Economics and Human Biology 11 (2013) 56–68

Contents lists available at SciVerse ScienceDirect

Economics and Human Biology

journal homepage: http://www.elsevier.com/locate/ehb

Birthweight outcomes in Bolivia: The role of maternal height, ethnicity, and behavior

Marcelo Delajara [a,*], Florian Wendelspiess Chávez Juárez [b]

[a] Banco de México, Av 5 de Mayo 18, Col. Centro, 06059 Mexico City, Mexico
[b] Department of Economics, University of Geneva, Switzerland

ARTICLE INFO

Article history:
Received 27 April 2011
Received in revised form 22 March 2012
Accepted 22 March 2012
Available online 6 April 2012

JEL classification:
I12
N36
O15

Keywords:
Birthweight
Health production function
Bolivia

ABSTRACT

We identify maternal behavioral factors associated with birthweight in Bolivia using data from the Demographic and Health Survey (DHS) of 2003. We estimate birthweight as a function of maternal behavior and the child's sex and gestational age. We control for maternal height, ethnicity, education, and wealth, and for differences observed across Bolivian regions in educational and health outcomes, demographic indicators, and altitude. We find that maternal age, fertility record, and birth spacing behavior are the main observable behavioral factors associated with birthweight, and that maternal height is associated with gestational age, a main determinant of birthweight. We also find that after controlling for gestational age, both ethnicity and altitude have an insignificant effect on birthweight.

1. Introduction

Latin America and the Caribbean is the region with the largest social and economic inequality in the world, and where inequality is also most persistent across generations (De Ferranti et al., 2004; UNDP, 2005). Among the countries of the region, Bolivia has one of the worst records in terms of poverty and inequality—human development has been on average persistently low and unequally distributed across population groups (UNDP, 2010). One of the factors perpetuating inequality in human development in Latin America is the way in which health capital is accumulated and transmitted over the generations (UNDP, 2010). We contribute to the understanding of this process by identifying the factors associated with birthweight, an important determinant of adult health capital. In particular, our objective is to identify the maternal behavioral factors associated with birthweight in Bolivia in order to provide evidence useful for the design of public health policies.

Low birthweight has been associated with slow infant growth and poor adult health; in particular, it has been associated with coronary heart disease and its biological risk factors (Barker et al., 1993, 2002; Barker, 1995, 1998); also, prenatal exposure to famine has been linked to decreased glucose tolerance in adults (Ravelli et al., 1998). Low birthweight has also been shown to affect adult height, educational attainment, and economic well-being. Behrman and Rosenzweig (2004) have used observations on genetically identical female twins from Minnesota to identify the causal effect of increasing birthweight; they found that birthweight differentials are partly the reason for inequality in adult height, adult educational achievement, and wages. Furthermore, Black et al. (2007) have used Norwegian nationally representative data on female and male twins to assess the causality from birthweight to adult outcomes; they found clear evidence that birthweight has a significant effect on adult height, IQ at age 18, education, and earnings. When poor health at birth interacts with low family income during childhood then the worst adult outcomes must be expected. Case et al. (2002) show that low-birthweight children growing up in

* Corresponding author.
E-mail address: delajaraj@banxico.org.mx (M. Delajara).

1570-677X/$ – see front matter
http://dx.doi.org/10.1016/j.ehb.2012.03.004

poor households suffer larger adverse effects than those belonging to better-off households.

Adult outcomes and choices in turn determine birthweight (Rosenzweig and Schultz, 1983; Grossman and Joyce, 1990). Black et al. (2007) even found that a 10% increase in birthweight among females results in an increase of 1.5% in the birthweight of their first off-spring; to this *direct* intergenerational effect one should add the *indirect* impacts operating via taller adult stature, higher IQ, larger educational capital and higher earnings in adulthood. According to these findings, public policies targeting low birthweight should be viewed not only as public health initiatives benefiting the current generation, but also as good instruments to reduce health and economic inequality among the future generations. Identifying the determinants of birthweight is, thus, crucial to understand the transmission of inequality in health capital across generations. This is of particular importance in the context of poor countries such as Bolivia.

We identify the determinants of birthweight in Bolivia by estimating a birthweight production function (Rosenzweig and Schultz, 1983). We estimate the relative importance for birthweight of maternal reproductive behavior (proxied by parity, birth spacing, prenatal health care utilization, and maternal age at birth), and of pre-determined factors, like maternal height. We also include the child's sex and gestational age, two important biological determinants of birthweight. We control for maternal individual characteristics, such as maternal ethnicity, educational attainment, and wealth, and for differences across Bolivian regions (*Departamentos*) in social development, demographic trends, health care coverage, and altitude.

To estimate the model we use microdata from the Demographic and Health Survey (DHS) of 2003, www.measuredhs.com. As it is case with the DHS data of other countries, gestational age is not reported in the DHS 2003 of Bolivia, and so we imputed it from birthweight tables in Tanner and Thomson (1970). According to the medical literature variations in gestational age are mainly associated with variations in maternal health endowments (which can be proxied by the mother's height), the child's sex, and parity. The assumption that the determinants of gestational age are a subset of the determinants of birthweight allows us to identify the role of maternal height in birthweight production. We take this indirect effect of height on birthweight to represent the effect of health capital accumulated in the previous generation on the health capital of the current one.[1]

Jewell (2007) studies the determinants of birthweight using Demographic and Health Survey (DHS) data of four South American countries (Bolivia, Brazil, Colombia, and Peru) between 1996 and 2000. The emphasis in Jewell (2007) is on the role of prenatal care, for which he finds a significant positive effect on birthweight. A problem with the estimation in Jewell (2007) is that he does not control for gestational age in the estimation of the birthweight production function (Rosenzweig and Schultz, 1983).

Wehby et al. (2010) study the factors affecting birthweight in six South American countries (Argentina, Bolivia, Brazil, Chile, Colombia, and Ecuador), and their main objective is to estimate the impact of altitude on birthweight and gestational age after controlling for maternal health conditions, socioeconomic status, demographic indicators, and healthcare characteristics. They find a negative effect of altitude on birthweight and gestational age. Although permanent differences in altitude could in part explain the persistence of inequality in birth outcomes, the potential for public policy to influence infant health arises from the association between a child's birthweight and its mother's choices and health endowments that we study in this paper. The findings in Wehby et al. (2010) are qualitatively similar to those reported by Morales et al. (2004), who had found that altitude (and also ethnicity) has a significant effect on children's height-for-age in Bolivia. Instead, we do not find any significant effect of these variables on birthweight when we control for gestational age.

In their birthweight regression Wehby et al. (2010) do not control for maternal behavior considered important for birthweight, like birth spacing and the demand for prenatal care. Moreover, they estimate separate reduced-form regressions for birthweight and gestational age. Voigt et al. (2004) provide convincing evidence against the use of reduced forms to study the relationship between birthweight, gestational age, and their determinants. Wehby et al. (2010) cannot fully account for the effect that maternal endowments—such as maternal height, have on birthweight, since these effects are intermediated by gestational age.

2. Model

2.1. The birthweight production function

We assume that the child's birthweight is produced with maternal behavioral and biological inputs. These inputs are determined by maternal choices regarding birth spacing (*Birth spacing*), number of live births (*Parity*), age of the mother at the time of the child's birth (*Age at birth*), and health service utilization during pregnancy (*Doctor delay*). Other biological inputs – considered important in the medical literature – are the child's sex (*Sex*) and gestational age-proxied by the maximum gestational age (*MGA*), to be defined below.

In our benchmark specification birthweight is assumed to be directly associated with all of the variables mentioned above. In alternative specifications we also control for the mother's ethnicity, height, BMI, and maternal socioeconomic characteristics. Ethnicity is captured by the binary variable *Indigenous*, which takes the value 1 if the mother speaks a native language, and takes

[1] Other important predictors of birthweight have been left out of the analysis, such as maternal smoking, birth length, and maternal gestational diabetes. These variables are normally available in the DHS, however, in our survey there are too many missing values reported—in particular, regarding the question if a person is smoking. Not being able to control for these factors, especially for prevalence of smoking, would probably bias the estimates of the coefficients of the behavioral inputs in unknown ways. However, as long as our behavioral inputs are correctly instrumented, the effect of omitting these variables would be captured by the error in the regression estimated (see Section 2 for a discussion of the empirical model).