World Cancer Research Journal WCRJ 2021; 8: e2106

THE CRISIS-CANCER CYCLE IN THE SHADOW OF COVID-19: EVIDENCE FROM TURKEY

G. ÇİĞDEM

Department of Banking and Insurance, Istanbul Gelişim University, Istanbul, Turkey

Abstract – *Objective:* *Determining the existence of the cycle between the economic crisis-unemployment-cancer and implementing appropriate policies for this is important in the fight against cancer, which is an important public health problem. Mass unemployment caused by the practices in the COVID-19 process is worrisome in this sense. The cost of policies that may prevent the unemployment process will be much cheaper than the costs of cancer screening, diagnosis, treatment, care, organ-life losses, production and labor losses.*

Materials and Methods: *Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) Unit Root Tests, Engel-Granger, Johansen Cointegration Test, Granger Causality Test Over VAR Model.*

Results: *Unemployment and cancer incidence are not cointegrated in the long run, according to the research. A one-sided causality from unemployment to cancer incidence has been discovered in the short term. As a result, unemployment is a Granger cause of cancer.*

Conclusions: *The determination of unemployment as a cause of cancer incidence, implementation of emergency policies to prevent unemployment will reduce costs in fighting cancer. And it will prevent cancer cases caused by the increase in stress and anxiety caused by unemployment.*

KEYWORDS: *Economic crisis, Cancer, Unemployment, Cancer incidence, Cointegration, COVID-19.*

INTRODUCTION

On a global scale, cancer is a major public health issue with a significant economic impact. This issue, which necessitates multidisciplinary work, harms economies due to prevention, screening, diagnosis, treatment, palliative care, organ and life loss, as well as a loss of productivity and workforce. Cancer is a terrible "expense item" for all economies, the cost of which can currently not fully calculated. It's the result of a *"cycle."* In 2018, 17 million new cancer cases were diagnosed worldwide, with 9.5 million cancer deaths. The global burden of cancer is projected to rise to 16.3 million cancer deaths and 27.5 million new cases by 2040 (American Cancer Society)[1]. According to Sung et al (2021), new cancer cases will reach 28.4 million in 2040, a 47% increase from 2020. This 47% increase will occur most in low and middle HDI countries, according to this study, which is based on the Human Development Index (HDI), the most widely used human development indicator. According to estimates, the highest increase in cancer incidence will occur in high HDI countries, with 4.1 million new cases in 2040 compared to 2020. According to these forecasts, an increase in the prevalence of risk factors, in addition to population aging, will be a significant factor. The most crucial step in reducing the cancer burden is identifying and preventing risk factors. As a result, it is critical demonstrate the existence of the crisis-cancer cycle, and multidisciplinary research is required. Policymakers' decisions have an impact on more

Corresponding Author: G. Çiğdem, Assoc. Prof.; e-mail: gulguncigdem@gmail.com

than just macroeconomic data. Economic crisis prevention and management are critical for public health and the economic burden they impose on economies. And may assist in mitigating this "expensive" outcome. The studies, which I named the *"Crisis-Cancer Cycle"* for the first time in 2019 and which I started to test whether there is a relationship between cancer and economic crises, are entirely aimed at this purpose[2]. If there is a relationship between the variables, implementing harmonized policies between countries, rather than being burdened by such a large global burden, would almost certainly be much cheaper and more accurate in minimizing or even avoiding this disastrous outcome. The data of Turkey is discussed in this study to prove the existence of this cycle. The relationship between the phenomenon of unemployment, which is one of the significant indicators of the crises, and the incidence of cancer, has been empirically tested based on Turkey. Future studies on the cycle are crucial in terms of being complementary. Some policies that can be implemented by proving and acknowledging the existence of this cycle can help prevent this "expensive" result, albeit partially.

EMPIRICAL ANALYSIS AND METHODS

As a continuation of the Cycle of Crisis-Cancer study, the presence of relationship between unemployment and the incidence of cancer in Turkey, will be questioned in this section. E-views 10+ package program was used in the analyzes. As the first and mandatory step, Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests were applied first. The ADF test, developed by Dickey and Fuller[3], and the PP Test, developed by Phillips and Perron[4], were used in the analysis. The Schwarz Information Criterion was used, as well as its compatibility with MacKinnon criteria was analyzed. Different techniques are used. The presence of a long-term relationship between the series was tested with Engle-Granger. Based on the findings, Granger Causality Test was used over the Vector Autoregressive (VAR) Model to question the short-term relationship.

The Data and The Empirical Results

Unemployment and cancer incidence were chosen as variables to investigate the crisis and cancer cycle in Turkey. Unemployment is a key indicator of the severity of a crisis. The unemployment rate is the percentage of the unemployed workforce[5]. Annual unemployment figures from 1990 to 2017 were provided from Turkstat.

Incidence is defined as the number of new cases of any type of cancer per 100,000 people[6]. Annual cancer incidence data for the same period was obtained from Worldbank. Table 1 shows the variables' abbreviations and where they came from.

TABLE 1. The variables in the analyses, abbreviations, and the obtained sources.

Variable Name	*Abbreviation*	*Source*
Unemployment	U	TURKSTAT
Cancer Incidence	CA	Worldbank

Figure 1 depicts the progression of the variables over the relevant period.

To measure the impact of the changes of the independent variable on the dependent variable, the following regression model was created first:

$$CA_t = \alpha_0 + \alpha_1 U_t + \in$$

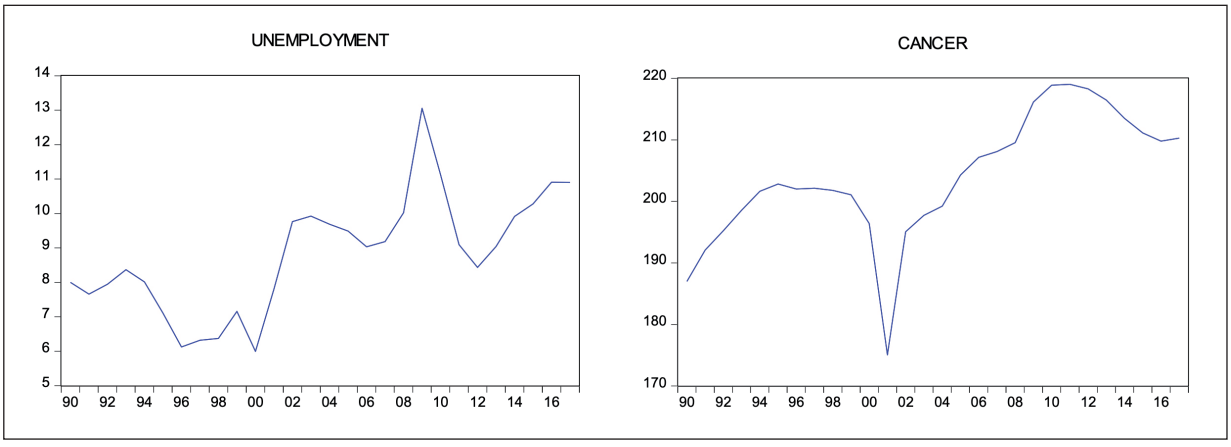

Fig. 1. The progression of unemployment and cancer incidence in Turkey between 1990-2020.

In the simple linear regression number 1, U was included in the analysis as an independent variable and CA as a dependent variable.

ϵ is the random error term (pure error term), and the parameters α_0 and α_1 show the quantitative values characterizing the behavior of the main mass. Null and alternative hypotheses are established as follows:

H_0: Unemployment is the cause of cancer incidence

H_1: Unemployment is not the cause of cancer incidence

In causality tests, the use of non-stationary series can lead to spurious causality results. For this reason, the existence of unit root is tested first in the study. The first unit root test was proposed by Fuller[7], Dickey and Fuller[8] and developed by Dickey and Fuller[9].

Although various analyses were developed later, the most common ones, Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root analyses, were used in this analysis. Table 2 shows the outcomes of the analysis. Analysis results show that the variables have a unit root at the level and become stationary after taking their first differences.

Cointegration Tests

The econometric literature offers a broad range of cointegration tests. The Engle-Granger[10] two-step cointegration process, which is based on unit root analysis of residues, was used to analyze the presence of a long-term relationship between unemployment and cancer incidence in this research, and no cointegration was found between variables.

The Johansen[11] Test, which was designed to solve the shortcomings of the Engle-Granger[12] system and produce healthier results, was also used, but the results were identical to those of the Engle-Granger Test (Table 3, 4). Unemployment and cancer incidence were discovered not to be cointegrated in the long run.

The Granger Causility Test Over Vector Autoregressive (VAR) Model

The Granger Causality Test is an extensively used test to define the presence of a causality relationship between two (or more) variables[13]. VAR models are used to predict the future[14], and

TABLE 2. The results of unit root tests used in analyses.

	Variables	*Test Statistic*	*Critical Values*		
			1%	*5%*	*10%*
UNEMPLOYMENT					
ADF	Unemployment, level	-3.217638	-4.356068	-3.595026	-3.233456
	Unemployment, 1st level	-4.204201	-4.356068	-3.595026	-3.233456
PP	Unemployment, level	-2.679549	-4.339330	-3.587527	-3.229230
	Unemployment, 1st level	-4.248594	-4.356068	-3.595026	-3.233456
CANCER INCIDENCE					
ADF	Incidence, level	-2.361092	-4.339330	-3.587527	-3.229230
	Incidence, 1st difference	-5.766137	-4.356068	-3.595026	-3.233456
PP	Incidence, level	-2.375650	-4.339330	-3.587527	-3.229230
	Incidence, 1st difference	-5.805452	-4.356068	-3.595026	-3.233456

*Note: "*** represents a significance level of 1%. The number of delays in the ADF tests is determined according to the Schwarz criteria. In the PP tests, the number of delays determined according to Newey-West Bandwith is taken. As a test format, fixed and trend equation options are used for all variables at the level value. The fixed equation option is used to obtain the first difference of the variables. MacKinnon critical values are contemplated".*

TABLE 3. The results of the Engle-Granger Test.

t Statistics	*Mac-Kinnon Critical Values*			*Result*
	(%1)	*(%5)*	*(%10)*	
-2.392429	-4.339330	-3.587527	-3.229230	No Long-term relationship

TABLE 4. The results of the Johansen Test.

	Λ *Trace Statistic*		
Eigenvalue	**Λ *trace***	***0.05 C.V.***	***Prob.***
0.437407	20.15141	25.87211	0.2184
0.181150	5.196224	12.51798	0.5684
	Λ *Max-Eigen Statistic*		
Eigenvalue	**Λ *Max***	***0.05 C.V.***	***Prob.***
0.437407	14.95519	19.38704	0.1960
0.181150	5.196224	12.51798	0.5684

the predictive adequacy of a variable is based on Granger (1969)[15]. In this research, the Granger Causality Test over VAR Model was applied to inquire whether there is a short-term relationship between variables whose cointegration could not be detected in the long run.

As a result of the examinations, a unidirectional causality amongst variables discovered; unemployment is the Granger cause of cancer incidence.

RESULTS

The study examines the long and short-term relationships between unemployment (defined as the percentage of the unemployed workforce[16]) and cancer incidence (defined as the number of new cases of any type of cancer per 100,000 people[17]). According to the analysis results:

- Unemployment and cancer incidence are not cointegrated in the long term (Table 4).
- A unidirectional causality has been detected between variables. Unemployment is a Granger cause of cancer incidence (Table 5, Figure 2).

DISCUSSION

Cancer is defined as "a group of diseases with numerous potential causes"[18]. Recent research has determined that immune system impairments and telomere length shortening are among the causes of cancer. Stress and anxiety disorders impair immunity and shorten telomeres. Stress and anxiety disorders suppress immunity and shorten telomeres. According to the "Crisis-Cancer Cycle," which adds a new reason to the list of detectable triggers, economic crises cause unemployment, income declines, and poverty; and thus anxiety, stress, immune system disturbances, telomere shortening, and a cancer-causing mechanism emerge. Several studies have been conducted that are related to various stages of this cycle. According to studies, crises, for example, result in a loss of output and workforce, as well as a significant impact on health[19]. According to the findings of this study[20], health issues are linked to poverty, inequality, and other social and economic indices of health. According to studies, the 2008 financial crisis, the world's first, harmed people's health by deteriorating their socioeconomic status[21], and the crisis has been linked to serious consequences, particularly in terms of mental health[22,23].

Anxiety and depression are exacerbated by underemployment[24], unstable or temporary employment[25,26], and lack of income[27]. Job insecurity increases the risk of depression symptoms[28] and the use of antidepressants[29]. In the United States, it has also been discovered that sudden loss of wealth increases depression and antidepressant use[30]. Unemployment and declines in investment income caused depression rates to burst[31], according to a study conducted in Hong Kong both prior to and following the 2008 financial crisis. Important genetic evidence on the relationship between stress and cancer has also been obtained[32]. The global financial crisis of 2008 has been linked to a substantial increase in cancer mortality between 2008 and 2010. Over 260,000 (preventable) deaths were attributed to unemployment as a result of the recession during this period[33].

TABLE 5. The findings of the short-run analysis.

Findings	***Directions of Causality***
I find that Unemployment causes Cancer Incidence (one-sided causality)	Unemployment → Cancer Incidence

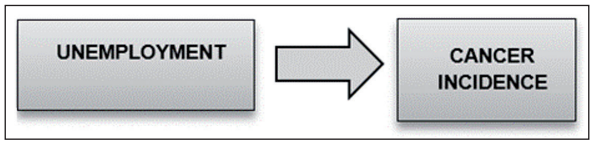

Fig. 2. The result of the Granger Causality Test over VAR Model.

Job and income losses as a result of economic crises, anxiety, and depression for the future, bring along telomere shortening. Telomere shortening also causes cancer. Many studies of parts of the Crisis-Cancer Cycle provide important evidence in the medical field. For example, many studies show that economic crises and the increase in psychiatric morbidity are related[34-40]. Wang et al[41] found that during the economic crisis, the rates of major depressive disorder have increased significantly. Tennant[42] also proved that major depression is linked to an increased risk of job insecurity. In addition to these studies, studies showing that telomere length is shortened considerably with anxiety, depression, stress, mood disorders, and adjustment disorders[43-51] completes the cycle in a sense. However, I have not come across any study that establishes a correlation between cancer and macroeconomic phenomena such as crisis, unemployment, and poverty with a multidisciplinary approach. Therefore, these studies are a contribution to the literature.

Turkey taken up in this study is a continuation of the Crisis-Cancer Cycle test run, which will be questioned whether the relationship between unemployment and the incidence of cancer. When compared to developing countries, it is seen that the Turkish economy is far from providing sufficient employment. The unemployment rate has not dropped below 9% since the 2001 crisis, except for the small drop seen in 2012 (Figure 1), and this rate is much higher than in developed and developing countries. The OECD average as of 2020 is 71.5% of the labor force participation rate in Turkey is 54.9% and is below the OECD average (Figure 3)[52]. It is thought that this low participation in the workforce may be due to the "discouragement" of the employees. "Ready to work but not seeking work" when about 2.5 million people also are included, the unemployment rate in Turkey rose 18.5% [53]. According to statistics, about one-quarter of Turkey's young people and more than one-third of its women are unable to obtain an education or a job. The extremely low female labor force participation rate in Turkey is one of the most visible manifestations of gender inequality. Also, the NEET rate (those who are at risk of being pushed out of the job market and exclusion from social life)[54], which is 24.8% in Turkey, which is alarming[55].

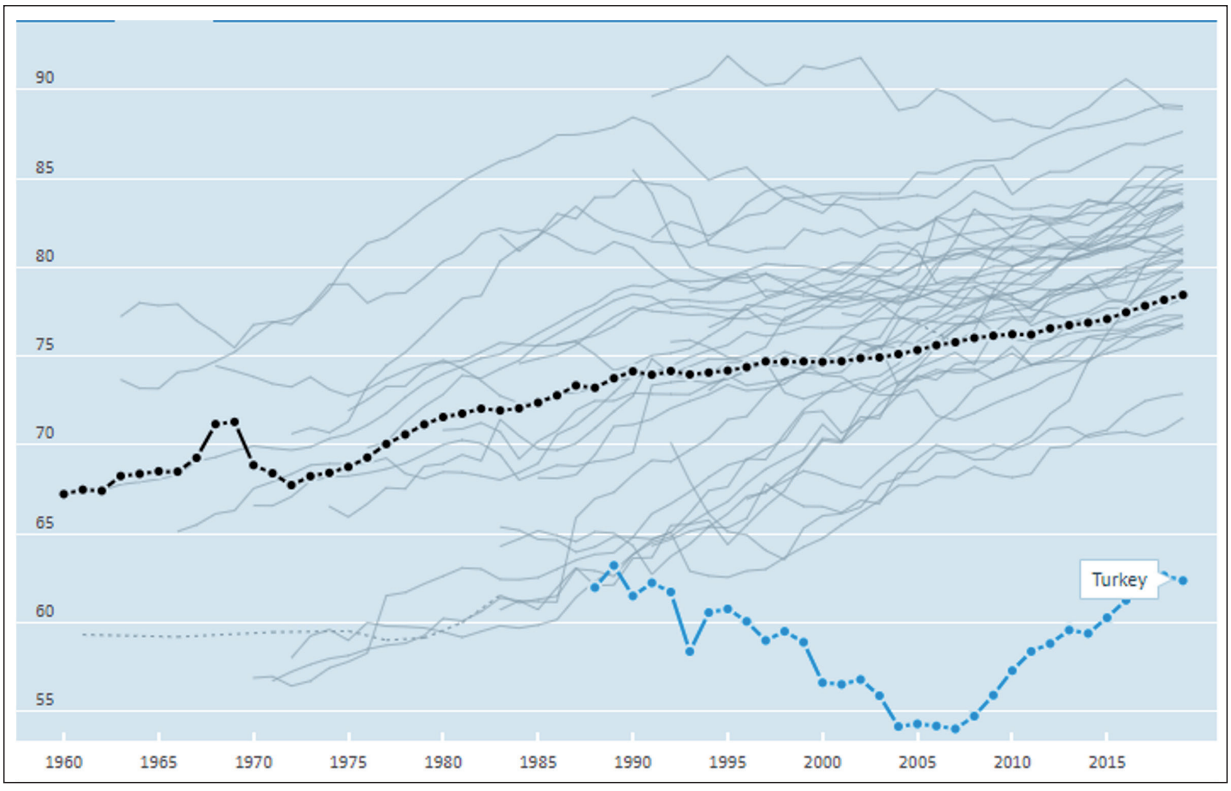

Fig. 3. Comparison of labor force participation in Turkey and OECD.

Turkey experienced serious crises in 1929-32, 1958-61, 1969-1970, 1978-83, 1988-1989, 1991, 1994, 1998-2001, 2008-2009. In Turkey, about 40% of the liberalization/globalization period was crisis years[56]. In addition to all these, having higher unemployment rates than other countries, in Turkey, is there a link between cancer and unemployment? In this study, which seeks the answer to this question, the unemployment rate used is the percentage of the unemployed workforce[57]. Incidence is the number of new cases of some cancers per 100,000 population[58]. This study is a contribution to *the Crisis-Cancer Cycle*.

CONCLUSIONS

Today, the uncertainty shock created by COVID-19 is evolving into a global depression. And COVID-19, with the promotion of social isolation, is driving mass unemployment and firm shutdowns. The priority of clinging to life and stopping the pandemic from spreading also obscures the economic impact of the shock. Different managers in different countries have different practices and financial capabilities, which lead to different outcomes. The success or failure achieved can destroy all efforts at once due to the rapid spreading power of the virus. There is a more critical cycle; COVID-19 is creating mass unemployment. Unemployment is another cause of cancer, and according to the research shared by the American Cancer Research Association, cancer increases the death rate from COVID-19 three times more. Some types of cancer impoverish the immune system and are at risk of increasing COVID-19 complications. It has been revealed that cancer patients living in China have worse results compared to the general public and that cancer cases have a higher risk of COVID-19[59]. In the United States, approximately 5000 new cancer cases will be diagnosed each day, and reports draw attention to the fact that COVID-19 can be fatal in cancer patients[60].

During the pandemic process that starts with a health crisis and turns into a global economic problem, unemployment, which is between two sharp ends, namely COVID-19 and cancer, is an important macro-economic phenomenon that should be prevented with policies. And this study offers important empirical evidence that unemployment is one of the causes of cancer. In the shadow of COVID-19, future multidisciplinary studies towards *the Crisis-Cancer Cycle* are important.

Ethical Statement:

The data presented in this document are the results of previous studies, so it was not necessary to seek opinions from the Ethics Committee.

Conflict of Interest:

The author declares that there is no conflict of interests regarding the publication of this paper.

REFERENCES

1. American Cancer Society. Cancer Statistics Center, Global cancer facts and figures. https://www.cancer.org/research/cancer-facts-statistics/global.html .
2. Çiğdem G. Is poverty another cause of cancer? An empirical analysis. WCRJ 2019; e1226: 1-5.
3. Dickey DA, Fuller WA. Distribution of the estimators for autoregressive time series with a unit root. J Am Stat Assoc 1979; 74: 427-431.
4. Phillips PCB, Perron P. Testing for a unit root in time series regression. Biometrika 1988; 75: 335-346.
5. Acemoğlu D, Laibson D, List JA. Makroekonomi. Beta Basım Yayım Dağıtım A.Ş., İstanbul Turkey, 2016.
6. Our World in Data. Cancer incidence, 1990 to 2017. https://ourworldindata.org/grapher/cancer-incidence?tab=chart&country=TUR
7. Fuller WA. Introduction to statistical time series. John Wiley & Sons, New York USA 1976.
8. Dickey DA, Fuller WA. Distiribution of the estimators or autoregressive time series with a unit root. J Am Stat Ass 1979; 74: 427-431.
9. Dickey DA, Fuller WA. Distribution of the estimators for autoregressive time series with a unit root. Econometrica 1981; 49: 1057-1072.
10. Engle R, Granger C. Cointegration and error correction representation: estimation and testing. Econometrica 1987; 55: 251-276.
11. Johansen, S. Statistical analysis of cointegration vectors. J Econ Dynam Control 1988; 12: 231-254.
12. Engle R, Granger C. Cointegration and error correction representation: estimation and testing. Econometrica 1987; 55: 251-276.
13. Granger CWJ. Investigating causal relations by econometric models and cross-spactral methods. Econometrica 1969; 37: 424-438.
14. Hamilton JD. Time series analysis. Princeton University Press, Princeton, New Jersey USA, 1994.
15. Granger CWJ. Investigating causal relations by econometric models and cross-spactral methods. Econometrica 1969; 37: 424-438.
16. Acemoğlu D, Laibson D, List JA. Makroekonomi. Beta Basım Yayım Dağıtım A.Ş., İstanbul Turkey, 2016.
17. Our World in Data. Cancer incidence, 1990 to 2017. https://ourworldindata.org/grapher/cancer-incidence?tab=chart&country=TUR
18. American Cancer Society. https://www.cancer.org/cancer/cancer-causes.html.
19. Bernanke BS. The crisis and the policy response, stamp lecture. London School of Economics, London England; 2009. http://www.federalreserve.gov/newsevents/sspeech/bern anke20090113a.htm
20. WHO. Impact of economic crises on mental health 2011 http://www.euro.who.int/ data/assets/pdf_file/0008/134 999/e94837.pdf

21. Marmot MG. How will the financial crisis affect health? BMJ 2009; 338: b1314. Doi:10.1136/bmj.b1314.
22. Clair A, Reeves A, Loopstra R, McKee M, Dorling D, Stuckler D. The impact of the housing crisis on self-reported health in Europe: multilevel longitudinal modelling of 27 EU countries. Eur J Public Health 2016; 26: 788-793.
23. Stuckler D, Basu S, Suhrcke M, Coutts A, McKee M. The public health effect of economic crises and alternative policy responses in Europe: an empirical analysis. Lancet 2009; 374: 315-323.
24. Dooley D, Prause J, Ham-Rowbottom KA. Underemployment and depression: longitudinal relationships. J Health Soc Behav 2000; 41: 421-436.
25. Ferrie JE, Martikainen P, Shipley MJ, Marmot MG, Stansfeld SA, Smith GD. Employment status and health after privatisation in white collar civil servants: prospective cohort study. Br Med J 2001; 322: 647-651.
26. Thomas C, Benzeval M, Stansfeld SA. Employment transitions and mental health: an analysis from the British household panel survey. J. Epidemiol Community Health 2005; 59: 243-249.
27. Prause J, Dooley D, Huh J. Income volatility and psychological depression. Am J Community Psychol 2009; 43: 57-70.
28. Ferrie JE, Shipley MJ, Stansfeld SA, Marmot MG. Effects of chronic job insecurity and change in job security on self reported health, minor psychiatric morbidity, physiological measures, and health related behaviours in British civil rervants: the Whitehall II study. J Epidemiol Community Health 2002; 56: 450-454.
29. Rugulies R, Thielen K, Nygaard E, Diderichsen F. Job insecurity and the use of antidepressant medication among Danish employees with and without a history of prolonged unemployment: a 3.5-year follow-up study. J Epidemiol Community Health 2010; 64: 75-81.
30. Mclaughlin KA, Nandi A, Keyes KM, Uddin M, Aiello AE, Galea S, Koenen KC. Home foreclosure and risk of psychiatric morbidity during the recent financial crisis. Psychol Med 2012; 42: 1441-1448.
31. Lee S, Guo WJ, Tsang A, Mak ADP, Wu J, Lam Ng K, Kwok K. Evidence for the 2008 economic crisis exacerbating depression in Hong Kong. J Affect Disord 2010; 126: 125-133.
32. Chang YS, Jalgaonkar SP, Middleton JD, Hai T. Stress-inducible gene Atf3 in the noncancer host cells contributes to chemotherapy-exacerbated breast cancer metastasis. Proc Natl Acad Sci U S A 2017; 114: 7159-7168.
33. Maruthappu M, Watkins J, Noor AM, Williams C, Ali R, Sullivan R, Zeltner T, Atun R. Economic downturns, universal health coverage, and cancer mortality in high-income and mid-income countries, 1990-2010: a longitudinal analysis. Lancet 2016; 388: 684-695.
34. Lee S, Guo WJ, Tsang A, Mak AD, Wu J, Ng KL, Kwok K. Evidence for the 2008 economic crisis exacerbating depression in Hong Kong. J Affect Disord 2010; 126: 125-133.
35. Avcin BA, Kucina AU, Sarotar BN, Radovanovic M, Plesnicar K. The present global financial and economic crisis poses an additional risk factor for mental health problems on the employees. Psychiatr Danub 2011; 23: 142-148.
36. Sargent-Cox K, Butterworth P, Ansteyk J. The global financial crisis and psychological health in a sample of Australian older adults: a longitudinal study. Soc Sci Med 2011; 73: 1105-1112.
37. Gili M, Roca M, Basu S, Mckee M, Stuckler D. The mental health risks of economic crisis in Spain: evidence from primary care centres, 2006 and 2010. Eur J Public Health 2012; 23: 103-108.
38. Evans-Lacko S, Knapp M, McCrone P, Thornicroft G, Mojtabai R. The mental health consequences of the recession: economic hardship and employment of people with mental health problems in 27 European countries. PLoS One 2013; 8: e69792.
39. Snorradottir A, Vilhjàlmsson R, Rafnsdottir GL, Tomasson K. Financial crisis and collapsed banks: psychological distress and work related factors among surviving employees - a nation-wide study. Am J Ind Med 2013; 56: 1095-1106.
40. Drydakis N. The effect of unemployment on self-reported health and mental health in Greece from 2008 to 2013: a longitudinal study before and during the financial crisis. Soc Sci Med 2015; 128: 43-51.
41. Wang X, Sundquist K, Hedelius A, Palmér A, Memon AA, Sundquist J. Leukocyte telomere length and depression, anxiety and stress and adjustment disorders in primary health care patients. BMC Psychiatry 2017; 148: 1-10.
42. Tennant C. Work-related stress and depressive disorders. J Psychosom Res 2001; 51: 697-704.
43. Simon NM, Smoller JW, McNamara KL, Maser RS, Zalta AK, Pollack MH, Nierenberg AA, Fava M, Wong KK. Telomere shortening and mood disorders: preliminary support for a chronic stress model of accelerated aging. Biol Psychiatry 2006; 60: 432-435.
44. Lung FW, Chen NC, Shu BC. Genetic pathway of major depressive disorder in shortening telomeric length. Psychiatr Genet 2007; 17: 195-199.
45. Hartmann N, Boehner M, Groenen F, Kalb R. Telomere length of patients with major depression is shortened but independent from therapy and severity of the disease. Depress Anxiety 2010; 27: 1111-1116.
46. Hoen PW, DE Jonge P, NA BY, Farzaneh-Far R, Epel E, LIN J, Blackburn E, Whooley MA. Depression and leukocyte telomere length in patients with coronary heart disease: data from the heart and soul study. Psychosom Med 2011; 73: 541-547.
47. Garcia-Rizo C, Fernandez-Egea E, Miller BJ, Oliveira C, Justicia A, Griffith JK, Heaphy CM, Bernardo M, Kirkpatrick B. Abnormal glucose tolerance, white blood cell count, and telomere length in newly diagnosed, antidepressant-naive patients with depression. Brain Behav Immun 2013; 28: 49-53.
48. Verhoeven JE, Revesz D, Epel ES, Lin J, Wolkowitz OM, Penninx BW. Major depressive disorder and accelerated cellular aging: results from a large psychiatric cohort study. Mol Psychiatry 2014; 19: 895-901.
49. Cai N, Chang S, Li Y, Li Q, Hu J, Liang J, Song L, Kretzschmar W, Gan X, Nicod J, Rivera M, Deng H, Du B, Li K, Sang W, Gao J, Gao S, Ha B, Ho H-Y, Hu C, Hu J, Hu Z, Huang G, Jiang G, Jiang T, Jin W, Li G, Li K, Li Y, Li Y, Lİ Y, Lin T-T, Liu L, Liu T, Liu Y, Liu Y, Lu Y, Lv L, Meng H, Qian P, Sang H, Shen J, Shi J, Sun J, Tao M, Wng G, Wang G, Wang J, Wang L, Wang X, Wang X, Wang X, Yang H, Yang L, Yin Y, Zhang J, Zhang K, Sun N, Zhang W, Zhang X, Zhang z, Zhong H, Breen G, Wang J, Marchini J, Chen Y, Xu Q, Xu X, Mott R, Huang G-J, Kendler K, Flint J. Molecular signatures of major depression. Curr Biol 2015; 25: 1146-1156.
50. Lindqvist D, Epel ES, Mellon SH, Penninx BW, Revesz D, Verhoeven JE, Reus VI, Lin J, Mahan L, Hough CM, Rosser R, Bersani FS, Blackburn EH, Wolkowitz OM. Psychiatric disorders and leukocyte telomere length: underlying mechanisms linking mental illness with cellular aging. Neurosci Biobehav Rev 2015; 55: 333-364.

51. Wang X, Sundquist K, Hedelius A, Palmér A, Memon AA, Sundquist J. Leukocyte telomere length and depression, anxiety and stress and adjustment disorders in primary health care patients. BMC Psychiatry 2017; 148: 1-10.
52. OECD. Labour force participation rate. https://stats.oecd.org/Index.aspx?DataSetCode=lfs_sexage_i_r
53. TURKSTAT. Reasons of not being in labour force by years and sex. http://www.tuik.gov.tr/PreTablo.do?alt_id=1007
54. Sara E. What does NEETs mean and why is the concept so easily misinterpreted? ILO 2015; Geneva. https://www.ilo.org/wcmsp5/groups/public/---dgreports/---dcomm/documents/publication/wcms_343153.pdf.
55. UNDP. Progress at risk, the case study on income and social inequalities in Turkey. Regional human development report 2016.
56. Kazgan G. Türkiye ekonomisinde krizler (1929-2009) ekonomi politik açısından bir irdeleme. 5th edn. İstanbul Bilgi Üniversitesi Yayınları, Istanbul Turkey, 2017.
57. Acemoğlu D, Laibson D, List JA. Makroekonomi. Beta Basım Yayım Dağıtım A.Ş., İstanbul Turkey, 2016.
58. Our World in Data. Cancer incidence, 1990 to 2017. https://ourworldindata.org/grapher/cancer-incidence?tab=chart&country=TUR
59. Liang W, Guan W, Chen R, Wang W, Li J, Xu K, Li C,Ai Q, Lu W, Liang H, Li S, He J. Cancer patients in SARS-CoV-2 infection: a nationwide analysis in China. Lancet Oncol 2020; 21: 335-337.
60. Kutikov A, Weinberg DS, Edelman MJ, Horwitz EM, Uzzo RG, Fisher RI. A war on two fronts: cancer care in the time of COVID-19. Annals of Internal Medicine 2020; 172: 756-758.