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A Culturally Competent Phenotypic Evaluation/Obesity Assessment in African and African American Populations: Pilot Study

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Abstract

Best practice, movement towards individualized medicine and deployment of effective models that impact the diabetes epidemic and its related precursors like insulin resistance and the metabolic syndrome, requires terminal use of BMI, a biologically meaningless and crude indicator of obesity, in favor of effective and culturally-competent non-relative body composition evaluation of genetically determined adiposity, that untenably compares values among groups. African Americans are among the increasingly affected groups for diabetes and possess unique composition variation requiring proper intra-cultural evaluation independent of inter-ethnic Eurocentric assumptions that over assesses obesity risk. Incorporating use of 4C models to evaluate adiposity and assess risk for diabetic predisposition and onset, provides an effective, unbiased assessment of the cultural components inherent within body composition variation among ethnicity, age and gender. Obesity and type 2 diabetes onset and pre-disposition was assessed phenotypically, in creation of a body mass profile among African and African American groups, using 4C model, photography, anthropometry, somatotype and genetic evaluation. Environmental, obeseogenic cultural factors were also explored. BMI was not found to be an accurate predictor of adiposity in Africans and African Americans. West Africans and other African Americans were found to be an accurate and culturally competent reference population for African American physiology vs. European. Africans and African Americans were found to be heavier and less fat and normal weight at higher BMI, attributable to cultural acceptance and more fat free mass. Skeletal weights were heavy (6-7lbs) among Africans and African Americans. African Americans had heavier bone density than Africans but African bone weight increased the longer they stayed in the U.S. BMI falsely assumed the presence of fat in this population. 70% of body mass was attributable to muscle, confirming the mesomorphic phenotype in these groups. African American women were larger than their male counterparts vs. Africans, a sexual dimorphic indicator that may be attributable to the absence of incarcerated Black male phenotypic data in this study.

Keywords: African-Americans, West-Africans, physiology, obesity, BMI.

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Introduction

Phenotypic Evaluation/Obesity Assessment

BMI, a ratio of weight over height, is a key tool used to measure obesity and diabetic predisposition by clinicians and government measurement standards like the NHANES survey. It emanated from 1959 ideal weight tables generated by Metropolitan Life Insurance Company that was exclusive to most of the population relative to White, upper class males (Loos et al., 2008) and became a mandated shibboleth as a proper measure of adiposity by researchers and publishers by the 1985 NIH Consensus Panel (Kuczymarksi and Flegal, 2000). What is problematic about this acceptance, is that a standard that fails to represent a proper relative sample or that excludes groups, cannot be used as a universal measure for all groups (Harrison, 1985). And the notion of "ideal weight" has been found to be biased and inaccurate as a universal standard (Knapp, 1983) across ethnicity, class, gender and age. Adipose tissue contains hormones that can upset metabolic homestasis with regards to an increase in insulin release. However, it is not the general bodily presence of adipose tissue that increases susceptibility to diabetes, rather, the location specific adiposity(Bjorntorp, 1985). Fat patterning is not relatively assumed but genetically determined (Wagner and Heyward, 2000). Adipose tissue located around the waist is correlated with metabolic syndrome, glucose intolerance-a precursor to diabetes, and diabetes onset (Bjorntorp, 1985; Fox, 2008). Body composition is an acceptable and proven method of evaluation of adiposity, and ideal weight (Wagner and Heyward, 2000) and has a variation across cultures (Harrison, 1985). African Americans have been shown to have a higher percentage of lean, fat free masses that include heavier skeletal weights, muscle and bone mineral content (BMC), longer extremities, adipose concentrations in the trunk, subscapular, back and lateral areas and low waist to hip ratios (Schutte et al., 1984; Hortobagyi et al., 1990). The universal body composition model that evaluates body fat percentage, historically was exclusive to African Americans relative to the evaluation of White, male cadavers and is therefore not an accurate representation for adiposity in African Americans. The relationship between adiposity and weight is weakly correlated (Harrison, 1985).Adipose tissue, accepted to be the result of energy storage over expenditure, is not correlated with obesity in Africans and African Americans' tissue (Ebersole et al., 2008). Body Mass Index represents an assumption of adiposity and its equal distribution and has a strong cultural component (Kleerokoper et al., 1994) that is different among ethnicity, culture, gender and age (Gallagher et al. 1996). BMI is not a useful tool to evaluate adiposity (Kaarma et al., 2009; Kennedy et al., 2009; Smalley et al., 1990) among ethnicities. It is not comparable across ethnic groups (Satija, 2016). It has been shown to over-estimate obesity among African Americans (Aloia et al., 1997; Aloia et al., 1998).The 4 C model is a proper tool to evaluate body fat that eliminates bias across ethnicity (Mott and et al., 1999; Durenberg and Durenberg, 2001).

Genes and Variants Associated with Obesity

Obesity has a genetic component. The following genes have been affiliated with obesity: 23HNF4A haplotypes in Intron 3 7 region,23HNF4A haplotypes in P2 promoter region, ADRB2, ADRB3, AGRP, ANKRD26, APOE (SNPs), CART, CART (mutation), CDKAL1 chromosome 6 SNP-rs9350270, Chromosome 3p26, Chromosome 6, E2F3 chromosome-6 SNP rs6939190, E2F3 chromosome 6 SNP-rs6939190, ENPP1, ENPP1 (3 allele haplotype), ESR 1 absence or variation, FETUB, FTO, FTO (SNP-rS11219800, FTO intron 1, GHRL, GNPA2, GNPDA2 (SNP-rs10938397), IL-6, IQGAP1, KCTD, MC4R, MC4R (mutation), MC4R (SNP s17782313), MC4R (SNP rs12970134), MC4R (SNP-rs17782313), MC4R mutation, MC4R(SNP- rs12970134), MC5R, MTCH2, MTCH2 (SNP-rs4752856), Multiple rare deleterous variants, MYO18B, MYO18B, NEGR1, NEGR1 (SNP-rs2815752), NR0B2, NROB2 (mutation), PCSKI (variation in), PDSS2, POMC, POMC (mutation), PPARG, PPARGC1B, PTPRD, PYY, RELA (1KBKB variants), rs2241766(adiponectin), rs23047595, rs2304795, rs2304795, rs2745367(resistin), rs8179071, rs894160, SDC3, SDC3 (SNPs), SH2B1, SH2B1 (SNP-rs7498665), SIM1, SNP-rs6004901, SNP-rs6870962, SSTR2, TMEM18, UCP1, UCP3 (Ahituv et al., 2007; Bagwell et al., 2005; Barroso, 2005; Bouchard et al., 1990; Branson et al., 2003; Calton and Vaisse, 2009; Chambers et al., 2008; Dong et al., 2003; Dong et al., 2005; Doumatey, 2009; Dubern et al., 2001; Farooqi et al., 2003; Gallagher et al., 2007; Lucas et al., 2011); Meyre et al., 2009; Norman et al., 1997; Paganini-Hill et al., 1981; Proctor, 2009; Sutton et al., 2005; Willer et al., 2009; Wing, 2010; Zonta et al., 1987; Nishigori et al., 2001).

Obesity Genotypes Affiliated with African Americans

Hassanein et al. (2010) discovered an association between variants rs3751812 and rs9941349 with BMI in African Americans. Wing et al. (2010) found that genetic heterogeneity between African Americans, Hispanic Americans and Caucasian Americans was affiliated with FTO intron 1. He also found the ratio of visceral to subcutaneous fat (VSR) to be associated with MYO18B, PDSS2 and IQGAP1. Doumatey et al. (2009) found the IL-6 was associated to body mass index (BMI), waist hip ratio (WHR), and the homeostatic model assessment (HOMA_IR) for insulin resistance in African Americans. The environmental mode of action being telomere shortening (Epel et al., 2004). It affects IL-6 (Lin et al., 2012). Doumatey et al. (2009) also found rs2241766 (adiponectin) to be associated with waist hip ratios and rs2745367(resistin) associated with circulating resistin in African Americans and West Africans. These groups were also found to regulate adopokines differently. Proctor et al. (2009) associated subcutaneous adipose tissue in African Americans with E2F3 chromosome 6-SNP rs4710930 and rs6939190.

Bagwell et al. (2005) found that 23HNF4A haplotypes in the P2 promoter region and 3-intron 7 region related significantly to measures of obesity in Hispanics and African Americans. Barroso et al, 2005 found association with risk-raising waist circumference, waist-hip-ratios, estimated percent body fat, body weight, and BMI>35 to be associated with gene variants rs2304795, rs894160 and rs230475. Metabolic syndrome prevalence was associated with rs2304794.Gallagher et al, 2004 associated the OPRM1 gene to type 2 diabetes susceptibility among African Americans. And Sutton et al. (2005) discovered a link between chromosome 3p26 and obesity phenotypes in African Americans.

Body Mass Index (BMI)

Is diabetes- as predicted by Body Mass Index (BMI) alone amongst African Americans- a problematic assessment? BMI is a key tool used to measure obesity and diabetic predisposition that uses the standards of Americans of European descent as a normative. BMI is defined as: a ratio of weight over height squared. It is widely accepted as a modernized height and weight tables that standardizes the measure of body fat using a weight over height ratio.

BMI and Ethnicity

There is variation in BMI among ethnicity. For the same BMI Black women have 1% less body fat that White women (Evans et al., 2006). Currently accepted BMI, when adjusted for race, produced a low sensitivity to fatness (Evans et al., 2006). It is different among Whites and Blacks (Evans et al., 2006) and is an imprecise measure of fatness across ethnicity (Mills et al., 2007). At the same BMI African American men had lower visceral/belly fat than White and Hispanic men (Carroll et al., 2008) and controlled for age, had less truncal fat and more skeletal muscle than Hispanic men (Aleman-Mateo et al., 2009).BMI cut off points are necessary to determine metabolic risk among different ethnic groups (Carroll et al., 2008). Environmental factors like screen time, school commuting and consumption of calorie dense snacks and sweetened drinks is dependent upon BMI and ethnicity (Singh et al., 2009).

BMI and Environmental Factors

In a study of African Americans and West Africans, BMI in African Americans was associated with insulin resistance (Doumatey, 2009).Among middle aged and older women, weight gain was affiliated with age (Ortega-Alonso et al., 2009).Variation in ponderosity-body weight relative to height as determined by BMI-23% was attributed to environmental or non-genetic factors (Komlos et al., 2009). 48% of variation among RFPI, skinfold thickness was due to environmental effects (Hasstedt et al., 1989). At all levels of BMI only 10% of fat cells die and are renewed annually. Adult fat cells are established during the childhood environment (Spalding, 2008). Disadvantaged community has an effect on BMI. It reduces racial disparities in BMI but does not affect BMI over time (Ruel et al., 2010). Physical activity can diminish the additive effects of the heritability of BMI (Mustelin et al., 2009). Chronic stress increases cortisol levels and BMI among populations with no college degree (Daniel et al., 2006). Cultural differences in BMI may be explained by behaviors effecting energy expenditure like television viewing, commuting to school and consumption of fruit juices (Singh et al., 2009). BMI was associated with smoking in AA males.

BMI and Inheritance

A child with one or more parents overweight, inherits an increase risk for overweight (Danielzik et al., 2002).The BMI of parents affect the offspring (Li et al., 2009; Robl et al., 2008). Heritability of BMI from parents was found to be 79%. Among males, physical activity reduced waist circumference and heritability to 78% and females reduced to 56% and 71% with physical activity (Mustelin et al., 2009). In an international study BMI heritability was measured at 80-82% (Hjelmborg et al., 2008). In an international study of 7 and 10yr olds, BMI heritability was found at 60-74%. The same environmental and genetic factors responsible for variation in BMI caused obesity (Haworth et al., 2008). A study by Hunt et al (n=38, 759) found evidence that increases in BMI act upon the genotype, increasing the allele frequency of the FTO gene (Hunt et al., 2008). In Dutch families weight class (thin, median, overweight or obese) and BMI are inherited from mothers and fathers. Different variants effected change and BMI levels. Genetic influences related to BMI levels is 60%. Genetic influences related to BMI change is 64%. (Ortega-Alonso et al., 2009). Dong et al. (2005) located chromosomes responsible for genomic imprinting of obesity from parents among Europeans. BMI imprinting from the father was on 12Q24 and on 10p12. The additive and non-additive genetic effects in African Americans on BMI are different from European Americans (Duncan et al., 2009). A small scale twins study (N=12) revealed genetic factors affecting the body's tendency to store energy as fat or lean tissue and various determinants of resting energy expenditure. This tendency affected regional fat distribution and abdominal/visceral fat. Hasstedt et al., in a study of 774 adults discovered 42.3% of variation in the relative fat pattern index (RFPI)-a ratio of subscapular skinfold thickness to the sum of subscapular and suprailac skinfold thickness, was due to recessive allele inheritance. 9.5% was polygenic and 48.2% attributable to random environmental effects(Hasstedt et al. 1989). Weight class (thin, median weight, overweight or obese) was found to be strongly related to the BMI of the mother (p=.0001) and the father (p=.02).

BMI is not a valid indicator of regional fat distribution (Kok et al., 2004).“Controlling for bone size, there is considerable variation in density and thus weight of the skeleton in human adults and this variation is correlated with age, sex and race (Harrison, 1985).” -Bone density is associated with hormonal regulation. Leptin levels have an inverse relationship to the regulation of ERa signaling. Increased levels of leptin in animal models was shown to increase bone density (Ohlsson, 2000).“An ideal weight cannot be identified at a point in time for a person or person differing from the group or groups on which the table was based (Harrison, 1985).” It is not accurate across ethnicity (Evans et al., 2006)”; (Mills et al., 2007). Many studies have disproven it as a reliable measure of adipoisity.

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BMI Not a Useful Measure

BMI cutoffs are not accurate across ethnicity (Evans, 2006; Mills, 2007). It is insensitive to the variation in body composition across ethnicity (Kok, 2004).When compared with measures of skinfolds and body composition, BMI does not correlate with body fat, height or length of extremities (Kaarma et al., 2009) and is inaccurate across levels of fatness (Freedman and Sherry, 2009). BMI is not a biological indicator of body fat distribution (Kok,,2004) and should not be used to evaluate obesity prevalence (McAdams et al., 2007). It introduces bias and misclassification (Rothman, 2008), overpredicts overweight and underpredicts obesity and should not be used in scientific or clinical research (Kennedy et al., 2009). BMI is a poor predictor of fat mass in adolescents where FFM is attributed to variation in BMI (Freedman et al., 2005).Using DEXA, BMI was found to be a measure of weight and not fatness or adiposity (Freedman and Sherry, 2009). Height and weight as absolute values cannot be expressed by BMI because it represents part and not the whole body (Kaarma et al., 2009). In meta-analysis it underpredicts excess body fat in half of its study participants(Okorodudu et al., 2010). Why is it still being used?

Given this history of quasi-breeding and phenotypic selection caused by slavery and its eight generations of African American commoditization, would the descendants of slaves thusly affected, present a BMI within the same normative range of a European culture that experienced no equivalent episodes of selection? Could African Americans posses a genetic tendency towards a larger BMI in response to historic selection pressures practiced in the era of slavery? This question is of general cultural significance and is an essential prerequisite towards validation of the "epidemic" of obesity/diabetes amongst Blacks.

African American Physiology

Body Composition and Genetics

Waist circumference is inherited via parental BMI (Mustelin et al., 2009). Genes determine body fat percentage and leanness (Ahituv et al., 2007).

Body Composition And Ethnicity

Body composition is variable across, ethnicity, age and sex and must be adjusted accordingly to determine health risks due to fatness (Kok et al., 2004). Race adds to prediction of body fat. For the same BMI Black women have 1% less body fat that White women (Evans et al., 2006). Percent body fat is different between Black and White (Evans et al., 2006). Caucasian males have higher body fat than African American men (Mills et al., 2007). African American fat increases with age faster than Asians and Hispanics (Mills et al., 2007). White women have higher percent body fat than other races (Mills, 2007). At low BMI Asian women have the highest percent body fat (Mills et al., 2007). At the same BMI and waist circumference, African American men had lower visceral fat than White and Hispanic men (Carroll et al., 2008). Whites and Hispanics have more visceral fat than African American women (Carroll et al., 2008). Visceral fat (adipose) tissue defines metabolic risk in different populations (Carroll et al., 2008). Different waist circumference (WC) and BMI cut off points are necessary to determine metabolic risk among different ethnic groups (Carroll et al., 2008). At the same BMI and age, Mexicans have more truncal (derriere) fat and less total appendicular skeletal muscle than African Americans (Aleman-Mateo et al., 2009).

Body Composition and Environment

Using a micro environmental analysis of phenotype shows that waist circumference inherited via parental BMI is subject to reduction by physical exercise (Mustelin et al., 2009). A Macro phenotypic analysis using Environmental Systems Theory reveals that hot climates encourage tall and lean phenoytpes (Walker and Hamilton, 2008).Cold climates encourage short and round phenotypes (Walker and Hamilton, 2008). Dense populations (i.e. Asia, India) encourage petite phenotypes via natural selection and small population density favors the large phenotype (Walker and Hamilton, 2008). Genes and mutations have been associated with obese phenotypes of geographical regions of North America (Feitosa et al., 2002), Europe (Bagwell et al., 2005; Branson et al., 2003), Japan (Chambers et al., 2008), Italy (Dubern et al., 2001) and cultures like the Pima Indians (Farooqi et al., 2003).

Genetics

Genes Associated with BMI in the literature included: BMIQ1, 7q31; BMIQI, BMIQI (near leptin gene) , 7q32.3;BMIQ2, 13q14; BMIQ3, 6q23-q25; BMIQ4, (variation in UCP2), 11q24; BMIQ5, 16p13; BMIQ6, 20pter-p11.2; BMIQ7, 4p15-p14; BMIQ8, 10p; BMIQ9, (variation in MC3R), 20q; BMIQ10; BMIQ 11; BMIQ12, (variation in PCSK1); BMIQ13; BMIQ14; BMIQ15, (PRKCA); BMIQ16; PPARG2 (polymorphism); NPC1; ADIPOQ, 10q; Xq24; 5q15-q21; 2q14.1; 16q12.2; 17q23.2-q25.1; 16p11.2; 18q11; 3q27; MTMR9; NPCI (rs1805081); MAF (rs1424233); GPRC5B (proximity variant); MC4R (susceptibility loci); POMC; SH2B1; BDNF; FTO; IRS1; SPRY2; MC4R (rs17782313)-Higher BMI; MC4R (rs17782313); MC4R (rs17782313-C). Increased risk of type 2 diabetes; MC4R (variant); FTO; HTR1B; HTR1B; HTR1B; UCP2; UCP3; VDR; IGF1; IL6R; GHSR; PPARGC1A LEP; CYP19A1; GLDN; HTR1B (polymorphism); CYP19A1 (polymorphism); HTR1B (polymorphism); HTR2C (AA, BMI X Environment); ADIPOR1 (AA, BMI x Environment); IGFBP3 (CA, BMI x environment); ADIPOR (CA, BMI x environment); PPARG (CA, BMI x environment); PPARG (CA, BMI x environment), 8p23-p22; 18q22-q23; 16q22-q23; 16p12; rs243650 (effecting allele T); rs534870 (effecting allele A); rs17782313; C allele of rs17782313; C allele of rs17782313; rs12970134; 6 (rs13212041; 6 (rs6296); 6 (rs4140535); 11 (rs17132534); 11 (rs7110607); 12 (rs4334089); 12 (rs6214); 18rs (17066829); 1 (rs12083537); 1 (rs12083537);

3 (rs11929140); 3 (rs2948694); 4 (rs6821591); 7 (rs2278815); 15 (rs1902584); 15 (rs1961177); (rs4140535) for BMI <25, 25-29, 30-34, >35)); rs1902584 for BMI, 25, 25-29, 30-34, >35); rs4140535 for BMI <25m 25-29, 30-34, >35); rs1902584 for BMI <25, 25-29, 30-34, >35); X (rs17095676xcigarette smoking) P=.001; 1 (rs6672643xcigarette smoking (current) P=.001; 7 (rs6670xsmoking (pack-years) P=.001; 1 (rs12045862 x physical activity) P=.001; 3 (rs709157 x time spent sitting) P=.001; 3 (rs1175540 x time spent sitting) P=.001; MTMR9; NPCI (rs1805081); MAF (rs1424233); GPRC5B (proximity variant); MC4R (susceptibility loci); POMC; SH2B1; BDNF; FTO; IRS1. New loci/decreasing body fat percentage; decreased IRSI expression, impaired metabolic profile, increased visceral to subcutaneous fat ratio, insulin resistance, dyslipidemia, diabetes risk, and coronary artery may be discovered (Edwards, 2012; Feitosa et al., 2002; Hsueh et al., 2001; Kilpeläinen et al., 2011; Loos et al., 2008; Meyre et al., 2009; Qi et al., 2008; Speliotes et al., 2010; Yanagiya et al., 2007).

Phenotype Evaluations

Subjects

Signed consent from subjects and approval from our local IRB preceded this study. Up to 142 randomly selected Africans and African American subjects, male and females-ages 18-45 from 4 populations (1-Africans in US 10 yrs or more, 2-Africans in U.S. to yrs or less, 3-African American, 4-African American Gullah); of varying education level (no high school diploma, GED, college degree and graduate degree); socioeconomic status (working class, unemployed, undergraduate and professional students), having parents of West African lineage or both parents African American descent, were recruited from college campuses, community churches, mosques and sporting organizations via newspaper ads, posters, flyers and word of mouth. Subjects filled out a questionnaire on lineage, a survey on food preferences and food frequency.

Phenotypic Measurements

Body mass, bioimpedence analysis (BIA) and anthropometrical data were collected by means of an examination in the Sports Medicine facility located in the Student Health Centers of two college campuses. Participants wore a hospital gown with underclothing (barefoot, w/underpants, sans the t-shirt for males, women retaining brassieres) A phenotypic profile was established by a trained clinician of six skin-fold, and nine girth and stature measurements. Digital photographs were taken of the participants from the neck down in their underclothing. Somatotype profiles were established (i.e. endo, ecto, mesomorphic) from the data collected. Measurements were evaluated using an ethnic appropriate 4 component model (Swan, Ball, Athena, 2006) of individual tissue composition that determined fat and fat free masses (water, bone mineral density and residual proteins) adjusted for ethnicity.

Bioimpedence Analysis (Aloia et al., 1997, 1998). Mass, fat and FFM was measured by a digital bioimpedence analysis scale. Output generated a value (+/-.003) for total body and muscle mass (g), total body water (TBW) and fat (%).

Girth measurements (9) (Ross et al., 2003; Carter, 2002). Girth measurements (cm/mm) was taken using steel anthropometric (Rosscraft, White Rock, BC, Canada) tape from the following positions:

Biepycondal humerus (relaxed and flexed), forearm, supine waist (abdominal), umbilicus, erect hip (hip/buttocks), biepycondal femur (thigh), flexed calf, foot width.

Skinfold Thickness (6). Regional body fat masses was evaluated by skinfold thickness using calipers (Harpenden and Lange) in the subscapular, suprasinale, abdominal, tricep, thigh and calf areas.

Stature (Ozaslan et al., 2003). Stature was evaluated by sliding calipers (Campbell 10 & 20/Rosscraft), a headblock and a Segmometer 4 (Rosscraft) in cm to measure standing, sitting and trochanteric heights, hand length, and lengths of the foot, leg (thigh and lower) and hand.

Somatotyping (1 of 2) (Ross et al., 2003; Carter, 2002). The Heath-Carter method was used to generate a somatotype profile ecto, endo or mesophoric) from 10 anthropometric positions:

1. *Body mass* (Ross et al., 2003; Carter and Heath, 1990). From a standing position body mass was recorded from a minimally clothed (hospital gown) subject using a Bioimpedence Analysis (BIA) scale (scale and body composition analyzer, Tanita, Arlington Heights, Illinois, USA). Values were estimated to nearest 0.1 kg and adjusted for clothing.
2. *Stretch stature (height)* (Ross et al., 2003; Carter 2002). From a standing position height was estimated using a headsquare (Rosscraft) and carpenters retractable tape (Lufkin). Subject was positioned against a wall, maximally erect with their back, heels and gluteals against the surface. The subjects' head was oriented along the Frankfort Plane with the headsquare (Rosscraft) resting w/ gentle pressure against the hair onto the vertex. Measurements were recorded to the nearest (mm).
3. *Tricep Skinfold* (Ross et al., 2003; Carter 2002). From a standing position and arms at sides, triceps skinfold was taken from a raised vertical section of the back of the tricep between the acromion and olecranion using a skinfold caliper (Harpenden). Values were estimated to the nearest 0.1 mm.
4. *Subscapular Skinfold* (Ross et al., 2003; Carter 2002). From a standing position the subscapular skinfold was taken from the subject 45 degrees from the scapula, 2cm diagonal from the scapula using a skinfold caliper (Harpenden). Values were recorded to the nearest 0.1 mm.
5. Supraspinale Skinfold (Ross et al., 2003; Carter 2002). From a standing position supraspinale skinfold was taken from the top of the iliac spine on a medial 45 degree line along the anxillary border. A minimal (5-7 cm) skinfold amount was evaluated relative to the subject using a skinfold caliper (Harpenden). Values was estimated to the nearest 0.1 mm.
6. *Medial Calf Skinfold* (Ross et al., 2003; Carter, 2002).

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From a standing position, subject raised the right leg to a 90 degree bent knee position upon a stool. Medial calf skinfold was obtained from the maximal girth site girth site on the medial side of the calf using a skinfold caliper (Harpenden). Values were recorded to the nearest 0.1 mm.

7. *Biepicondylar Breadth of Humerus* (Ross et al., 2003; Carter, 2002). From a seated position, the subject raised the right humerus and bent it 90 degrees at the elbow. Biepicondylar humerus breadth was recorded from the medial and lateral epicondyles using a sliding bone caliper (Campbell 10). Diameter values were recorded to the nearest 0.5 mm.
8. *Biepicondylar Breadth of Femur* (Ross et al., 2003; Carter, 2002). From a seated position biepicondylar breadth of the femur was evaluated from the subject. The examiner located the medial and lateral epicondyles from a flexed femur, using a small bone caliper (Campbell 10). The maximum epicondylar distance was taken and the diameter was recorded to the nearest 0.5 mm. values.
9. *Flexed Arm Girth* (Ross et al., 2003; Carter, 2002). Flexed arm girth was taken along the subject's raised, flexed, right arm, bent to a 90 degree position using a flexible steel tape (Rosscraft). The maximal flexed value was recorded at the highest peak of the tricep. Values were estimated to the nearest mm.
10. *Tensed Calf Girth* (Ross et al., 2003; Carter, 2002). From a standing position calf girth was taken from the right calf of the subject using a retractable steel tape (Rosscraft). Three to four circumference values was taken along the long axis of the lower leg and the highest circumference value recorded to the nearest mm.

This profile was further utilized to evaluate the tendency of the participants towards mesomorphy using the Heath Carter Somatoype method. Data was plotted on a somatochart and a 2D somatochart was also produced.

Somatotyping (2 of 2). Participants were photographed from the neck down (minimally clothed) with a digital camera (10mp) against a grid pattern to generate a photoscopic somatogram. This data was supplementary to the general somatoyping to further classify and accommodate the evaluation of a potential mixed proportioned participant.

Adjustments

Errant assumptions inherent in standardized lean density calculations was adjusted for BF% by ethnicity using, (Schutte et al., 1984), for Black women, (Wagner and Heyward, 2000) for Black men the following calculations for higher proportions of lean body mass inherent in African/African Americans:

4C Model: (Friedl et al., 1992)

Where: BF= Body fat; Db= Body density; TBW= Total body bone mineral; BM

2C Model: (Schutte et al., 1994)

(Black Women)

Where: lean density (LD)=1.113g/ cm3 Blacks (Schutte et al., 1994) vs.1.100 Whites (Siri 1956)

Table 1. FP Survey Category Tables PCA Analysis of Significant Interactions.

FP SURVEY CATEGORY TABLES PRINCIPAL COMPONENT ANALYSIS SIGNIFICANT INTERACTIONS	
VARIABLES	SIGNFICIANCE/ VARIATION PROPORTION
17. OBESITY	
92owc	<.0001
90owself	.49914
92owc	<.0001
91nwt	-0.45198
90owself	<.0001
91nwt	-0.77344
90owself	<.0001
fat_p	.43528
91nwt	<.-0001
fat	.46351
91nwt	<.0001
Age	-0.43424
fat_p	<.0001
BMI	.68101
fat_p	<.0001
89wt	.64505

Note: Adapted from (Johnson et al., 2019; in press).

Table 2. FP Survey Significant Questions Multiple Regression (BF%).

FP Survey Significant Questions Multiple Regression Dependent Variable =Body Fat %		
[Code]/QUESTIONS	SECONDARY VARIABLES	P/F VALUE
[brorbtl] Were You Breast or Bottle Fed?	N/A	<.0001
[2friedfs] Do you eat fried foods?	N/A	<.0001
[2a2x] How often (do you eat fried foods?	N/A	<.0001
[63fsitdown} Were you raised having family sit down meals?	N/A	<.0001
[92owc] If you describe yourself as overweight, were you overweight as a child?	N/A	<.0001
[26sodalike] Do you like soda?	Weight <.0001	<.0001
[26asodaxwk] If so, how often do you consume soda per week?	Weight <.0001	<.0001
[13tveat] Do you eat while watching t.v.	Weight <.0001	<.0001
[yrs] How long have you been in the U.S.	Weight <.0001	<.0001
[24waterdrink] Do you drink water regularly?	Weight <.0001	<.0001
[1ahowmswts] Do you eat sweets more than 5 times a week?	N/A	.02804
[57rsetgff] Were you raised eating fast foods?	Group #1 <.0001	.0092

Note: Adapted from (Johnson et al., 2019; in press).

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Table 3. Physiology Data . 4 Component Model Fat Percentages African & African Americans.

Physiology Data 4 Component Model-Fat Percentages									
ID	Group	4C.fat (%)	Age	Gender	ID	Group	4C.fat (%)	Age	Gender
P13	Afr1[a]	23.4	20	M	P32	AA	24	23	F
P15	Afr1	11.7	26	M	P34	AA	11.6	21	M
P18	Afr1	21	32	F	P300	AA	30	21	F
P17	Afr1	34.3	38	M	P313	AA	60	20	F
P19	Afr1	12.7	32	F	P325	AA	32	23	F
P110	Afr1	25.3	28	M	P326	AA	29	21	M
P111	Afr1	17.9	34	M	P328	AA	30	25	M
P112	Afr1	11.7	26	M	P329	AA	31.2	19	F
P114	Afr1	24.2	36	M	P332	AA	27.7	22	F
P117	Afr1	17	25	M	P333	AA	25.7	25	F
P121	Afr1	23	27	M	P334	AA	27.2	21	F
P130	Afr1	31	19	M	P36	AA	39	33	F
P131	Afr1	12.1	24	M	P338	AA	25	25	M
P135	Afr1	36.9	28	M	P340	AA	27.8	20	F
P136	Afr1	23.8	24	M	P344	AA	27	20	M
P141	Afr1	16.3	21	M	P345	AA	26	27	F
P144	Afr1	22	23	M	P347	AA	26.8	20	M
P146	Afr1	11.5	21	M	P349	AA	27.8	22	F
P148	Afr1	17	28	M	P350	AA	26.8	25	M
P152	Afr1	22.8	29	M	P351	AA	32.2	45	F
P154	Afr1	25.1	33	M	P356	AA[c]	28	22	M
P155	Afr1	19.8	29	M	P361	AA	16.6	21	M
P157	Afr1	22.3	37	M	1P3-12	AA	38.9	21	F
P162	Afr1	18.3	24	M	2P3A-12	AA	25.5	20	F
P164	Afr1	16.3	23	M	3P3-12	AA	27	43	F
1P1-12	Afr1	28.6	37	M	4P3-12	AA	16	22	M
2P1-12	Afr1	25.3	27	M	5P3-12	AA	25.4	19	F
3P1-12	Afr1	48	27	F	6P3-12	AA	13.6	23	M
1P2-12	Afr2[b]	18.8	18	M	7P3-12	AA	46.4	34	F
2P2-12	Afr2	9.9	25	M	9P3-12	AA	17	21	M
3P2-12	Afr2	10.6	18	M	10P3-12	AA	31.3	19	F
4P2-12	Afr2	31	19	F	11P3-12	AA	41.3	29	M
P215	Afr2	16.7	21	F	12P3-12	AA	18	20	M
P237	Afr2	19.8	20	F					
P239	Afr2	17	19	M					
P242	Afr2	21	28	F					
P243	Afr2	18.8	20	M					
P253	Afr2	24.2	18	M					
P260	Afr2	18	33	F					
P263	Afr2	23	19	F					

[a]Afr1= Africans in the U.S. 10 years or less
[b]Afr2=Africans in the U.S 10 years or more
[c]AA= Non African Affiliated Black Americans

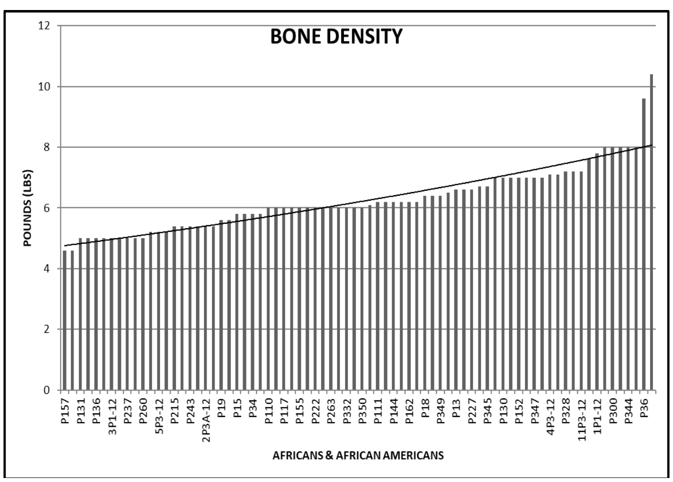

Figure 1. African & African American Bone Density (Db) in (lbs).

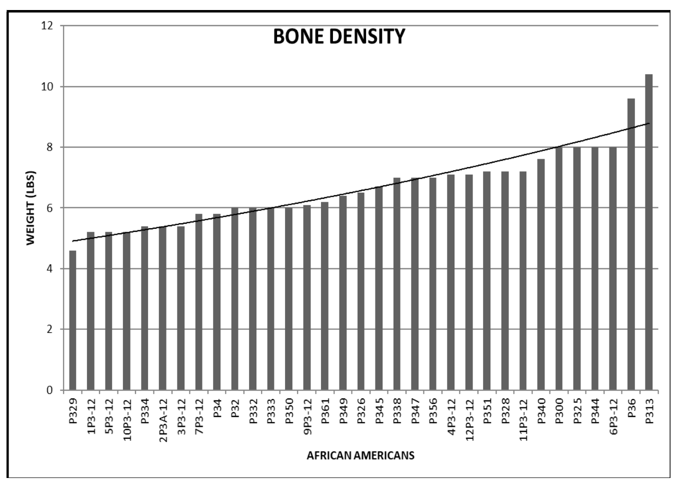

Figure 2. African American Bone Density (Db) in (lbs).

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Table 4. Four Component Model Physiology Data. Weight in (lbs) for Africans and African Americans.

Physiology 4-Component Model Body Weight (lbs)							
ID	**Group**	**M.weight (lbs)**	**Age**	**ID**	**Group**	**M.weight (lbs)**	**Age**
P13	Afr1	173.4	20	P32	AA	142	23
P15	Afr1	133	26	P34	AA	132.8	21
P18	Afr1	166	32	P36	AA	313.8	33
P17	Afr1	214.8	38	P300	AA	212	21
P19	Afr1	129	32	P313	AA	486	20
P110	Afr1	163.6	28	P325	AA	158	23
P111	Afr1	153.4	34	P326	AA	200	21
P112	Afr1	139.6	26	P328	AA	200	25
P114	Afr1	174.2	36	P329	AA	136.8	19
P117	Afr1	161	25	P332	AA	190	22
P121	Afr1	200	27	P333	AA	165.6	25
P130	Afr1	219	19	P334	AA	150.2	21
P131	Afr1	145	24	P338	AA	162	25
P135	Afr1	164.6	28	P340	AA	215	20
P136	Afr1	155	24	P344	AA	176	20
P141	Afr1	147.8	21	P345	AA	167	27
P144	Afr1	165	23	P347	AA	175	20
P146	Afr1	121.5	21	P349	AA	179.2	22
P148	Afr1	220	28	P350	AA	170	25
P152	Afr1	184	29	P351	AA	218.4	45
P154	Afr1	169	33	P356	AA	165	22
P155	Afr1	151	29	P361	AA	153.4	21
P157	Afr1	120.2	37	1P3-12	AA	170.6	21
P162	Afr1	154	24	2P3A-12	AA	143.2	20
P164	Afr1	127	23	3P3-12	AA	157	43
1P1-12	Afr1	223.8	37	4P3-12	AA	137	22
2P1-12	Afr1	165	27	5P3-12	AA	137.8	19
3P1-12	Afr1	188	27	6P3-12	AA	188.6	23
1P2-12	Afr2	120.8	18	7P3-12	AA	213.4	34
2P2-12	Afr2	180.8	25	9P3-12	AA	145	21
3P2-12	Afr2	147.8	18	10P3-12	AA	151.4	19
4P2-12	Afr2	160	19	11P3-12	AA	248.6	29
P215	Afr2	132	21	12P3-12	AA	172	20
P227	Afr2	219	19				
P237	Afr2	128.6	20				
P239	Afr2	130.4	19				
P242	Afr2	137	28				
P243	Afr2	160	20				
P253	Afr2	161.4	18				
P260	Afr2	136	33				
P263	Afr2	140	19				

AFR1= Africans in the U.S. 10 yr or less
AFR2= African in the U.S. 10 yrs or more
AA= African Americans

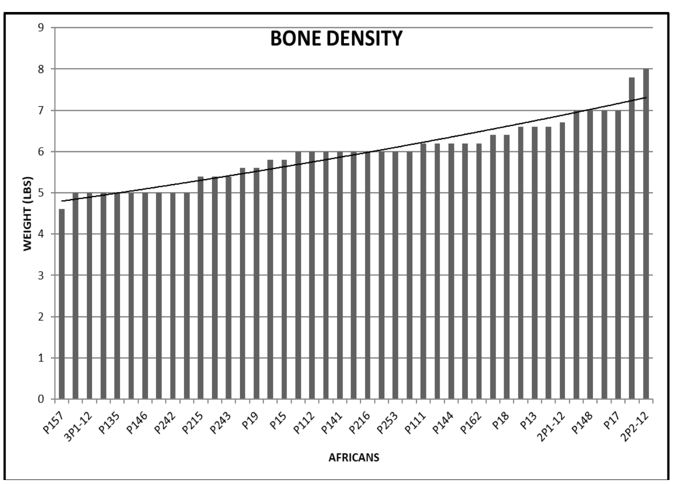

Figure 3. African Bone Density in (lbs).

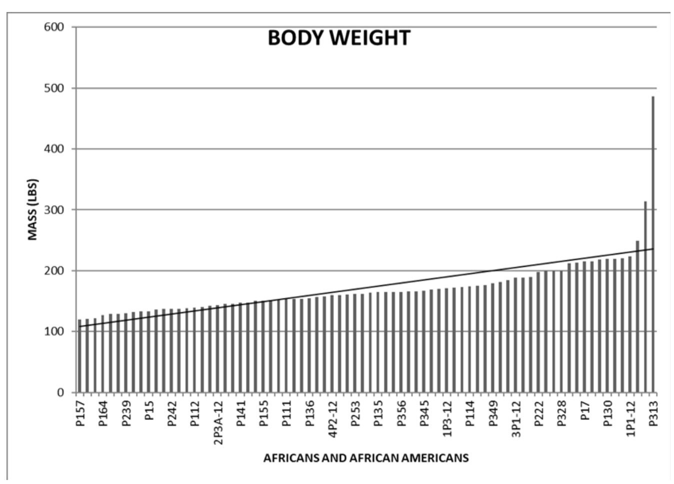

Figure 4. African & African American Body Weight in (lbs). Data shows physiological agreement of African Americans with reference population of West African.

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Table 5. Physiology Data. 4 Component Model Muscle Weight (lbs) for Africans and African Americans.

Physiology 4-Component Model Muscle Weight (lbs) & (%)										
ID	**Group**	**Muscle (lbs)**	**M. Weight (lbs)**	**%**		**ID**	**Group**	**4C.muscle (lbs)**	**M.weight (lbs)**	**%**
P13	Afr	126.2	173.4	0.727		P32	AA	101.9	142	0.717
P15	Afr	111.6	133	0.839		P34	AA	112.2	132.8	0.844
P18	Afr	124.7	166	0.751		P36	AA	181.8	313.8	0.579
P17	Afr	134.1	214.8	0.624		P300	AA	117	212	0.55
P19	Afr	107.5	129	0.833		P313	AA	184	486	0.378
P110	Afr	116.2	163.6	0.710		P325	AA	99.4	158	0.629
P111	Afr	119.7	153.4	0.780		P326	AA	135.5	200	0.677
P112	Afr	117.3	139.6	0.840		P328	AA	132.8	200	0.664
P114	Afr	125.6	174.2	0.721		P329	AA	89.5	136.8	0.654
P117	Afr	127	161	0.788		P332	AA	131.4	190	0.691
P121	Afr	147.8	200	0.739		P333	AA	117	165.6	0.706
P130	Afr	144.1	219	0.657		P334	AA	103.9	150.2	0.691
P131	Afr	122.5	145	0.844		P338	AA	114.5	162	0.706
P135	Afr	98.9	164.6	0.600		P340	AA	147.5	215	0.686
P136	Afr	112.3	155	0.724		P344	AA	130.5	176	0.741
P141	Afr	117.7	147.8	0.796		P345	AA	116.9	167	0.7
P144	Afr	122.5	165	0.742		P347	AA	121.1	175	0.692
P146	Afr	102.5	121.5	0.843		P349	AA	123	179.2	0.686
P148	Afr	175.6	220	0.798		P350	AA	118.4	170	0.696
P152	Afr	135	184	0.733		P351	AA	140.9	218.4	0.645
P154	Afr	120.4	169	0.712		P356	AA	107	165	0.648
P155	Afr	115.1	151	0.762		P361	AA	121.7	153.4	0.793
P157	Afr	88.8	120.2	0.738		1P3-12	AA	99	170.6	0.580
P162	Afr	119.6	154	0.776		2P3A-12	AA	101.2	143.2	0.706
P164	Afr	100.7	127	0.792		3P3-12	AA	109.2	157	0.695
1P1-12	Afr	152	223.8	0.679		4P3-12	AA	108	137	0.788
2P1-12	Afr	116.6	165	0.706		5P3-12	AA	97.6	137.8	0.708
3P1-12	Afr	92.8	188	0.493		6P3-12	AA	155	188.6	0.821
1P2-12	Afr	93.1	120.8	0.770		7P3-12	AA	109	213.4	0.510
2P2-12	Afr	154.9	180.8	0.856		9P3-12	AA	114.2	145	0.787
3P2-12	Afr	125.5	147.8	0.849		10P3-12	AA	98.8	151.4	0.652
4P2-12	Afr	104.6	160	0.653		11P3-12	AA	138.8	248.6	0.558
P215	Afr	104.7	132	0.793		12P3-12	AA	133.9	172	0.778
P216	Afr	105	152	0.690						
P222	Afr	118.7	198	0.599						
P227	Afr	124.8	219	0.569						
P237	Afr	98.1	128.6	0.762						
P239	Afr	102.8	130.4	0.788						
P242	Afr	103.2	137	0.753						
P243	Afr	124.5	160	0.778						
P253	Afr	116.3	161.4	0.720						
P260	Afr	106.5	136	0.783						
P263	Afr	101.8	140	0.727						

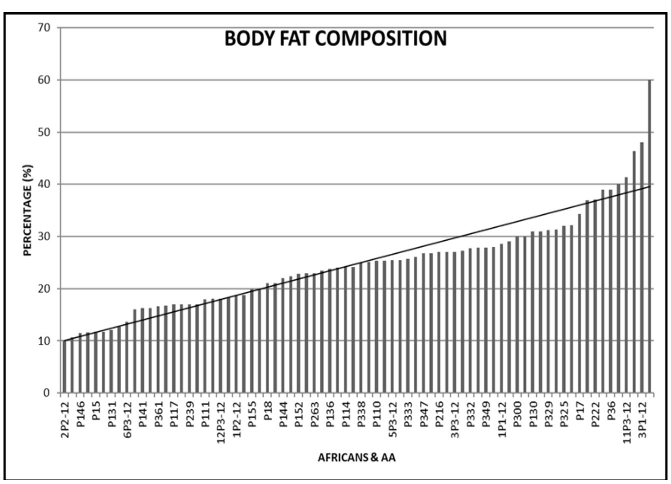

Figure 5. African & African American Body Fat Composition (%). Data shows African American agreement with West African reference population. Body fat comprises less than 30 percent of total body mass.

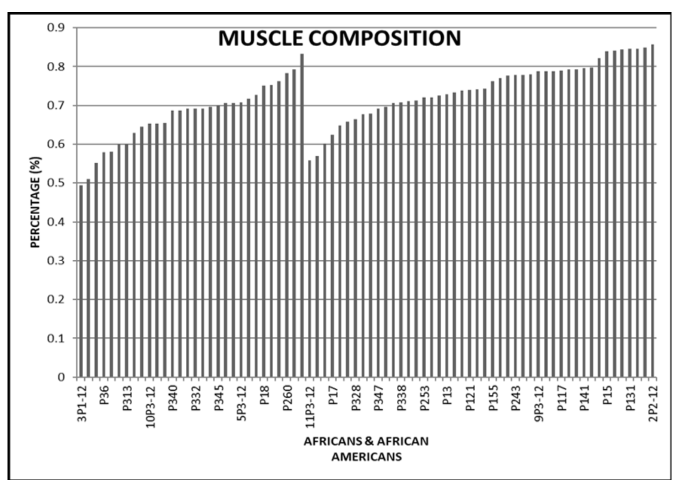

Figure 6. African & African American Muscle Compostion (%). Both groups showed agreement with mesomorphic phenotype w/ muscle composition in excess of 60% of total body mass.

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Table 6. Physiology Data. Group BMI (%) for Africans and African Americans.

Physiology Data African and African American Group BMI (%)										
ID	**Group**	**BMI**	**Gender**	**Age**		**ID**	**Group**	**BMI**	**Gender**	**Age**
P13	Afr1	21.9	M	20		P32	AA	22.1	F	23
P15	Afr1	19.7	M	26		P34	AA	18.9	M	21
P18	Afr1	32	F	32		P36	AA	62.8	F	33
P17	Afr1	29.4	M	38		P300	AA	27	F	21
P19	Afr1	24	F	32		P313	AA	75.4	F	20
P110	Afr1	22.6	M	28		P325	AA	28.6	F	23
P111	Afr1	22.6	M	34		P326	AA	28	M	21
P112	Afr1	23	M	26		P328	AA	37.4	M	25
P114	Afr1	25.7	M	36		P329	AA	21	F	19
P117	Afr1	21	M	25		P332	AA	32.4	F	22
P121	Afr1	27.1	M	27		P333	AA	27.3	F	25
P130	Afr1	31.2	M	19		P334	AA	24.7	F	21
P131	Afr1	21.8	M	24		P338	AA	22	M	25
P135	Afr1	26.9	M	28		P340	AA	32.8	F	20
P136	Afr1	42.9	M	24		P344	AA	27	M	20
P141	Afr1	23.2	M	21		P345	AA	27	F	27
P144	Afr1	24.8	M	23		P347	AA	23	M	20
P146	Afr1	21.1	M	21		P349	AA	27.2	F	22
P148	Afr1	29.9	M	28		P350	AA	31.9	M	25
P152	Afr1	26.5	M	29		P351	AA	42	F	45
P154	Afr1	25.6	M	33		P356	AA	28	M	22
P155	Afr1	25.2	M	29		P361	AA	23.4	M	21
P157	Afr1	22.3	M	37		1P3-12	AA	27.9	F	21
P162	Afr1	24.2	M	24		2P3A-12	AA	23	F	20
P164	Afr1	20.9	M	23		3P3-12	AA	26.3	F	43
1P1-12	Afr1	32.2	M	37		4P3-12	AA	20.6	M	22
2P1-12	Afr1	30.9	M	27		5P3-12	AA	20.4	F	19
3P1-12	Afr1	30	F	27		6P3-12	AA	26	M	23
1P2-12	Afr2	20.5	M	18		7P3-12	AA	39	F	34
2P2-12	Afr2	27.7	M	25		9P3-12	AA	20.3	M	21
3P2-12	Afr2	21.4	M	18		10P3-12	AA	23.3	F	19
4P2-12	Afr2	28.9	F	19		11P3-12	AA	35.6	M	29
P215	Afr2	20.4	F	21		12P3-12	AA	22.6	M	20
P216	Afr2	16.5	F	18						
P227	Afr2	34.4	M	19						
P237	Afr2	22.2	F	20						
P239	Afr2	19.1	M	19						
P242	Afr2	20.6	F	28						
P243	Afr2	30	M	20						
P253	Afr2	25.3	M	18						
P260	Afr2	21.2	F	33						
P263	Afr2	22.6	F	19						

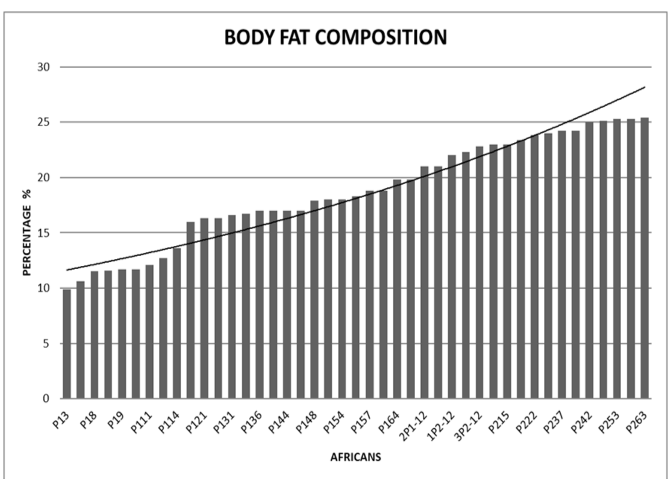

Figure 7. African Body Fat Percentages. Fat mass accounted for less than 30 percent of total body mass in West Africans.

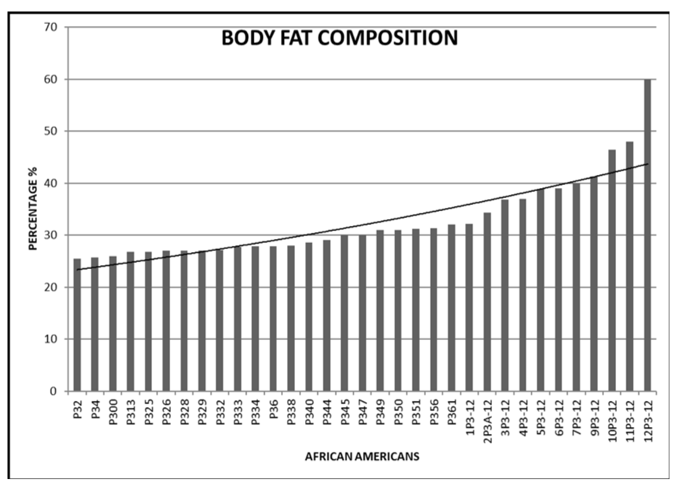

Figure 8. African American Body Fat Percentage. Body fat accounted for 30-40 percent of actual body mass in African Americans.

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Table 7. Significant Variables for Physiology Data.

Table of Significant Variables For Physiology Data				One Way Anova (OWA) =AFR X AA Linear Regression (LR) = Var1 x Var 2 Multiple Regression (MR) =Dependent Var x V1, V2, V3, V4, V5….
Variable	**Dependent Variable**	**P/F Value**	**Significance**	**Data**
BMI	Muscle_lbs	<.0001	Highly Significant	Multiple Regression
BMI	Muscle%	<.0001	Highly Significant	Multiple Regression
BMI		<.0001	Highly Significant	Multiple Regression
BMI	Bones	<.0001	Highly Significant	Multiple Regression
BMI X FAT		<.0001	Highly Significant	Linear Regression
Bone Density X BMI		<.0001	Highly Significant	Linear Regression
Bones	Muscle_lbs	<.0001	Highly Significant	Multiple Regression
Bones	BMI	<.0001	Highly Significant	Multiple Regression
Bones	Intercept	<.0001	Highly Significant	Multiple Regression
Fat	Muscle%	<.0001	Highly Significant	Multiple Regression
Muscle%	Intercept	<.0001	Highly Significant	Multiple Regression
Muscle_lbs		<.0001	Highly Significant	Multiple Regression
Weight	BMI	<.0001	Highly Significant	Multiple Regression
Fat		0.0002	Very Significant	Multiple Regression
Fat		0.0003	Very Significant	Multiple Regression
Fat		0.0006	Very Significant	Multiple Regression
Group 1 (Afr)	Fat	0.0002	Very Significant	Multiple Regression
Muscle_lbs	Intercept	0.0027	Significant	Multiple Regression
Body Fat %		0.0039	Significant	One Way Anova
Fat Composition	BMI	0.006	Significant	Multiple Regression
Group 2	Bones	0.0061	Significant	Multiple Regression
Fat	Muscle_lbs	0.0071	Significant	Multiple Regression
BMI	Intercept	0.0072	Significant	Multiple Regression
BMI	Intercept	0.009	Significant	Multiple Regression
BMI	Fat	0.0097	Significant	Multiple Regression
Fat	BMI	0.01	Significant	Multiple Regression
Weight		0.0246	Significant	One Way Anova
Gender	Fat	0.0366	Significant	Multiple Regression
Group 1 (Afr)	Bones	0.0367	Significant	Multiple Regression
Gender	Fat	0.0372	Significant	Multiple Regression
BMI		0.0481	Significant	One Way Anova

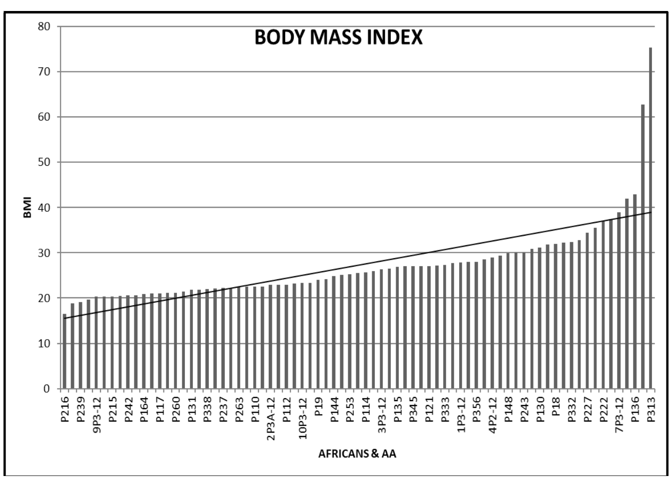

Figure 9. African and African Americans BMI (%).

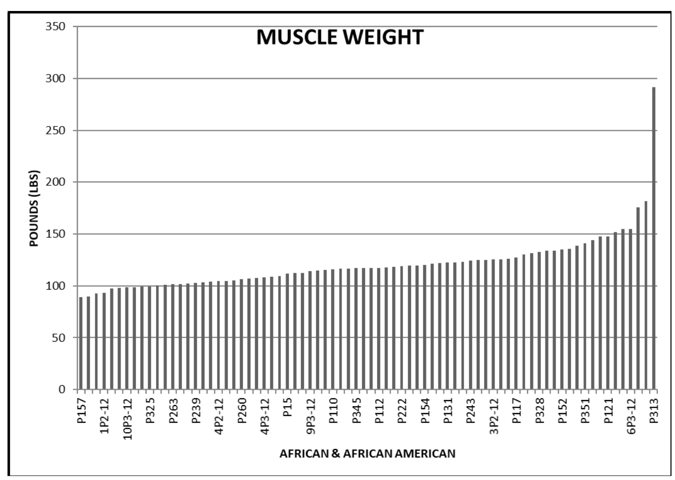

Figure 10. African & African American Muscle Weights (lbs).

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Table 8. Physiology Data . 4 Component Model Fat Percentages African & African Americans.

Physiology Data
4 Component Model-Fat Percentages

ID	Group	4C.fat (%)	Age	Gender	ID	Group	4C.fat (%)	Age	Gender
P13	Afr1[a]	23.4	20	M	P32	AA	24	23	F
P15	Afr1	11.7	26	M	P34	AA	11.6	21	M
P18	Afr1	21	32	F	P300	AA	30	21	F
P17	Afr1	34.3	38	M	P313	AA	60	20	F
P19	Afr1	12.7	32	F	P325	AA	32	23	F
P110	Afr1	25.3	28	M	P326	AA	29	21	M
P111	Afr1	17.9	34	M	P328	AA	30	25	M
P112	Afr1	11.7	26	M	P329	AA	31.2	19	F
P114	Afr1	24.2	36	M	P332	AA	27.7	22	F
P117	Afr1	17	25	M	P333	AA	25.7	25	F
P121	Afr1	23	27	M	P334	AA	27.2	21	F
P130	Afr1	31	19	M	P36	AA	39	33	F
P131	Afr1	12.1	24	M	P338	AA	25	25	M
P135	Afr1	36.9	28	M	P340	AA	27.8	20	F
P136	Afr1	23.8	24	M	P344	AA	27	20	M
P141	Afr1	16.3	21	M	P345	AA	26	27	F
P144	Afr1	22	23	M	P347	AA	26.8	20	M
P146	Afr1	11.5	21	M	P349	AA	27.8	22	F
P148	Afr1	17	28	M	P350	AA	26.8	25	M
P152	Afr1	22.8	29	M	P351	AA	32.2	45	F
P154	Afr1	25.1	33	M	P356	AA[c]	28	22	M
P155	Afr1	19.8	29	M	P361	AA	16.6	21	M
P157	Afr1	22.3	37	M	1P3-12	AA	38.9	21	F
P162	Afr1	18.3	24	M	2P3A-12	AA	25.5	20	F
P164	Afr1	16.3	23	M	3P3-12	AA	27	43	F
1P1-12	Afr1	28.6	37	M	4P3-12	AA	16	22	M
2P1-12	Afr1	25.3	27	M	5P3-12	AA	25.4	19	F
3P1-12	Afr1	48	27	F	6P3-12	AA	13.6	23	M
1P2-12	Afr2[b]	18.8	18	M	7P3-12	AA	46.4	34	F
2P2-12	Afr2	9.9	25	M	9P3-12	AA	17	21	M
3P2-12	Afr2	10.6	18	M	10P3-12	AA	31.3	19	F
4P2-12	Afr2	31	19	F	11P3-12	AA	41.3	29	M
P215	Afr2	16.7	21	F	12P3-12	AA	18	20	M
P237	Afr2	19.8	20	F					
P239	Afr2	17	19	M					
P242	Afr2	21	28	F					
P243	Afr2	18.8	20	M					
P253	Afr2	24.2	18	M					
P260	Afr2	18	33	F					
P263	Afr2	23	19	F					

[a]Afr1= Africans in the U.S. 10 years or less
[b]Afr2=Africans in the U.S 10 years or more
[c]AA= Non African Affiliated Black Americans

2C Model: Wagner et al. {%BF=[(4.858/Db)-4.394] x 100 (Wagner and Heyward, 2000)
(Black Men)
Additionally, data was adjusted for age and gender.

Statistical Analysis

Phenotypic data was evaluated among the three groups where:
Group 1: Reference population of African Americans-West Africans in US less than 10 yrs
Group Two: Reference population for African Americans- West African in the US 10 years or more
Group Three: African Americans

Statistical analysis was used to determine the significance of the variances among the groups. Phenotypic data (mass, heights, breadths, girths, skinfold thicknesses) were used as variables (32). Statistical significance was obtained among variables using ANOVA (SAS Inc. Cary, NC). Significant variables shown on Table 1 were ranked using Principal Component Analysis (SAS) and Table 2 shows further analysis on a regression curve using Multiple Regression (SAS).

Self-Reported Physiology Survey Response Data

Non/Normal Weight (Self- Reported)

The majority of Africans and African Americans described themselves as normal weight. A larger percentage of Africans described themselves as normal weight than African Americans. About 61% of African Americans described themselves as normal weight, 39% did not (Table 2). Almost 79% of Africans described themselves as normal weight, 21% did not.

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Table 9. Four Component Model Body Measurement Data for Africans and African Americans.

African & African American
4-Component Model Physiology Data

ID	Group	Fat (%)	Muscle (lbs)	TBW (%)	Bones (lbs)	Weight (lbs)	BMI	WHR	Age (yrs)	Gender
P13	Afr_Tenplus [a]	23.4	126.2	32	6.6	173.4	21.9	0.77	20	M
P15	Afr_Tenplus	11.7	111.6	48	5.8	133	19.7	0.81	26	M
P18	Afr_Tenplus	21	124.7	34.6	6.4	166	32	0.74	32	F
P17	Afr_Tenplus	34.3	134.1	21	7	214.8	29.4	0.88	38	M
P19	Afr_Tenplus	12.7	107.5	38.3	5.6	129	24	0.77	32	F
P110	Afr_Tenplus	25.3	116.2	33.3	6	163.6	22.6	0.8	28	M
P111	Afr_Tenplus	17.9	119.7	39	6.2	153.4	22.6	0.82	34	M
P112	Afr_Tenplus	11.7	117.3	46.1	6	139.6	23	0.84	26	M
P114	Afr_Tenplus	24.2	125.6	31.7	6.4	174.2	25.7	0.88	36	M
P117	Afr_Tenplus	17	127	32	6	161	21	0.8	25	M
P121	Afr_Tenplus	23	147.8	32	6.2	200	27.1	0.86	27	M
P130	Afr_Tenplus	31	144.1	23.5	7	219	31.2	0.95	19	M
P131	Afr_Tenplus	12.1	122.5	41.1	5	145	21.8	0.79	24	M
P135	Afr_Tenplus	36.9	98.9	27.9	5	164.6	26.9	0.95	28	M
P136	Afr_Tenplus	23.8	112.3	35.8	5	155	42.9	0.83	24	M
P141	Afr_Tenplus	16.3	117.7	41.3	6	147.8	23.2	0.95	21	M
P144	Afr_Tenplus	22	122.5	36.3	6.2	165	24.8	0.8	23	M
P146	Afr_Tenplus	11.5	102.5	47.7	5	121.5	21.1	0.8	21	M
P148	Afr_Tenplus	17	175.6	26.1	7	220	29.9	0.89	28	M
P152	Afr_Tenplus	22.8	135	30.5	7	184	26.5	0.82	29	M
P154	Afr_Tenplus	25.1	120.4	31.9	6.2	169	25.6	0.94	33	M
P155	Afr_Tenplus	19.8	115.1	38.7	6	151	25.2	0.92	29	M
P157	Afr_Tenplus	22.3	88.8	47.1	4.6	120.2	22.3	0.84	37	M
P162	Afr_Tenplus	18.3	119.6	38.7	6.2	154	24.2	0.85	24	M
P164	Afr_Tenplus	16.3	100.7	55	5.6	127	20.9	0.83	23	M
1P1-12	Afr_Tenplus	28.6	152	51.8	7.8	223.8	32.2	0.9	37	M
2P1-12	Afr_Tenplus	25.3	116.6	0.36	6.7	165	30.9	85	27	M
3P1-12	Afr_Tenplus	48	92.8	41.3	5	188	30	0.81	27	F
1P2-12	Afr_Tenless [b]	18.8	93.1	61.1	5	120.8	20.5	0.89	18	M
2P2-12	Afr_Tenless	9.9	154.9	63	8	180.8	27.7	0.83	25	M
3P2-12	Afr_Tenless	10.6	125.5	62.5	6.6	147.8	21.4	0.79	18	M
4P2-12	Afr_Tenless	31	104.6	36.2	5.8	160	28.9	0.83	19	F
P215	Afr_Tenless	16.7	104.7	45.9	5.4	132	20.4	0.73	21	F
P216	Afr_Tenless	27	105	36.8	6	152	16.5	0.76	18	F
P222	Afr_Tenless	37	118.7	32.8	6	198	37	0.79	20	F
P227	Afr_Tenless	40	124.8	20.5	6.6	219	34.4	0.88	19	M
P237	Afr_Tenless	19.8	98.1	45.4	5	128.6	22.2	0.84	20	F
P239	Afr_Tenless	17	102.8	46.3	5.4	130.4	19.1	0.82	19	M
P242	Afr_Tenless	21	103.2	32.1	5	137	20.6	0.78	28	F
P243	Afr_Tenless	18.8	124.5	22.7	5.4	160	30	0.83	20	M
P253	Afr_Tenless	24.2	116.3	34	6	161.4	25.3	0.81	18	M
P260	Afr_Tenless	18	106.5	39.7	5	136	21.2	0.77	33	F
P263	Afr_Tenless	23	101.8	45.7	6	140	22.6	0.78	19	F
P32	AA [c]	24	101.9	43.6	6	142	22.1	0.78	23	F
P34	AA	11.6	112.2	48.4	5.8	132.8	18.9	0.82	21	M
P36	AA	39	181.8	14	9.6	313.8	62.8	0.89	33	F
P300	AA	30	117	31	8	212	27	0.8	21	F
P313	AA	60	184	24	10.4	486	75.4	0.95	20	F
P325	AA	32	99.4	34.1	8	158	28.6	0.93	23	F
P326	AA	29	135.5	31.9	6.5	200	28	0.8	21	M
P328	AA	30	132.8	48.9	7.2	200	37.4	0.96	25	M
P329	AA	31.2	89.5	36.6	4.6	136.8	21	0.86	19	F
P332	AA	27.7	131.4	32	6	190	32.4	0.81	22	F
P333	AA	25.7	117	32.4	6	165.6	27.3	0.78	25	F
P334	AA	27.2	103.9	35.2	5.4	150.2	24.7	0.81	21	F
P338	AA	25	114.5	24.1	7	162	22	0.8	25	M
P340	AA	27.8	147.5	24.5	7.6	215	32.8	0.85	20	F
P344	AA	27	130.5	27	8	176	27	0.81	20	M
P345	AA	26	116.9	42	6.7	167	27	0.83	27	F
P347	AA	26.8	121.1	34.7	7	175	23	0.82	20	M
P349	AA	27.8	123	29.4	6.4	179.2	27.2	0.75	22	F
P350	AA	26.8	118.4	32.9	6	170	31.9	0.77	25	M
P351	AA	32.2	140.9	22.6	7.2	218.4	42	0.77	45	F
P356	AA	28	107	24	7	165	28	0.7	22	M
P361	AA	16.6	121.7	39.4	6.2	153.4	23.4	0.89	21	M
1P3-12	AA	38.9	99	47	5.2	170.6	27.9	0.83	21	F
2P3A-12	AA	25.5	101.2	53.4	5.4	143.2	23	0.76	20	F
3P3-12	AA	27	109.2	32.7	5.4	157	26.3	0.76	43	F
4P3-12	AA	16	108	34.7	7.1	137	20.6	0.87	22	M
5P3-12	AA	25.4	97.6	53.1	5.2	137.8	20.4	0.81	19	F
6P3-12	AA	13.6	155	60	8	188.6	26	0.8	23	M
7P3-12	AA	46.4	109	51	5.8	213.4	39	1.06	34	F
9P3-12	AA	17	114.2	35.8	6.1	145	20.3	0.8	21	M
10P3-12	AA	31.3	98.8	50.7	5.2	151.4	23.3	0.75	19	F
11P3-12	AA	41.3	138.8	55	7.2	248.6	35.6	0.98	29	M
12P3-12	AA	18	133.9	38.3	7.1	172	22.6	0.83	20	M

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Overweight (Self-reported)

Among African Americans, 61% did not describe themselves as overweight, 39% did. About 81% of Africans did not describe themselves as overweight, 16% did (Table 1).

Childhood Overweight (Self-reported)

The majority of African and African Americans were not overweight as children. More African Americans were overweight as children than Africans. About 64% of African Americans said they were not overweight as children, 21% couldn't remember (Table 2). Just 18% of African Americans said they were overweight as children. Among African groups, 60% said they were not overweight as children, 32% didn't remember. Just 5% of Africans said they were overweight as children (Table 2). Therefore, there may be a population at risk for adult obesity due to childhood obesity.

Parents

Participants were asked if either of their parents were overweight. About 59% of all groups responded that their parents were not overweight. Almost 41% of all groups said their parents were overweight.

The majority of Africans and African Americans said their parents were not overweight. African American parents were reported overweight at the same percentage as they were not reported overweight. More African Americans reported their parents overweight than Africans. Among African Africans, 52% said their parents were overweight, and the same percentage said their parents were not.

About 65% of Africans said their parents were not overweight. Just 35% of African Americans did not have parents who were overweight. Therefore, because a majority population of African Americans reported parents who were overweight, African Americans are at risk of overweight due to parental inheritance of BMI (Danielzik et al., 2002; Robl et al., 2008).

Prevention/Breast Feeding

Almost all Africans were breast fed and not even half of African Americans were. Among African Americans 42% were not breast fed and 45% were. Just 12% of African Americans couldn't remember. About 95% of Africans were breast fed, 5% were not (Table 2). Therefore, African Americans are were more at risk of childhood and adult obesity due to lack of breastfeeding than Africans (Dewey, 2003).

Bone Density

There was variation in bone density (Db) between African participants in the U.S. ten years or more (tenplus) and those who had been in the U.S. 10 years or less (tenless). The former had lighter skeletal weights or bone density and the latter had heavier bone density. African Americans had the heaviest bone density (Table 3). It seems to suggest a relationship between time in the U.S. and bone density in Africans and African Americans (Figures 1-3; Suppl. Figures A1 and A2). Perhaps there are characteristics of foods grown in American soils that is related to this phenomenon. A future study might examine the relationship between U.S. soil nutrients and its effect on bone mineral density of immigrant populations like Africans, over time.

African American and African Weights vs. Gender

African Americans females weighed more on average than African American males and Africans. African males weighed more than African females (Tables 6-7). More than 60% of their body mass was attributed to muscle (Figures 4-6; Suppl. Figuress A3-6, A7-14).

Fat Percentage

About 72% of African Americans were found to be over-fat by the standard of hydrodensitometry (Smalley et al) and 58% of Africans. However, when adjusted for cultural acceptance, based on the participant's response of themselves as overweight (39% of AAs; 16% of Afr), the total was corrected by respondents whose body fat exceeded 31%. The total number of over-fat went from 72% African Americans to 9% and 58% Africans to 2% (Figures 1-3; Table 7).

Conclusion

This study asked the question: "if BMI is a proper assessment tool to measure obesity among African and African American populations" and it is not. According to the BMI standard 48% of both of these groups would be classified as overweight and obese with African Americans comprising 41% of this category and Africans comprising even more at 45% (Table 8, Figures 5, 7-8).

1. BMI falsely assumed the presence of fat. It was assumed that the resultant values for mass in this population correlated with fat. It did not (Tables 6-9).
2. A breakdown of values into a 4-component model (body fat percentage, body water, bone density and muscle mass) was more informative towards adiposity (Tables 3-8, Suppl. Tables A1-A2; Figures 1-10; Suppl. Figures A1-34).
3. Body Fat Percentage among the groups was at 24.7% overall and 29.3% for females, 21.8% for males, 28.1 % for African Americans and 22.1% for Africans. According to the BMI tables these values are all within normal range. The hydrodensitometry standard for body fat percentage is 20% for male and 25% for female (Smalley et al., 1990). Therefore, 4.3% of AAs in the study were over-fat and 1.8% of Africans (Table 7; Figures 5, 7-8).
4. Fat free mass value of bone density on average comprised 6lbs for Africans and 7lbs for African Americans of total body mass value (Table 3).
5. Fat free mass value of Total Body Water (TBW) comprised 37.8% of body mass value in Africans and Afri-

can Americans (Suppl. Table A1).

6. Fat-free mass values of Muscle Composition were around 70% of body mass value for African and African Americans, confirming a mesomorphic somatotype. Muscle comprised 123lbs of weight in African Americans and 118lbs for Africans (Tables 5, 7, and Figure 10).

The BMI standard cannot be used accurately to assess adiposity among all cultural groups only within groups. When applied within the comparison of African Americans and their reference population-West Africans, there is stern disagreement in the data that this population is 48% overweight and obese. The within group comparison showed the BMI value to be within normal range, w/ 70% of body mass to be explained by fat free muscle composition. This is in agreement with the cultural standard for Africans and African American somatotype of mesomorphy, having a large component of body mass comprised of muscle mass (Table 6; Suppl. Figures 18-25).

Ideal Weight

The notion of "ideal weight" is biologically meaningless and represents the efforts of persons well placed politically and well published academically. Height and weight tables are popular, prevalent and standardized but not objective, biologically meaningless, and unscientific.

Statistics

Multiple Regression analysis (Table 1) using the fat free mass value of muscle weight in lbs as the dependent variable showed it to have a highly significant (P=<.0001) positive correlation with BMI. Muscle percentage had a highly significant (P=<.0001) positive correlation with BMI. The fat free mass value of bones, when used a dependent variable in Multiple Regression analysis had a highly significant (P=<.0001) positive correlation with BMI.

Linear Regression analysis examining Bone Density (Db) as a variable against BMI found it to be a highly significant (P=<.0001) interaction. Linear Regression analysis examining the interaction between BMI and Fat resulted in a highly significant (P=<.0001) positive correlation (Table 2).

A Multiple Regression analysis examining the same interaction found it to be a significant positive correlation (P=.0060) (Kennedy et al., 2009; Smalley et al., 1990).

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Suppl. Table A1. Four Component Model Total Body Water (TBW) data in (lbs) for Africans and African Americans.

Physiology Data 4 Component Model Total Body Water (TBW) in (lbs)								
ID	Group	4C.TBW (%)	Gender		ID	group	4C.TBW (%)	Gender
P13	Afr1	32	M		P32	AA	43.6	F
P15	Afr1	48	M		P34	AA	48.4	M
P18	Afr1	34.6	F		P300	AA	31	F
P17	Afr1	21	M		P313	AA	24	F
P19	Afr1	38.3	F		P325	AA	34.1	F
P110	Afr1	33.3	M		P326	AA	31.9	F
P111	Afr1	39	M		P328	AA	48.9	M
P112	Afr1	46.1	M		P329	AA	36.6	M
P114	Afr1	31.7	M		P332	AA	32	F
P117	Afr1	32	M		P333	AA	32.4	F
P121	Afr1	32	M		P334	AA	35.2	F
P130	Afr1	23.5	M		P36	AA	41	F
P131	Afr1	41.1	M		P338	AA	24.1	M
P135	Afr1	27.9	M		P340	AA	24.5	F
P136	Afr1	35.8	M		P344	AA	27	M
P141	Afr1	41.3	M		P345	AA	42	F
P144	Afr1	36.3	M		P347	AA	34.7	M
P146	Afr1	47.7	M		P349	AA	29.4	F
P148	Afr1	26.1	M		P350	AA	32.9	M
P152	Afr1	30.5	M		P351	AA	22.6	F
P154	Afr1	31.9	M		P356	AA	24	M
P155	Afr1	38.7	M		P361	AA	39.4	M
P157	Afr1	47.1	M		1P3-12	AA	47	F
P162	Afr1	38.7	M		2P3A-12	AA	53.4	F
P164	Afr1	55	M		3P3-12	AA	32.7	F
1P1-12	Afr1	51.8	M		4P3-12	AA	34.7	M
2P1-12	Afr1	0.36	M		5P3-12	AA	53.1	F
3P1-12	Afr1	41.3	F		6P3-12	AA	60	M
1P2-12	Afr1	61.1	M		7P3-12	AA	51	F
2P2-12	Afr2	63	M		9P3-12	AA	35.8	M
3P2-12	Afr2	62.5	M		10P3-12	AA	50.7	F
4P2-12	Afr2	36.2	F		11P3-12	AA	55	M
P215	Afr2	45.9	F		12P3-12	AA	38.3	M
P216	Afr2	36.8	F					
P222	Afr2	32.8	F					
P227	Afr2	20.5	M					
P237	Afr2	45.4	F					
P239	Afr2	46.3	M					
P242	Afr2	32.1	F					
P243	Afr2	22.7	M					
P253	Afr2	34	M					
P260	Afr2	39.7	F					
P263	Afr2	45.7	F					

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Suppl. Table A2. African and African American Waist Hip Ratio (WHR).

Physiology Data **African & African American Waist Hip Ratio (WHR) in (%)**										
ID	**Group**	**WHR**	**Age**	**Gende r**		**ID**	**Group**	**WHR**	**Age**	**Gende r**
P13	Afr	0.77	20	M		P32	AA	0.78	23	F
P15	Afr	0.81	26	M		P34	AA	0.82	21	M
P18	Afr	0.74	32	F		P300	AA	0.8	33	F
P17	Afr	0.88	38	M		P313	AA	0.95	21	F
P19	Afr	0.77	32	F		P325	AA	0.93	20	F
P110	Afr	0.8	28	M		P326	AA	0.8	23	F
P111	Afr	0.82	34	M		P328	AA	0.96	21	M
P112	Afr	0.84	26	M		P329	AA	0.86	25	M
P114	Afr	0.88	36	M		P332	AA	0.81	19	F
P117	Afr	0.8	25	M		P333	AA	0.78	22	F
P121	Afr	0.86	27	M		P334	AA	0.81	25	F
P130	Afr	0.95	19	M		P36	AA	0.89	21	F
P131	Afr	0.79	24	M		P338	AA	0.8	25	M
P135	Afr	0.95	28	M		P340	AA	0.85	20	F
P136	Afr	0.83	24	M		P344	AA	0.81	20	M
P141	Afr	0.95	21	M		P345	AA	0.83	27	F
P144	Afr	0.8	23	M		P347	AA	0.82	20	M
P146	Afr	0.8	21	M		P349	AA	0.75	22	F
P148	Afr	0.89	28	M		P350	AA	0.77	25	M
P152	Afr	0.82	29	M		P351	AA	0.77	45	F
P154	Afr	0.94	33	M		P356	AA	0.7	22	M
P155	Afr	0.92	29	M		P361	AA	0.89	21	M
P157	Afr	0.84	37	M		1P3-12	AA	0.83	21	F
P162	Afr	0.85	24	M		2P3A-12	AA	0.76	20	F
P164	Afr	0.83	23	M		3P3-12	AA	0.76	43	F
1P1-12	Afr	0.9	37	M		4P3-12	AA	0.87	22	M
2P1-12	Afr	0.85	27	M		5P3-12	AA	0.81	19	F
3P1-12	Afr	0.81	27	F		6P3-12	AA	0.8	23	M
1P2-12	Afr	0.89	18	M		7P3-12	AA	1.06	34	F
2P2-12	Afr	0.83	25	M		9P3-12	AA	0.8	21	M
3P2-12	Afr	0.79	18	M		10P3-12	AA	0.75	19	F
4P2-12	Afr	0.83	19	F		11P3-12	AA	0.98	29	M
P215	Afr	0.73	21	F		12P3-12	AA	0.83	20	M
P216	Afr	0.76	18	F						
P222	Afr	0.79	20	F						
P227	Afr	0.88	19	M						
P237	Afr	0.84	20	F						
P239	Afr	0.82	19	M						
P242	Afr	0.78	28	F						
P243	Afr	0.83	20	M						
P253	Afr	0.81	18	M						
P260	Afr	0.77	33	F						
P263	Afr	0.78	19	F						

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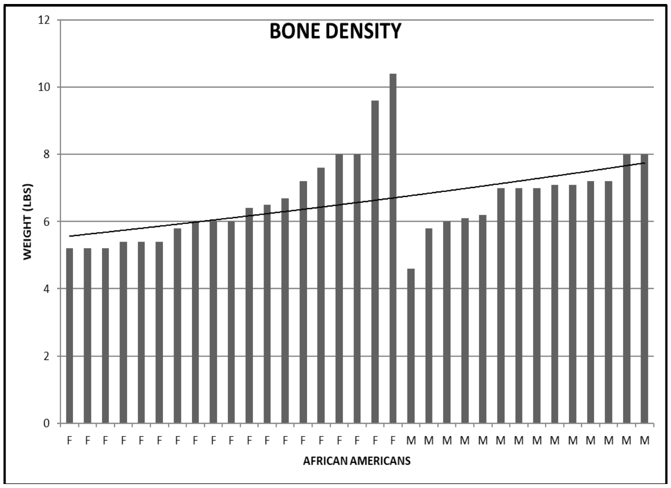
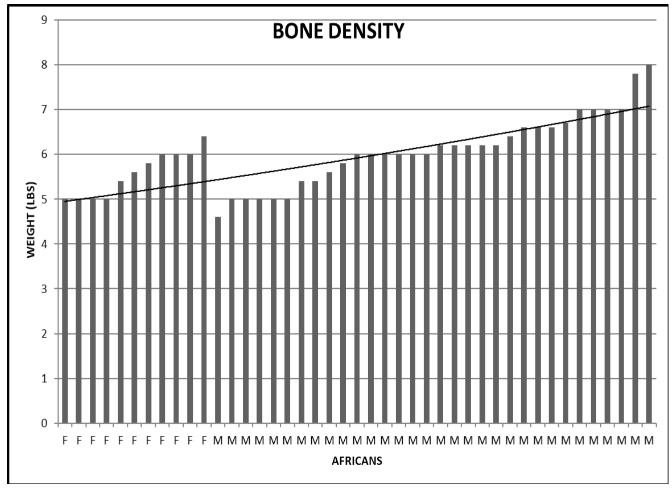
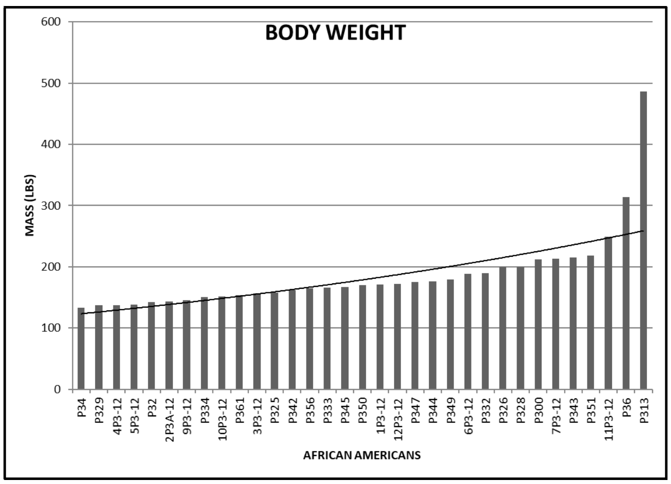


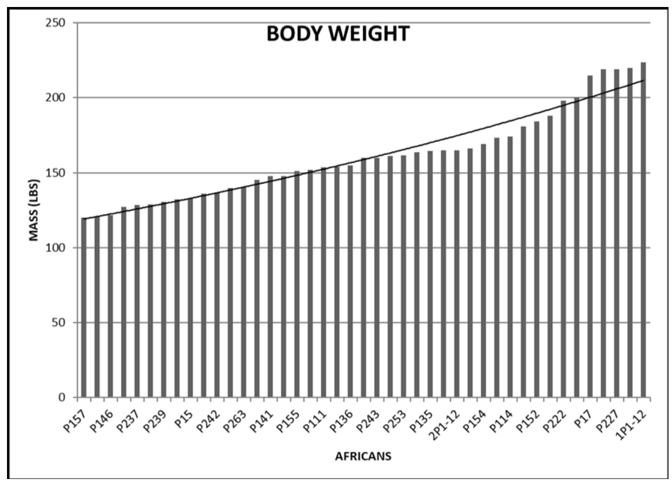
Suppl. Figure A1. African American Bone Density (Db) in (lbs) by Gender.



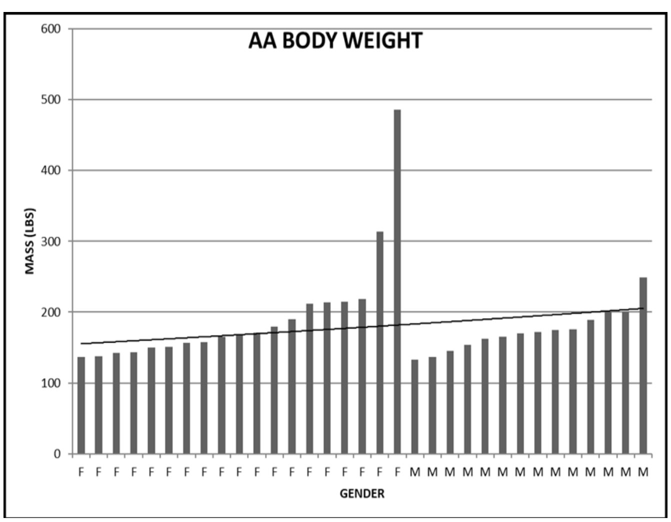
Suppl. Figure A2. African Bone Density (Db) in (lbs) by Gender.



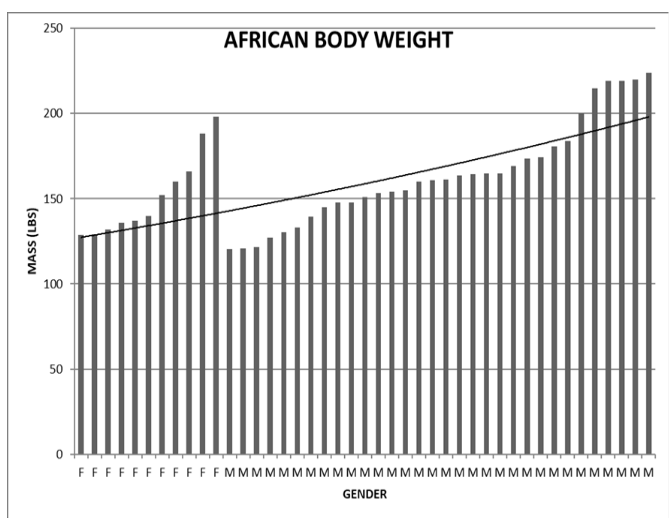
Suppl. Figure A3. African American Body Weight in (lbs).



Suppl. Figure A4. African Body Weight in (lbs).



Suppl. Figure A5. African American Body Weight (lbs) by Gender.



Suppl. Figure A6. African Body Weight (lbs) by Gender.

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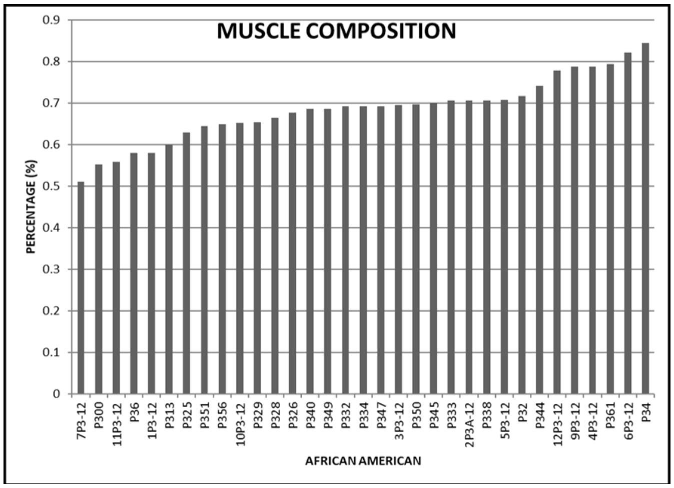
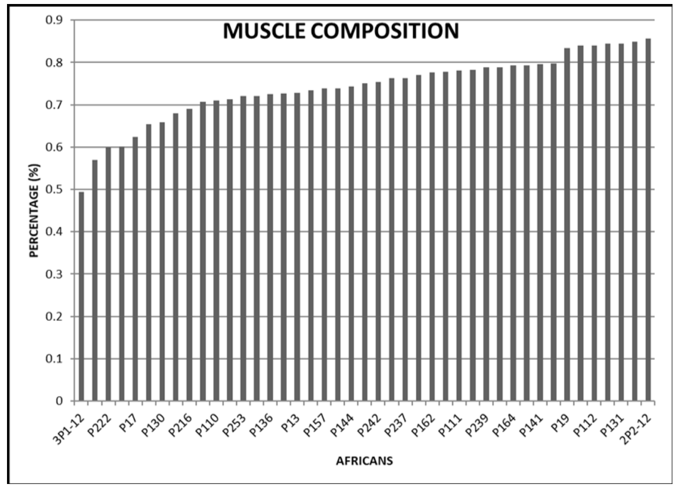
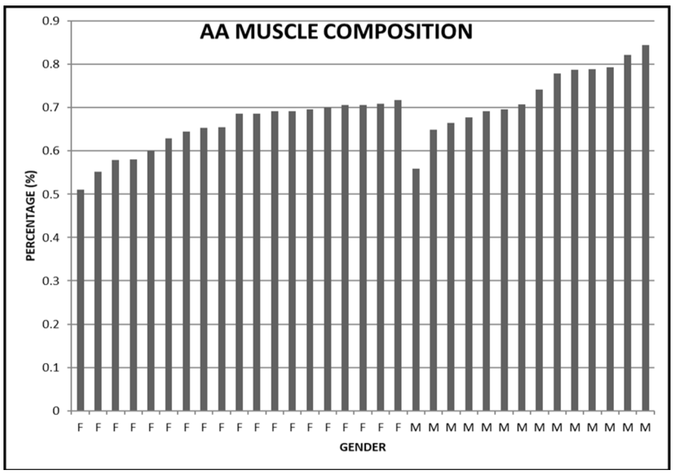


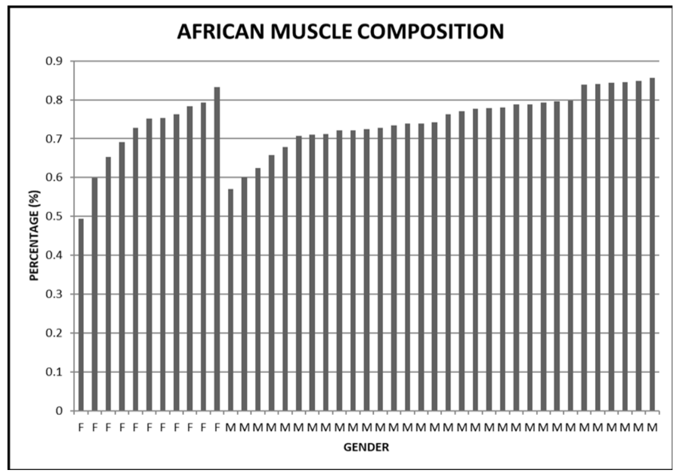
Suppl. Figure A7. African American Muscle Composition (%). African Americans showed agreement with mesomorphic phenotype, having muscle composition in excess of 60% of total body mass.



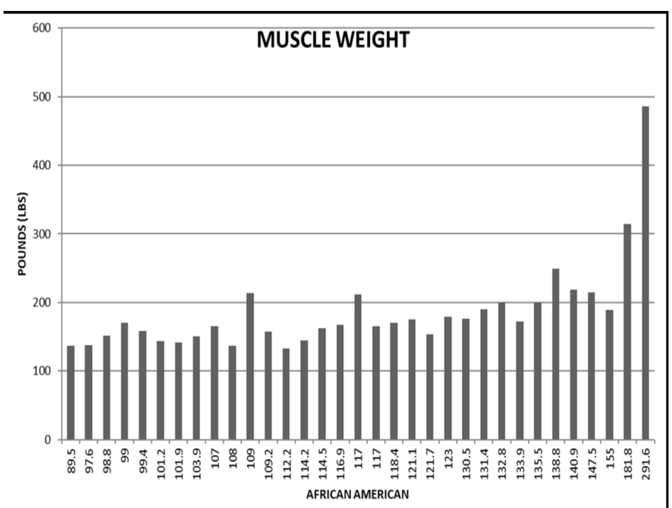
Suppl. Figure A8. African Muscle Composition (%).African muscle composition was shown to be 60% and beyond, in agreement with mesomorphic phenotype.



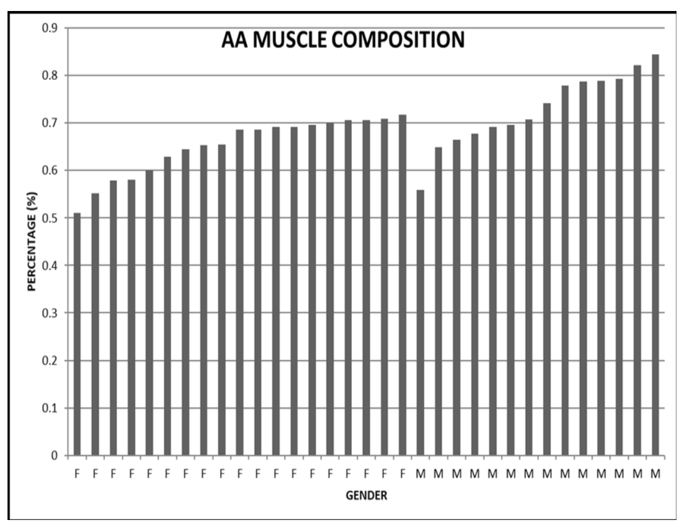
Suppl. Figure A9. African American Male and Female Muscle Composition (%). AA muscle composition in males and females were found to agree with the mesomorphic phenotype, accounting for 60% and beyond of total body mass.



Suppl. Figure A10. African Muscle Composition (%).



Suppl. Figure A11. African American Muscle Weight (lbs).



Suppl. Figure A12. African American Muscle Composition (%) by Gender.

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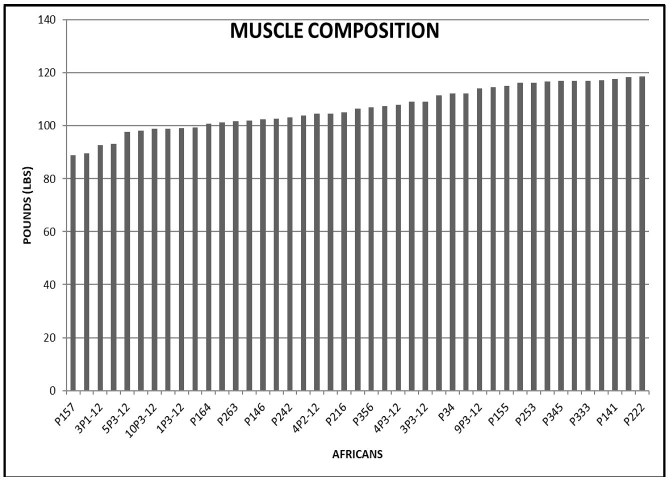
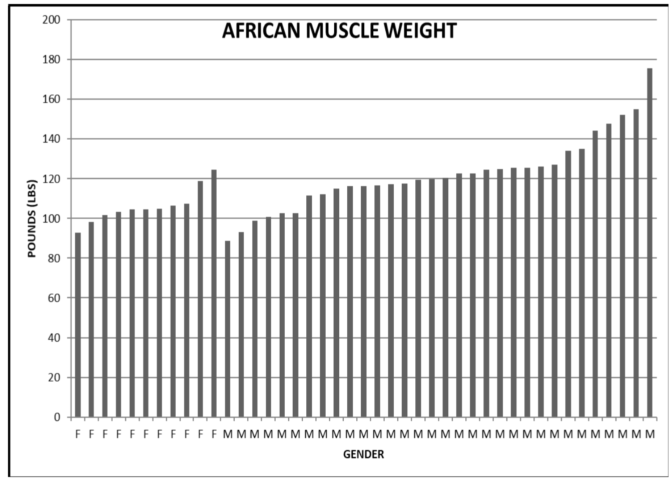
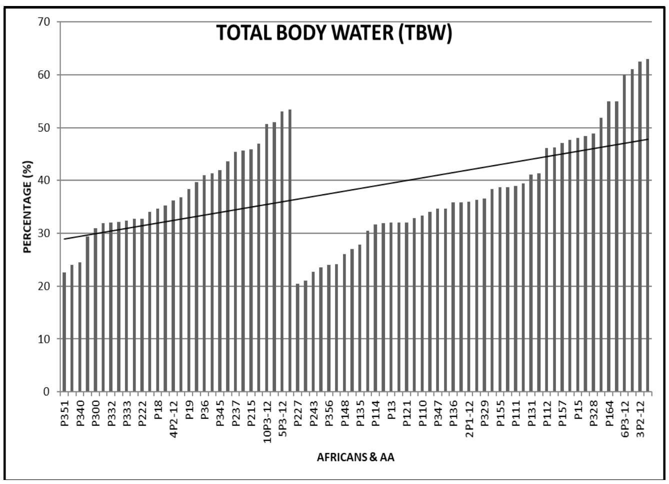


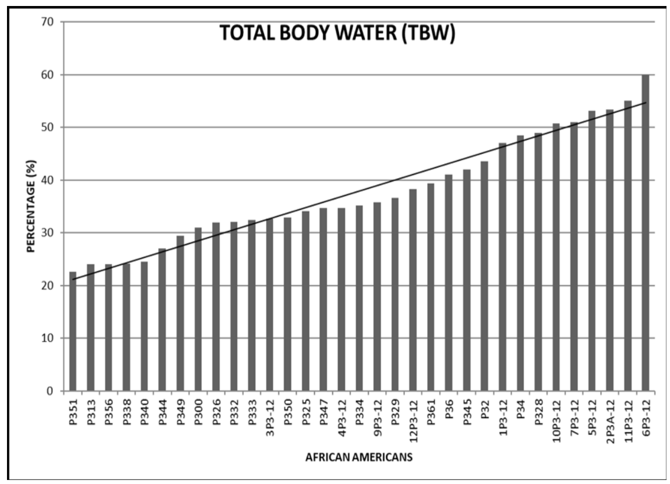
Suppl. Figure A13. African Muscle Composition (lbs).



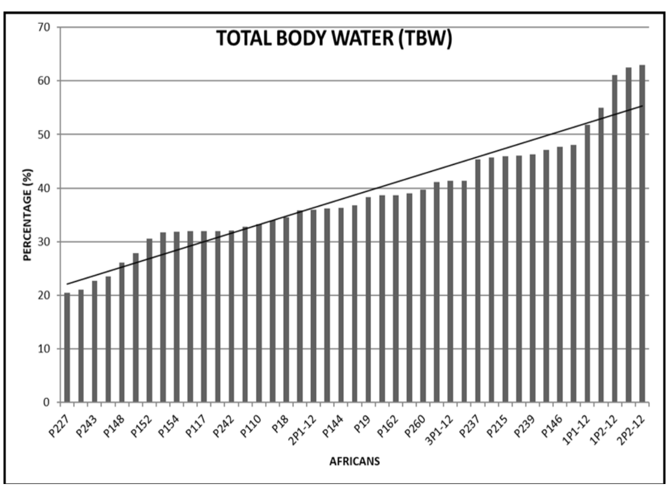
Suppl. Figure A14. African Muscle Weight (lbs) by Gender.



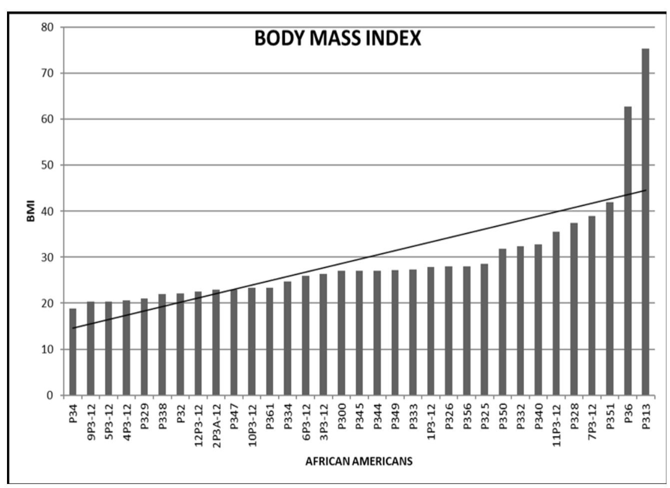
Suppl. Figure A15. African and African American Total Body Water (%).



Suppl. Figure A16. African American Total Body Water (%).



Suppl. Figure A17. African Total Body Water (TBW) by (%).



Suppl. Figure A18. African American BMI (%).

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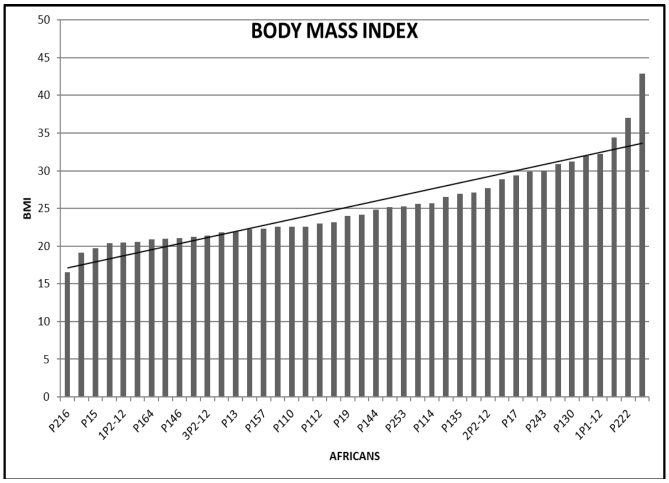
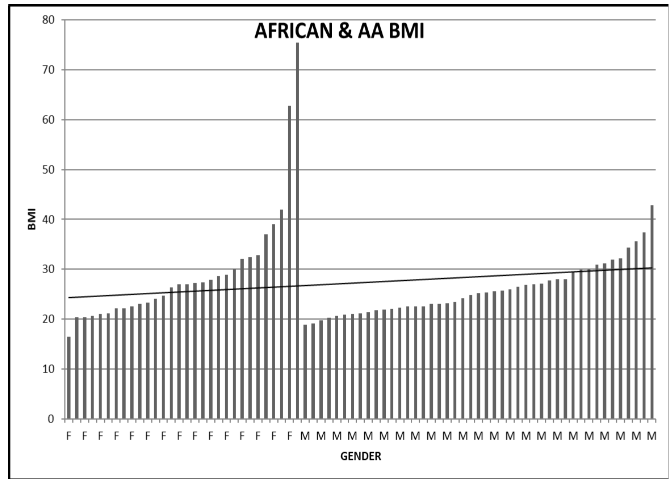
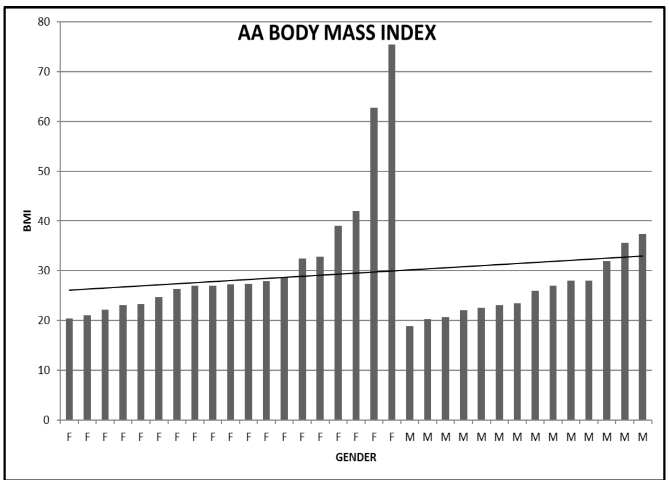


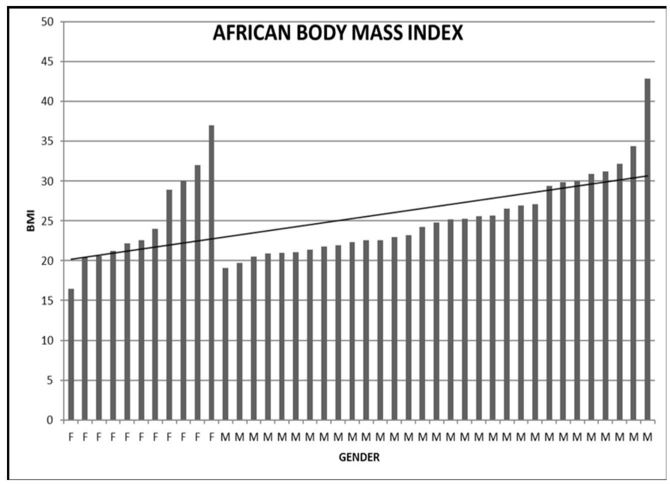
Suppl. Figure A19. African BMI (%).



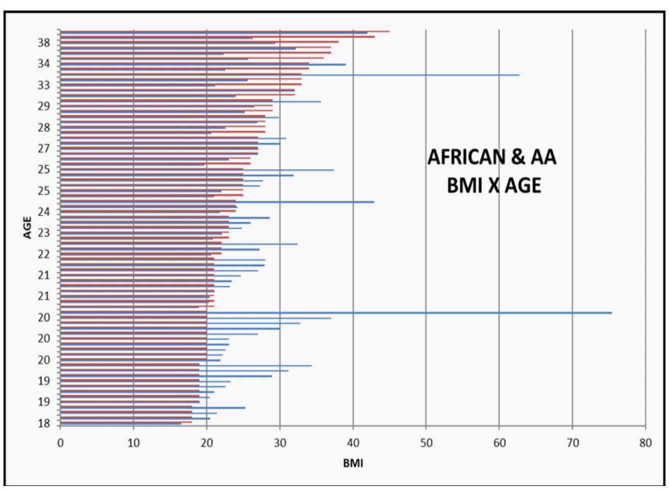
Suppl. Figure A20. African & African American BMI (%) by Age.



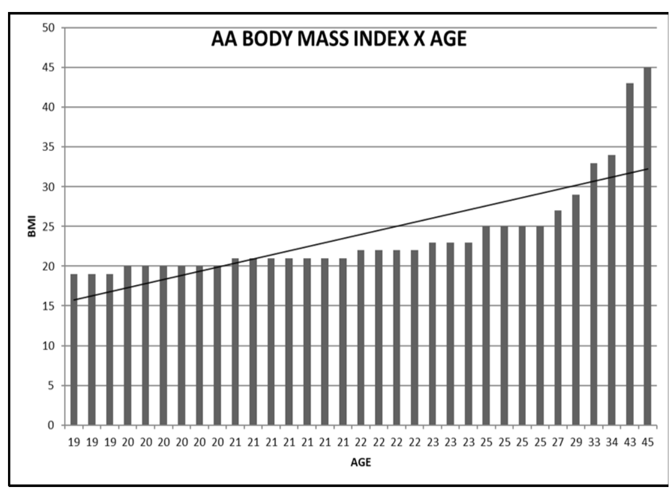
Suppl. Figure A21. African American BMI (%) by Gender.



Suppl. Figure A22. African BMI by Gender (%).



Suppl. Figure A23. African & African American BMI (%) by Age.



Suppl. Figure A24. African American BMI (%) by Age.

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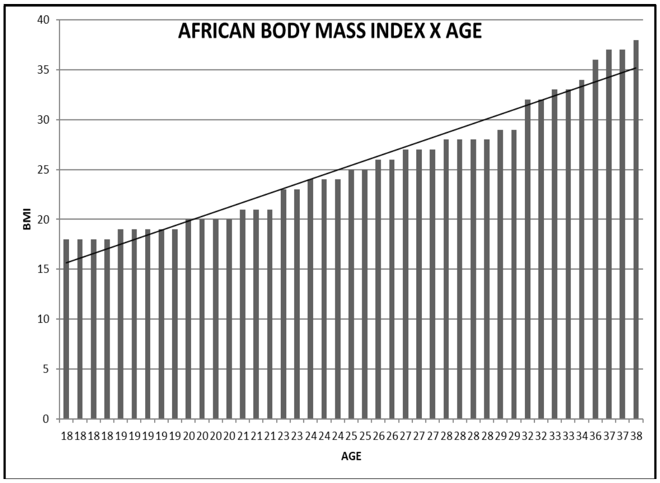
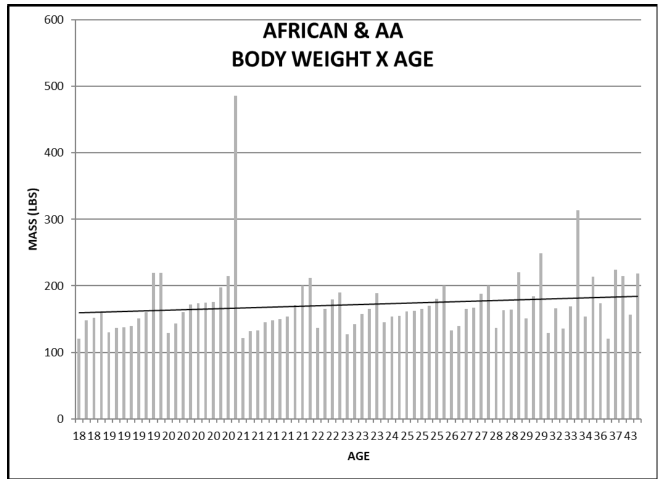
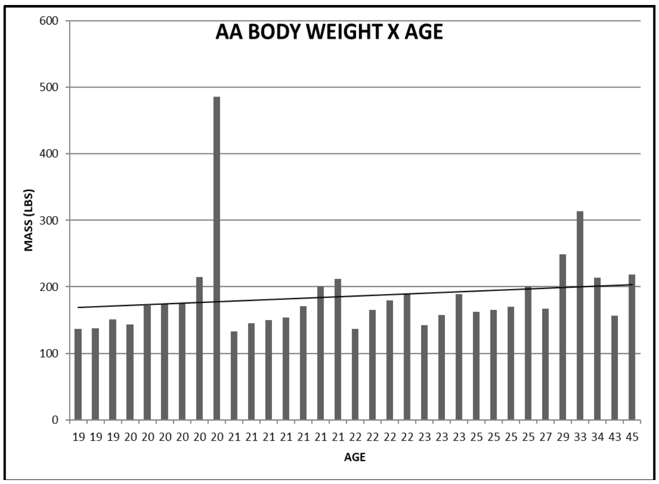


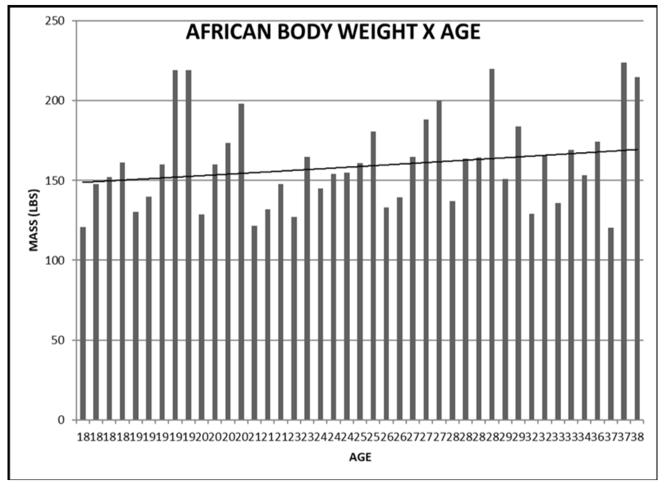
Suppl. Figure A25. African BMI (%) by Age.



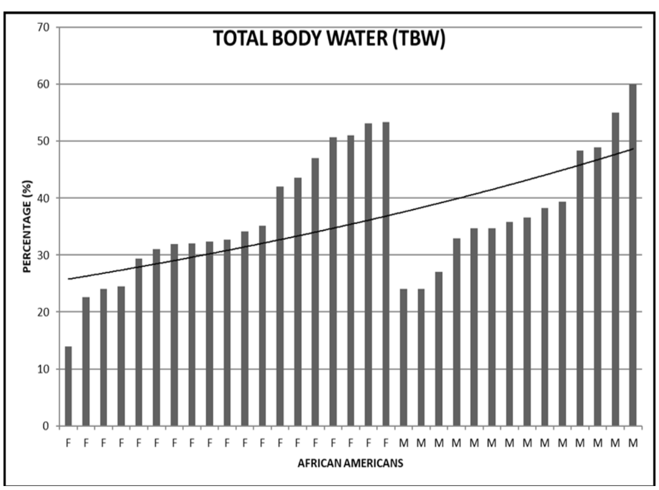
Suppl. Figure A26. African & African American Body Weight (lbs) by Age.



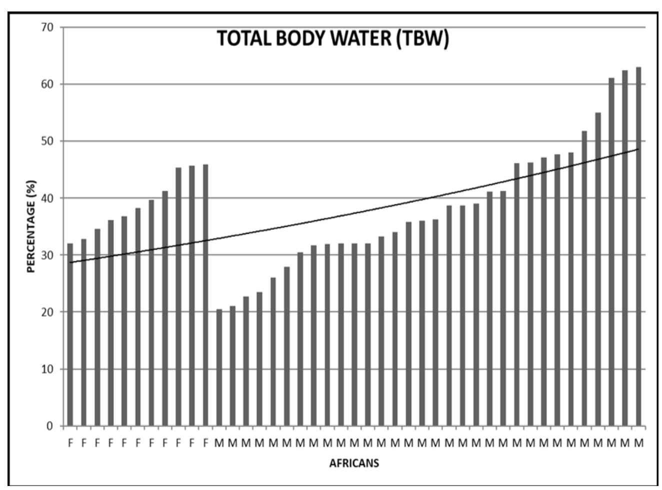
Suppl. Figure A27. African American Body Weight (lbs) by Age.



Suppl. Figure A28. African American Total Body Water (%) by Gender.



Suppl. Figure A29. African Total Body Water (TBW) by Gender.



Suppl. Figure A30. African & African American Waist Hip Ratio (WHR).

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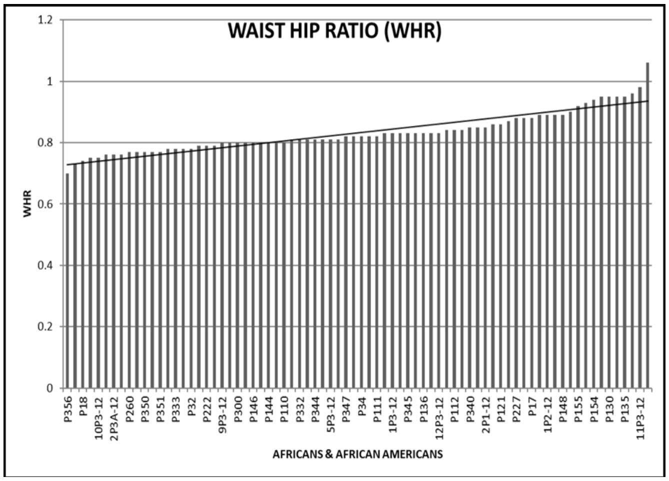
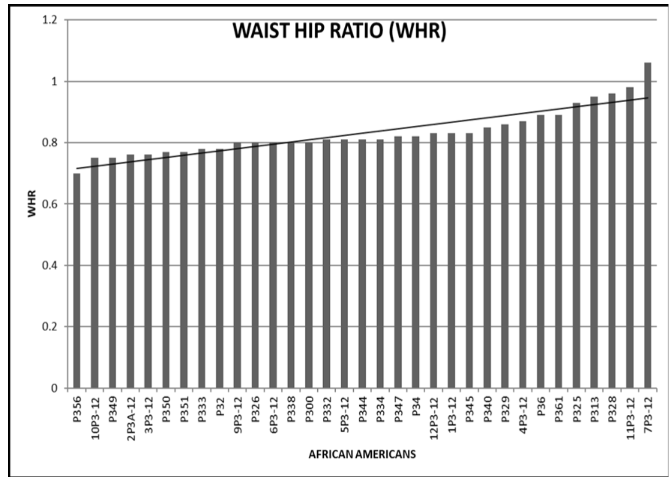
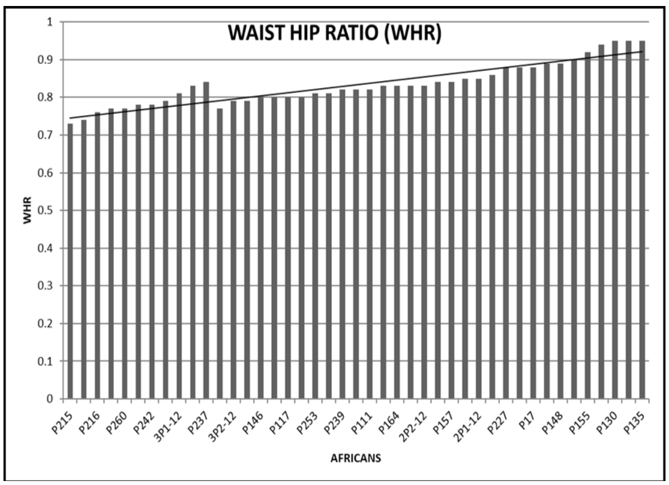


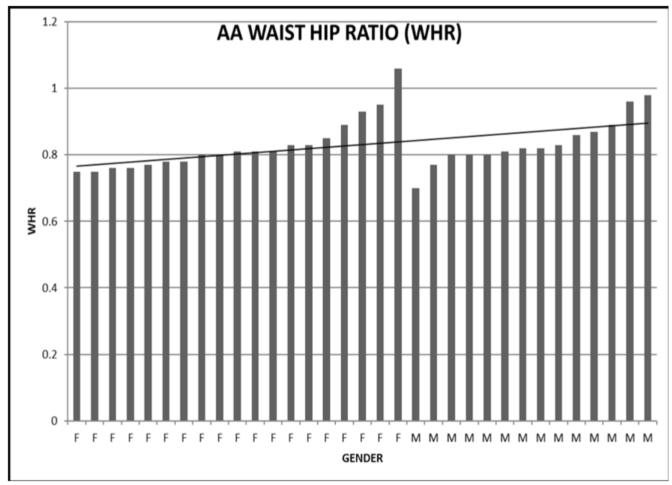
Suppl. Figure A31. African American Waist Hip Ratio WHR (%).



Suppl. Figure A32. African Waist Hip Ratio (%).



Suppl. Figure A33. African American Waist Hip Ratio -WHR (%) by Gender.



Suppl. Figure A34. African Waist Hip Ratio (%) by Gender.