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Stunting later in childhood and outcomes as a young adult: Evidence from India

Rozana Himaz

Department of Accounting, Finance and Economics, Oxford Brookes University, Oxford OX3 0BP, UK

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ABSTRACT

This paper looks at patterns of growth faltering and catch up of around 1000 children as they moved from 8 to 19 years of age, from middle childhood through adolescence to young adulthood, using Height for Age Difference (HAD) and the more conventional Height for age z-scores (HAZ). It also looks at what individual and household characteristics may have moved these children into or out of situations of nutritional deprivation and how their stunting profile in later childhood correlates with psychosocial outcomes at age 19 and how it may have intergenerational consequences. The paper uses 4 rounds of longitudinal data collected in 2002, 2006, 2009 and 2013 from Andhra Pradesh and Telengana, India when the children were aged 8, 12, 15 and 19. The paper finds that there are significant gender based biases in growth faltering later in childhood disfavouring girls and that becoming newly stunted as an adolescent is strongly correlated with a child reporting to have poorer relationships with peers compared to the group that were never stunted. We also find that a girl experiencing stunting in middle childhood or adolescence (even if they were not stunted at age 8 or eventually moved out of being stunted by age 19) correlates significantly with offspring being shorter and thinner than the offspring of girls never stunted. This is one of few, if any, studies that look at growth patterns in middle childhood and adolescence and outcomes as a young adult and the results are important for their implications for further research and policy.

1. Introduction

Stunting affects around a quarter to half of children in developing countries due to poverty, nutritional deprivation and burden of diseases (Grantham-McGregor et al., 2007; Victora, de Onis, Hallal, Blössner, & Shrimpton, 2010). Its consequences for outcomes later in life can be detrimental with significant negative effects on cognitive and non-cognitive development, schooling attainment and later outcomes as an adult in terms of earnings and productivity (Doyle, Harmon, Heckman, & Tremblay, 2009; Maluccio et al., 2009; Dercon & Sánchez, 2013, Hoddinott et al., 2013). Short stature is also found to increase the chances of giving birth to smaller babies and experiencing complications during pregnancy and childbirth (Black et al., 2008). Recent studies have also found evidence that both contemporary and childhood health of the mother correlate positively with offspring health, and these effects are likely to be persistent (Bhalotra & Rawlings, 2011). Most papers on stunting, however, focus on children under 5. This is unsurprising given that stunting is argued to occur mainly within the first few years of life (Martorell, Khan, & Schroeder, 1994). Moreover children usually enter middle childhood (defined here as ages 7–12) and adolescence (between ages 13–19) with nutritional deficits accrued from earlier on in life. However, children already stunted may 'catch up' later on childhood given appropriate conditions (Golden, 1994; Tanner, 1986) just as much as some of those who did not enter middle childhood stunted may falter in their growth and become stunted by the time they reach young adulthood. There is little empirical research on growth patterns of those who enter middle childhood stunted: Did they remain stunted as adults or move out of being stunted during adolescence? Were those not stunted in middle childhood falter in their growth during adolescence such that they were stunted as adults? What observable individual and household characteristics drove these results? To what extent did variations in the stunting profile in middle childhood and adolescence influence outcomes as young adults including cognitive and psychosocial outcomes, and health outcomes of the offspring of the stunted children? This paper attempts to answer these questions using 4 rounds of the *Young Lives* longitudinal data collected for children from Andhra Pradesh and Telangana from ages 7–19. There is some evidence in the economic and public health literature, obtained using earlier rounds of the same longitudinal data set used in this paper, that growth catch up can

E-mail address: rhimaz@brookes.ac.uk

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occur in middle childhood (Himaz, 2009) and early adolescence (Fink & Rockers, 2014; Outes & Porter, 2013). These studies use height for age z-scores (HAZ) as the key unit of measurement to assess catch-up growth. However, a recent debate in the literature argues that HAZ is inappropriate for measuring 'catch up' in a longitudinal dataset although it is appropriate for comparing groups of children between countries at a given point in time (Leroy, Ruel, Habicht, & Frongillo, 2015). The argument is based on the observation that the HAZ is derived by using the difference between the actual height of the child in centimetres and the expected height according to the standard (HAD), divided by the age-sex based standard deviation for the reference population. This standard deviation increases over time and is based on cross section data. Thus a gain in the HAZ value may partly be due 'true gains' in HAD (the numerator), but also due to the fact that the denominator has risen even if the numerator has not. This means that observed 'catch up' when measured using longitudinal data is a statistical artefact if driven by increases in the denominator that are higher than the numerator. Thus HAD arguably is a more suitable measure of assessing catch-up. There are significant differences in results depending on what you use. For example the 'substantial' changes in catch up growth observed by Fink and Rockers (2014) that appear 'equally likely' in middle childhood and early adolescence are not quite substantial if one uses HAD. Instead, catch up growth is more noticeable in adolescence.

Thus this paper deviates from the previous Young Lives data based studies on growth catch up and faltering by (a) analysing the latest round of data for India (available at the time of writing) that includes information for the children aged 19, (b) using both HAD and HAZ to reassess faltering and catch-up effects in middle childhood and adolescence and (c) looking at differentials in growth patterns between boys and girls in the sample (d) looking at how variations in the stunting profile between ages 8 and 19 have an impact on various psychosocial outcomes as a young adult as well as offspring outcomes. Psychosocial outcomes (which refer to behavioural attributes of the individual) are measured using the rich data collected in the Young Lives survey including measures of agency (the child's sense of freedom of choice to influence own life), self-esteem (overall evaluation of self-worth), self-efficacy (coping with daily hassles as well as adaptation after experiencing all kinds of stressful life events), relationship with peers and parents, and general subjective wellbeing.

The paper is organised as follows. Section 2 describes some methodological issues and data used. Section 3 looks descriptively at growth patterns based on how the stunting profile changed among our children as a group as they moved from middle childhood to adolescence and how using HAZ and HAD indicates differences in growth patterns among boys and girls. Section 4 uses HAZ to categorise the sample based on their stunting profile as those who were never stunted, persistently stunted, moved out of being stunted as an adolescent and moved into being stunted during adolescence, to glean insights as to what individual and household characteristics may have influenced height as an adult among individuals in the different groups. Section 5 looks at how the stunting profile correlates with psychosocial outcomes as young adults and the health outcomes of offspring for the subsample who became parents. Section 6 concludes.

2. Methodological issues and data

2.1. Reference values, growth faltering and catch up

The HAZ for a child proxies accumulated investments in child health and is derived by standardizing a child's height using the expected height and standard deviation for a child of his (or her) age and sex. The expected height and standard deviation come from the mean growth trajectory of a population of healthy children from birth to 19 years of age, as constructed by the World Health Organisation, referred to as the WHO reference 2007.[1] The reference population mean growth trajectory is expected to be at the median of the growth standard. A population level deficit in height (calculated as the average of the individual height-for-age differences-HADs), is reflective of growth impairment caused by a deficient environment that may include poor diet, inadequate care and attitudes to health, as faced by the population of children under study.

A child is deemed 'stunted' if the HAZ is below −2 standard deviations of the mean. The −2 Z-score cut off is used by the World Health Organisation (WHO) Global Database on Child Growth and Malnutrition implying that 2.3% of the reference population will be classified as being stunted even if they have no growth impairment and are not unhealthy.

Catch up growth can be defined as partial recovery from a linear growth deficit accumulated in the past. For recovery to happen children should grow faster than the expected velocity for their age and gender, making up for lost growth in height. But as Chrestani, Santos, Horta, Dumith, and de Oliveira Dode (2013) observe in a systematic review of articles in the medical and public health literature as found in Medline/PubMed databases on catch up growth among children under 12, there is no uniformity in the operational definition of the concept of catch up. In recent econometric literature such 'catch-up' has been identified by looking at the slope of the lagged HAZ in a dynamic model of nutritional status. But as discussed in the introduction, the use of HAZ to measure catch up when using longitudinal data, is debated. Leroy et al. (2015) suggest that when using longitudinal data, true catch up can be measured only using the HAD absolute values. HAD uses an expected growth trajectory based on a reference population of children unlike HAZ changes that do not compare against an "expected HAZ trajectory". Thus this paper avoids measuring catch up growth using regression analysis and instead investigates it in descriptive terms using changes to HAD in Section 3, which is compared to trends in HAZ.

2.2. Data

The data for much of this paper comes from the older cohort of the Young Lives longitudinal survey data for children, households and their communities collected in 2002, 2006, 2009 and 2013 from two regions in Andhra Pradesh (Coastal Andhra and Rayalaseema), and Telangana, India, when the 'index child', was aged 8, 12, 15 and 19 years on average, respectively.[2] The original sample contained 1000 children which dropped to 994 and 976 in the second and third rounds. By the fourth round the number was 951. Still, the overall attrition rate of 4.8 per cent over 11 years (averaging 0.4 per cent per year) is one of the lowest in longitudinal surveys of this nature (Barnett et al. 2012).[3]

The sample is largely pro-poor, as the aim of the Young Lives project is to look at the causes and consequences of childhood pov-

[1] http://www.who.int/childgrowth/standards/height_for_age/en/. See also Onis et al. (2007) for methods and detail pertaining to the WHO 2007 standard. The young Lives Round 4 sample has children between ages 18.5 years and 19.5 years. In order to include the children over 19 years of age in the sample and thus avoid loss of data, the ages of those over 19 are rounded down to 19, under the assumption that 'growth virtually ceases because of epiphyseal fusion, typically at a skeletal age of 15 years in girls and 17 years in boys' (Rogol, Clark, & Roemmich, 2000:524; Tanner, 1989).

[2] See Huttly and Jones (2014), Boyden (2014ab,2016) and Boyden et al. (2016).

[3] See Hill (2004) or Alderman, Behrman, Kohler, Maluccio, and Watkins (2001) for some examples of developing country longitudinal datasets and their attrition rates that can be as high as 50 per cent in some cases.