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Scarred for Life? Early-Life Experience of the Post-Reunification Economic Crisis in East Germany and Physical and Mental Health Outcomes in Early Adulthood

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Abstract: Existing research suggests adverse short-term health effects of economic crises during early life, yet, the long-term health effects for children and adolescents exposed to economic crises are still understudied. We investigated the early-adult health implications of experiencing the post-reunification economic crisis in East Germany in the early 1990s during infancy, childhood and adolescence. Using data from the German Socio-Economic Panel (SOEP) and its linkage with German pension records (SOEP-RV), we applied entropy balancing and conditional quantile regression to assess the relationship between the experience of the economic crisis during early life (ages 0-17) and physical and mental health effects (SF-12 summary scores) in N = 2,337 young adults (aged 17-30) from East and West Germany. Our results indicate mainly no significant physical health effects, yet, significant adverse mental health effects for respondents exposed to the economic crisis in East Germany, especially in young women of average and better mental health. Parental unemployment was an additional risk factor for young women's mental health. Thus, we suggest women who experienced economic crises during early life are at increased risk of adverse mental health effects already early in their adulthood. Support for families in times of economic crisis and early prevention for infants, children and adolescents exposed to economic adversities is warranted.

Keywords: Economic crisis · Life course approach · Family stress · SF-12 · Health · Germany

1 Introduction

Economic stress is consistently associated with adverse physical and mental health outcomes, especially during economic crises (see *Karanikolos et al.* 2016; *Mucci et al.* 2016; and *Thompson et al.* 2019 for review). Children and adolescents are especially vulnerable to the adverse health effects of economic crises, as their

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health is sensitive to changes in their socio-economic environment (*Elder* 1998; *Kuh et al.* 2013) while being entirely dependent on their families and unable to mitigate the consequences of the emerging economic stress themselves (*Elder* 1999). This process may be explained by physiological dysregulation resulting from increased distress exposure (*Glei et al.* 2007) that may result in later-life adverse physical and mental health outcomes (*Alastalo et al.* 2013; *Elder/Caspi* 1988). Therefore, exploring the relationship between early-life exposure to economic crises and long-term health outcomes is particularly important for understanding the accumulation processes of poor health over the life course and explaining health inequalities in adulthood.

Both empirical evidence and the theoretical view of the life course approach strongly suggest that exposure to a significant adverse life event – such as an economic crisis – early in life carries significant physical and mental health risks over the remaining life course. First, recent empirical studies conducted in high-income countries have found adverse short-term health effects among children and adolescents of both the general occurrence of an economic crisis (*Anagnostopoulos/Soumaki* 2013; *Cui/Zack* 2013; *Rajmil et al.* 2013) and the family exposure to an economic crisis, i.e., through parental unemployment and family economic hardship (*Briody* 2021; *Costa et al.* 2020; *Rajmil et al.* 2013). In addition, studies on infant exposure to economic stress suggest higher mortality and cardiovascular health differences in later life compared to unexposed children (*Alessie et al.* 2019; *van den Berg et al.* 2006, 2011).

Second, the theoretical assumptions of the life course approach imply mid- and long-term mental health effects of exposure to economic crisis during childhood and adolescence, considering the sensitive period model within the life course approach (*Ben-Shlomo et al.* 2014). Specifically, children and adolescents are more susceptible to external stressors than adults; thus, early-life exposure can lead to long-term adverse health outcomes (*Kuh et al.* 2013). Economic stressors, in particular, increase family stress and ultimately harm children's and adolescents' physical and mental health (cf. *Gard et al.* 2020; *Masarik/Conger* 2017). In addition, recent studies on parental unemployment show that particularly school-age children and adolescents might suffer long-term mental health effects until adulthood (*Moustgaard et al.* 2018; *Nikolova/Nikolaev* 2018; *Powdthavee/Vernoit* 2013). While these results emphasise the vulnerability of children and adolescents to family economic stress, the adult health consequences of early-life economic adversities, particularly economic crises, remain unclear.

This study seeks to contribute to this discussion by investigating the relationship between early-life exposure to an economic crisis, i.e., during infancy, childhood and adolescence, and physical and mental health in early adulthood. Specifically, we study this relationship in the context of the post-reunification economic crisis in East Germany in the early 1990s (see 2.2. for more information). To our knowledge, research on the long-term health consequences of early-life exposure to the post-reunification economic crisis in East Germany is limited to one study on metabolic health effects (*Bister et al.* 2022). We are the first to study this economic crisis' long-

term comprehensive mental and physical health consequences while considering not only the general but also the family-level exposure to economic stress.

Accordingly, we address the following research questions:

(1) What is the general early adult physical and mental effect of exposure to the post-reunification economic crisis in East Germany during infancy, childhood and adolescence?
(2) What is the role of parental unemployment in this relationship, i.e., the direct exposure to the economic crisis?

In assessing the exposure to this economic crisis in early life and subsequent physical and mental health consequences in early adulthood, we follow the life course approach by distinguishing between infancy, childhood and adolescence as the three main sensitive phases of the life course (*Kuh et al.* 2013). Furthermore, we conceptualise the adverse health effects of experiencing economic stress at the family level during economic crises for children and adolescents using the family stress model (see *Masarik/Conger* 2017 for review; *Solantaus et al.* 2004) and specifically consider parental unemployment during the economic crisis period. Our results thereby contribute to the understanding of long-term health consequences of early-life economic adversities and further provide insights into the setting of the post-reunification economic crisis in East Germany, which we utilise for our study and which has been widely understudied.

2 Background

2.1 Theoretical considerations

In our efforts to investigate the early-adult health implications of experiencing severe economic stress during early life, we rely on two theoretical concepts, namely the family stress model and the life course approach. First, the Family Stress Model (FSM) broadly explores how external stressors affect family dynamics (*Masarik/Conger* 2017) focusing on traditional family constellations, i.e. a two-generation household consisting of one or two parent(s) and at least one of their dependent children. The mechanism of action is described as follows: the external stressor is initially absorbed by the parents. In processing the related adversities of this stressor, they experience increased distress leading to disruptions in the family dynamics and eventually to a decline in parenting. This decline in parenting entails the significantly decreasing ability to fulfil parental duties to varying extents, ranging from lacking emotional support to child neglect (*Masarik/Conger* 2017). Subsequently, the family stress transmitted from the parents to their children may negatively impact child development, potentially resulting in adverse health consequences such as developmental delays or immense physical and mental health problems (cf. *Gard et al.* 2020; *Solantaus et al.* 2004).

Economic stressors, such as poverty, unemployment, or financial strain, are amongst the common stressors studied when it comes to applications of the FSM in empirical research. Specifically, economic stressors at the family level triggered

by worsened economic conditions – i.e., low income, debts, or other adverse financial events – may lead to decreased parenting capabilities in the parents (cf. *Schmiedeberg/Bozoyan* 2021) and subsequently increased psychological distress in children (*Conger et al.* 2012; *Conger/Conger* 2002). In turn, children are at higher risk of suffering from adjustment problems (see *Masarik/Conger* 2017 for review), leading to developmental delays and subsequently adverse long-term health outcomes.

While the FSM may aid in conceptualising how economic stressors during an economic crisis, it does not explain the relationship between early-life economic adversities and later life health consequences. Therefore, we additionally utilise the life course approach. The life course approach (*Brandt et al.* 2012; *Kuh et al*. 2013) stresses the significance of early-life conditions for the healthy development of individuals until and throughout adulthood. Specifically, it emphasises children's and adolescents' emotional, social, and physical dependence on their social environment, such as their family. Exposure to sources of family economic stress during the vulnerable early years of life, such as an economic crisis during infancy, childhood or adolescence, may accumulate adverse health outcomes over the life course, into significant health differences in adulthood (*Kuh et al*. 2013). Hence, the experience of an economic crisis and its subsequent family economic stress during early life may play a critical role in individuals' long-term health.

2.2 Effects of economic crises on child and adolescent health

Previous research has shown that economic crises are particularly severe for children and adolescents' short-term physical and mental health (see *Rajmil et al.* 2014 for review). For mental health, *Costa* and colleagues (2020) studied children aged 7 to 10 born shortly before or during the Great Recession of 2008 in Portugal. They found that children directly exposed to the economic crisis showed increased psychosocial functioning problems, poorer health-related quality of life, and increased symptoms of depression, anxiety, and stress. Similarly, *Rajmil* and colleagues (2013) found in Spain that parental unemployment during this economic crisis immediately and adversely affected the health-related quality of life of children aged 0-12. In their research on US adolescents, *Cui* and *Zack* (2013) observed that mental health declined during the Great Recession. Finally, *Anagnostopoulos* and *Soumaki* (2013) showed increased uptake of psychiatric services in children and adolescents in Greece during the same economic crisis.

At the same time, research on the physical health effects of economic crises for children and adolescents is scarce. Of the previously discussed studies, *Cui* and *Zack* (2013) are the only ones that also examined physical health outcomes and showed declined self-rated health but no significant decreases in physical health in adolescents. *Rajmil* and colleagues (2013) also studied children's body mass index and found an increased prevalence in child adiposity after exposure to the economic crisis. These findings are consistent with studies investigating children's weight gain after the Great Recession of 2008 in Portugal (*Rodrigues et al.* 2021) and Ireland (*Briody* 2021). Both concluded a positive association between

deteriorated nutritional status and decreasing physical activity in families affected by an economic crisis and children's weight gain.

The fact that children and young people are affected by the onset of economic crises is generally unsurprising. Several studies suggest that the sole onset of an economic crisis can lead to psychological distress in the population (see *Mucci et al.* 2016 for review). This general negative health effect likely evolves from higher levels of economic insecurity during economic crises that, in turn, reinforce economic stress emerging from any occurring unemployment (*Hessel et al*. 2014; *Reibling et al.* 2017). Parents, in particular, may experience increased distress as they experience a greater sense of responsibility for their children and thus might feel strongly threatened by an economic crisis. Accordingly, a study by *Chzhen* (2016) showed that the presence of children in the household increased the probability of reporting distress in the context of the Great Recession of 2008 in Europe.

Consequently, and based on the Family Stress Model (FSM), parental distress experiences during economic crises may have a negative impact on their children. *Solantaus* and colleagues (2004) validated the assumptions of the FSM for children's mental health during the 1990s economic crisis in Finland. Their study showed that increased economic pressure and negative changes in parental mental health, marital interaction, and parenting quality contributed to children's mental health risks. At the same time, a family's socio-economic capability is crucial for the coping with the adverse economic conditions, and may decide on adverse health effects in the children (*Currie/Stabile* 2002; *Doyle et al.* 2007). Specifically, parental educational attainment (*Rajmil et al.* 2013) or household income (*Burgess et al.* 2004) might facilitate physical and mental child health inequalities induced by family economic stress.

Accordingly, we hypothesise that children from families that were more severely affected by economic stress show worse physical and mental health in early adulthood.

2.3 Adult health effects of economic adversities during early life

Studies on adult health effects of exposure to economic crises in early life are scarce. Only one study by *Bister* and colleagues (2022) investigates early-adult metabolic health effects of early-life exposure to an economic crisis. Specifically, they studied several metabolic health outcomes of East Germans born shortly before or during the post-reunification economic crisis. They found increased early-adult metabolic health risks in women exposed to the economic crisis in utero and infancy. However, they only analysed the overall burden of the economic crisis and did not consider experiences of family economic stress through, e.g., parental unemployment. Following the insights of the life course approach, we hypothesise that exposure to an economic crisis during early life increases the long-term physical and mental health risks.

While research on the long-term health consequences of economic crises during early life is scarce, evidence from studies of parental unemployment provides support. Several studies showed adverse long-term physical and mental health

outcomes after experiencing economic hardship and parental unemployment at a young age (*Lindström et al.* 2012, 2014; *Moustgaard et al*. 2018; *Nikolova/Nikolaev* 2021; *Widding-Havneraas/Pedersen* 2020). For example, *Moustgaard* and colleagues (2018) observed increased psychotropic medication use in adolescents experiencing paternal unemployment in Finland with long-lasting effects. *Nikolova* and *Nikolaev* (2021) found decreases in life satisfaction during early adulthood (ages 18-31) for individuals experiencing parental unemployment during childhood. *Lindström* and colleagues (2012, 2014) confirmed in their research in Sweden that childhood and adolescent economic stress (ages 0-18) accumulates to poor self-rated general health (*Lindström et al*. 2012) and mental health (*Lindström et al*. 2014) in adulthood. *Widding-Havneraas* and *Pedersen* (2020) confirmed these findings for 20 European countries and found an association between childhood and adolescent economic stress (ages 0-18) and adult self-rated health and cancer. Accordingly, we hypothesise that the exposure to severe early-life economic stress is associated with worse physical and mental health in early adulthood.

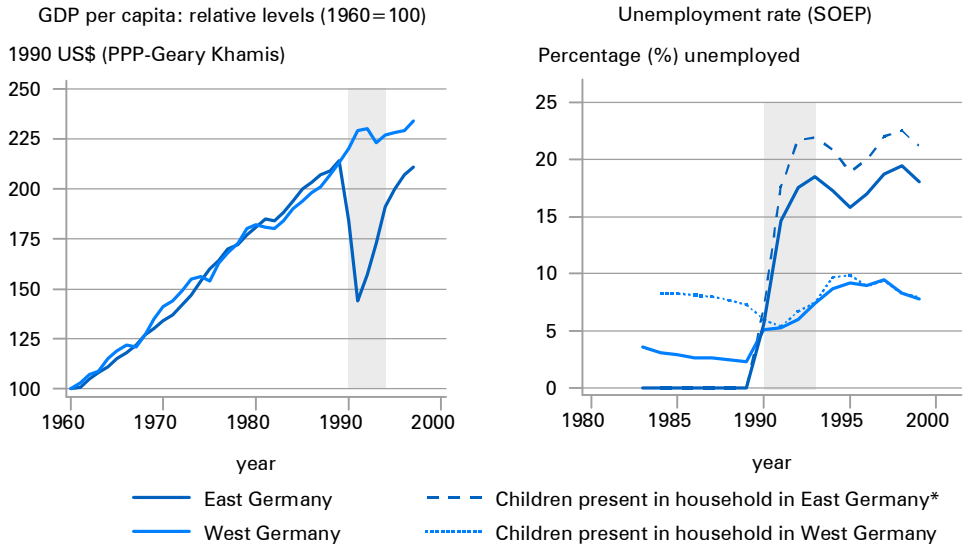
2.4 The post-reunification economic crisis in East Germany and its health effects

In this paper, we study the relationship between exposure to an economic crisis during childhood and adolescence and health in early adulthood using the post-reunification economic crisis in East Germany in the early 1990s. This economic crisis followed the sudden economic restructuring in East Germany following the German reunification in 1990, during which the previously centrally planned East German economy was transformed into a competitive market economy (*Burda/Hunt* 2001). This process caused many East German companies to go bankrupt, resulting in mass unemployment in entire East Germany, where full employment had been a political imperative before the reunification (*Burda/Hunt* 2001; *Chevalier/Marie* 2017).

This significant economic shock in East Germany occurred within a few months and suddenly exposed more than 16 million East Germans to a severe economic crisis that escalated between 1990 and 1994 (*Federal Statistical Office* 2020a). Although West Germany also saw a slight increase in unemployment, the changes were not comparable to the substantially rising unemployment rate in East Germany in combination with the overall decline of the East German economy. Figure 1 illustrates the tremendous economic growth and unemployment rate differences between East and West Germany. We identified the main economic crisis period between 1990 and 1994 with a sudden drop in the gross domestic product (GDP) per capita in 1990 that only recovered to pre-reunification levels in 1995 (Fig. 1, left panel), and a sharp increase in unemployment from 1990 that slightly decreased again in 1995 (Fig. 1, right panel).

The variation in the economic situation between East and West Germany was particularly evident in the unemployment statistics: in 1993, for example, only about 7 percent of the West German population was directly or indirectly affected by unemployment compared to approximately 27 percent of the East German

Fig. 1: Comparison of the GDP per capita and the unemployment rate during pre-reunification period (1960-1989), pre-reunification economic crisis (approx. 1990-1994, in grey) and later years between East and West Germany



Note: Gross Domestic Product (GDP) per capita (1960-1997) in 1990 US$ converted at Geary Khamis purchasing power parity (GK PPP) and compared to 1960 (1960 = 100) (left graph); unemployment rate (1984-1999) for total population and for households, in which children below the age of 16 are present, for East and West Germany. *No unemployment data available for pre-reunification East Germany (1983-1989); however, since full employment was a political imperative in pre-reunification socialist East Germany (cf. *Burda/Hunt* 2001), we assume the unemployment rate from 1983 to 1989 being zero; the grey area indicates years of post-reunification economic crisis in East Germany from 1990-1994.

Source: GDP per capita data from *The Conference Board Total Economy Database*™ (2013); unemployment rates (own calculations) from the German Socio-Economic Panel (SOEP), *Liebig et al.* (2019).

population (*Federal Statistical Office* 2020b; *Hauser* 1996; *Hofer et al.* 1995). The rapid increase in unemployment rates in East Germany was not only a macroeconomic shock but also a completely new experience for East Germans who were not used to unemployment prior to the German reunification, neither its anticipation nor its consequences. Different from the GDP, however, the unemployment rates did not recover after 1994 but established themselves and introduced a decade of futile labour market prospects in East Germany.

Although the post-reunification economic crisis in East Germany was a significant economic shock for the entire East German population, its health effects have received relatively little attention, especially those of children and adolescents exposed to it. Previous research mainly focused on East-West German mortality differences and reported general East German health disadvantages in the older

population (*Grigoriev/Pechholdová* 2017; *Nolte/McKee* 2004; *Vogt* 2013). Some of these health differences can be attributed to the inherently different public health system in pre-reunification East Germany (*Busse/Riesberg* 2005; *Lampert et al.* 2019). However, the role of the post-reunification economic shock in East Germany remains unknown.

The prolonged economic insecurity in East Germany after the reunification and its influence on East Germans' health has been frequently studied (*Berth et al.* 2011; *Easterlin/Plagnol* 2008; *Frijters et al.* 2005). However, these studies mainly focused on short-term health effects for the adult East German population, and the younger population remained largely unresearched. Only two studies addressed the health of younger East Germans. First, *Forkel* and *Silbereisen* (2001) researched East German adolescents' well-being in 1993, i.e., during the post-reunification economic crisis, concerning parental unemployment, parental mood, and family climate. Their results did not indicate significant health disadvantages for East German compared to West German adolescents. However, they adopted a cross-sectional study design, which only provided a snapshot during one year of the post-reunification economic crisis and did not account for individual or family-level confounding or a longitudinal perspective.

Second, *Bister* and colleagues (2022) observed in their recent study increased long-term metabolic health risks of the post-reunification economic crisis. However, they did not consider parental unemployment, i.e., the direct experience of the economic crisis. Thus, the full extent of the long-term mental and physical health consequences of this economic crisis for children and adolescents, particularly concerning the experience of family economic stress, remains unclear.

3 Methods

3.1 Data and sample

We used data from the German Socio-Economic Panel (SOEP) (*Liebig et al.* 2019), a nationally representative longitudinal study of private households in Germany. The survey, which includes more than 25,000 respondents in nearly 15,000 households, has been conducted annually since 1984 in West Germany and 1990 in East and West Germany. With an East German sample compiled already in June 1990, the SOEP is the only longitudinal study enabling the study of East German families during the post-reunification period introducing disrupting political and economic transformation to an entire society (*Liebig et al.* 2019). The SOEP core study contains detailed personal, social, and economic information for all household members aged 16 and older (*Wagner et al.* 2007). To identify the pre- and post-reunification household residence in East or West Germany, we additionally retrieved information from the SOEP regional data (*Knies/Spiess* 2007) (identification of 84.5 percent of the final sample) and the SOEP-RV data linkage with longitudinal data on social security pension records from the German Pension Insurance ("Deutsche Rentenversicherung") (*Lüthen et al.* 2022) (identification of 16.5 percent of the final

sample). These additional data sets complement the comprehensive survey data of the SOEP with objective information from survey metadata (SOEP regional data) and administrative registers (SOEP-RV) and are thus highly reliable.

To summarise, for the purpose of our study we utilised the SOEP survey year of 1990 and the pre-1990 information from the SOEP-RV data link to identify the place of residence at the onset of the post-reunification economic crisis in East Germany (with West Germany as reference); the 1990-1994 SOEP survey years and respective SOEP-RV information to reconstruct the family-level exposure during the economic crisis years; and the 2002-2009 SOEP survey years to retrieve the SF-12 variables informing on physical and mental health. Thereby, the SOEP enabled us to study the long-term physical and mental health of a vastly understudied population, i.e., East German cohorts experiencing the post-reunification economic crisis as children or adolescents. The SOEP thereby aided in depicting the long-term health consequences of exposure to extreme economic stress for these cohorts and their families. Subsequently, our premise in the sample selection was to obtain as large a sample as possible with high statistical power to address our objective.

We restricted our sample to respondents born between 1973 and 1989, i.e., those who were between zero and 17 years old at the onset of the post-reunification economic crisis in 1990. We refrained from including individual respondents born after the onset of the post-reunification economic crisis to avoid bias due to birth selection in post-reunification East Germany (cf. *Adler* 1997; *Huinink/Kreyenfeld* 2006). We only considered respondents with, first, at least one parent included as a respondent themselves in the SOEP and, second, the parental household residence in either East or West Germany before the German reunification. Since neither the SOEP regional data nor the SOEP-RV differentiates between East and West Berlin, we excluded Berlin. Subsequently, our final sample consisted of N = 2,337 individuals from East (n = 982, 42.0 percent) and West Germany (n = 1,355, 58.0 percent) (see Table 1 for sample description and Figure S1 for sample selection).

3.2 Health outcome variables

We measured two dependent variables indicating the physical and mental health of the respondents using the SF-12 summary scores for physical and mental health functioning (SF-12) (SOEP-version, see *Andersen et al*. 2007 and Appendix page 37). The SF-12 physical (PCS) and mental component scores (MCS) were computed from eight domains: namely, physical role limitation, general health perception, vitality, bodily pain, physical functioning, social function, socio-emotional role limitations, and mental health (*RAND Corporation* 2020). The SF-12 is known as a valid and reliable tool for assessing physical and mental health based on subjective health measures (*Andersen et al*. 2007; *RAND Corporation* 2020) and has previously been used to measure health functioning in adolescents aged 13-19 and young adults aged 20-23 (cf. *Ge et al.* 2019; *Jörngården et al.* 2006; *Moscarelli/Manning* 2009) on a scale from zero (poor health) to 100 (good health) (*Turner-Bowker/Hogue* 2014).

We included both the PCS and the MCS as continuous variables observed once per respondent at the earliest available age in young adulthood to avoid unobserved

Tab. 1: Sample description of the unbalanced sample (i.e., with no balancing weights from entropy balancing applied) of the full N = 2,337 sample

Variable	Mean / %	Std. dev.	Min	Max
Health outcomes during early adulthood (using SF-12)				
Mental Component Score (MCS)+	49.56	9.56	13.17	71.81
Physical Component Score (PCS)+	56.18	6.49	13.63	73.61
Age at SF-12 in years	21.00	3.60	17	30
Parental household residence before the German reunification (%)				
West Germans (n = 1,355)	57.98%			
East Germans (n = 982)	42.02%			
migrated to West Germany*	29.74%			
stayed in East Germany*	70.26%			
Parental unemployment 1990-94 (%)				
Total	31.66%			
West German (n = 1,355)	20.52%			
East German (n = 982)	47.05%			
Demographics				
Birth year	1982.23	4.51	1973	1989
Female (%)	50.02%			
Age at onset of the economic crisis (1990)	7.7 7	4.51	0	17
in age groups in 1990 (%)				
Infancy (aged 0-2)	21.31%			
Early childhood (aged 3-5)	22.12%			
Childhood (aged 6-11)	38.30%			
Adolescence (aged 12-17)	18.27%			
Number of siblings	1.49	1.26	0	9
Mother's age at birth in years	25.97	5.05	12	48
Same residence region at health outcome	91.62%			

+ SF-12 Physical Component Score (PCS) and Mental Component Score (MCS) are scale measures that may potentially range from 0 (poor health) to 100 (very good health).

* Percentage of East German subsample migrating to West Germany or staying in East Germany during the 1990s.

Source: German Socio-Economic Panel (SOEP) and SOEP-RV link

heterogeneity due to the accumulation of additional health risks over their adult life. Specifically, we measured the respondents' health outcomes between ages 17 (the minimum response age for the health measure) and 30 (the earliest available response age for the 1973 cohort in 2002).

3.3 Main explanatory variables

We measured the experience of the post-reunification economic crisis in East Germany using two variables, namely the region of the pre-reunification residence and the experience of migration to West Germany. For the first measure, we created

a binary variable indicating the respondents' parental pre-reunification residence in East Germany (reference: West Germany) identified by either their household residence retrieved from the SOEP regional data or by their employment location retrieved from the SOEP-RV data (see Data and sample).

For the second measure of migration from East to West Germany, we created a binary variable indicating the migration from the pre-reunification residence in East or West Germany to the opposite region (reference: no migration) between 1990 and 1994. With this measure, we aimed to consider the large share of East Germans migrating to West Germany during the early 1990s (*Heiland* 2004), which undeniably shortened the exposure period to the post-reunification economic crisis in East Germany. We included this measure as an interaction with the exposure to the post-reunification economic crisis to account for the sole exposure to the initial post-reunification economic shock (i.e., the initial region of residence in East Germany and subsequent migration to West Germany (*Liebig et al.* 2019) and shortened exposure to an economic crisis), or full exposure to the severe economic crisis in post-reunification East Germany (i.e., no migration).

We further assessed the respondents' family's direct exposure to the economic crisis by including a binary variable on their experience of any spell of parental unemployment during the economic crisis period between 1990 and 1994 (reference: no parental unemployment). We base this information on paternal and maternal unemployment spells between January 1990 and December 1994. We retrieved these from parental employment biographies in either the SOEP core study for households that entered the SOEP in 1990 or earlier or the social security pension records (SOEP-RV) for households that entered the SOEP later than 1990. We interacted the parental-unemployment variable with the above-mentioned binary variable indicating the respondent's parental pre-reunification residence to account for different meanings in parental unemployment during the post-reunification economic crisis period between East and West Germany.

3.4 Control variables

As control variables, we included first, a categorical measure for the exposure age at the onset of the post-reunification economic crisis in 1990 with categories of "Infancy" (age 0-2, reference), "Early childhood" (age 3-5), "Childhood" (age 6-11), and "Adolescence" (age 12-17); second, a continuous measure for the number of siblings; third, the respective other SF-12 PCS or MCS value to control for the reciprocal influence of physical and mental health; and, fourth, a continuous measure for the mothers' age at first childbirth, z-standardised for East and West Germany respectively.

The final control variable served as proxy for the respondents' socio-economic background. More commonly used measures such as the parental education comparably showed many missing values for our sample (see Table A1) or relied on respondent-reported approximations (see Fig. A2). To maintain a larger sample and achieve higher statistical power, we therefore decided to measure the socio-economic background using the mothers' age at first childbirth. This measure has

been used before as a proxy for socio-economic background (*van Roode et al.* 2017) and general effects on later-life health outcomes (*Carslake et al.* 2017). We, however, tested the robustness of our variable selection in a sensitivity analysis replacing mothers' age at first childbirth with the highest parental education leading to nearly congruent results and thus confirming our modelling choice (see Fig. A2).

Moreover, the included control variable of the exposure age at the onset of the post-reunification economic crisis in 1990 additionally captures the respondents' ages at the health outcome assessment and thereby partially accounts for the monitoring gap between the exposure and the health outcome assessment. Corresponding to the SF-12, the survey questions were roughly collected at the same time for the vast majority of our sample, i.e., in the years of 2002 (n = 1,549, 66.3 percent), 2004 (n = 427, 18.3 percent), and the years thereafter (n = 361, 15.4 percent). With a collinearity coefficient of 0.7847 ($p<0.0001$), the exposure age to the economic crisis should thereby reflect on the age at the respondents' SF-12 assessment.

3.5 Analytical approach

In our analysis, we proceeded in two steps (Table 2). In Step 1, we applied entropy balancing to adjust the covariate distribution of the control group data (i.e., the West German sample) by re-weighting the observations to improve the comparability of both groups regarding the covariate distribution in the treatment group (i.e., the East German sample). Based on known sampling moments, entropy balancing improves the covariate balance and helps to adjust survey samples to the known characteristics of a target population (*Hainmueller* 2012). We calculated the entropy balancing sample weights in StataSE 17 using "ebalance" (*Hainmueller/Xu* 2013). We matched the East and the West German respondents on (1) their parental unemployment experiences, (2) their birth year, (3) their gender, (4) their age at the SF-12 survey, (5) their number of siblings, and (6) their mothers' maternal age at childbirth (z-standardised for East and West German samples separately) (see Table A1 for matching statistics).

Using the obtained sampling weights, we re-weighted the observations for the analysis in Step 2. With this re-weighting strategy, we refrained from achieving results representative of the East and West German population structure. However, we aimed to obtain two comparable samples (in at least the specific attributes used) and enable the isolation of the exposure effect of the post-reunification economic crisis.

In Step 2 of our analysis, we applied conditional quantile regression with a re-weighted sample using the entropy balancing weights from Step 1 (Table 2). Conditional quantile regression is an extension of linear regression and estimates the conditional mean within a quantile of a response variable across the values of a predictor variable. Specifically, we used conditional quantile regression to identify the heterogeneous effects of the experience of the post-reunification economic crisis on physical (PCS) and mental health (MCS) for the quantiles of their respective distribution. We decided for quantile regression as our main analytical strategy,

Tab. 2: Overview of the analytical strategy using entropy balancing (Step 1) and conditional quantile regression (Step 2)

Used measures	Step 1: Entropy balancing	Step 2: Conditional quantile regression models
Aim	To balance the sample to improve the comparability of the East and the West German subsamples.	To obtain the predicted average change in SF-12 measures for quantiles of the PCS/MCS distribution applying sample weights from Step 1.
SF-12 PCS SF-12 MCS	*[No conditioning on SF-12 measures in Step 1.]*	Health outcome variables
Pre-reunification residence (X)	*"Treatment" measure*	(Main) explanatory variables
Internal East-West migration Parental unemployment Age at economic crisis	Variables used for matching → predictors conditioning the treatment probability	
Gender Age at SF-12 assessment Maternal age at first childbirth		Control variables
N	2,337	2,337

Note: SF-12 summary score for health functioning shown as physical (SF-12 PCS) and mental component scores (SF-12 MCS); other measures correspond to descriptions in Health outcome variable and Main explanatory variables.

Source: Own design

as it allows to estimate a linear relationship while accounting for different slopes depending on the quantile in the outcome variable distribution. It thereby allows for a more efficient inclusion of data outliers compared to mean-based regression techniques such as ordinary least squares regression (cf. *Rios-Avila/Maroto* 2022). Specifically, we suggested that the effect of the experience of the post-reunification economic crisis in East Germany during childhood and adolescence on the young adult physical (PCS) and mental health outcomes (MCS) differed over different quantiles of the conditional distribution. Therefore, we fit quantile regression at the 20th, 40th, 60th, and 80th percentiles of the conditional distribution of the exposure to the economic crisis in East Germany on both health outcomes PCS and MCS.

4 Results

4.1 Descriptive results

We observed in two-sample t-tests that East Germans scored on average 0.3 units lower in the PCS ($p=0.2440$) and 2.2 units significantly lower in the MCS ($p<0.001$) compared to the West German sample. The descriptive analysis further

showed that 47.0 percent of the East German respondents experienced parental unemployment between 1990 and 1994, which was significantly higher than the West German respondents with 20.5 percent ($p<0.001$). The health scores for those who experienced parental unemployment between 1990 and 1994 were significantly lower with 1.19 units for the PCS ($p<0.001$) and 0.95 units for the MCS ($p<0.5$) for the total sample. However, we only found significantly lower health scores for East Germans who experienced parental unemployment during that time for the PCS (1.68, $p<0.001$), yet not for the MCS (0.33, $p=0.6015$).

Table 3 shows the differences in early adult physical and mental health of the East German sample compared with the West German sample over the 20 percent, 40 percent, 60 percent and 80 percent quartiles of the distribution using mean difference testing (t-test results). Again, we observed no significant difference between the PCS of the East and West German samples across all quantiles, with lower PCS only in the 60 percent and 80 percent quantiles. The MCS, however, were smaller for the East German sample across all quantiles, with significant differences at the 5 percent level for the 60 percent and 80 percent quantiles, indicating health differences especially among those respondents at the upper end of the distribution of mental health scores.

Tab. 3: Differences in early adult physical and mental health of the East German sample compared with the West German sample over the 20 percent, 40 percent, 60 percent and 80 percent quartiles of the PCS/MCS distribution

Quantile	20%	40%	60%	80%
Means per subsample				
	Physical Component Score (PCS)			
West German	45.51	50.23	52.70	54.63
East German	46.57	50.33	52.58	54.30
p-value (T-test)	0.0547	0.8084	0.7001	0.2350
	Mental Component Score (MCS)			
West German	35.08	40.50	*44.24*	*47.28*
East German	34.33	39.65	*43.30*	*45.88*
p-value (T-test)	0.1525	0.0548	*0.0217*	*0.0003*

Note: Mean differences (t-test results) of the health outcome variables SF-12 Physical Component Score (PCS) and Mental Component Score (MCS) over 20 percent, 40 percent, 60 percent and 80 percent quartiles of the distribution for the full N = 2,337 sample (no weighting applied). Annotations: italic font indicates significant differences ($p<0.05$) between West German and East German quantile-specific mean.

Source: German Socio-Economic Panel (SOEP) and SOEP-RV link

To fully understand how the experience of the post-reunification economic crisis in East Germany during early life shaped individuals' physical and mental health in early adulthood, we turned to the multivariate analysis.

4.2 Regression results

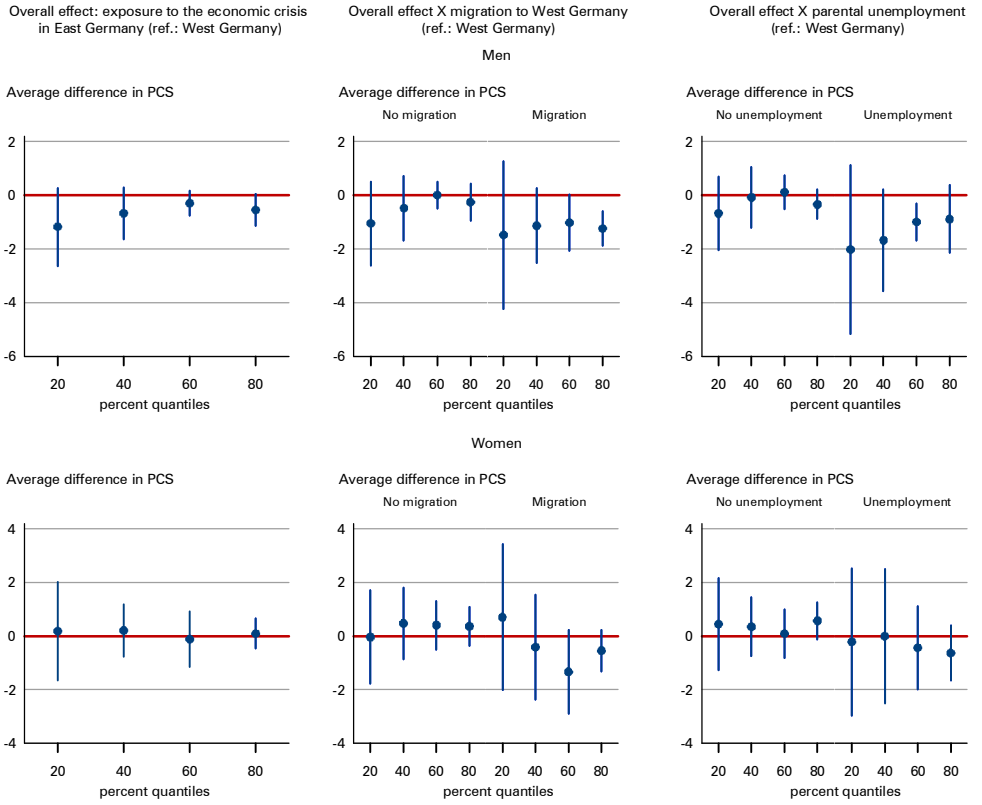
Figures 2 and 3 present the association between the experience of the post-reunification economic crisis during early life and early adult physical (PCS) and mental (MCS) health outcomes, along with the distribution of PCS and MCS (as average marginal effects, complete regression and effect tables available in Tables A3). In doing so, we structured our main results around three aspects, for physical and mental health outcomes respectively: first, the general experience of the onset of the economic crisis in 1990 (indicated by the birthplace in East or West Germany prior to the German reunification in 1990); second, the exposure to the post-reunification economic crisis throughout its duration from 1990 to 1994 (indicated by an interaction of the birthplace and an East-West migration during the economic crisis years); and third, the experience of parental unemployment between 1990 and 1994.

First, we present our results on the general experience of the onset of the economic crisis in 1990 (research question 1). The quantile regression showed lower PCS for East German men across all quantiles ranging from -1.2 in the 20 percent quantile to -0.3 in the 60 percent quantile lower PCS compared to West German men. Nevertheless, none of the effects were statistically significantly different from zero ($p>0.05$). We observed almost no difference in PCS for East German women compared to West German women (Fig. 2). For MCS (Fig. 3), we found consistently lower scores for East German men and women than their West German counterparts. MCS differences for men ranged from -0.8 in the 80 percent quantile to -2.6 in the 60 percent quantile lower for East Germans, with significant effects at the 5 percent level only for the 60 percent quantile ($p<0.01$). For women, the MCS were from -2.0 in the 20 percent quantile to -3.4 in the 40 percent quantile lower for the East German samples, with statistically significant effects at the 5 percent level for the 40 percent ($p<0.01$), 60 percent and 80 percent quantiles ($p<0.001$).

Second, we show our findings on the exposure to the post-reunification economic crisis, which showed increased East-West migration (research questions 1). The quantile regression results for the region of birth in East Germany that interacted with migration to West Germany showed no significant differences for PCS in men and women who migrated and did not migrate compared to their West German counterparts (Fig. 2). For MCS (Fig. 3), we observed significant effects at the 5 percent level for East German men only for those exposed to the economic crisis throughout its duration (i.e., no migration), with effects ranging from -1.5 in the 80 percent quantile to -3.1 in the 60 percent quantile decreased MCS, all statistically significant ($p<0.05/p<0.01$) except for the 20 percent quantile. For East German women, we found significant effects at the 5 percent level on the MCS for those who did and did not migrate to West Germany with similar effects.

Third, we assessed the experience of parental unemployment during the economic crisis years between 1990 and 1994. The quantile regression results for the region of birth in East Germany that interacted with parental unemployment experience in the respective period revealed no statistically significant effects at the 5 percent level for PCS (Fig. 2), neither for East German men nor women. However,

Fig. 2: Overall effect of the exposure to the post-reunification economic crisis in East Germany on physical health scores (SF-12 PCS) over four quantiles (20 percent, 40 percent, 60 percent and 80 percent) of the PCS distribution, estimated from conditional quantile regression models

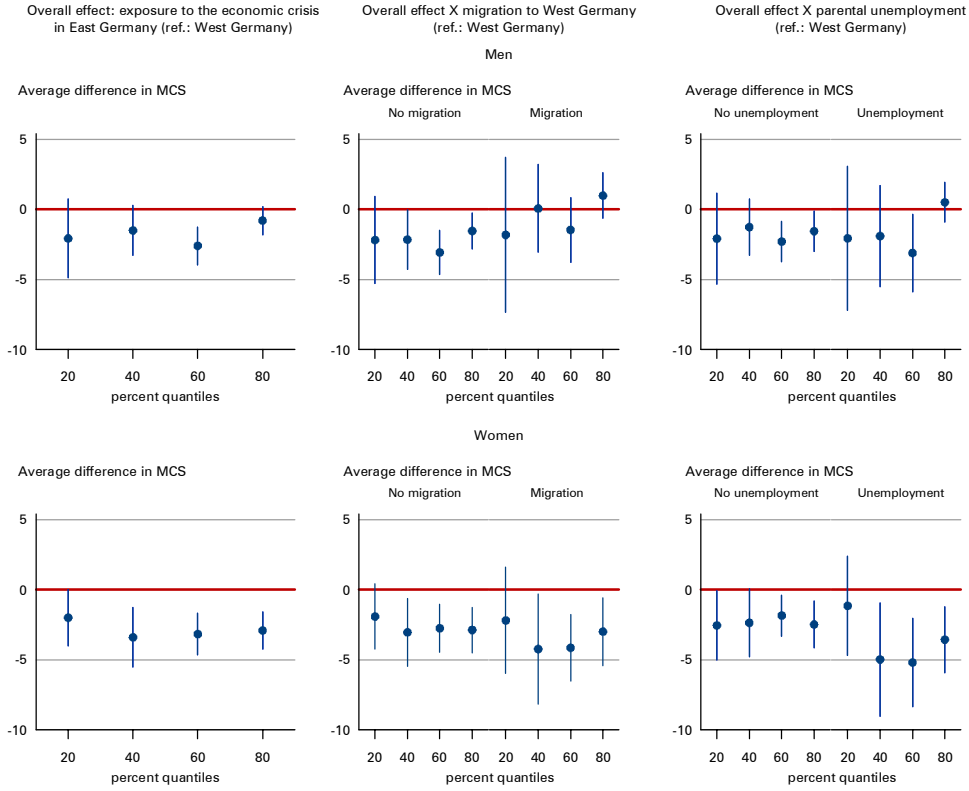


Note: Reference for each effect is pre-reunification residence in West Germany. Effects were calculated based on quantile regression models adjusted for East-West Germany migration and parental unemployment (both interacted with the pre-reunification residence), age at onset of the post-reunification economic crisis, children's gender, their age at SF-12 assessment, and their mother's age at first childbirth. See Tables A3 for full regression and effect tables.

Source: German Socio-Economic Panel (SOEP) and SOEP-RV link

the PCS of East German men experiencing parental unemployment was slightly lower than those who did not experience parental unemployment. The effects on the PCS in women tended towards zero. For MCS (Fig. 3), we found an overall trend of lower scores for both East German men with and without experience of parental unemployment during the economic crisis, with most scores not statistically significant. Similarly, the MCS for women were also overall lower for those who did and did not experience parental unemployment compared to their West German counterparts. However, the effects for those who experienced parental

Fig. 3: Overall effect of the exposure to the post-reunification economic crisis in East Germany on mental health scores (SF-12 MCS) over four quantiles (20 percent, 40 percent, 60 percent and 80 percent) of the MCS distribution, estimated from conditional quantile regression models



Note: Reference for each effect is pre-reunification residence in West Germany. Effects were calculated based on quantile regression models adjusted for East-West Germany migration and parental unemployment (both interacted with the pre-reunification residence), age at onset of the post-reunification economic crisis, children's gender, their age at SF-12 assessment, and their mother's age at first childbirth. See Tables A3 for full regression and effect tables.

Source: German Socio-Economic Panel (SOEP) and SOEP-RV link

unemployment were far larger compared to those who did not, ranging from -1.2 in the 20 percent quantile to -5.2 in the 60 percent quantile, with statistically significant effects at the 5 percent level for all ($p<0.05/p<0.01$) except the 20 percent quantile.

5 Discussion

5.1 Summary of results

This study analysed the relationship between exposure to the economic crisis in post-reunification East Germany during infancy, childhood and adolescence (ages 0-17) and physical and mental health in early adulthood (ages 17-29). We sought to investigate (1) the general physical and mental health responses to the experience of an economic crisis while exploring the influence of the initial economic shock immediately after the German reunification in 1990 and the following economic crisis in the early 1990s, and (2) the influence of parental unemployment during this economic crisis, i.e., the direct exposure to this economic crisis.

Our results indicate no significant early-adult physical health effects of the post-reunification economic crisis for East German-born men and women compared to their West German counterparts. However, we observed significantly worse mental health in East German men and women, especially among women of average and better mental health. Furthermore, when differentiating between the experience of the initial economic shock of the post-reunification economic crisis and the experience of the subsequent economic crisis from 1990 to 1994 (using an indicator of migration to West Germany), we only found significantly lower mental health for East German men who experienced the economic crisis throughout its duration. We further found significantly lower mental health for East German women who experienced parental unemployment during the post-reunification economic crisis compared to their West German counterparts, especially for those of average and better mental health.

5.2 Discussion of results

Our findings emphasise the adverse long-term mental health effects of early-life economic adversities. In line with previous research, this result confirms our hypothesised negative relationship between early-life exposure to the economic crisis and early-adult health, as derived from previous research on immediate health and stress responses of children and adolescents to economic crises (*Anagnostopoulos/Soumaki* 2013; *Cui/Zack* 2013; *Rajmil et al.* 2013).

Furthermore, our study provides evidence that women in particular carry the long-term mental health consequences after experiencing an economic crisis early in life, both in general and through parental unemployment at the family level. These findings align with prior studies showing stronger reactions to external stressors in women than in men and increased hormonal and physical dysregulation (*Dedovic et al*. 2009), which may also affect their mental health. Similarly, *Bister* and colleagues (2022) observed significantly worse (metabolic) health outcomes in East German than West German young women, but not for men. Similar to the results presented in this study, early-life experiences of distress in the family environment might drive these adverse health outcomes for women.

Our findings on the relevance of parental unemployment during an experience of an economic crisis suggest an accumulation of mental health risks from infancy to young adulthood rooted in economic stress (cf. *Lindström et al*. 2012, 2014). As previous research has unambiguously shown, the health hazard for children in settings of economic stress, both in the short- and in the long-term (*Lindström et al.* 2012; *Moustgaard et al.* 2018; *Nikolova/Nikolaev* 2021), is nested in their families (cf. family stress model, *Masarik/Conger* 2017). Our investigation of the family experience of the economic crisis, i.e., parental unemployment, showed negative associations with early-adult mental health, corresponding to insights from recent research on health consequences of childhood economic crises (cf. *Briody* 2021; *Cui/Zack* 2013; *Rajmil et al*. 2013) and on children's immediate mental health and long-term stress dysregulation consequences of experiencing economic hardship (*Evans/Kim* 2007; *Solantaus et al.* 2004).

Unlike literature assessing longer-term physical health effects of early-life exposure to economic stress (cf. *Alessie et al*. 2019; *van den Berg et al.* 2011), our results show little to no evidence for physical health effects of the post-reunification economic crisis in East Germany. We should acknowledge the nature of our chosen health outcome: the SF-12 assesses physical and mental health functioning but not its causes (*RAND Corporation* 2020). Subsequently, we might underestimate the actual effects of the economic crisis on physical and mental health, as only their expression in health functioning was analysed. Concerning the young age of our sample, we might expect more far-reaching health consequences in the longer term.

However, we also found significantly lower physical and mental health among East German men and women who migrated to West Germany during the early 1990s compared to West German respondents who did not migrate. This result might indicate that the initial economic shock of the reunification in East Germany explains the adverse early-adult health outcomes of those affected better than the consequent economic crisis itself. Hence, the experience of the economic and political shock in East Germany accompanying the German reunification might be the common denominator in both East German groups, those who did migrate to West Germany and those who remained in East Germany.

On the other hand, we acknowledge that the adaptation process that families had to go through who migrated from East to West Germany might have negatively contributed to the physical and mental health of their children, and potentially have cancelled out the health benefits gained by withdrawing from the economic crisis though moving to West Germany. Prior studies provide evidence for adverse physical and mental health effects of residential relocation experienced during early life (cf. *Simsek et al.* 2021; *Tseliou et al.* 2016) and we cannot exclude the existence of additional stressors related to the migration to West Germany (cf. *Kley* 2013; *Rosenbaum-Feldbrügge et al.* 2022). At the same time, the relocation to West Germany implied the escape from the economic crisis in East Germany that potentially led to a decline in economic stress in the parents and had an alleviating effect on the children. In addition, a positive health selection was observed among East-West German migrants (cf. *Westphal* 2016) indicating that the respective

children and adolescents likely belonged to families that were able to mitigate negative consequences of the move.

5.3 Strengths and limitations

Our study is the first to investigate the association between economic crises during infancy, childhood and adolescence and early-adult physical and mental health in post-reunification East Germany. We paid particular attention to the role of family stress by assessing parental unemployment during the economic crisis. Our data source, the data link between the German Socio-Economic Panel (SOEP) survey and social security pension records (SOEP-RV), allows us to identify the exposure to the economic crisis studied (i.e., the family household residence when the initial economic shock happened right after the German reunification in 1990 as well as throughout the economic crisis from 1990 to 1994), to reconstruct economic family conditions during the economic crisis through linked parental unemployment information, and to obtain health information of our respondents in early adulthood. We are among the first to utilise this new and unique linkage between the SOEP and the pension registers. Furthermore, given that West Germany did not experience the post-reunification economic crisis, we can utilise the quasi-experimental situation of the East German respondents experiencing a treatment with the West German respondents serving as a control group (under the application of advanced methods of sample weighting).

Nonetheless, our study has some data-driven limitations.

First, we used the SF-12 score for physical and mental health functioning, a self-reported health measure. The SF-12 is calculated following a validated and population-based algorithm (*Andersen et al.* 2007), which may lead to lacking comparability with other studies. We further acknowledge potential biases in our results due to cultural differences in health perceptions between East and West Germany (*Lampert et al.* 2019) and – probably to a lesser extent due to the young age of our study population – inherently different public health systems in pre-reunification East and West Germany (*Busse/Riesberg* 2005; *Lampert et al.* 2019). On the other hand, the converging cultural and living conditions as well as having spent a large part of their lives in reunified Germany may also have led to further convergence in the answers to the health questions in the SOEP between the East and the West German respondents. Accordingly, East Germans might – to a certain extent – have underreported their health-related restrictions, potentially leading to an underestimation of the health consequences of the post-reunification economic crisis for East Germans (cf. *Nolte/McKee* 2004).

Second, the SOEP does not consider all of the potential effects of the post-reunification economic crisis in East Germany, including developmental information during the post-reunification economic crisis on all cohorts we are observing. Since the SOEP only includes individual respondents from age 17 onwards, we faced a substantial monitoring gap between exposure to the economic crisis and measuring the health outcomes. Subsequently, our results may suffer unobserved heterogeneity (cf. *Schmiedeberg/Bozoyan* 2021), and the observed effect of the

economic crisis may be partially underestimated due to prevailing East-West German health perception differences. Furthermore, we potentially underestimated the health impact over the years due to the reunification gains in East Germany, i.e., improved economic perspective for younger generations (cf. *Forkel/Silbereisen* 2001). While we cannot analytically consider these aspects, they should be kept in mind when interpreting our results.

Although we considered the exposure to parental unemployment, the experience of this economic crisis may have varied enormously with the family's socio-economic status, e.g., parental education. As previous studies have shown, children in families with higher education show fewer adverse health effects of an economic crisis (*Rajmil et al.* 2013). Unfortunately, we were unable to consider parental education due to many missing values in the respective measures (see Table A1). We approximated the socio-economic background by adding the mothers' age at the child's birth, yet, acknowledge that the omission of parental education might have led to an underestimation of the adverse health effects of exposure to the economic crisis.

5.4 Conclusion and implications

Despite some limitations, we conclude that, in line with our hypotheses, the exposure to the post-reunification economic crisis in East Germany during infancy, childhood and adolescence was associated with lower mental health for women, especially for those who experienced parental unemployment during the economic crisis period. We thereby emphasise the relevance of this direct exposure to severe economic stress for girls regarding their later-life mental health.

Although we did not observe any statistically significant effects for men (although most point estimates were below zero), we cannot exclude an influence of severe early-life economic stress in boys (e.g., on other health outcomes such as health behaviour or behavioural problems). Nevertheless, our findings deliver insights into the long-term health development of the currently understudied East German reunification cohorts. In addition, our findings suggest long-term health disadvantages for those experiencing severe economic stress during early life, implying a double burden to these populations.

Future research should therefore follow the East German reunification cohorts to monitor their health development throughout their adulthood, as the early-adult health disadvantages may translate into worse physical and mental health at older ages. On a more general note, our results once again urge policy makers to especially focus on the support of directly affected families in times of economic crisis and implicate early prevention methods for children and adolescents exposed to these economic adversities protecting their long-term mental health.

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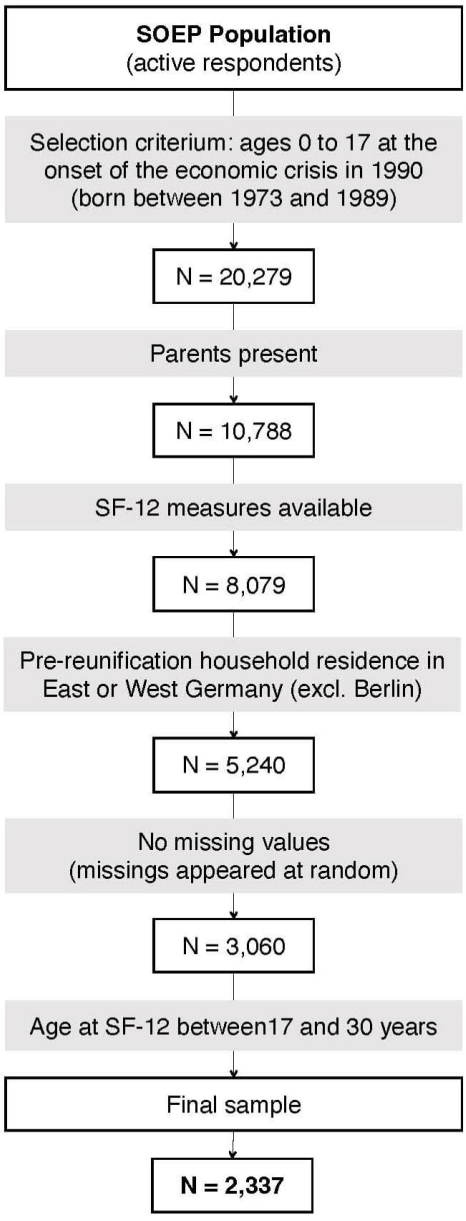
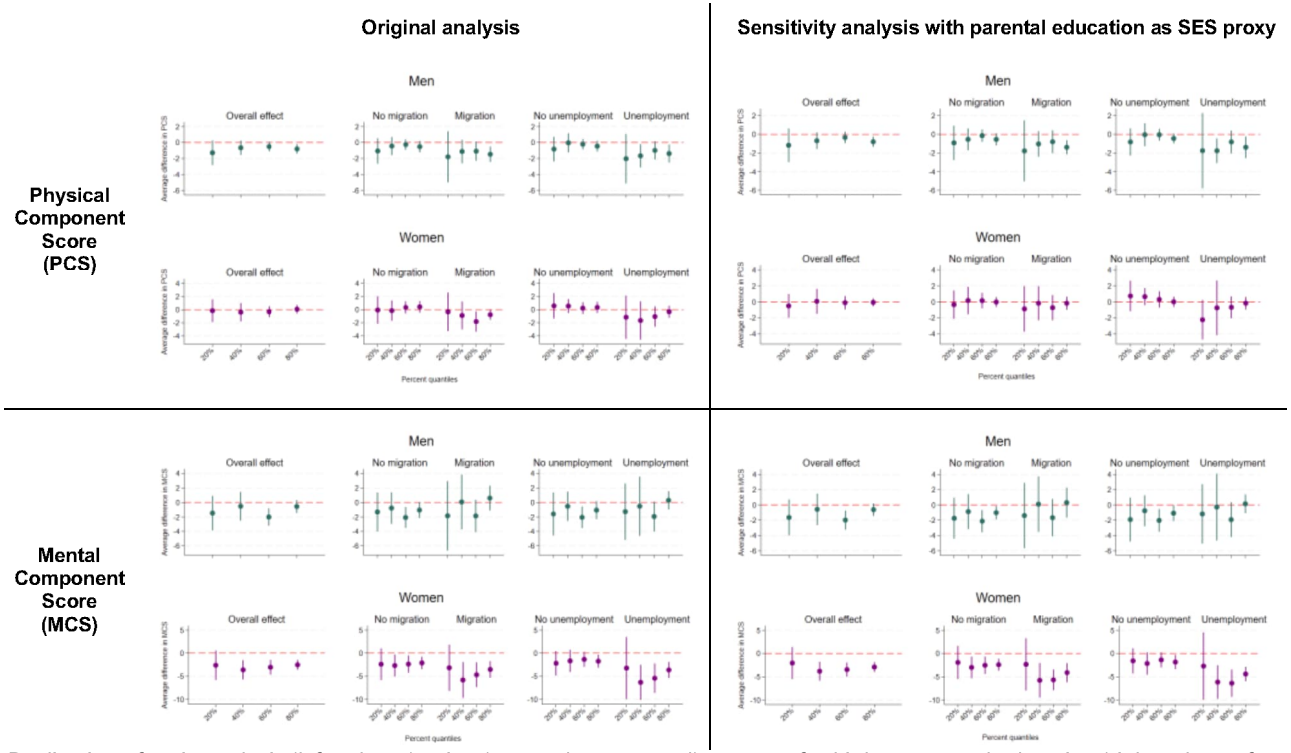
Appendix

Fig. A1: Sample selection of the used sample in the analysis derived from the SOEP population (active respondents only)



Source: German Socio-Economic Panel (SOEP) and SOEP-RV link

Fig. A2: Results sensitivity analysis using (respondent-reported) parental highest education as a proxy for the socioeconomic status instead of mothers' age



Note: Replication of main analysis (left column) using (respondent-reported) measure for highest parental education (right column, from SOEP data set bioparen) (N=2,198). Measure consists of information on the maternal and paternal school and professional education degrees, combined in line with ISCED-based categories: (1) no formal education, (2) lower secondary education, (3) upper secondary education, (4) post-secondary education, or (5) tertiary education. Distribution of highest parental education: n=84 respondents (3.8 percent) had parents with a secondary school education only, n=1,786 (81.3 percent) with post-secondary (non-academic) professional education and n=328 (14.9 percent) with tertiary (academic) professional education.

Source: German Socio-Economic Panel (SOEP) and SOEP-RV link

Tab. A1: Missing values in highest parental education variable (SOEP data set *pl*)

Highest parental education (ISCED)	West Germany		East Germany		Total	
ISCED 1	9	0.66%	0	0.00%	9	0.39%
ISCED 2	4	0.30%	0	0.00%	4	0.17%
ISCED 3	1	0.07%	1	0.10%	2	0.09%
ISCED 4	154	11.37%	259	26.37%	413	17.67%
ISCED 5	30	2.21%	18	1.83%	48	2.05%
ISCED 6	0	0.00%	3	0.31%	3	0.13%
Missing	1,157	85.39%	701	71.38%	1,858	79.50%
Total	1,355		982		2,337	

Note: percentages show column percentages, ISCED levels are in accordance with ISCEDv1997.

Source: German Socio-Economic Panel (SOEP) and SOEP-RV link

Tab. A2: Missing values in highest parental education variable (SOEP data set *pl*)

Sample group:		Treatment			Control (before matching)			Control (after matching)	
Matching variables:	Mean	Variance	Skewness	Mean	Variance	Skewness	Mean	Variance	Skewness
East-West migration	0.297	0.209	0.887	0.261	0.193	1.087	0.297	0.209	0.887
Parental unemployment	0.130	0.036	1.672	0.054	0.021	4.051	0.130	0.068	2.294
Birth year	1982	19.93	-0.301	1982	20.63	-0.367	1982	19.8	-0.392
Year of SF-12	2003	4.23	2.226	2003	5.213	2.445	2003	4.539	2.537
Gender: female	0.489	0.250	0.045	0.509	0.250	-0.034	0.489	0.250	0.045
Number of siblings	1.269	1.137	1.606	1.647	1.834	1.607	1.27	1.086	1.223
Mother's age in years	25.11	21.79	0.904	26.6	27.32	0.52	25.11	23.8	0.608

Note: Entropy balancing sample weights were calculated in StataSE 17 using "ebalance" (*Hainmueller/Xu* 2011: Ebalance: A Stata Package for Entropy Balancing. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.1943090). Matching of the treatment sample (East German born individuals) and the control sample (West German born individuals) using measures of East-West migration, parental unemployment between 1990 and 1994, birth year, year of SF-12 assessment, gender (male and female), number of siblings, mother's age at birth. Convergence achieved after eleven iterations of balancing optimisation with maximum difference between treatment and control groups of 0.002991999. A total of 982 sampling weights achieved.

Source: German Socio-Economic Panel (SOEP) and SOEP-RV link

Tab. A3.1-A3.4: Quantile regression tables and average marginal effect tables (N = 2,337)
Tab. A3.1: Quantile regression results on SF-12 Physical Component Score (PCS) (N = 2,337)

	Men Quantiles				Women Quantiles			
Variables	20%	40%	60%	80%	20%	40%	60%	80%
Born in East Germany	-0.553	0.110	0.416	-0.0583	0.954	0.227	0.616	0.617
(ref.: West Germany)	(0.803)	(0.730)	(0.360)	(0.346)	(0.633)	(1.099)	(0.695)	(0.545)
East-West Migration	-0.221	0.252	0.191	-0.0344	0.859	-0.456	1.168	1.367**
(ref.: no migration)	(1.029)	(0.618)	(0.460)	(0.281)	(0.709)	(1.037)	(0.768)	(0.587)
Born in East Germany X Migration								
East X Migration	-0.432	-0.658	-1.030*	-0.983***	-1.192	0.737	-0.886	-1.736*
	(1.516)	(0.905)	(0.607)	(0.381)	(0.930)	(1.645)	(1.107)	(0.894)
Born in East Germany X Parental unemployment (1990-94)								
West X Unemplyoment	0.0657	0.269	-0.163	-0.577	-0.248	-1.355	-1.036	-0.191
	(1.632)	(0.962)	(0.307)	(0.651)	(0.935)	(1.041)	(1.070)	(0.730)
East X Unemplyoment	-1.275**	-1.329**	-1.269***	-1.121***	-1.113	-2.014	-1.390	-0.721
	(0.628)	(0.659)	(0.360)	(0.251)	(0.712)	(1.312)	(0.862)	(0.545)
Age in 1990 (ref.: Infancy (age 0-2))								
Early childhood (age 3-5)	0.650	0.261	0.0786	-0.0344	0.672	0.184	0.350	0.197
	(0.919)	(0.555)	(0.406)	(0.256)	(0.647)	(0.952)	(0.676)	(0.560)
Childhood (age 6-11)	0.819	0.648	-0.199	-0.168	0.713	0.381	0.837	0.470
	(0.916)	(0.536)	(0.396)	(0.280)	(0.606)	(0.886)	(0.562)	(0.535)
Adolescence (age 12-17)	-0.490	-0.654	-0.923*	-1.106**	0.0325	-3.107**	0.306	-0.260
	(1.171)	(0.703)	(0.530)	(0.436)	(0.761)	(1.458)	(1.151)	(0.677)
Number of siblings	-0.189	-0.0294	-0.0205	-0.0233	0.267	-0.428	0.175	0.193
	(0.263)	(0.203)	(0.0868)	(0.113)	(0.208)	(0.396)	(0.242)	(0.148)
SF-12 MCS	0.0538	-0.0464*	-0.105***	-0.174***	0.0141	0.163***	0.0597*	-0.0170
	(0.0385)	(0.0262)	(0.0175)	(0.0136)	(0.0271)	(0.0406)	(0.0341)	(0.0245)
Mother's age (z-std.)	0.172	0.231	0.215**	0.118	0.453**	0.173	0.528**	0.229
	(0.270)	(0.210)	(0.0909)	(0.0991)	(0.199)	(0.376)	(0.266)	(0.170)
Constant	50.48***	58.94***	64.62***	70.53***	55.66***	44.72***	52.12***	58.83***
	(2.338)	(1.524)	(1.090)	(0.819)	(1.580)	(2.309)	(2.068)	(1.458)
Observations	1,168	1,168	1,168	1,168	1,169	1,169	1,169	1,169

Note: Robust standard errors in parentheses. Significance levels: *** p<0.001, ** p<0.01, * p<0.05.
Source: German Socio-Economic Panel (SOEP) and SOEP-RV link

Tab. A3.2: Average marginal effect tables for SF-12 Physical Component Score (PCS) (N = 2,337)

	Men Quantiles				Women Quantiles			
Average marginal effects	20%	40%	60%	80%	20%	40%	60%	80%
Born in East Germany	-1.177	-0.675	-0.296	-0.549*	0.188	0.210	-0.114	0.0962
(ref.: West Germany)	(0.744)	(0.495)	(0.237)	(0.303)	(0.749)	(0.606)	(0.419)	(0.287)
Born in East Germany X Migration to West Germany								
No migration	-1.049	-0.481	0.00659	-0.260	-0.0340	0.477	0.408	0.369
	(0.798)	(0.614)	(0.261)	(0.357)	(0.889)	(0.682)	(0.463)	(0.377)
Migration	-1.482	-1.139	-1.023	-1.243**	0.703	-0.409	-1.328	-0.539
	(1.405)	(0.712)	(0.538)	(0.330)	(1.385)	(0.997)	(0.803)	(0.398)
Born in East Germany X Any parental unemployment 1990-1994								
No unemployment	-0.680	-0.0832	0.113	-0.347	0.448	0.350	0.0956	0.571
	(0.698)	(0.581)	(0.318)	(0.279)	(0.877)	(0.558)	(0.463)	(0.351)
Unemployment	-2.021	-1.682	-0.993**	-0.891	-0.210	-0.00343	-0.434	-0.628
	(1.604)	(0.969)	(0.349)	(0.645)	(1.402)	(1.271)	(0.790)	(0.519)
Observations	1,168	1,168	1,168	1,168	1,169	1,169	1,169	1,169

Note: Robust standard errors in parentheses. Significance levels: *** p<0.001, ** p<0.01, * p<0.05.
Source: German Socio-Economic Panel (SOEP) and SOEP-RV link

Tab. A3.3: Quantile regression results on SF-12 Mental Component Score (MCS) (N = 2,337)

	Men Quantiles				Women Quantiles			
Variables	20%	40%	60%	80%	20%	40%	60%	80%
Born in East Germany	-2.191	-1.919	-2.769***	-2.298***	-2.468	-2.004	-1.429	-2.444*
(ref.: WestGermany)	(1.897)	(1.266)	(0.925)	(0.882)	(1.511)	(1.486)	(0.951)	(1.057)
East-West Migration (ref.: no migration)	-1.793	-0.755	-1.372	-0.721	-0.651	-0.0740	-0.322	-1.108
	(2.574)	(1.176)	(0.899)	(0.454)	(1.856)	(1.358)	(0.968)	(1.064)
Born in East Germany X Migration								
East X Migration	0.369	2.224	1.615	2.520**	-0.280	-1.190	-1.390	-0.113
	(3.139)	(1.895)	(1.388)	(1.045)	(2.274)	(2.269)	(1.404)	(1.491)
Born in East Germany X Parental unemployment (1990-94)								
West X Unemplyoment	0.617	1.774	1.321	-0.239	-3.213*	0.280	0.708	-0.0563
	(2.549)	(1.686)	(1.343)	(0.478)	(1.811)	(1.920)	(1.360)	(1.217)
East X Unemplyoment	0.637	1.132	0.507	1.820*	-1.812	-2.333	-2.637**	-1.142
	(1.756)	(1.361)	(0.948)	(0.961)	(1.307)	(1.493)	(1.166)	(0.911)
Age in 1990 (ref.: Infancy (age 0-2))								
Early childhood (age 3-5)	-0.277	0.344	1.530*	0.365	1.636	-2.060	-2.121**	-1.288
	(1.892)	(1.057)	(0.843)	(0.613)	(1.614)	(1.449)	(0.954)	(0.927)
Childhood (age 6-11)	-4.234**	-3.584***	-1.088	-1.978***	-1.328	-2.616*	-1.972**	-2.251***
	(1.736)	(1.133)	(0.801)	(0.470)	(1.596)	(1.475)	(0.767)	(0.720)
Adolescence (age 12-17)	-2.946	-1.510	-1.000	-2.107***	-1.917	-4.413***	-3.603***	-1.620
	(2.258)	(1.271)	(1.111)	(0.521)	(1.853)	(1.536)	(1.371)	(1.339)
Number of siblings	-0.291	-0.0329	-0.0791	0.0325	0.933**	0.362	0.213	-0.152
	(0.655)	(0.440)	(0.283)	(0.186)	(0.382)	(0.426)	(0.303)	(0.251)
SF-12 PCS	-0.0971	-0.132*	-0.269***	-0.288***	0.109**	0.0632	-0.0117	-0.0871
	(0.117)	(0.0722)	(0.0665)	(0.0238)	(0.0553)	(0.0799)	(0.0552)	(0.0540)
Mother's age (z-std.)	-0.185	-0.219	-0.179	-0.117	0.330	-0.134	0.331	0.493
	(0.617)	(0.448)	(0.321)	(0.158)	(0.515)	(0.508)	(0.377)	(0.314)
Constant	52.91***	59.62***	71.48***	76.33***	35.27***	47.12***	55.83***	65.21***
	(6.984)	(4.278)	(3.972)	(1.476)	(3.620)	(4.711)	(3.183)	(3.195)
Observations	1,168	1,168	1,168	1,168	1,169	1,169	1,169	1,169

Note: Robust standard errors in parentheses. Significance levels: *** p<0.001, ** p<0.01, * p<0.05.

Source: German Socio-Economic Panel (SOEP) and SOEP-RV link

Tab. A3.4: Average marginal effect tables for SF-12 Mental Component Score (MCS) (N = 2,337)

	Men Quantiles				Women Quantiles			
Average marginal effects	20%	40%	60%	80%	20%	40%	60%	80%
Born in East Germany	-2.075	-1.502	-2.595***	-0.794	-1.998*	-3.396***	-3.170***	-2.908***
(ref.: West Germany)	(1.433)	(0.907)	(0.683)	(0.515)	(1.014)	(1.083)	(0.755)	(0.679)
Born in East Germany X Migration to West Germany								
No migration	-2.183	-2.156*	-3.070***	-1.536*	-1.913	-3.038*	-2.752***	-2.874***
	(1.585)	(1.078)	(0.807)	(0.644)	(1.189)	(1.230)	(0.876)	(0.822)
Migration	-1.814	0.0682	-1.455	0.985	-2.194	-4.229*	-4.142***	-2.987**
	(2.813)	(1.595)	(1.176)	(0.823)	(1.936)	(1.996)	(1.220)	(1.231)
Born in East Germany X Any parental unemployment 1990-1994								
No unemployment	-2.082	-1.265	-2.294***	-1.557*	-2.552*	-2.362	-1.847*	-2.478***
	(1.654)	(1.016)	(0.741)	(0.734)	(1.250)	(1.240)	(0.746)	(0.859)
Unemployment	-2.062	-1.906	-3.108*	0.503	-1.152	-4.975*	-5.191***	-3.564***
	(2.626)	(1.837)	(1.416)	(0.726)	(1.803)	(2.059)	(1.602)	(1.204)
Observations	1,168	1,168	1,168	1,168	1,169	1,169	1,169	1,169

Note: Robust standard errors in parentheses. Significance levels: *** p<0.001, ** p<0.01, * p<0.05.
Source: German Socio-Economic Panel (SOEP) and SOEP-RV link

Calculation of the SF-12 summary score

Description

The SOEP version of the SF-12 *summary score for physical and mental health functioning (SF-12)* has been included biannually in the SOEP since 2002 and is used as a reliable tool of meas-uring self-reported health functioning and health-related quality of life (*Andersen et al.* 2007). The SF-12 is a subset of the SF-36v2® that measures eight domains of health, which are used to calculate a physical (PCS) and a mental component score (MCS): role limitation due to physical problems, general health perceptions, vitality, bodily pain, physical functioning, social function, role limitations due to emotional problems, and general mental health (*RAND Corporation* 2020). The SF-12 is known as a valid and reliable standardised tool for assessing mental health functioning and health-related quality of life (*Andersen et al.* 2007; *RAND Corporation* 2020).

Tab. A4: SOEP survey questions and method of creating the SF-12 items for calculating the physical (PCS) and mental com-ponents scores (MCS) for physical and mental health functioning

Item	SOEP variable	Survey question	Answer categories	Method of item creation
Physical functioning (PF)	*ple0004*	When you have to climb several flights of stairs, does your current health limit you?	1 Strong 2 Slightly 3 Not at all	Combined as mean
	ple0005	And what about other demanding everyday activities, such as when you have to lift something heavy or do something requiring physical mobility: Does your health limit you?	1 Strong 2 Slightly 3 Not at all	
General health (GH)	*ple0008*	How would you describe your current health?	1 Very good 2 Good 3 Satisfactory 4 Poor 5 Bad	Reversed answer categories from 1 = bad to 5 = very good
Bodily pain (BP)	*ple0030*	How often in the last four weeks did you suffer from severe physical pain?	1 Always 2 Often 3 Sometimes 4 Almost never 5 Never	No adjustment
Role physical (RP)	*ple0031*	How often in the last four weeks, due to physical problems, did you achieve less in your work or everyday activities than you actually intended?	1 Always 2 Often 3 Sometimes 4 Almost never 5 Never	Combined as mean
	ple0032	How often in the last four weeks did you experience limitations due to physical problems?	1 Always 2 Often 3 Sometimes 4 Almost never 5 Never	

Tab. A4: Continuation

Item	SOEP variable	Survey question	Answer categories	Method of item creation
Mental health (MH)	*ple0027*	How often in the last four weeks did you feel in low spirits and melancholy?	1 Always 2 Often 3 Sometimes 4 Almost never 5 Never	Combined as mean (reversed answer categories of second question from 1 = never to 5 = always)
	ple0028	How often in the last four weeks did you feel well-balanced?	1 Always 2 Often 3 Sometimes 4 Almost never 5 Never	
Role emotional (RE)	*ple0033*	How often in the last four weeks, due to psychological or emotional problems, did you achieve less in your work or everyday activities than you actually intended?	1 Always 2 Often 3 Sometimes 4 Almost never 5 Never	Combined as mean
	ple0034	How often in the last four weeks, due to psychological or emotional problems, were you less careful in your work or everyday activities than you actually intended?	1 Always 2 Often 3 Sometimes 4 Almost never 5 Never	
Social functioning (SF)	*ple0035*	How often in the last four weeks, due to health or psychological problems, have you been restricted in terms of your social contact to for example friends, acquaintances or relatives?	1 Always 2 Often 3 Sometimes 4 Almost never 5 Never	No adjustment
Vitality (VT)	*ple0029*	How often in the last four weeks did you feel full of energy?	1 Always 2 Often 3 Sometimes 4 Almost never 5 Never	Reversed answer categories from 1 = never to 5 = always good

Source: SOEP Companion Topics of Health and Care [http://companion.soep.de/Topics%20of%20SOEPcore/Health%20and%20Care.html]

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