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The Influence of Patient Care Based on the Race Calculation of Estimated Glomerular Filtration Rate

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ABSTRACT

The estimated glomerular filtration rate (eGFR) is a measurement used to determine kidney function and uses a distinct equation based upon race to determine results. This is an essential equation in measuring kidney function, which is used to diagnose acute kidney failure, chronic kidney failure, and end-stage renal failure. The eGFR measurement for non-Hispanic African Americans is multiplied by 1.159, where the eGFR result is not multiplied for non-Hispanic Caucasians. The purpose of this literature review was to determine if, based on the estimated glomerular filtration rate measurement, African American males receive the same level of care in terms of kidney failure diagnosis and treatment as Caucasian males. This review analyzes 15 studies that encompass the different levels of care based on race and eGFR. The literature describes the impact on non-Hispanic African Americans vs. non-Hispanic Caucasians. These studies include meta and statistical analyses and case-cohort, cross-sectional, retrospective, and controlled-case studies. Based on the research, it was found that there is a significant racial disparity in the diagnosis and treatment amongst the African American population based on the eGFR equation. In conclusion, this equation should be reassessed and reevaluated, and perhaps eradicated from the hospital setting so that non-Hispanic African Americans are treated with equal care to their non-Hispanic Caucasian counterparts.

INTRODUCTION

Kidney disease is a prominent issue in today's world. Many disease processes can cause kidney diseases including diabetes, hypertension, obesity, and polycystic kidney disease [1,2,3] (see Figure No. 1). A critical diagnostic tool in diagnosing kidney function and failure is the estimated glomerular filtration rate (eGFR). eGFR is an equation determined by measuring the amount of creatinine in the blood used to diagnose the different stages of kidney failure. In a healthy patient, the eGFR should be above 90. Anything below 90 would indicate a slight loss of kidney function, but anything less than 60 indicates potential kidney failure. On average, African American males must have an eGFR multiplied by 1.159, where Caucasian males do not have that extra multiplying factor to be diagnosed with kidney failure [3]. The African American patient may not receive treatment or the same treatment level as the Caucasian male based on this race multiplier. This leads to differences in diagnosis and treatment that cause inferior outcomes in African American males with renal failure.

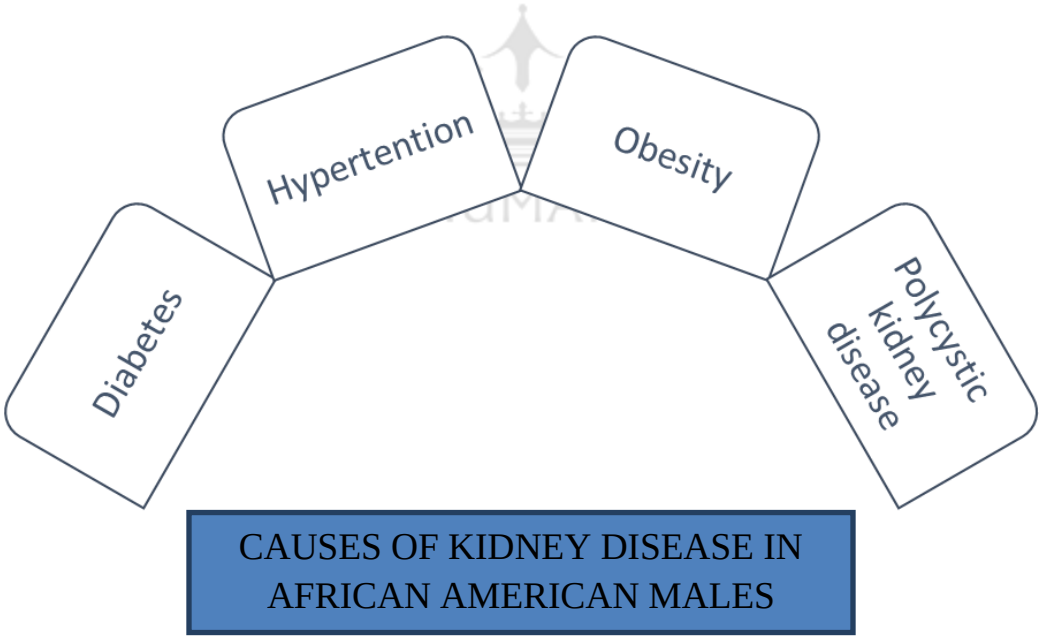

Figure No. 1: Causes of kidney disease in African American males.

The purpose of this literature review was to determine the differences in diagnosing African American males and Caucasian males with kidney disease using eGFR and further explore if race also affects the diagnosis and treatment of renal failure patients. So, the question stands: in

African American males, how does the normal estimated glomerular filtration rate compare to the normal Caucasian male estimated glomerular filtration rate in terms of the diagnosis and treatment in kidney failure?

METHOD

The method used is a review of the literature. Scientific databases were used to collect appropriate information about kidney diagnosis and treatment to obtain studies that pertained to this review. The databases used included the Cumulative Index of Nursing and Allied Health Literature (CINAHL) and EBSCOhost. The keywords used to search this literature had kidney diagnosis in African Americans, eGFR and race, race relationship to kidney failure, and black vs. white kidney failure (see Table No. 1). Based on the keywords, 28,107 studies were found in CINAHL and EBSCOhost.

Table No. 1. Keywords used and their definitions.

Kidney Failure	A condition in which the kidneys lose their ability to remove waste and balance fluids
Estimated glomerular filtration rate	An estimation based on a blood test for creatinine, a waste product in the blood. Determination of how well the kidneys are functioning
Race	Each of the major groupings into which humankind is considered (in various theories or contexts) to be divided based on physical characteristics or shared ancestry
Race relationship	Refers to those forms of behavior that arise from the contacts and resulting interaction of people with varied physical and cultural characteristics

Fifteen studies were used that pertained to the research. This can be seen in Table No. 2, search strategy, and limitations of the study. The studies provided peer-reviewed primary sources with evidence from the top four tiers in the evidence-based practice hierarchy to ensure the literature's quality. There is one exception where a level six qualitative analysis study was analyzed. The

literature was published from 2012-2020, where the articles that were more than three years old were used because of the specific pertinence to race and the relationship with eGFR.

Table No. 2: Search Strategy and Limitations of Study

Database Search	Search Strategy and Limiters	Number of Articles Found	Number of Articles Used	Number of Articles Addressing Specific Intervention Types
Cumulative Index of Nursing and Allied Health Literature (CINAHL)	Keywords: black vs. white kidney failure, kidney diagnosis in African Americans; eGFR and race; race relationship to kidney failure Limitations: journal articles, books, 2015-2020, not relevant to specific research, did not contain specific control groups	469	5	2
EBSCOhost	Keywords: eGFR and race, white vs. black kidney function males, white male's vs. black male's kidney function, African American male's kidney failure Limitations: 2015 or newer, peer-reviewed, Bethel University Library, academic journals, articles did not specifically pertain to PICOT question	27,638	10	1

Limitations of eGFR Measurement Literature

The research behind the impact of the different eGFR measurements on the diagnosis and treatment of African Americans vs. Caucasians is scarce. However, there is more research that pertains to health disparities among the two population groups. Therefore, most of the research obtained in this study focuses on the different levels of care and why there are different levels of care between races. The eGFR measurement factors into the reviews, but only one recent study advocates eliminating the eGFR race multiplier. After analyzing the studies explicitly based on race and kidney healthcare differences, the impact of the eGFR race multiplication factor was more easily identified. The race multiplier utilization component becomes more relevant after identifying how the eGFR measurement dictates a patient's diagnosis and treatment, displaying how the elimination of the eGFR race multiplier component could positively impact African Americans' kidney healthcare.

LITERATURE REVIEW

The literature reviewed analyzes 15 studies that pertain to kidney diagnosis and treatment of African American and Caucasian individuals. The review identifies common themes that demonstrate the differences in the level of care and treatment the two people groups receive and what factors cause those differences. Based on the findings, four themes were established that evaluated how impactful race is for kidney healthcare, specifically when applied to a medical equation.

African Americans at Higher Risk for Kidney Disease

Based on the 15 studies reviewed, each study indicated that African Americans and specifically African American males are at a higher risk for acute kidney injury (AKI) and progression for the worsening of kidney disease [4]. Each study used the race multiplying factor when measuring eGFR and used it to determine the results of each study. Throughout the review, a common theme observed was that throughout the healthcare system, when it came to the diagnosis of kidney injury or failure, African Americans are at a higher risk of a diagnosis of kidney disease and faster disease progression with the influence of the eGFR.

Association of Race with the Progression of Kidney Disease

A meta-analysis based on the association of eGFR, age, race, and sex with acute kidney injury determined that "male sex was associated with a higher risk of AKI… [and] African Americans had higher AKI risk at higher levels of eGFR…" [4]. African Americans are not only at a higher risk for AKI but have a faster progression to chronic kidney disease (CKD) and end-stage renal disease (ESRD). Research shows that African Americans are more likely to be diagnosed with end-stage renal disease (ESRD) secondary to hypertension and diabetes. At the same time, white Americans are more likely to be diagnosed secondary to polycystic kidney disease (Murphy et al., 2019). African Americans also have a faster progression of the disease; George *et al.*[2] stated: "individuals with African ethnicity progress faster from moderately decreased kidney function to ESRD." African American patients are more likely to start dialysis at a younger age than Caucasians and are four times more likely to progress to ESRD [1,2,3].

Another study, a cohort study, was performed in 2015 to determine where the burden of ESRD and its risk factors are high, focusing specifically on the low socioeconomic status of African Americans and Caucasians. Bock *et al.* [5] discovered baseline kidney function is a strong predictor of ESRD risk, and interaction with race was detected. The study was done by taking blood samples and calculating the eGFR from serum creatinine, resulting in a higher ESRD risk among African Americans relative to Caucasians.

There was also a baseline hypothesis that “the observed racial disparity in risk may be explained by differences in kidney function at baseline” [5]. This hypothesis was found to be true after the study was concluded, “Differences in baseline risk profiles were also apparent, with blacks who subsequently developed ESRD more likely to be obese and hypertensive while diabetes and CVD were more common among whites who developed ESRD" [5]. The baseline progression of kidney disease comes from the very beginning, with African Americans automatically disadvantaged.

Association of eGFR with Progression of Kidney Disease

Kidney dysfunction is usually recognized when a patient's eGFR falls below 60/mL/min and is based on creatinine clearance [2]. Creatinine is a chemical waste product produced by the muscles [6]. In the 1970s, researchers Cockcroft and Gault created a formula for creatinine

clearance based on age, weight, and sex. In the 1990s, researchers determined that this formula did not give accurate results for African American patients. Researchers needed a better way to measure black patients' creatinine clearance, creating the Modification of Diet in Renal Disease (MDRD) equation and the Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) equation [6].

These equations added race as an indicator to determine what creatinine clearance was for African American patients, thus furthering the eGFR equation's development [7]. On average, it was determined that African Americans have a higher muscle mass and therefore produce more creatinine, leading to a higher eGFR measurement. The eGFR in African American patients was higher than in Caucasians because, naturally, African Americans had higher creatinine levels in their bodies.

Similar studies also showed that creatinine levels were higher in African Americans; however, genetic and environmental factors were said to have played a big part in the creatinine levels [3]. With this emergence of data, the MDRD and CKD-EPI equations became the new base for determining African Americans' eGFR measurements. With the race multiplying factor, it takes a longer time for African Americans to be diagnosed with kidney failure. Other studies show that African Americans have a faster progression of kidney failure and a worsening status in kidney diseases. Perhaps kidney disease progression occurs "faster" in African Americans because while their eGFR is measured to be higher, they would progress at the same rate as Caucasian males without the race multiplying component.

Association of Physical Fitness

"Non-white minorities are at a higher risk for CKD than non-Hispanic whites" [8]. Once again, this finding is discussed in another study. This time, better cardiorespiratory fitness in patients proves to slow the decline of eGFR and lower the incidence rate of CKD. Essentially, if an individual maintains a healthy cardiovascular fitness level, they are less likely to develop hypertension and diabetes than individuals who are less fit. This study compared two different racial group's fitness levels and then compared the incidence of CKD. It was discovered that there is a strong negative impact of low fitness on CKD, once again putting African Americans at greater risk than Caucasian patients for CKD. However, this is not an *all* statement, but rather

a trend discovered from this specific study. It does not mean if you are an African American, you automatically will have CKD. Instead, they need to be more intentional about maintaining their respiratory fitness due to their increased CKD risk if they have a low fitness level.

Influence of Socioeconomic Status on Kidney Diagnosis and Treatment

The eGFR plays a significant role in the stage of kidney disease diagnosed and the types of treatment options a person can obtain. When the race multiplier is applied, an African American patient's eGFR is typically higher than a Caucasian person, which means that it takes longer to receive dialysis treatment or be put on the kidney transplant list. Before a person can even be diagnosed, patients have to afford to go to the doctor to receive the proper care. Individuals also have to be able to afford the lifestyle to take care of their bodies. Based on the studies reviewed, African Americans' socioeconomic status negatively impacts access to adequate healthcare, negatively impacting diagnosis, and treatment.

Kidney Failure Diagnosis Referrals

When a patient is diagnosed with kidney failure, they are often referred to a nephrologist who will prescribe medications and develop a plan to take care of the diagnosis of kidney failure. The idea is that the earlier a patient with decreasing function is referred to a nephrologist, there is a "reduced mortality rate and progression of kidney disease" [9]. In a study measuring the rate of renal function decline, race, and referral in primary care patients, Koraishy *et al.* [9] determined "those with fast CKD progression are more likely to be referred to nephrologists than slow progressors; however, a majority of patients are not referred." However, "Black patients, who are more likely to have faster eGFR decline were also more likely to be referred to nephrology compared to whites" [9]. In another study, "African Americans are suggested to have a higher risk of developing CKD than whites… low socioeconomic status (SES) is a commonly suggested explanation of the increased CKD risk in African Americans compared to whites…" [10]. This further displays the evidence that socioeconomic status plays a large role in African Americans' healthcare, leading to a racial divide in the level of care black patients receive.

Furthermore, studies have shown that African Americans are more likely to not follow up on the referrals made by their physicians. The Jackson Heart Study analyzed the low use of routine medical care (RMC) among African Americans with high CKD risk by examining socio-

demographics, comorbidity, healthcare access, and psychosocial factors that would affect RMC use. The study showed that "among African Americans with CKD or at an increased risk of CKD, those who were younger, and males, were more likely to report low use of routine medical care" [11].

When the socioeconomic variable is inserted into the equation for African Americans receiving proper diagnoses, it encompasses a lack of healthcare access, including lack of health insurance, financial resources, and transportation methods, making it more difficult for individuals to take proper care of themselves. This factor added with a race-based equation for the eGFR continues to put African Americans at a disadvantage. The lack of healthcare access also contributes to the lack of routine care and often worsens trust amongst African American patients and their providers. "Low trust in medical care among ethnic and racial minorities has been associated with lower medication adherence, reduced rates of preventive health services, worsened blood pressure control, and varying degrees of shared-decision making" [11]. The socioeconomic impact leaves a gaping hole in proper diagnoses for African American men without emphasizing the eGFR.

Kidney Transplants in Relationship to Race and eGFR

Socioeconomic status doesn't just impact the diagnosis of kidney failure for African Americans but also affects the treatment. Transplantation rates are significantly higher for white Americans with ESRD than African Americans [1]. In a controlled case study obtained by the Clinical Transplantation team, Peng *et al.* [12] identified racial disparities between blacks and whites on the kidney transplant waitlist in Chicago, IL. As illustrated in Figure No. 2, researchers found that "in Chicago, African Americans are significantly less likely than whites to appear on the renal transplant waitlist" [12]. The study also found that African Americans in poor neighborhoods were "significantly less likely to be waitlisted than patients in rich, white neighborhoods… Over 69% of African Americans with ESRD live in these [poor] neighborhoods" [12].

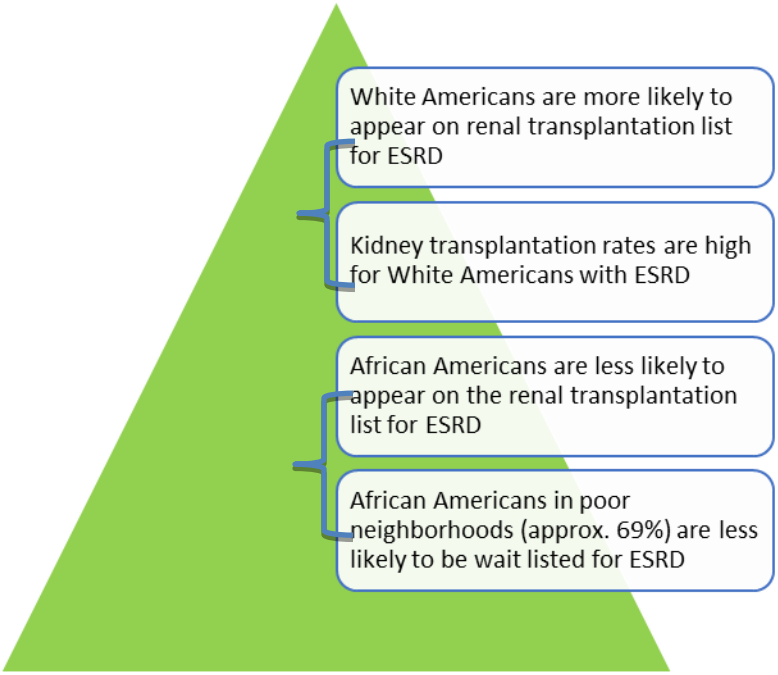

Figure No. 2: Racial disparities between blacks and whites on the kidney transplant waitlist

When it comes to looking specifically at the eGFR and the relationship between transplant lists, in a recent study performed by a team at Harvard's Medical School, the researchers sought to remove the race multiplier variable from the eGFR equation. When doing so, "3.1% of the patients were reassigned to a lower eGFR, meeting the criterion for accumulating kidney transplant priority" [13]. While the socioeconomic status is not explicitly addressed in this study, the racial disparities amongst African Americans are pointed out, including the racial barriers that negatively impact African American patients, including the low socioeconomic status as a significant barrier.

Underrepresentation of African Americans in Studies

In 2009, the CKD-EPI equation identified a better eGFR equation with more precision when adding race as a variable. One of the only limitations of the study was the lack of racial and ethnic minorities. Regardless of this limitation, it became the new face of the eGFR equation that currently determines hundreds of thousands of patients' diagnoses and treatment status.

In the CKD-EPI equation, the eGFR measurement was established based on a singular study. In the study *Racial Disparities in Creatinine-based Kidney Function Estimates Among HIV-infected*

Adults, the researchers notice that "the MDRD was derived in a mostly white population with low GFR and without HIV infection. The equation includes a race coefficient that raises the calculated eGFR in all African Americans by approximately 21% compared with non-black persons with the same serum creatinine, age, and sex, but this may overestimate eGFR among blacks" [14]. The MDRD and CKD-EPI equations lead to the evidence of the need for a race multiplier in the eGFR equation. Still, both studies had a limited number of African American patients, underrepresenting the African American population.

A significant weakness in most studies evaluated was that African Americans are vastly underrepresented in the number of people surveyed [1,2]. In a study *Race/Ethnicity, Dietary Acid Load, and the Risk of End-Stage Renal Disease Among US Adults with Chronic Kidney Disease,* the results were based on a study of 351 non-Hispanic blacks and 772 non-Hispanic whites [15]. This is a significant limitation when studying the differences between the two groups and using race as a specific factor within a study. Upon further review, this appeared to be a common theme among most of the studies. In another analysis, out of six studies performed that identify the participating cohorts' characteristics by AKI status, six out of eight studies had 0-1% African Americans represented [4]. Grams *et al*. [4] also studied chronic kidney disease cohorts, where five out of the six studies had 0-6% African Americans represented in terms of the participating cohorts' characteristics.

Lack of Education about Diagnosis and Treatment of Kidney Failure

When assessing the difference between eGFR in African American males and Caucasian males and how diagnosis and treatment of kidney failure affect these two racial groups, it is pertinent that a baseline knowledge of the disease is obtained. The physician must know to ask questions about when to diagnose CKD, how CKD is identified if patients know what the condition is, and if patients know they have several risk factors before they are diagnosed. In several studies, it was found there is a lack of knowledge about CKD in both parties, physicians, and patients.

Physician Knowledge

Plantinga *et al.* [16] looked at the difference in automatic eGFR reporting between African American patients and non-black patients. The results showed no racial discrepancies for African American patients CKD reporting in the pre/post stages of the disease. However, the issue is

within the lack of "attention to competing health issues, concern over unnecessary nephrology referrals, and provider's lack of knowledge about the risk of CKD" [16]. The coding or "identification "of CKD was shown to detect relatively few cases of CKD. More CKD identification is said to be documented with ICD-9-CM codes related to "lower eGFR and a decrease in nonsteroidal anti-inflammatory drug prescriptions, giving face validity to the use of ICD-9-CM codes as a measure of physician awareness of CKD" [16]. If there is a physician increased awareness/knowledge of CKD regarding when or how to diagnose and when to begin treatment, there would be improved disease treatment. A targeted education towards physicians is a strong recommendation for this study.

Patient Knowledge

Kazley *et al.* [17], regarding lack of patient knowledge of an increased risk of kidney disease, says, "the findings are in agreement with and expand upon previous research... which recommend prevention efforts for kidney disease aimed at high-risk populations." Interventions included early education and physician teamwork to build a better rapport to build trust with their patients. They found through their qualitative study from one patient who stated, "...a lot of people are not knowledgeable about it because it is something that seems like it just sprung up quick" [17]. The end-goal is to educate patients about their health to provide early prevention and education for those considered a "high-risk population." Hence, more patients aren't in situations where they find out too late.

With contributing factors such as socioeconomic status, poverty, and lack of healthcare access, patient knowledge is essential in understanding kidney failure. The more patients understand about their diagnosis, the better equipped they are to advocate for themselves. Understanding the eGFR and the race multiplying variable offers the chance to ask more questions about their diagnosis and the desire to see that race variable change so that African Americans receive the same care level as Caucasian patients.

Summary of Findings

The literature review of each study offers a further glimpse into the difference in diagnosis and treatment between African American and Caucasian males based on the eGFR and the contributing factors that negatively impact the level of care received. Prominent themes

discovered in the literature review can be found in Figure No.3. The eGFR puts African Americans at a disadvantage when it comes to being diagnosed with the proper stage of kidney failure and further impacts the type of treatment they can receive. The different themes can be identified in Table 3 Differences in Diagnosis and Treatment for African Americans vs. Caucasians. The largest common theme identified was that African Americans are at a higher risk for kidney disease. Many studies indicated that the common factor in determining any type of kidney diagnosis included the high risk of African American patients. The eGFR race factor potentially overestimates what black patients' eGFR is, leading to "faster" progression. Another common theme was the socioeconomic status that had a considerable influence over the diagnosis and treatment African Americans received compared to Caucasian patients.

Underrepresentation was another common theme established after determining how few African Americans were a part of the studies to create the MDRD and CKD-EPI equation and other studies that look at kidney failure in African Americans vs. Caucasians. Finally, a lack of education impacts the type of diagnosis and treatment obtained by African Americans compared to Caucasians, demonstrating how a lack of knowing what to look for does not allow patients to advocate for themselves. If African American patients obtained more knowledge, the eGFR could be further questioned and the race variable removed when determining their diagnosis and treatment.

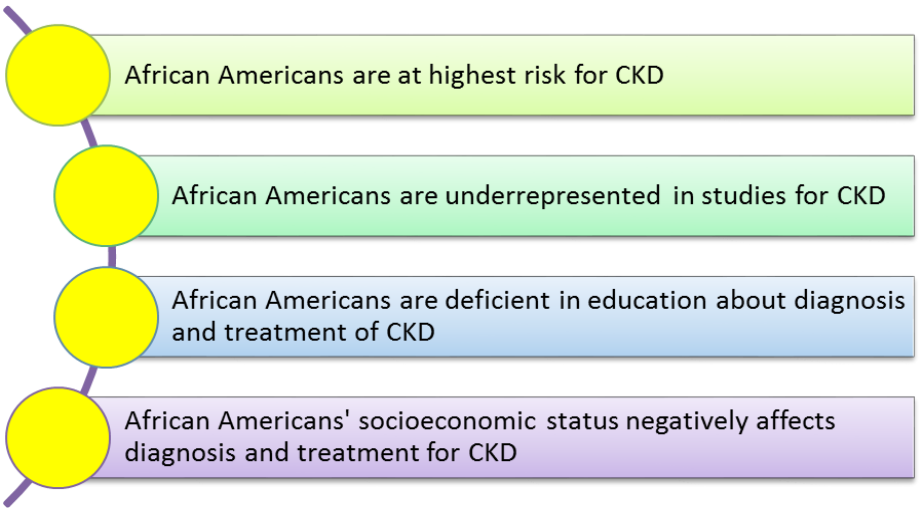

Figure No. 3: Differences in Diagnosis and Treatment for African Americans Vs. Caucasians with Chronic Kidney Disease

DISCUSSION

In response to how the normal estimated glomerular filtration rate impacts the diagnosis and treatment of African American males vs. Caucasian males, the research has concluded that the race variable negatively impacts African Americans. The eGFR is one of the main determinants in diagnosing and treating kidney failure and does not benefit African American patients. The findings highlight eliminating the race multiplier, and eGFR, should be measured the same between races, specifically African Americans and Caucasians. There are a few strengths, weaknesses, and recommendations to discuss after analyzing all fifteen studies.

Strengths

One strength in this analysis is the variety of studies that were reviewed. There were meta and statistical analyses as well as case-cohort, cross-sectional, retrospective, and controlled-case studies. There was 15 studies total, and all these studies yielded various effects of eGFR and kidney diagnosis and treatment. Out of the 15 studies, the level of evidence was a level 4 or above, besides one article that was a level 5 because of its relevance to the topic. There were three studies that were level 1, zero level 2, four level 3, and six level 4.

Weaknesses

The primary weakness is the relatively small amount of research that has been performed on this topic. It was not until just recently that light has been shined on this problem. As a result, the studies' level of evidence averaged approximately 3.2, and one study was down to a level 5. Another problem Ahmed *et al.* [13] pointed out, is "the limited geographic cohort and a relatively small proportion of African Americans and other racial minorities." This is accurate where the predominant race in America is Caucasian and African Americans are considered the minority, making any study when comparing these groups disproportionately.

Recommendations

From the themes identified from our analysis, there need to be more studies conducted on the topic of ESRD/CKD about African Americans compared to Caucasians. More specifically, more studies should be done on how race multiplier affects African Americans' diagnosis and treatment. There ought to be more studies performed on the effects of using an exact GFR, not

estimated or studies on the effect of getting rid of the race multiplier in eGFR. Studies have already shown that it impacts where African American patients are categorized and how eradicating the race variable would put African Americans in a different kidney failure stage, changing the treatment received. Removing the race variable eliminates the potential to overestimate an African American man's eGFR and gives African American males the same diagnosis and treatment as Caucasian males. The complete elimination can only be discovered if more work is put into the significant disparities amongst black men based on risk, research studies, socioeconomic status, and health education.

CONCLUSION

The studies show that there is indeed a difference in how eGFR measurement affects Non-Hispanic Blacks (NHB) versus Non-Hispanic Whites (NHW) diagnosis and treatment. The major effects are found in the level of eGFR measurement and at what level a patient is either referred to a nephrologist, diagnosed with CKD or ESRD and provided treatment such as dialysis or a kidney transplant.

Ahmed *et al.* [13] discuss the concept of a "race multiplier," which is essentially the eGFR for African Americans, is automatically multiplied by 1.159, commonly referred to as the "default equation." In their study, 434 patients were reclassified from a higher level of kidney function to a lower level when the race multiplier was removed. "Of 2225 African Americans, a total of 743, 33.4%, would change in the level of CKD stage to a more severe stage if the race multiplier were removed." Not only that but if the race multiplier was removed, 3.1% of African Americans would be reclassified and would then qualify for a kidney transplant [13].

The race multiplier results and their removal across the nation would impact hundreds to thousands of African American patients and their kidney function level. For some, that could mean life or death. The race multiplier also casts a Caucasian perspective of what is defined as "black" on patients, where the provider could misidentify the patient's race but is a further result of structural racism [13].

By researching the effects of eGFR in NHB versus NHW, there was a lot of data discovered about gaps in the healthcare system. For example, the low level of trust, lack of patient education, lack of patient referral, and socioeconomic status can affect a patient's course of care.

However, based on the little evidence found, the racial multiplier is a major disadvantage to the diagnosis and treatment of CKD for NHB regarding delay of care when their kidney function is just as impaired as an NHW patient. Still, the lab result does not allow this adjustment to be made. The recommendation remains the same; race multiplier should be eliminated, and eGFR should be measured the same between all races, adjusting precisely per patient, specifically between Non-Hispanic Black patients and Non-Hispanic White patients.

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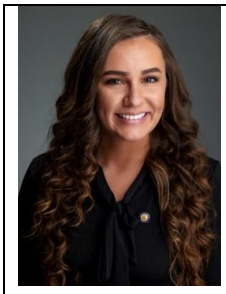	**Brianna R. Andrews** *Bethel University School of Nursing, Mishawaka, Indiana, USA*
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