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"A Bias Recognized is A Bias Sterilized": A Literature Review on How Biased Datasets Have Led to the Long-standing Misdiagnosing of People of Color (POC) and Female Patients

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Abstract

Introduction: Health disparities disproportionately impact minority group patients. Various factors perpetuate health inequity, including socioeconomic status, prejudice and discrimination. Historically, sample biases favoring White males in healthcare literature have led to the underrepresentation of certain groups in scientific literature, particularly people of color (POC) and female populations. Many revolutionary studies in healthcare research have used biased samples, which challenges their generalizability to POC and female populations. This review explores the mechanisms by which these gaps in the literature have led to the misdiagnoses of POC and female patients in psychiatric and biomedical settings.

Methods: A comprehensive literature review was conducted to investigate: (1) misrepresentation of minority groups in literature, (2) variation in the symptomatology and etiology of disorders and diseases in female and POC populations; and (3) biases within accepted diagnostic measures and criteria. Electronic databases such as PubMed, PsychINFO and Google Scholar were used to search key terms including 'health inequity', 'cross-cultural validity', 'racial disparities', 'sex disparities', 'diagnostic delays', 'misdiagnosis', 'clinical heterogeneity'.

Results: Eighty-seven studies were examined, and 38 studies were included in the review. Findings suggest that misclassification of group membership, poor conceptualizations of minority identities, inadequate understanding of symptomatology variation, exclusion of social context, lack of culturally sensitive approaches, biased diagnostic tools and an absence of diverse samples in historical datasets have resulted in a harmful deficit in minority representation within medical literature.

Discussion: Bias in healthcare literature has led to the systematic underrepresentation of minority populations in medical research and contributes to the misdiagnosis and subsequent health inequities within these groups. Present findings emphasize the necessity to regard past health research with reasonable skepticism and a call for prioritization of inclusive and diverse research.

Conclusion: This review sheds light on how to bridge the literature deficit caused by biased research through highlighting how minority populations are differentially impacted within the healthcare field and identifying factors that perpetuate these disparities. Further research on the examined factors must be conducted to develop approaches to mitigate misdiagnosis rates and subsequent health inequities among POC and female patients.

Keywords: healthcare disparities; health inequities; minority populations; biased samples; unrepresentative samples; delayed diagnosis; misdiagnosis; racial disparities; group differences; sex disparities

Introduction

The National Institute on Minority Health Disparities (NIMHD) defines health disparities as "pattern[s] of poorer health outcomes, indicated by the overall rate of disease incidence, prevalence, morbidity, mortality, [and] survival in the population as compared with the general population" [1]. Numerous studies have shown that minority groups in western countries experience a disproportionately higher rate of health disparities, including higher rates of misdiagnosis [1]. These groups include people of color (POC), females and LGBTQIA+ populations [1].

In the US, people with physical and/ or mental illnesses can have lowered life expectancies by 6-20 years [2,3]. Misdiagnosing patients can prevent them from accessing medications, accommodations, social supports and services that can adequately improve their quality of life [4]. Moreover, repeatedly visiting medical professionals and refining treatments through trial-and-error can significantly

increase financial burdens [2]. Addressing the root causes of misdiagnosis and diagnostic delays is imperative in reducing the health disparities that minority groups face [2,4].

The lack of diversity within samples used in healthcare literature is a major contributing factor to healthcare inequity. Many past health studies have exclusively used male participants and generalized their findings to non-male populations, including females and intersex individuals [5]. Around 60% to 70% of clinical trials have historically studied White males in the U.S. alone[6]. A recent review found that 86% of participants in clinical trials across 29 countries over a period of 21 years identified as White [6]. This phenomenon also extends to psychological research, where *WEIRD* (Western, Educated, Industrialized, Rich, Democratic) samples, predominantly consisting of White males, have been used in 96% of all research, despite only representing 12% of the global population [7]. As such, biases and misclassification in study samples have led to the historic underrepresentation of certain communities in scientific literature, particularly POC and female populations [5-7].

This review investigates how biased research has led to the misdiagnoses of POC and female patients in psychological and biomedical settings. Given the complexity of this issue, the review will explore three areas accounting for the most significant contributors to data-driven bias; (1) misrepresentation of minority groups in literature, (2) variation in the symptomatology and etiology of disorders and diseases in female and POC populations; and (3) biases within accepted diagnostic measures and criteria.

Methods

The electronic databases PubMed, PsychINFO, Omni and Google Scholar were used to conduct a title and abstract search identifying recurring themes around female and POC underrepresentation in healthcare. Themes were defined as overarching mechanisms, cited by two or more articles, connecting biased research with misdiagnosis/ diagnostic delays. Key terms used included: "health inequity," "cross-cultural validity," "racial disparities," "racial diversity in research," "sex disparities," "diagnostic delays," "misdiagnosis," and "clinical bias," and the various health conditions mentioned in this review.

Researchers ZP and SS independently screened articles to determine their eligibility for this review. Results were limited to peer-reviewed primary journal articles and reviews published in English. No restrictions were placed on publishing dates to include historic/landmark studies. News articles and opinion pieces were excluded from the results to maintain an empirical approach.

Eighty-seven articles met the search criteria and were further scanned for relevance. When necessary, secondary citations were also scanned. Articles deemed relevant provided examples of racial and/or sexual disparities in healthcare research, critiqued or cited critiques of contemporary or past diagnostic tools and measures, and/or examined the role of other sources of bias in the diagnostic process. Thirty-eight articles were included in the results and sorted according to the themes identified by the preliminary search.

Results

Misrepresentation of Minority Groups in Literature

Misclassification of Sociodemographic Variables

Research centered around sociodemographic variables is obfuscated by inconsistencies in how they are operationally defined [8]. One review by Ma et al. found that medical research typically used variable terms to define race, where the rationale behind the operationalization of race as a variable has been underreported [8]. The study indicated that only 16% of the articles explained their inclusion of race as a variable, highlighting how healthcare research has continuously reported suboptimal sociodemographic variables [8]. Misclassification has detrimental implications for the minority groups that have been misrepresented [9]. For instance, a study by Sasa and Horse indicated that the racial misclassification of Native Hawaiians and Pacific Islanders (NHPI) as "Asian or Pacific Islander" in health literature has led to gross misconceptions of the health experiences of NHPI populations, which has consequently contributed to the health inequities experienced by NHPIs [9].

Amidst misclassification, scientific literature has frequently conflated sociocultural constructs as biological constructs [10]. Amutah et al. highlight how studies often use race – a social category – as a proxy for biological similarity [10]. This contributes to the "pathologization" of race, where researchers and physicians interpret higher prevalence rates among racialized groups as an indicator of genetic difference, rather than a product of intersecting systemic barriers [10,11]. It also perpetuates false beliefs about POC, including the idea that Black patients have an inherently higher pain tolerance than White patients [12,13]. Similarly, gender and sex are also largely conflated in research, leading to the misrepresentation of gender- and sex-diverse individuals in studies [14].

Lack of Participation and Inclusion

Minority group populations have consistently been underrepresented in medical research [15,16]. Studies have either excluded minority participants or have used an unmeaningful amount of minority participants [15]. This is highlighted in a literature review by Polo et al. which investigated diversity in randomized clinical trials (RCTs) of Major Depressive Disorder (MDD) [15]. The findings indicated that clinical trial studies for MDD frequently excluded specific racial minority groups, including Asian Americans, Native Hawaiian and Pacific Islanders, Native Americans/Alaskans, and multi-ethnic subgroups [15]. Although minority groups are more widely included in

research today, many studies fail to analyze sex- and race-specific results [17]. For example, a systematic review of 482 orthopedic clinical trials found that 456 studies (94.6%) reported sex, 35 (7.3%) reported race and 15 (3.1%) reported ethnicity; however, only 72 studies (14.9%) analyzed sex, 6 (1.2%) analyzed race and 1 (0.2%) analyzed ethnicity [17].

In addition, studies suggest that minority group individuals are reluctant to participate in research due to their perceptions of research [16]. Clark et al. reported that racial and ethnic minority group individuals were less likely to participate in clinical trials due to general mistrust, lack of understanding of the value of information, lack of comfort, lack of information, and resource constraints regarding study participation [16].

Variation in Symptomatology and Etiology

Sociocultural Factors Shaping Presentation and Diagnosis

Since pathological models often focus on the roles of biological and physiological factors, the influence of sociocultural factors on symptom presentation and diagnosis is often underestimated [18]. For example, Schwartz et al. analyzed the cause of diagnostic discrepancies of schizophrenia between White and African American populations, where they hypothesized that clinician bias resulted in differential diagnoses [18]. The study investigated symptom ratings, clinical diagnoses, and behavioral measures [18]. Findings indicated that there was no difference in clinician ratings as a function of race [18]. Instead, behavioral measures suggested that African American participants exhibited less blunt affect and greater speed disorder as compared to White participants, which calls into the impact of cultural factors in communication [18].

Moreover, female patients with poorly understood symptoms have historically been discredited by physicians [19-22]. For example, women with chronic pain were commonly diagnosed with hysteria – a condition that evolved from being defined as 'female madness due to the absence of sexual activity and motherhood' to 'the conversion of repressed trauma, such as sexual desire, into physical symptoms in women' to 'unexplained physical pain that presents overwhelmingly in women' [23-25]. Hysteria was removed from the DSM-III in 1980, but biased attitudes surrounding chronic pain, accompanied by a lack of research into its pathogenesis, prevailed [19]. In a qualitative study with 25 women, Åsbring and Närvänen reported that women with chronic pain often felt they were scrutinized, ignored, perceived as whining or complaining, and/ or belittled by physicians [20]. Doctors frequently believed that they were imagining their illness, and/ or misdiagnosed them with psychiatric disorders [21-22]. Some women also reported that doctors attributed their pain to psychological causes without giving them thorough assessments.

Differences in Genetic Variation and Symptomatology

Genetic research is instrumental to uncovering the etiology of various health conditions [26]. Genome-wide association studies (GWAS) can help detect genetic mutations that either contribute to conditions or serve as biomarkers to detect them [26]. Sirugo et al. found that over 78% of samples used in GWAS studies are from individuals of European descent [27]. However, individuals of non-European descent can exhibit distinct profiles of genetic variations [28]. For example, one study found that prostate cancer-associated loci (locations of genetic variation) in samples of European and Asian descent have either not been replicated in African descent samples or have been replicated with a smaller or directionally opposite effect size [28]. Gaps in current literature about risk-mediating genes in diverse populations translate into a higher likelihood of receiving false-positive/ negative diagnoses and ambiguous genetic screening results for POC [29].

Sex differences have been observed in the symptomatology of various health conditions [30]. For example, Keteepe-Arachi and Sharma outline how women often exhibit milder and/or atypical symptoms of cardiovascular disease (CVD), including breathing difficulties and fatigue without chest pain [30]. Most CVD research was initially conducted with older White males; consequently, many of these symptoms are considered atypical because they are atypical *in men* [30,31]. Similarly, Ragavan and Patel show that current lung cancer screening guidelines, which were developed from studies underrepresenting women, do not capture the unique risk factors that women are more likely to be exposed to, such as indoor cooking fumes and oils that produce carcinogens [32]. This is consistent with the finding that 50–80% of women diagnosed with lung cancer do not meet the national agency-outlined screening criteria for it [32].

Medical literature regarding phenotypic variation as a function of race has been controversial and has yielded inconclusive findings [33]. For example, Garett et al. investigated whether specific biomarkers in cerebrospinal fluid (CSF) varied across race, based on the racial disparities in Alzheimer's disease risk between White and Black populations [33]. The study measured CST biomarkers in both normal and mildly cognitively impaired (MCI) Black and White participants [33]. Results indicated that Black participants had lower biomarker levels than White participants, independent of neurodegeneration levels, cognitive performance, and vascular risk; however, these results cannot justify broad generalizations for an entire racial group [33].

Instead, studies investigating phenotypic variation in minority group populations can be used to identify trends, with focus on how individuals from these groups are impacted by disease. A study by Michelle et al. explored the clinical heterogeneity of race and sex in inclusion body

myositis (IBM) patients [34]. While past literature emphasizes the prevalence of IBM among White and male populations, the present study identified separate clinical subgroups of female and non-White populations within the IBM cohort, wherein these subgroups exhibited distinct clinical phenotypes that fell within the typical IBM clinical phenotype [34].

Bias of Accepted Diagnostic Criteria and Measures

Validity of Measures on Diverse Populations

Notwithstanding its role in the prevention of misrepresentation and misdiagnoses among minority populations, the need for cross-culturally validated measures has become increasingly important with the proliferation of cultural migration [35]. From the reviewed literature, weak construct validity in cross-cultural contexts was identified as a significant issue with present diagnostic measures [35-37]. For example, a study by Alang highlighted how the expression of depression among African Americans was inconsistent with the diagnostic criteria for MDD in the DSM-V, where this discrepancy varied as a function of the conceptualization of depression in these communities [35]. Similarly, a review by Gilmoor et al. investigated the validity of post-traumatic stress disorder (PTSD) measures which were developed around Eurocentric and Western conceptualizations of PTSD, where existing measures have failed to account for how the conceptualization of the construct of PTSD differ in non-Western contexts [37].

The use of nonrepresentative samples in the development of diagnostic measures has led to a lack of culturally sensitive measures that are unable to accurately detect underlying health concerns in minority populations [38]. This can be seen in a study by Eyton and Neuwirth, who found that the Social Readjustment Rating Questionnaire (SRRQ) and Cornell Medical Index (CMI) both misrepresented the physiological and psychological well-being of Vietnamese refugee samples due to an ethnocentric bias [38].

In biomedical settings, certain diagnostic tests have been shown to produce results that are less accurate in minority groups [39,40]. For example, myocardial perfusion tests, which use an imaging technique called gated single positron emission tomography (SPECT) to depict blood flow through cardiac muscles, can be used to diagnose and/ or measure the risk of coronary heart disease (CAD) [41]. Nguyen et al. reported that myocardial perfusion tests produced higher false-positive rates for women [40]. This is because the overlap between breast tissue and the heart can produce 'breast attenuation artifacts' on myocardial perfusion images [40]. Unsurprisingly, many of the studies that initially validated SPECT as an effective tool for CAD detection were conducted with male-majority participants [39,41].

Similarly, risk score calculators are diagnostic algorithms that integrate variables such as age, race, sex and medical history to predict whether patients are at high or low risk of developing diseases [42]. Vyas et al. outlined how data used to develop these algorithms is biased for some calculators, and unavailable due to unexplained rationales from the developers for others [43]. For example, the Vaginal Birth after Cesarean (VBAC) algorithm predicts that African American and Hispanic patients who previously had cesarean sections are less likely than White patients to have successful vaginal births, even though this finding is not supported by research [43]. Risk stratification systems can exhibit sex-based disparities as well, especially when there are sex differences in the symptomatology of health conditions [31].

Role of Provider-Bias in Patient Health Outcomes

Research shows that healthcare provider bias is a factor that impacts minority group health outcomes [44]. Parker et al. conducted a study which identified that interpersonal provider-level racial bias was a factor that significantly contributed to disparities in electroconvulsive therapy (ECT) treatment referrals for POC patients, where racial and ethnic minorities were often misdiagnosed and consequently underrepresented in severe affective disorders due to influence of racial bias [45].

Strategies implemented to attenuate implicit provider bias have yielded minimal improvements [46]. An experimental study by Centola et al. aimed to mitigate the impact of implicit racial and gender bias in clinicians' treatment by implementing peer-networks [46]. Clinicians were shown either a White male patient-actor or a Black female patient-actor depicting signs of cardiac chest pain, and then prompted provide a clinical assessment and recommended treatment for the patient [46]. Results showed significant disparities in clinical assessment and recommended treatment between patient-actors, where the Black female patient-actor was more often prescribed unsafe undertreatment and experienced greater treatment delay than the White male patient-actor [46]. This trend persisted across control and experimental conditions, where clinical assessment was either completed independently or within a peer network, in which participants exchanged information with other clinicians [46].

Discussion

Systemic oppression continues to be a fundamental barrier for minority group individuals and is reflected by the rampant health disparities in minority group populations [47]. From a research perspective, few studies have investigated the reliability and validity of data from past healthcare literature in minority populations [48]. This literature review identified three major mechanisms of bias in healthcare literature that contributed to the misdiagnoses and consequent health disparities of POC and female patients.

Scientific literature has often poorly operationalized sociodemographic variables [49]. This has led to the misclassification of these variables in past literature, where

the populations that we wish to study today may not have been accurately or validly studied at all [49,50]. Past health data has broadly grouped together subgroups under singular categories, obscuring significant differences that may define them, including risk factors and genetic heterogeneity [50]. For example, "Asian" as a demographic variable has typically referred to individuals of East Asian descent (e.g., Chinese, Japanese, Korean, etc.) but it would also include individuals from South Asian (e.g., Indian, Pakistani, Bangladeshi, etc.) and Southeast Asian descent (e.g., Vietnamese, Filipino, Bruneian, etc.) [50]. Similarly, healthcare research has a history of conflating different social constructs with one another, particularly biological sex and gender [51-52]. Not only does this contribute to the false narrative that these variables are binaries, but it also obfuscates the health experiences of gender and sex diverse individuals [53].

Additionally, healthcare research follows a model of pathology that overemphasizes the role of biological factors and minimizes the impact of social and cultural factors on diagnosis [54]. For example, behaviors are only considered 'abnormal' if they cause an individual significant dysfunction and distress, and they deviate from the individual's cultural norms [54]. Since different cultures have different norms, what is considered abnormal or pathological can vary between populations [18,54]. Implicit and explicit biases in physicians' perceptions of minority group patients can also perpetuate healthcare disparities [12,13,19-22]. Given that certain health conditions can present differently in women [30-32], and there is a history of physicians dismissing women's health complaints [19-22], there is a need for the development of diagnostic criteria that encourage the contextualization of symptoms in POC and women.

The existing body of past healthcare literature must be heeded with considerable caution, particularly when consulting past findings to treat minority group patients. Data-driven bias in healthcare literature should be regarded as a driving factor behind the current health disparity crisis that minority populations are subject to, especially in the current static and increasingly multicultural world [55]. Recent healthcare research has indicated that health disparities for POC and women will continue to persist unless research focuses on these populations and the role that social context plays in healthcare accessibility and efficacy [56]. Several approaches have been proposed, ranging from the inclusion of experts of other disciplines to the implementation of diversity, equity, and inclusion (DEI) strategies to minimize bias [6,57]. Despite these efforts, present mechanisms in place to diversify research are not enough to eliminate systemic bias [47,58]. Significant change in research will only be observed once the scientific community makes the inclusion of underrepresented groups a priority [59].

Conclusions

This review demonstrates how centralizing White male samples in healthcare research has led to the misdiagnosis and consequent health inequities in female and POC patients. The findings illustrate the importance of including diverse samples within psychiatric and biomedical fields, where breakthroughs and technological innovations will continue paving the way for more advanced and accurate treatments. Although modern research recruits more diverse samples, targeted analysis of minority group identities is still required to meaningfully improve representation in research. Future research must better report and analyze these variables in order to help overcome the existing health disparities in minority groups.

List of Abbreviations Used

CAD: coronary heart disease
CMI: Cornell medical index
CSF: cerebrospinal fluid
CVD: cardiovascular disease
DEI: diversity, equity, and inclusion
DSM: diagnostic and statistical manual of mental disorders
ECT: electroconvulsive therapy
GWAS: genome-wide association studies
IBM: inclusion body myositis
LGBTQIA+: lesbian, gay, bisexual, transgender, queer, questioning, intersex, asexual, +
MCI: mildly cognitively impaired
MDD: major depressive disorder
NHPI: Native Hawaiians and Pacific Islanders
NIMHD: national institute on minority health disparities
POC: people of color
PTSD: post-traumatic stress disorder
RCT: randomized clinical trials
SPECT: single positron emission tomography
SRRQ: social readjustment rating questionnaire
VBAC: vaginal birth after cesarean
WEIRD: western, educated, industrialized, rich, democratic

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Ethics Approval and/or Participant Consent

Ethics approval and participant consent were not required for this type of study, as it is a literature review.

Authors' Contributions

SS: Conducted independent literature search, reviewed and analyzed papers, drafted and reviewed manuscript, and gave final approval of the version to be published.
ZP: Conducted independent literature search, reviewed and analyzed papers, drafted and reviewed manuscript, and gave final approval of the version to be published.

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