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# Geographical and temporal changes of anthropometric traits in historical Yemen



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### ABSTRACT

This study investigates secular changes of anthropometric variables among four geographic groups in historical Yemen, to evaluate possible regional differences in the evolution of living standards. Nineteen somatic and cephalic measures collected by Coon in 1939, and 8 anthropometric indices in 1244 Yemenite adult males were analyzed. The individuals were divided into 10-year age groups. Within-group variations were tested by One-way ANCOVA (age as covariate). ANCOVA (controlling for age), and Forward step-wise discriminant analysis were used to evaluate and represent regional differences. ANCOVA and discriminant analysis confirmed and enhanced previous findings. At the time, the Yemenite population presented high intergroup heterogeneity. The highest mean values of height at all ages were found in the “mountain” region, which is characterized by very fertile soils and where, nowadays, most of the cereals and pulses are grown and where most livestock is raised. Within-group variations were limited and generally inconsistent in all geographic regions and concern vertical dimensions, but mean values of height never differed. The prolonged internal isolation of these groups resulted in significant regional morphometric differentiation. The main evidence comes from height which suggests that socioeconomic factors have played

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a role. Nevertheless, the possible better living conditions experienced by the “mountain” group, with the highest mean values of stature in all periods, did not allow the secular trend to take place in that region, too.

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## Introduction

The analysis of height at temporal and spatial level is a fundamental tool for the reconstruction of socioeconomic trends in countries and/or periods where any other kind of relevant information is lacking. However, anthropological studies which use multiple body measurements and based on analyses of samples divided into age cohorts (generally 5- or 10-year age classes) can provide new insights because they make it possible to study the evolution of body dimensions over several generations (Cavelaars et al., 2000; Danubio et al., 2011, 2012; Danubio and Sanna, 2012; Henneberg, 2001; Henneberg and Grantham, 2014; Sanna and Danubio, 2009; Sanna et al., 2014).

Yemen has always been characterized by high levels of internal geographic isolation, due to the presence of impervious mountains and deserts. Nevertheless, the entire coastal belt has constituted one of the principal commercial routes for spices connecting the East, Africa and the Eastern Mediterranean. These facts are supported by many historical sources (Richard, 1984; Seligman, 1917; Van Beek, 1970). This might have caused gene flow from these areas through the centuries, a fact that is indirectly confirmed by the presence of genetic markers of African and Eastern origin in the coastal and southern populations of Yemen (Abu-Amero et al., 2009; Maranjian et al., 1966; Marengo Rowe et al., 1974; Mourant, 1954; Mourant and Tills, 1967; Rowold et al., 2007; Saha et al., 1980; Sawhney et al., 1984; Tills et al., 1977). Coon's data, collected in 1933/1934, reflect this regional heterogeneity because he classified the individuals into six geographical areas according to birth place and ethnicity: Tihamah, the Western Mountains, the Central Plateau, the South Coast, the Eastern Mountains, and Hadhramawt.

In a previous study, Danubio et al. (2012) used Coon's dataset to analyze the regional variations of 8 body dimensions and 11 measures of the head. The study aimed to evaluate the presence of geographic microdifferentiation on a biological basis among the six geographical regions indicated by Coon. It emerged that the Yemenite population seems to be composed of three main morphologically distinct groups: (1) the Western Mountains and Central Plateau, the “mountain” group, (2) the Southern Coast/Hadhramawt, (3) the Tihamah, these latter two being the “plain/desert” groups. In addition, the Eastern Mountains group was biologically intermediate between the Southern Coast/Hadhramawt and the “mountain” group. Finally and interestingly, the average height of the global sample was 1626 mm, 30–60 mm less than the values reported for other six coeval Middle-Eastern Arab countries, Egypt, and four Northern-African nations. Similarly, mean values of armspan, sitting height, head circumference and length were lower than those found in four Northern-African countries (Chamla, 1973; Danubio et al., 2011; Stegl and Baten, 2009; Tourky, 1961).

In this paper we further deepened the study of Coon's dataset in two ways. The first step was to re-examine the dataset according to regional microdifferentiation as reported in Danubio et al. (2012) in order to better describe the anthropometry of historical Yemen. The second step was to analyze eventual variations in time of the body, head and face measurements and of some anthropometric indices in the four geographic regions. Indeed, given both the geographical and socio-cultural differences that are responsible for morphometric microdifferentiation in the country, it is of particular interest to evaluate possible regional differences in the evolution of living standards by considering, together with height, also other related measurements and indices that are sensitive to particular conditions.

For this purpose it is important to mention a number of factors in the long running debate regarding secular changes. These include head shape toward dolichocephalization (Abu Dalou et al., 2008; Billy, 1966; Buretić-Tomljanović et al., 2007; Gyenis et al., 2003; Kouchi, 2004; Sanna et al., 2015; Shah

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