

Report on the impact of early-life stressors on population and individual economic outcomes

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List of Abbreviations

CBS: Centraal Bureau voor de Statistiek (Statistics Netherlands)

TSIV: two-sample instrumental variable

Executive summary

There is a strong association between socio-economic status (education, income, wealth) and health at adult ages: those from lower socio-economic background generally have worse health and vice versa. In recent decades it has become clear that health and mortality differences originate in the earliest stages of human life, even before birth. In this context, economists often look at education and labor market outcomes. After all, if adverse conditions early in life affect health and cognition, then it is plausible that this may also translate to later life labor outcomes of the offspring. The VU team headed by professor Maarten Lindeboom has looked at three of such adverse effects on offspring later life outcomes: maternal undernutrition, iodine deficiency and exposure to a stressful event.

The project “Early life famine exposure, hunger recall and later life health” examines the long-run consequences of actual exposure to hunger early in life. We use recall data from older persons in the same family, or from the same village to proxy hunger exposure very early in life. Validation of this new measure requires development of new statistical methods. We develop a new statistical method to examine the effect of actual hunger exposure early in life on later life health. We find that exposure to hunger early in life leads to worse health among females fifty years later. This effect is much larger than the effect found in previous studies that relied on proxies such as being born in a specific area. This implies that it is plausible that the previous studies have underestimated the consequences of hunger exposure. This study is relevant in periods of food insecurity as we nowadays face in developing countries and people with insufficient means in developed countries.

The project “A bit of salt, a trace of life: the effect of a national iodization program on human capital formation of school aged children” evaluates the effect of a national salt iodization program on the cognition of school aged children in China. We find a strong positive impact of prenatal exposure to the program on cognition and schooling for girls. For boys, we find no effect. Child preferences play an important role in parental investment decisions and may therefore impact program effects. Parents invest in girls, but primarily in girls who show potential. For boys, this is different. Parents invest in boys, irrespective of their initial endowment. The nationally implemented program may therefore primarily benefit low endowment girls. This study shows that child gender preferences can be important for the investment decision of parents and

large scale programs can have positive and possible unintended effects on gender equality in societies where boy preferences are important.

The project “Traumatic experiences adversely affect life cycle labor market outcomes of the next generation - Evidence from WWII Nazi raids” examines the causal effect of a traumatic event experienced by pregnant women on the life-long labor market outcomes of their offspring. We exploit a unique natural experiment that involved randomly placed Nazi raids in municipalities in Italy during WWII. We link administrative data on male private sector workers to information about Nazi raids and war casualties. Our results suggest that prenatal exposure to traumatic events affect offspring earnings throughout the working career and in retirement. The lower earnings are due to lower educational attainment, the type of jobs held and interruptions in working careers due to unemployment. We further find that prenatal exposure exacerbates the adverse effects of later life job loss on earnings. We use a medical database on health expenditures to interpret the effect estimates. The prenatally exposed have higher medical expenditures on diseases of the nervous system and mental disorders, indicating that stress is likely to be an important factor driving our findings. Traumatic experiences are not limited to war situations, but also hold for deprived neighborhoods, where crime, unemployment and poverty rates are high. Such adversities affect families with poor qualifications and limited resources most. Therefore, traumatic and stressful events may play an important role in the persistence of low socio-economic status across generations.

The studies summarized above use historical data and in some cases rare events. Historical events are necessary to be able to follow individuals for an extremely long period. The events studied may be perceived as rare. It should be noted that this does not mean that it is not relevant for current societies and policies. Food shortages around the world and traumatic and stressful events are still relevant today and vulnerable populations are most sensitive to such adverse events. This is an important message for today’s policy makers.

1. Introduction

This task aimed to identify links between early-life stressors and economically related later-life outcomes and elucidate mechanisms underlying these links. The group used longitudinal data linking early-life stressors to economically-related outcomes in childhood, adolescence and adulthood. Registry-based data from Statistics Netherlands (CBS) and Statistics Finland were used to relate early-life stressors, such as recessions, to economically related outcomes later in life.

There is a strong association between socio-economic status (education, income, wealth) and health at adult ages: those from lower socio-economic background generally have worse health and vice versa. In recent decades it has become clear that health and mortality differences originate in the earliest stages of human life, even before birth. The epidemiologist David Barker postulated in the last decade of the previous century that fetal undernutrition may lead to metabolic adaptation affecting the phenotype of the offspring such that the risk of diseases later in life is increased. Animal studies have established effects of fetal undernutrition on later life diabetes. Other studies have found strong associations between insufficient intake of essential micro-nutrients (such as iodine, iron and zinc) early in life and cognitive outcomes. Similarly, studies have found a strong association between maternal exposure to stress and offspring cognition and mental health. While epidemiologists primarily focus on health-related outcomes, economists often look at education and labor market outcomes. After all, if adverse conditions early in life affect health and cognition, then it is plausible that this may also translate to later life labor outcomes of the offspring. The VU team headed by professor Maarten Lindeboom has looked at three of such adverse effects on offspring later life outcomes: maternal undernutrition, iodine deficiency and exposure to a stressful event.

2. Description of progress and results

2.1 Early-life Famine Exposure, Hunger Recall and Later-life Health (1)

Scientific summary: We use newly collected individual-level hunger recall information from the China Family Panel Survey to estimate the causal effect of undernourishment on later-life health. We develop a two-sample instrumental variable (TSIV) estimator that can deal with heterogeneous samples. We find a nonlinear relationship between mortality rates and individual hunger experience. This nonlinear relationship may explain the variation in the famine's effect found in previous studies. We find that hunger exposure early in life leads to worse

health among females 50 years later. This effect is much larger than reduced-form effects found in previous studies. For males, we find no impact.

Interpretation: The project “Early life famine exposure, hunger recall and later life health” examines the long-run consequences of actual exposure to hunger early in life. In empirical studies researchers use aggregate indicators (such as region of birth) to proxy individual conditions early in life. However, being born when the event in question took place is not equivalent to actually being exposed to adverse conditions. For example, researchers have used famine in a region as a proxy for being exposed to hunger. However, living in a food deprived area is not equivalent to actually experiencing hunger, even if the famine’s timing and location are precisely known. Wealthier households may still have sufficient food, or some parts of an exposed area may be less affected by the famine. Also, there is often uncertainty about the location and timing of the famine. For instance, the famine may be preceded by a prolonged period of food insecurity, so it is not always clear when the famine started. Information on actual hunger exposure would be a solution, but this kind of information is rare. Moreover, people may not recall that they experienced hunger when they were very young.

In this project we use hunger recall data from the China Family Panel Survey. We use recall data from older persons in the same family, or from the same village to proxy hunger exposure very early in life. Validation of this new measure requires development of new statistical methods. We develop a new statistical method to examine the effect of actual hunger exposure early in life on later life health. We find that exposure to hunger early in life leads to worse health among females fifty years later. This effect is much larger than the effect found in previous studies that relied on proxies such as being born in a specific area. This implies that it is plausible that the previous studies have underestimated the consequences of hunger exposure. This study is relevant in periods of food insecurity as we nowadays face in developing countries and people with insufficient means in developed countries.

2.2 Gender norms and the impact of a salt iodization program on human capital formation of school aged children (2)

Scientific summary: This paper examines the effects of a massive salt iodization program on human capital formation of school-aged children in China. Exploiting province and time variation we find strong positive effects on cognition for girls and no effects for boys. For non-cognitive skills we find the opposite. We show in a simple model of parental investment that gender preferences can explain our findings. Analyses exploiting within province, village level variation in gender attitudes confirm the importance of parental gender preferences. Consequently,

large scale programs can have positive and possibly unintended effects on gender equality in societies where boy preferences are important.

Interpretation: The project “A bit of salt, a trace of life: the effect of a national iodization program on human capital formation of school aged children” evaluates the effect of a national salt iodization program on the cognition of school aged children in China. To fight iodine deficiency-related diseases, the Chinese government implemented a national program requiring salt to contain iodine in October 1994. In this project we focus on the potential impact of this policy on cognitive ability and school attainment for children who are affected by this program *in utero*. We find a strong positive impact of prenatal exposure to the program on cognition and schooling for girls. For boys, we find no effect. Child preferences play an important role in parental investment decisions and may therefore impact program effects. Parents invest in girls, but primarily in girls who show potential. For boys, this is different. Parents invest in boys, irrespective of their initial endowment. The nationally implemented program may therefore primarily benefit low endowment girls. This study shows that child gender preferences can be important for the investment decision of parents and large scale programs can have positive and possible unintended effects on gender equality in societies where boy preferences are important.

2.3 Traumatic experiences and life cycle labor market outcomes of the next generation (3)

Scientific summary: This paper examines the causal effect of a traumatic and stressful event experienced by pregnant women on the life-long labor market outcomes of their offspring. We exploit a unique natural experiment that involved randomly placed Nazi raids in municipalities in Italy during WWII. We link administrative data on male private sector workers to information about war casualties and Nazi raids. Our results suggest that prenatal exposure to violence affects offspring earnings along the whole working career and in retirement. The lower earnings are due to lower educational attainment, the type of jobs that are held and interruptions in working careers due to unemployment. We further find that prenatal exposure exacerbates the negative effects of later life job-loss on earnings, deepening the negative impact on earnings in later life. We use a medical database on health expenditures to interpret the effect estimates. The prenatally exposed have higher medical care expenditures on diseases of the nervous system and mental disorders. This indicates that stress induced by the violent raids is likely to be an important factor driving our findings.

Interpretation: The project “Traumatic experiences adversely affect life cycle labor market outcomes of the next generation - Evidence from WWII Nazi raids” examines the causal effect of a traumatic event experienced by pregnant women

on the life-long labor market outcomes of their offspring. We exploit a unique natural experiment that involved randomly placed Nazi raids in municipalities in Italy during WWII. We link administrative data on male private sector workers to information about Nazi raids and war casualties. Our results suggest that prenatal exposure to traumatic events affect offspring earnings throughout the working career and in retirement. The lower earnings are due to lower educational attainment, the type of jobs held and interruptions in working careers due to unemployment. We further find that prenatal exposure exacerbates the adverse effects of later life job loss on earnings. We use a medical database on health expenditures to interpret the effect estimates. The prenatally exposed have higher medical expenditures on diseases of the nervous system and mental disorders, indicating that stress is likely to be an important factor driving our findings. This study concerns a historical event that could be described as extreme and rare. Unfortunately, extreme violence against civilians in wars and civil conflicts are still very relevant today. According to UNHCR, by the end of 2021, propelled by new waves of conflict and violence the number of displaced people worldwide rose to 90 million. In 2022, the war in Ukraine has displaced 8 million within the country and forced around 6 million to leave the nation. Our study shows that such traumatic experiences of pregnant women scar the next generation's educational and labor outcomes. Traumatic experiences are not limited to war situations, but also hold for deprived neighborhoods, where crime, unemployment and poverty rates are high. Such adversities affect families with poor qualifications and limited resources most. Therefore, traumatic and stressful events may play an important role in the persistence of low socio-economic status across generations.

3. Conclusion

During the life course people can be exposed to adversities. In this deliverable, we examine the effects of *in utero* exposure to under-nutrition and stress on health and labor market outcomes of the exposed and whether policy interventions can curb these negative effects. On the latter, indeed, the effect of a large-scale salt iodization project has positive effects on the cognition of the child, but also that the social and cultural environment and parental behavior is very important. Parents invest in their children and in this way they may counter or even reinforce the effects of a bad start. Further, traumatic events experienced by pregnant women affects educational outcomes and lifecycle wages, occupation and even retirement benefits of the next generations. Additionally, the exposed are more sensitive to adverse events later in life. Since stress-related events more often occur for the lower educated and the poor, this

leads to intergenerational persistence in poverty and lower educational outcomes.

4. Contribution of partners

Due to the very specific nature of the research performed, VU performed all studies in this deliverable.

5. Deviations from original plan

This deliverable has been fulfilled fully in line with the original plan as stated in the grant agreement.

6. Dissemination activities

Maarten Lindeboom has done multiple seminars and presentations on “Maternal stress and offspring life-long labor market outcomes” in the following institutes/workshops:

- Bocconi University, Milan
- Ca’ Foscari University, Venice
- INPS Rome
- Tor Vergata University Rome
- Monash University, Melbourne
- Lancaster University, UK
- Mannheim University
- NBER summer institute
- NBER – Max Planck workshop
- Nova Lisbon

Two PhD thesis were completed at VU in relation to the work in this task:

- Zichen Deng defended his thesis “Empirical Studies in Health and Development Economics” in January 2021 (4).
- Coen van de Kraats defended his thesis “On inequalities in Well-being and Human Capital Formation” in May 2022 (5).

7. References

1. Deng Z, Lindeboom M. Early-life Famine Exposure, Hunger Recall and Later-life Health. *Journal of Applied Econometrics*. 2022;37(4):771-87.
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4. Deng Z. Empirical studies in health and development economics. 2021. 165 p. Link: [Empirical Studies in Health and Development Economics – Tinbergen.nl](#)
5. van de Kraats CWA. On Inequalities in Well-Being and Human Capital Formation. s.l.: s.n., 2022. 260 p. Link: [On Inequalities in Well-Being and Human Capital Formation – Tinbergen.nl](#)