

INEQUALITY IN THE AMERICAN SOUTH: EVIDENCE FROM THE NINETEENTH CENTURY MISSOURI STATE PRISON

SCOTT ALAN CARSON

*School of Business, University of Texas, Permian Basin and University of Munich,
CESifo, Germany*

Summary. The use of height data to measure living standards is now a well-established method in economic history. Moreover, a number of core findings in the literature are widely agreed upon. There are still some populations, places and times, however, for which anthropometric evidence remains thin. One example is 19th century African-Americans in US border-states. This paper introduces a new data set from the Missouri state prison to track the heights of comparable black and white men born between 1820 and 1904. Modern blacks and whites come to comparable terminal statures when brought to maturity under optimal conditions; however, whites were persistently taller than blacks in the Missouri prison sample by two centimetres. Throughout the 19th century, black and white adult statures remained approximately constant, while black youth stature increased during the antebellum period.

Introduction

An anomalous finding has emerged where the physical stature of 19th century male African-American slaves increased during the antebellum period, while Northern white and free-black statures declined. If Southern planters and overseers rationally controlled slave nutrition and medical allocations to maximize slave-owner wealth, slave heights would have increased with antebellum slave values and probably decreased with the removal of the institution (Rees *et al.*, 2003, p. 22; Steckel, 1995; Komlos & Coclanis, 1997, p. 445; Komlos, 1998; Conrad & Meyer, 1964, p. 49). While the former has been well documented, the latter remains unresolved. When brought to maturity under optimal net nutritional conditions, blacks and whites should reach comparable adult terminal statures (Eveleth & Tanner, 1976; Tanner, 1977; Steckel, 1995, p. 1910; Barondess *et al.*, 1997, p. 968; Komlos & Baur, 2004, pp. 64, 69; Nelson *et al.*, 1993, pp. 18–20; Godoy *et al.*, 2005, pp. 472–473; Margo & Steckel, 1982, p. 519; Komlos & Lauderdale, 2005); however, 19th century blacks were physically shorter than whites. By using a new source of 19th century Missouri

prison records, the present study contrasts male heights of comparable blacks and whites in an American border-state from the antebellum period through the end of the 19th century.

The use of height data to measure living standards is now a well-established method in economics. A population's average stature reflects the cumulative interaction between nutrition, disease exposure, work and the physical environment. By considering average versus individual stature, genetic differences are mitigated, leaving only the influence of economic and physical environments on stature. When diets, health and physical environments improve, average stature increases and decreases when diets become less nutritious, disease environments deteriorate or the physical environment places more stress on the body. Hence, stature provides significant insights into understanding historical processes and augments other welfare measures for 19th century blacks and whites in the American South.

The Missouri prison population is particularly interesting because Missouri was a slave state with close proximity to major waterways, was agriculturally productive, and its population was racially polarized, where blacks faced considerable degrees of racial animosity from whites. This paper considers three questions. First, how did black and white statures compare by race and how did they vary over the course of the 19th century? Given the 19th century racial disparity in material conditions between black and whites, we may expect that 19th century whites encountered more favourable biological conditions than blacks, and if average stature varied in Missouri around the time of the Civil War, such variation may have been due to the institutional change from a slave to free labour force. Second, how did Missouri inmate statures compare with other American statures? Missouri was unique because of its central location in America's 19th century transportation and migration revolutions while embracing the institution of slavery. Third, how did Missouri statures vary by socioeconomic status and occupation, and which was most associated with stature variation?

Nineteenth century Missouri

Missouri's most distinctive 19th century features were its physical environment, central location within the US, politics and culture. Conjoined just north of Saint Louis, Missouri's most prominent physical features were the Mississippi and Missouri Rivers, which are America's two longest rivers and were central to Missouri's economic development, transporting goods and peoples and probably served as carriers of disease. Missouri's economic system and biological conditions were also influenced by its northern Plains, central Ozark Plateau, and south-eastern Bootheel. The northern Dissected Till Plains were the basis for Missouri's 19th century wheat and grain production (Fig. 1). The Ozark Plateau – historically settled by Scot-Irish immigrants – is a highland region in the southern half of Missouri and during the 19th century was mined for lead and iron. The Ozark Plateau is also suited to beef ranching and dairy production, which enhanced biological conditions. The Missouri Bootheel, located in the flattest and wettest part of Missouri, is part of the Mississippi Alluvial Delta, and is only a few hundred feet above sea level, and there generally is an inverse relationship between proximity to water and stature (Haines *et al.*, 2003, p. 405; Craig & Weiss, 1998, p. 197–198, p. 205). These regional comparisons create

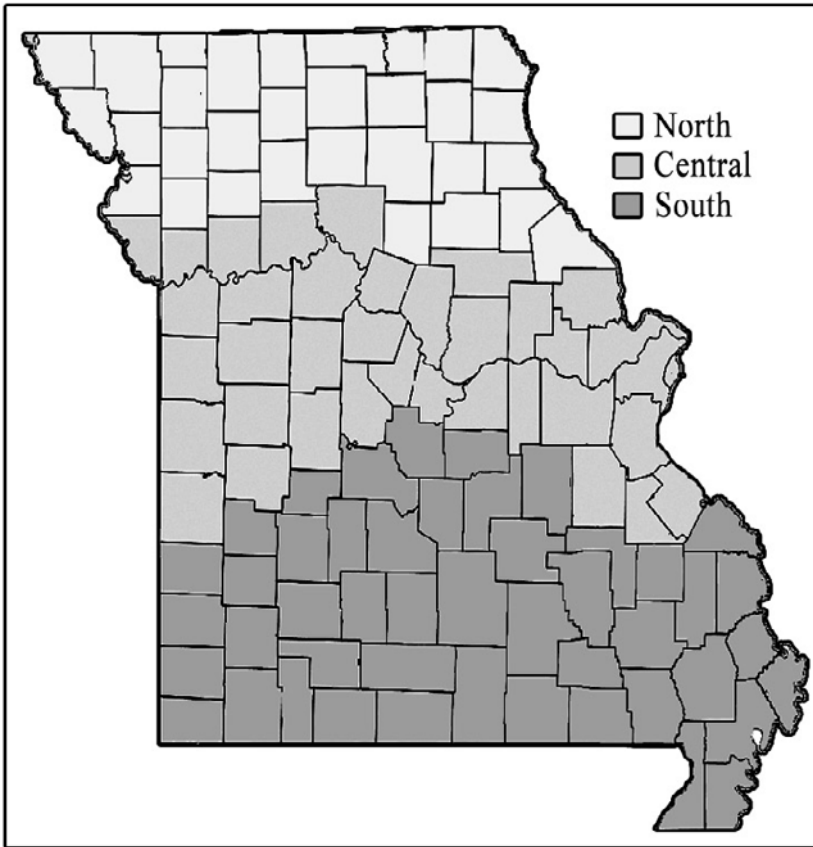


Fig. 1. Nineteenth century Missouri regions. Missouri's northern region consists of Adair, Clark, Knox, Lewis, Linn, Macon, Marion, Monroe, Pike, Putnam, Ralls, Randolph, Schuyler, Scotland, Shelby, Sullivan, Andrew, Atchison, Buchanan, Caldwell, Clinton, Daviess, DeKalb, Gentry, Grundy, Harrison, Holt, Livingston, Mercer, Nodaway and Worth counties. The central region consists of Franklin, Jefferson, Lincoln, Montgomery, Saint Charles, Saint Francois, Saint Genevieve, Saint Louis, Warren, Washington, Audrian, Benton, Boone, Calloway, Carroll, Cole, Cooper, Chariton, Howard, Morgan, Osage, Pettis, Saline, Bates, Cass, Clay, Henry, Jackson, Johnson, Lafayette, Platte, Ray, Saint Clair, Vernon counties. The southern region consists of Bollinger, Butler, Cape Girardeau, Carter, Dunklin, Iron, Madison, Mississippi, New Madrid, Pemiscot, Perry, Reynolds, Ripley, Scott, Stoddard, Wayne, Camden, Crawford, Dent, Douglas, Gasconade, Howell, Laclede, Maries, Miller, Oregon, Ozark, Phelps, Pulaski, Shannon, Texas, Wright, Barry, Barton, Cedar, Christian, Dade, Dallas, Greene, Hickory, Jasper, Lawrence, McDonald, Newton, Polk, Stone, Taney, Webster counties. Missouri counties that share a border with the Mississippi River are Clark, Lewis, Marion, Ralls, Pike, Lincoln, Saint Charles, Saint Genevieve, Saint Louis, Jefferson, Perry, Cape Girardeau, Scott, Mississippi, New Madrid, and Pemiscot counties.

a natural experiment to assess whether northern Missouri's agricultural productivity outpaced the biological benefits of access to dairy production and animal proteins in southern Missouri. Finally, Missouri's central location within America uniquely positioned it as a slave state but not part of the Black Belt, which is the southern region of 623 counties that contain higher than average black concentrations and form a belt-like swath across eleven Southern states. Consequently, not part of the Black Belt but still part of the slave-holding South, Missouri offers insight into black and white conditions in a slave state not part of the plantation South (Ransom & Sutch, 1977, pp. 73–78).

Data and Methods

In 1832 governor John Miller suggested a state penitentiary be constructed in Jefferson City to strengthen its position as the state capital. The prison was completed in 1836 and housed many of Missouri's early criminals in – what was at the time – America's western frontier. To assess how 19th century black and white statures varied in the American South, nearly 30,000 male Missouri state prison inmate records from between 1838 and 1920 are examined, and stature comparisons probably reflect changes in the Missouri and US population's biological conditions because individuals were incarcerated for criminal, not biological, reasons. Stature measurements were taken at the time inmates were admitted to prison; therefore, stature reflects pre-incarceration conditions. Prison enumerators routinely recorded the date inmates were received, age at incarceration, complexion, nativity, stature, pre-incarceration occupation, and crime. For inmates incarcerated between 1906 and 1920, county of incarceration is also available, and provides residential and stature relationships. There were a small number of females incarcerated in the Missouri prison; however, prison enumerators did not record female stature. Because the focus here is on US male statures, females and immigrants are excluded from the analysis. By having the same prison official record characteristics over much of the period, the consistency of the Missouri sample creates reliable comparisons across both race and time.

Fortunately, prison enumerators were quite thorough when recording inmate complexion and occupation. For instance, enumerators recorded African-Americans as blacks, copper and various shades of mulatto. While mulatto inmates possessed genetic traits from both black and white ancestry, they were treated as blacks throughout 19th century America and are grouped here with black inmates. Enumerators recorded white inmate complexions as light, fair, dark and sallow. The white inmate complexion classification is further supported by the complexion of European immigrants, who were always of fair complexion and were also recorded as light, medium and dark.

Enumerators recorded a broad continuum of occupations and defined them narrowly, recording over 200 different occupations. These occupations are classified into four categories. Workers who were merchants and high-skilled workers are classified as white-collar workers; manufacturing, carpenters and craft workers are classified as skilled workers; workers in the agricultural sector are classified as farmers; labourers are classified as unskilled workers. Unfortunately, prison enumerators did not distinguish between farm and common labourers. Since common

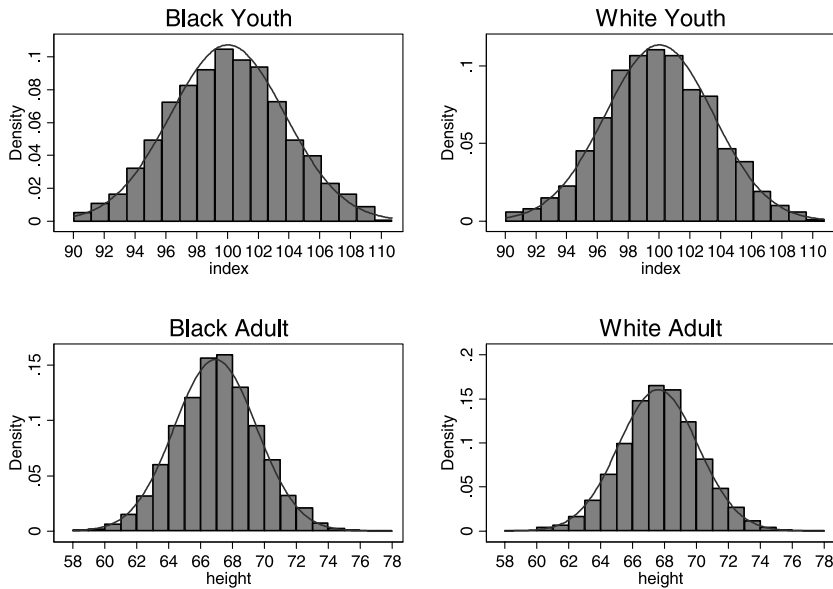


Fig. 2. Nineteenth century Missouri black and white stature distributions. Source: see Tables 1 and 2. A normal distribution is superimposed on the stature histograms.

labourers may have come to maturity under less favourable biological conditions than farm labourers, this potentially overestimates the biological benefits of being a common labourer and underestimates the advantages of being a farm labourer.

All historical height data have selection biases. The prison data probably selected many of the materially poorest individuals, although there are skilled and agricultural workers in the sample. While prison records are not random, the selectivity they represent has its own advantages in stature studies, such as being drawn from lower socioeconomic groups, who were more vulnerable to economic change (Bogin, 1991, p. 288; Cutler, 2004, p. 110). For the study of height as an indicator of biological variation, this kind of selection is preferable to that which marks many military records – minimum height requirements for service (Fogel *et al.*, 1978, p. 85).

Because the direct effects of age on stature are different between youths and adults, their statures are considered separately here. Youths are inmates between the ages of 15 and 22; adults are inmates between the ages of 23 and 55. Because the youth height distribution is itself a function of the age distribution, a youth stature index is constructed that standardizes for age to determine youth stature normality. First, the average stature for each youth age category is calculated. Second, each observation is then divided by the average stature for the relevant age group (Komlos, 1987, p. 899). Figure 2 demonstrates that black and white statures were distributed approximately normally.

Tables 1 and 2 present average heights and proportions for black and white males incarcerated in the 19th century Missouri prison by birth year, occupations and nativity. Whites were a larger proportion of the prison sample than blacks; 33% of the Missouri prison population was black. Occupations reflect socioeconomic status,

Table 1. Missouri youth stature by birth, occupation and nativity

	White				Black				Percentage difference	Stature difference
	<i>n</i>	%	Stature (cm)	Index	<i>n</i>	%	Stature (cm)	Index		
Birth decade										
1840s	120	1.83	170.93	99.58						
1850s	988	15.03	169.80	99.42	401	10.46	167.17	99.33	4.57	2.63
1860s	432	6.57	171.79	100.51	219	5.72	167.30	99.69	0.85	4.49
1870s	1636	24.89	171.48	100.22	1051	27.43	168.98	100.35	-2.54	2.50
1880s	1376	20.94	171.11	100.02	1031	26.91	168.28	99.95	-5.97	2.83
1890s	1832	27.88	171.18	100.01	1012	26.41	168.45	99.99	1.47	2.73
1900s	188	2.86	170.24	100.08	118	3.08	168.08	100.33	-0.22	2.60
Occupation										
White collar	534	8.13	170.43	99.55	98	2.56	168.13	99.72	5.57	2.30
Skilled	1363	20.74	170.61	100.02	289	7.54	168.42	99.86	13.2	2.19
Farmer	1085	16.51	171.98	100.58	316	8.25	170.06	101.13	8.26	1.92
Unskilled	3590	54.63	171.02	100.02	3129	81.65	168.16	99.91	-27.02	2.86
Birth region										
Great Lakes	1166	17.74	170.52	99.70	193	5.04	167.76	99.70	12.70	2.76
Middle Atlantic	480	7.30	169.55	99.19	52	1.36	166.50	98.93	5.94	3.05
North-east	71	1.08	168.44	98.51	7	0.18	167.28	99.30	0.90	1.16
Plains	3854	58.64	171.41	100.21	2613	68.19	168.15	99.91	-9.55	3.26
South-east	734	11.17	171.28	100.14	802	20.93	168.81	100.21	-9.76	2.47
South-west	147	2.24	170.63	99.78	124	3.24	170.17	100.94	-1.00	0.46
Far West	120	1.83	170.96	99.89	41	1.07	170.68	101.30	0.76	0.28

Source: Data used to study black and white anthropometrics is a subset of a much larger 19th century prison sample. All available records from American state repositories have been acquired and entered into a master file. These records include Arizona, California, Colorado, Idaho, Illinois, Kansas, Kentucky, Missouri, New Mexico, Ohio, Oregon, Pennsylvania, Tennessee, Texas, Utah and Washington. Only prison records for inmates incarcerated in the Missouri prison are used in this project.

Notes: Youth age is between ages 15 and 22. The occupation classification scheme is consistent with Ferrie (1997). The following geographic classification scheme is consistent with Carlino & Sill (2000): New England=CT, ME, MA, NH, RI and VT; Middle Atlantic=DE, DC, MD, NJ, NY and PA; Great Lakes=IL, IN, MI, OH and WI; Plains=IA, KS, MN, MO, NE, ND and SD; South-east=AL, AR, FL, GA, KY, LA, MS, NC, SC, TN, VA and WV; South-west=AZ, NM, OK and TX; Far West=CA, CO, ID, MT, NV, OR, UT, WA and WA. Stature difference is average white stature less average black stature. Proportion difference is white proportion less black proportion.

and while prison inmates typically come from the lower working class, there was a sizeable share of inmates from white-collar and skilled occupations. White inmates were 178% and 113%, respectively, more likely than blacks to occupy white-collar and skilled occupations. Even in agriculture, whites were more likely than blacks to come from planting and stock-raising occupations. Blacks were 60% more likely than whites

Table 2. Missouri adult stature by birth, occupation and nativity

	White			Black			Percentage difference	Stature difference
	<i>n</i>	%	Stature (cm)	<i>n</i>	%	Stature (cm)		
Birth decade								
1820s	164	1.21	170.85					
1830s	382	2.82	171.60					
1840s	1255	9.25	171.35	339	5.67	169.69	3.58	1.66
1850s	1815	13.38	171.39	549	9.18	169.54	4.20	1.85
1860s	2768	20.40	172.08	1101	18.42	170.28	1.98	1.80
1870s	3414	25.16	171.81	1815	30.36	170.12	- 5.20	1.69
1880s	2747	20.25	171.50	1657	27.72	169.94	- 7.47	1.56
1890s	1022	7.53	172.13	517	8.65	169.72	- 1.12	2.41
Occupation								
White collar	1648	12.15	171.55	279	4.67	170.22	7.48	1.33
Skilled	4287	31.60	171.48	983	16.44	169.25	15.16	2.23
Farmer	1812	13.36	172.54	373	6.24	171.06	7.12	1.48
Unskilled	5820	42.90	171.67	4343	72.64	170.04	- 29.74	1.63
Birth region								
Great Lakes	2828	20.84	171.61	317	5.30	169.88	15.54	1.73
Middle Atlantic	1445	10.65	170.25	135	2.26	168.99	8.29	1.26
North-east	215	1.58	170.46	25	0.42	171.40	1.16	- 0.94
Plains	6528	48.12	171.92	3353	56.09	169.64	- 7.97	2.28
South-east	2068	15.24	172.17	1874	31.35	170.57	- 16.11	1.6
South-west	252	1.86	172.73	215	3.60	170.63	- 1.74	2.10
Far West	231	1.70	171.96	59	0.99	170.89	0.71	1.07

Note: Adult age is between 23 and 55. The occupation classification scheme is consistent with Ferrie (1997). The geographic classification scheme is consistent with Carlino & Sill (2000) (see footnote to Table 1). Stature difference is average white stature less average black stature. Proportion difference is white proportion less black proportion.

to occupy unskilled occupations. Inmates within the prison were mobile; 49% of the sample was Missouri-born. Nativity within the Missouri prison was mostly from Plains states, which includes Missouri.

How well prison records reflect socioeconomic processes of Missouri's general population is assessed by comparing the Missouri prison records with Missouri's decennial federal censuses. Table 3 illustrates that blacks in the general Missouri population were predictably less likely than whites to be white-collar workers, skilled workers and farmers, and were more likely to be unskilled workers. Missouri urbanized along racial lines. In 1860, 19.39% of Missouri whites lived in urban locations. By 1900, 35.55% of Missouri whites lived in urban locations; 58.60% of blacks lived in urban locations.

It is possible that stature variations among blacks and whites in the Missouri

Table 3. Distribution of nineteenth century Missouri census household head occupations by race (%)

	1860		1870		1880		1900	
	White	Black	White	Black	White	Black	White	
White collar	8.52	0	9.22	1.62	10.14	6.05	12.61	
Skilled	12.53	2.07	12.77	2.43	12.55	1.91	15.10	
Farmer	57.27	19.31	54.31	24.29	55.16	14.97	43.31	
Unskilled	21.22	78.62	23.70	67.61	20.62	77.07	28.68	
No occupation	0.46	0	0	4.05	1.54	0	0.30	

Source: Ruggles *et al.* (2004).

Table 4. Nineteenth century white and black physical stature by crime

	White youth		Black youth		White Adult		Black Adult	
	Coeff.	<i>p</i> value	Coeff.	<i>p</i> value	Coeff.	<i>p</i> value	Coeff.	<i>p</i> value
Intercept	171.14	<0.01	168.52	<0.01	171.55	<0.01	169.69	<0.01
Physical assault	0.302	0.46	-0.065	0.86	0.036	0.89	0.581	0.03
Fraud	0.931	<0.01	1.15	0.05	0.826	<0.01	0.559	0.21
Murder	-0.079	0.83	-0.393	0.43	0.524	0.03	0.510	0.09
Sexual offence	-0.531	0.31	-0.526	0.43	0.270	0.32	0.611	0.19
Theft	-0.323	0.08	-0.382	0.13	-0.011	0.94	0.287	0.17
Other offences			Ref.		Ref.		Ref.	
<i>n</i>	6572		3832		13,567		5978	
<i>R</i> ²	0.0032		0.0020		0.0023		0.0011	

Source: see Tables 1 and 2.

prison were the result of the types of crimes for which individuals were incarcerated, and crimes in the Missouri prison are reported in five categories: physical assault, fraud, murder, sexual offences and theft. For example, prisoners incarcerated for theft may have been shorter than other prisoners because theft is a sign of poverty. However, Table 4 demonstrates that neither white nor black statures were systematically related to the types of crimes committed. Although whites and black youths who committed fraud were somewhat taller than those who committed other crimes, there were relatively few such offences, and it probably reflected the social status of the individuals involved.

Missouri counties are available between 1906 and 1920, and augment other patterns observed in two ways. First, regions are classified into three general categories: northern, central and southern Missouri (Fig. 1). Northern Missouri was composed mostly of fertile farmlands. Central Missouri had greater population

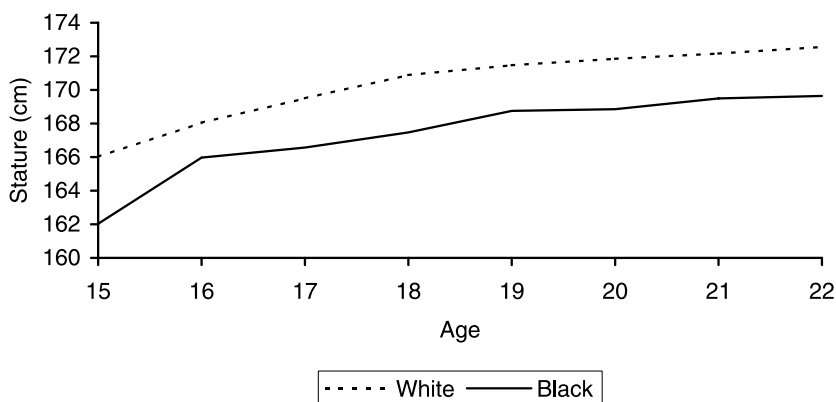


Fig. 3. Missouri youth black and white stature profiles. Source: see Table 5.

concentrations, and early industrial centres near Saint Louis, and was the most urbanized of all regions within Missouri. Southern Missouri had greater access to animal proteins and dairy products (Fig. 1).

Nineteenth century proximity to water may have been related to stature in at least one of two ways. Close proximity to major waterways created access to trade routes, which may have improved biological conditions because agricultural products were more easily imported; access to water would have had a positive relationship with stature. Alternatively, proximity to rivers can be a drain on local resources because agricultural products can be more easily exported, thereby increasing the relative price of food and nutrition, which is probably the case with Missouri's agricultural surplus. Closer proximity to rivers also increases exposure to disease vectors, such as insects and bacteria (Haines *et al.*, 2003, p. 395; Craig & Weiss, 1998, pp. 197–198). Malaria and yellow fever are two insect-borne diseases spread by mosquitoes. *Tubular basilli* and *Vibrio cholerae* are two bacteria causing tuberculosis and cholera, which were prominent 19th century diseases in the American South (Crimmens & Condran, 1983, p. 33; Breeden, 1988). Higher disease rates in regions with closer proximity to water, in turn, would have increased calorie requirements used to fend off disease, taking calories away from stature growth. In this case, access to rivers would have a negative relationship with stature (Cuff, 2005, p. 217).

Results

Black and white statures were related to age, socioeconomic status and birth cohorts; they were also related to nativity, residence within Missouri and proximity to the Mississippi and Missouri Rivers. The youth height pattern by age is itself noteworthy, and whites were generally taller than blacks (Fig. 3). While 15-year-old black stature growth was impressive, it was less impressive after the age of 16, which is consistent with Cuff (2005, p. 16) and Steckel (1979, pp. 374–376). Taller white youth stature in the Missouri prison indicates that biological disparity started early and lasted throughout life.

Tables 5 and 6 present regressions for individual youth and adult statures on

Table 5. Missouri youth stature by age, birth, occupation and nativity

	All		Missouri		White		Black		Black slave states	
	Coeff.	<i>p</i> value	Coeff.	<i>p</i> value	Coeff.	<i>p</i> value	Coeff.	<i>p</i> value	Coeff.	<i>p</i> value
Intercept	172.49	<0.01	172.27	<0.01	172.56	<0.01	169.64	<0.01	169.31	<0.001
Race										
White	Ref.		Ref.							
Black	- 2.74	<0.01	- 3.00	<0.01						
Age										
15	- 7.38	<0.01	- 6.62	<0.01	- 6.54	<0.01	- 7.61	<0.01	- 6.36	<0.01
16	- 4.08	<0.01	- 4.05	<0.01	- 4.51	<0.01	- 3.67	<0.01	- 3.96	<0.01
17	- 3.08	<0.01	- 2.78	<0.01	- 3.06	<0.01	- 3.07	<0.01	- 2.77	<0.01
18	- 1.86	<0.01	- 1.63	<0.01	- 1.67	<0.01	- 2.17	<0.01	- 1.88	<0.01
19	- 1.03	<0.01	- 1.03	<0.01	- 1.09	<0.01	- 0.887	0.01	- 1.02	0.01
20	- 0.722	<0.01	- 0.412	0.14	- 0.704	<0.01	- 0.788	0.03	- 0.363	0.38
21	- 0.310	0.13	- 0.142	0.61	- 0.392	0.11	- 0.147	0.69	0.337	0.43
22	Ref.		Ref.		Ref.		Ref.		Ref.	
Birth decade										
1840s	- 0.905	0.14	- 0.283	0.86	- 0.633	0.31				
1850s	- 1.31	<0.01	- 1.21	<0.01	- 1.09	<0.01	- 1.63	<0.01	- 1.75	<0.01
1860s	- 0.036	0.90	0.014	0.97	0.571	0.08	- 1.14	0.03	- 1.01	0.09
1870s	Ref.		Ref.		Ref.		Ref.		Ref.	
1880s	- 0.293	0.11	- 0.197	0.40	- 0.216	0.35	- 0.404	0.16	- 0.373	0.27
1890s	- 0.359	0.04	- 0.312	0.16	- 0.270	0.21	- 0.464	0.11	- 0.497	0.14
1900s	- 0.145	0.71	0.126	0.80	- 0.236	0.61	0.127	0.85	0.831	0.31

Table 5. Continued

	All		Missouri		White		Black		Black slave states	
	Coeff.	<i>p</i> value	Coeff.	<i>p</i> value	Coeff.	<i>p</i> value	Coeff.	<i>p</i> value	Coeff.	<i>p</i> value
Occupation										
White collar	-0.658	0.01	-1.05	<0.01	-0.751	<0.01	-0.237	0.71	-0.321	0.70
Skilled	-0.371	0.05	-0.327	0.22	-0.479	0.02	-0.043	0.93	0.162	0.77
Farmer	1.12	<0.01	1.75	<0.01	0.825	<0.01	1.99	<0.01	2.18	<0.01
Unskilled	Ref.		Ref.		Ref.		Ref.			
Birth region										
North-east	-2.29	<0.01	Missouri-born only		-2.62	<0.01	-0.561	0.74		
Middle Atlantic	-1.21	<0.01			-1.34	<0.01	-1.40	0.15	-0.870	0.81
Great Lakes	-0.573	<0.01			-0.747	<0.01	-0.188	0.70		
Plains	Ref.				Ref.		Ref.		Ref.	
South-east	0.260	0.29			-0.002	0.99	0.595	0.11	1.00	0.02
South-west	0.509	0.20			-0.510	0.33	1.77	<0.01	1.69	0.04
Far West	0.427	0.44			-0.394	0.51	2.80	0.02		
Black Belt	0.069	0.83			0.029	0.95	-0.029	0.95	-0.029	0.95
<i>n</i>	10,404		5824		6572		3832		2863	
<i>R</i> ²	0.0806		0.0987		0.0429		0.0541		0.0554	

Source: See Table 1.

Note: The US geographic classification scheme is consistent with Carlino & Sill (2000) (see footnote to Table 1).

Table 6. Missouri adult stature by birth, occupation and nativity

	All		Missouri		White		Black		Black Slave States	
	Coeff.	<i>p</i> value	Coeff.	<i>p</i> value	Coeff.	<i>p</i> value	Coeff.	<i>p</i> value	Coeff.	<i>p</i> value
Intercept	171.88	<0.01	171.96	<0.01	171.89	<0.01	169.85	<0.01	169.95	<0.01
Race										
White	Ref.		Ref.							
Black	- 1.98	<0.01	- 2.23	<0.01						
Birth decade										
1820s	- 0.792	0.16	-0.694	0.05	- 0.657	0.25				
1830s	- 0.019	0.96	1.07	0.37	0.116	0.75				
1840s	- 0.419	0.03	- 0.067	0.85	- 0.292	0.19	- 0.644	0.12	- 0.173	0.74
1850s	- 0.458	<0.01	- 0.412	0.09	- 0.343	0.07	- 0.650	0.04	- 0.725	0.06
1860s	0.238	0.08	0.194	0.33	0.311	0.05	0.129	0.60	0.118	0.70
1870s	Ref.		Ref.		Ref.		Ref.		Ref.	
1880s	- 0.275	0.04	- 0.184	0.31	- 0.327	0.04	- 0.230	0.31	- 0.358	0.20
1890s	0.014	0.94	- 0.145	0.57	0.219	0.34	- 0.464	0.16	- 0.804	0.04

Table 6. Continued

	All		Missouri		White		Black		Black Slave States	
	Coeff.	<i>p</i> value	Coeff.	<i>p</i> value	Coeff.	<i>p</i> value	Coeff.	<i>p</i> value	Coeff.	<i>p</i> value
Occupation										
White collar	-0.056	0.73	-0.471	0.07	-0.054	0.76	0.148	0.70	-0.050	0.91
Skilled	-0.254	0.02	-0.512	<0.01	-0.094	0.46	-0.811	<0.01	-0.860	<0.01
Farmer	0.804	<0.01	1.28	<0.01	0.764	<0.01	1.13	<0.01	0.974	0.02
Unskilled	Ref.		Ref.		Ref.		Ref.		Ref.	
Birth region										
North-east	-0.903	0.03	Missouri-born only		-1.35	<0.01	1.92	0.19		
Middle Atlantic	-1.32	<0.01			-1.54	<0.01	-0.424	0.46	-2.51	0.03
Great Lakes	-0.127	0.34			-0.273	0.06	0.317	0.42		
Plains	Ref.				Ref.		Ref.		Ref.	
South-east	0.526	<0.01			0.241	0.22	0.984	<0.01	0.979	<0.01
South-west	0.882	<0.01			0.849	0.05	0.998	0.04	0.910	0.12
Far West	0.400	0.29			0.100	0.82	1.36	0.07		
Black Belt	0.112	0.60			0.095	0.75	-0.030	0.92	0.495	0.33
<i>n</i>	19,545		8790		13,567		5978		4094	
<i>R</i> ²	0.0249		0.0358		0.0118		0.0106		0.0126	

Source: See Table 2.

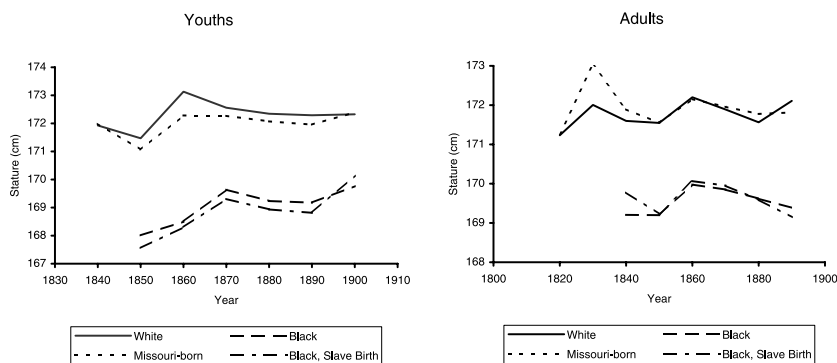


Fig. 4. Missouri 19th century black and white stature. Source: see Tables 4 and 5. Year represents birth year. Black slave birth is for blacks born in a state that practised 19th century slavery and includes AL, AR, DE, FL, GA, LA, MD, MS, MO, NC, SC, TN, TX and VA.

observable characteristics. Models 1 in both Tables 5 and 6 present stature regressions for the entire black and white samples. To compare how Missouri biological conditions contrasted with the rest of the United States, Model 2 reports regression results for only Missouri-born male stature on characteristics. Model 3 reports regression stature estimates for only white male characteristics, while Model 4 does the same for blacks. Model 5 restricts the sample to only blacks born in slave states. By using the birth decade coefficients from Tables 5 and 6, Fig. 4 depicts black and white stature variation over time.

Two general patterns emerge when comparing black and white stature variations. First, it is striking the degree to which average white stature exceeds black stature. After controlling for age, white youths and adults were each nearly two centimetres taller than black youths and adults. This is even more significant since modern black and white statures are comparable when brought to maturity under optimal biological conditions (Eveleth & Tanner, 1976; Tanner, 1977; Steckel, 1995, p. 1910; Barondess *et al.*, 1997, p. 968; Komlos & Baur, 2004, pp. 64, 69; Nelson *et al.*, 1993, pp. 18–20; Godoy *et al.*, 2005, pp. 472–473).

Figure 4's second pattern is that both black and white average statures approximately varied with institutional change (Conrad & Meyer, 1964, pp. 50, 75). During the antebellum period, black youth stature increased by over two centimetres, while young white statures remained constant at 172 centimetres, and young black stature growth may have been disrupted during Reconstruction. Adult black statures increased during the early antebellum period, while adult white statures remained approximately constant throughout the 19th century. With some fluctuations, Missouri-born adults were also considerably taller than other inmates for much of the century, but declined after slavery.

For several other categories, expected patterns hold. Black and white farmers were taller than white-collar, skilled and unskilled individuals, due partly to the nearness of nutrients. Individuals from the US South-west were taller than those from the Plains (Margo, 2000, pp. 72–73, Tables 3A.10 and 3A.11; Rosenbloom, 2002, pp. 53,

124–125).

Using over 7800 observations for inmates incarcerated between 1906 and 1920, the relationships between residence at time of incarceration, proximity to water and stature are evaluated (Table 7). Stature relationships with age, socioeconomic status and birth are consistent with Tables 5 and 6. Individuals from southern Missouri counties were taller than individuals from northern counties, and individuals from central Missouri – which includes urbanized Saint Louis County – reached the shortest terminal stature (Figure 5). The overall effect of close proximity to a major waterway in Missouri was negative, which held for both whites and blacks, indicating water access had a negative effect on stature in 19th century agriculturally rich farmlands.

Conclusion

The timing and extent of stature variation not only reflect the cumulative relationship between diet and disease, but also the distribution of wealth, population density, urbanization and industrialization (Steckel, 1994). The most striking comparison that results from the Missouri prison is the degree to which white average stature exceeds black stature, which is significant because modern black and white statures are comparable when brought to maturity under optimal biological conditions (Eveleth & Tanner, 1976; Tanner, 1977; Steckel, 1995, p. 1910; Barondess *et al.*, 1997, p. 968; Komlos & Baur, 2004, pp. 64, 69; Nelson *et al.*, 1993, pp. 18–20; Godoy *et al.*, 2005, pp. 472–473; Margo & Steckel, 1982, p. 519; Komlos & Lauderdale, 2005). Margo & Steckel (1982) and Sünder (2004) demonstrate that antebellum Southern whites were nearly 2 inches taller than Southern blacks, and adult male slaves were shorter than Northern whites (Margo & Steckel, 1982, p. 519). Moreover, compositional effects cannot explain the black–white stature differential, which was due, in part, to white's access to meat and better nutrition (Margo & Steckel, 1982, p. 514–515, 517 and 519).

Nineteenth century black youth stature in the American South increased during the antebellum period, which is consistent with the Rees *et al.* (2003) hypothesis that Southern slave owners and overseers consciously controlled slave food and health allocations to maximize slave-owners' wealth. However, once removed, black youth statures experienced a short-run growth interruption, which recovered by the end of the 19th century. On the other hand, white youth stature was roughly constant throughout the antebellum period and stagnated with the removal of slavery and Reconstruction, indicating that institutional change in the American South influenced both blacks and whites.

The Missouri prison sample confirms several other patterns observed in other 19th century American samples. First, blacks and whites born in the South were taller than their northerly born counterparts, suggesting that although the South experienced higher disease rates, the net benefit from Southern nativity was positive. Although Southern wages were generally lower than Northern wages, west/south/central labourer wages were comparable to those in the Middle-Atlantic regions. Moreover, limited skilled immigration to the south-west created a relative scarcity of skilled labour, which may have enhanced their material and biological conditions (Rosenbloom, 2002, pp. 53, 124–125). Second, farmers consistently benefited from

Table 7. Missouri youth and adult stature regression with residence and proximity to water, received between 1906 and 1920

	Whites		Blacks		Youths		Adults	
	Coeff.	<i>p</i> value	Coeff.	<i>p</i> value	Coeff.	<i>p</i> value	Coeff.	<i>p</i> value
Intercept	171.42	<0.01	166.78	<0.01	171.82	<0.01	170.67	<0.01
Race								
White					Ref.		Ref.	
Black					-2.43	<0.01	-1.65	<0.01
Age								
17	-3.45	<0.01	-3.86	<0.01	-3.09	<0.01		
18	-1.48	<0.01	-2.41	<0.01	-1.34	<0.01		
19	-1.32	<0.01	-1.27	<0.01	-0.847	<0.01		
20	-0.391	0.23	-0.963	0.05	-0.130	0.69		
21	0.147	0.65	-0.542	0.17	0.319	0.33		
22	-0.378	0.23	-0.494	0.21	Ref.			
23-55	Ref.		Ref.					
Birth decade								
1850	Ref.		Ref.				Ref.	
1860	-0.175	0.78	3.00	0.08			0.441	0.47
1870	0.122	0.84	3.33	0.04			0.792	0.17
1880	-0.104	0.97	3.08	0.08	Ref.		0.630	0.27
1890	0.341	0.57	2.93	0.08	-0.060	0.83	0.933	0.11
1900	0.400	0.60	3.83	0.03	0.155	0.75		
Occupation								
White collar	-0.003	0.99	0.139	0.76	-0.348	0.38	0.111	0.64
Skilled	0.156	0.36	-0.549	0.14	-0.285	0.35	-0.048	0.79
Farmer	0.764	<0.01	1.29	0.01	1.39	<0.01	0.637	0.02
Unskilled	Ref.		Ref.		Ref.		Ref.	
Birth region								
North-east	-0.978	0.15	2.55	0.08	-2.52	0.04	0.078	0.91
Middle Atlantic	-1.19	<0.01	-0.991	0.24	-1.27	0.04	-1.01	<0.01
Great Lakes	-0.444	0.02	0.726	0.13	-1.12	<0.01	0.106	0.62
Plains	Ref.		Ref.					
South-east	0.661	0.02	1.39	<0.01	0.203	0.62	1.25	<0.01
West	0.524	0.11	1.13	<0.01	0.520	0.23	0.850	<0.01
Black Belt	-0.498	0.29	-0.322	0.43	0.012	0.98	-0.440	0.22
Missouri County								
North	0.419	0.04	0.046	0.88	0.381	0.22	0.196	0.33
Central	Ref.		Ref.					
South	0.592	<0.01	0.674	0.03	-0.003	0.99	0.770	<0.01
Mississippi River	-0.536	<0.01	-1.20	<0.01	-0.933	<0.01	0.685	<0.01
<i>R</i> ²	0.0178		0.0327		0.0668		0.0291	
<i>n</i>	7852		4293		3781		8364	

Source: See Table 1.

Notes: See Table 1 for American nativity classification. See Fig. 4 for Missouri classification. Black slave birth is for blacks born in a state that practised 19th century slavery and includes AL, AR, DE, FL, GA, LA, MD, MS, MO, NC, SC, TN, TX and VA.

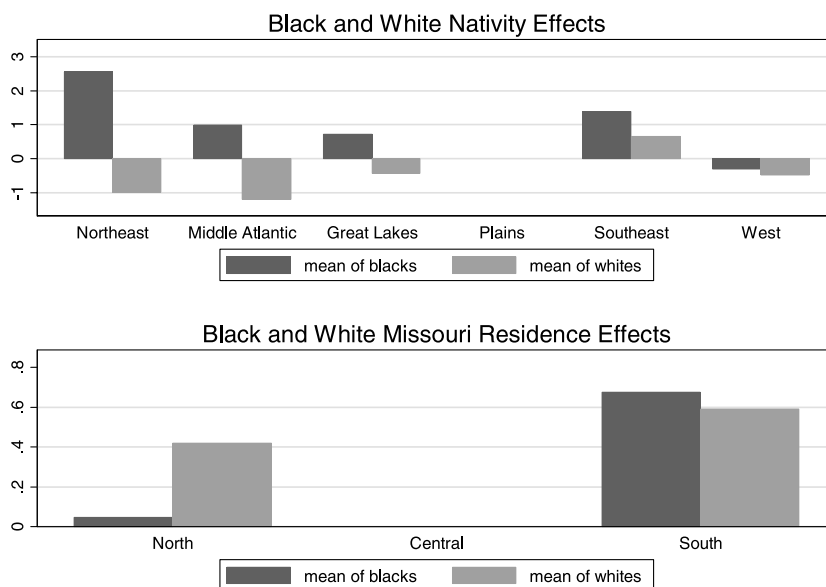


Fig. 5. Missouri 19th century black and white stature effects by nativity and residence. Source: see Table 7. See Table 5 for the definition of nativity. See Fig. 1 for the definition of residence.

close proximity to nutritious food sources, mild disease environments and removal from population centres, and individuals from urbanized central Missouri counties were shorter than individuals from northern and southern counties. While southern Missouri was closer to the South's slavery stronghold, Missouri's southern Ozarks specialized in beef production, and animal fats and dairy productivity were propitious to stature growth, indicating that proximity to animal and dairy products contributed more to human growth than access to grains (Cuff, 2005, pp. 207, 216). Stature was also sensitive to proximity to water and individuals in counties that shared borders with the Mississippi or Missouri Rivers were consistently shorter than those who did not. The Missouri sample also contrasts the prominent types of agriculture related to stature growth; northern Missouri specialized in grain, which contains essential amino acids related to growth. However, southern Missouri was suitable for animal husbandry and dairy production, which contributed more to stature growth than access to grains, and southern Missourians reached taller statures than elsewhere within the state.

Acknowledgments

The author appreciates comments from participants from the Western Social Science Association, and the Center for Economic Studies at the University of Munich. Comments from Marco Sunder and John Komlos were particularly helpful. Craig O. Davis, Sandy Triepke and Anita Voorhies provided excellent research assistance. All errors are the author's.

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