False Dichotomies: Cultural Bias in Medical Models

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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Introduction

Social and cultural biases are accepted as fact to such an extent that they are integrated into medical models including diagnostic tools, diagnostic criteria, device development, and system infrastructure. Observed correlations and patterns are crucial scientific data, but when those observations are tied to social bias, scientists often perceive a causative association, regardless of whether it is scientifically true. This phenomenon occurs (albeit with different effects) in relation to race, gender, sexuality, body size, and other categories–all of which are associated with deeply ingrained social constructs. It is impossible to separate social and biological variables, but when given the choice, the scientific community will almost always attribute differences to biology first. For example, in cases of sex and gender, the scientific community will far more often assume medical differences associated with male and female are a result of sex, and overlook the contributions of socialization and environmental factors, when in actuality these gender[1]-based factors may be equally or more significant. The true cause of the observed correlation may be a combination of both, or it may be exclusively due to either biology or environment, but these possibilities often are not investigated with the same degree of scientific rigor afforded to observations that do not coincide with such deeply ingrained social constructs. A similar pattern exists in medical findings that involve race. Currently and throughout United States history, correlations that are found along racial divisions of white and non-white (written as such because white is treated as the standard) are usually attributed *a priori* to some inherent biological difference of the races, rather than to the many social and environmental factors that result from systemic racism, generational trauma, and widespread bias. This occurrence with respect to race is particularly troubling given the growing body of

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[1] Here I will loosely define gender, in accordance with its popular use, as pertaining to the social perceptions associated with male, female, non-binary, and other categories of self identification. Sex will imply biological characteristics associated with the chromosomal differences labeled male, female, and intersex.

evidence demonstrating that race is a social category with an incredibly tenuous connection to biology–the only biological attribute of race (and likewise ethnicity) might be the shared genetic background of regional ancestry, but in most contexts, with as much genetic diversity within racial categories as between them, attempts to use race as a proxy for genetic background are dubious at best. At the same time, modern scientific research has demonstrated the concrete detrimental effects of social stressors on human health, so ignoring these factors in research dubbed "race-based medicine" constitutes a huge gap in scientific methodology. Other cultural dichotomies are subject to the same circumstance, and it occurs on different scales and within subcategories as well, for example with the dichotomization of trans- and cis-gender people and of different non-white racial groups. This acceptance of social dichotomization as medical fact without attention to context or other contributing variables not only applies cultural bias in a way that damages quality of care and patient outcomes, but also reinforces the cultural biases at play.

In a chapter for *The Handbook of Science and Technology Studies*, anthropology and STS expert Lucy Suchman writes about how divisions like human vs. nonhuman and nature vs. culture have become central to how the intersection of science and technology is understood, regardless of whether those divisions are accurate or inherently truthful (2007). Suchman also notes that the first term in these pairings of A vs. B is usually the standard against which the second term is judged for its similarity or its success in meeting the same criteria. This second term is not only judged against but defined by the first term, with B seen in some contexts as "not A" more than as its own separate entity. Per Suchman's analysis, these divisions and their roles in technoscientific politics are reinforced "through ongoing reiterations, generated from within everyday social action and interaction" (2007). There are far too many examples within healthcare of arbitrary distinctions that have been so thoroughly embedded in the "everyday interactions" of clinical practice that their arbitrary nature is overlooked and their validity is assumed or overstated. The resulting methods by which statistical correlations are implemented in clinical models often reflect social biases and have the potential to exacerbate medical inequity based on demographic criteria.

Methods

To formulate my argument, I perform a thematic analysis of primary and secondary sources in order to establish the role of cultural biases in modeling methods across medical disciplines. I use case studies, surveys, and statistical data to establish concrete effects of the observed patterns on clinical practice and outcomes, and contextualize these observations with anecdotal accounts. I also cite previous academic analyses that have noted these same patterns in specific medical circumstances, in order to demonstrate the similarities between these findings across disciplines, and to show that similar observations have been consistently acknowledged. To establish the ongoing prevalence of these patterns in modern medical science, I use sources published within the last fifteen years. I also reference older sources for historical context, which is relevant because systemic biases are typically carried forward as society develops. Since sex and gender are the most extensively studied dichotomies in feminist STS, I have to some extent used those as a basis for demonstrating how similar dichotomies have been imposed on other social categories with respect to medicine. In addition to using works by feminist scholars like Suchman, Oodshorn, and Jordan-Young as a conceptual framework for my interpretation of the topic, I devote several paragraphs to literature review and my own analysis of sex and gender dichotomies in the medical field. Ultimately, I aim to establish that the influence of sociocultural dichotomization and accepted norms on the methodology of medical modeling is a common paradigm across branches of the medical field. While the exact mechanisms and repercussions of cultural bias in medical modeling vary across specific programs of medical science, there are notable similarities that make this paradigm worth conceptualizing as an overarching systemic issue in addition to as a collection of interconnected but separate circumstances.

Literature Review and Analysis

Race is often incorporated into medical models as a proxy for more scientifically relevant categorizations such as genetic background and lifestyle factors associated with culture or socioeconomic status. Using race in this manner has exacerbated medical inequity by allowing social stereotypes to be acted on in clinical practice, and also by allowing medical professionals to overlook other factors that may be clinically significant, instead attributing those factors to a vague category of statistical similarity labeled "race" (Vyas et al., 2020). In the United States, Black people have frequently been the targets of this phenomenon, and one such example is the use of estimated glomerular filtration rate, or eGFR. eGFR is a mathematically estimated measurement of kidney function, used in place of actual glomerular filtration rate, which is difficult to measure (Kanungo et al., 2022). It is calculated from a model formula based on the amount of creatinine in a patient's blood, and it is used for dosing medication, enrollment in clinical trials, evaluation for dialysis, and evaluation as a kidney transplant donor or candidate, among other medical applications. Until 2021, the equations used to calculate eGFR included a race coefficient for Black versus non-Black patients, which would indicate Black patients as having better kidney function than white patients with identical creatinine levels (Tsai et al., 2021). This coefficient was based on data that showed higher average creatinine levels in patients who identified as Black, and on paper it was an attempt to personalize healthcare by incorporating this statistical correlation (*Race and EGFR*, 2020). Unfortunately, instead of creating more personalized care, the coefficient served to categorize Black patients in a way that was detrimental to them. As a result of the association with their racial "category," many Black patients were barred from receiving appropriate treatments indicated by their individual medical parameters. A paper by Tsai et al. also points out the dubious process by which the race coefficient was incorporated into the MDRD, one of the two dominant eGFR calculations (2021). The 1999 study in which it was proposed included "black ethnicity" as one of several regression variables, but did not include a functional definition for the term. "Black ethnicity" as a social category is incredibly broad, and does not denote any biological criterion (Tsai, 2021). Black people are severely underrepresented as kidney transplant recipients, especially as a first course of treatment prior to dialysis, with white candidates placed on transplant lists with almost twice the frequency of Black candidates (King et al., 2023). While a study by King et al. showed that eGFR calculations are not the only contributing factor, they do exacerbate this disparity (King et al., 2023). The race coefficient in eGFR and similar "correction factors" are not simply the result of poorly incorporated statistics, they are a consequence, whether intentional or implicit, of existing social bias.

A significant portion of the "racial differences" that still permeate the medical field reflect a history of pseudo-scientific justification for enslavement and discrimination, and thus are based in confirmation bias that is scientifically unsound. With regards to eGFR, it is possible that the higher average creatinine levels of Black patients actually indicated worse kidney function across the demographic, not higher creatinine tolerance. Incorporating a race-based "correction factor" may have allowed medical professionals to ignore possible causes for that discrepancy, including social stressors from race-based discrimination and generational trauma. In a paper analyzing the normalization of race correction in medicine, Linda Braun discusses another example, the spirometer, a device for measuring pulmonary function that is typically used in conjunction with either a race correction factor or population-specific diagnostic standards. Braun describes “a history of simplistic explanations for observed difference” in which researchers studying pulmonary function consistently ignored the environmental factors introduced by systemic racism, instead concluding that observed differences in pulmonary function between white people and Black people must be the result of innate biological traits (2021). The authors of some of these studies altogether ignored environmental and occupational factors, while others chose to disregard them in their interpretation of the results, favoring an explanation that reaffirmed their perception of Black people as inherently different and inferior, outside the normative standard of whiteness. This erasure, seemingly demonstrating disregard for good scientific practice and consideration of variables, can be better understood in context of the ideas it was used to justify. Physician Samuel Cartwright, one of the first to codify racial differences in pulmonary function, used the statistical difference as evidence for a bizarre theory of “deficiency” in various biological systems of Black people, which through convoluted logic he concluded made them intellectually inferior (Caplan et al., 2004). Even for researchers less determined to defend such an explicitly racist agenda, the division of Black and non-Black is so deeply ingrained in culture that the categories seemed a natural explanation for observed difference. It is an important distinction that based on the flawed methodology of these studies and the preconceived notions of their authors, the idea of inferiority is the basis for the pseudo-scientific conclusion of pulmonary difference based on race, not its result. Other examples throughout history show that regardless of what difference had been observed, deviation from the standard of whiteness would have been considered inferior or pathological. In one study comparing Black children to children of Italian and Irish descent, authors May

Wilson and Daton Edwards at the Cornell School of Medicine went as far as to exclude the Black children from their “normal totals”, designating “blackness” as inherently pathological at the same time as they conflated it with population differences in pulmonary function (Braun, 2021). Regardless of the reason for the observed statistical difference, designing the hardware of the spirometer and the protocols for its use on the basis of a white “standard”–further evidenced by the terminology of a racial “correction” factor for Black patients–is detrimental to equity in healthcare. As with eGFR, practices based on this conclusion of innate difference were carried forward by iterations of the same normative standards, with these methodologically flawed studies consistently cited even in the 21st century. Braun points out that “it was and is possible to think differently at different moments in time about race correction by substituting racism for race as the conceptual framework of research investigations" (2021). Replacing the binary of white vs. black with not affected vs. affected by systemic racism, a discrepancy is achieved that is numerically identical but merits further investigation instead of race “correction,” and introduces considerations that are neglected by a model based on perceived innate biological difference. This idea of innate biological difference is commonly applied as justification for distinctions between patient populations, but it is not always well-founded.

As with race, the dichotomies of sex and gender are so deeply ingrained in cultural politics of difference that sociocultural factors are often overlooked in the assumption of sex differences as a biological cause. Although sex is a crucial biological factor in some medical models, the way it is incorporated is too often based on conjecture or social bias, and clinical models often fail to account for stereotypes and the social influence of gender norms. The methodology for attributing certain physical or behavioral characteristics to biological sex is often less rigorous than typical scientific methodology for investigating correlation and causative factors, because the idea of fundamental difference is so heavily ingrained in the social perception of sex and gender. One example of how this phenomenon presents itself in medical practice is in the diagnosis of Autism Spectrum Disorder, a developmental disorder usually diagnosed in childhood that historically has been diagnosed in boys with a much higher prevalence than in girls. More recently, diagnostic rates in girls and adult women have increased, following acknowledgment by clinicians and the public that sociocultural and environmental factors affect both how autistic symptoms present and how they are perceived by medical professionals (Hartley & Sikora, 2009). Despite this realization, a significant chunk of autism research assumes a biological basis for the diagnostic gender disparity, and several attempts have been made to explain it as such, even without concrete evidence to support this theory (Lai et al., 2017). It is only fairly recently that the impact of social factors has been widely recognized in literature as a legitimate contributing factor. While it is impossible to separate social and environmental variables from biological ones in the study of human development, attempting to account for social stereotypes in the identification of autistic symptoms in more recent literature has yielded the possibility of a much smaller or possibly nonexistent gender disparity in autism diagnosis (Schuck et al., 2019). In a biosocial analysis of how sex and gender contribute to autism diagnosis, Sylvie Goldman argues that because children are often not diagnosed with autism until an age when developmental delays or highly organized play become evident, those children are raised until that age in a manner identical to their non-autistic peers. As a result, compared against a control group of those non-autistic children in their age range, those children have been raised the same, and thus have had equal opportunity to internalize gendered expectations, particularly those related to language and play. These "sex-based behavioral expectations" include girls being quieter, less disruptive, and more socially aware, while young boys are expected to be more expressive and social, potentially making their autistic traits more difficult to mask (Goldman, 2013, p.677; Lai et al., 2017). These recent trends of accounting for social factors undermine the assumptions made by previous research in treating the discrepancy as unquestioningly biological.

Even the scientists who acknowledge and document environmental variables are not immune to confirmation bias in how they account for them. In the concluding remarks of her biosocial analysis, Goldman demonstrates this bias and her own preconceptions by including claims that are unsupported by the content of her report. She says that while "sensitivity of the clinical instruments needs to be raised…biologic sex almost certainly bears the major responsibility for the male preponderance in autism" (Goldman, 2013, p. 677). She makes this claim even despite admitting that all hypotheses relating autism to biological sex remain "highly speculative" and she does not cite a single example of a theory that has confidently established such a relationship (p. 676). In most scientific contexts, "almost certainly" would imply a reasonable body of scientific evidence, and while some studies are underway, Goldman does not cite a significant body of research supporting biological mechanisms for the diagnostic discrepancy, nor does such a body of research exist that outweighs the research supporting a sociocultural mechanism. Goldman's certainty about autism as a sex-linked disorder may be attributable to the same deeply ingrained idea of biological separation between male and female that has led researchers to overlook the social factors she draws attention to in her analysis.

Sociocultural binaries often replace analysis of actual sociocultural factors relating to biomedical research, and these binaries affect the conclusions that are drawn not only in terms of their interpretation relative to environmental factors but also in terms of the scientific findings themselves. The existence of a social gender binary informs the way that scientists perceive biological data in a way that restricts the conclusions drawn from that data. One such example is the complex system of hormones dubbed “sex hormones” for their influence on sexual development. In her book on the archaeology of sex hormones, Nelly Oodshorn documents how the existence of a gender binary led scientists to classify developmental hormones in a dichotomous way and heavily conflate them with either side of that binary, even though that system of classification was no more coherent than if they had been classified according to other functions (Oudshoorn, 2003). The classification of these hormones as such slowed the scientific community's acknowledgment that people of any sex produce all of the hormones in question, not just one set or the other. Hormones and other aspects of physiology generally do not fit neatly into binary classifications, as has been plainly exhibited by recent media discussions regarding women’s sports and the participation of transgender women, intersex and non-binary people, and cisgender women whose hormone levels are outside what is considered “standard.” Interpreting these physiological traits as binary has real implications in medical care and diagnosis, as well as in the models used for new scientific research. Regarding bone density, another difference in accepted medical models of male and female, public health professor and feminist scholar Katarina Hamberg explains that while men on average have denser bones than women, there is huge variation and significant overlap between the categories (Hamberg, 2008). In a hypothetical scenario in which for whatever reason drug effectiveness and required dosage of bone cancer drugs was found to correlate with bone density–for the sake of discussion: higher density higher dosage required–it would be far from ideal to base drug dosage on whether the patient receiving care was male or female. Doing so would mean that women with higher-than-average bone density would receive too low a dosage, while men with lower-than-average bone density would receive too much. While individual calculations would be ideal, the overlap might be enough that those two patients would benefit more from getting the dose intended for the opposite sex. It is also likely that the clinicians administering care would perceive dosage to be based on sex, rather than on bone density, and this perception might prevent this complication from ever being taken into account. Unfortunately, when correlations are applied to medicine in this manner, the reasoning often gets lost behind the social dichotomy.

Sometimes social dichotomy also comes before reasoning, and data is fitted to existing conceptions instead of the other way around. In her 2010 book, *Brain Storm: The Flaws in the Science of Sex Differences*, Rebecca Jordan-Young explains this point as it relates to brain science. According to her, researchers design studies intended to show a relationship between biological sex and gendered behavior, and so as with the case of sex hormones, the internalized binary categories influence interpretations of findings (Jordan-Young, 2010, p. 17). While it may be that the theory of male and female brains is somewhat less prevalent than in 2010, sex nonetheless plays a significant role in assumptions about brain science research, despite the fact that brain science–with its connection to human behavior and the nature vs. nurture debate–is especially wedded to environmental variables. Discussions of “nature” in this context are heavily reliant on preconceptions about differences in sex. In the previously discussed case of a sex-linked biological mechanism for autism, the effect of hormone differences on brain development is one of the predominant proposed theories. Especially in medicine, the biological categories have never been understood without influence of the social, with gender historically used as a basis for scientific study of difference, even before the scientific differences in question had been adequately characterized.

In terms of preconceived notions as a basis for scientific and clinical interpretations, medical fatphobia also provides a plethora of examples. While body composition can be affected by a huge variety of medical conditions and clinically relevant lifestyle factors, the way that medicine currently accounts for it too often reflects an acceptance of the medical status quo that is based in social bias instead of clinical analysis. The body mass index, or BMI, is widely used as a measure of health by physicians and insurance companies alike. The BMI was created by 19th century statistician Lambert Quetelet, and is an arbitrary ratio of mass to the square of height, with no medical rationale. It was not even intended to be applied to individuals as it is today; it was invented as part of a flawed statistical survey effort–flawed among other reasons because its creator wanted to find the "average man" and included only certain ethnic populations in his surveys, most of them white (Quetelet, 1869). Notwithstanding both its intended purpose and its scientific irrelevance, BMI was employed by the healthcare industry and insurance providers to enforce the supposed division of "healthy" vs. "overweight", despite managing to provide no definition of clinical significance for either of those terms. Despite demonstrable evidence that certain health issues do not automatically correlate with weight (never mind questions of causation); it is a well-documented issue that the medical complaints of individuals considered "overweight" are dismissed and attributed to their body composition, often incorrectly and without further investigation (Meerai, 2019; Pilane, 2020). Even in the treatment of eating disorders, notoriously linked to poor body image, it is not uncommon for patients to be denied appropriate care by medical providers who do not perceive them as being sick (Puhl et al., 2014). Weight discrimination in medicine reflects an arbitrary dichotomy of "thin" vs. "unhealthy" in which unhealthy is conflated with the social perception of being fat. Like other medical models that reflect social biases, medical fatphobia both weaponizes and reinforces the biases on which it is based.

In terms of weaponizing bias, it is also worth considering the unique connections between racism and fatphobia in the medical modeling of human systems (Strings, 2020). Regardless of whether it is true and of why the perception exists, there is a persistent cultural perception in the United States that Black Americans tend to be proportionally heavier than non-Black people. Given the previously described pattern of conflating physical traits with racial binaries, it is interesting and relevant to note that size discrimination supports an indirect method of race discrimination on those grounds, and biases around race absolutely contributed to the rise of size discrimination. It is possible that people of African ancestry are more likely to have certain physical traits in common beyond skin color and hair texture; overall genetic diversity within racial groups does not preclude certain shared genetic markers within those groups, and in terms of epigenetics it seems likely that Black Americans may be affected by inherited aspects of racism-based generational trauma. However, even genetic differences and differences that do correlate with specific demographic populations do not exist in a vacuum, and people have a tendency both to invent data and to shape their interpretation of actual data so that it confirms their existing bias. It is also important to note that unlike more racially homogenous regions, the United States and the North American continent–owing to centuries of forced colonization and also immigration–have regional genetic populations that do not align with what is traditionally conceived as race. Whether or not this correlation between body composition and race exists and has a biological basis is less important than the way fatphobia is applied to racial contexts: treating certain body types as inherently unhealthy is another way of pathologizing deviation from the white standard. Social dichotomies are interconnected, and they can reinforce not only their own core biases but others as well.

Conclusion

Most binary medical categorizations do not guarantee specific biological parameters. This weakness may be a function of the statistical models from which many of the categorizations are derived, but only models based on the most deeply ingrained and culturally perceived social categories–sex, gender, race, size, etcetera–are used with abandon in diagnostic and experimental medicine. For other social categories like region, for example, which may well have concrete medical impacts (such as city air quality, food availability, even UV exposure), it is usually acknowledged that caution is necessary in scientific analysis because observed correlations will not apply to every individual. This caution contrasts with the methodology around claiming causative associations between body type and health, or between biology and differences associated with sex or race. These realities coincide with Suchman's argument in *The Handbook* and more broadly a central argument of feminist STS analysis, that binary social perceptions of difference are used to define how reality is understood. Some of the discriminatory medical practices that have arisen as a result of race only maintain their ability to cause harm as long as the original cultural bias remains ingrained in society. If medical professionals and the public did not have an implicit idea of certain body types as "pathological" then the BMI might not be as readily used as criteria for diagnosis. At the same time, the existence of the BMI reinforces the idea of certain body types as pathological. If there was no implicit bias against Black people, then some of the tools previously mentioned might not be used, but their use reinforces the idea of innate difference on which the original bias is based. Biomedical research is distinct from many scientific disciplines for its relationship to the human body, which comes with particular relationships to sociology and anthropology. Where in some scientific fields it might be possible to separate the object of study from its social and anthropological influences, in biomedical research the object of study is the human itself, both creator and product of the sociocultural landscape. Separating the two in the name of biological objectivity is scientifically invalid, the equivalent of growing one plant on the windowsill and another in a dark closet and claiming different amounts of water account for any differences in growth. In order to reconcile medical models with the human systems they represent, it is necessary to reconcile biology with the social sciences and think critically about the social dichotomies involved in the creation of those models.

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