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Meta-Analysis

Market Failures in Women's Health: Systemic Undervaluation and Paths to Reform

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ABSTRACT

Background: Despite medical advances, persistent disparities in women's health remain under-addressed across healthcare systems, research priorities, and innovation pathways. This paper argues that many of these gaps reflect market failures–instances where economic systems fail to allocate resources fairly or efficiently. **Methods:** A narrative literature review was conducted using structured searches across major databases and reference lists. Seventeen empirical studies published between 2003 and 2025 were included based on relevance to gender-specific health disparities and structural or economic explanations. **Results:** This review identifies major drivers of underinvestment in women's health: information asymmetries, the public good nature of foundational research, stigma that distorts demand signals, and biased investment patterns in venture capital and insurance markets. Across the included articles, we analyzed how these failures manifest in clinical settings, such as the underdiagnosis of conditions like chronic pelvic pain and insomnia, and the neglect of high-burden issues such as endometriosis, fibromyalgia, and menopause related disorders. Furthermore, we found that structural factors —such as gender bias in medical training, exclusion from clinical trials, and lack of women in leadership—compound market dysfunction. **Conclusion:** The market failure framework was adopted to discuss the findings across studies, but it has limitations. Some health needs lack profit incentives or do not fit easily into economic models. Issues rooted in stigma, sexism, or cultural silence often require solutions beyond market reform. As such, this article proposes recommendations that combine economic and policy responses. By identifying how systemic neglect in women's health stems from identifiable economic failures, this paper offers a novel lens for shaping health policy and resource allocation to advance gender equity.

Keywords: Women's Health; Market Failure; Underdiagnosis; Gender Bias; Public Health Policy; Structural Inequities; Health Disparities

INTRODUCTION

Despite significant advances in biomedical science and healthcare delivery, women's health remains chronically under-researched, underfunded, and underserved (1, 2). Conditions that predominantly or uniquely affect women, such as endometriosis, fibromyalgia, menopause-

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related symptoms, and postpartum disorders, continue to receive delayed diagnoses, limited treatment options, and inadequate public or private investment (3–5). These gaps persist even though women constitute over half the population and are primary decision-makers in family healthcare (6). The mismatch between the scale of these needs and the lack of response from health systems, markets, and research institutions points to deeper systemic issues (7, 8).

Many of these persistent disparities can be understood through the lens of market failure–a condition in which economic systems fail to allocate resources efficiently or equitably (9). In women's health, such failures emerge through information asymmetries, demand misperception, stigma, and underinvestment, even in the face of social need and economic cost (10). By adopting this framework, policymakers and stakeholders can apply tools from public economics, regulation, and innovation policy to correct these inefficiencies and promote equitable solutions.

Framing women's health as a public interest issue rather than a niche consumer mark*et al*lows for a more proactive and coordinated response. Conditions such as chronic pelvic pain or menopause-related sleep disturbances impose spillover costs like lost productivity, caregiver burden, and social exclusion which markets alone are unlikely to address without intervention public health agencies, policymakers, and insurers (11, 12). Moreover, structural inefficiencies such as exclusion from clinical trials, limited insurance coverage, and gender bias in venture capital further entrench inequality (13, 14).

Yet the market failure perspective has its limits. Many women's health needs lack profit potential or cannot be captured by conventional economic models. Structural sexism, entrenched taboos, and institutional inertia play equally powerful roles in maintaining neglect (15, 16). Biases in medical education, regulatory blind spots, and the underrepresentation of women in biomedical leadership reinforce patterns that market-based solutions alone cannot fix (17).

This paper adopts a literature review approach, drawing on interdisciplinary sources to analyze how women's health has been historically marginalized. Through synthesizing findings across studies in economics, public health, and medical sociology, it examines how systemic undervaluation emerges from both market inefficiencies and structural bias. Focusing on conditions such as chronic pain, menstrual disorders, menopause, and migraine care, the review identifies recurring patterns of underdiagnosis, underfunding, and exclusion.

METHODS AND MATERIALS

This study is a narrative literature review that synthesizes findings from peer-reviewed papers on gender disparities in healthcare, economic barriers to women's health innovation, and the structural determinants of underinvestment in female-focused health services. The aim was to examine the utility of the market failure framework in understanding persistent neglect in women's health.

Search Strategy and Sources

Relevant literature was identified using databases including Google Scholar, PubMed, and WHO Global Index Medicus. In addition, reference lists from key articles were manually reviewed to identify further relevant studies. Keyword combinations included "market failure", "women's health", "health equity". "investment gaps", "gender bias in medicine", "chronic pain", "underdiagnosis", "public goods", and "healthcare innovation." These terms were chosen to encompass economic, sociological, and biomedical perspectives relevant to the paper's core arguments about inefficiencies and inequities in the healthcare system.

Inclusion and Exclusion Criteria

To be included, studies had to meet the following criteria: (i) peer-reviewed article published in English between 2003 and 2025, (ii) empirical studies involving human participants, (iii) examined gender-specific health outcomes, healthcare access, or investment patterns, and (iv) addressed economic or structural explanations for disparities. Studies were excluded if they focused solely on biomedical treatments without economic or structural analysis, lacked sex-specific data, or were theoretical papers without empirical support.

Selection and Screening Process

A total of 440 records were identified through database searches, including 211 from Google Scholar, 171 from PubMed, and 47 from WHO Global Index Medicus. An additional 11 records were identified through reference chaining of relevant studies. After removing 117 duplicates, 323 unique records remained for screening. Titles and abstracts were reviewed to assess relevance based on the inclusion criteria, and 94 full-text articles were selected for detailed evaluation. Of these, 77 articles were excluded: 17 were not empirical (such as reviews or commentaries), 21 lacked gender-specific analysis, 15 focused exclusively on disease prevalence without addressing policy or economic implications, 14 did not discuss healthcare access or innovation, and 10 were found to be overlapping or redundant. Ultimately, 17 empirical studies m*et al*l inclusion criteria and were included in the final narrative synthesis. These studies represented a mix of observational, experimental, and policy evaluation research and covered a range of age groups, countries, and populations. Table 1 provides an overview of study characteristics, including sample size, methodology, region, and key findings, while a PRISMA-style flow diagram (Figure 1) illustrates the selection process.

RESULTS

Despite decades of progress in public health and medicine, women's health remains chronically underserved across multiple domains. The consequences are not only clinical but also economic and social. This section presents evidence of how gender-based disparities manifest in diagnosis, treatment, innovation, and investment. It draws from case studies and empirical data to illustrate the systematic neglect of women's health issues, particularly in conditions that are underfunded, stigmatized, or considered less profitable. These results

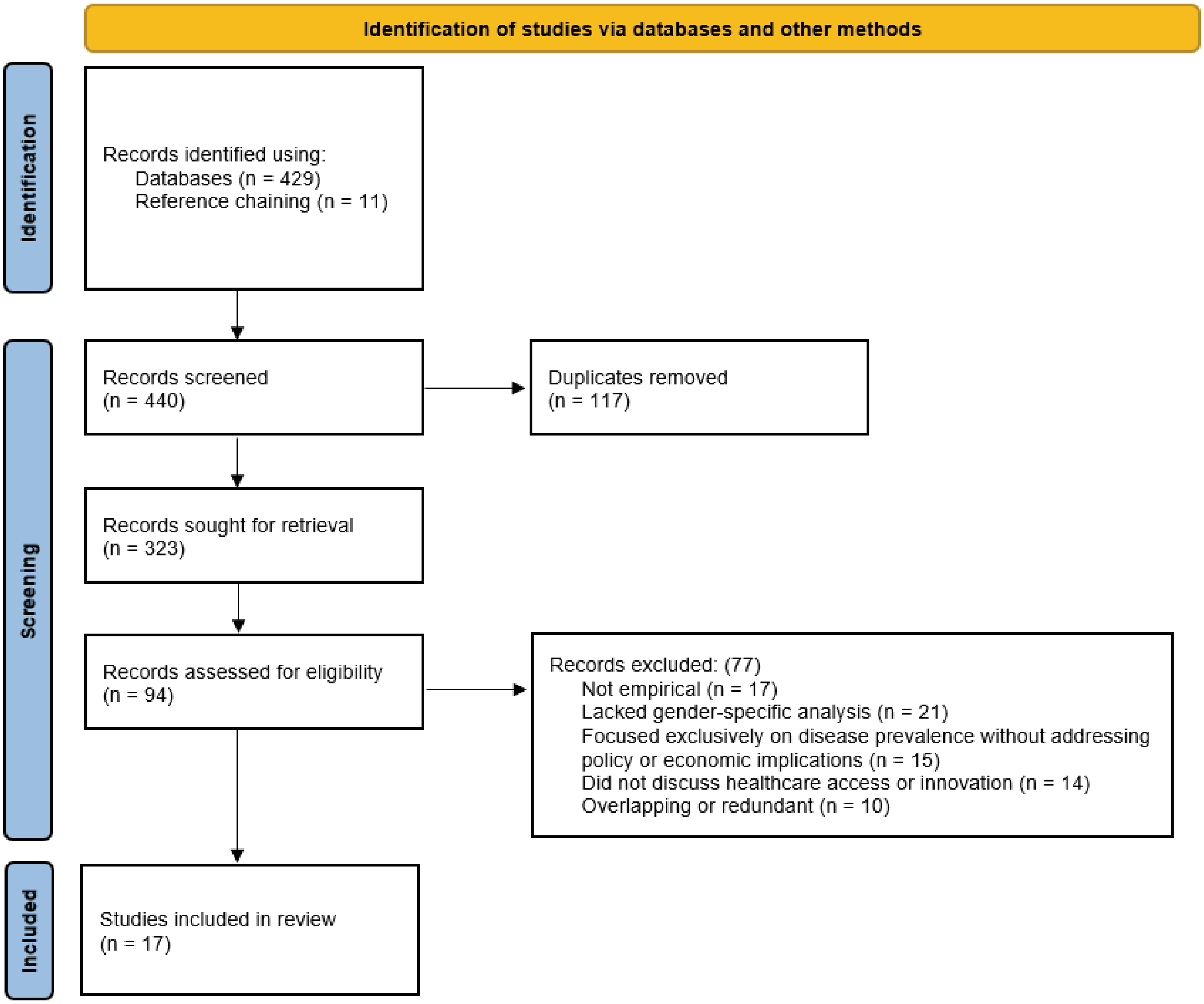

Figure 1. PRISMA-style flow diagram of study selection for empirical literature on failures in addressing women's health needs.

Table 1. Characteristics of included studies

References	Objective	Study Design	Sample Characteristics	Measure of Key Variables	Key Findings
3	To assess the diagnostic delay in women with surgically confirmed endometriosis.	Retrospective survey combined with chart review.	173 women with histologically confirmed endometriosis.	Time interval between onset of symptoms and final diagnosis.	The average delay from first symptoms to diagnosis was approximately 9 years, indicating a substantial gap in timely identification and treatment of endometriosis.
4	To estimate the prevalence and economic burden of endometriosis, including direct medical costs and work productivity losses, in a cohort of U9.S. women.	Retrospective observational analysis using health insurance claims linked with patient-reported survey data.	Approximately 10,000 women with a confirmed endometriosis diagnosis drawn from a large, insured U.S. population.	Prevalence of endometriosis based on claims data; Direct medical costs; Indirect costs, specifically work loss (absenteeism and short-term disability) reported via surveys	Endometriosis was associated with a substantial economic burden, averaging US-$9,000 per patient per year in combined direct and indirect costs. Women with the disease exhibited significantly more work loss and productivity impairment compared to those without endometriosis. The results highlight the high prevalence of endometriosis and underscore its significant financial and societal impact.
7	To evaluate compliance with NIH policies regarding the inclusion and assessment of women and minorities in randomized controlled trials (RCTs).	Cross-sectional analysis	NIH-funded RCTs published in 14 leading U.S. medical journals in 2005, 2009, and 2015, focusing on federally funded studies.	Inclusion rates of women and minorities; whether data were analyzed and reported by sex and race/ethnicity.	Most RCTs included women, but few analyzed or reported outcomes by sex. Reporting on minority inclusion and subgroup analysis remained limited, showing little improvement since prior evaluations.
11	To assess the health-related quality of life (HRQOL) of Canadian women aged 18–49 who self-reported a diagnosis of endometriosis.	Cross-sectional online survey conducted from December 2018 to January 2019.	A total of 2,004 women with self-reported endometriosis and 26,528 women without, aged 18–49 years.	HRQOL measured using SF12 (Mental and Physical Component Summary scores); Endometriosis-specific impact via EHP30 scores; Severity of hallmark symptoms: menstrual/nonmenstrual pelvic pain and dyspareunia	The study found that Canadian women with endometriosis experienced significantly lower health-related quality of life compared to women without the condition, with SF-12 physical and mental scores notably lower (47.3 vs. 52.1 and 38.6 vs. 41.2, respectively; $P < 0.001$). These disparities were more pronounced among women reporting severe symptoms, highlighting a substantial quality-of-life burden that remains underrecognized and undertreated in women's health.

Continued Table 1. Characteristics of included studies

References	Objective	Study Design	Sample Characteristics	Measure of Key Variables	Key Findings
13	To systematically evaluate women's participation in cardiovascular clinical trials conducted between 2010 and 2017, comparing female enrollment with disease prevalence.	Empirical, cross-sectional analysis of trials registered on ClinicalTrials.gov.	Included 740 completed cardiovascular trials from 2010–2017, encompassing 862,652 adult participants	Proportion of women enrolled in each trial; female-to-male ratio; participation prevalence ratio; trial characteristics including age group, intervention type, disease category, sponsor type, geographic region, and trial size.	Women made up only 38.2% of participants overall, with particularly low representation in trials for acute coronary syndrome and heart failure. Participation varied by age, intervention type, and disease category, revealing persistent underrepresentation despite some recent improvements in specific conditions like stroke.
20	To examine sex differences in the treatment of pain in emergency departments, focusing on waiting times to analgesia and types of medications administered.	Retrospective cohort analysis of ED patient records.	About 21,851 adult patients presenting with pain complaints and included 109 nurses who evaluated simulated clinical cases.	The researchers measured analgesic prescription rates (opioid vs non-opioid), ED wait times, documentation of pain scores, and nurse-rated pain intensity in identical clinical scenarios.	Female patients were less likely than males to receive pain medication and waited longer for treatment. Nurses also underestimated women's pain in controlled clinical vignettes, suggesting implicit gender bias.
25	To identify multifactorial contributors to chronic pelvic pain severity in women.	Cross-sectional analysis within a cohort at a tertiary chronic pelvic pain center.	656 women (mean age ~34.5 years; 55 % with endometriosis)	Self-reported pain severity (0–10); associated factors including musculoskeletal tenderness, psychological scales, medical history	Severity independently associated with abdominal wall pain, pelvic floor tenderness, painful bladder, high pain catastrophizing, sexual assault history, elevated BMI, smoking, and family pain history.
28	To evaluate the utility of menstrual-tracking app data (specifically from Phendo) in capturing and analyzing symptoms related to menstrual health, such as pain, bleeding, and fertility indicators.	Observational, app-based cohort study using real-world digital health data.	More than 10,000 users of the Phendo app, primarily self-identified women, contributing longitudinal self-tracked data across a range of menstrual cycles.	Self-tracked menstrual pain (location, severity); Bleeding patterns (duration, flow); Fertility-related symptoms (e.g., cervical mucus, basal body temperature); App usage metrics (frequency, consistency)	The study demonstrated that app-based data can effectively capture real-time, individualized experiences of menstrual health. It revealed significant variation in symptoms across individuals and cycle phases, supporting the potential of digital phenotyping for large-scale, low-burden menstrual health research.

Continued Table 1. Characteristics of included studies

References	Objective	Study Design	Sample Characteristics	Measure of Key Variables	Key Findings
30	To determine prevalence of self-injurious thoughts and behaviors (STBs) in individuals with prospectively confirmed PMDD	Cross-sectional global survey of individuals with DSM-5 PMDD, recruited via support networks	2,689 respondents; 599 (23 %) met criteria for PMDD	Lifetime prevalence of suicidal ideation, planning, intent, attempts, and non-suicidal self-injury.	Among the PMDD cohort, 72 % reported lifetime suicidal ideation, 49 % had plans, 42 % reported intent, 34 % had attempted suicide, and 51 % reported non-suicidal self-injury; 70 % had at least one comorbid psychiatric diagnosis.
36	To compare the prevalence of professionally diagnosed comorbid conditions in U.S. adults with versus without migraine and to assess how headache pain intensity and monthly headache day (MHD) frequency are associated with comorbidities within the migraine cohort	Prospective, web-based cross-sectional survey (the MAST study) including both migraine and non-migraine control groups	15,133 adults meeting modified ICHD-3 beta criteria for migraine (≥ 1 MHD in past 3 months) and 77,453 non-migraine controls (total N = 92,586); 73% of the migraine group were women, mean age ~43 years; controls were mean age ~52, 46% women	Self-reported, healthcare-diagnosed comorbidities from a list of 21 conditions; headache pain intensity rated on a 0–10 scale; MHD frequency categorized into 1–4, 5–9, 10–14, 15–20, and ≥21 days	The study found that women comprised 73% of the migraine cohort and had significantly higher odds of reporting comorbidities such as depression (OR 3.18), anxiety (OR 3.18), and insomnia (OR 3.79) compared to non-migraine controls. These disparities underscore the disproportionate burden of migraine and related conditions in women, highlighting the need for more integrated and gender-sensitive healthcare ap6proaches.
40	To quantify diagnostic delays and identify contributing factors for superficial and deep infiltrating endometriosis among women in the United Kingdom.	Cross-sectional observational study using patient questionnaires and retrospective chart reviews.	101 women with laparoscopically confirmed endometriosis recruited from a UK pelvic pain clinic.	Time from symptom onset to diagnosis; presence of deep lesions; clinician responses to pain complaints.	The median diagnostic delay was 8 years, with longer delays associated with adolescent symptom onset, deep lesions, and clinician dismissal of symptoms. The study highlights how structural and clinical factors contribute to prolonged diagnostic timelines for endometriosis.
42	To assess gender disparity in administering analgesia for acute abdominal pain in the ED.	Cohort study of consecutive nonpregnant adults with acute abdominal pain	981 patients (mean age 41 ± 17 years; 65 % female)	Receipt of any analgesia and opioid analgesia; time to treatment initiation	Women were 7 % less likely to re8ceive any analgesia (60 % vs 67.9%), 11 % less likely to receive opioids, and waited a median of 16 minutes longer than men (65 vs 49 min), after adjusting for confounders

Continued Table 1. Characteristics of included studies

References	Objective	Study Design	Sample Characteristics	Measure of Key Variables	Key Findings
44	To update and assess gender disparities in clinical trial participation by analyzing enrollment percentages by sex.	Empirical analysis—examining clinical trial registration and results data.	More than 20,000 trials registered at ClinicalTrials.gov, encompassing approx. 5.11 million participants.	Percentage of female vs. male enrollees in each trial; Trends in sex-based enrollment over time	The analysis found persistent underrepresentation of women in Eve quantified through enrollment ratios that lag behind female disease burden.
45	To investigate the relationship between sleep disturbances and hormonal changes in midlife women.	Prospective cohort study as part of the Study of Women's Health Across the Nation (SWAN).	Approximately 1,982 women, aged 45–55 at baseline.	Sleep quality assessed via standardized sleep questionnaires; Serum hormone levels (e.g., estrogen, follicle-stimulating hormone)	Declines in estrogen levels during the menopausal transition were significantly associated with increased insomnia and poorer sleep quality. This suggests that hormonal changes contribute to sleep disturbances commonly experienced by midlife women.
46	To estimate the total duration of vasomotor symptoms (VMS) during the menopausal transition and identify factors associated with longer symptom duration.	Longitudinal cohort study (SWAN)	~3,300 women aged 45-55 with frequent VMS, diverse racial/ethnic backgrounds, followed over a median of 13 years.	Frequency and duration of VMS (hot flashes and night sweats); menopausal stage; sociodemographic and psychosocial factors.	75%+ had symptoms; 33% had severe symptoms >7 years. Median duration of frequent VMS was 7.4 years. Women who experienced VMS earlier in the menopausal transition had symptoms for longer.
51	To quantify gender disparities in digital health venture capital investment, specifically the share of deals and funding dollars directed toward female-focused health solutions.	Retrospective deal-level analysis using VC investment data.	Digital health VC deals from 2015 to 2021, sourced from commercial databases tracking startup funding.	Number of deals targeting female-focused digital health solutions; Total VC dollars invested in those deals versus all digital health deals	Fewer than 2% of VC investments in digital health went to female-focused startups during the study period. These ventures received a disproportionately small share of total deal volume and funding, underscoring significant underinvestment in women's health innovation.
62	To determine the prevalence and burden of migraine in the U.S. adult population.	Cross-sectional national survey (American Migraine Prevalence and Prevention—AMPP).	Approximately 17,000 adults who met criteria for migraine from a larger stratified random sample of U.S. households.	Migraine prevalence; frequency of headache days; migraine disability assessed via MIDAS (Migraine Disability Assessment) scores.	About 18% of U.S. women experienced migraine, with significant disability—many reporting multiple headache days per month. The study documented a substantial gender disparity, with women bearing a disproportionate burden of migraine in terms of both prevalence and impact on daily functioning.

highlight how underdiagnosis and undertreatment persist due to structural bias, limited data, market inefficiencies, and outdated medical paradigms.

Underdiagnosis and Undertreatment of Women's Issues

Despite advances in modern medicine, numerous health conditions that disproportionately affect women, such as menstrual disorders, reproductive health issues, menopause related symptoms, autoimmune diseases, and bone health concerns, continue to receive comparatively less clinical attention and research funding. Studies consistently document disparities in diagnostic rates, treatment effectiveness, and resource allocation for these conditions. These patterns appear across multiple areas of care and are associated with limitations in medical education, gaps in clinical research, and the continued reliance on models of care that are primarily developed around male physiology (18).

Research across a wide range of conditions indicates that women are more likely than men to experience delays in diagnosis, have their symptoms minimized or overlooked, and receive treatments that do not fully account for biological and hormonal differences. These trends have been documented in multiple clinical areas and suggest systemic inconsistencies in how care is delivered across genders (1, 2). Documented disparities in the areas of pain and sleep highlight consistent gender-based differences in diagnosis, treatment, and clinical outcomes.

In the case of pain, studies show that women report more frequent, longer lasting, and more intense pain than men, particularly in conditions such as fibromyalgia, migraine, temporomandibular disorders, and irritable bowel syndrome (19). Despite these reports, their symptoms are more likely to be described as emotional or overstated, whereas men's pain is more often addressed as physical and in need of urgent attention. This disparity is reflected in patterns of misdiagnosis, delayed care, and undertreatment (20). This disparity is reflected in patterns of misdiagnosis, delayed care, and undertreatment. For example, women presenting with chest pain are more frequently diagnosed with psychological conditions and are less likely to undergo cardiac testing compared to men with similar symptoms (21).

Patterns observed in sleep health reflect similar gender-based differences. Women are more likely to experience insomnia, restless leg syndrome, and disrupted sleep during key life stages such as menstruation, pregnancy, and menopause (22). However, much of the existing research has concentrated on male subjects and has often overlooked the roles of hormonal variation and caregiving responsibilities. As a result, many women receive treatments that are generalized rather than tailored, which may limit their effectiveness for addressing specific biological and social factors (23).

The patterns observed in pain and sleep research reflect a broader trend of underdiagnosis and undertreatment that extends across many areas of women's health. These patterns are associated with measurable impacts, including reduced productivity, increased emotional strain, and lower quality of life for large populations of women (24). They are also linked to persistent gender-based disparities in long term health outcomes and levels of trust in the health care system.

One contributing factor frequently identified in the literature is the historical exclusion of women from clinical trials and biomedical research. Until the 1990s, many studies either omitted women entirely or did not report results by sex, often assuming that findings from male participants were universally applicable (2). While more recent policies have promoted greater inclusion, important gaps remain. Sex specific data continue to be limited, and many health conditions that primarily affect women receive comparatively less research funding and attention (13).

In addition, many health technologies, including diagnostic tools, digital platforms, and therapeutic protocols, have been developed using generalized models of disease and care. These models may overlook biological differences, caregiving responsibilities, and social stigma, potentially reducing the effectiveness and accessibility of interventions for women.

Case Studies: Conditions Often Ignored

Persistent gaps have been documented in the diagnosis, treatment, and funding of several health conditions that disproportionately affect women. These gaps are rooted in historical trends in medical research and appear to be influenced by structural limitations in current health care and innovation systems. The following case studies present specific conditions that remain insufficiently addressed in clinical practice and research, alongside examples of how emerging technologies may contribute to improved care delivery.

Chronic Pelvic Pain (CPP). Chronic pelvic pain is defined as noncyclic pain in the pelvic region lasting for more than six months, and it affects approximately 15% of women of reproductive age (25). Despite its high prevalence, CPP is frequently undiagnosed or misdiagnosed, in part due to its complex and multifactorial etiology, which may include conditions such as endometriosis, interstitial cystitis, pelvic inflammatory disease, and irritable bowel syndrome.

A key challenge in clinical management is the limited availability of diagnostic tools and the absence of standardized care pathways. Women with chronic pelvic pain often experience multiple referrals and invasive procedures, and their symptoms are at times attributed to psychological causes (26). Coordination of interdisciplinary care is limited in traditional fee-for-service models, and pharmaceutical development has shown minimal engagement with chronic pelvic pain, partly due to its heterogeneous presentation and the perceived challenges in developing targeted therapies (27).

Emerging technologies, including digital pain diaries, artificial intelligence assisted ultrasound imaging, and wearable biosensors, are beginning to provide more detailed and individualized insights into pain patterns. For example, *Phendo*, a mobile application developed for tracking symptoms related to endometriosis, enables patients to contribute real time data that can support both personal management and research efforts (28). While these technologies demonstrate potential to improve care, their broader implementation is currently constrained by limited investment, lack of insurance coverage, and variable clinician adoption.

Menstrual Disorders. Menstrual disorders, including heavy menstrual bleeding (HMB), amenorrhea, dysmenorrhea, and premenstrual dysphoric disorder (PMDD), affect millions of women globally. Despite their prevalence, many individuals experience these conditions without receiving adequate medical evaluation or treatment. HMB affects up to 30% of women of reproductive age and is associated with anemia, fatigue, and reduced quality of life (29). PMDD, a severe form of premenstrual syndrome (PMS), impacts an estimated 3 to 8% of menstruating women and is frequently misdiagnosed as depression or anxiety (30).

Documented gaps in care include limited innovation in menstrual health products, lack of inclusion of menstrual disorders in national health guidelines, and continued underrepresentation of women in clinical trials. Menstrual health remains stigmatized in many societies, which may contribute to reduced demand visibility and lower levels of commercial investment.

Recent advances such as app based menstrual tracking (e.g., Clue and Flo) and at home hormone level monitoring are enabling users to better understand their hormonal cycles and detect abnormalities earlier. However, concerns regarding algorithmic bias and data privacy continue to present challenges for equitable and effective use of these tools (31).

Sleep Disturbances in Perimenopause. Women transitioning through perimenopause frequently report sleep disturbances, including insomnia, frequent night awakenings, and non-restorative sleep. These symptoms are associated with fluctuations in estrogen and progesterone levels, which influence thermoregulation and circadian rhythm (32). Estimates indicate that more than 40% of perimenopausal women experience sleep related issues, yet these symptoms are often not addressed proactively by healthcare providers (32).

Pharmaceutical treatments such as hormone replacement therapy (HRT) are not always appropriate due to individual health risks or personal preferences. In addition, standard sleep medications are commonly evaluated in predominantly male populations, resulting in off label use in women without sufficient sex specific efficacy data (33).

Emerging technologies are beginning to provide alternative approaches to managing these sleep challenges. Wearable devices such as Oura and Fitbit, which monitor sleep architecture, are increasingly incorporated into menopause related research and personalized care strategies. Digital cognitive behavioral therapy for insomnia (CBT-I), delivered through platforms such as *Sleepio*, has also shown potential in addressing sleep concerns without pharmacological side effects (34). While these tools offer new possibilities for patient engagement and symptom management, their accessibility remains limited for individuals in low income or digitally underserved settings.

Fibromyalgia. Fibromyalgia is a chronic condition characterized by widespread musculoskeletal pain, fatigue, and cognitive dysfunction. It is up to nine times more prevalent in women than in men (35). Migraines show a similar sex difference, affecting approximately 18% of women compared to 6% of men (36). These conditions are frequently comorbid and share underlying mechanisms involving central sensitization and hormonal modulation.

Historically, both disorders have often been characterized as psychosomatic, which has contributed to delays in diagnosis and inconsistent treatment. Fibromyalgia was not formally recognized by the American Medical Association until the 1980s, and many clinicians continue to report low confidence in managing the condition, citing limited training and unclear treatment guidelines (5).

The pharmaceutical industry has developed only a small number of FDA approved medications for fibromyalgia, such as pregabalin and duloxetine, which provide partial relief and are associated with side effects. In contrast, migraine treatment has advanced with the development of calcitonin gene related peptide (CGRP) inhibitors, though these therapies remain costly and are not widely adopted in clinical practice (37).

Recent studies describe a growing range of technological approaches to support diagnosis and symptom management. For example, mobile applications such as Migraine Buddy apply machine learning to help users identify patterns and potential triggers (38). Telehealth platforms have expanded access to headache and pain specialists in geographically underserved areas. Researchers are also evaluating brain stimulation methods, including transcranial magnetic stimulation, and wearable neurofeedback devices for fibromyalgia and migraine management (39). These tools may increase nonpharmacologic care options, although access remains limited by cost, infrastructure, and awareness.

Historical Failures in Women's Health

Persistent gaps in women's health care have been documented across multiple domains, reflecting patterns of systemic bias, scientific neglect, and limited market engagement. Observed disparities in outcomes and resource allocation are particularly evident in the delayed recognition of women's distinct medical needs across the lifespan. The following case studies highlight four areas where these challenges have had measurable impacts: endometriosis, emergency pain management, clinical trial design, and menopause related care.

Delays in Diagnosis. Endometriosis, a condition with high prevalence and severity, continues to be underdiagnosed. Studies report an average delay of 7 to 10 years between symptom onset and formal diagnosis for most patients (40). This delay has been attributed to gendered assumptions in clinical practice and limited investment in diagnostic development. For decades, clinicians frequently dismissed pelvic pain in women as psychological in origin, attributing symptoms to anxiety or stress rather than investigating for underlying organic conditions (41). The current diagnostic gold standard, laparoscopy, remains invasive and costly, and few noninvasive diagnostic alternatives have reached the market due to limited public and private sector investment.

The economic impact of delayed diagnosis is considerable. Endometriosis has been associated with significant productivity losses and elevated health care costs, estimated at 22 billion dollars annually in the United States alone, much of which results from misdiagnosis and inappropriate treatments (11). The continued absence of early-stage diagnostics reflects both a gap in scientific development and a lack of recognition of women as a distinct health consumer group.

Dismissal of Women's Pain in Emergency Settings. Disparities in the treatment of acute pain are well documented, particularly in emergency care settings. One recent cohort study found that women presenting with abdominal pain were less likely than men to receive opioid analgesia and more likely to receive sedatives or be triaged as lower urgency, even when presenting with comparable symptoms (42). Women also experience longer wait times for pain relief in emergency departments, with some studies reporting average delays of over an hour (42). Such delays not only reflect clinical judgment errors but also suggest deeper cultural biases about how women express and experience pain.

These patterns suggest not only variability in clinical decision making but also broader cultural perceptions about how women express and experience pain (15). From a technology standpoint, few pain assessment tools have been developed or validated with sex specific criteria in mind. Although advances in biometric monitoring and artificial intelligence assisted triage have emerged in digital health, these technologies have not been widely adapted to address sex-based disparities in pain care.

Lack of Sex-Specific Clinical Trials. Historically, male subjects have been prioritized in both preclinical and clinical research. Until the early 1990s, women were routinely excluded from clinical trials due to concerns regarding hormonal variability, reproductive safety, and analytical complexity (7, 13). Although regulatory policies have increased inclusion, sex specific data remains inconsistently collected and reported.

A 2021 review found that only 38% of cardiovascular drug trials disaggregated outcomes by sex, despite clear evidence of biological differences in disease progression and treatment response (7, 13). Women also continue to be underrepresented in early phase trials, particularly in fields such as cardiology and neurology (43, 44). This gap has contributed to suboptimal treatment protocols. Several recent drugs have demonstrated higher rates of adverse effects in women due to differences in pharmacokinetics and dosing that were not evaluated prior to approval (5, 22).

Limited investment in sex specific research and trial design reduces the precision and safety of treatments for female patients. It also represents a missed opportunity for the development of targeted therapies that could address unmet needs and expand market potential.

Underdiagnosis and Neglect of Menopause-Related Issues vs. Delay in Diagnosis. Menopause, a universal phase of biological aging for women, continues to receive limited clinical attention. Common symptoms such as vasomotor instability, sleep disruption, mood fluctuations, and sexual dysfunction are frequently underrecognized and undertreated in clinical practice (45, 46). Surveys indicate that many clinicians receive minimal training in menopause care, and pharmacologic options remain limited (47). Hormone replacement therapy (HRT), while effective for many, is underutilized due to lingering concerns about safety that stem from earlier studies such as the WHI trial (48).

The economic implications of menopause related symptoms have been recently quantified. A 2023 study in *Mayo Clinic Proceedings* estimated that productivity losses due to menopause symptoms amount to nearly 26.6 billion dollars annually in the United States (49). These patterns reflect a broader lack of alignment between clinical needs, market priorities, and research funding in the area of midlife women's health.

Structural Reasons

Persistent gaps in women's health across biomedical research, clinical care, and health innovation have been linked to structural factors documented in the literature (2, 7). These factors include longstanding gender disparities in leadership and decision making, as well as historical underinvestment in health conditions that primarily affect women (16). Research identifies interconnected influences within scientific institutions, medical education systems, funding structures, and regulatory frameworks that contribute to the limited visibility and prioritization of women's health needs. Recognizing how these systems interact is important for understanding broader patterns in access, diagnosis, and treatment that disproportionately affect female patients.

Male-Centric Medical Research and Data. One of the most widely documented structural patterns in women's health research is the historical reliance on male subjects in biomedical studies. Throughout much of the twentieth century, clinical and preclinical research predominantly used male participants, based on the assumption that male physiology could serve as a universal standard (7). As a result, diagnostic tools, drug dosing guidelines, and treatment protocols were often developed around male norms, with limited consideration for differences in hormonal cycles, anatomy, or physiology in female populations.

For decades, researchers and regulatory bodies frequently excluded women from early-stage clinical trials due to concerns about hormonal variability and reproductive risk. Although the United States National Institutes of Health (NIH) adopted a 1993 policy requiring the inclusion of women in NIH funded research, disparities in representation persist (16). A recent meta-analysis reported that women comprise less than 40% of participants in cardiovascular drug trials, despite cardiovascular disease being the leading cause of death among women in the United States (8).

Even when women are enrolled in studies, sex-based analyses are inconsistently applied. Results are often reported without disaggregation by sex, which can obscure important differences in drug response, side effect profiles, and clinical outcomes (7). These gaps in study design and data reporting contribute to limitations in clinical evidence and may influence the quality and timeliness of care delivered to women.

Investor Bias and Underfunding of Women's Health. Despite increasing attention to women's health needs, investment in technologies designed to address these needs remains limited. An analysis of United States healthcare innovation trends found that women focused solutions received less than 5% of total venture capital funding, even in the context of substantial unmet clinical demand (50, 51). Research suggests that underinvestment is influenced in part by investor perceptions. Studies report that female entrepreneurs receive significantly less venture funding than their male counterparts and startups led by women in the health sector are often viewed as serving niche markets, regardless of demonstrated need or potential impact (6). The predominance of male partners in venture capital firms has been identified as a contributing factor in the limited funding allocated to reproductive and sexual health, sectors that form the foundation of femtech innovation (51).

Qualitative reports from femtech founders describe recurring experiences of having their products characterized as niche or not relatable to male investors, even though women constitute more than half of the global population and make an estimated 80% of household healthcare decisions (52). The framing of women's health as a specialized rather than universal domain may reduce perceived market viability and limit investment in technologies with broad public health relevance.

Taboos Around Menstruation, Menopause, and Female Sexuality. Cultural stigma has been identified as an influential factor in the marginalization of women's health within healthcare systems. Topics such as menstruation, menopause, and female sexuality are frequently framed as private or sensitive, which can limit open discussion in both clinical settings and health policy development (15, 53, 54).

Menopause, a universally experienced life stage among women, remains underrepresented in both medical education and pharmaceutical research. As of 2020, fewer than 25% of obstetrics and gynecology residency programs in the United States reported including formal training on menopause management (17). This limited preparation has been associated with low physician confidence and a narrow range of therapeutic options, many of which are based on legacy studies that did not include older female participants.

In the area of sexual health, disparities are also evident. Female sexual dysfunction receives substantially less clinical attention and research funding than male focused conditions such as erectile dysfunction has received significantly more pharmaceutical development (23). This pattern reflects persistent differences in how health systems prioritize and approach male and female sexual health needs.

Low Representation of Women in Biomedical Leadership. Structural disparities in leadership and decision-making continue to shape priorities in biomedical research and health innovation. Women remain underrepresented in senior positions across academic medicine, biotechnology firms, and regulatory institutions. In 2022, women held 19% of medical school dean roles and 26% of department chair positions in the United States, despite comprising nearly half of all medical school graduates (55).

In the private sector, leadership gaps are more pronounced. In 2021, women accounted for only 9% of chief executive officers in biopharmaceutical companies globally (56). Research indicates that leadership composition can influence institutional priorities. Studies have found that more diverse leadership teams are associated with broader research agendas and increased investment in products that serve underrepresented populations (57).

Workforce studies also describe persistent barriers to advancement for women in science and health innovation. Limited mentorship, reduced access to funding, and differential evaluation standards have been cited as factors contributing to lower retention and slower advancement of women in STEM fields. These patterns may contribute to lower representation in biomedical entrepreneurship and leadership, despite women entering the field at comparable rates to men (6).

Payment Models That Undervalue Women's Health. Current reimbursement structures often deprioritize women's health interventions by anchoring value to historical utilization patterns that already reflect gender bias (10). For example, Diagnosis Related Group (DRG) systems and fee for service models reimburse based on average costs and procedures, which often undercompensate for conditions more common in women such as endometriosis or fibromyalgia (3–5). These conditions have historically been underdiagnosed or treated conservatively (3, 5). As a result, innovative diagnostics or therapeutics for these conditions may appear less cost effective within these frameworks, discouraging provider adoption and insurer coverage (58). In addition, value-based payment models sometimes exclude patient reported outcomes that matter most to women, such as menstrual regularity, sexual pain, or sleep quality (11, 59). This further marginalizes interventions targeting these domains. The result is a feedback loop where lack of reimbursement leads to underinvestment and ongoing neglect of women focused innovations.

The Economic and Health Burden of Women's Health Conditions

Common conditions such as endometriosis, migraine, insomnia, and menopause related disorders are highly prevalent and are frequently characterized by underdiagnosis, limited treatment options, and inadequate research funding. Evidence from multiple studies highlights that these conditions are associated with a dual burden: they contribute to diminished quality of life for affected individuals and generate significant economic costs at both personal and societal levels. Despite affecting millions of women globally, the overall impact of these conditions is often underestimated. Contributing factors include limited availability of diagnostic tools, insufficient inclusion in medical research, and gaps in market based incentives for targeted intervention and innovation (60).

Endometriosis. Endometriosis is a chronic gynecological condition estimated to affect approximately 10% of reproductive age women worldwide (4). It is characterized by the growth of endometrial-like tissue outside the uterus, which can lead to chronic pelvic pain, infertility, and other symptoms. Despite its prevalence and clinical impact, the average time from symptom onset to formal diagnosis remains between 7 to 10 years (3, 45).

The economic burden associated with endometriosis is considerable. One analysis estimated that the average annual cost per patient in the United States exceeds 10,000 dollars, with major contributors including absenteeism, medical consultations, and surgical procedures (11). A 2022 global study projected societal costs of over 100 billion dollars annually, reflecting both lost productivity and direct medical expenditures (62). Health systems also face high utilization demands due to repeated hospitalizations, surgical interventions, and fertility care associated with the condition.

Migraines. Migraine is a neurological disorder characterized by recurrent, often severe headaches accompanied by symptoms such as nausea, sensitivity to light, and visual disturbances. It disproportionately affects women, who are approximately three times more likely than men to experience migraines, particularly during their reproductive years—a pattern associated with hormonal fluctuations (33, 47). n estimated 18% of women in the United States report experiencing migraines, making it one of the most disabling neurological conditions affecting women globally (64).

The economic impact of migraines is substantial. Estimates suggest that migraines cost the United States economy more than 35 billion dollars annually, primarily due to medical expenditures and productivity losses (65). Women with migraines are more likely to report absenteeism, reduced productivity while at work, and disruptions in long term employment. Those with chronic migraine, defined as experiencing symptoms on 15 or more days per month, face higher rates of healthcare utilization and related costs (36). Despite these trends, migraine remains underdiagnosed and undertreated among women.

Insomnia and Sleep Disorders. Insomnia and other sleep disorders are more frequently reported and often more severe in women compared to men. Studies indicate that women are up to 40% more likely to experience insomnia, with prevalence increasing during life stages such as pregnancy, the postpartum period, and menopause (66). Chronic insomnia has been associated with fatigue, mood disturbances, impaired cognitive performance, and elevated risks for chronic conditions including hypertension, diabetes, and depression.

The economic impact of insomnia is substantial. In the United States, annual costs are estimated to exceed 60 billion dollars, driven by productivity losses and increased health care utilization (67). Evidence suggests that women carry a disproportionate share of this burden, particularly given their higher representation in unpaid caregiving roles and limited structural support for managing these responsibilities (68). In clinical settings, reports of sleep disturbance among women are sometimes attributed to stress or emotional factors, which may delay appropriate evaluation and treatment (23).

Menopause-Related Health Issues. Menopause typically occurs between the ages of 45 and 55 and signals the end of reproductive capacity. It is associated with a range of symptoms, including hot flashes, night sweats, mood fluctuations, sleep disturbances, cognitive changes, and genitourinary syndrome. More than 75% of women report experiencing vasomotor symptoms during menopause, and approximately one third describe these symptoms as severe and persistent for over seven years (46).

Despite its universality, menopause is not consistently addressed within health care systems. Many women do not receive counseling or symptom management, and the use of hormone replacement therapy (HRT) has declined following earlier studies that raised safety concerns. Limited training among clinicians and the absence of standardized care pathways may contribute to inconsistent treatment. These factors have been linked to reductions in quality of life and work performance for women during midlife (53, 54).

From an economic perspective, menopause related symptoms have been associated with significant productivity losses. A recent United States based study found that women experiencing moderate to severe vasomotor symptoms had higher levels of work impairment and incurred estimated annual indirect costs exceeding 770 dollars per person (69). Given the increasing representation of women in the global workforce, these effects may have broader labor market implications.

DISCUSSION

Framing women's health disparities as market failures offers a powerful tool for driving systemic change. This economic lens clarifies why persistent underinvestment occurs despite significant societal demand and cost burden. More importantly, it enables the application of well-established policy mechanisms such as regulation, subsidies, and public private partnerships to correct inefficiencies and encourage innovation (9).

When gaps in care are viewed solely as public health failures, proposed solutions tend to focus narrowly on awareness and education. But when these same gaps are recognized as economic inefficiencies, a wider range of actors, including governments, insurers, investors, and employers, can be mobilized. For instance, understanding the underdiagnosis of endometriosis or fibromyalgia as a failure of information systems encourages regulatory bodies to mandate better sex specific data collection (3, 5). Similarly, acknowledging the lack of menopause care as a public good problem supports public investment in research, training, and reimbursement reform (17).

This perspective also aligns moral urgency with economic logic. Many of the conditions that disproportionately affect women, such as chronic pain, perinatal depression, and menopausal symptoms, generate substantial societal costs in the form of lost productivity, caregiving demands, and long term disability (11, 12). Because these costs are borne by households and public systems rather than private firms, the market lacks the incentive to respond. Reframing these impacts as negative externalities strengthens the case for corrective policy tools like tax incentives, innovation grants, and outcome based payment models (56, 57).

In addition, identifying gendered investment gaps as failures in capital markets brings attention to systemic bias and misinformation. Investors have long underestimated the potential of women focused health technologies due to inaccurate assumptions about market size, return on investment, and consumer engagement (6, 14). When these distortions are addressed through transparent data, strong case studies, and targeted investor education, capital begins to flow toward underfunded areas. This allows for the creation of de-risked innovation pipelines that support sustainable growth in women's health ventures (39, 44).

A market failure framework helps integrate women's health into the core of policy and innovation agendas. Whether through regulatory reform, funding allocation, or technology development, this approach embeds gender equity in broader economic systems. It allows policymakers to treat women's health not as a niche or siloed concern but as an essential component of national productivity, public well-being, and long term health system sustainability (72).

Market Failures in Women's Health

Market failures occurs when the free market does not allocate resources efficiently or equitably, leading to outcomes that are suboptimal for society (9). In women's health, such failures are particularly persistent and damaging. Despite clear and growing evidence of demand, high societal costs from untreated conditions, and vast opportunities for innovation, the market continues to underinvest in products, services, and research aimed at women's unique health needs (2, 7, 13). This failure stems from multiple, interconnected economic and is compounded by structural features of the healthcare system, including reimbursement models that deprioritize women's health needs.

Information Failure and Historical Bias. Markets rely on accurate and complete information to function efficiently. Yet, in women's health, there have been longstanding data gaps caused by the exclusion of women from clinical trials and the assumption that male biology is the norm. Until the early 1990s, drug development was largely based on male participants due to concerns about hormonal variability and reproductive risk. Even after reforms, disparities persist: women remain underrepresented in trials for cardiovascular, oncological, and neurological diseases. For example, in heart failure clinical trials, women have comprised only around 38% of participants, despite bearing a high disease burden (7). Underrepresentation across several NIH-funded trials, particularly in neuroscience and oncology, remains common (13, 44). Without sex-disaggregated data, both diagnostic accuracy and treatment effectiveness suffer. A review of cardiovascular research found that nearly three-quarters of studies failed to stratify outcomes by sex, leading to treatment recommendations that may not be equally effective for women (2). Framing this gap as an information failure supports regulatory interventions mandating sex-specific analysis in trials and post-market evaluations.

Public-Good Characteristics of Research and Gendered Investment Patterns. Foundational health research often functions as a public good, being nonexcludable and non-rivalrous, which discourages private investment. This dynamic has led to chronic underfunding in critical areas like endometriosis, menopause, autoimmune disorders, and chronic pain, many of which disproportionately affect women (11). Without public incentives or coordinated funding mechanisms, these gaps persist. Recognizing women's health research as public good justifies increased public funding and targeted innovation grants. As discussed in the *Investor Bias and Underfunding of Women's Health* section, women's health continues to receive disproportionately low levels of venture capital and R&D funding. Structural factors such as the dominance of male decision makers in such firms contribute to the perception that women's health is a niche rather than mainstream market, reinforcing cycles of underinvestment (3). These distortions reflect a capital market failure, where investor bias and lack of data lead to inefficient allocation of resources.

Perceived Risk and Demand-Side Externalities. Women's health needs are often misclassified by investors and insurers as economically risky or marginal due to incomplete data, low historical return visibility, and regulatory uncertainty. Sparse sex-specific evidence in clinical trials and digital tools leads to hesitancy in product development and market entry (10). Health innovations in areas like menstrual care, menopause, and fertility are perceived as lacking predictable returns, which discourages resource allocation even in the presence of clear clinical need. In addition, many women normalize symptoms such as menstrual pain or hot flashes, resulting in lower treatment-seeking behavior and masking true demand. These demand-side externalities distort market signals and lead to chronic underinvestment. Structural gaps in insurance coverage for hormone therapy, fertility services, or pain management exacerbate these trends, reducing access and reinforcing a cycle of unmet needs (58). Structural reimbursement practices that undervalue interventions based on historical underutilization further exacerbate these failures. Addressing these inefficiencies requires targeted interventions such as outcome-based reimbursement, payer mandates for coverage of validated solutions, and mechanisms to internalize social benefits into investment decisions.

Demand Misperception and Societal Stigma. Beyond economic risk perception, cultural stigma plays a critical role in suppressing market visibility of women's health needs. Cultural taboos in menstruation, menopause, fertility, and female sexuality limit public discourse, discourage symptom disclosure, and inhibit health-seeking behaviors. This silence distorts consumer feedback loops and leads stakeholders to underestimate both the size and urgency of the women's health market. For instance, although the market exceeded $60 billion in 2022, it still attracted only a small share of digital health investment (13, 24). Cultural misperceptions compound market failures by limiting user engagement, deterring product adoption, and perpetuating the view that women's health is a niche concern. Corrective strategies include investing in inclusive product design, conducting consumer-led development cycles, and promoting public awareness campaigns that normalize women's health conditions (74). Investor education that emphasizes latent demand and social impact can also help recalibrate value assessments and correct distorted market narratives.

Asymmetric Information and Dismissal in Care. Asymmetric information, where patients and providers have unequal knowledge, also undermines women's health. Many women normalize pain or hormonal symptoms and delay seeking care, while providers may dismiss or misattribute their concerns. Recent studies confirm that clinicians still underestimate women's pain and are more likely to offer psychological explanations over physiological ones, contributing to delayed diagnoses and ineffective treatments (75). This reduces healthcare efficiency and erodes patient trust. Reducing these inefficiencies requires patient centered tools, decision support systems, and mandatory clinician training on sex and gender health disparities.

Externalities and Societal Costs. The burden of poorly addressed women's health issues extends beyond individual suffering to broader economic and social costs. Lost productivity, increased caregiving responsibilities, and long-term disability create negative externalities that are absorbed by households and public systems. For example, untreated maternal mental health issues cost the U.S. over $14 billion annually (12). Yet, because these costs are borne collectively rather than by firms or investors, there is little incentive for market correction (76). Public policies such as tax credits, caregiver subsidies, and innovation accelerators can help internalize these costs and redirect private investment.

Regulatory and Institutional Barriers. Innovation in women's health often outpaces regulation. Digital tools for hormonal health, reproductive tracking, or menopause care face outdated approval pathways and a lack of gender-sensitive evaluation standards. Moreover, institutional norms have deprioritized conditions that affect quality of life rather than mortality, like pelvic floor disorders or perimenopausal sleep disturbances, especially when they lack strong advocacy (72). Modernizing regulatory frameworks and adopting sex specific validation criteria would enhance both safety and market uptake (77).

These multifaceted market failures listed above, ranging from information gaps to undervaluation of demand, demonstrate the need for targeted, systemic reform. The following section outlines evidence-based strategies to correct these inefficiencies and promote gender equity in health outcomes.

Recommendations

The findings of this review highlight recurrent underinvestment and inefficiencies in addressing women's health conditions, such as underdiagnosis, limited clinical trial representation, investor bias, and inadequate integration of validated technologies. To address these gaps, targeted policy and funding interventions are needed. The following recommendations are derived from patterns observed across the included studies and aim to correct the specific market and structural failures identified in the results. These include information asymmetries, public-good limitations in research, misperceptions of demand, and regulatory or reimbursement constraints.

Increase Investment in Women-Focused Research

and Development. Funding for women's health research is historically low. A recent review found that women remain underrepresented in key clinical research areas, contributing to poorer treatment outcomes and a persistent gender data gap (1, 44). For example, in 2020, women represented only 43% of participants in FDA-registered clinical trials, despite differences in disease symptoms and treatment responses (78). Governments should offer targeted grants, tax incentives, and regulatory fast-tracking to companies prioritizing women's health innovation.

Public-private partnerships (PPPs) that link government research bodies with startups focused on female-specific conditions can catalyze innovation. For instance, efforts modeled after the NIH Revitalization Act have shown the effectiveness of integrating gender equity into research policy (79). These partnerships can drive progress in under-researched areas like menstrual health, menopause, and chronic pain, while also expanding funding for women-led health ventures (80). Incentivizing these investments corrects capital market failures where high impact opportunities are overlooked due to structural bias or perceived risk.

Require Sex-Specific Data in All Clinical and Digital Health Studies. Medical research often fails to report findings by sex, reducing the quality of evidence for women. Regulators should require the transparent collection and reporting of sex-disaggregated data across all clinical trials and real-world studies. This includes digital health applications such as AI diagnostics, mobile platforms, and wearable sensors, which frequently underperform for women when trained on male-skewed datasets (79, 80).

Global regulatory agencies like the FDA and EMA should mandate sex-specific evidence for approval and post-market surveillance, with criteria addressing safety, usability, and performance for female users (83). Labeling systems indicating whether a product has been validated in women would also improve transparency and user trust. Such requirements help correct information failures by ensuring products are evaluated under real world use conditions for diverse populations.

Expand Insurance Coverage for Validated Women's Health Technologies. Despite growing evidence for their effectiveness, many women-centered health innovations remain uncovered by insurance. This includes mobile pelvic floor training tools, digital CBT platforms for menstrual pain, and menopause interventions. These tools can be cost-effective and clinically validated yet remain inaccessible due to the absence of formal reimbursement pathways (71).

Germany's DiGA fast-track model provides a potential template, offering conditional reimbursement for digital tools while further evidence is gathered (70). Similar pilots in the U.S. and other countries could enable outcome-based payment schemes for high-burden women's conditions such as postpartum depression or endometriosis (59). These policies can internalize positive externalities, such as productivity gains and caregiver relief, and stimulate innovation in underserved areas.

In addition, reimbursement frameworks should be reformed to avoid anchoring value to historical utilization data that reflect gender bias. Payment models such as DRGs and fee for service systems must account for conditions disproportionately affecting women, including endometriosis and fibromyalgia, by incorporating updated costing, appropriate procedure codes, and equitable coverage benchmarks (3–5, 10, 58). Value based models should also recognize and reward improvements in patient reported outcomes like sleep quality, sexual pain, and menstrual regularity (11, 56). Without such changes, reimbursement policy will continue to act as a bottleneck to innovation focused on women.

Build Inclusive Digital Health Technologies. Digital tools must be inclusive to be effective. Currently, many algorithms are developed and validated predominantly on male data, leading to lower accuracy and usability for women. Product design should systematically include women across age, ethnicity, and reproductive stages to improve usability and clinical relevance (84). Participatory co-design, which involves working directly with female users, can improve usability, adoption, and impact (85). Funders should prioritize technologies addressing often-ignored needs like menstrual irregularities, perimenopausal insomnia, or postpartum pain. Regulators should encourage algorithmic transparency, bias audits, and equitable performance benchmarks during approval (82). These measures help address asymmetric information and ensure that market innovations do not replicate existing gender disparities.

Promote Health Literacy and Reduce Stigma. Stigma continues to suppress women's health-seeking behaviors. This social silence leads to missed diagnoses, poorer outcomes, and suppressed market demand (46). Public awareness campaigns and inclusive health education, particularly in schools, workplaces, and primary care settings, can destigmatize these topics and encourage timely care seeking. Empowering women with culturally appropriate, scientifically sound information can boost health literacy, normalize symptoms that require care, and drive demand for better solutions and tools (86). Raising awareness reduces demand side externalities by making invisible burdens visible and actionable to policymakers and investors.

Educate Investors and Support High-Impact Women's Health Ventures. Many femtech companies show significant growth and engagement metrics, but investor misconceptions about market size and ROI continue to suppress funding. Educational efforts targeting investors, such as ROI case studies, market sizing reports, and clinical outcome summaries, can shift attitudes. Public grants, accelerator programs, and impact investment competitions can de-risk women's health ventures and draw attention to high-impact startups (13). These measures can help correct capital allocation inefficiencies driven by underappreciated social returns and misperceived market potential.

Limitations

While the market failure framework offers a useful economic lens to explain underinvestment in women's health, it remains an incomplete solution. Framing deeply rooted gender inequities as economic inefficiencies risk oversimplifying complex social and structural problems. Structural sexism, stigma, and power imbalances in healthcare, academia, and biotechnology often operate independently of market dynamics and require cultural, institutional, and regulatory reform. Moreover, not all valuable health services are profitable—or should be. Many essential interventions, such as comprehensive sex education or perimenopausal care, may lack short-term financial returns yet yield significant societal benefits. The market failure approach also assumes that rational corrections, such as better data or improved incentives, will shift investment priorities. Markets are not always responsive to moral or social arguments, and entrenched bias or short-termism may continue to marginalize women's health regardless of economic logic. Finally, attributing blame to "the market" can obscure the specific roles and responsibilities of regulators, funders, medical institutions, and professional societies. Meaningful progress requires not only economic realignment but also accountability and reform across multiple non-market domains.

Directions for future research

To build on the market failure framework, future research should adopt a multidisciplinary approach that integrates health economics with gender studies, public health policy, and innovation systems. One important avenue is the systematic evaluation of policy tools, such as targeted research grants, regulatory fast tracking, tax credits, and public private partnerships, that aim to correct underinvestment in women's health. Empirical studies should assess how these interventions influence venture capital flows, R&D activity, and clinical uptake in specific high-burden areas like endometriosis, fibromyalgia, menopause, and maternal mental health.

Additionally, greater attention is needed on the role of data infrastructures in perpetuating or mitigating inequities. Research should investigate how the inclusion of sex-disaggregated data and gender-sensitive outcome measures in clinical trials, digital platforms, and regulatory submissions affects diagnostic accuracy, treatment efficacy, and product adoption. The performance of AI-driven health technologies requires scrutiny regarding algorithmic bias, training datasets, and real-world effectiveness for diverse female populations.

Another area for inquiry is the long-term relationship between investment in women's health and macroeconomic outcomes such as workforce participation, caregiving burdens, and health system efficiency. Prospective studies could quantify how improving access to women-focused technologies impacts productivity, employment continuity, and public expenditure.

Finally, research must address the cultural and institutional barriers that cannot be solved by market forces alone. This includes exploring how implicit bias in medical education, exclusionary clinical guidelines, and homogeneity in leadership affect the pipeline of women's health innovations. Evaluating interventions aimed at reforming regulatory standards, diversifying biomedical leadership, and embedding equity into translational research can provide critical insights for advancing systemic change.

CONCLUSION

Women's health has long been underserved due to persistent market failures rooted in gender bias, underinvestment, and systemic neglect. Despite rising awareness and growing consumer demand, critical needs in areas such as reproductive health, chronic pain, menopause, and sleep continue to be underdiagnosed, undertreated, and misunderstood. These gaps are not only a result of clinical oversight but also of structural failures in research funding, product design, regulation, and insurance coverage.

The evidence is clear that existing models of health innovation have not adequately accounted for sex and gender differences. When health systems treat male biology as the default, women are left with delayed diagnoses, poor treatment outcomes, and a diminished quality of life. Inaccurate diagnoses, one size fits all treatments, and exclusion from research trials result in poor outcomes for women and lost opportunities for the health sector. Moreover, the economic and social costs of this neglect, including lost productivity, caregiver strain, and rising healthcare burdens, are absorbed by individuals, families, and society at large.

Correcting these failures will require more than incremental changes. It requires rethinking how the market defines value, how it measures success, and who it is built to serve. A coordinated strategy is needed, one that combines inclusive research practices, equitable investment, updated regulatory policies, and culturally sensitive health technologies. Innovations in digital health, artificial intelligence, and personalized medicine offer promising tools, but only if they are developed with women in mind from the outset. Requiring sex-specific reporting, expanding insurance coverage for evidence-based tools, and educating investors on the value of women’s health solutions are essential first steps.

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