75(1):118–125.e1.

58. Lee KMN, Rushovich T, Gompers A, Boulicault M, Worthington S, Lockhart JW, et al. A Gender Hypothesis of sex disparities in adverse drug events. Soc Sci Med. 2023;339:116385.

59. Rubin JB, Cullaro G, Ge J, Lai JC. Women who undergo liver transplant have longer length of stay post-transplant compared with men. Liver Int. 2020;40(7):1725–35.

60. Bolinger C, Dembowski J, Mory K. Pneumonia: Does Age or Gender Relate to the Presence of an SLP Dysphagia Consultation? Geriatrics (Basel). 2020;5(3).

61. Jackson AM, Zhang R, Findlay I, Robertson K, Lindsay M, Morris T, et al. Healthcare disparities for women hospitalized with myocardial infarction and angina. Eur Heart J Qual Care Clin Outcomes. 2020;6(2):156-65.

62. Wesley E, Patel I, Kadra-Scalzo G, Pritchard M, Shetty H, Broadbent M, et al. Gender disparities in clozapine prescription in a cohort of treatment-resistant schizophrenia in the South London and Maudsley case register. Schizophr Res. 2021;232:68-76.

63. Rucker D, Warkentin LM, Huynh H, Khadaroo RG. Sex differences in the treatment and outcome of emergency general surgery. PLoS One [Internet]. 2019;14(11):e0224278.

64. Liu P, Yang Y, Cheng J. Gender differences in medical errors among older patients and inequalities in medical compensation compared with younger adults. Front Public Health. 2022;10:883822.

65. Peters F, Kreutzburg T, Rieß HC, Heidemann F, Marschall U, L'Hoest H, et al. Editor's Choice - Optimal Pharmacological Treatment of Symptomatic Peripheral Arterial Occlusive Disease and Evidence of Female Patient Disadvantage: An Analysis of Health Insurance Claims Data. Eur J Vasc Endovasc Surg. 2020;60(3):421-9.

66. Stodolski M, Zirngibl H, Ambe PC. Gender discrimination in endoscopic groin hernia repair. Minimal invasive groin hernia repair is offered less often to female patients compared to male patients. J Visc Surg. 2020;157(4):271-6.

67. Araujo C, Pereira M, Laszczynska O, Dias P, Azevedo A. Sex-related inequalities in management of patients with acute coronary syndrome-results from the EURHOBOP study. Int J Clin Pract. 2018;72(1).

68. Bak JCG, Serné EH, de Valk HW, Valk NK, Kramer MHH, Nieuwdorp M, et al. Gender gaps in type 1 diabetes care. Acta Diabetol. 2023;60(3):425-34.

69. Ihle-Hansen H, Sandset EC, Hagberg G, Thommessen B, Rønning OM, et al. Sex differences in the Norwegian Tenecteplase Trial (NOR-TEST). Eur J Neurol. 2022;29(2):609-14.

70. Lytsy P, Hallqvist J, Alexanderson K, Ahs A. Gender differences in healthcare management of depression: aspects of sick leave and treatment with psychoactive drugs in a Swedish setting. Nord J Psychiatry [Internet]. 2019;73(7):441–50.

71. Sederholm Lawesson S, Isaksson RM, Ericsson M, Ängerud K, Thylén I. Gender disparities in first medical contact and delay in ST-elevation myocardial infarction: a prospective multicentre Swedish survey study. BMJ Open. 2018;8(5):e020211.

72. Găman MA, Cozma MA, Dobrică EC, Bacalbașa N, Bratu OG, Diaconu CC. Dyslipidemia: A Trigger for Coronary Heart Disease in Romanian Patients with Diabetes. Metabolites. 2020;10(5).

73. Mondschein S, Quinteros M, Yankovic N. Gender bias in the Chilean public health system: Do we all wait the same? PLoS One [Internet]. 2020;15(9):e0239445.

74. Podell R, Kaufman-Shriqui V, Sagy YW, Manor O, Ben-Yehuda A. The quality of primary care provided to the elderly in Israel. Isr J Health Policy Res. 2018;7(1):21.

75. Listabarth S, König D, Berlakovich G, Munda P, Ferenci P, Kollmann D, et al. Sex Disparities in Outcome of Patients with Alcohol-Related Liver Cirrhosis within the Eurotransplant Network-A Competing Risk Analysis. J Clin Med. 2022;11(13).

76. Grinberg K, Sela Y. A Literature Review on Pain Management in Women During Medical Procedures: Gaps, Challenges, and Recommendations. Medicina (Kaunas). 2025;61(8).

77. Shaw LJ, Pepine CJ, Xie J, Mehta PK, Morris AA, Dickert NW, et al. Quality and Equitable Health Care Gaps for Women: Attributions to Sex Differences in Cardiovascular Medicine. J Am Coll Cardiol. 2017;70(3):373-88.

78. Viamonte Ros AM, Markham SM, Wu D, Nicholas PK. A Rapid Scoping Review of Gender Inequities in the Medical Profession. Nursing & Health Sciences Research Journal. 2019;2(1):12-20.

79. Parsons Leigh J, de Grood C, Ahmed S, Bosma K, Burns KEA, Fowler R, et al. Improving gender equity in critical care medicine: a protocol to establish priorities and strategies for implementation. BMJ Open. 2020;10(6):e037090..

80. Nadarajah R, Farooq M, Raveendra K, Nakao YM, Nakao K, Wilkinson C, et al. Inequalities in care delivery and outcomes for myocardial infarction, heart failure, atrial fibrillation, and aortic stenosis in the United Kingdom. Lancet Reg Health Eur. 2023;33:100719.

81. van Doorslaer E, Wagstaff A, van der Burg H, Christiansen T, De Graeve D, Duchesne I, et al. Equity in the delivery of health care in Europe and the US. J Health Econ. 2000;19(5):553-83.

82. Ruiz MT, Verbrugge LM. A two way view of gender bias in medicine. J Epidemiol Community Health. 1997;51(2):106-9.

83. Goddard M, Smith P. Equity of access to health care services: theory and evidence from the UK. Soc Sci Med. 2001;53(9):1149-62.

84. Raine R. Does Gender Bias Exist in the Use of Specialist Health Care? Journal of Health Services Research & Policy. 2000;5(4):237-49.

85. Elderkin-Thompson V, Waitzkin H. Differences in clinical communication by gender. Journal of General Internal Medicine. 1999;14(2):112-21.

86. Temkin SM, Clayton JA. Inclusion of Sex and Gender to Improve the State of the Science in Women's Health. J Bone Joint Surg Am. 2024;106(15):1423-8.

87. White J, Tannenbaum C, Klinge I, Schiebinger L, Clayton J. The Integration of Sex and Gender Considerations Into Biomedical Research: Lessons From International Funding Agencies. J Clin Endocrinol Metab. 2021;106(10):3034-48.

88. Johnson J, Sharman Z, Vissandjee B, Stewart DE. Does a change in health research funding policy related to the integration of sex and gender have an impact? PLoS One.

2014;9(6):e99900.
89. Hunt L, Nielsen MW, Schiebinger L. A framework for sex, gender, and diversity analysis in research. Science. 2022;377(6614):1492-5.
90. Kane JC, Elafros MA, Murray SM, Mitchell EMH, Augustinavicius JL, Causevic S, et al. A scoping review of health-related stigma outcomes for high-burden diseases in low- and middle-income countries. BMC Med. 2019;17(1):17.
91. Thomas A, Lubarsky S, Varpio L, Durning SJ, Young ME. Scoping reviews in health professions education: challenges, considerations and lessons learned about epistemology and methodology. Adv Health Sci Educ Theory Pract. 2020;25(4):989-1002

Statements and Declarations

Ethical Considerations

Not applicable

Consent to participate

Not applicable

Consent for publication

Not applicable

Declaration of conflicting interests

The authors declare that they have no conflicting interests

Funding

No financial declarations

Availability of data and materials

Not applicable

Appendix 1

PubMed Search term 01/01/2018 – 19/12/2023

(sexism [tiab] OR "gender bias" [tiab] OR "sex bias" [tiab] OR "gender roles" [tiab] OR "gender inequality" [tiab] OR "sex inequality" [tiab] OR "sex factors" [tiab] OR "gender factors" [tiab] "gender equity" [tiab] OR "sex equity" [tiab] OR "gender disparities" [tiab] OR "sex disparities" [tiab] OR "gender discordance" [tiab] OR "sex discordance"[tiab]) AND ("healthcare" [tiab] OR "medicine" [tiab])

Embase Search term 01/01/2018 – 19/12/2023

('sexism':ti,ab OR 'gender bias':ti,ab OR 'sex bias':ti,ab OR 'gender roles':ti,ab OR 'gender inequality':ti,ab OR 'sex inequality':ti,ab OR 'sex factors':ti,ab OR 'gender factors':ti,ab OR 'gender equity':ti,ab OR 'sex equity':ti,ab OR 'gender disparities':ti,ab OR 'sex disparities':ti,ab OR 'gender discordance':ti,ab OR 'sex discordance':ti,ab) AND ('healthcare':ti,ab OR 'medicine':ti,ab)

Measured treatment differences between sexes and genders: A scoping review

Miriam Veenhuizen[1,2] and Andrew O'Malley[1]

[1] University of St Andrews, St Andrews, KY16 9AJ, United Kingdom

[2] University of Keele, Newcastle-under-Lyme, ST5 5BG, United Kingdom

Corresponding author: Andrew O'Malley (aso2@st-andrews.ac.uk)

1 Abstract

Background: Sex and gender-based inequality is found throughout medicine. Although there has been significant research in gender disparities affecting healthcare professionals, there is a lack of research into gender differences in the treatment of patients. Despite recognition of systemic issues, recent empirical evidence on how gender influences actual treatment decisions remains fragmented across specialties. A preliminary search of MEDLINE, the Cochrane Database of Systematic Reviews and JBI (Joanna Briggs institute) Evidence Synthesis was conducted and no current or underway systematic reviews or scoping reviews on the topic were identified.

Methods: Studies in English published between 2018 and 2023 were included. Only research which studied measurable differences in the care received by patients of different sexes or genders was included. Both authors independently screened the literature against the a priori defined eligibility criteria. A thematic synthesis approach was used and results summarised qualitatively.

Results: Forty-one papers were included in this review. Of the thirty-eight retrospective case series, thirty-three found a significant difference between the treatment of male and female patients. Of the twenty-nine case series using a multivariate analysis, twenty-five studies found a significant difference in treatment between male and female patients.

Conclusions: The results of this review indicate that men and women are frequently treated differently by healthcare systems. During 2018-2023, five hundred and fifty-one papers were published which studied gender-based differences in opportunities given to healthcare professionals, but only forty-one studying the treatment given to patients. This highlights an area of unmet research need.

Keywords: bias; discrimination; healthcare; feminism

2 Introduction

Sex inequities are evident throughout medicine. Women remain underrepresented in senior academic roles (1), conference presentations (2), and surgical careers where male-dominated culture and structural barriers persist (3). Harassment and discrimination during training further entrench disadvantage, with one study reporting that 87% of women in surgery experienced sex-based discrimination in medical school (4). These inequities extend into pay gaps (5), differential allocation of healthcare resources (6), and even patient interactions, where staff report gender- and race-based abuse (7, 8). Policy initiatives, such as commitments from the Medical Schools Council and General Medical Council (9, 10), signal recognition of the problem but persistent disparities remain.

Similar structural inequities also exist from a patient perspective. The field of women's health has developed considerably since the women's health movement of the 1960s and 1970s, which centred on reproductive rights and the exclusion of women from clinical research (11). While the term sex refers to a biological difference between females and males, gender refers to societal views and norms differentiating women from men (12). Over time, the scope has broadened to encompass sex- and gender-based differences across all populations, though significant challenges remain (11). Females are still underrepresented in clinical research trials; this results in clinical guidelines being based on data skewed towards male patients (13). However, some feel that knowledge of sex differences will not result in a reduction in gender discrimination in healthcare (12).

The term administrative sex refers to the classification of a person's sex on official documentation such as medical records (14). Current clinical databases have been criticised for failing to allow for recording of a patient's gender, or for intersex patients (14). The lack of information in medical databases can make research into sex and gender inequality challenging (14).

Within healthcare, sex plays a role in the diagnosis and management of patients (13). Research into this phenomenon began in the 1970s, with psychiatric and gynaecologic practise coming under scrutiny (15). In the 1990s, the concept of the Yentl Syndrome was published, describing poorer outcomes for women following myocardial infarction and differences in clinical presentation (16). This work helped to catalyse the field of gender medicine, which aims to research sex differences in disease and reduce gender-based management disparities (13, 17).

Cardiovascular medicine illustrates many of these ongoing disparities. Females remain substantially underrepresented in clinical trials of cardiovascular drugs, acute coronary syndromes, heart failure and interventional procedures (18). Similar gaps exist in authorship and leadership, with under-representation of women as investigators being associated with lower recruitment of women as participants (18). Despite decades of institutional efforts, including mandates from the National Institutes of Health and the FDA, females (particularly females from underrepresented minority groups) continue to be under-enrolled in cardiovascular research (19). This under-representation has clinical consequences, contributing to reduced efficacy and higher rates of adverse effects in females. These findings underscore the need for systematic approaches to embed gender-sensitive practice into both research and healthcare delivery (11, 20). These patterns may reflect wider systemic and societal issues.

The COVID-19 pandemic and contemporary social movements have significantly influenced discourse on gender inequities in healthcare and medical education. The pandemic threatened progress toward gender equity in academic medicine, as women faculty faced disproportionate challenges from unequal household labour division and may experience reduced academic productivity (21). Four key social movements (#MeToo, #NiUnaMenos, intersectional feminism, and the global trans rights movement) are transforming health sciences by forcing examination of gendered power relations (22). The pandemic revealed structural gendered racism as a root cause of health inequities, particularly women of colour who occupy disadvantaged positions in households, occupations, and healthcare institutions (23). Intersectionality provides a useful conceptual lens, recognising that gender interacts with other axes of identity such as race, class and age, compounding inequities (24, 25). In healthcare, this perspective is vital for understanding how treatment disparities may be shaped by multiple overlapping factors.

Research demonstrates that intersectionality significantly influences healthcare diagnosis, treatment, and outcomes, though this area remains understudied. A systematic review found that while implicit bias research in healthcare exists, studies examining multiple social identity domains (race, sex, class) typically analyse them separately rather than investigating their overlapping effects (26). In mental health, intersectional analysis reveals that sex, race, class, and ethnicity combine in mutually constitutive ways to explain variation in ADHD diagnosis patterns, demonstrating "paradoxical" stratification effects (27). Studies confirm that socioeconomic status measures cannot fully account for sex inequalities in health, and that both sex and class affect how risk factors translate into health outcomes through complex intersections (28). In cardiovascular care, intersectionality approaches are needed to understand how multiple factors interact to influence heart failure patients' behaviours and health outcomes (29).

Despite recognition of systemic issues, recent empirical evidence on how sex influences actual treatment decisions remains fragmented across specialties, with little synthesis of findings across healthcare systems. A preliminary search of MEDLINE, the Cochrane Database of Systematic Reviews and JBI Evidence Synthesis was conducted and no current or underway systematic reviews or scoping reviews on the topic were identified.

The aim of this scoping review is to synthesise recent evidence (2018–2023) on sex-based differences in the management of patients by healthcare systems, identifying where inequities in treatment provision are most evident.

3 Methods

The scoping review was informed by the JBI methodology for scoping reviews (30). A research question was developed using the PCC (Population, Concept, Context) framework: What recent evidence of measured inequalities in sex and gender are found in the practice of medicine? Key terms were identified ~~(Table 1)~~, and a search was conducted using Ovid Embase and PubMed databases. MEDLINE (via PubMed) and Embase (via Ovid) were selected as the two principal biomedical databases indexing the clinical literature relevant to the review question (31). Key terms were adapted for the requirements of each database. The Population was defined as “Patients with any clinical condition or presentation receiving care within healthcare systems.”. The Concept was “Inequalities in the management or treatment of patients based on sex or gender (including differences in diagnosis, access to interventions, procedures, medications, or outcomes).”, with key terms: “sexism”, “gender bias”, “sex bias”, “gender roles”, “gender inequality”, “sex inequality”, “sex factors”, “gender factors”, “gender equity”, “sex equity”, “gender disparities”, “sex disparities”, “gender discordance”, “sex discordance”. The Context was defined as “Healthcare delivery and practice, across specialties and healthcare systems in Europe, the US, Australia, and New Zealand, with key terms: “healthcare”, “medicine”.

~~**PCC Component**~~	~~**Key Terms**~~
~~Population~~	~~Patients with any clinical condition or presentation receiving care within healthcare systems.~~
~~Concept~~	~~Inequalities in the management or treatment of patients based on sex or gender (including differences in diagnosis, access to interventions, procedures, medications, or outcomes).~~ ~~Sexism, “gender bias”, “sex bias”, “gender roles”, “gender inequality”, “sex inequality”, “sex factors”, “gender factors”, “gender equity”, “sex~~

	~~equity", "gender disparities", "sex disparities", "gender discordance", "sex discordance"~~
~~Context~~	~~Healthcare delivery and practice, across specialties and healthcare systems in Europe, the US, Australia, and New Zealand.~~ ~~"healthcare", "medicine"~~

~~*Table 1: PCC framework and related key words for the search strategy*~~

The results of both searches were collected, uploaded to and stored in the literature management software EndNote. This scoping review considered both experimental and quasi-experimental study designs including randomized controlled trials, non-randomized controlled trials, before and after studies and interrupted time-series studies. In addition, analytical observational studies including prospective and retrospective cohort studies, case-control studies and analytical cross-sectional studies were considered for inclusion. This review also considered descriptive observational study designs including case series, individual case reports and descriptive cross-sectional studies for inclusion. Qualitative studies were considered if they presented primary data. Grey literature, opinion and editorial articles, reviews and articles without primary data were not considered in this review. Full eligibility criteria~~, presented in Table 2,~~ were predetermined and used to screen the literature. The inclusion criteria were: written in English, published in or after 2018, published in peer reviewed journals and reporting primary data; address sex/gender differences affecting real patients; compares the healthcare received by patients of different genders. The exclusion criteria were: written in languages other than English, published before 2018, grey literature, opinion and editorial articles, reviews and articles without primary data; address sex/gender differences affecting virtual or simulated patients, healthcare professionals, or in authorship of academic publications; descriptions of differences in presentation between sex/gender without comment on the healthcare they receive, descriptions of the knowledge or attitudes of healthcare practitioners rather than their actions/the actions of systems towards patients, descriptions of patients' opinions on how healthcare should be apportioned, descriptions about barriers to access or lack of representation, only discussing interventions to previously identified inequalities, reviews the framing of disease in news articles, economic analysis.

~~**Inclusion**~~	~~**Exclusion**~~
~~Written in English~~ ~~Published in or after 2018~~ ~~Published in peer reviewed journals and reporting primary data~~	~~Written in languages other than English~~ ~~Published before 2018~~ ~~Grey literature, opinion and editorial articles, reviews and articles without primary data.~~
~~Address sex/gender differences affecting real patients~~	~~Address sex/gender differences affecting virtual or simulated patients~~ ~~Addressing sex/gender differences affecting healthcare professionals~~ ~~Addresses sex/gender differences in authorship of academic publications~~
~~Compares the healthcare received by patients of different genders~~	~~Descriptions of differences in presentation between sex/gender without comment on the healthcare they receive~~ ~~Descriptions of the knowledge or attitudes of healthcare practitioners rather than their actions/the actions of systems towards patients.~~

	~~Descriptions of patients' opinions on how healthcare should be apportioned~~ ~~Descriptions about barriers to access or lack of representation~~ ~~Only discussing interventions to previously identified inequalities~~ ~~Reviews the framing of disease in news articles~~ ~~Economic analysis~~

~~*Table 2: Inclusion and exclusion criteria*~~

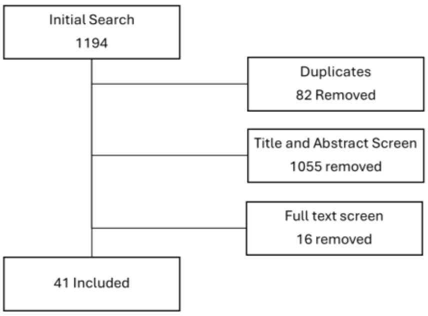
Both authors independently screened the literature against the a priori defined eligibility criteria and disagreements were resolved through discussion between the authors. Quality appraisal of the included papers was undertaken using the JBI appraisal checklists (32). The JBI appraisal checklist is a widely-used method for assessing quality of evidence in healthcare research (33).

A spreadsheet with pre-determined columns was populated with information from each study, including year, authors, country of origin, participants, study type, outcomes measured, results, level of evidence and JBI checklist risk of bias results.

To identify themes and concepts across the included studies, a thematic synthesis approach was used (34). Quantitative and qualitative data from each study were compared and summarised qualitatively.

4 Results

The initial search of OVID Embase and PubMed after exclusion of duplicates returned 1,112 results. Title and abstract screening reduced this to fifty-seven results. Full text screening resulted in forty-one papers remaining for analysis (see Figure 1). The most common reason for non-inclusion of papers was that the study focused on differences in the treatment of healthcare professionals by gender rather than the treatment of patients. See Figure 1~~Table 3~~ for full information on reasons for exclusion.



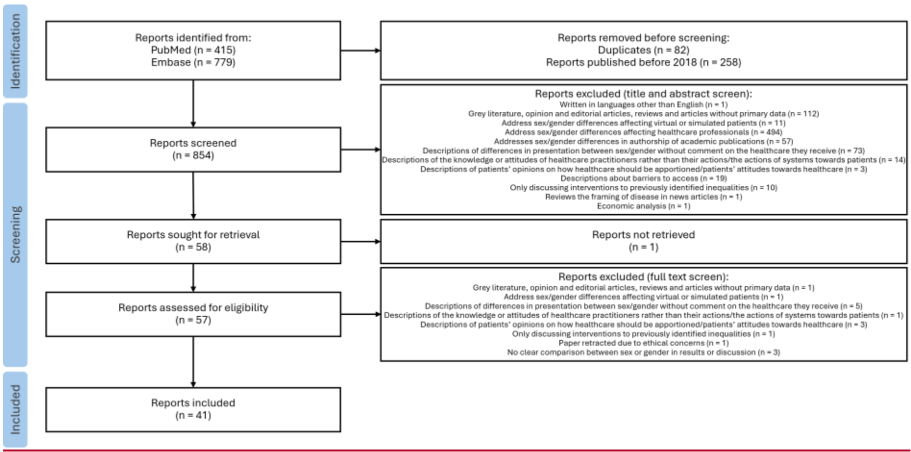


Figure 1: PRISMA flow chart

~~Reason for Exclusion~~	~~Number of papers excluded~~		
	~~Title and Abstract Screen~~	~~Full Text Screen~~	~~Total~~
~~Written in languages other than English~~	~~1~~	~~0~~	~~1~~
~~Published before 2018~~	~~258~~	~~0~~	~~258~~
~~Grey literature, opinion and editorial articles, reviews and articles without primary data.~~	~~112~~	~~1~~	~~113~~
~~Address sex/gender differences affecting virtual or simulated patients~~	~~11~~	~~1~~	~~12~~
~~Addressing sex/gender differences affecting healthcare professionals~~	~~494~~	~~0~~	~~494~~
~~Addresses sex/gender differences in authorship of academic publications~~	~~57~~	~~0~~	~~57~~
~~Descriptions of differences in presentation between sex/gender without comment on the healthcare they receive~~	~~73~~	~~5~~	~~78~~
~~Descriptions of the knowledge or attitudes of healthcare practitioners rather than their actions/the actions of systems towards patients.~~	~~14~~	~~1~~	~~15~~
~~Descriptions of patients' opinions on how healthcare should be apportioned/ patients attitudes towards healthcare~~	~~3~~	~~3~~	~~6~~
~~Descriptions about barriers to access~~	~~19~~	~~0~~	~~19~~
~~Only discussing interventions to previously identified inequalities~~	~~10~~	~~1~~	~~11~~
~~Reviews the framing of disease in news articles~~	~~1~~	~~0~~	~~1~~
~~Economic analysis~~	~~1~~	~~0~~	~~1~~
~~Paper retracted due to ethical concerns~~	~~0~~	~~1~~	~~1~~
~~No clear comparison between sex or gender in results or discussion~~	~~0~~	~~3~~	~~3~~

~~Unable to source full text~~	~~1~~	~~0~~	~~1~~
~~**Totals**~~	~~**1055**~~	~~**16**~~	~~**1071**~~

~~*Table 3: Reasons for exclusion from review*~~

Of the forty-one papers included in this study, twenty-six were conducted in the United States (35-60), two in the United Kingdom (61, 62), one in Canada (63), one in China (64), two in Germany (65, 66), one in Portugal (67), one in the Netherlands (68), one in Norway (69), two in Sweden (70,71), one in Romania (72), one in Chile (73), one in Israel (74) and one across Europe (75). The studies were published in twenty-seven different journals between 2018 and 2023.

Thirty-eight were retrospective case series. One study combined retrospective case series with survey of participants, one combined retrospective case series with prospective case series and survey of participants and one study used mixed methods.

The papers were grouped by specialty area of medicine to aid the development of a synthesised narrative. Fifteen were from cardiovascular medicine (35, 36, 40-42, 49, 50, 52, 54, 57, 61, 65, 67, 71, 72), four from neurology (37, 44, 60, 69), one from renal medicine (38), four from surgical medicine (39, 56, 63, 66), three from transplant medicine (43, 59, 75), three from emergency medicine (45, 51, 55), three from endocrinology (46, 47, 68), three from psychiatry (48, 62, 70) two from medico-legal (58, 64), one from anaesthetics (53), one regarding waiting times across the health system (73) and one from primary care (74).

For the thirty-eight papers that used a retrospective case series, nine did not include multivariate analysis as part of their statistical analysis. Seventeen did not include the ethnicity of the participants. Thirteen did not include comorbid conditions in their description of the participants.

As all included papers were retrospective reviews of medical records, all results are assumed to be relating to the administrative sex of the patients. None of the included papers made any comment about the gender of patients, as opposed to sex. None of the reviews included any patients who were intersex.

Of the thirty-eight retrospective case series, thirty-three noted a statistically significant difference between the treatment of male and female patients. Of the twenty-nine case series using a multivariate analysis, twenty-five studies found a statistically significant difference in treatment between male and female patients.

4.1 Descriptive Results by Specialty

4.1.1 Cardiovascular

For cardiovascular conditions such as myocardial infarction, heart failure and supraventricular tachycardia, females are more likely to be managed conservatively with medication when compared to invasive procedures such as coronary artery bypass grafting, percutaneous coronary intervention or ablation therapy (41, 42, 50, 61, 67). One study showed that females had worse mortality when presenting with cardiovascular conditions (50), however the others that examined this found no significant difference in mortality (35, 61). In a Swedish study, the time from experiencing the first symptoms of a myocardial infarction to receiving a diagnostic electrocardiogram was longer for females (71). The discharge destination was examined in one study showing that females were more likely to be discharged to a skilled nursing facility after having a myocardial infarction, likely a marker of worse clinical outcomes (35). For patients with atherosclerosis of vessels, all studies found females were less likely than males to receive lipid lowering therapies (36, 40, 54, 65). In patients with diabetes, there was no statistically significant difference between the prescription of lipid-lowering therapies in males and females (72). During elective cardiovascular surgery females were more likely to receive allogeneic blood transfusion (which has a well-established link with poorer outcomes) (49). Post-aortic repair surgery, statistically significantly fewer females were discharged with optimal medical management (57).

The group-dynamics of the teams deciding on allocation of advanced heart-failure therapies (AHFT) affected the allocation process. Teams which functioned well were more likely to allocate AHFT to females than males, teams which functioned less well were more likely to allocate AHFT to men than women.

4.1.2 Neurology

For patients with Parkinson's disease, men were more likely to be referred for consideration of deep brain stimulation devices, an implantable device to help manage symptoms of Parkinson's disease. After referral, there was no statistically significant difference in whether males and females went on to have the procedure. For females who did not undergo surgery this was more likely than in males to be due to patient preference (37). For patients with dementia, females were more likely to receive treatment (44). For patients admitted to hospital with pneumonia, males were more likely to be screened for underlying neurological causes with a speech and language consult (60). In the data from a large trial of thrombolysis (an emergency treatment for stroke) no significant difference was found between the treatment of males and females (69).

4.1.3 Endocrinology and Diabetes

For patients with diabetes, studies found no difference in the management between males and females (47, 68). For children, a study found no difference in the number of males vs females who are overweight being screened for diabetes. Males who were obese were more likely than females to be screened for diabetes (46).

4.1.4 Renal and Transplant Medicine

For the papers that looked at likelihood of liver transplantation, both found that males were more likely to receive a liver transplant than females (43, 75). Females on the transplant list were more likely to be hospitalised and more likely to be transplanted from the intensive care unit (59).

For dialysis a permanent means of access is preferred to a central venous catheter, females who required dialysis were found to spend longer using a central venous catheter and were less likely to transition to a permanent means of access (38).

4.1.5 Surgery

Length of stay in hospital (a negative outcome) was longer for females than males in two of three surgical studies (39, 66). There was no difference in discharge destination found for males and females who had elective adult spinal deformity correction (39). Endovascular treatment is a preferred treatment option for hernia repair operations however females were more likely to receive open hernia repairs (66).

When older patients were studied in Canada, females were less likely to be offered an operation (63). The outcomes for males and females who had been offered an operation were not significantly different (63). Prior to surgical management for symptomatic spinal stenosis, females were advised to trial significantly more non-operative treatments (56).

4.1.6 Emergency Medicine

Females were less likely to receive treatment from prehospital emergency medical teams both with targeted temperature management for out of hospital cardiac arrests (45), and opioids for pain management (51). Bystanders were less likely to use a defibrillator on females in cardiac arrest (55). A decision to terminate resuscitation efforts was less likely in females in cardiac arrest compared with males. Females were more likely to survive to hospital admission compared with men (55).

4.1.7 Anaesthetics

Females were less likely to receive an appropriate size of endotracheal tube for their height, receiving on average tubes too large for them (53).

4.1.8 Psychiatry

Males were less likely to receive a diagnosis of bipolar disorder than females (48). Females were less likely to be treated with clozapine for treatment resistant schizophrenia (62). Males with depression are more likely to be prescribed medications (70) but after taking into account six month follow up, are equally likely to be sick-leave certified (70).

4.1.9 Waiting Times

In a comparison of waiting times between males and females in Chile, sixteen conditions were studied (73). After multivariate analysis, in nine there was no significant difference in waiting times between males and females. For two conditions males waited for significantly longer and in five females waited significantly longer than males (73).

4.1.10 Primary Care

In a review of primary care delivery to geriatric patients in Israel, females were vaccinated at a lower rate (74). Females were prescribed benzodiazepines at a higher rate than males (74).

4.1.11 Medico-legal

For drug adverse events that were documented by health-care professionals, more were documented for females. The adverse reactions documented for femaleswere less serious than the events documented for males (58). One of the most common adverse drug events for females listed was “feeling hot”, however for males one of the most common adverse drug events listed was “death” (58).

A Chinese study of medical errors in elderly patients found numerical differences in the rates of reported errors between males and females between specialties, however there was no statistical analysis of the cases (64). Females were more likely to report medical errors in nephrology, respiratory, oncology, primary care and internal medicine. Males were more likely to report medical errors in the emergency department, general surgery and medical technology departments. Incidence of errors in the orthopaedic department was the same between males and females (64).

4.2 Results of Thematic Analysis

4.2.1 Interventional procedures

A theme which emerged during the analysis was papers studying the likelihood of patients of different sex's having interventional procedures. The ten papers which studied this question are summarised in Table ~~4~~1 below. The effect direction and estimate refer to the likelihood of female patients receiving an interventional procedure as compared with male patients.

Table 1: Likelihood of interventional procedures. AOR = adjusted odds ratio, uOR = unadjusted odds ratio, NR = not recorded, asHR = adjusted subdistribution hazard ratio, uIRR = unadjusted incidence rate ratio.

Study	JBI bias risk	Level of evidence	Effect direction	Effect estimate (95% confidence interval)	p-value
Sacks, N.C. et al. (2020)					
~~Sacks, N.C. et al. (2020)~~ ~~*ablation*~~ Ablation for paroxysmal supra-ventricular tachycardia	Moderate	Level 4	▼ (decreased)	aOR 0.83 (0.70-0.98)	0.0278
Verghese, D. et al. (2022)					
~~Verghese, D. et al.~~ ~~*coronary*~~ Coronary angiography	Moderate	Level 4	▼ (decreased)	uOR 0.65 (0.64-0.66)	<0.001

Formatted: Caption, Centered

Formatted: Font: (Default) +Body (Aptos), Font color: Text 2

Formatted: English (United Kingdom)

Formatted: Font: Not Italic

Formatted: Font: Not Italic

~~*early angiography*~~ ~~*percutaneous coronary intervention*~~					
~~Verghese, D. et al.~~ ~~e~~Early angiography	Moderate	Level 4	▼ (decreased)	uOR 0.70 (0.69-0.71)	<0.001
~~Verghese, D. et al.~~ ~~p~~Percutaneous coronary intervention	Moderate	Level 4	▼ (decreased)	aOR 0.69 (0.68-0.70)	<0.001
Jackson, A. M. et al. (2020)					
~~Jackson, A. M. et al.~~ ~~*coronary*~~ Coronary angiography ~~*percutaneous coronary intervention*~~	Low	Level 4	▼ (decreased)	aOR 0.66 (0.60 - 0.73)	<0.0001
~~Jackson, A. M. et al.~~ ~~p~~Percutaneous coronary intervention	Low	Level 4	▼ (decreased)	aOR 0.60 (0.54-0.66)	<0.0001
Araujo, C. et al. (2018)					
~~Araujo, C. et al.~~ ~~*coronary*~~ Coronary	Moderate	Level 4	▼ (decreased)	aOR 0.61 (0.41-0.90)	0.0138

Formatted: Font: Not Italic

Formatted: Font: Not Italic

Formatted: Font: Italic

Formatted Table

Formatted: Font: Not Italic

Formatted: Font: Not Italic

Formatted: Font: Not Italic

angiography: STEMI group ~~*coronary angiography: NSTEMI group*~~					
~~Araujo, C. et al.~~ ~~c~~Coronary angiography: NSTEMI group	Moderate	Level 4	— (no effect)	aOR 0.79 (0.62-1.01)	≥ 0.05
Shpiner, D. S. et al. (2019)					
~~Shpiner, D. S. et al.~~ ~~*referral*~~ Referral for DBS surgery ~~*proceeding with DBS surgery after referral*~~	Moderate	Level 4	▼ (decreased)	uOR 0.51 (0.37-0.71)	<0.0001
~~Shpiner, D. S. et al.~~ ~~p~~Proceeding with DBS surgery after referral	Moderate	Level 4	— (no effect)	uOR 0.94 (0.52-1.68)	0.8220
Darden, M. et al. (2021)					
~~Darden, M. et al.~~ ~~liver~~ Liver transplant ~~*liver ablation*~~ ~~*liver resection*~~	Moderate	Level 4	▼ (decreased)	aOR 0.854 (NR)	0.002
~~Darden, M. et al.~~ ~~l~~Liver ablation	Moderate	Level 4	▲ (increased)	aOR 1.623 (NR)	0.000

Formatted: Font: Not Italic

Formatted: English (United Kingdom)

Formatted Table

Formatted: Font: Not Italic

Formatted: Font: Not Italic

Formatted: Font: Not Italic

Formatted: Font: Not Italic

Formatted: Font: Not Italic

Formatted: Font: Italic

~~Darden, M. et al.~~ ~~/~~Liver resection	Moderate	Level 4	▼ (decreased)	aOR 0.918 (NR)	0.021
Listabarth, S. et al. (2022)					
~~Listabarth, S. et al.~~ ~~liver~~ Liver transplant	Moderate	Level 4	▼ (decreased)	aOR 0.78 (0.73-0.82)	<0.0001
Arya, S. et al. (2020)					
~~Arya, S. et al.~~ ~~transition~~ Transition to permanent means of access for dialysis	Low	Level 4	▼ (decreased)	asHR 0.96(0.93-0.98)	<0.001
Rucker, D. et al. (2019)					
~~Rucker, D. et al.~~ ~~*operative*~~ Operative management	Low	Level 4	▼ (decreased)	uOR 0.74 (0.56-0.97)	0.03
Tandon, V. et al. (2020)					
~~Tandon, V. et al.~~ ~~*number*~~ Number of procedures	Moderate	Level 4	▼ (decreased)	uIRR 0.84 m(NR)	<0.05
Breathett, K. et al. (2023)					
~~Breathett, K. et al~~ Allocated to advanced therapies	Moderate	Level 4	▲ (increased)		

~~*Table 4: Likelihood of interventional procedures. AOR = adjusted odds ratio, uOR = unadjusted odds ratio, NR = not recorded, asHR = adjusted subdistribution hazard ratio, uIRR = unadjusted incidence rate ratio.*~~

4.2.2 Guideline compliant care/ optimal medical management

Formatted: Font: Italic

Formatted: English (United Kingdom)

Formatted: Font: Not Italic

Formatted: Font: Not Italic

Formatted: English (United Kingdom)

Formatted: Font: Not Italic

Formatted: Font: Not Italic

Formatted: English (United Kingdom)

Formatted: Font: Not Italic

Formatted: English (United Kingdom)

Formatted: Font: Not Italic

Another theme which emerged during the analysis was papers studying the likelihood of patients of different sex's having care which was compliant with guidelines. The seventeen papers which studied this question are summarised in Table ~~5~~2 below. The effect direction and estimate refer to the likelihood of female patients receiving guideline-compliant care as compared with male patients.

Table 2: Likelihood of guideline compliant care. aOR = adjusted odds ratio, uOR = unadjusted odds ratio, aHR = adjusted hazard ratio, a% difference = adjusted percentage difference.

Study	JBI bias risk	Level of evidence	Effect direction	Effect estimate (95% confidence interval)	p-~~-~~value
Shen, X. et al. (2019)					
~~Shen, X. et al.~~ ~~statin~~ Statin prescription from cardiologist: commercial insurance plan ~~statin prescription from cardiologist: Medicare Advantage insurance plan~~	Moderate	Level 4	▼ (decreased)	aOR 0.69 (0.65-0.74)	<0.0001
Statin prescription from cardiologist: Medicare Advantage insurance plan	Moderate	Level 4	▼ (decreased)	aOR 0.78 (0.76-0.79)	<0.0001
Podell, R. et al. (2018)					
~~Podell, R. et al.~~	Moderate	Level 4	▼ (decreased)	uOR 0.83 (0.83-0.84)	<0.0001

Formatted: Caption, Centered

Formatted: Font: (Default) +Body (Aptos), Font color: Text 2

Formatted: English (United Kingdom)

Formatted Table

Formatted: Font: Not Italic

Formatted: Font: Not Italic

Formatted: Font: Not Italic

Formatted: English (United Kingdom)

~~influenza~~ Influenza vaccination ~~pneumococcal vaccination~~					
Pneumococcal vaccination	Moderate	Level 4	▼ (decreased)	uOR 0.79 (0.78-0.80)	<0.0001
Mahtta, D. et al. (2020)					
~~Mahtta, D. et al.~~ ~~statin~~ Statin prescription	Moderate	Level 4	▼ (decreased)	aOR 0.68 (0.62-0.75)	<0.0001
Peters, F. et al. (2020)					
~~Peters, F. et al.~~ ~~optimal~~ Optimal pharmacological treatment	Moderate	Level 4	▼ (decreased)	aOR 0.89 (0.86-0.92)	<0.0001
Găman, M. A. et al. (2020)					
~~Gaman M. A. et al~~ ~~statin~~ Statin prescription	High	Level 4	— (no effect)	uOR 0.62 (0.36-1.08)	0.09
Ilyas, S. et al. (2022)					
~~Ilyas, S. et al~~ ~~aspirin~~ Aspirin at discharge ~~statin at discharge~~	Moderate	Level 4	▼ (decreased)	uOR 0.74 (0.63-0.86)	0.0001
Statin at discharge	Moderate	Level 4	▼ (decreased)	uOR 0.66 (0.56-0.76)	<0.0001
Lu, Z. K. et al. (2021)					
~~Lu, Z. K. et al.~~ Anti-dementia medications	Moderate	Level 4	▲ (increased)	aOR 1.71(1.19-2.45)	0.0036

Formatted: Font: Not Italic

Formatted: Font: Not Italic

Formatted: English (United Kingdom)

Formatted: Font: Not Italic

Formatted: Font: Not Italic

Formatted: English (United Kingdom)

Formatted: Font: Not Italic

Formatted: Font: Not Italic

Formatted: Font: Italic, English (United Kingdom)

Formatted: Font: Not Italic

Formatted: Font: Not Italic

Formatted: English (United Kingdom)

Formatted: Font: Not Italic

Formatted: Font: Not Italic

Formatted: English (United Kingdom)

Stodolski, M. et al. (2020)					
~~Stodolski, M. et al.~~ ~~endoscopic~~ Endoscopic hernia repair	Moderate	Level 4	▼ (decreased)	uOR 0.29 (0.19-0.46)	<0.0001
Morris, N. et al. (2021)					
~~Morris, N. et al~~ ~~*targeted*~~ Targeted temperature management	Moderate	Level 4	▼ (decreased)	aOR 0.90 (0.87-0.92)	<0.001
Wimbish, L. et al. (2022)					
~~Wimbish, L. et al.~~ ~~opioid~~ Opioid administration	Low	Level 4	▼ (decreased)	aOR 0.90(NR)	0.004
Wesley, E. et al. (2021)					
~~Wesley, E. et al.~~ ~~*clozapine*~~ *Clozapine* *prescription*	Low	Level 4	▼ (decreased)	aOR 0.66 (0.44-0.97)	<0.05
Ihle-Hansen, H. et al. (2022)					
~~Ihle-Hansen, H. et al.~~ ~~onset~~ Onset of symptoms to admission ~~door to needle time~~	Moderate	Level 4	— (no effect)	Mean 91.6 vs 95.3 min	0.2900
Door to needle time	Moderate	Level 4	— (no effect)	Mean 38.6 vs 37.0 min	0.3100
Ahmed, F. et al. (2022)					
~~Ahmed, F. et al.~~	Low	Level 4	— (no effect)	uOR 1.14 (0.61-2.12)	0.682

Formatted: English (United Kingdom)

Formatted: Font: Not Italic

Formatted: Font: Not Italic

Formatted: English (United Kingdom)

Formatted: Font: Not Italic

Formatted: Font: Not Italic

Formatted: Font: Not Italic

Formatted: English (United Kingdom)

Formatted Table

Formatted: English (United Kingdom)

Formatted: Font: Not Italic

Formatted: English (United Kingdom)

~~prescribed~~ Prescribed statin therapy ~~Received appropriate intensity statin therapy~~					
Received appropriate intensity statin therapy	Low	Level 4	— (no effect)	uOR 1.14 (0.64-2.00)	0.658
Bak, L. et al. (2023)					
~~Bak, L. et al.~~ *19 diabetes process measurements*	Moderate	Level 4	— (no effect)	aORs ranged from 0.87-1.06	All >=0.06
Roberts, M. M. et al. (2023)					
~~Roberts, M. M. et al.~~ ~~aspirin~~ Aspirin ~~cholesterol managament~~ ~~BP control~~ ~~smoking cessation counselling~~	Moderate	Level 4	▼ (decreased)	a% difference -4.36 (-5.38--3.34)	<0.001
Cholesterol management	Moderate	Level 4	▼ (decreased)	a% difference -3.88 (-4.63--3.14)	<0.001

Formatted: Font: Not Italic

Formatted: Font: Not Italic

Formatted: English (United Kingdom)

Formatted: English (United Kingdom)

Formatted: Font: Not Italic

Formatted: Font: Not Italic

Formatted: Font: Not Italic

Formatted: Font: Not Italic

Formatted Table

Formatted: Font: (Default) Aptos, English (United Kingdom)

BP control	Moderate	Level 4	▲ (increased)	a% difference 1.80 (1.28-2.32)	<0.001
Smoking cessation counselling	Moderate	Level 4	▲ (increased)	a% difference 1.67 (0.95-2.38)	<0.001
Bolinger, C. et al. (2020)					
~~Bollinger, C. et al.~~ ~~speech~~ Speech and language consult	Moderate	Level 4	▼ (decreased)	uOR 0.73 (0.58-0.91)	0.0051
Vajravelu, M. E. et al. (2021)					
~~Vajravelu, M. E. et al.~~ ~~diabetes~~ Diabetes screening in overweight patients ~~diabetes screening in obese patients~~	Moderate	Level 4	▲ (increased)	aHR 1.67 (1.43-2.00)	<0.0001
Diabetes screening in obese patients	Moderate	Level 4	▲ (increased)	aHR 1.43(1.43-1.67)	<0.0001

~~*Table 5: Likelihood of guideline compliant care. aOR = adjusted odds ratio, uOR = unadjusted odds ratio, aHR = adjusted hazard ratio, a% difference = adjusted percentage difference.*~~

4.3 Analysis of intersectional identities

Formatted: Font: (Default) Aptos, English (United Kingdom)

Formatted: English (United Kingdom)

Formatted: Font: Not Italic

Formatted: Font: Not Italic

Formatted Table

Formatted: English (United Kingdom)

Formatted: Font: Not Italic

Formatted: Font: Not Italic

Formatted: Font: Not Italic

Out of the forty-one papers, twenty nine did not have result reporting for identities other than sex. Where results were reported for other identities such as age or ethnicity, these were presented separately in seven papers. Five papers gave results for intersectional identities, all of these reported the intersection between sex and ethnicity. See Table ~~6~~3 below for a summary of these results.

Table 3: Intersectional identity results. aOR = adjusted odds ratio, uOR = unadjusted odds ratio, aHR = adjusted hazard ratio, a% difference = adjusted percentage difference, aCE = adjusted estimate of co-efficient, NR = not reported

Study	JBI bias risk	Level of evidence	Effect direction	Effect estimate (95% confidence interval)	p-value
Darden, M. et al. (2021)					
~~Darden, M. et al.~~ Caucasian Women transplant ~~African-American women transplant~~ ~~Caucasian women resection~~ ~~African-American~~	Moderate	Level 4	(decreased)	0.82 (0.73-0.91) [aOR]	<0.001

Formatted: Caption, Centered, Space After: 8 pt

Formatted: Font: (Default) +Body (Aptos)

Formatted Table

~~women resection~~ ~~Caucasion women ablation~~ ~~African-American women ablation~~					
~~Darden, M. et al.~~ African-American women transplant	Moderate	Level 4	(decreased)	0.42 (0.32-0.54) [aOR]	<0.001
~~Darden, M. et al.~~ Caucasian women resection	Moderate	Level 4	(increased)	1.597 (1.446-1.765) [aOR]	<0.001
~~Darden, M. et al.~~ African-American women resection	Moderate	Level 4	(increased)	1.579 (1.303-1.913) [aOR]	<0.001
~~Darden, M. et al.~~ Caucasion women ablation	Moderate	Level 4	(decreased)	0.918 (0.849-0.993) [aOR]	0.033
~~Darden, M. et al.~~ African-American women ablation	Moderate	Level 4	(decreased)	0.813 (0.684-0.967) [aOR]	0.020
Ahmed, F. et al. (2022)					

~~Ahmed, F. et al~~ ~~white~~ White males vs white female statin prescription ~~Non-white females vs white female statin prescription~~ ~~Non white males vs white female statin prescription~~	Low	Level 4	— (No Effect)	0.68 (0.25–1.90) [aOR]	0.4600
Non-white females vs white female statin prescription~~ref~~	Low	Level 4	— (No Effect)	Effect)0.36 (0.12–1.06) [aOR]	0.0600
Non white males vs white female ~~ref~~statin prescription	Low	Level 4	— (No Effect)	2.19 (0.53–8.98) [aOR]	0.2800
Tandon, V. et al. (2020)					
~~Tandon, V. et al.~~ ~~*number*~~ Number of procedures	Moderate	Level 4	Native american women had the lowest average number of procedures, with asian men having the highest	NR	NR
Breathett, K. et al. (2023)					

Formatted: Font: Not Italic

Formatted: Font: Not Italic

Formatted: Font: Not Italic

Formatted: Font: Not Italic

Formatted Table

Formatted: Font: Not Italic

Formatted: English (United Kingdom)

~~Breathett, K. et al~~ Race x gender with group function score probability of allocation to advanced heart failure therapies	Moderate	Level 4	— (No Effect)	-0.37 (-3.453-2.713) [aCE]	0.815

Formatted Table

~~*Table 6: Intersectional identity results. aOR = adjusted odds ratio, uOR = unadjusted odds ratio, aHR = adjusted hazard ratio, a% difference = adjusted percentage difference, aCE = adjusted estimate of co-efficient, NR = not reported*~~

5 Discussion

Gender based differences in the treatment of patients were unable to be studied in this scoping review due to the lack of research found containing information on the gender of patients. This is likely due to the reliance on electronic health records for the papers studied in this scoping review. The electronic health records contain information on the administrative sex of patients, rather than their gender. This issue could be addressed using prospective studies designed specifically to answer questions regarding gender- based inequality in the current healthcare system. The HL7 gender harmony model is a logical model which gives a framework for healthcare organisations to document additional information regarding a patient's sex and gender (14). If this model or similar were to be adopted into wide-spread use, research into gender inequality within healthcare could be undertaken at a larger scale.

The results of this scoping review indicate that males and females are frequently treated differently by healthcare systems, though the evidence does not consistently clarify whether such differences confer disadvantage to either sex. Many studies, excluded from the formal part of this review, did not directly measure patient care but instead examined professional attitudes or workforce equity, which fall outside the central focus here. The studies that did examine management revealed variation in treatment practices, raising questions about whether these reflect appropriate clinical considerations or systemic inequities. Notably, very few papers explicitly referenced clinical guidelines recommending sex-specific management, leaving uncertainty about the drivers of observed disparities. Observed differences in treatment practices may relate to patient choice or barriers to access treatment. These findings align with other adjacent reviews, which have synthesised evidence of gender inequities across multiple medical specialties, revealing persistent disparities in both clinical care delivery and professional representation. Grinberg & Sela (76) identified significant gender biases in pain management, with women receiving inadequate analgesia during medical procedures due to unconscious biases, lack of sex-specific protocols, and cultural stereotypes. Shaw et al. (77) examined cardiovascular medicine, emphasizing that achieving equitable care requires consideration of unique gendered structural determinants of health and development of women-optimised care pathways. Ros et al. (78) conducted a broader scoping review revealing substantial inequities in women's representation across medical professions, particularly in leadership positions and senior faculty roles, with only 13% of identified studies addressing potential interventions. Parsons Leigh et al. (79) focused on critical care medicine, noting it has among the lowest female representation and proposing comprehensive strategies to synthesise and implement solutions for improving gender equity.

Most included studies originated from the United States, limiting the generalisability of findings. This raises the need to examine evidence from other regions such as Europe, the UK, and Australasia, where healthcare systems and policy frameworks differ. Research evidence reveals significant sex inequities in healthcare delivery across the UK and Europe. In the UK's National Health Service, females and older people receive guideline-recommended cardiovascular treatments less frequently than malesand younger people, with limited research available on ethnic disparities (80). A broader European analysis found that after adjusting for healthcare needs, significant pro-rich inequity emerged in half of studied countries for physician contacts, primarily due to higher-income groups' greater use of specialist services while lower-income groups relied more on general practitioner care (81). Sex bias in healthcare manifests in two ways: assuming similarities between male's and female's health situations when differences exist, and assuming differences where similarities occur, both potentially leading to negative health outcomes for females (82). Despite equity being a central NHS objective since 1948, important inequities persist in UK healthcare access, though methodological limitations often prevent firm conclusions about underlying causes (83). This regional evidence reinforces the broader pattern identified in this review, showing that inequities in healthcare delivery are not confined to the US context but also persist across European systems.

A consistent trend was observed: females were statistically less likely than males with similar clinical characteristics to be offered invasive management, and when managed conservatively, females were statistically less likely to receive optimal pharmacological therapy. It is not possible to determine whether this was as a result of inequities or due to another cause. Breathett et al. studied how group dynamics may influence the allocation of treatment to patients and found that worse group dynamics resulted in females and patients of colour being less likely to be allocated intensive treatment options.

Much of the recent research on sex differences in management has been conducted in cardiovascular medicine, reflecting the historical prominence of this field since early studies on sex-based disparities (82). It remains unclear whether this concentration reflects a true predominance of inequities in cardiovascular care or simply research inertia building on prior work.

Research has identified several explanations for observed sex differences in healthcare delivery. Raine (84) found evidence of sex disparities across multiple conditions, with males more likely to receive certain procedures like renal transplantation and HIV treatments, while females were more likely to undergo liver transplantation and cataract surgery. The study attributed these differences to both demand factors (disease prevalence, severity, patient preferences) and supply factors (clinical judgment). With patient preference also being attributed to the reduced implantation of deep-brain stimulation devices in females in one study in this review (37). Elderkin-Thompson & Waitzkin (85) highlighted communication differences as a key factor, noting that physicians commonly attribute women's symptoms to "over anxiousness" and make more diagnostic errors with female patients, even when positive test results are present. These explanations provide possible mechanisms underlying the consistent trend observed in this review, where females are statistically less likely than males to receive invasive management or optimal pharmacological therapy.

Although thirteen studies reported results comparing outcomes for groups other than males and females, only four presented the results using intersectional identities. The results of these studies are summarised in Table ~~6~~3, no clear conclusions could be drawn due to the lack of data. The reporting of results for different identities separately rather than in an intersectional manner has been noted in previous reviews (26).

The evidence base remains limited in quality. Many studies relied on retrospective analyses of medical records, with incomplete data limiting the strength of conclusions. Several did not perform multivariate analyses to adjust for potential confounders such as race, comorbidity, or socioeconomic status. Future research should prioritise prospective designs to establish whether differences are attributable to sex itself rather than intersecting factors.

Several major international funding agencies have implemented policies requiring or encouraging sex and gender analysis in health research. The National Institutes of Health (NIH) has instituted policies requiring researchers to include appropriate populations and analyse data accordingly, focusing on sex as a biological variable (SABV) to enhance reproducibility (86, 87). The Canadian Institutes of Health Research (CIHR) implemented a sex- and gender-based analysis (SGBA) policy, with mandatory questions introduced in 2010 showing increased compliance over time, though disparities across disciplines persist (87, 88). The European Commission requires integration of the "gender dimension," incorporating sex, gender, and intersectional analysis into research and innovation (87). A comprehensive analysis of 22 major national funding agencies across six continents reveals varying approaches to implementing sex, gender, and diversity analysis policies, highlighting opportunities for improved international collaboration and research excellence (89).

A limitation of this paper relates to the methodology employed. Scoping reviews in health research face several common methodological limitations that must be acknowledged when interpreting findings. Key limitations include a lack of prospective studies, non-representative samples that limit generalizability, and insufficient data on mediators and moderators of relationships between variables (90). The heterogeneous nature of literature in scoping reviews creates challenges in gathering, analysing, and interpreting information, with epistemological considerations significantly influencing methodological decisions (91). The search was restricted to two biomedical databases and did not include allied health or multidisciplinary indexes such as CINAHL, so relevant studies indexed solely in those sources may have been missed. Consistent with the mapping aim of a scoping review, the consistency of effect directions observed across specialties suggests the principal patterns are unlikely to be materially altered by a small number of additional records.

6 Conclusions

This review demonstrates that recent evidence points to persistent sex-based differences in the treatment of patients. Across multiple specialties, the most consistent finding was that females were statistically less likely than males with comparable clinical characteristics to receive invasive or intensive treatments, and when treated conservatively, were less likely to receive guideline compliant therapy. Important gaps in evidence quality exist, with many studies limited by retrospective designs, incomplete adjustment for confounders, and a predominance of US-based data. A gap in research investigating the gender of patients rather than administrative sex was evident. Future research must integrate equity considerations and intersectional analysis into study design, employ rigorous analytical methods, and extend to diverse healthcare systems. Addressing these gaps will be critical to determining whether observed differences represent appropriate clinical variation or systemic inequities, and to ensuring that practice reflects equitable standards of care.

Acknowledgements

None

Author Contributions

MV designed and performed the search. MV and AO reviewed results of search. Both authors contributed to, read and approved the final manuscript.

References

1. Richter KP, Clark L, Wick JA, Cruvinel E, Durham D, Shaw P, et al. Women Physicians and Promotion in Academic Medicine. N Engl J Med. 2020;383(22):2148-57.
2. Arora A, Kaur Y, Dossa F, Nisenbaum R, Little D, Baxter NN. Proportion of Female Speakers at Academic Medical Conferences Across Multiple Specialties and Regions. JAMA Netw Open. 2020;3(9):e2018127.
3. Lim WH, Wong C, Jain SR, Ng CH, Tai CH, Devi MK, et al. The unspoken reality of gender bias in surgery: A qualitative systematic review. PLoS One. 2021;16(2):e0246420.

4. Walton MM. Sexual equality, discrimination and harassment in medicine: it's time to act. Med J Aust. 2015;203(4):167-9.

5. Hoff T, Lee DR. The gender pay gap in medicine: A systematic review. Health Care Manage Rev. 2021;46(3):E37-E49.

6. Mondal B, Dubey JD. Gender discrimination in health-care expenditure: An analysis across the age-groups with special focus on the elderly. Soc Sci Med. 2020;258:113089.

7. Whitgob EE, Blankenburg RL, Bogetz AL. The Discriminatory Patient and Family: Strategies to Address Discrimination Towards Trainees. Acad Med. 2016;91(11 Association of American Medical Colleges Learn Serve Lead: Proceedings of the 55th Annual Research in Medical Education Sessions):S64-S9.

8. McKinley SK, Wang LJ, Gartland RM, Westfal ML, Costantino CL, Schwartz D, et al. "Yes, I'm the Doctor": One Department's Approach to Assessing and Addressing Gender-Based Discrimination in the Modern Medical Training Era. Acad Med. 2019;94(11):1691-8.

9. Active Inclusion: Challenging exclusions in medical education.: Medical Schools Council; 2021.

10. Corporate Strategy 2020-2025. General Medical Council; 2020.

11. Fuentes Artiles R, Gebhard CE, Gebhard C. Integrating gender medicine into modern healthcare: Progress and barriers. Eur J Clin Invest. 2025;55(10):e70089.

12. Risberg G, Johansson EE, Hamberg K. A theoretical model for analysing gender bias in medicine. International Journal for Equity in Health. 2009;8(1):28.

13. Lippi D, Bianucci R, Donell S. Gender medicine: its historical roots. Postgrad Med J. 2020;96(1138):480-6.

14. McClure RC, Macumber CL, Kronk C, Grasso C, Horn RJ, Queen R, Posnack S, Davison K. Gender harmony: improved standards to support affirmative care of gender-marginalized people through inclusive gender and sex representation. J Am Med Inform Assoc. 2022 Jan 12;29(2):354-363. doi: 10.1093/jamia/ocab196. Erratum in: J Am Med Inform Assoc. 2022 Jan 12;29(2):411. doi: 10.1093/jamia/ocab255. PMID: 34613410; PMCID: PMC8757317.

15. Levinson R. Sexism in Medicine. The American Journal of Nursing. 1976;76(3):426-31.

16. Healy B. The Yentl syndrome. N Engl J Med. 1991;325(4):274-6.

17. Machluf Y, Chaiter Y, Tal O. Gender medicine: Lessons from COVID-19 and other medical conditions for designing health policy. World J Clin Cases. 2020 Sep 6;8(17):3645-3668. doi: 10.12998/wjcc.v8.i17.3645. PMID: 32953842; PMCID: PMC7479575.

18. Burgess S, Zaman S, Towns C, Coylewright M, Cader FA. The under-representation of women in cardiovascular clinical trials: State-of-the-art review and ethical considerations. Am Heart J. 2025;282:81-92.

19. Cho L, Vest AR, O'Donoghue ML, Ogunniyi MO, Sarma AA, Denby KJ, et al. Increasing Participation of Women in Cardiovascular Trials: JACC Council Perspectives. J Am Coll Cardiol. 2021;78(7):737-51.

20. Sinha T, Bakht D, Bokhari SFH, Amir M, Fatima R, Bakht K, et al. Gender Matters: A Multidimensional Approach to Optimizing Cardiovascular Health in Women. Cureus. 2024;16(6):e61810.

21. Woitowich NC, Jain S, Arora VM, Joffe H. COVID-19 Threatens Progress Toward Gender Equity Within Academic Medicine. Acad Med. 2021;96(6):813-6.

22. Shannon G, Jansen M, Williams K, Caceres C, Motta A, Odhiambo A, et al. Gender Equality in Science, Medicine, and Global Health: Where Are We At and Why Does It Matter? In: Benatar S, Brock G, editors. Global Health: Ethical Challenges. 2 ed. Cambridge: Cambridge University Press; 2021. p. 76-85.

23. Laster Pirtle WN, Wright T. Structural Gendered Racism Revealed in Pandemic Times: Intersectional Approaches to Understanding Race and Gender Health Inequities in COVID-19. Gender & Society. 2021;35(2):168-79.

24. Crenshaw K. Mapping the Margins: Intersectionality, Identity Politics, and Violence against Women of Color. Stanford Law Review. 1991;43(6):1241-99.

25. The Oxford Handbook of Feminist Theory. Disch L, Hawkesworth M, editors: Oxford University Press; 2016 06 Jan 2015.

26. Roberts JK, Mitra AK, Ogungbe O. A systematic review of implicit bias in health care: A call for intersectionality. IMC Journal of Medical Science. 2019;13(1).

27. Bergey M, Chiri G, Freeman NLB, Mackie TI. Mapping mental health inequalities: The intersecting effects of gender, race, class, and ethnicity on ADHD diagnosis. Sociol Health Illn. 2022;44(3):604-23.

28. Iyer A, Sen G, Ostlin P. The intersections of gender and class in health status and health care. Glob Public Health. 2008;3 Suppl 1:13-24.

29. Allana S, Ski CF, Thompson DR, Clark AM. Intersectionality and heart failure: what clinicians and researchers should know and do. Curr Opin Support Palliat Care. 2021;15(2):141-6.

30. Peters MDJ GC, McInerney P, Munn Z, Tricco AC, Khalil, H. Scoping Reviews. Aromataris E LC, Porritt K, Pilla B, Jordan Z, editor: JBI; 2020.

31. Goossen K, Hess S, Lunny C, Pieper D. Database combinations to retrieve systematic reviews in overviews of reviews: a methodological study. BMC Med Res Methodol. 2020 Jun 1;20(1):138. doi: 10.1186/s12874-020-00983-3. PMID: 32487023; PMCID: PMC7268249.

32. Munn Z, Barker TH, Moola S, Tufanaru C, Stern C, McArthur A, et al. Methodological quality of case series studies: an introduction to the JBI critical appraisal tool. JBI evidence synthesis. 2020;18(10):2127-33.

33. Joanna Briggs Institute. Supporting document for the Joanna Briggs Institute levels of evidence and grades of recommendation. Adelaide: The Joanna Briggs Institute. 2014.

34. Thomas J, Harden A. Methods for the thematic synthesis of qualitative research in systematic reviews. BMC Med Res Methodol. 2008;8:45.

35. Perl L, Peiffer V, Fuhrer AE, D'Ascenzo F, Pietzsch JB. Sex differences in discharge destination following acute myocardial infarction. Coron Artery Dis. 2018;29(6):502-10.

36. Shen X, DiMario S, Philip K. Gender Disparities in Health Resource Utilization in Patients with Atherosclerotic Cardiovascular Disease: A Retrospective Cross-Sectional Study. Adv Ther. 2019;36(12):3424-34.

37. Shpiner DS, Di Luca DG, Cajigas I, Diaz JS, Margolesky J, Moore H, et al. Gender Disparities in Deep Brain Stimulation for Parkinson's Disease. Neuromodulation. 2019;22(4):484-8.

38. Arya S, Melanson TA, George EL, Rothenberg KA, Kurella Tamura M, Patzer RE, et al. Racial and Sex Disparities in Catheter Use and Dialysis Access in the United States Medicare Population. J Am Soc Nephrol. 2020;31(3):625-36.

39. Elsamadicy AA, Freedman IG, Koo AB, David WB, Lee M, Kundishora AJ, et al. Influence of gender on discharge disposition after spinal fusion for adult spine deformity correction. Clin Neurol Neurosurg. 2020;194:105875.

40. Mahtta D, Ahmed ST, Ramsey DJ, Akeroyd JM, Lee MT, Rodriguez F, et al. Statin Prescription Rates, Adherence, and Associated Clinical Outcomes Among Women with PAD and ICVD. Cardiovasc Drugs Ther. 2020;34(6):745-54.

41. Sacks NC, Everson K, Emden MR, Cyr PL, Wood DR, Raza S, et al. Disparities in the Management of Newly Diagnosed Paroxysmal Supraventricular Tachycardia for Women Versus Men in the United States. J Am Heart Assoc. 2020;9(19):e015910.

42. Tandon V, Stringer B, Conner C, Gabriel A, Tripathi B, Balakumaran K, et al. An Observation of Racial and Gender Disparities in Congestive Heart Failure Admissions Using the National Inpatient Sample. Cureus. 2020;12(10):e10914.

43. Darden M, Parker G, Monlezun D, Anderson E, Buell JF. Race and Gender Disparity in the Surgical Management of Hepatocellular Cancer: Analysis of the Surveillance, Epidemiology, and End Results (SEER) Program Registry. World J Surg. 2021;45(8):2538-45.

44. Lu ZK, Xiong X, Wang X, Wu J. Gender Disparities in Anti-dementia Medication Use among Older Adults: Health Equity Considerations and Management of Alzheimer's Disease and Related Dementias. Front Pharmacol. 2021;12:706762.

45. Morris NA, Mazzeffi M, McArdle P, May TL, Burke JF, Bradley SM, et al. Women receive less targeted temperature management than men following out-of-hospital cardiac

arrest due to early care limitations - A study from the CARES Investigators. Resuscitation. 2021;169:97-104.

46. Vajravelu ME, Lee JM, Amaral S, Kelly A. Sex-based differences in screening and recognition of pre-diabetes and type 2 diabetes in pediatric primary care. Pediatr Obes. 2021;16(2):e12699.

47. Ahmed F, Lin J, Ahmed T, Siddiqui D, Nguyen J, Sarpong D. Health Disparities: Statin Prescribing Patterns Among Patients with Diabetes in a Family Medicine Clinic. Health Equity. 2022;6(1):291-7.

48. Liu G, Kong L, Baweja R, Ba D, Saunders EFH. Gender disparity in bipolar disorder diagnosis in the United States: A retrospective analysis of the 2005-2017 MarketScan Commercial Claims database. Bipolar Disord. 2022;24(1):48-58.

49. O'Shaughnessy S, Tangel V, Dzotsi S, Jiang S, White R, Hoyler M. Non-White Race/Ethnicity and Female Sex Are Associated with Increased Allogeneic Red Blood Cell Transfusion in Cardiac Surgery Patients: 2007-2018. J Cardiothorac Vasc Anesth. 2022;36(7):1908-18.

50. Verghese D, Patlolla SH, Cheungpasitporn W, Doshi R, Miller VM, Jentzer JC, et al. Sex disparities in management and outcomes of cardiac arrest complicating acute myocardial infarction in the United States. Resuscitation. 2022;172:92-100.

51. Wimbish LA, Simpson JR, Gilbert LR, Blackwood A, Grant EA. Examining Racial, Ethnic, and Gender Disparities in the Treatment of Pain and Injury Emergencies. HCA Healthc J Med. 2022;3(3):111-8.

52. Breathett K, Yee R, Pool N, Thomas Hebdon MC, Knapp SM, Herrera-Theut K, et al. Group Dynamics and Allocation of Advanced Heart Failure Therapies-Heart Transplants and Ventricular Assist Devices-By Gender, Racial, and Ethnic Group. J Am Heart Assoc. 2023;12(5):e027701.

53. De La Chapa JS, Webb K, Stadlin C, Reddy A, Schoeff SF, Reed R, et al. Evolving Endotracheal Tube Preferences and Practices: Intensivist Knowledge Gaps and Sex Disparities. Laryngoscope. 2023;133(11):3080-6.

54. Roberts MM, Marino M, Wells R, Atem FD, Balasubramanian BA. Differences in Use of Clinical Decision Support Tools and Implementation of Aspirin, Blood Pressure Control, Cholesterol Management, and Smoking Cessation Quality Metrics in Small Practices by Race and Sex. JAMA Netw Open. 2023;6(8):e2326905.

55. Chavez S, Huebinger R, Chan HK, Schulz K, Panczyk M, Villa N, et al. Racial/ethnic and gender disparities of the impact of the COVID-19 pandemic in out-of-hospital cardiac arrest (OHCA) in Texas. Resuscitation. 2022;179:29–35.

56. Davison MA, Lilly DT, Moreno J, Bagley C, Adogwa O. Gender differences in use of prolonged non-operative therapies prior to index ACDF surgery. J Clin Neurosci. 2020;78:228–35.

57. Ilyas S, Stone DH, Kang J, Cooper MA, Columbo JA, Huber TS, et al. Non-guideline-compliant endovascular abdominal aortic aneurysm repair in women is associated with increased mortality and reintervention compared with men. J Vasc Surg. 2022;75(1):118–125.e1.

58. Lee KMN, Rushovich T, Gompers A, Boulicault M, Worthington S, Lockhart JW, et al. A Gender Hypothesis of sex disparities in adverse drug events. Soc Sci Med. 2023;339:116385.

59. Rubin JB, Cullaro G, Ge J, Lai JC. Women who undergo liver transplant have longer length of stay post-transplant compared with men. Liver Int. 2020;40(7):1725–35.

60. Bolinger C, Dembowski J, Mory K. Pneumonia: Does Age or Gender Relate to the Presence of an SLP Dysphagia Consultation? Geriatrics (Basel). 2020;5(3).

61. Jackson AM, Zhang R, Findlay I, Robertson K, Lindsay M, Morris T, et al. Healthcare disparities for women hospitalized with myocardial infarction and angina. Eur Heart J Qual Care Clin Outcomes. 2020;6(2):156-65.

62. ~~Wellesley~~ Wesley E, Patel I, Kadra-Scalzo G, Pritchard M, Shetty H, Broadbent M, et al. Gender disparities in clozapine prescription in a cohort of treatment-resistant schizophrenia in the South London and Maudsley case register. Schizophr Res. 2021;232:68-76.

63. Rucker D, Warkentin LM, Huynh H, Khadaroo RG. Sex differences in the treatment and outcome of emergency general surgery. PLoS One [Internet]. 2019;14(11):e0224278.

64. Liu P, Yang Y, Cheng J. Gender differences in medical errors among older patients and inequalities in medical compensation compared with younger adults. Front Public Health. 2022;10:883822.

65. Peters F, Kreutzburg T, Rieß HC, Heidemann F, Marschall U, L'Hoest H, et al. Editor's Choice - Optimal Pharmacological Treatment of Symptomatic Peripheral Arterial Occlusive Disease and Evidence of Female Patient Disadvantage: An Analysis of Health Insurance Claims Data. Eur J Vasc Endovasc Surg. 2020;60(3):421-9.

66. Stodolski M, Zirngibl H, Ambe PC. Gender discrimination in endoscopic groin hernia repair. Minimal invasive groin hernia repair is offered less often to female patients compared to male patients. J Visc Surg. 2020;157(4):271-6.

67. Araujo C, Pereira M, Laszczynska O, Dias P, Azevedo A. Sex-related inequalities in management of patients with acute coronary syndrome-results from the EURHOBOP study. Int J Clin Pract. 2018;72(1).

68. Bak JCG, Serné EH, de Valk HW, Valk NK, Kramer MHH, Nieuwdorp M, et al. Gender gaps in type 1 diabetes care. Acta Diabetol. 2023;60(3):425-34.

69. Ihle-Hansen H, Sandset EC~~, Ihle-Hansen H~~, Hagberg G, Thommessen B, Rønning OM, et al. Sex differences in the Norwegian Tenecteplase Trial (NOR-TEST). Eur J Neurol. 2022;29(2):609-14.

70. Lytsy P, Hallqvist J, Alexanderson K, Ahs A. Gender differences in healthcare management of depression: aspects of sick leave and treatment with psychoactive drugs in a Swedish setting. Nord J Psychiatry [Internet]. 2019;73(7):441–50.

71. Sederholm Lawesson S, Isaksson RM, Ericsson M, Ängerud K, Thylén I. Gender disparities in first medical contact and delay in ST-elevation myocardial infarction: a prospective multicentre Swedish survey study. BMJ Open. 2018;8(5):e020211.

72. Găman MA, Cozma MA, Dobrică EC, Bacalbașa N, Bratu OG, Diaconu CC. Dyslipidemia: A Trigger for Coronary Heart Disease in Romanian Patients with Diabetes. Metabolites. 2020;10(5).

73. Mondschein S, Quinteros M, Yankovic N. Gender bias in the Chilean public health system: Do we all wait the same? PLoS One [Internet]. 2020;15(9):e0239445.

74. Podell R, Kaufman-Shriqui V, Sagy YW, Manor O, Ben-Yehuda A. The quality of primary care provided to the elderly in Israel. Isr J Health Policy Res. 2018;7(1):21.

75. Listabarth S, König D, Berlakovich G, Munda P, Ferenci P, Kollmann D, et al. Sex Disparities in Outcome of Patients with Alcohol-Related Liver Cirrhosis within the Eurotransplant Network-A Competing Risk Analysis. J Clin Med. 2022;11(13).

76. Grinberg K, Sela Y. A Literature Review on Pain Management in Women During Medical Procedures: Gaps, Challenges, and Recommendations. Medicina (Kaunas). 2025;61(8).

77. Shaw LJ, Pepine CJ, Xie J, Mehta PK, Morris AA, Dickert NW, et al. Quality and Equitable Health Care Gaps for Women: Attributions to Sex Differences in Cardiovascular Medicine. J Am Coll Cardiol. 2017;70(3):373-88.

78. Viamonte Ros AM, Markham SM, Wu D, Nicholas PK. A Rapid Scoping Review of Gender Inequities in the Medical Profession. Nursing & Health Sciences Research Journal. 2019;2(1):12-20.

79. Parsons Leigh J, de Grood C, Ahmed S, Bosma K, Burns KEA, Fowler R, et al. Improving gender equity in critical care medicine: a protocol to establish priorities and strategies for implementation. BMJ Open. 2020;10(6):e037090..

80. Nadarajah R, Farooq M, Raveendra K, Nakao YM, Nakao K, Wilkinson C, et al. Inequalities in care delivery and outcomes for myocardial infarction, heart failure, atrial fibrillation, and aortic stenosis in the United Kingdom. Lancet Reg Health Eur. 2023;33:100719.

81. van Doorslaer E, Wagstaff A, van der Burg H, Christiansen T, De Graeve D, Duchesne I, et al. Equity in the delivery of health care in Europe and the US. J Health Econ.

2000;19(5):553-83.

82. Ruiz MT, Verbrugge LM. A two way view of gender bias in medicine. J Epidemiol Community Health. 1997;51(2):106-9.

83. Goddard M, Smith P. Equity of access to health care services: theory and evidence from the UK. Soc Sci Med. 2001;53(9):1149-62.

84. Raine R. Does Gender Bias Exist in the Use of Specialist Health Care? Journal of Health Services Research & Policy. 2000;5(4):237-49.

85. Elderkin-Thompson V, Waitzkin H. Differences in clinical communication by gender. Journal of General Internal Medicine. 1999;14(2):112-21.

86. Temkin SM, Clayton JA. Inclusion of Sex and Gender to Improve the State of the Science in Women's Health. J Bone Joint Surg Am. 2024;106(15):1423-8.

87. White J, Tannenbaum C, Klinge I, Schiebinger L, Clayton J. The Integration of Sex and Gender Considerations Into Biomedical Research: Lessons From International Funding Agencies. J Clin Endocrinol Metab. 2021;106(10):3034-48.

88. Johnson J, Sharman Z, Vissandjee B, Stewart DE. Does a change in health research funding policy related to the integration of sex and gender have an impact? PLoS One. 2014;9(6):e99900.

89. Hunt L, Nielsen MW, Schiebinger L. A framework for sex, gender, and diversity analysis in research. Science. 2022;377(6614):1492-5.

90. Kane JC, Elafros MA, Murray SM, Mitchell EMH, Augustinavicius JL, Causevic S, et al. A scoping review of health-related stigma outcomes for high-burden diseases in low- and middle-income countries. BMC Med. 2019;17(1):17.

91. Thomas A, Lubarsky S, Varpio L, Durning SJ, Young ME. Scoping reviews in health professions education: challenges, considerations and lessons learned about epistemology and methodology. Adv Health Sci Educ Theory Pract. 2020;25(4):989-1002

Statements and Declarations

Ethical Considerations

Not applicable

Consent to participate

Not applicable

Consent for publication

Not applicable

Declaration of conflicting interests

The authors declare that they have no conflicting interests

Funding

No financial declarations

Availability of data and materials

Not applicable

Appendix 1

PubMed Search term 01/01/2018 ~~-~~– 19/12/2023~~4~~

(sexism [tiab] OR "gender bias" [tiab] OR "sex bias" [tiab] OR "gender roles" [tiab] OR "gender

inequality" [tiab] OR "sex inequality" [tiab] OR "sex factors" [tiab] OR "gender factors" [tiab] "gender equity" [tiab] OR "sex equity" [tiab] OR "gender disparities" [tiab] OR "sex disparities"

[tiab] OR "gender discordance" [tiab] OR "sex discordance"[tiab]) AND ("healthcare" [tiab] OR "medicine" [tiab])

Embase Search term 01/01/2018 – 19/12/2023

('sexism':ti,ab OR 'gender bias':ti,ab OR 'sex bias':ti,ab OR 'gender roles':ti,ab OR 'gender inequality':ti,ab OR 'sex inequality':ti,ab OR 'sex factors':ti,ab OR 'gender factors':ti,ab OR 'gender equity':ti,ab OR 'sex equity':ti,ab OR 'gender disparities':ti,ab OR 'sex disparities':ti,ab OR 'gender discordance':ti,ab OR 'sex discordance':ti,ab) AND ('healthcare':ti,ab OR 'medicine':ti,ab)

Dear Reviewer and Editor,

We again thank the reviewer and editor for their time and effort invested into this submission. Below, we outline the reviewer's most recent comments and (in red) indicate our adjustments made to the paper.

- Tables 1 and 2 should be removed. The contents of these tables could be moved to the main text.

We have removed Tables 1 and 2, and moved the contents to the main text as suggested.

- Table 3 and Figure 1 should be combined into a standard PRISMA flowchart. A standard flowchart would also need the exact number of records retrieved from each database.

We have combined Table 3 (now removed) and Figure 1 into a standard PRISMA flowchart. We have also included the number of records retrieved from each database.

- Tables 4, 5, and 6 need to be revised. For example, in Table 4, different procedures within the same study should be presented in separate rows.

- Please apply the same format to Tables 5 and 6.

Tables 4, 5, and 6 (now Tables 1 to 3) have been reformatted as suggested, with separate rows for different procedures within the same study. We have also added years of publication to all references in these tables.

- Also, move the table legends to the top of each table.

We have moved the table captions/legends to the top of each table.

- Please provide the Embase search strategy.

We have provided the Embase search strategy in the appendix.

- Please provide the exact start and end dates of the literature search (e.g., 01/01/2018–31/12/2024).

We have provided the exact start and end dates of the literature search in the Appendix.

Kind regards,

Andrew O'Malley and Miriam Veenhuizen