Long-run Mental Health Impact of the Korean War

Young-Il Albert Kim

In this study, we investigate whether exposure to a major civil war has a long-run impact on the mental health of individuals who experienced the war in late childhood. We use difference-in-differences strategy and exploit geographic variations in the intensity of the Korean War using Korean Longitudinal Study of Aging. War exposure in late childhood to early teenage years has a long-run negative impact on variables related to mental health, including depression, fear, insomnia, and loneliness. The effect is exacerbated by poverty and household structure for two outcome variables: fear and loneliness.

Keywords: Korean War, Mental health, Sensitive age, Traumatic event

JEL Classification: D74, I10, I12

I. Introduction

The Korean War was a devastating conflict between South Korea and North Korea, which lasted for slightly over three years between June 1950 and July 1953. The war, which was initiated by the undeclared invasion of North Korea, ended in a ceasefire treaty between North Korea and the joint United Nations (UN) forces and has left the Korean peninsula divided until today. North Korea initially swept the South, and the North took control of almost all parts of South Korea by September 1950. The successful retaliation of the UN allied forces

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quickly pushed the war to the North and the allied forces occupied almost the entire North Korea until the Chinese army joined the war to aid North Korea in the late 1950s. The allied forces were then pushed back to the middle of the peninsula and the battle line was set near the 38 degree parallel, which is the current border between North Korea and South Korea.

The Korean War has three distinct characteristics ideal for the study of the long-run impact of exposure to traumatic events at a certain age. First, the ceasefire was maintained for over six decades, which makes the war the only major traumatic event that affected nationwide population during the time. Second, its impact was devastating. Civilian casualty reached 2 million out of the 30 million combined populations of North Korea and South Korea. Over a quarter million students were brought to the war, over 100 tons of grains were lost, more than 4,000 schools were destroyed, and the number of refuges reached over 1.2 million (Kim 1996). Thus, the Korean War was a traumatic event for its civilian population. Third, civilian damage for South Koreans occurred mainly in 1950 as the war stagnated in the 38 degree line between 1951 and 1953, which was fought almost exclusively between soldiers (Lee 2014). Therefore, I can use the age in the year 1950 as the age when trauma was experienced.

The persistent impact of in utero and early life exposure to traumatic events is well documented in literature. Consistent with the fetal origin hypothesis of Barker (1992), several bodies of literature found a significant and positive impact of birth weight on labor market outcomes and education outcomes (Behrman, and Rosenzweig 2004; Black *et al.* 2007); and a significant intergenerational impact of low birth weights of children (Currie, and Moretti 2007). Thus, early childhood shocks before the age of five left profound impacts on labor market and health outcomes in the long run (Currie, and Almond 2011). Several studies showed a significant negative impact of exposure to major war during early childhood on health, education, and labor market outcomes (Akbulut-Yuksel 2014; Akresh *et al.* 2012, Alderman *et al.* 2006; Kesternich *et al.* 2014; Parlow 2012). Exposure to other traumatic events during childhood, such as Chinese famine and the 1918 influenza, also left negative long-run health, education, and labor market outcomes (Almond 2006; Lou *et al.* 2006; Meng, and Quian 2009).

The long run influence of birth weights and early life trauma mostly

affected exposed individuals through physical health deficiencies engendered by physical destruction (Akbulut-Yuksel 2014), hunger, persecution, and parental absence (Kesternich *et al.* 2014). However, the impact of trauma on preference, attitudes, personality, and mental health may be related to the mental shock that affected the fundamental functions of the brain through psychological channel. A growing body of literature showed the impact of major wars on preferences, attitudes, and political behaviors in the short run (Bellows, and Miguel 2009; Cassar *et al.* 2011; Rohner *et al.* 2013) and in the long run (Callen *et al.* 2014; Malmendier, and Nigel 2011). If psychological impact is strong enough, then even an indirect exposure through media may sufficiently impact mental health outcomes. A recent work by Kim and Kim (2017) found that indirect exposure to the Charlie Hebdo shooting left an immediate detrimental impact on the mental well-being of French respondents following the attack.

This finding leads to two interesting questions about the impact of traumatic events: 1) whether psychological shock has a lasting impact on mental well-being as in the case of physical health outcomes; and 2) whether war experience after early childhood has a persistent impact. The term "sensitive age" is used in psychology to describe an essential timing, wherein a provocative event may leave a lasting impact on the attitudes and personalities of individuals. A number of psychological literature identified the sensitive age for mental health effect using Hurricane Katrina (Osofsky *et al.* 2009), wildfire disaster in Canberra, Australia (McDermott *et al.* 2005), the Buffalo Creek dam collapse (Green *et al.* 1994), and war violence in the Republic of Georgia and Sierra Leone (Bauer *et al.* 2014).

In this study, I use Korean Longitudinal Study of Aging (KLoSA) to identify the sensitive ages for different mental health measures by exploiting variance in the casualty of the Korean War by province. I also examine subgroup impacts by income and family structure to investigate whether current economic and household status influences the degree of impact. This study is closely related to two papers. Lee (2014) examined in-utero exposure to Korean War and socioeconomic and health outcomes. By using South Korean census and vital statistics, the present study exploits variation in regional war intensity to show that the war had a negative impact on schooling and professional employment. Kim and Lee (2014) investigated the sensitive age of Korean War exposure for risk preference using Korean

Labor and Income Panel, which includes hypothetical lottery questions. They found that the impact of war on risk preference persisted in later childhood cohorts, wherein sensitive age group for risk preferences was identified.

This study makes three notable contributions to existing literature. First, to the best of the author's knowledge, this study is the first to identify sensitive age for mental health outcomes. The first wave of KLoSa includes many important mental health-related variables and sufficient number of observations between -12–42 years old in 1950, which provides sufficient number of observations for different 4-5 year age cohorts for difference-in-differences (DID) analysis to identify sensitive age. This approach may have significant policy implication because identifying the age group may require additional public health support. Moreover, mental health may have substantial implications on subjective well-being and productivity (Kim, and Kim 2017; Oswald *et al.* 2009), and, in turn, on national income, growth, and utility. Second, subgroup analysis examines whether the impact of war is alleviated/exacerbated by economic condition and family structure. This finding implies whether the mental health damage is triggered by other factors or results from a fundamental altering of neurophysiological unaffected by socioeconomic status. Third, this is the first study to identify the impact of exposure to traumatic event after five decades. The unique characteristic of the Korean War, which was devastatingly intense yet civilian damage was concentrated in the first nine months, combined with a large dataset comprising ample health and demographic characteristics, enables me to examine the long-run impact of traumatic event on mental health after five decades.

I find that later child exposure to the Korean War adversely affected the four main mental well-being measures, namely, depression, fear, insomnia, and loneliness. Sensitive ages slightly differ, but they span from late childhood to early teenage years. The results from subgroup analysis show that poverty and single person household more severely affect the respondents in fear, insomnia and loneliness.

Section II presents the empirical strategy and data. I report results and discuss in Section III. Conclusion follows in Section IV.

II. Analysis

A. Data

I use the first wave of KLoSA conducted in 2006, which is the nationally representative survey with 10,246 respondents aged 45 and up. The cross-section dataset is large and thoroughly covers old individuals between -12 and 42 years of age in 1950[1]; this dataset also reports many mental well-being related questions, which are the key dependent variables of this study. The dataset also includes ample demographic characteristics used to control individual heterogeneity. However, it contains only the place of residence at the survey date and it does not include birth place information. Therefore, I first use the full sample with age cohorts as key independent variable. Given that urbanization was concentrated in the North between 1930 and 1945 (Cho 2010), I assume that migration from their place of birth was trivial before the war. Likewise, I assume that rural dwellers stayed in their village of birth because the internal population movement was mostly rural-to-urban migration since the war[2]. Thus, I use geographic war intensity variation by province on the rural subsample for the main analysis. Out of 10,246 observations, I exclude 873 observations with missing covariates. For the main analysis on rural subsample, I use 2,230 observations from the rural area and eliminating 4,068 observations from major cities and 3,075 observations from small to medium cities.

War intensity for civilians is calculated using civilian casualty per population by province (See Table 1). I divide total civilian casualty per province from Kim (1996) by total provincial population from 1950 Census of Korea and calculate Korean War casualty per population by province. For the main analysis, I use the continuous value of war casualty per population. Additionally, I use the indicator variable for risky area and divides provinces into two categories, namely, risky

[1] For respondents who reported birth month by lunar calendar, I added 1 to their age if they were born in December. For example, for an observation born in December 1938 in lunar calendar was considered to have been born in 1939 and its age in 1950 was estimated as 11.

[2] Since 1950, internal migration in South Korea is driven by rapid urbanization. Following the end of Korean War, the urban area has rapidly increased from 28 percent in 1960 to 79.7% in 2000 (Cho 2010).

TABLE 1
KOREAN WAR CASUALTY PER POPULATION BY PROVINCE

	Province	Number of Casualty	Population	War Casualty per Population
Risky Area	Gangwondo	130,777	1,137,191	0.115
	Seoul	129,908	1,446,025	0.090
	Jeollanamdo	193,788	3,027,938	0.064
	Chungcheongbukdo	70,003	1,147,590	0.061
Safe Area	Gyeonggido	128,740	2,739,149	0.047
	Jeollabukdo	91,861	2,041,356	0.045
	Chungcheongnamdo	75,409	2,038,081	0.037
	Gyeongsangbukdo	97,851	3,156,484	0.031
	Gyeongsangnamdo	72,301	3,143,522	0.023
	Jejudo	325	254,503	0.001

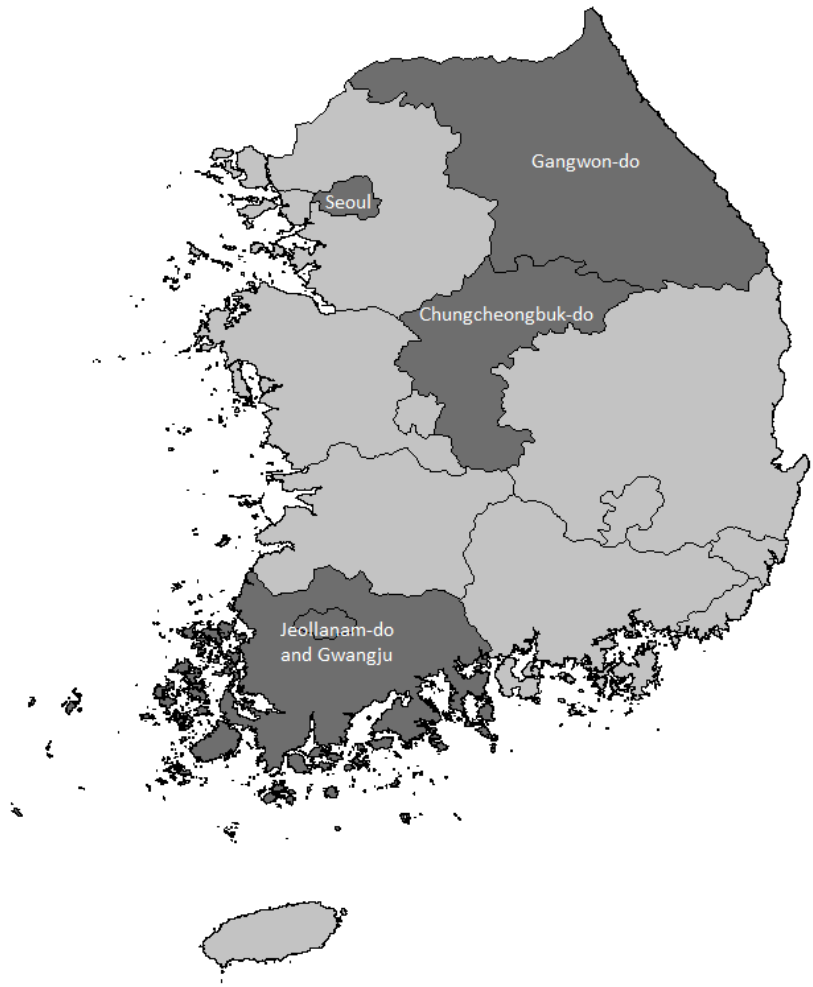
Note: Population data from the 1949 Census of South Korea. The number of civilian injuries/casualties per population is shown in parenthesis. The data on civilian injuries and casualties are obtained from Kim (1996, p. 85).

provinces and safe provinces.[3] Risky areas include provinces with casualty per capita greater than 0.05 and safe areas are those with casualty per capita lower than 0.05. Figure 1 shows the four risky provinces on the map.[4]

Table 2 presents the descriptive statistics of the full sample and the rural sample. A total 2,230 rural samples are divided between risky area with 625 observations and safe area with 1,605 observations. I obtain five dependent variables, four for variables related to mental well-being and a behavioral variable for alcohol consumption. All dependent variables are indicator variables. Approximately 19 percent of observations from the risky area indicated that they have depression, which is a number substantially greater than the full population

[3] Busan, Daegu, Gwangju, Ulsan, Incheon and Daejeon were part of Gyeonsangnam-do, Gyeongsangbuk-do, Jeoollanam-do, Gyeongsangnam-do, Gyeonggi-do and Chungcheongnam-do respectively in 1950. However, all the aforementioned cities are eliminated for the main analysis on rural sample only. There is no observation from Jeju-do.

[4] Seoulites are entirely metropolitan hence they are eliminated from the rural subsample. In actuality, the rural dwellers in Gangwon-do, Chungcheongbuk-do, and Jeollanam-do and Gwangju are the treatment group in the supplementary analysis using the indicator variable of war treatment.



Source: Population data from the 1949 Census of South Korea. The number of civilian injuries/casualties per population is shown in parenthesis. The data on civilian injuries and casualties are obtained from Kim (1996, p. 85).

FIGURE 1
RISKY PROVINCES IN SOUTH KOREA

average of 12 percent and the safe area average of 10 percent. In terms of insomnia, the safe area average is greater than the other two. The other dependent variable means are similar for all three groups.

The covariate means are considerably dissimilar among three groups.

TABLE 2
DESCRIPTIVE STATISTICS

	Full Sample	Rural Sample	
		Risky Area	Safe Area
Dependent Variables			
Depressed (The respondent replied that they have depression)	0.12 (0.32)	0.19 (0.40)	0.10 (0.30)
Fear (=1 if feared something 5 days or more in the past week)	0.012 (0.11)	0.010 (0.10)	0.013 (0.11)
Insomnia (=1 Cannot fall asleep for 5 days or more in the past week)	0.041 (0.20)	0.037 (0.19)	0.052 (0.22)
Lonely (=1 if felt alone in the world for 5 days or more in the past week)	0.020 (0.14)	0.018 (0.13)	0.019 (0.14)
Ever had alcohol regularly (=1 Either drinks now or ever had alcohol regularly)	0.45 (0.50)	0.47 (0.50)	0.43 (0.50)
Covariates			
Male	0.44 (0.50)	0.43 (0.50)	0.44 (0.50)
Age	61.22 (11.00)	65.53 (10.86)	63.80 (10.83)
Married	0.79 (0.41)	0.75 (0.44)	0.75 (0.41)
No education and illiterate	0.067 (0.25)	0.16 (0.36)	0.10 (0.30)
No education but literate	0.11 (0.31)	0.26 (0.44)	0.16 (0.37)
Primary education	0.28 (0.45)	0.32 (0.47)	0.35 (0.50)
Middle and high school education	0.44 (0.50)	0.24 (0.43)	0.34 (0.47)
Higher than high school education	0.11 (0.31)	0.03 (0.17)	0.05 (0.21)
Has a religion	0.55 (0.50)	0.43 (0.50)	0.50 (0.50)
Lives alone	0.09 (0.28)	0.15 (0.35)	0.10 (0.31)
Urban	0.76 (0.43)		

TABLE 2
(CONTINUED)

	Full Sample	Rural Sample	
		Risky Area	Safe Area
Annual income (in millions KRW)	19.06	10.69	15.78
	(24.80)	(13.28)	(20.61)
Low income (annual income less than 10 million KRW)	0.42	0.60	0.45
	(0.49)	(0.49)	(0.50)
Very low income (annual income less than 5 million KRW)	0.30	0.40	0.31
	(0.46)	(0.49)	(0.46)
Age Group Covariates			
Was less than -1 year old in 1950	0.33	0.20	0.23
	(0.47)	(0.40)	(0.42)
-1–2 years old in 1950	0.11	0.08	0.11
	(0.32)	(0.26)	(0.31)
3–8 years old in 1950	0.23	0.17	0.25
	(0.42)	(0.38)	(0.44)
9–12 years old in 1950	0.12	0.18	0.13
	(0.32)	(0.39)	(0.34)
13–18 years old in 1950	0.14	0.23	0.17
	(0.35)	(0.42)	(0.37)
19 years old or older in 1950	0.13	0.19	0.17
	(0.34)	(0.39)	(0.38)
Number of observations	9,373	625	1,605

Note: Standard deviations are in brackets.

The difference between the full sample and other two rural samples are mainly driven by urban-rural differences. The disparities in numbers between two rural groups may be a cause for concern as it may suggest that the provinces are not similar enough to make common trend assumption. The risky area seems less educated, less religious, and poorer. However, the provincial characteristics of the risky provinces and safe provinces were similar in the pre-war periods of 1943 and 1948, which suggest that the two groups of provinces diverged in these characteristics after the end of the war, which mostly depends on the degree and speed of urbanization in the surrounding areas (See Appendix Table A). Age group covariates show that each 4–5 year age cohort and cohorts born before/after the war contain more than 10

percent of all observations, including the ones who are 19 years or older in 1950.

B. Empirical Analysis

This study aims to estimate sensitive age of war exposure. I achieve this by estimating the effect of age cohort fixed effects on outcome variables. The OLS estimates are used in the analysis. Corresponding probit analysis are also conducted. For interpretational convenience, I report results of the linear probability model, but the probit results are quantitatively and qualitatively similar. The specification for the full sample analysis is:

$$Y_i = \alpha Age_i^{a,b} + X_i \Gamma + \delta_{province} + \varepsilon_i, \quad (1)$$

where i denotes the individual. Y_i is the dependent variable listed in Table 2. The key independent variable is the indicator variable $Age_i^{a,b}$, which is equal to 1 if the age of the respondent was between a and b in 1950, which was the peak of the Korean War. Key coefficient α represents sensitive age war exposure. X_i is individual characteristic, which includes gender, age, quadratic age, marital status, education level, religiosity, single person household, urban dweller, and annual income. $\delta_{province}$ pertains to province fixed effect.[5]

However, estimate α from Equation (1) does not distinguish age effect with the war cohort effect. The coefficient only represents how the specified age group differs from other age groups. Thus, in the main analysis, I restrict the sample to rural dwellers only and use DID method to utilize geographic war intensity differences and define the treatment group. The treatment group pertains to the respondents in the sensitive age cohort in 1950 and those that resided in risky areas:

$$Y_i = \alpha_1 Age_i^{a,b} + \alpha_2 Risky_i + \beta Age_i^{a,b} \times Risky_i + X_i \Gamma + \delta_{province} + \varepsilon_i, \quad (2)$$

where the key independent variable is the interaction term between the sensitive age indicator and the dummy variable for risky area $Risky_i$.

[5] In all analyses, the standard errors are clustered by province. With 9-province clusters or less, we report the wild-bootstrapped standard errors to deal with the "too few clusters" problem (Cameron *et al.* 2008).

Individual characteristic X_i is identical to the previous equation, except that the urban dweller is excluded. Similarly, I replace the indicator variable $Risky_i$ with a continuous provincial civilian war casualty measure $Casualty_i$ and estimate:

$$Yi = \alpha Age_i^{a,b} + \beta Age_i^{a,b} \times Casualty_i + X_i\Gamma + \delta_{province} + \varepsilon_i, \quad (3)$$

where the interaction term between the sensitive age indicator and the continuous war casualty variable is the key independent variable. In Equations (2) and (3), key coefficient β represents the causal impact of sensitive age exposure to Korean War. $Casualty_i$ is excluded to fully specify the model because multicollinearity issue occurs with province fixed effects.

The key identifying assumptions is that there is no selection by the respondents, and that their location is randomly assigned before the war. The breakout of the war was completely unexpected, wherein the majority of South Korean soldiers were on vacation because it was a Sunday. Civilian casualty did not have any discernable pattern (See Figure 1) by geographic location. Rather, the war intensity for civilians mostly depended on its progress, which is solely based on the decision making of the two sides at war. Moreover, most of these individuals were too young to decide to move. The place of residence was likely decided by their parents. Thus, the assumption is reasonable that it was difficult for respondents to make the migration decision into a "safe area" and that the war was a natural experiment.

Another contribution of study is the investigation of whether the impact of sensitive age exposure on mental well-being depends on the current economic status and household structure after over five decades. The treatment effect may be extra severe for individuals with low income, non-married individuals, and single person households. By using the fully saturated triple-difference model used by previous economic literatures for subgroup analysis (Milligan 2005; Chetty *et al.* 2009), I examine the heterogeneous response to the sensitive age war exposure by income and family structure subgroups:

$$\begin{aligned} Y_i = {} & \alpha_1 Age_i^{a,b} + \alpha_2 G_i + \beta_1 Age_i^{a,b} \times Casualty_i + \beta_2 Age_i^{a,b} \times G_i \\ & + \beta_3 Casualty_i \times G_i + \theta Age_i^{a,b} \times Casualty_i \times G_i \\ & + X_i\Gamma + \delta_{province} + \varepsilon_i, \end{aligned} \quad (4)$$

where G_i is the subgroup indicator variable that represents low income, very low income, married, and single person household group. Similar to Equation (3), $Casualty_i$ is omitted to fully specify the model. Coefficient θ for the triple interaction term is the specific subgroup effect superfluous of the treatment effect. If the outcome variable is affected by economic and family structure characteristics, θ will be economically and statistically significant.

III. Results and Discussions

A. Sensitive Age Analysis

By using full specification models from Equations (1)–(3), I initially identify the sensitive age groups that are persistently affected by the war exposure. The age cohorts are divided into four groups depending on their age in 1950, when the civilian war damage peaked during the war. The key coefficients are reported in Table 3, where each cell represents a single regression using the age cohort defined by the column and dependent variable shown in the row. Panel A of Table 3 presents the OLS estimate α from Equation (1) on the full sample. Overall, the coefficients are statistically insignificant and economically unsubstantial. The only significant result is for the in-utero/early life age group of $Age_i^{-1,2}$ for alcohol consumption behavior. For this group of individuals, the probability of either drinking regularly or having regular intake of alcohol in the past is high at 3.1 percentage points.

Panel B reports the DID coefficient β from Equation (2) and the treatment group, which is the interaction term between age cohort indicator and the indicator variable for risky area for the rural sample. Panel C reports β from Equation (3) and the treatment group is now the interaction term between the continuous civilian casualty per capita variable and age cohort indicator. In both specifications, the estimated coefficients for mental well-being measures of fear, insomnia, and loneliness show that late childhood age cohorts 3–8, 13–18, and 9–12 are the sensitive age groups, respectively. Coefficients are sizable and statistically significant in both specifications. The results from panel B indicate that probability of fear increases by 1.5 percentage points or 115 percent; probability of sleeping difficulty increases by 5 percentage points or 96 percent; and probability of feeling lonely increases by 3.9 percentage points or 205 percent for risky area residents compared

TABLE 3

LONG-RUN KOREAN WAR IMPACT ON MENTAL WELL-BEING AND BEHAVIORAL VARIABLES BY AGE AT WAR

	Age in 1950: -1–2	Age in 1950: 3–8	Age in 1950: 9–12	Age in 1950: 13–18
A. Age group dummy (full sample)				
Depressed (The respondent replied that they have depression)	0.012	-0.011	0.006	0.013
	(0.011)	(0.011)	(0.010)	(0.014)
Fear (=1 if feared something 5 days or more in the past week)	-0.0001	-0.0001	-0.001	-0.0001
	(0.002)	(0.001)	(0.003)	(0.003)
Insomnia (=1 Cannot fall asleep for 5 days or more in the past week)	0.004	-0.004	-0.004	0.007
	(0.010)	(0.003)	(0.011)	(0.009)
Lonely (=1 if felt alone in the world for 5 days or more in the past week)	0.007	-0.001	-0.004	-0.004
	(0.005)	(0.004)	(0.005)	(0.005)
Ever had alcohol regularly (=1 Either drinks now or ever had alcohol regularly)	0.031**	-0.004	0.011	-0.006
	(0.012)	(0.009)	(0.016)	(0.014)
Sample size	9,373	9,373	9,373	9,373
B. Age group dummy X risky province (rural sample)				
Depressed (Respondent indicated that they have depression)	0.012	-0.028	0.048	0.013
	(0.047)	(0.032)	(0.063)	(0.019)
Fear (=1 if feared something 5 days or more in the past week)	-0.002	0.015**	0.008	-0.007
	(0.010)	(0.007)	(0.010)	(0.008)
Insomnia (=1 Cannot fall asleep for 5 days or more in the past week)	-0.003	-0.007	-0.000	0.050**
	(0.021)	(0.015)	(0.023)	(0.019)
Lonely (=1 if felt alone in the world for 5 days or more in the past week)	0.012	0.007	0.039***	0.007
	(0.023)	(0.010)	(0.011)	(0.019)
Ever had alcohol regularly (=1 Either drinks now or ever had alcohol regularly)	0.102	0.010	0.025	0.040
	(0.062)	(0.055)	(0.080)	(0.038)
Sample size	2,230	2,230	2,230	2,230
C. Age group dummy X casualty per province (rural sample)				
Depressed (Respondent indicated that they have depression)	-0.220	-0.933	1.711**	-0.036
	(0.840)	(0.605)	(0.619)	(0.415)
Fear (=1 if feared something 5 days or more in the past week)	-0.212	0.354***	0.135	-0.106
	(0.178)	(0.095)	(0.139)	(0.175)
Insomnia (=1 Cannot fall asleep for 5 days or more in the past week)	-0.472	0.028	-0.137	0.683**
	(0.304)	(0.353)	(0.408)	(0.262)
Lonely (=1 if felt alone in the world for 5 days or more in the past week)	-0.109	-0.046	0.667***	0.074
	(0.232)	(0.195)	(0.117)	(0.284)
Ever had alcohol regularly (=1 Either drinks now or ever had alcohol regularly)	2.032***	0.683	-0.862	0.169
	(0.638)	(1.162)	(1.237)	(0.668)
Sample size	2,230	2,230	2,230	2,230

Note: Dependent variables are shown in each row. Table 3 presents the estimates of the Equations (1)–(3) in Panels A–C, respectively. The table only reports the key coefficients on the (Age Dummy) variable in Panel A and the interaction term between the (Age Dummy) and (War Risk Measure) variable in Panels B and C only. Standard errors are in the bracket. A single asterisk denotes statistical significance at 90% level of confidence, double 95%, and triple 99%.

with safe area residents in the specified age group. The coefficient for depression is significant for 9–12 age group in continuous treatment of war intensity specification similar to alcohol consumption for in-utero exposure.

Results for mental health-related measures suggest that persistent impact exists for individuals who experienced the war in late childhood. War exposure in sensitive age adversely affected mental health measures after five decades. This result is consistent with psychology literature that also found late childhood as the sensitive age group driven by periods of brain development. Mental health symptoms and treatment requirements increased for children/youths in grades 4–6 who experienced Hurricane Katrina after two years (Osofsky *et al.* 2009); in grades 4–12 for wildfire disaster of Canberra after six months (McDermott *et al.* 2005); and aged 2–15 years for the Buffalo Creek dam collapse after two years (Green *et al.* 1994). By referring to the conflicts in Georgia and Sierra Leone, Bauer *et al.* (2014) found that the attitude measure of egalitarian motive changes for individuals exposed to war violence between ages 7 and 20.

The significant long-run impact of alcohol consumption behavior is present for the in-utero/early life exposure group, which is consistent with economic literature and the fetal origin hypothesis of Barker (1992). Alcohol consumption is not a direct measure of mental well-being and it may be driven by other physical health factors that are mainly affected by war exposure at a younger age. The result suggests that the physical health channel may dominate mental health channels in terms of drinking behavior.

Table 4 presents DID estimates for depression, which is an indicator of whether the respondent identified that they had depression, using Equation (3) with different set of covariates in Columns (1)–(4). The age group 9–12 is identified as sensitive age for depression in Table 3 and I use the cohort in this analysis. Coefficient β on the interaction term is consistently positive, which shows that experiencing the Korean War at a young age positively impacts the probability of depression even after 56 years. The estimated β in all four columns are quite similar, which may show that the intensity of war was randomly assigned. The consistent estimate of the key coefficient does not support the nonrandom assignment of respondents to different provinces. The addition of fixed effects on province from Columns (3)–(4) has little effect on the magnitude of β and this suggests that province-level

TABLE 4
DEPRESSION AND KOREAN WAR

	(1)	(2)	(3)	(4)
Event Variables				
9–12 in 1950 X casualty per province	1.703**	1.669**	1.734**	1.711**
	(0.617)	(0.585)	(0.615)	(0.619)
9–12 in 1950	-0.053*	-0.052*	-0.057*	-0.056*
	(0.029)	(0.027)	(0.029)	(0.029)
Casualty per province	2.149***	2.138***	1.939***	
	(0.361)	(0.388)	(0.379)	
Individual characteristics				
Age	-0.002	0.005	-0.006	-0.006
	(0.005)	(0.004)	(0.006)	(0.006)
Age squared	0.000	-0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Male		-0.024	0.001	0.002
		(0.014)	(0.013)	(0.014)
Married		-0.123***	-0.094*	-0.098*
		(0.032)	(0.047)	(0.049)
No education and illiterate			0.111**	0.116**
			(0.047)	(0.046)
No education but literate			0.066**	0.073**
			(0.029)	(0.032)
Primary education			0.084*	0.085*
			(0.042)	(0.041)
Middle and high school education			-0.009	-0.012
			(0.025)	(0.023)
Has a religion			0.003	-0.003
			(0.021)	(0.021)
Lives alone			0.030	0.027
			(0.042)	(0.043)
Annual income (in millions KRW)			-0.001*	-0.001
			(0.000)	(0.001)
Province fixed effects	No	No	No	Yes
R^2	0.031	0.055	0.073	0.082
Number of observations	2,230	2,230	2,230	2,230

Note: The equation estimates the Equation (1) and reports β only. Column (2) contains the number of days to/from the date of the shooting and their interaction terms with the "post Charlie Hebdo shooting" dummy variable, similar to the regression discontinuity estimation. Standard errors are in the bracket. A single asterisk denotes statistical significance at 90% level of confidence, double 95%, and triple 99%.

unobservables are largely uncorrelated with the intensity of war. The estimates in Table 4 also suggest that depression is negatively associated with marriage and education level.

B. Robustness Check

The main analysis establishes that the Korean War negatively affected the mental health of older cohorts and the affected age groups slightly differ by measure. In this section, I vary the age group cohort definitions by outcome variables around the identified sensitive age group to potentially expand and compare the ranges of sensitive age cohorts. Table 5 reports the key coefficient of Equations (1)–(3) in Columns (1)–(3), respectively, by outcome and age cohorts. Panel A contains the four mental well-being variables and Panel B includes alcohol consumption. For each outcome variable, the top row replicates sensitive age groups identified by Equation (3). In Panel B, drinking behavior seems to have in-utero and early childhood sensitive age and the sensitive age cohort does not expand to older ages.

Results in the first column of Panel A are not sizable and rarely statistically significant. Coefficients in Columns (2) and (3) suggest that the sensitive age are wide around the identified age cohorts. Depression coefficients are substantial and significant for age groups 7–12 and 9–14 in continuous treatment of war intensity specification shown in Column (3). In terms of fear, fine definitions are similar for age groups 4–8 and 5–8 are also substantial and significant. In terms of insomnia and loneliness, the results in Columns (2) and (3) suggest that age groups 7–14 and 11–14, age groups 7–12 and 7–14 are substantial and significant, respectively.

According to the results of other age groups around the identified sensitive age groups in Table 3, three of the four metal health measures, such as depression, insomnia, and loneliness, have considerably similar late childhood sensitive age groups. In terms of fear, the expanded sensitive ages slightly overlap with the other three. This finding may imply that depression, loneliness, and sleep disorder are closely related and fear is a different type of emotion related to essential brain development periods. Overall, this exercise shows that mental well-being outcomes are affected by late childhood to early teenage exposure to traumatic events and are more similar in affected age groups than the results from Table 3.

TABLE 5

MENTAL WELL-BEING, DRINKING HABIT, AND KOREAN WAR BY AGE AT WAR

	Age dummy (1)	Age dummy X risky area (2)	Age dummy X casualty (3)
A. Dependent variable–mental well-being			
Depressed			
Age 9–12	0.006	0.048	1.711**
	(0.010)	(0.063)	(0.619)
Age 7–12	-0.009	0.026	1.294**
	(0.006)	(0.047)	(0.523)
Age 9–14	0.013	0.040	1.300**
	(0.010)	(0.048)	(0.524)
Fear			
Age 3–8	-0.0001	0.015**	0.354***
	(0.001)	(0.007)	(0.095)
Age 4–8	0.001	0.020	0.610*
	(0.002)	(0.017)	(0.306)
Age 5–8	-0.0001	0.032	1.106**
	(0.004)	(0.026)	(0.480)
Insomnia			
Age 13–18	0.007	0.050**	0.683**
	(0.009)	(0.019)	(0.262)
Age 7–14	-0.002	0.020*	0.276
	(0.008)	(0.009)	(0.232)
Age 11–14	0.003	0.030*	0.641*
	(0.008)	(0.014)	(0.355)
Lonely			
Age 9–12	-0.004	0.039***	0.667***
	(0.005)	(0.011)	(0.117)
Age 7–12	-0.006*	0.033***	0.583***
	(0.003)	(0.009)	(0.081)
Age 7–14	-0.006	0.036***	0.674***
	(0.004)	(0.007)	(0.190)
B. Dependent variable–behavioral			
Ever had alcohol regularly			
Age -1–2	0.031**	0.102	2.032***
	(0.012)	(0.062)	(0.638)
Age 3–4	-0.026*	-0.044	-0.362
	(0.015)	(0.079)	(1.452)
Age 3–6	-0.003	0.025	0.737
	(0.011)	(0.057)	(1.052)
Number of observations	9,373	2,230	2,230

Note: Table 5 reports the estimates of the Equations (1)–(3) in Columns (1)–(3), respectively. Age groups refer to age in 1950. Standard errors are in the bracket. A single asterisk denotes statistical significance at 90% level of confidence, double 95%, and triple 99%.

C. Subgroup Analysis

The long-run mental health impact of war exposure after more than five decades since the initial shock suggests that it entails a fundamental change in the exposed psychological development of individuals if the shock happened during their critical development period. However, mental well-being measures may be affected by poverty because limited resources may adversely affect the psychological welfare of individuals. Moreover, relationships and presence of cohabiting friends and family maybe a coping mechanism for alleviating mental health problems. I study whether the impact of war exposure is fundamentally mind altering or whether it may still be affected by possible coping mechanism and more abundant supply of economic resource using the subgroup analysis. Poverty subgroups are defined by annual income. The low income group is defined as household annual income less than 10 million KRW and the very low income group is defined as that less than 5 million KRW. Family structure subgroups are defined using marital status and single-person household.

Table 6 reports θ from Equation (4), which indicates how the subgroup is differently affected by the treatment compared with the other group. The results are mixed. Depression and insomnia are mostly unaffected by family structure subgroup. The only statistically significant subgroup is low income for 9–12 age groups (depression) and for 11–14 age groups (insomnia). This result suggests that depression and insomnia may be driven by an essential change that may not be alleviated by other factors. Fear is positively affected by living alone and poverty, but is negatively affected by marriage. This finding suggests that economic and family status may diminish fear and the war exposure had less fundamental impact on fear. Loneliness is unaffected by poverty, but is significantly affected by family structure variables. Respondents who live alone are likely to be lonely, whereas married respondents are less likely to be lonely.

Results imply that the impact of war on fear is less fundamental than other mental well-being variables. However, depression and sleep disorder seem deep-rooted and economic and family coping mechanisms are less likely to affect people who experience them as a result of war exposure during critical development period. Loneliness is affected by family structure variables, which may seem obvious given that the definition of loneliness is being alone. Hence, the probability

TABLE 6

MENTAL WELL-BEING, DRINK HABIT, AND KOREAN WAR: SUBGROUP DIFFERENCE-IN-DIFFERENCES ANALYSIS

	Mental well-being											Ever drank regularly
	Depressed			Fear			Insomnia			Lonely		
Age at war:	9–12	7–12	9–14	3–8	4–8	5–8	13–18	7–14	11–14	9–12	7–12	7–14	-1–2
A. Low income (annual < 10 million KRW)													
Casualty X Age dummy	0.449	-1.104	-1.060	0.686**	1.339**	1.960**	0.324	-0.743	-0.079	-0.072	-0.191	-0.172	1.906*
X Low income	(1.594)	(0.909)	(1.034)	(0.280)	(0.536)	(0.769)	(1.308)	(1.026)	(0.628)	(0.660)	(0.506)	(0.530)	(1.028)
B. Very low income (annual < 5 million KRW)													
Casualty X Age dummy	3.978***	2.026	1.740	1.243*	1.552*	2.178***	-1.086	-1.658	-1.352**	-0.151	-0.376	-0.174	4.712**
X Very low income	(1.238)	(1.149)	(1.367)	(0.680)	(0.727)	(0.686)	(1.175)	(0.968)	(0.523)	(0.465)	(0.362)	(0.465)	(1.814)
C. Married													
Casualty X Age dummy	-0.237	0.597	0.043	-4.005**	-6.114**	-8.713**	-0.205	-0.136	0.324	-1.870	-1.727	-2.121***	-2.138
X Married	(3.595)	(3.853)	(3.970)	(1.566)	(2.069)	(3.914)	(2.584)	(0.611)	(0.608)	(1.312)	(1.280)	(0.392)	(3.942)
D. Live alone													
Casualty X Age dummy	-0.683	-2.161	1.536	4.412***	6.517***	9.513**	-0.285	-0.773	-0.086	2.560**	1.553	1.749***	-4.795
X Live alone	(6.065)	(4.017)	(4.262)	(1.355)	(1.779)	(3.517)	(2.960)	(0.632)	(0.981)	(1.157)	(1.060)	(0.484)	(4.342)
Number of observations	2,230	2,230	2,230	2,230	2,230	2,230	2,230	2,230	2,230	2,230	2,230	2,230	2,230

Note: Table 6 reports the estimates of θ from Equation (4). Standard errors are in the bracket. A single asterisk denotes statistical significance at 90% level of confidence, double 95%, and triple 99%.

of feeling lonely will be lower with cohabiting spouse/family/friend. However, similar to depression and insomnia, economic resources are ineffective in alleviating the persistent and negative impact of war on loneliness.

IV. Conclusion

This study finds that the persistent impacts of exposure to the Korean War on mental health outcomes are specific to age cohort. After five decades since the original shock, exposure to the war during this "sensitive age" continued to have a significant negative impact on the mental well-being of the exposed individual. Identified sensitive age for mental health variables is in late childhood, which is older than most of the other sensitive age identified for economic, labor, and physical health outcomes from previous literatures. This finding suggests that countries and regions that experience the war may face an increased demand for appropriate mental health treatment in the long run. Policymakers may target this group of individuals to provide them with preemptive health support because existing literature suggests that mental health is an important determinant of labor productivity and overall happiness. Subgroup analysis suggests that mental health-related variables may be affected by the current income and family structure. The rise in inequalities coupled with aging population in a war-torn country may further worsen the mental health levels of its population, even if the war occurred many years ago, such as the Second World War and the Korean War. Old age happiness for the sensitive age cohorts may be improved by effective public transfer programs and improvement in mental health service accessibility.

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