



THE CENTRE FOR MARKET AND PUBLIC ORGANISATION

War and Stature: Growing Up During the Nigerian Civil War

Richard Akresh, Sonia Bhalotra, Marinella Leone
and Una Osili

December 2011

Working Paper No. 11/279

Centre for Market and Public Organisation
Bristol Institute of Public Affairs
University of Bristol
2 Priors Road
Bristol BS8 1TX
<http://www.bristol.ac.uk/cmipo/>

Tel: (0117) 33 10952

Fax: (0117) 33 10705

E-mail: cmipo-admin@bristol.ac.uk

The Centre for Market and Public Organisation (CMPO) is a leading research centre, combining expertise in economics, geography and law. Our objective is to study the intersection between the public and private sectors of the economy, and in particular to understand the right way to organise and deliver public services. The Centre aims to develop research, contribute to the public debate and inform policy-making.

CMPO, now an ESRC Research Centre was established in 1998 with two large grants from The Leverhulme Trust. In 2004 we were awarded ESRC Research Centre status, and CMPO now combines core funding from both the ESRC and the Trust.

ISSN 1473-625X

War and Stature: Growing Up During the Nigerian Civil War

Richard Akresh¹, Sonia Bhalotra², Marinella Leone³ and Una Osili⁴

¹*University of Illinois at Urbana-Champaign and IZA*

²*CMPO, University of Bristol and IZA*

³*University of Sussex*

⁴*Indiana University-Purdue University Indianapolis*

December 2011

Abstract

The Nigerian civil war of 1967-70 was precipitated by secession of the Igbo-dominated south-eastern region to create the state of Biafra. It was the first civil war in Africa, the predecessor of many. We investigate the legacies of this war four decades later. Using variation across ethnicity and cohort, we identify significant long run impacts on human health capital. Individuals exposed to the war at all ages between birth and adolescence exhibit reduced adult stature and these impacts are largest in adolescence. Adult stature is portentous of reduced life expectancy and lower earnings.

Keywords: war, height, early life, human capital investments, Nigeria.

JEL Classification: I12, O12, J13

Electronic version: www.bristol.ac.uk/cmipo/publications/papers/2011/wp279.pdf

Acknowledgements

We are grateful to Jorge Agüero and Alexander Moradi for helpful discussions.

Address for correspondence

CMPO, Bristol Institute of Public Affairs
University of Bristol
2 Priory Road
Bristol BS8 1TX
s.bhalotra@bristol.ac.uk
www.bristol.ac.uk/cmipo/

1. Introduction

The Nigerian civil war was the first modern war in sub-Saharan Africa after independence and one of the bloodiest. It raged in Biafra, the secessionist region in the South-East of Nigeria from 6 July 1967 to 15 January 1970, killing between 1 and 3 million people and causing widespread malnutrition and devastation. We investigate the impact of exposure to the war as reflected in adult height, a latent stock measure of health. A number of studies establish adult height as a marker of the nutritional environment in early childhood, and environmentally determined variation in height predicts longevity, education, earnings, and the health of the next generation (Steckel 1995, Strauss and Thomas 1998, Schultz 2002, Case and Paxson 2008, 2010, Bhalotra and Rawlings 2010).

We estimate a difference-in-differences model, interacting an indicator for war exposed ethnicity with a continuous cohort-based measure of months of exposure to the war. We find that the full consequences of this war are still being realized, some thirty to forty years later. Despite massive survival selection and substantial flows of foreign aid, the war left scars familiar from studies of famine and epidemic disease. Individuals exposed to the war as children and adolescents, who are still alive today, exhibit reduced stature. A striking finding is that the impact of war exposure in adolescence is stronger than at younger ages. We discuss the reasons for and the implications of this.

This paper contributes to an emerging literature on the legacies of war in producing evidence of its long run human capital costs. Estimates of the costs of war are pertinent given the increase in the incidence of conflict in the decades following the Biafran war. Civil war has afflicted a third of all nations in the past half century. This paper is related to a growing body of work on the long run impacts of fetal and childhood shocks (Almond and Currie 2011) and critical periods for investments in children (Cunha and Heckman 2007). We depart from previous studies in allowing for the fact that height experiences a second growth spurt

during adolescence. Recent studies in economics recognize that adolescence may be a critical period in height formation (Schultz 2002, Case and Paxson 2008) but there is limited (causal) evidence of the consequences of nutritional deprivation at this age.

2. Data and Methodology

The Nigerian Demographic and Health Surveys (NDHS) are large nationally representative cross-sections with information for women aged 15 to 49 at the date of the survey. Heights are measured by trained surveyors, producing more reliable data than from self-reported measures of the stock of health. We use the most recent survey rounds of 2003 and 2008, which allow us to include cohorts who were adolescents during the war (the oldest cohort in the sample was born in 1954). We restrict the estimation sample to birth cohorts 1954-1974. We note that the sample only includes women who survived the war and this will tend to lead us to under-estimate its impact. The main estimated equation is $height_{imcesr} = \beta_a war_{mce} + \alpha_c + \delta_a m_{mc} + \theta_e + \lambda_s + \mu_r + \gamma_{e,t} + u_{imces}$. The subscripts i , m , c , e , s and r index an individual woman i of birth month m and birth year c of ethnicity e born in state s whose height is measured in round r . The main variable of interest, war_{mce} is specified as the interaction term, $(war\text{-exposed ethnicity})_e * (months\ of\ war\ exposure)_{mc}$. The equation includes fixed effects for ethnicity, θ_e , and birth year, α_c , and it additionally includes (un-interacted) months of war exposure (m_{mc}). We control for ethnicity-specific linear trends, $\gamma_{e,t}$, to allow for any underlying divergence or convergence in height across ethnic groups. Although there is a strong overlap of ethnicity and state, they are not identical, so we also include state fixed effects, λ_s . Survey round fixed effects, μ_r , are included to allow, for instance, for any lifecycle changes across cohort.

The coefficients β_a and δ_a vary with the age at which the individual was exposed to the war. Importantly, this allows for the possibility that being exposed to the war for one year at age one could be more damaging than being exposed for the same duration but at age

seven. The coefficients β_a indicate the causal impact of the war under the standard identifying assumptions in a difference-in-difference model. The coefficients δ_a capture spillovers, in particular, they tell us whether the “untreated” ethnic groups suffer reduced stature from being alive during the war. The full impact of the war on the war exposed ethnicities for a given age cohort, a , is $\delta_a + \beta_a$. The equation is estimated by OLS and standard errors are clustered at the ethnicity-year level. We discuss below an alternative indicator for the treated group that proxies the intensity of the war by ethnicity (see Notes to Table 2). The rest of this section discusses our identification of the ethnic groups exposed to the war and our definition of a cohort-specific measure of exposure duration. Robustness checks on our identifying assumptions are presented in the results section.

Exposed Ethnicity: The underlying causes of the Nigerian civil war are complex (Kirk-Greene, 1971). The war was precipitated by the (predominantly Christian) southeastern region’s declaration of independence from the rest of the country, leading to the formation of the Republic of Biafra. The war was fought in the south-east and direct civilian exposure to the war was largely restricted to this region. This region also witnessed the greatest food shortages. Given the importance of protein in height formation (Moradi 2010), it is relevant to note that Biafra imported protein prior to the war and these imports collapsed during the war (Aall 1970). Biafra was populated by the Igbo and other minority ethnic groups (who, together, accounted for about a fourth of the population), and so we define these as the war-exposed group. Many of the Igbo who lived outside of Biafra before the war fled to it for refuge once the war started. It is estimated that Biafra received 1.5 million refugees (Aall 1970). We focus on ethnicity in measuring war exposure, because a geography-based demarcation is sensitive to migration, although the results are consistent if we define treatment using geographic regions.

Cohort and Age Specific Exposure Duration: We use information on the month and year of birth to construct duration of exposure to the war in months, allowing heterogeneity in the exposure coefficients by age. To smooth over measurement error in age and gain precision, we define five age-ranges, namely, the fetal year and ages 0-3, 4-6, 7-12, and 13-16. Age banding also allows for slight variation in the timing of the early childhood and pubertal growth spurts that, even in non-war conditions, will arise from differences in baseline socioeconomic status across girls (Case and Paxson 2008).¹ The control group consists of post-war births from November 1970 (nine months after the end of the war to avoid *in utero* war exposure) up until December 1974. We select a narrow window for the control group since the potential for confounding events increases with window size.

3. Results

The coefficients on the treatment variable (war_{mce}) are statistically significant for each age band (Table 1). The point estimates are not significantly different between the fetal year and age twelve. However there is a significant increase in the coefficient at age 13-16. War-exposed girls who were 0-3 years of age during the war had an average exposure of 17.5 months and, for average exposure, suffered a reduction in adult height of 0.75 centimetres relative to unexposed girls of the same cohort. Exposure duration does not vary much with age and girls aged four to twelve during the war register impacts of similar size. The mean exposure duration at age 13-16 was 20.6 months and this led to a striking 4.53 cm deficit in height relative to unexposed women, which is two thirds of the standard deviation (s.d.) of height in the estimation sample.

¹ The age bands are constructed with reference to the age profile of height growth (e.g. Figure 3, Case and Paxson 2008). Growth is rapid until age three and then relatively stable until adolescence (at about 6 cm per year), at which point it tends to experience a jump (to about 10 cm per year) (Beard and Blaser 2002). Consistent with this age profile of growth velocity, height-for-age Z-scores for girls in Ghana and Cote d'Ivoire fall below a reference population of well-resourced children before the age of three and after the age of eleven but they track the reference in the intervening age interval (Moradi 2010). Our overall findings are not sensitive to small changes in the age boundaries.

Interestingly, the estimates indicate that *all* Nigerian children who were 0-3 years of age during the war suffered a long term loss of stature. This is plausible since the war created country-wide food shortages, although these were more severe in the Igbo dominated war region. Note that adding up the coefficients $\delta_a + \beta_a$ to get the full impact of the war on the exposed ethnicity produces an age gradient in impact that more closely corresponds to a typical growth velocity age profile (e.g. Figure 3 in Case and Paxson 2008)

The age gradient in the coefficients on war_{mce} , β_a , is possibly surprising given that the growth velocity, while elevated at both stages, is higher at age 0-3 than at age 13-16. However even if growth is more rapid in early childhood than in adolescence, the increase in food demand may be greater for adolescents given their larger baseline size. A further potential explanation pertains to the age gradient in survival selection.² Writing in the immediate aftermath of the war, an International Red Cross Committee official remarked: “*In many of the hardest hit areas, one hardly ever sees children aged between six months and five years. This is something which is immediately noticeable in a population in which normally up to 50% or more are children aged below 15 years.*” (Aall 1970). This author estimates that the number of births in the war regions fell by about half a million, suggesting that there was further selection into live births. In a manner of speaking, children exposed *in utero* and up until age five were a “lost generation.”

Table 2 presents estimates using estimated excess mortality among the war-exposed ethnicities during the war. These estimates produce the same age gradient in war impact as is visible in Table 1 and, in fact, the same effect sizes (see Notes to Table 2). This is remarkable given that the mortality rates we used are estimated from self-reported sibling deaths and it

² In line with the risk of death declining sharply in age, positive selection of survivors is greater for individuals exposed to the war at age 0-3 than for individuals exposed at later ages. This will tend to play against scarring (Almond 2006, Bozzoli et al. 2009).

suggests that our identification of the treated group based upon ethnicity, while simple, is accurate and powerful.

Robustness Checks: We conducted placebos on both ethnic group and cohort (results available on request). We created a placebo treated group by defining an indicator for ethnicities in the Central region, a region that was largely uninvolved in the war. We redefined the treatment variable, war_{mce} , as $placebo_e * (months\ exposed\ to\ the\ war)_{mc}$ and dropped the actual war-exposed ethnicities from the sample. We similarly conducted a placebo on cohorts by defining the war years as December 1983 to June 1986 (31 months like the actual war, just 16 years later) and including cohorts 1970-1990 in the estimation, with the control group defined as cohorts 1987-1990. In neither case were any of the placebo treatment coefficients significant. These results mitigate potential concerns that our estimates of the impact of war are biased by differential trends that are not sufficiently accounted for by the inclusion of ethnicity-specific trends.

We investigated extending the control window up until 1990 and the reported coefficients remain comparable. If the health environment did not recover from the war immediately upon its cessation, our strategy of defining control cohorts from November 1970 onwards will tend to lead us to under-estimate impact. We therefore re-estimated the equations dropping first 1971 and then 1971 and 1972 from the control group. The war_{mce} coefficients rise, as expected, but are not significantly different.

4. Conclusions

Our investigation of the Biafran war of 1967-70 shows that several generations of Nigerian women, many of whom are alive today, carry the scars of their exposure to this war. The striking feature of our findings is that adult stature is more sensitive to the environment in adolescence than it is at younger ages. This is important since adolescent growth mediates the relationship between childhood stunting and adult stature. Our estimates (being derived from

differencing across war exposed and unexposed cohort and ethnicity) indicate the size of catch-up growth that is feasible in non-emergency conditions. The extent of catch up growth tends to increase with the extent of nutritional deficiency in childhood (Case and Paxson 2008). Thus it being so large is consistent with girls who were 13-16 during the Biafran war being born in the early 1950s into generally impoverished conditions.

The age gradient in the sensitivity of height to war exposure relates to recent debates on the height-wage premium which turn on whether the productivity of a given height advantage depends upon the age at which it is acquired. The evidence in Case and Paxson (2008), in contrast to that in Persico et al. (2004), suggests that, in the US and the UK, it is height growth in childhood that predicts wages. This is because nutritional insults in childhood lower cognitive ability and height is a marker for this. This may stand modification in poorer countries where manual work is still important since even if adolescent growth only contributes “brawn”, there are labour market returns to both “brain and brawn” (Schultz 2002). However, the relative returns to brawn appear to be larger for men than for women (Thomas and Strauss 1997, Pitt et al. 2010) and our estimates pertain to women. This said, adolescent growth in women may have an intergenerational payoff. There is limited evidence on these questions and our findings motivate further research on the gender-specific productivity loss associated with nutritional limitations on adolescent growth.

References

- Aall, Cato. 1970. Relief, Nutrition and Health in the Nigerian/Biafran war. *Journal of Tropical Pediatrics*. 16(2):70-90.
- Almond, Douglas, and Janet Currie. 2011. Killing Me Softly: The Fetal Origins Hypothesis. *Journal of Economic Perspectives*, 25(3): 153–72.
- Almond, Douglas. 2006. Is the 1918 Influenza Pandemic Over? Long-Term Effects of In Utero Influenza Exposure in the Post-1940 U.S. Population. *Journal of Political Economy*. 14(4): 672-712.
- Beard, Albertine S. and Martin J. Blaser. 2002. The Ecology of Height: The Effect of Microbial Transmission on Human Height. *Perspectives in Biology and Medicine*. 2002, 45(4): 475–498.
- Bhalotra, Sonia and Samantha B. Rawlings. 2011. Intergenerational persistence in health in developing countries: The penalty of gender inequality?. *Journal of Public Economics*. 95(3-4): 286-299.
- Bozzoli, Carlos; Angus S. Deaton and Climent Quintana-Domeque. 2009. Adult height and childhood disease. *Demography*. 46(4): 647-669 (NBER Working Paper No. 12966).
- Case, Anne and Christina Paxson. 2008. Stature and Status: Height, ability, and labor market outcomes. *The Journal of Political Economy*. 116 (3): 499-532.
- Case, Anne and Christina Paxson. 2010. Causes and Consequences of Early Life Health. *Demography*. 47, Supplement: S65-S85.
- Cunha Flavio and James Heckman. 2007. The Technology of Skill Formation. *American Economic Review*. 97(2): 31-47.
- Kirk-Greene, Anthony H.M. 1971. Crisis and Conflict in Nigeria. 1971. Oxford: Oxford University Press.
- Moradi, Alexander. 2010. Nutritional status and economic development in sub-Saharan Africa, 1950-1980. *Economics and Human Biology*. 8(1): 16-29.
- Persico, Nicola; Andrew Postlewaite and Dan Silverman. 2004. The Effect of Adolescent Experience on Labor Market Outcomes: The Case of Height. *Journal of Political Economy*. 112(5): 1019-1053.
- Pitt, Mark M. ; Rosenzweig, Mark R. and Hassan, Nazmul. 2010. Human Capital Investment and the Gender Division of Labor in a Brawn-Based Economy. Yale University, Department of Economics. Working Paper. September, 83.
- Schultz, T. Paul. 2002. Wage Gains Associated with Height as a Form of Health Human Capital. *American Economic Review*, American Economic Association, 92(2): 349-353.
- Steckel, Richard H. 1995. Stature and the Standard of Living. *Journal of Economic Literature*. 33(4):1903-1940.
- Strauss, John and Duncan Thomas. 1998. Health, Nutrition, and Economic Development. *Journal of Economic Literature*, American Economic Association. 36(2): 766-817.
- Thomas, Duncan and John Strauss. 1997. Health and Wages: Evidence on Men and Women in Urban Brazil. *Journal of Econometrics*. 77(1): 159-185.

**Table 1: Difference in Difference Estimates of the Impact of War on Stature:
Duration of Exposure to War*Exposed Ethnicity**

Dependent variable: Adult Height	(1)	(2)
Months exposure in utero*War ethnicity	-0.027 (0.030)	-0.047 (0.038)
Months exposure at ages 0-3*War ethnicity	-0.028*** (0.009)	-0.043** (0.021)
Months exposure at ages 4-6*War ethnicity	-0.035** (0.014)	-0.061* (0.034)
Months exposure at ages 7-12*War ethnicity	-0.054*** (0.011)	-0.094* (0.050)
Months exposure at ages 13-16*War ethnicity	-0.162*** (0.033)	-0.220*** (0.076)
Months exposure in utero	-0.087 (0.059)	-0.081 (0.060)
Months exposure at ages 0-3	-0.129*** (0.034)	-0.125*** (0.034)
Months exposure at ages 4-6	-0.022 (0.070)	-0.015 (0.071)
Months exposure at ages 7-12	-0.014 (0.083)	-0.003 (0.083)
Months exposure at ages 13-16	-0.038 (0.138)	-0.022 (0.137)
State Fixed Effects	Yes	Yes
Ethnicity Fixed Effects	Yes	Yes
Year Fixed Effects	Yes	Yes
Ethnicity Time Trends	No	Yes
Number of women	13407	13407

Notes: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$; Robust standard errors in parenthesis, clustered at the ethnicity*year level. In addition to the named fixed effects, regressions include a survey year dummy. The sample includes adult women born between 1954 and 1974. Ethnicity time trends are defined by an interaction between ethnicity category and birth year. War ethnicity equals 1 if the individual belongs to the Igbo ethnicity or to another South-Eastern minority. The mean height in the sample is 158.70 cm and the standard deviation is 7.06. The mean [s.d.] of exposure duration in months (for the exposed ethnicities) at ages -1, 0-3, 4-6, 7-12 and 13-16 is 7.3 [2.4], 17.5 [9], 17.9 [8.6], 23 [9.9] and 20.6 [10.8] respectively.

**Table 2: Difference in Difference Estimates of the Impact of War on Stature:
Duration of Exposure to War*Excess Ethnic Group Mortality During the War**

Dependent variable: Adult Height	(1)	(2)
Months exposure in utero*Ethnic mortality	-0.094 (0.221)	-0.373 (0.257)
Months exposure at ages 0-3*Ethnic mortality	-0.124* (0.064)	-0.339*** (0.127)
Months exposure at ages 4-6*Ethnic mortality	-0.158* (0.095)	-0.522** (0.217)
Months exposure at ages 7-12*Ethnic mortality	-0.320*** (0.076)	-0.866*** (0.294)
Months exposure at ages 13-16*Ethnic mortality	-0.848** (0.346)	-1.607*** (0.531)
Months exposure in utero	-0.045 (0.137)	0.108 (0.155)
Months exposure at ages 0-3	-0.070 (0.047)	0.047 (0.076)
Months exposure at ages 4-6	0.054 (0.081)	0.252* (0.137)
Months exposure at ages 7-12	0.145 (0.092)	0.441** (0.181)
Months exposure at ages 13-16	0.361 (0.242)	0.784** (0.317)
State Fixed Effects	Yes	Yes
Ethnicity Fixed Effects	Yes	Yes
Year Fixed Effects	Yes	Yes
Ethnicity Time Trends	No	Yes
Number of women	13407	13407

See Notes to Table 1. The sample, as for Table 1, consists of female birth cohorts 1954-1974. *Ethnic mortality* is shorthand for the percentage change in mortality during the war (1967-70) relative to a post-war period (1973-76) among the war-exposed ethnicity (Igbo and other south-eastern ethnicities). This is estimated from self-reported sibling death records and is set to zero for the control ethnicities. We have replaced the indicator for exposed ethnicity in Table 1 with this variable, interacting it with the individual woman's months of exposure to the war. The average difference between war-exposed and non-war exposed ethnicities for mortality in war-time versus peace-time is 12%. Multiplying the coefficients in Table 2 by 0.12 delivers estimates that are very close to the coefficients in Table 1.