



# War during childhood: The long run effects of warfare on health



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## ABSTRACT

This paper estimates the causal long-term consequences of an exposure to war *in utero* and during childhood on the risk of obesity and the probability of having a chronic health condition in adulthood. Using the plausibly exogenous city-by-cohort variation in the intensity of WWII destruction as a unique quasi-experiment, I find that individuals who were exposed to WWII destruction during the prenatal and early postnatal periods have higher BMIs and are more likely to be obese as adults. I also find an elevated incidence of chronic health conditions such as stroke, hypertension, diabetes, and cardiovascular disorder in adulthood among these wartime children.

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## 1. Introduction

Globally, child malnutrition continues to be one of the most serious problems, affecting the lives of millions of children and families. According to the [UNICEF-WHO-World Bank joint Report \(2012\)](#), 26% of children under five years of age worldwide, a total of some 165 million children, currently suffer from malnutrition. If current trends continue, malnutrition will affect more than 450 million children globally over the next 15 years. Child malnutrition has devastating consequences for children's well-being, both immediate and long lasting. The thrifty phenotype hypothesis suggests that individuals' metabolisms adapt to the dire nutritional conditions that they experience during the pre- or early post-natal period in order to survive. This leaves individuals who suffer from malnutrition during this critical period more susceptible to both obesity and chronic health conditions such as coronary heart disease, stroke, diabetes and hypertension later in life ([Barker, 1992](#)). Wars and armed conflicts pose a substantial threat to the economic resources and health care available to infants and children, and create food

shortages and changes in the composition of food eaten; therefore, they may have especially enduring and devastating impacts on children's long-term health. However, to date there has been only limited research exploring how such an exposure to armed conflict before birth and in early childhood affects children's body size, obesity, and probability of having a chronic health condition later in life.

This paper analyzes the long-run causal effects of being born or growing up during war on an individual's adult BMI, obesity and probability of having a stroke, hypertension, cardiovascular disorder, or diabetes. Specifically, I use the city-by-cohort variation in destruction in Germany that arose from the extensive Allied Air Forces ("AAF") aerial attacks during WWII as a unique quasi-experiment. I employ a difference-in-differences-type strategy, where the "treatment" variable is an interaction between the city-level intensity of WWII destruction and an indicator for being born or being a young child during WWII. In this setting, I also control for city and birth year fixed effects. The validity of difference-in-differences estimation relies on the existence of parallel trends in body size and chronic health conditions between the affected and control cohorts across cities of varying levels of intensity of wartime destruction, had WWII not occurred. I assess the plausibility of this assumption below by performing a falsification test where I repeat the analysis using the older and younger cohorts. The control experiment shows that the parallel trend assumption is satisfied, which lends credence to the difference-in-differences estimation.

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This paper contributes to several areas of research. The first is the literature that examines the causal association between the early childhood environment and health outcomes later in life. In accordance with [Barker's \(1992\)](#) hypothesis, this strand of the literature finds that malnutrition and poor living conditions *in-utero* and during early childhood have long-lasting adverse effects on individuals' self-reported health status, mental health, height, schizophrenia in adulthood, and life expectancy.<sup>2</sup> Such research has addressed the effects of extreme weather conditions, famines, disease, natural disasters, and economic crises. This paper adds to this literature by quantifying the long-term effects of an exposure to wartime destruction following conception and during early childhood on body size, obesity and the probability of having a chronic health condition later in life.

This study also contributes in several ways to the growing body of literature examining the immediate and long-term consequences of armed conflicts on children's health outcomes. By mainly focusing on armed conflicts in developing countries, several studies have found that exposure to armed conflicts during pre- or early post-natal period is associated with lower birth weights, lower height-for-age, height and self-reported health in teenage years and adulthood. [Mansour and Rees \(2012\)](#) find that Palestinian mothers' exposure to armed conflict during pregnancy by the Israeli security forces is associated with a modest increase in the probability of having a low birth weight child. [Alderman et al. \(2004\)](#), [Minoiu and Shemyakina \(2014\)](#) and [Akresh et al. \(2012b\)](#) examine how pre-or-early post-natal exposure to armed conflict affects the height-for-age Z-scores among children in Zimbabwe, Cote d'Ivoire and Eritrea, respectively. These papers find that such exposure to armed conflict in conception or during early childhood leads to a substantially lower height-for-age among the affected children.

Similarly, [Akresh et al. \(2012a,b\)](#) find that wartime girls who were 3 and younger during the Nigerian civil war are 0.75 cm shorter as adults relative to girls of the same cohort residing in unaffected areas. [Akbulut-Yuksel \(2014\)](#) shows that the school disruption caused by the extensive bombing campaign of Allied Air Forces leads to a 0.4 fewer years of schooling, and lower self-rated health satisfaction among school-age children and lower adult height. However, [Almond and Currie \(2011b\)](#) and [Hoynes et al. \(2016\)](#) suggest that *in utero* or early childhood exposure to dire conditions could have a direct effect on the individuals' long-term health outcomes such as body mass index, obesity and chronic health conditions independent of its effect through years of schooling due to the mismatch experienced between childhood and adulthood environment in the availability of nutrition. Therefore, it is imperative to investigate these latent effects of armed conflicts on very long-term health outcomes.

To the best of my knowledge, this is the first paper that studies the long-term effects of early childhood exposure to armed conflicts by focusing on adult BMI, obesity and chronic health conditions that are not readily available in many survey data. Second, this paper improves our knowledge on the pathways through which armed conflicts affect longer-term health outcomes. Such detailed formal investigation of channels and sources of heterogeneity is limited in the previous studies exploring health effects of warfare. I have collected a battery of city-level historical data from German archives such as immediate postwar birth and infant mortality rates, destruction of hospitals and postwar per capita health expenditure for the analyses in this paper to assess the postwar conditions and health care available to wartime children. I further

<sup>2</sup> For detailed information on the long-term effects of early childhood shocks, see [Almond and Currie \(2011a,b\)](#).

formally test other potential mechanisms and heterogeneity in the longer-term health effects of early childhood exposure to war by parental educational attainment, father's occupation, the loss of a parent during the war years, and the deployment of a father for war combat. Finally, by collecting very detailed data on rubble per capita for each of former West Germany's 75 cities from historical archives, this paper quantifies the realized wartime destruction and explores the spatial variation in wartime destruction intensity within Germany. Thus, it estimates the long-term effects of WWII on children's health outcomes in adulthood in a richer way than previous studies have done.

I find that an exposure to wartime destruction during the fetal period or early childhood had long-term detrimental effects on individuals' health that remained even 60 years after WWII. First, individuals who were born or were young children during WWII in a hard-hit city had about 1.5-point higher body mass index in adulthood than the wartime children in the less destroyed cities. Second, I find that these wartime children were almost 16 percentage points more likely to be obese as adults if they were residing in highly destroyed city over the course of WWII. Third, my results suggest that an exposure to armed conflict during the prenatal and early postnatal periods significantly increases the likelihood of having a chronic health condition later in life. Wartime children in the hard-hit cities are 0.23 standard deviations more likely to have a chronic health condition as adults compared to their counterparts in the less destroyed cities. The long-term health costs of WWII fell disproportionately on wartime children residing in urban areas in the most hard-hit cities, and with less well-educated parents. Furthermore, my analysis shows that a father's involvement in combat and the death of one or both parents during the war years have limited long-term effects on future body size or chronic health conditions. Therefore, malnutrition, changes in daily diet and a limited access to health care during WWII are potential mechanisms for the observed long-term health effects. These results remain robust after I account for the potential changes in the composition of the population, infant and adult mortality rates, selective wartime fertility, and city-specific trends by prewar city characteristics and state-specific policies in postwar Germany.

The remainder of the paper is organized as follows. Section 2 provides a brief background of AAF bombing in Germany during WWII. Section 3 describes the city-level destruction data and individual-level survey data used in the analysis. Section 4 discusses the identification strategy. Section 5 presents the main results and robustness checks. Section 6 describes potential mechanisms and heterogeneity in the long-term health effects of WWII. Section 7 concludes.

## 2. Background on the extensive bombing campaign of Allied Air Forces during World War II

Bomber Command's area offensive represented "true aerial warfare", and the bombing campaign was the only offensive action in Germany between 1940 and 1944 ([Werrell, 1986](#)). The overwhelming majority of the AAF's aerial attacks consisted of nighttime area bombing. The objective of area bombing was to drop a bomb that would start a fire in the center of a town that might consume the whole town. The AAF's extensive bombing campaign left more than 14 million people in Germany homeless, and killed close to 3.5 million civilians and 3.3 million soldiers ([Meiners, 2011](#); [Heineman, 1996](#)). While most of the destroyed buildings were apartment buildings, every city also lost other kinds of public buildings, including hospitals, as well as roads, which led to food shortages and limited access to health care.

Over the course of WWII, every German city was bombed, though the number of bombs dropped and the resulting

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