Explorations in Economic History 46 (2009) 149–159

Contents lists available at ScienceDirect

Explorations in Economic History

journal homepage: www.elsevier.com/locate/eeh

Geography, insolation, and vitamin D in nineteenth century US African-American and white statures ☆

Scott Alan Carson *

School of Business, University of Texas, Permian Basin, 4901 East University, Odessa, TX 79762, USA
University of Munich, CESifo, Shackstrasse 4, 80539 Munich, Germany

ARTICLE INFO

Article history:
Received 12 February 2008
Available online 17 October 2008

Keywords:
Nineteenth century US black and white statures
Insolation
Vitamin D

ABSTRACT

Using a new source of nineteenth century US state prison records I contrast the biological living conditions of comparable African-Americans and whites. Although blacks and whites today in the US reach similar terminal statures, nineteenth century African-American statures were consistently shorter than those of whites. Greater insolation (vitamin D production) is shown to be associated with taller black and white statures and a considerable share of the stature difference between US blacks and whites was attributable to insolation and vitamin D production. Black statures increased during the antebellum period, while white statures declined. Black and white statures both decreased after the Civil War. Farmers were taller than workers in other occupations, and an alternative explanation for stature variation by social class is considered.

1. Introduction

The use of height data to measure living standards is now a well-established method in economics (Fogel, 1994, p. 138). The average stature of a population reflects the cumulative interaction between nutrition, disease exposure, work, and the physical environment (Steckel, 1979, pp. 365–367; Tanner, 1962, pp. 1–27). By considering average versus individual stature, genetic differences are mitigated, leaving only the influences of the 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. Therefore, stature provides considerable insights into understanding historical processes and augments other welfare measures.

This study focuses on nineteenth century African-Americans and whites. Using a new source of data—nineteenth century United States prison records—I contrast the heights of comparable black and white males in the US throughout the nineteenth century and also add a new explanation for black and white stature differences by socioeconomic status.

Black and white statures have the ability to reach comparable average levels when brought to maturity under similar biological conditions (Eveleth and Tanner, 1976, Appendix. Tables 5, 29, and 44; Tanner, 1977, pp. 341–342; Margo and Steckel, 1982). However, comparison of nineteenth century black and white statures demonstrates that blacks were consistently shorter than whites, but we are less certain of the source for this difference (Margo and Steckel, 1982; Sunder, 2004; Carson,

☆ I appreciate comments from participants at the Western Social Science Association, and the Center for Economic Studies at the University of Munich. Comments from John Komlos, Marco Sünder, Tom Maloney, Larry Wimmer, Nina Jablonski, Paul Hodges, and Thomas Poder were particularly helpful. I am also grateful for comments from two anonymous referees. Owen Wallace-Servera, Sandy Triepke, Kellye Manning, Brandon Hayes, and Anita Voorhies provided excellent research assistance. All errors are mine.

* Fax: +1 432 552 2174.
E-mail address: carson_s@utpb.edu

0014-4983/$ - see front matter © 2008 Elsevier Inc. All rights reserved.
doi:10.1016/j.eeh.2008.09.002

2008). Moreover, any explanation must account for a robust geographical finding: blacks were shorter than whites in both the South and the North (Margo and Steckel, 1992, p. 516).

An unexplored source for this white stature advantage and why Southerners were taller than Northerners in general may be related to an important interaction between biology and geography. Calcium and vitamin D are two chemical elements required throughout life for healthy bone and teeth formation; however, their abundance are most critical during younger ages (Wardlaw et al., 2004, pp. 394–396; Tortolani et al., 2002, p. 60). Calcium generally comes from dairy products, and vitamin D is not dietary but is produced by the synthesis of cholesterol and sunlight in the epidermis' stratum granulosum (Holick, 2004, pp. 363–364; Nesby-O'Dell et al., 2002, p. 187; Loomis, 1967, p. 501; Norman, 1998, p. 1108; Holick, 2007). This paper illustrates that up to 50% of the white–black stature differential is attributable to lower black vitamin D production than whites.

Vitamin D is vital in all vertebrates because it allows them to absorb more calcium from their diets and contributes to stronger skeletal systems and stature growth (Jablonski, 2006, p. 62).[1] In order of importance, the primary sources of vitamin D in humans are the amount of time exposed to sunlight, skin pigmentation, and nativity (Holick et al., 1981, p. 590). Greater direct sunlight (insolation) produces more vitamin D, and vitamin D is related to adult terminal stature (Xiong et al., 2005, pp. 228, 230–231; X-ZLiu et al., 2003; Ginsburg et al., 1998; Uitterlinden et al., 2004). However, after the circulatory system contains sufficient amounts of vitamin D and to avoid vitamin D toxicity, vitamin D production is restricted within the stratum granulosum and residual vitamin D is broken down into inert matter (Holick et al., 1981, pp. 591–592; Jablonski, 2006, p. 62; Holick, 2001, p. 20; Holick, 2004, p. 363). This self-limiting vitamin D effect may account for some of the difference between how black and white statures were associated with insolation, because at North American latitudes whites are closer than blacks to the natural threshold where vitamin D production is curtailed. At the opposite extreme, insufficient vitamin D has been linked to rickets, osteomalasia, auto-immune diseases, and certain cancers (Holick, 2001, p. 28; Garland et al., 2006, pp. 252–256; Grant, 2003, p. 372).

Vitamin D production also depends on melanin in the stratum corneum (Norman, 1998, p. 1108), and lighter colored nineteenth century blacks were consistently taller than darker pigmented blacks (Tanner, 1962, pp. 150–151; Tanner, 1977; Steckel, 1979, pp. 374–376; Margo and Steckel, 1982, pp. 532–534, Table 6; Bodenhorn, 1999, 2002; Xiong et al., 2005, pp. 228, 231; Z Liu, 2003, p. 825). Greater melanin (skin pigmentation) in the stratum corneum interferes with vitamin D's synthesis in the stratum granulosum, and darker pigmentation filters between 50% and 95% of the sunlight that reaches the stratum granulosum (Jablonski, 2006, pp. 80–81; Kaidbey et al., 1979, pp. 249 and 253; Loomis, 1967, p. 502; Weisberg et al., 2004, p. 1703S; Holick, 2007, p. 270).[2] Moreover, a common explanation for taller mulatto statures is that nineteenth century social and economic forces favored fairer complexions over lighter complexions, and lighter colored blacks benefited from these social and economic institutions (Margo and Steckel, 1982, p. 521; Bodenhorn, 1999, p. 983). Nonetheless, a more complete explanation that addresses the interaction between stature, sunlight, and vitamin D production may be related to human biology.

It is against this backdrop that this paper addresses two paths of inquiry into nineteenth century African-American and white stature variation. First, how did male statures vary with insolation across the US by nativity and race? This study illustrates that black and white statures were positively related to insolation, and black stature increases in insolation were greater than white stature increases over the same insolation interval. Moreover, given that whites produce more vitamin D with the same insolation and because vitamin D production is restricted when sufficient vitamin D is present in the circulatory system, the white stature rate of increase with insolation should have diminished before the black stature rate of increase (Holick, 2001, p. 20). Second, after controlling for both nativity and the physical environment, how were statures related to socioeconomic status? A new explanation that addresses the nexus between socioeconomic status, nutrition, and exposure to sunlight is considered. Workers who spent more time outdoors exposed to sunlight were consistently taller than workers who traditionally spent more time indoors, away from the stature benefits of solar radiation.

2. Nineteenth century US prison data

2.1. Prison records

The data used here to study black and white statures are part of a large nineteenth century prison sample. All state prison repositories were contacted and available records were acquired and entered into a master data set. These prison records include Arizona, California, Colorado, Idaho, Illinois, Kansas, Kentucky, Missouri, New Mexico, Ohio, Oregon, Pennsylvania, Texas, and Washington (Table 1). Most blacks in the sample were imprisoned in the Deep South or Border States—Kentucky, Missouri, Georgia, and Texas. Most whites in the sample were imprisoned in Missouri and Texas, but Northern whites were also from Illinois, Ohio, and Pennsylvania. The Far West is also represented in the sample.

All historical height data have various biases, and prison and military records are the most common sources for historical stature data. One common shortfall for military samples is a truncation bias imposed by minimum stature requirements

[1] There are few dietary sources of vitamin D.

[2] To address rickets in the US population, in the 1930s the federal government advocated fortification of the US milk supply with vitamin D (Bishai and Nalubola, 2002, p. 41; Holick, 2004, p. 1679S). However, blacks, who are more likely to be lactase intolerant, did not consume milk to the same degree as that comsumed by whites (Kiple and King, 1981).