The Impact of Race on Plantar Loading and Research Engagement

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ABSTRACT

African Americans (AA) are twice as likely as White Americans (WA) to experience diabetes-related foot amputation due to foot ulcers. Foot ulcers are often caused by high plantar pressure, and several factors can impact plantar loading. Thus, there is a need to determine if race is a significant predictor of plantar loading. Additionally, with the current state of racial health disparities there is a need to determine racial differences in research engagement and mistrust between AA and WA. Data was collected from 107 participants, aged 18-30, in this Institutional Review Board approved study. An EMED pressure-measurement system (Novel Electronics, St. Paul, MN, USA) was used to collect plantar loading data. Additional measurements collected from each participant included arch height index (AHI), standing height, gait speed, and weight. Participants also completed two surveys focused on research engagement and research mistrust. A multiple linear regression was used to test if race and other factors significantly predicted plantar loading. Non-parametric tests were used to test if there were significant differences in research engagement and mistrust between AA and WA. The analysis determined that race was a significant predictor for plantar loading, along with age, AHI, gait speed, sex, and body mass index (BMI). Additionally, it was found that research engagement practices and feelings of research mistrust differed significantly between AA and WA young adults. These findings could improve our understanding as to why AA are more likely to have diabetic foot ulcers than WA, and why AA are less likely to participate in research than WA.

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GENERAL AUDIENCE ABSTRACT

African Americans (AA) are twice as likely than White Americans (WA) to experience diabetes-related foot amputation due to foot ulcers. Foot ulcers are often caused by high plantar pressure, and several factors can alter plantar loading. Thus, there is a need to determine if race is a significant predictor of plantar loading. Additionally, with the current state of racial health disparities, there is a need to determine racial differences in research engagement and mistrust between AA and WA. Data was collected from 107 participants, aged 18-30. A pressure-measurement system was used to collect plantar loading data in seven regions of the foot during self-selected speed walking. The measurements collected from each participant, included arch height, standing height, gait speed, and weight. Participants were also asked to complete two surveys focused on research engagement and research mistrust. We used this data to evaluate if race and other factors predicted plantar loading and to compare survey responses between AA and WA. It was found that race, age, arch height, gait speed, sex, and BMI were considered significant predictor variables for plantar loading measures. Additionally, research engagement practices and feelings of research mistrust differed significantly between this younger sample of AA and WA. These findings help to improve our understanding of why AA are more likely to have diabetic foot ulcers than WA, and why AA are less likely to participate in research than WA, even as young adults.

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List of Abbreviations

AA	African American
AHI	Arch Height Index
BMI	Body Mass Index
FPMS	Foot Posture Measurement System
GBMMS	Group-Based Medical Mistrust Survey
ICD-9-CM	International Classification of Diseases, 9th Revision, Clinical Modification
IRB	Institutional Review Board
MTH	Metatarsal Head
MTPJ	Metatarsophalangeal Joint
VIF	Variance Inflation Factor
WA	White American

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Attribution

Multiple individuals contributed to the creation of this study. Dr. Queen and Dr. McCullough contributed to conceptualization of the first manuscript's study design, while Dr. London aided in conceptualization of the second manuscript's study design. Dr. Baker assisted in statistical analysis for both manuscripts. Lastly, Dr. Queen assisted in finalizing the research questions, design, and logistics. Additionally, she secured funding for the study and edited the thesis document.

INTRODUCTION

African Americans (AA) are more likely than White Americans (WA) to have chronic illnesses [1], such as diabetes [2], [3]. Diabetes is one of the leading causes for death in the United States [4], with AA being more likely to die from diabetes than WA [5]. Additionally, AA have worse diabetes symptom management and higher rates of diabetic complications than WA [6]. One example of diabetic complications is a foot amputation, which is often needed due to the presence of foot ulcers [7]. AA are more likely than WA to experience foot ulcers and are twice as likely to experience diabetes-related foot amputation [6]. Overloading in a specific area of the foot is a major risk factor for the development of many diabetic-related foot ulcers [6]–[10].

According to existing literature, diabetic-related foot ulcers are mostly caused by high plantar pressure [6]–[10]. Diabetic patients with foot ulcers are more likely to have higher peak plantar pressure than patients without foot ulcers [11], [12]. Studies have found that sex may also influence the development of diabetic foot ulcers, as women have less severe neuropathy and lower foot pressures than men [13]. Because men and women have different foot shape characteristics (e.g. arch height, ball of the foot, hallux, etc.), they also have different plantar loading outcomes when examining measures such as contact area, maximum force and force-time integral which are reported to be different based on the foot region [14], [15]. Research has shown that foot type can substantially impact plantar loading [16]–[18]. Differences in plantar loading have been documented in different foot regions when comparing pes planus (flat foot), pes rectus (normal arch), and pes cavus feet (high arch) [16]. Additionally, existing research studies have reported that AA are more likely to have a pes planus foot type when compared to WA, while pes rectus foot type is more common in WA than AA [19]. However, limited

research has been conducted to examine the effect of race on plantar loading variables with. Currently, the literature tells us that AA with diabetic ulcers have lower plantar pressures than WA with diabetic foot ulcers, but in this study AA were underrepresented, making up 14% of the sample [20]. Additionally, there is a need to understand plantar loading in healthy individuals in order to build knowledge on what all can affect plantar loading. While it is known that diabetic foot neuropathy, foot type, and sex can impact plantar loading, there is a need to determine if race is a significant predictor of plantar loading.

Although this study identifies a gap in the existing literature on plantar loading differences in racial groups, there is a unique challenge of gathering participants for this study. It is critical that racial minorities are included in research to strengthen the generalizability of findings and reduce racial health disparities. However, there is a mistrust of the medical community due to the historic exploitation of AA in the US over the last 400 years, which is one of the reasons for the lack of participation of AA in medical studies [21]–[27]. Consequently, the mistrust of research personnel has affected the ongoing racial health disparities that have influenced the health outcomes of AA [22], [28], [29]. Community engagement has been shown to be an essential component to improve participation of older AA adults in research [30]–[33]. Limited research has assessed research engagement in young adults, especially within the AA community [34]. With the impact of the COVID-19 pandemic and the current state of racial health disparities it cannot be assumed that young AA adults have the same attitudes towards research engagement as the older members of the community or younger WA.

Therefore, the objectives of this study are: 1) Determine the impact of race, arch height, age, BMI, sex, family history of diabetes, and gait speed on plantar loading, and 2) Identify racial differences in research engagement in young adults between AA and WA. The study

sample will include 2 racial groups, African Americans, and White Americans. Green's rule of thumb for regression was used to drive the power analysis [35]. Based off the power analysis, 106 participants were needed to adequately power the study to detect a difference.

Specific Aim 1: Determine the impact of race, arch height, age, BMI, sex, family history of diabetes, and gait speed on plantar loading

Hypothesis: Race, arch height, sex, and gait speed will be significant predictors of plantar loading.

Specific Aim 2: Identify racial differences in research engagement in young adults between AA and WA.

Hypothesis: AA will have higher feelings of mistrust in biomedical research than WA and be less willing to participate in biomedical research than WA.

There is currently a lack of information on racial differences in plantar loading, therefore by assessing differences this study could potentially inform the development of intervention strategies for patients with diabetic foot neuropathy. Additionally, identifying racial differences in research engagement among young adults can provide insights on how to modify recruitment practices to increase participation in biomechanics research among African Americans.

LITERATURE REVIEW

Racial Health Disparities

Race is used to group people based on physical features, social identity, and cultural background [36]. It is important to note that race is very complex, and due to its social construction, its definition has evolved throughout history [37], [38]. However, race is a salient

factor when looking at health inequities that contribute to the health disparities by race [37]. For example, heart disease is a leading cause of death for people in the United States, but African Americans are 30 percent more likely than White Americans to die from heart disease [38]. So, as illustrated by this example and others, when we want to solve these health inequities, it is important that we factor in race [37], [39].

The Center for Disease Control and Prevention recognizes racism as a system that negatively affects the health of millions of people, specifically minority communities [40]. Racism contributes to the differential health outcomes among minority populations due to inequitable access to social, material, and educational resources [41]. When a specific group doesn't have the same health access as another group, this can affect their overall health status and continue to persist for generations [41]. This in turn leads to minorities often having differential health outcomes than their White counterparts [41].

Differential health outcomes have existed between African Americans and White Americans for more than 400 years [29]. Documentation shows that African Americans experience higher rates of chronic illnesses compared to White Americans [42]. Examples of these illnesses include many noncommunicable diseases such as type 2 diabetes, asthma, and cardiovascular disease, which account for 70 percent of deaths worldwide [42]. With higher rates of chronic illnesses, there is a higher chance for death. One of the chronic diseases that disproportionately affects African Americans is diabetes [29]. As noted earlier, there are many reasons for the existing racial health disparities today, including: access to education, lack of healthcare, employment, social justice issues, and health insurance, just to name a few [29]. One way to mitigate these issues is having African Americans participate in health-related research studies so researchers can better understand and identify health disparities as well as the

underlying mechanisms driving those disparities, and ultimately, develop and evaluate interventions to improve their health outcomes [33]. However, there is an ongoing challenge of engaging African Americans in biomedical research which is deeply connected to the mistreatment of African Americans in not only research, but the healthcare system [33]. Thus, there is a need to explore these issues in order to increase African American participation.

Research Engagement & Mistrust

Health inequities, which affect the most vulnerable populations such as minorities, are currently intensifying around the U.S. due to a variety of complex factors such as the COVID-19 pandemic. There is a need to better understand the mechanisms driving these inequities, however, due to racial health disparities, there has been and continues to be a mistrust of medical research and researchers that have deterred African Americans from participating in research studies [39]. There is a long history of unethical research (e.g., Tuskegee Syphilis Study and Henrietta Lacks), however, some say that the mistrust dates back to slavery [23]. African Americans have been mistreated by healthcare providers which also affects their willingness to participate in medical research and, in general, their trust of medical providers [23]. In short, mistrust is oftentimes seen as the most important factor in explaining why African Americans may not engage in medical research.

It is important that African Americans are engaged in research so we can not only have racially and ethnically diverse studies, but also to improve our understanding of medical conditions that are pertinent in the African American community. Using a diverse sample of research investigators, Passmore et al found that relationship-building and respect were key to successful engagement of minorities in research [33]. Institutions also play a minimal role in establishing that trust and it is up to the researchers to establish trust within minority

communities. Fryer et al found that becoming really connected to the community in which they are doing research helped when recruiting minorities [32].

Additionally, minority participants suggest several strategies for researchers to build trust: engaging with the communities they are serving, overall transparency of the research, race matching between participants and research investigators, and using trusted members of the community to recruit participants [43]. One study found that mistrust in the health care system was seen as the primary reason for lack of participation in medical research by African Americans [22]. They saw that this mistrust stemmed not just from historical examples of unethical research such as the Tuskegee study but was enforced by current issues in the health care system and discrimination [22]. In another study, community engagement was identified as one method to use when helping older African Americans have a better sense of their health and well-being [31].

Instruments that have been used to measure research engagement and mistrust

The Group Based Medical Mistrust Scale (GBMMS) was developed to measure medical mistrust among Black and Latina women completing breast cancer screening and treatment [36]. This scale measured suspicion of health care providers, lack of support from health care providers, and disparities in health care [44]. More recently, this scale was modified to measure mistrust in medical research and researchers [28]. In a previous study using the modified GBMMS, African American adults and adolescents were found to be more likely to score higher on the scale than their White American counterparts [28].

Corbie-Smith et al. created a 12-item questionnaire that examined trust in relationship to research participation [20]. From this study, it was found that African Americans were more

likely to not trust their physician compared to White Americans. More specifically, African Americans were more likely to believe that their physician will put them at risk, believe they would be used as a guinea pig in research, and not trust their physician in explaining a research study [23]. In another study, Garza et al. utilized a survey covering topics related to research participation [23]. While the survey was administered by telephone to only African Americans and Latinos, the study found that African Americans were not asked to participate in medical research as often as Latinos. However, some of the top motivators for African Americans participating in research was helping others, helping themselves, having the diseases being studied or being close with a person who has the disease being studied [26]. Participants also stated that researchers being clear about their research and race-matching also led them to participate more in research.

Diabetes in African Americans

One area in which we have seen a racial health disparity is in the diagnosis of diabetes. In 2018, it was reported that African American adults were 60 percent more likely to be diagnosed with diabetes by a physician [37]. Additionally, African Americans were twice as likely as White Americans to die from diabetic-related complications such as, visual impairments, lower extremity amputations, and end stage renal disease [45]. One complication that often impacts people living with diabetes are foot ulcers, which are open sores or lesions that have difficulty healing. Foot ulcers experienced by individuals with diabetes often occur on the bottom of the foot and can be attributed to nerve damage in the foot caused by chronic high blood sugar, also known as diabetic foot neuropathy. In severe cases, foot ulcers can lead to foot amputation and sometimes death [46]. African Americans with diabetes have higher incidences of foot amputations than White Americans [39]. Additionally, African Americans experience a higher

severity and incidence of amputations than their White counterparts [47]. Using ICD-9-CM codes, researchers were able to find that African Americans were more likely to have higher-level amputations than White Americans [48]. Foot amputations do not just vary by race, but also by income. Skrepneck et al found that people from lower income regions had higher incidences of major foot amputations than those from higher income regions [49].

Diabetic Foot Ulcers

It has been established that high plantar pressure in those with diabetes correlates with foot ulceration, especially when there is neuropathy [50], [51]. Ulceration was more likely to occur in the 3rd metatarsal head (MTH), followed by the 2nd MTH and the toes [41]. A previous study found that higher foot pressures and diabetic foot neuropathy was associated with diabetic foot ulcers in a diabetic population that included White Americans, Hispanics, and African Americans [43]. However, this study found that joint mobility and plantar pressure were less predictive of foot ulceration in African American and Hispanics with diabetes [20]. One study found that African Americans tend to be diagnosed with foot ulcers at a younger age than their White American counterparts [48]. Women are shown to have a lower risk of developing foot ulcers than men, which appears to be associated with having less severe neuropathy, lower foot pressure, and increased joint mobility. However, women should be considered to have an equal risk of developing foot ulcers when neuropathy is present [13]. Pedography systems, which can be used to measure plantar pressure during a variety of static and dynamic tasks, have been used to treat, diagnose, and study diabetic foot neuropathy [12], [52]–[54].

Arch Height & Plantar Loading

Arch height, also known as arch index, is used to denote foot posture as either pes planus, which denotes a low arch, pes rectus, which corresponds to a normal arch, or pes cavus, which corresponds to a high arch. Arch index can be calculated using a pedography system, such as the EMED X plate (Novel Electronics, St. Paul, MN, USA), and this measure was developed through previous research [55]. Research has shown that foot type can substantially impact plantar loading including common outcome variables such as maximum force, force-time integral, center of pressure, and contact area [16], [17]. For example, previous studies have shown that pes cavus feet demonstrate lower maximum force, force-time integral and contact area in the medial midfoot when compared to pes rectus and planus feet [16]. Force-time integral and contact area have also been reported as higher values in the lateral forefoot in pes cavus feet compared to rectus and planus [16]. Additionally, center of pressure was also measured more laterally in cavus feet compared to rectus and planus foot types [16]. Further, in planus feet, previous studies measured higher peak pressure in the 2nd metatarsophalangeal joint (MTPJ) and lower maximum force and force-time integral in the 4th and 5th MTPJ when compared to other foot types [16]. In addition, studies have measured lower maximum forces in the 1st MTPJ and higher peak pressures in the hallux of pes planus feet compared to cavus and rectus feet [16]. It is also worth noting that men and women have different foot characteristics, particularly with respect to the arch, lateral column of the foot, the great toe and the ball of the foot [15]. As indicated by the examples above and others, these foot characteristics have been shown to impact a variety of plantar pressure outcome measures (i.e., maximum force, peak pressure, etc.).

Very few studies have examined how race can affect arch height and also foot disorders [19], [56], [57]. Golightly et al found that African Americans were three times more likely than White Americans to have pes planus feet [19]. Additionally, prior studies show that African

Americans are more likely to have certain foot disorders such as hallux valgus, a foot deformity affecting the 1st MPTJ, and hammer toes, a foot deformity affecting the 2nd, 3rd or 4th MPTJ [19], [56]. For those with a BMI under 30, previous studies have reported higher odds for African Americans having hallux valgus, hammer toes, and overlapping toes, suggesting obesity may mask racial differences [19].

Plantar Loading & Diabetes

Previous work has shown that individuals with diabetes have a slower walking speed and increased peak plantar pressure in the midfoot than those without, which could be due to diabetic individuals walking more cautiously [47] [58]. Another study found that those with diabetic foot neuropathy have a different walking pattern than those without based on differences in loading patterns and COP excursions [59]. Additionally, prior studies showed that those with diabetes have higher plantar pressure under the hallux or 1st MTH as opposed to individuals without diabetes who have higher plantar loading beneath the 2nd and 3rd MTH [58].

Peak plantar pressure is considered a factor that leads to foot ulcers, and as a result, clinical interventions aimed at decreasing ulceration are often aimed at decreasing peak plantar pressure (i.e. casting, customized shoes, insoles, cautious walking, walking assistance) [58]. Rearfoot and forefoot plantar loading is higher in those with more severe diabetic foot neuropathy than those with mild or no diabetic foot neuropathy [46]. Additionally, there is an increase in the forefoot-to-rearfoot plantar pressure ratio (F/R ratio) which may point towards a pressure distribution imbalance as foot neuropathy becomes more severe [60]. Abri et al found that those with severe diabetic foot neuropathy exhibited higher peak plantar pressure in the midfoot, heel and medial forefoot, also suggesting that diabetic foot neuropathy increases the chance for higher peak plantar pressure [61].

IMPACT OF RACE AND OTHER FACTORS ON PLANTAR LOADING

Abstract

Diabetes is one of the leading causes for death in the United States, with AA being twice as likely to die from diabetes than WA. AA are twice as likely to experience diabetes-related foot amputation due to foot ulcers, which are most often caused by high plantar pressure. While it is known that diabetic foot neuropathy, foot type, and sex can impact plantar loading, there is a need to determine if race is a significant predictor of plantar loading. Data was collected from 107 participants in this Institutional Review Board approved study. Exclusion criteria were being unable to walk without an assistive device, having a lower extremity injury in the past 6 months that limited physical activity for more than two days, or having a history of lower extremity surgery. An EMED pressure-measurement system (Novel Electronics, Inc, St Paul, MN, USA) was used to collect plantar loading data in seven-foot regions at 100 Hz. Each participant walked barefoot at a self-selected walking pace ten times. Contact area, maximum force, and force-time integral were collected for each step on the pressure plate. Measurements, including arch height index, standing height and weight were collected from each participant. Arch height index (AHI) was measured using the Foot Posture Measurement System. Gait speed was measured using a timing system (Brower Timing Systems, Draper, UT). A multiple linear regression was used to test if race, age, AHI, gait speed, sex, family history of diabetes, and BMI significantly predicted plantar loading. Race, age, AHI, gait speed, sex, and BMI were considered significant predictor variables for plantar loading. Most importantly, race was a significant predictor of maximum force in the hallux ($\beta=6.46$, $p<0.001$), rearfoot ($\beta=-6.36$, $p<0.001$), and lateral midfoot ($\beta=-2.72$, $p<0.001$), and the force-time integral in the hallux ($\beta=2.37$, $p<0.001$), rearfoot ($\beta=-2.14$, $p<0.001$), and lateral midfoot ($\beta=-0.65$, $p<0.001$). This study demonstrates that race, along with

age, AHI, gait speed, sex, and BMI are significant predictors of plantar loading. These findings could help with understanding why AA are more likely to have diabetic foot ulcers than WA and why they develop in specific regions of the foot due to higher loading in those regions.

Introduction

Diabetes ranks seventh in the leading causes of death for people in the United States [4]. While the total number of individuals diagnosed with diabetes has doubled in the past two decades, data shows that diabetes is more likely to occur to racial/ethnic minority groups than White Americans [37]. One group that is detrimentally affected by diabetes is African Americans. African Americans are more likely to die from diabetes than White Americans, along with having worse management of diabetes symptoms and higher rates of diabetic complications than White Americans [37]. An example of a serious complication of diabetes is foot ulcers, which occur due to poor circulation and neuropathy in the foot. Oftentimes, these ulcers become infected and not heal, requiring foot amputation and at times even lead to death. Diabetic foot ulceration is usually caused by high plantar pressure which can be caused by diabetic foot neuropathy [61]. The current literature suggests that individuals with who have diabetic foot ulcers have higher plantar pressure than those without diabetic foot neuropathy and no diabetes [12]. Those with diabetic peripheral neuropathy can also continue to have high plantar pressure after the ulcer has been resolved. Treatment for diabetic foot ulcers can include off-loading using shoes, casts, and/or orthotic devices [62], as increased plantar pressure is believed to have caused foot ulcers in those with diabetes.

The current literature suggests that plantar loading is impacted by a variety of factors. One example is sex, given the known differences in foot characteristics, particularly arch height,

rearfoot width, and hallux height, which can lead to differences in plantar pressure [15]. Men were reported to have a significantly higher contact area than women, along with force-time integral being higher in the 1st, 3rd, and 4th MTH during walking. In addition, maximum force was reported to be higher in the rearfoot, 1st MTH and 3rd MTH [14]. Differences in plantar loading have also been seen by foot type: pes planus (flat foot), pes rectus (normal arch), and pes cavus (high arch) [16]–[18]. For pes planus feet, higher maximum force, force-time integral, and contact area are displayed in the medical arch, central forefoot, and hallux, with lower maximum force, force-time integral, and contact area in the rearfoot and lateral forefoot. Pes cavus feet display lower maximum force, force-time integral and contact area in the midfoot and hallux. Pes cavus feet display a more laterally deviated center of pressure while pes planus feet display a more medial center of pressure [16]. Gait speed has also been identified as a variable that can affect plantar loading [63]. Prior literature has reported that increased gait speed can contribute to higher plantar peak pressures in the hallux, 1st MTH, 2nd MTH, 3rd MTH, and the rearfoot. An increase in gait speed was also correlated with a decrease in peak plantar pressure beneath the 5th MTH [63].

One factor that has not been investigated in relation to plantar loading is race. In a study by Golightly et al., it was found that there are racial differences in foot types, particularly between AA and WA [19]. Research shows that AA are three times as likely to have pes planus feet than WA, and five times less likely to have pes cavus feet than WA [19]. AA are also more likely to suffer from diabetic foot neuropathy than WA [17], [20], [45]. Given that plantar loading is associated with diabetic foot ulcers, there is a need to know if there are racial differences in plantar loading in a younger, non-diabetic population. Additionally, it is unknown how race in combination with family history of diabetes, sex, arch height, BMI, gait speed, and

age affects plantar loading. The purpose of this study was to determine whether race and other factors can impact plantar loading. Based on the current literature, we hypothesized that race, arch height, and sex will be significant predictors of plantar loading parameters.

Methods

Participants

108 individuals were recruited for this study based off a power analysis determined by Green's rule of thumb, shown in the equation below [35].

Equation 1: Green's rule of thumb

$$N \geq 50 + 8m$$

In this equation, m is the number of predictors. In this study, we were interested in examining seven predictors which made our minimum sample size 106. Healthy young adults between the ages of 18-30 were recruited from the University and the surrounding community. Participants came from two racial groups: African American and White American, with the goal of having an even racial split. Race was self-determined by the participant. Exclusion criteria included being unable to walk without an assistive device, having a lower extremity injury in the past 6 months that limited physical activity for more than two days, or having a history of lower extremity surgery. Each participant signed Institutional Review board approved informed consent prior to participation in the study.

Testing Protocol

Measurements, including arch height index, standing height and body weight, were collected from each participant. Arch height index (AHI) was measured using the Foot Posture

Measurement System (FPMS) [64]. Using the FPMS, the height of the dorsum of the foot at half the total foot length and the truncated foot length (Equation 2) were obtained for each participant. A ratio of 0.315 or less classified participants as pes planus, between 0.315 and 0.365 classified participants as pes rectus, and a ratio of 0.365 and above classified participants as pes cavus [65]. Family history of diabetes was asked via survey stating: Do you have a mother, father, sister, or brother with diabetes?

Equation 2: Arch height index equation

$$AHI = \frac{Dorsal\ Height_{50\%\ Foot\ Length}}{Truncated\ Foot\ Length}$$

An EMED pressure-measurement system (Novel Electronics, Inc, St Paul, MN) was used to collect plantar pressure data at 100 Hz, as shown in Figure 1. Participants were asked to walk barefoot across the testing space 10 times at a self-selected speed that was similar to the speed they would walk during normal daily activities. All testing was completed in a laboratory setting. Five trials in which their left foot land on the pressure plate and five trials with their right foot contacting the plate. Walking speed was measured using a timing gate system (Brower Timing Systems, Draper, UT). Data was collected using the two-step method. This requires the participant to take one step before hitting the pressure plate, with at least two more steps following. This method has been shown to produce data that is comparable to the mid-gait method when at least five trials are recorded [66].

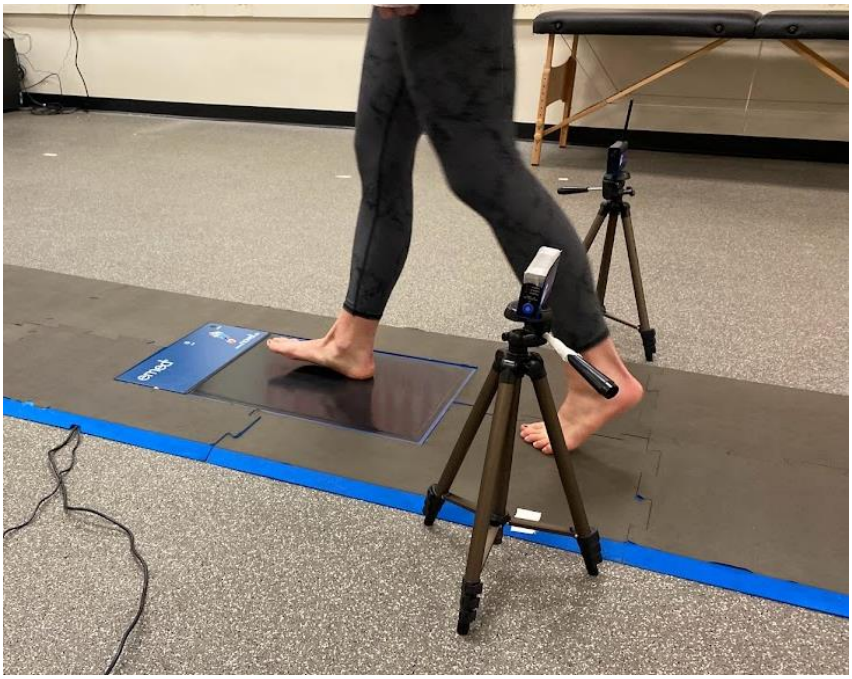

Figure 1: Participant walking on EMED pressure plate system

Data Processing & Statistical Analysis

The foot was divided into eight regions, as shown in Figure 2. Plantar loading was evaluated in the hallux, medial forefoot, central forefoot, lateral forefoot, medial midfoot, lateral midfoot, and rearfoot. Lesser toes were excluded during data processing. Plantar loading variables include maximum force normalized by body weight, force-time integral normalized by body weight, and contact area. Data was collected sing the Novel EMED software and processed using Novel Database Pro, Microsoft Excel and RStudio (RStudio, PBC, Boston, MA, USA). Two multiple linear regression models were run to determine which variables were significant predictors of plantar loading. The independent variable was race with sex, BMI, gait speed, family history of diabetes, AHI, and age serving as covariates.

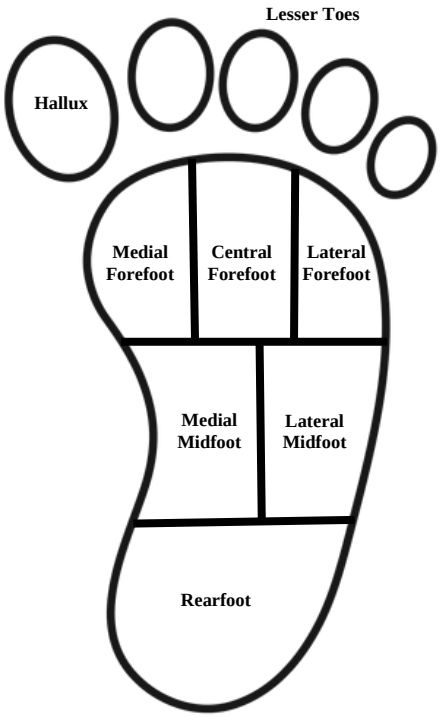

Figure 2: Regions of the foot being analyzed

Results

108 participants completed the testing protocol, with one participant being excluded due to not meeting the age eligibility criteria. This resulted in 107 participants being included in the study. Of the 107 participants whose data could be used for the study, 44 identified as African American. Multicollinearity was assessed by calculating the variance inflation factor (VIF) for each of the independent variables. A VIF of 1 indicates there is no correlation between the variables, while a VIF exceeding 5 indicates high multicollinearity. For every variable, the VIF did not exceed 5 and the mean VIF was 1.17 indicating there was no multicollinearity between the variables.

Table 1: Participant demographics with means, standard deviations and p-values

	AA	WA	*p-value*

Age	22 ± 3.2	21 ± 2.6	0.3528
AHI	0.302 ± 0.0304	0.323 ± 0.0341	0.0010
BMI	26 ± 5.9	24 ± 3.9	0.1445
Gait speed (m/s)	0.94 ± 0.158	1.04 ± 0.150	0.0026

Gait speed and AHI between AA and WA were shown to be statistically different ($p<0.010$) using an independent t-test, which could alter the outcome as to whether race is a predictor variable in the model. 31 out of 44 (71 %) AA were classified as pes planus and 22 out of 63 (35%) WA were classified as pes planus.

In the first model, a multiple linear regression was run with race as the independent variable and age, AHI, gait speed, assigned sex, family history of diabetes, and BMI as covariates. Race, age, AHI, gait speed, sex, and BMI were considered significant predictor variables for plantar loading. Most importantly, race was a significant predictor of maximum force in the hallux ($\beta=6.46$, $p<0.001$), rearfoot ($\beta=-6.36$, $p<0.001$), and lateral midfoot ($\beta=-2.72$, $p<0.001$), in addition, the force-time integral in the hallux ($\beta=2.37$, $p<0.001$), rearfoot ($\beta=-2.14$, $p<0.001$), and lateral midfoot ($\beta=-0.65$, $p<0.001$) were also significant predictor variables. As shown in Figure 3, AAs had a lower maximum force and force-time integral in their hallux than WAs. They also had a higher maximum force and force-time integral in the lateral midfoot and hindfoot than WAs. Additionally, race was a significant predictor of contact area for all parts of the foot, excluding the hallux. When examining the values, AA had a higher contact area in the medial forefoot, central forefoot, lateral forefoot, medial midfoot, lateral midfoot, rearfoot and the whole foot.

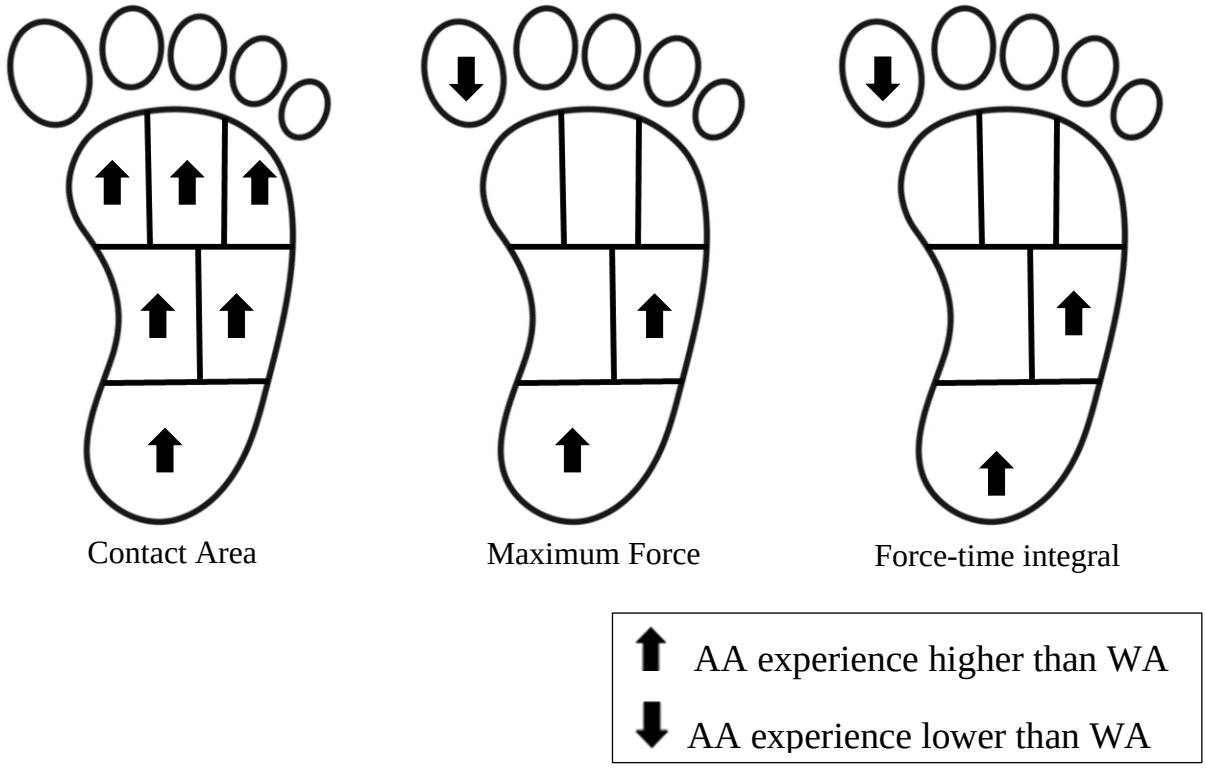

Figure 3: Results from multiple linear regression comparing AA and WA for contact area, maximum force, and force-time integral in the seven regions of the foot during barefoot walking.

In the second model, a multiple linear regression was run with the same independent variable and covariates as first model, but family history of diabetes was removed since it only had an effect on one out of twenty-four predictor variables. In addition, four interactions were added to the model: BMI and gait speed, race and gait speed, sex and gait speed, and AHI and race. When looking at the results, race, age, AHI, gait speed, sex, and BMI were still significant predictors of plantar loading in addition to interactions between BMI and gait speed, race and gait speed, sex and gait speed, and AHI and race. Race was a significant predictor of contact area (Table 2) in the hallux, medial forefoot, medial midfoot, rearfoot, and the whole foot, maximum force (Table 3) in the lateral forefoot, central forefoot and lateral midfoot, and the force-time integral (Table 4) in the lateral forefoot, central forefoot, medial forefoot, and the lateral midfoot. As shown in Figure 4, AA had a higher maximum force in the central forefoot and lateral

midfoot, but a lower maximum force in the lateral forefoot. Additionally, AA had a higher force-time integral in the lateral midfoot, medial forefoot, and central forefoot, but a lower force-time integral in the lateral forefoot. When looking at interactions with race, race and gait speed serve as a significant predictor of contact area (Table 2) in the hallux and medial midfoot, force-time integral (Table 3) for lateral midfoot and medial midfoot, and maximum force (Table 4) for lateral midfoot. When looking at race interacting with AHI, the interaction serves as a significant predictor in contact (Table 2) area for the medial forefoot, medial midfoot, rearfoot and the whole foot. Maximum force (Table 3) and force time integral (Table 4) in the lateral forefoot, central forefoot, and lateral midfoot.

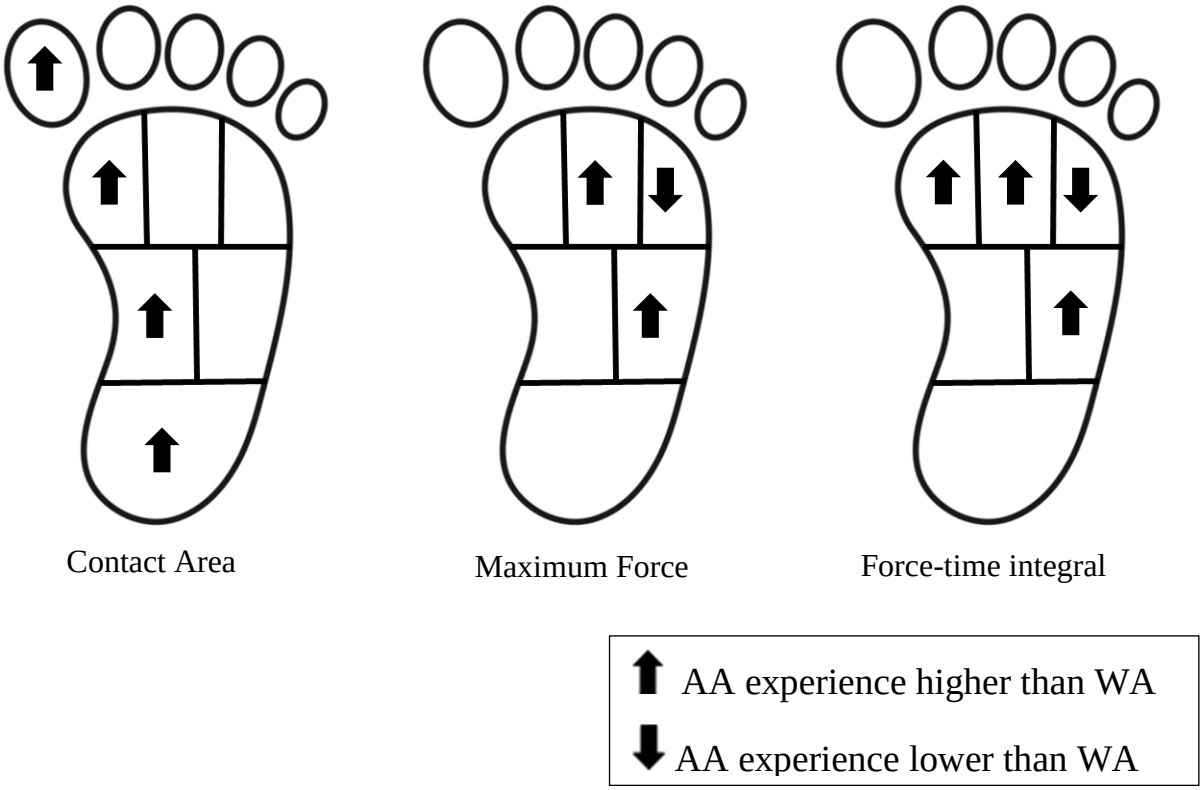

Figure 4: Results from multiple linear regression comparing AA and WA for contact area, maximum force, and force-time integral in the seven regions of the foot during barefoot walking.

Table 2: Second model identifying independent variables affecting contact area. Standardized beta coefficients and standard error shown for each predictor.

Plantar region	*Race*	Age	AHI	Gait speed	Sex	BMI	BMI*Gait speed	Race*Gait speed	Gait speed*Sex	AHI*Race
Hallux	-5.491* (2.179)	-0.009 (0.036)	-20.420* (10.300)	-12.087* (4.821)	-3.409** (1.258)	-0.113 (0.136)	0.220 (0.139)	3.479** (1.310)	1.698 (1.223)	5.933 (6.008)
Lateral Forefoot	0.832 (4.407)	-0.175* (0.073)	14.607 (20.828)	-6.793 (9.749)	-6.204* (2.545)	0.228 (0.275)	0.037 (0.281)	1.722 (2.649)	1.927 (2.494)	-11.611 (12.148)
Central Forefoot	-3.020 (2.232)	-0.066 (0.037)	-27.637** (10.548)	-3.265 (4.937)	-1.014 (1.289)	-0.050 (0.140)	0.299* (0.142)	-1.442 (1.342)	-0.484 (1.263)	12.089 (6.152)
Medial Forefoot	-13.940*** (3.524)	-0.197*** (0.058)	-89.393*** (16.654)	-24.859** (7.795)	-6.220** (2.035)	-0.385 (0.220)	0.807*** (0.225)	-0.259 (2.118)	4.581* (1.994)	41.607*** (9.714)
Lateral Midfoot	10.805 (9.134)	-0.293 (0.151)	8.600 (43.174)	-34.215 (20.208)	-15.689** (5.275)	0.075 (0.571)	0.598 (0.582)	-1.788 (5.492)	12.531* (5.170)	-42.071 (25.181)
Medial Midfoot	-25.466*** (5.903)	-0.180 (0.098)	-228.577*** (27.899)	7.123 (13.058)	-4.796 (3.408)	0.123 (0.369)	0.394 (0.376)	-12.568*** (3.549)	4.680 (3.341)	110.462*** (16.271)
Rearfoot	-14.056** (4.871)	-0.219** (0.081)	-83.391*** (23.022)	-30.409** (10.775)	-9.947*** (2.813)	-0.516 (0.304)	0.979** (0.311)	1.281 (2.928)	4.626 (2.757)	35.659** (13.427)
Total Foot	-57.869** (21.021)	-1.026** (0.348)	-432.456*** (99.356)	-112.826* (46.503)	-46.710*** (12.138)	-0.762 (1.314)	3.442* (1.340)	-1.315 (12.638)	27.568* (11.898)	151.930** (57.948)

* p<= 0.050, ** p<=0.010, *** p<=0.001

Table 3: Second model identifying independent variables affecting maximum force. Standardized beta coefficients and standard error shown for each predictor.

Plantar region	*Race*	Age	AHI	Gait speed	Sex	BMI	BMI*Gait speed	Race*Gait speed	Gait speed*Sex	AHI*Race
Hallux	22.614 (12.232)	0.149 (0.202)	112.711 (57.814)	54.657* (27.060)	14.030* (7.063)	0.265 (0.764)	-1.068 (0.780)	0.473 (7.354)	-13.241 (6.923)	-51.770 (33.719)
Lateral Forefoot	-23.480* (11.537)	-0.172 (0.191)	-100.219 (54.533)	-69.110** (25.524)	-10.460 (6.662)	-1.664* (0.721)	1.905* (0.736)	4.467 (6.936)	9.799 (6.530)	65.396* (31.805)
Central Forefoot	37.516** (14.365)	0.001 (0.238)	193.536** (67.898)	48.856 (31.779)	8.945 (8.295)	1.083 (0.898)	-1.133 (0.916)	-5.539 (8.636)	-11.568 (8.131)	-105.1860** (39.600)
Medial Forefoot	-1.434 (6.274)	0.295** (0.104)	14.501 (29.656)	11.267 (13.880)	3.386 (3.623)	-0.139 (0.392)	0.002 (0.400)	4.154 (3.772)	3.422 (3.551)	-4.833 (17.296)
Lateral Midfoot	-24.053*** (5.750)	-0.089 (0.095)	-205.116*** (27.178)	10.922 (12.721)	-3.464 (3.320)	0.217 (0.359)	0.150 (0.367)	-10.639** (3.457)	3.822 (3.255)	101.807*** (15.851)
Medial Midfoot	-5.713 (5.691)	0.245** (0.094)	-11.406 (26.899)	8.007 (12.590)	-0.445 (3.286)	0.237 (0.356)	-0.512 (0.363)	6.511 (3.421)	0.483 (3.221)	-0.293 (15.688)
Rearfoot	14.787 (13.197)	-0.158 (0.218)	0.121 (62.375)	40.480 (29.194)	-1.938 (7.620)	1.795* (0.825)	-1.230 (0.842)	-8.743 (7.934)	3.034 (7.469)	-40.319 (36.379)
Total Foot	-3.537 (7.276)	-0.010 (0.120)	10.962 (34.392)	-21.814 (16.097)	-2.515 (4.202)	-0.556 (0.455)	0.430 (0.464)	5.456 (4.375)	2.119 (4.118)	-8.232 (20.058)

* p<= 0.050, ** p<=0.010, *** p<=0.001

Table 4:Second model identifying independent variables affecting force-time integral. Standardized beta coefficients and standard error shown for each predictor.

Plantar region	Race	Age	AHI	Gait speed	Sex	BMI	BMI*Gait speed	Race*Gait speed	Gait speed*Sex	AHI*Race
Hallux	3.894 (6.022)	-0.082 (0.100)	6.803 (28.463)	12.350 (13.322)	4.717 (3.477)	0.549 (0.376)	-0.688 (0.384)	-1.558 (3.620)	5.085 (3.408)	1.085 (16.601)
Lateral Forefoot	-10.588* (4.236)	-0.057 (0.070)	-45.253* (20.023)	-33.801*** (9.372)	-5.354* (2.446)	-0.654* (0.265)	0.754** (0.270)	2.694 (2.547)	4.581 (2.398)	27.134* (11.678)
Central Forefoot	10.952* (5.480)	-0.070 (0.091)	79.961** (25.902)	-1.073 (12.123)	0.480 (3.164)	0.189 (0.342)	-0.255 (0.349)	1.065 (3.295)	-2.453 (3.102)	-39.804** (15.107)
Medial Forefoot	-14.301* (6.788)	-0.162 (0.112)	-66.874* (32.085)	-19.804 (15.017)	0.008 (3.920)	0.782 (0.424)	-0.678 (0.433)	4.748 (4.081)	-3.196 (3.842)	33.490 (18.713)
Lateral Midfoot	-6.693*** (1.401)	-0.033 (0.023)	-51.302*** (6.621)	1.703 (3.099)	-0.478 (0.809)	0.064 (0.088)	0.033 (0.089)	-1.984* (0.842)	0.565 (0.793)	25.666*** (3.862)
Medial Midfoot	-1.922 (1.391)	0.047* (0.023)	-4.258 (6.573)	-0.817 (3.077)	-0.018 (0.803)	0.019 (0.087)	-0.065 (0.089)	1.793* (0.836)	-0.070 (0.787)	0.981 (3.834)
Rearfoot	0.630 (4.235)	-0.055 (0.070)	-17.516 (20.015)	19.186* (9.368)	1.658 (2.445)	1.005*** (0.265)	-0.739** (0.270)	-1.615 (2.546)	-1.266 (2.397)	-3.398 (11.673)
Total Foot	-18.907 (11.364)	0.323 (0.188)	-44.667 (53.711)	-39.520 (25.139)	-8.223 (6.562)	-0.884 (0.710)	0.526 (0.725)	15.488* (6.832)	8.463 (6.432)	8.846 (31.326)

* p<= 0.050, ** p<=0.010, *** p<=0.001

Discussion

From the linear regression models, we know that race can be considered a significant predictor of plantar loading while age, AHI, gait speed, sex and BMI are also affecting the plantar loading outcomes. The second model demonstrates that there are interaction relationships between race and gait speed, and race and AHI. According to the literature, individuals with a pes planus feet have higher contact area and maximum force in the medial midfoot and lower maximum force in the lateral forefoot as compared to normal arched feet [17]. Results of the current study indicate that AA have a lower force-time integral and maximum force in the lateral forefoot, and when interacting with AHI it served as a significant predictor, thus telling us that race and AHI interacting together can affect plantar loading. From the literature, it is known that foot type varies by race indicating the importance of considering the interaction between race and AHI. Additionally, in the current study sample AA were more likely than WA to have a pes planus foot type as determined from a lower AHI.

The current literature also suggests that at slower walking speeds, there is a decrease in peak pressure in the rearfoot and medial forefoot, but an increase in the midfoot and lateral forefoot [63]. The current study found that AA had higher maximum force and force-time integral in the lateral midfoot, and when race and gait speed were interacting, it serves as a significant predictor of maximum force and force-time integral in the midfoot. Current literature tells us that AA walk at a slower gait speed than WA [67], [68] therefore, slower walking speeds in AA could contribute to plantar loading differences when compared with WA. Overall, our findings contribute to the understanding that plantar loading in AAs is affected by other factors such as AHI and gait speed.

It is also important to note that race is socially constructed and that racial differences in plantar loading could be affected by factors that are not race [67]. So, it is possible that by AA having a typically slower gait speed and lower AHI that they exhibit differences in planar loading, which could explain their higher risk for diabetic foot ulcers. However, plantar loading in AA is not just explained by gait speed and AHI. Our data also suggests that AA have higher contact area in all regions of the foot, except the hallux, when compared to WA. This could be explained by AHI but the current literature suggests that there are only statistically significant differences in contact area of the medial midfoot between pes planus and normal feet [17]. Further research should be done to classify characteristics that contribute to higher contact area in AA and WA. Additionally, AA had a lower maximum force and force-time integral in the hallux and a higher maximum force and force-time in the rearfoot, which is not currently explained in the literature as being related to foot type or gait speed. Thus, there is a need to examine other foot or gait characteristics that could affect plantar loading.

There are several limitations for this study. First is that BMI was used as a measure instead of a more accurate measure of body composition. BMI only provides a rough estimate of a body's fat percentage based on weight and height, where there are measures that can include weight, statures, bone density, and other measurements that can more accurately characterize body composition [69]. Another limitation is that there were unequal AA and WA participants. AA were underrepresented in this study (41%), which was expected based on the demographic diversity in the local area from which we recruited. Additionally, almost half of our population was pes planus, whereas the literature indicates that approximately 20% of the population is pes planus [70]. However, there is a chance the literature was not representative of the population as many studies do not include a representative sample of racial/ethnic minorities. Lastly,

participants were asked to self-identify as either AA or WA. While race is socially constructed [37], we do know that there are differences in gait characteristics between AA and WA [67], [71], gait could manifest differently depending on if the individual belongs to more than one racial group, which was the case for some of the study participants.

Acknowledgements

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RACIAL DIFFERENCES IN RESEARCH ENGAGEMENT AND MISTRUST

Abstract

For 400 years, differential health outcomes have existed between African Americans (AA) and White Americans (WA), with documentation showing higher rates of chronic illnesses among AA as compared to WA. Examples include type 2 diabetes, asthma, and cardiovascular disease, which account for 70 percent of deaths worldwide. Due to the historic exploitation of AA, there is a lack of participation of AA in medical studies which has influenced the health outcomes of AA. Consequently, it is critical that racial minorities are included in research to strengthen the generalizability of findings and reduce racial health disparities. However, few studies have assessed research engagement and feelings of research mistrust in young adults, especially within the AA community. With the current state of racial health disparities, it cannot be assumed that young AA adults have the same attitudes towards research engagement as the older members of the community or young WA. Data was collected from 107 participants in this Institutional Review Board approved study. Participants were healthy adults between the ages of 18-30 who identified as either African American or White American. Participants were

instructed to complete three surveys focused on factors associated with participation in research. Likert scale data was collected from both survey instruments. Wilcoxon Rank Sum and Kruskal Wallis tests were used to determine if significant differences existed in the responses between AA and WA, along with assessing the impact of sex. Research engagement practices and feelings of research mistrust differed significantly between AA and WA. AA were less likely than WA to participate in research if they were required to take medicine ($W=1696$, $p=0.041$) or a new drug ($W=1678$, $p=0.049$). AA were less likely than WA to participate in a research study involving a blood draw because: of curiosity ($W=1744$, $p=0.007$), friends or relatives encouraging participation ($W=1664$, $p=0.040$) or having the disease being studied ($W=1578$, $p=0.021$). Additionally, AA believe they are more likely to be guinea pigs in research ($W=647$, $p<0.001$), to care more about having research staff that looks like them ($W=227$, $p<0.001$), and know more about the Tuskegee Syphilis Study ($W=952$, $p=0.004$). AA have significantly higher feelings of research mistrust ($p<0.001$). These findings show that in this younger cohort of participants, AA have higher feelings of mistrust in biomedical research than WA and will likely be less willing to participate in biomedical research than WA. These results could improve our understanding as to why AA are less likely to participate in research than WA, even as young adults.

Introduction

It is important for research to reflect the diversity of our country and the people who could benefit from the research being conducted. This is important because by including racial minorities in research, we can strengthen the generalizability of our findings. The lack of African American research engagement has contributed to previous mistreatment and underrepresentation of African Americans in research [39]. The lack of representation and

mistrust of the medical community has resulted in ongoing racial health disparities and has contributed to unequal health outcomes of African Americans [38]. By increasing minority representation in research, we can learn more about pathologies that disproportionately affect minority populations, such as diabetes [38], [39], [72].

Several studies have investigated African American mistrust in medical research. Corbie-Smith and colleagues found that African Americans were afraid that the medical community would be dishonest when communicating the risks associated with participation in a research study [73]. Additionally, there were fears of being used as a "guinea pig" [73]. Paskett and colleagues found that minority populations associate mistrust in medical research with a lack of interest in the research being conducted [74]. Additionally, lack of participation from minorities was found to be attributed to barriers such as economic burdens, lengthy study times, and recruitment issues [74]. Strong interpersonal relationships and community engagement have been recommended to close the gap between medical researchers and their participants, specifically among older populations [30]–[33]. Additionally, while racial concordance is oftentimes seen as the fix for building relationships, becoming connected and having the researcher do self-reflection has also been shown to strengthen researcher-participant relationships [32].

Several instruments have been used to measure research engagement and mistrust. The Group Based Medical Mistrust Scale was developed and modified to measure the suspicion of medical researchers, lack of support from medical researchers, and disparities in medical research [25]. Garza and colleagues developed a survey to assess previous engagement of minorities in research, their knowledge of racial health disparities, barriers to research participation, and willingness to participate in a variety of research studies [26]. However,

limited research has investigated the feelings of mistrust and willingness to participate in research among younger adults, specifically African Americans as compared to White Americans [34]. Additionally, with the impact of the COVID-19 pandemic and the changing state of racial health disparities, one cannot assume that younger African American adults hold the same feelings as their older counterparts reflected in the literature.

Limited research has assessed research engagement in young adults, especially within the African American community. However, it is important to understand the feelings that African American young adults hold when approaching medical research, as they are a much-needed demographic. Thus, the purpose of this study was to identify racial differences in research engagement and mistrust in young adults between African Americans and White Americans. Due to the current state of racial health disparities, it is hypothesized that African Americans will have higher feelings of mistrust in biomedical research than White Americans. Additionally, we hypothesize that African Americans will be less willing to engage in biomedical research than their counterparts.

Methods

Participants

In this study, individuals were asked to participate in a research study that consisted of taking three surveys and completing 10 barefoot walking trials over a pressure-measurement system. 107 healthy participants between the ages of 18 and 30 participated in this study. Two racial groups served as the primary focus for this study: African American and White American. Race was determined and self-reported by the participant. Each participant gave consent through signing the Institutional Review Board approved consent prior to participation in the study and

were asked to complete all parts of the study. Due to the nature of the two-part study, participants were also required to meet eligibility criteria for the biomechanics research study to complete each portion of the current study. Therefore, inclusion criteria for this study were: no history of lower-extremity surgery, no lower extremity injuries within the past 6 months that has lasted for more than two days and must be comfortable walking unassisted.

Recruitment

Participants were recruited from the local community as a sample of convenience. Recruitment occurred from flyers posted around the community, social medical, verbal communication, and email. Due to the low enrollment of African Americans at the University, 5.4 percent of the school's population being African American, it was anticipated that there would be difficulties recruiting from this group. Thus, an emphasis was placed on recruiting from primarily Black and Black-centered student groups.

Instruments and Data collection

Participants were instructed to complete one survey consisting of demographic questions and two survey instruments: Factors associated with research engagement [26] and the Group-Based Medical Mistrust Survey (GBMMS) [44]. Garza's instrument was chosen since it most closely measured research engagement practices. The modified version of the GBMMS from Knopf and colleagues [28] was used since it was validated for research mistrust in adolescents and adults. Internal reliability of the survey instrument was assessed using Cronbach's alpha and external factor analysis between the items in the revised scale [28]. The surveys were completed in REDCap [75], [76] using an iPad.

Data Processing & Statistical Analysis

Data from REDCap was exported into Microsoft Excel. Statistical Analysis was completed using RStudio (RStudio, PBC, Boston, MA, USA). Wilcoxon Rank Sum tests were completed for each survey item comparing responses between AA and WA. Kruskal Wallis tests were completed for each survey item comparing responses between AA men, AA women, WA men, and WA women. Dunn tests were completed for survey items that were shown to be statistically significant in the Kruskal Wallis tests. The level of significance was set at alpha = 0.5.

Results

Wilcoxon Rank Sum tests found that research engagement practices and feelings of research mistrust differed significantly between AA and WA. As shown in Table 5, AA were less likely than WA to participate in research if it required them to "take medicine by mouth" and "take a new drug as part of a test" [26]. AA were less likely than WA to be in a research study involving a blood draw because of: "curiosity" (Table 5), "close friends or relatives encouraging their participation" (Table 5), and a "close friend or relative [having] or had the disease being studied" (Table 5) [26]. Additionally, AA believe they are more likely to be guinea pigs in research (Table 5), to care more about having research staff that looks like them (Table 5) and know more about the Tuskegee Syphilis Study (Table 5).

Table 5: Wilcoxon Rank Sum Test for factors associated with research participation

Survey Item		**W**	***p-value***	**AA**		**WA**	
				M	**SD**	**M**	**SD**
If you were asked to be a subject in a medical research study, do you think that you would or would not agree to participate?		1423	0.785	3.07	0.70	3.13	0.55
How likely are you to participate in a medical study if the study	Take a survey	1344	0.724	3.77	0.42	3.73	0.48
	Participate in an education program	1273	0.433	3.25	0.65	3.13	0.73
	Participate in a group interview	1370	0.912	3.16	0.71	3.14	0.72

required you to (INSERT ITEM)?	Limit or restrict your diet	1347	0.796	2.57	0.97	2.54	0.93
	Do exercises	1423	0.795	3.43	0.70	3.51	0.54
	Take medicine by mouth	1696	0.041	1.98	1.00	2.37	1.01
	Take a new drug as part of a test	1678	0.049	1.71	0.95	2.05	0.97
	Receive medication by a needle (e.g., shot)	1664	0.469	1.64	0.87	1.94	0.90
	Give blood	1277	0.469	2.96	1.01	2.83	1.01
	Take a DNA test	1527	0.349	2.82	1.11	3.05	0.92
	Give urine	1480	0.526	3.00	0.92	3.13	0.79
Have you ever been asked to participate in a medical research study?		1429	0.742	0.32	0.47	0.35	0.48
Have you ever participated in a medical research study?		1404	0.887	0.27	0.45	0.29	0.46
How do you feel about medical research involving people?		1406	0.893	4.25	0.78	4.29	0.73
How important do you feel medical research is?		1396	0.808	2.98	0.15	2.98	0.14
If you were asked to be a subject in a medical research study that involved drawing blood, what would make you more likely, less likely, or have no effect on your agreeing to participate?	Money	1517	0.183	2.61	0.78	2.79	0.60
	Curiosity	1744	0.007	2.25	0.70	2.64	0.84
	Close friends or relatives encouraging your participation	1664	0.040	2.23	0.89	2.56	0.76
	Close friends or relatives also participating	1550	0.180	2.48	0.79	2.64	0.75
	A close friend or relative has or had the disease being studied	1578	0.021	2.73	0.62	2.95	0.22
	Having the disease that is being studied in the research	1460	0.160	2.89	0.44	2.98	0.13
	Feeling that the researchers were honest about the risks	1466	0.458	2.68	0.64	2.73	0.65
	Free medical care	1381	0.970	2.55	0.82	2.54	0.82
	Free transportation	1214	0.209	2.36	0.92	2.13	0.98
	The idea of helping others	1503	0.236	2.71	0.63	2.79	0.60
	Helping you (yourself)	1417	0.749	2.82	0.45	2.79	0.57
If your doctor wanted you to participate in research, you trust he/she would fully explain it to you.		1509	0.107	0.86	0.35	0.95	0.22

Your doctor would not ask you to participate in medical research if he/ she thought it would harm you.		1349	0.626	0.93	0.26	0.91	0.30
How much would (INSERT) benefit from medical research?	Scientists	1431	0.577	3.89	0.32	3.91	0.35
	Your community	1475	0.535	3.30	0.80	3.43	0.62
	Your family or friends	1255	0.377	3.16	0.81	3.00	0.84
	You, yourself	1168	0.142	3.25	0.81	3.02	0.81
	The general public	1457	0.582	3.64	0.53	3.68	0.53
How often, if ever, do you think participants in medical research are pressured into participating?		1252	0.325	2.32	0.67	2.22	0.61
Researchers are always honest with the people they want to participate in their studies.		1293	0.497	0.59	0.50	0.52	0.50
How likely is it that you, or people with the same race or ethnicity as you, might be used as guinea pigs in research studies without your consent?		647	<0.001	2.11	0.69	1.40	0.58
How important would it be to you to have a researcher or research staff who looks like you ask you to participate in a study		227	<0.001	2.50	0.67	1.16	0.41
How much have you heard or read about the Tuskegee Syphilis Study?		952	0.004	2.82	1.15	2.13	1.21

Overall, AA had significantly higher feelings of research mistrust. AA were more likely to agree that people of their racial/ethnic group should: not trust medical researchers (Table 6), be suspicious of information from medical researchers (Table 6) and be suspicious of medical research (Table 6). AA were also more likely to believe that medical researchers treat AA like guinea pigs (Table 6), and hide information from them (Table 6).

Table 6: Wilcoxon Rank Sum Test for revised GBMMS scale

Survey item	**W**	***p-value***	**AA**		**WA**	
			M	**SD**	**M**	**SD**
People of my racial/ethnic group should not trust medical researchers.	823	<0.001	2.25	0.92	1.60	0.73
People of my racial/ethnic group should be suspicious of information from medical researchers.	601.5	<0.001	2.82	1.06	1.73	0.79

People of my racial/ethnic group should be suspicious of medical research.	732	<0.001	2.61	1.15	1.67	0.82
Medical researchers treat people of my racial/ethnic group like guinea pigs.	457	<0.001	3.07	1.04	1.71	0.75
Medical researchers hide information from my racial/ethnic group.	535	<0.001	3.05	1.01	1.81	0.91

From the Kruskal Wallis tests and Dunn tests, there were significant differences based on racial-sex groups. WA men were significantly more likely than AA women to participate if they had to orally take medicine (Table 9). WA men were significantly more likely than both WA and AA women to participate if the study required them to take a new drug (Table 9). AA men were more likely than AA women to participate if they were required to give urine (Table 9). When examining research engagement practices, there were significant differences between AA men and AA women. AA men were more likely to have been asked to participate and have participated in a research study, before participating in the current research study (Table 9). Both AA men and AA women were more likely than WA men and WA women to feel that people of their race or ethnicity are used as guinea pigs in research without consent and feel that it is important to have a researcher or research staff that looks like them to ask for their participation in a study (Table 9). Additionally, WA men were less likely to have heard or read about the Tuskegee Syphilis Study than AA men and AA women (Table 9).

From the GBMMS items, there were significant differences among the racial-sex groups. WA men were less likely than AA men and AA women to believe that people of their racial/ethnic group should not trust researchers (Table 10). WA women were less likely than AA women to believe that people of their racial/ethnic group should not trust researchers, but there was not a statistically significant difference between WA women and AA men (Table 10). WA

men were less likely than AA men and AA women to believe that people of their racial/ethnic group should be suspicious of research (Table 10). WA women were less likely to than AA women to believe the same, while there was not a statistically significant difference between WA women and AA men (Table 10). WA men and WA women were less likely than AA men and AA women to believe that people of their racial/ethnic group should be suspicious of information from medical researchers (Table 10). WA men and WA women also were less likely than AA men and AA women to believe that medical researchers treat people of their racial/ethnic group like guinea pigs and that medical researchers hide information from racial/ethnic group (Table 10).

Table 7: Kruskal Wallis Test for factors associated with research participation

Survey Item		χ^2	**df**	***p-value***
If you were asked to be a subject in a medical research study, do you think that you would or would not agree to participate?		5.8114	3	0.121
How likely are you to participate in a medical study if the study required you to (INSERT ITEM)?	Take a survey	1.1927	3	0.755
	Participate in an education program	1.7554	3	0.625
	Participate in a group interview	3.4796	3	0.323
	Limit or restrict your diet	0.27299	3	0.965
	Do exercises	5.9772	3	0.113
	Take medicine by mouth	10.182	3	0.017
	Take a new drug as part of a test	13.096	3	0.004
	Receive medication by a needle (e.g., shot)	6.4437	3	0.092
	Give blood	6.2154	3	0.102
	Take a DNA test	6.2678	3	0.099
	Give urine	8.583	3	0.035
Have you ever been asked to participate in a medical research study?		9.0763	3	0.028
Have you ever participated in a medical research study?		9.0454	3	0.029
How do you feel about medical research involving people?		4.3713	3	0.224
How important do you feel medical research is?		1.3315	3	0.722
If you were asked to be a subject in a medical research study that involved drawing blood, what would make you more likely,	Money	1.9887	3	0.575
	Curiosity	8.3704	3	0.039
	Close friends or relatives encouraging your participation	4.3866	3	0.223
	Close friends or relatives also participating	3.5212	3	0.318

less likely, or have no effect on your agreeing to participate?	A close friend or relative has or had the disease being studied	6.5878	3	0.086
	Having the disease that is being studied in the research	2.3043	3	0.512
	Feeling that the researchers were honest about the risks	0.86337	3	0.834
	Free medical care	2.0827	3	0.555
	Free transportation	3.0758	3	0.380
	The idea of helping others	4.8914	3	0.180
	Helping you (yourself)	0.99429	3	0.803
If your doctor wanted you to participate in research, you trust he/she would fully explain it to you.		3.2047	3	0.361
Your doctor would not ask you to participate in medical research if he/ she thought it would harm you.		4.5003	3	0.212
How much would (INSERT) benefit from medical research?	Scientists	0.33958	3	0.952
	Your community	0.85398	3	0.837
	Your family or friends	1.6386	3	0.651
	You, yourself	4.1547	3	0.245
	The general public	2.2099	3	0.530
How often, if ever, do you think participants in medical research are pressured into participating?		4.4158	3	0.220
Researchers are always honest with the people they want to participate in their studies.		2.2348	3	0.525
How likely is it that you, or people with the same race or ethnicity as you, might be used as guinea pigs in research studies without your consent?		26.148	3	<0.001
How important would it be to you to have a researcher or research staff who looks like you ask you to participate in a study		67.715	3	<0.001
How much have you heard or read about the Tuskegee Syphilis Study?		11.675	3	0.009

Table 8: Kruskal Wallis Test for revised GBMMS scale

Survey item	χ^2	**df**	***p-value***
People of my racial/ethnic group should not trust medical researchers.	16.586	3	<0.001
People of my racial/ethnic group should be suspicious of information from medical researchers.	28.527	3	<0.001
People of my racial/ethnic group should be suspicious of medical research.	20.001	3	<0.001
Medical researchers treat people of my racial/ethnic group like guinea pigs.	41.708	3	<0.001
Medical researchers hide information from my racial/ethnic group.	31.965	3	<0.001

Table 9: Dunn's tests for factors associated with research participation

Survey Item		Comparison	Z	*p-value*
How likely are you to participate in a medical study if the study required you to (INSERT ITEM)?	Take medicine by mouth	WA men – WA women	2.0625	0.196
		WA men – AA men	1.5415	0.493
		WA women – AA men	-0.1613	0.872
		WA men – AA women	3.1807	0.009
		WA women – AA women	1.4566	0.436
		AA men – AA women	1.3226	0.372
	Take a new drug as part of a test	WA men – WA women	2.9238	0.017
		WA men – AA men	2.2437	0.099
		WA women – AA men	-0.1639	0.870
		WA men – AA women	3.4202	0.004
		WA women – AA women	0.8246	1.000
		AA men – AA women	0.8167	0.828
	Give urine	WA men – WA women	-0.0466	0.963
		WA men – AA men	-1.3310	0.366
		WA women – AA men	-1.4283	0.460
		WA men – AA women	1.6194	0.422
		WA women – AA women	1.8938	0.291
		AA men – AA women	2.8591	0.025
Have you ever been asked to participate in a medical research study?		WA men – WA women	-0.0175	0.986
		WA men – AA men	-1.5833	0.340
		WA women – AA men	-1.7334	0.415
		WA men – AA women	1.4824	0.277
		WA women – AA women	1.7071	0.351
		AA men – AA women	2.9942	0.017
Have you ever participated in a medical research study?		WA men – WA women	0.2485	0.804
		WA men – AA men	-1.5592	0.476
		WA women – AA men	-1.9471	0.258
		WA men – AA women	1.5090	0.394
		WA women – AA women	1.4580	0.290
		AA men – AA women	2.9937	0.017
If you were asked to be a subject in a medical research study that involved drawing blood, what would make you more likely, less likely, or have no effect on your agreeing to participate?	Curiosity	WA men – WA women	0.1950	0.845
		WA men – AA men	1.1247	1.000
		WA women – AA men	1.0662	0.859
		WA men – AA women	2.4194	0.078
		WA women – AA women	2.5514	0.064
		AA men – AA women	1.0555	0.582
How likely is it that you, or people with the same race or ethnicity as you, might be used as guinea pigs in research studies without your consent?		WA men – WA women	-0.3055	1.000
		WA men – AA men	-3.3165	0.003
		WA women – AA men	-3.3878	0.003
		WA men – AA women	-3.697	0.001
		WA women – AA women	-3.8909	<0.001
		AA men – AA women	0.0378	0.970
		WA men – WA women	-0.9370	0.698

How important would it be to you to have a researcher or research staff who looks like you ask you to participate in a study	WA men – AA men	-4.9265	<0.001
	WA women – AA men	-4.5957	<0.001
	WA men – AA women	-6.5630	<0.001
	WA women – AA women	-6.4925	<0.001
	AA men – AA women	-0.9255	0.355
How much have you heard or read about the Tuskegee Syphilis Study?	WA men – WA women	-1.8244	0.272
	WA men – AA men	-2.9022	0.019
	WA women – AA men	-1.5572	0.358
	WA men – AA women	-2.9208	0.021
	WA women – AA women	-1.4107	0.317
	AA men – AA women	0.3213	0.748

Table 10: Dunn's tests for revised GBMMS scale

Survey item	**Comparison**	**Z**	***p-value***
People of my racial/ethnic group should not trust medical researchers.	WA men – WA women	-1.2042	0.457
	WA men – AA men	-2.5115	0.048
	WA women – AA men	-1.6862	0.275
	WA men – AA women	-3.6699	0.002
	WA women – AA women	-2.9157	0.018
	AA men – AA women	-0.7689	0.442
People of my racial/ethnic group should be suspicious of information from medical researchers.	WA men – WA women	-1.0054	0.630
	WA men – AA men	-3.2575	0.005
	WA women – AA men	-2.6900	0.021
	WA men – AA women	-4.5035	<0.001
	WA women – AA women	-4.0743	<0.001
	AA men – AA women	-0.7621	0.446
People of my racial/ethnic group should be suspicious of medical research.	WA men – WA women	-0.9027	0.733
	WA men – AA men	-2.8758	0.016
	WA women – AA men	-2.3611	0.055
	WA men – AA women	-3.7363	0.001
	WA women – AA women	-3.3081	0.005
	AA men – AA women	-0.4533	0.650
Medical researchers treat people of my racial/ethnic group like guinea pigs.	WA men – WA women	-1.5078	0.233
	WA men – AA men	-3.7038	<0.001
	WA women – AA men	-2.7291	0.019
	WA men – AA women	-5.7145	<0.001
	WA women – AA women	-4.9262	<0.001
	AA men – AA women	-1.4110	0.158
Medical researchers hide information from my racial/ethnic group.	WA men – WA women	-0.6706	1.000
	WA men – AA men	-3.3984	0.003
	WA women – AA men	-3.1484	0.005
	WA men – AA women	-4.5218	<0.001
	WA women – AA women	-4.4468	<0.001
	AA men – AA women	0.6331	0.527

Discussion

The purpose of this study was to determine if there were racial differences in research engagement and mistrust between WA young adults and AA young adults. This was accomplished through using survey instruments examining these constructs. This study found that there were significant differences in the research engagement practices of WA and AA, and that AA had stronger feelings of research mistrust than WA, which is supported by previous literature [72], [77], [78]. In a qualitative study, AA participants often associated the term "guinea pig" when thinking about medical research [19], as in this study it was found that AA were more likely to be used as guinea pigs in research without their consent and that medical researchers treat people of their racial/ethnic group like guinea pigs. Additionally, our results found that AA were more likely to have heard about the Tuskegee Syphilis Study and prefer research staff that looks like them. Previous research shows that knowledge of the Tuskegee Syphilis Study affects the research engagement of AA, as this study serves as an example of why AA should mistrust the healthcare system and the government [22]. Racial concordance is oftentimes seen as a strategy to increase participation of racial/ethnic groups in medical research [32], particularly AA [27]. Further investigation is warranted for exploring factors that would influence participation in a research study involving blood draws, as AA in our study were less likely than WA to be a subject in a research study that involved drawing blood because of curiosity, close friends, and relatives.

Post hoc testing found that there were differences among racial-sex groups, with WA men oftentimes having significant differences when compared with AA women. This is congruent with current literature, as it has been found that medical mistrust of AA women is the result of racism and sexism in the healthcare system [79]. Jaiswal and Halkitis discuss that a

majority of medical mistrust literature oftentimes only explores the experiences of people of color and AA, but not as much on sexual minorities such as women of color [80]. In clinical trial research, AA women are often underrepresented in research, lower than WA women and AA men. While AA men are more likely than AA women to have diabetes, AA women are more likely than their majority women counterparts to have breast and cervical cancers, high blood pressure, and a stroke [81]. In community-based participatory research, work has been done to engage AA women in research, however as evidenced by this study, there is still work to be done.

Another key result from this study is that AA men were more likely than AA women to be asked to participate in a medical study and to agree to participate, while on average there was no difference between AA and WA men being asked to participate and to agree to participate. However, when recruiting for this study, AA women made up 25.2% of the sample and AA men made up 15.7% of the sample. This is congruent with previous studies that have recruited both AA women and men, AA women often being overrepresented compared to their male counterparts [26]. However, previous research shows us that AA women are more likely to participate in research than AA men [82]. This shows us that it is important that AA women are asked to participate in research, and that simply through asking it may be possible to increase AA participation in research [26].

A major limitation of this study is that this survey was only taken by individuals who consented to also participating in a biomechanics study. There is a major need to investigate the reasons why AA do not participate in research or compare results between AA who would participate in research versus AA who would not participate in research. Secondly, this study occurred during the Fall 2021 semester on a college campus, affecting the individuals who

participated in this study. The Fall of 2021, was in the middle of the COVID-19 pandemic, which also could have affected those who participated in this study [29]. Additionally, the college in which this study was completed is a R1 university, which could have affected participants perceptions of research.

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CONCLUSIONS

AA experience major health inequities due to the persistence of racial health disparities in the United States [21], [38]. One of the outcomes of this is disproportionate rates of diabetes and diabetic complications [5], with AA being twice as likely as WA to have diabetes [5] and foot amputations caused by foot ulcers [6]. Literature shows that high plantar pressure can contribute to diabetic foot ulcers [6]-[10], but there is a need to understand why AA are more likely to have diabetic ulcers than WA. Findings from this study demonstrates that race, along with age, AHI, gait speed, sex, and BMI are significant predictors of plantar loading. Since our results show that gait speed and AHI may interact with race, we can begin to believe that because AA are more likely to have a slower walking speed and lower arch height, gait speed and arch height could contribute to plantar loading differences between AA and WA. However, because race is posited as a social construct [37], [38], there is a need for more research to understand what is really behind the statistically significant differences that emerged from this study. Future work should build on investigating gait and foot characteristics that can affect plantar loading and how these could contribute to AA having differences in plantar loading from WA.

Due to the difficulty in recruiting AA for this study, it was important that we address factors that are associated with AA being less likely to participate in research. Additionally, a majority of the research on this topic focuses on older adult AA [30], [31], [83]. Because of the current state of health disparities that is compound by the COVID-19 pandemic [29], it was important that we assess the feelings of research mistrust and factors impacting research participation in young adult AA. Our findings found that AA had stronger feelings of research mistrust than WA and that AA were less likely to participate in research. When looking across racial-sex groups, oftentimes AA women had differing practices in research engagement than WA men and AA men. The current literature suggests that there is a need to factor in gender when addressing minority participation in research [84], [85]. A limitation of this work was that to participate in the current study, individuals had to also consent to participate in a biomedical research study. Future work should highlight the feelings of mistrust and factors for research participation among those who do not participate in medical research.

The findings from this study can provide direction for many communities. For the medical research community, this work provides valuable information on plantar loading differences between AA and WA which can inform future research. Additionally, because of these differences in plantar loading, arch height and gait speed, it is important that medical researchers ensure not only are they studying AA, but they also have a diverse sample that includes AA and other minority groups that are not usually represented in research, as current research may not be generalizable to all racial and ethnic groups. This work also has implications for many stakeholders. First, there is a need for research teams and medical professionals have a racial and ethnic makeup that is representative of the people they are studying. Additionally, there is a need for the public to have a better understanding of and participation in medical

science research to resolve some of the deep-seated beliefs of medical research that inhibit those from participating.

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APPENDIX

Tables

Table 11: First model identifying independent variables affecting contact area. Standardized beta coefficients and standard error shown for each predictor.

Plantar region	*Race*	Age	AHI	Gait speed	Sex	Family diabetes	BMI
Hallux	-0.153 (0.210)	-0.018 (0.036)	-11.677*** (2.879)	1.514* (0.637)	-1.672*** (0.205)	-0.175 (0.258)	0.105*** (0.022)

Lateral Forefoot	-1.097** (0.413)	-0.189** (0.070)	-4.986 (5.661)	0.004 (1.253)	-4.244*** (0.394)	-0.767 (0.509)	0.281*** (0.042)
Central Forefoot	-0.634** (0.215)	-0.049 (0.037)	-8.321** (2.948)	0.887 (0.652)	1.610*** (0.205)	0.039 (0.265)	0.226*** (0.022)
Medial Forefoot	-0.968** (0.359)	-0.152* (0.061)	-22.409*** (4.921)	1.520 (1.089)	-1.798*** (0.342)	0.406 (0.442)	0.357*** (0.037)
Lateral Midfoot	-3.658*** (0.878)	-0.289 (0.149)	-60.817*** (12.023)	-1.881 (2.660)	3.189*** (0.836)	-0.753 (1.080)	0.654*** (0.090)
Medial Midfoot	-3.318*** (0.629)	-0.027 (0.107)	-45.617*** (8.620)	3.029 (1.907)	-0.542 (0.599)	0.705 (0.775)	0.396*** (0.064)
Rearfoot	-1.535** (0.474)	-0.187* (0.081)	-27.580** *(6.498)	2.619 (1.438)	5.541*** (0.452)	-1.223* (0.584)	0.419*** (0.049)
Total Foot	-10.883*** (2.060)	-0.842* (0.350)	-189.830** * (28.211)	11.978 (6.242)	-19.891*** (1.962)	-2.346 (2.544)	2.452*** (0.211)

* p<= 0.050, ** p<=0.010, *** p<=0.001

Table 12: First model identifying independent variables affecting maximum force. Standardized beta coefficients and standard error shown for each predictor.

Plantar Region	*Race*	Age	AHI	Gait speed	Sex	Family diabetes	BMI
Hallux	6.387*** (1.169)	0.079 (0.199)	28.608 (16.009)	8.400* (3.542)	0.913 (1.113)	-0.943 (1.438)	-0.701*** (0.120)
Lateral Forefoot	1.910 (1.118)	-0.118 (0.190)	3.048 (15.311)	-0.001 (3.388)	-0.904 (1.065)	0.654 (1.376)	0.123 (0.114)
Central Forefoot	-1.284 (1.380)	-0.075 (0.234)	22.491 (18.898)	-5.438 (4.182)	-2.597* (1.314)	-2.023 (1.698)	0.073 (0.141)
Medial Forefoot	1.044 (0.591)	0.264** (0.101)	5.460 (8.101)	12.501*** (1.793)	0.019 (0.553)	-0.354 (0.728)	-0.113 (0.061)
Lateral Midfoot	-2.720*** (0.599)	0.046 (0.102)	-35.943*** (8.202)	2.675 (1.815)	-0.048 (0.570)	1.133 (0.737)	0.262*** (0.061)
Medial Midfoot	0.489 (0.544)	0.209* (0.092)	-11.710 (7.451)	6.511*** (1.649)	0.294 (0.518)	-0.222 (0.669)	-0.234*** (0.056)
Rearfoot	-6.428*** (1.251)	-0.145 (0.213)	-61.027*** (17.129)	1.604 (3.790)	1.262 (1.191)	0.990 (1.539)	0.591*** (0.128)

Total Foot	-0.572 (0.687)	-0.037 (0.117)	-4.199 (9.409)	1.009 (2.082)	-0.327 (0.654)	0.020 (0.845)	-0.127 (0.070)

* p<= 0.050, ** p<=0.010, *** p<=0.001

Table 13: First model identifying independent variables affecting force-time integral. Standardized beta coefficients and standard error shown for each predictor.

Plantar region	*Race*	Age	AHI	Gait speed	Sex	Family diabetes	BMI
Hallux	2.379*** (0.572)	-0.088 (0.097)	9.767 (7.836)	-15.304*** (1.734)	-0.332 (0.545)	-0.496 (0.704)	-0.101 (0.059)
Lateral Forefoot	0.807 (0.413)	-0.038 (0.070)	-2.266 (5.662)	-3.815** (1.253)	-0.830* (0.394)	0.553 (0.509)	0.050 (0.042)
Central Forefoot	-0.522 (0.523)	-0.111 (0.089)	14.576* (7.168)	-9.199*** (1.586)	-1.901*** (0.498)	-0.637 (0.644)	-0.022 (0.054)
Medial Forefoot	0.539 (0.651)	-0.172 (0.111)	-11.335 (8.921)	-34.440*** (1.974)	-3.004*** (0.620)	-0.042 (0.802)	0.136* (0.067)
Lateral Midfoot	-0.648*** (0.146)	-0.003 (0.025)	-8.830*** (2.000)	-0.033 (0.442)	0.018 (0.139)	0.186 (0.180)	0.074*** (0.015)
Medial Midfoot	0.132 (0.133)	0.038 (0.023)	-2.776 (1.817)	0.328 (0.402)	-0.034 (0.126)	-0.009 (0.163)	-0.038** (0.014)
Rearfoot	-2.171*** (0.405)	-0.056 (0.069)	-21.042*** (5.543)	-3.566** (1.227)	-0.513 (0.385)	0.326 (0.498)	0.291*** (0.041)
Total Foot	-0.584 (1.087)	0.269 (0.185)	-32.941* (14.882)	11.642*** (3.293)	0.572 (1.035)	0.108 (1.337)	-0.353** (0.111)

* p<= 0.050, ** p<=0.010, *** p<=0.001

Surveys

Below are the survey items that will be administered to each of my participants. The survey questions will be administered in REDCap via an iPad from the Granata Lab. Information in the parentheses is the scale for each question. The first two parts of the survey (demographic questions and factors associated with research engagement) will be administered before the walking trials with the last part of the survey (research mistrust) being administer after the walking trials.

<u>Demographic Questions</u>

1. Please indicate your race/ethnicity (select all that apply: American Indian or Alaska Native, South Asian (e.g., Indian, Pakistani, Bangladeshi, Sri Lankan, etc., East Asian (e.g. Chinese, Korean, Japanese, etc.), Southeast Asian (e.g., Thai, Vietnamese, Burmese, etc.), Middle Eastern or North African, Black or African American, Hispanic or Latino, Native Hawaiian or Other Pacific Islander, White or European, Other)
2. We want to make sure we appropriately identify as participants in this study. Please provide an answer to the following two questions.
    a. What is your assigned sex at birth? (Female, Male, Other/Intersex)
    b. What is your gender identity? This is how you view yourself. It may be different that your sex and is not defined by body parts. (Female/Woman/Girl, Male/Man/Boy, Transgender, Non-Binary, Agender, Other (Please write in))
3. Age (enter integer)
4. Do you currently have health insurance coverage? (Yes, No)
5. Do you currently have access to medical care? (Yes, No)
6. Have you ever been identified as prediabetic? (Yes, No)
7. Have you ever been diagnosed with diabetes? (Yes, No)
8. Do you have a mother, father, sister or brother with diabetes? (Yes, No)

<u>Factors associated with research engagement</u>

1. "If you were asked to be a subject in a medical research study, do you think that you would or would not agree to participate? (4 – Definitely would, 3 – Probably would, 2 – Probably would not, 1 – Definitely would not)
2. How likely are you to participate in a medical study if the study required you to (INSERT ITEM)? (4 – Very likely, 3 – Somewhat likely, 2 – Somewhat unlikely, 1 – Very unlikely)
    a. Take a survey
    b. Participate in an education program
    c. Participate in a group interview
    d. Limit or restrict your diet
    e. Do exercises
    f. Take medicine by mouth
    g. Take a new drug as part of a test
    h. Receive medication by a needle (e.g., shot)

i. Give blood

j. Take a DNA test

k. Give urine

3. Have you ever been asked to participate in a medical research study? (Yes/no)
4. Have you ever participated in a medical research study? (Yes/no)
5. How do you feel about medical research involving people? (5 – Very positive, 4 – Somewhat positive, 3 – Neutral, 2 – Somewhat important, 1 – Not important at all)
6. How important do you feel medical research is? (3 – Very important, 2 – Somewhat important, 1 – Not important at all)
7. If you were asked to be a subject in a medical research study that involved drawing blood, what would make you more likely, less likely, or have no effect on your agreeing to participate? (3 – More likely, 2 – Less likely, 1 – Would have no effect)
    a. Money
    b. Curiosity
    c. Close friends or relatives encouraging your participation
    d. Close friends or relatives also participating
    e. A close friend or relative has or had the disease being studied
    f. Having the disease that is being studied in the research
    g. Feeling that the researchers were honest about the risks
    h. Free medical care
    i. Free transportation
    j. The idea of helping others
    k. Helping you (yourself)" [26]
8. (Optional) Are there any responses that you would like to elaborate on? (Open response)
9. "If your doctor wanted you to participate in research, you trust he/she would fully explain it to you. (Yes/no)
10. Your doctor would not ask you to participate in medical research if he/ she thought it would harm you. (Yes/no)
11. How much would (INSERT) benefit from medical research? (4 – A great deal, 3 – A moderate amount, 2 – Only a little, 1 – Not at all)
    a. Scientists

b. Your community

c. Your family or friends

d. You, yourself

e. The general public

12. How often, if ever, do you think participants in medical research are pressured into participating? (5 – Always, 4 – Most of the time, 3 – About half of the time, 2 – Only occasionally, 1 – Never)

13. Researchers are always honest with the people they want to participate in their studies. (Yes/no)

14. How likely is it that you, or people with the same race or ethnicity as you, might be used as guinea pigs in research studies without your consent? (3 – Very likely, 2 – Somewhat likely, 1 – Not likely at all)

15. How important would it be to you to have a researcher or research staff who looks like you ask you to participate in a study (3 – Very important, 2 – Somewhat important, 1 – Not important at all)

16. How much have you heard or read about the Tuskegee Syphilis Study? (4 – A great deal, 3 – A moderate amount, 2 – Only a little, or 1 – None at all)" [26]

17. (Optional) Are there any responses that you would like to elaborate on? (Open response)

----------BREAK ----------

<u>Research mistrust</u>

1. "People of my racial/ethnic group should not trust medical researchers. (1 – Strongly Disagree, 2 – Disagree, 3 – Neither agree nor disagree, 4 – Agree, 5 – Strongly Agree)

2. People of my racial/ethnic group should be suspicious of information from medical researchers. (1 – Strongly Disagree, 2 – Disagree, 3 – Neither agree nor disagree, 4 – Agree, 5 – Strongly Agree)

3. People of my racial/ethnic group should be suspicious of medical research. (1 – Strongly Disagree, 2 – Disagree, 3 – Neither agree nor disagree, 4 – Agree, 5 – Strongly Agree)

4. Medical researchers treat people of my racial/ethnic group like guinea pigs. (1 – Strongly Disagree, 2 – Disagree, 3 – Neither agree nor disagree, 4 – Agree, 5 – Strongly Agree)

5. Medical researchers hide information from my racial/ethnic group. (1 – Strongly Disagree, 2 – Disagree, 3 – Neither agree nor disagree, 4 – Agree, 5 – Strongly Agree)" [28]

6. (Optional) Are there any responses that you would like to elaborate on? (Open response)