



# Heterogeneity in the long term health effects of warfare



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## ABSTRACT

This paper estimates the long-term heterogeneous legacies of exposures to war *in utero* and during early childhood on height in adulthood. Using a novel dataset on the regional WWII destruction in Germany, combined with the German Socio-Economic Panel (SOEP), we find that individuals who experienced warfare *in utero* and during childhood are an average of 2 cm shorter as adults, suggesting that the negative scarring effect of WWII dominated the positive effect coming from a selection. Among war survivors, children from less privileged families who resided in highly destroyed regions, particularly girls, suffered the greatest health consequences of warfare. Our analyses also show that wartime children who lost their parents during the war years are an average of 1.3 cm shorter as adults. However, the father's conscription during WWII had no long-term effect on adult height.

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## 1. Introduction

Armed conflict compromises virtually every aspect of economic and social life in conflict-torn countries, due to the loss of life, deterioration of physical and human capital, erosion of institutional capacity, and reduced economic growth. The World Bank estimates the global economic costs of all conflicts to be over \$100 billion each year (Council on Foreign Relations, 2013). Many conflict-torn countries are trapped in a cycle of violence. According to the World Bank Development Report (2011), 90% of the 39 countries that have suffered civil wars in the 21st century had also had a civil war in the previous three decades. This vicious cycle of civil unrest has its roots in the inadequacy of post-conflict policies to identify and target the most vulnerable groups. For public policy and peacekeeping operations, it is essential to ascertain the segments of the population that suffered the most from civil unrest in both the short and long terms, and to tailor post-conflict policies to assist these groups.

This paper identifies the groups that disproportionately bear the long-term consequences of warfare. Specifically, we estimate the heterogeneous effects of being born and growing up during a war on an individual's adult height. Germany experienced an extensive

bombing campaign by the Allied Air Forces (hereafter, AAF) during World War II. These AAF aerial attacks killed about 3.6 million civilians and 3.7 million soldiers (Meiners, 2011), and 40% of German homes were destroyed or heavily damaged (USSBS, 1945). However, there was considerable variation in the extent of the wartime destruction within Germany. The wartime destruction was greater in some areas than others, due to either size (e.g., larger areas or regions with more visible landmarks were more likely to be the targets of air raids) or chance (e.g., changing weather conditions affected the number of bombs dropped). In addition, wartime children who were born between 1934 and 1945 (hereafter, “the affected cohorts”) would potentially have had their adult height affected by the WWII destruction, while such effects might not be present for the postwar cohorts born in the 1950s (hereafter, “the control cohorts”). Therefore, we explore the region-by-cohort variation in WWII destruction in Germany engendered by the extensive bombing campaigns of AAF as a plausible exogenous source of identification. The paper employs a difference-in-differences-type strategy, where the “treatment” variable is an interaction between regional WWII destruction and an indicator for being a young child during WWII.

Their exposure to war and limited access to health care during a critical period of development could lead to selection (culling) and scarring effects among wartime children (Havari and Peracchi, 2016; Valente, 2015). The culling effect would suggest that challenging wartime conditions would see only the fittest wartime children surviving, leading to positive selection among the

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<sup>1</sup> The authors bare the sole responsibility for any errors that may remain.

surviving wartime cohorts. On the other hand, the scarring effect would shift the health endowments of surviving wartime children down. This implies that wartime children would suffer from the adverse effects of warfare as adults, even though they have survived. The overall effects of a childhood exposure to war on their long-term health would be determined by the relative importance of the selection and scarring effects.

This paper makes several contributions. First, it adds to the growing body of literature exploring the short- and long-term effects of armed conflicts on children's health. Devakumar et al. (2014) suggest in their review paper that armed conflicts affect mothers', fetuses', and children's health through wartime violence, mental health challenges, infectious diseases, and malnutrition. By focusing mainly on armed conflicts in developing countries, several studies have documented that an exposure to armed conflicts *in utero* and during early childhood is associated with a sex ratio imbalance in favor of girls, lower birth weights, a lower height-for-age, and lower heights both in the teenage years and in adulthood (Valente, 2015; Minoiu and Shemyakina, 2014; Akresh et al., 2012a,b; Mansour and Rees, 2012; Verwimp, 2011). Akbulut-Yuksel (2014) provides further evidence on the long-term impacts of armed conflicts using the extensive AAF aerial attacks on Germany during WWII and focusing mainly on the educational attainments of school-aged German children in the second world war. She also analyzes the adulthood height, mortality, and health satisfaction of school-aged children, but without making any mention of potential channels or heterogeneity in the long-term health effects of a childhood exposure to warfare.

As was stated by Currie and Vogl (2013), previous studies of armed conflicts have provided limited evidence to help us to either distinguish the mechanisms underlying their long-term effects on children or identify the vulnerable groups that are affected the most by the devastating consequences of armed conflicts. Thus, our study informs us regarding the heterogeneous health effects of conflicts and provides formal tests of potential mechanisms through which warfare may have influenced the affected cohorts of children. More specifically, we estimate whether the effects of armed conflicts on adult height vary by a child's gender, parental education and occupation, the loss of a mother or father during the war years, father's active involvement in war combat, the length of exposure to warfare, and whether an individual was born and/or a young child during the war years. Moreover, we conduct our empirical analysis by combining a novel detailed regional-level dataset on wartime destruction with the survey data from the German Socio-Economic Panel (SOEP). The richness of these data enables us to explore finer spatial variations in the war intensity within Germany, and to tackle the potential mechanisms through which a childhood exposure to warfare influenced an individual's long-term health, which is vital for combating the vicious cycle of civil unrest in conflict-torn countries around the globe.

Our analyses demonstrate that an exposure to wartime destruction during the prenatal and early postnatal periods had detrimental effects on adult health outcomes even decades after the warfare ended. We find that individuals who experienced warfare *in utero* and during childhood are an average of 2 cm shorter as adults, suggesting that the adverse scarring effect of WWII dominates the positive effect coming from selection. Our results also point out striking disparities in the long-term effects of WWII by gender, parental background, and the intensity of destruction experienced. We find that, among war survivors, children from less privileged families who resided in highly destroyed regions, particularly girls, suffered the greatest health consequences of warfare. Our analyses also show that wartime children who lost their parents during the war years had lower heights as adults. However, we find that the absence of a father during the war years had no differential effect on the individual's

adult height. Our results remain statistically and quantitatively similar when we use the length of exposure to warfare as an alternative measure of exposure. These results survive after we account for internal migration, selective parental migration, selective wartime fertility and mortality, composition bias and reporting bias in height in our analysis. The changes in household income and wealth, the loss of a parent, and a limited access to nutrition and health care during the war years are potential mechanisms that may explain these heterogeneous long-term health effects.

Previous research has shown that height is an essential ingredient of professional and personal success (Case and Paxson, 2008; Persico et al., 2004; Heineck, 2006).<sup>2</sup> Height is also found to be closely related to educational attainments and academic success (Cinnirella et al. 2011; Heineck, 2006). Similarly, several studies have documented that height is associated with higher self-esteem (Freedman, 1979) and increased social dominance (Hensley, 1993), and is rewarded in the mating and marriage market (Belot and Fidrmuc, 2010). Moreover, Akbulut-Yuksel and Kugler (2016) and Coneus and Spiess (2012) show that shorter individuals generally bear shorter offspring. Given this well-established relationship between height and socioeconomic outcomes, the detrimental and long-lasting consequences of WWII for wartime children clearly extend well beyond the health effects that we quantify in our paper. The high intergenerational correlation in height over generations also suggests that not only do wartime children themselves suffer the long-term effects of warfare, but their children are at risk too. Thus, our results provide lower-bound estimates of the enduring harmful effects of war.

The remainder of the paper is organized as follows. Section 2 lays out the conceptual framework. Section 3 describes the regional-level destruction data and individual-level survey data used in the analysis. Section 4 discusses the identification strategy, and Section 5 presents the main results. Section 6 discusses the robustness checks. Section 7 concludes.

## 2. Conceptual framework

A large body of literature has examined the causal association between early-life shocks and long-term outcomes. As was summarized in the seminal work of Almond and Currie (2011), this strand of literature finds that malnutrition and poor living conditions during the key developmental window (*i.e.*, 0–5 years of age), engendered by the macroeconomic crisis, increased temperature variability, famine, crop failure, disease environment, and air pollution, cause a deterioration in childhood and adulthood outcomes. These outcomes include health status, birth weight and height (Molina and Saldarriaga, 2017; Banerjee et al., 2010; Bozzoli, Deaton and Quintana-Domeque, 2009); education, labor market earnings and marriage outcomes (Almond et al., 2010; Almond, 2006; Case and Paxson, 2008; Meng and Qian, 2006); child behavioral outcomes and physical growth (Gupta et al., 2013); late-life cognitive abilities (Chen, 2016); and life expectancy (Van den Berg et al., 2006).

As a shock to the early childhood environment, an exposure to armed conflict provides a unique opportunity to study the impact of malnutrition *in utero* and during early childhood on long-term health outcomes. The demographics literature suggests that an exposure to warfare during the critical period of development could lead to selection (culling) and scarring effects among wartime children (Bozzoli et al., 2009; Elo and Preston, 1992;

<sup>2</sup> Hübler (2009) provides further evidence on the nonlinearity between height and earnings, finding that shorter men and women suffer in the labor market along with very tall men.

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