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Research Article

Environmental determinants of life expectancy at birth in Turkey

Serap Taşkaya[1]*, Mustafa Demirkiran[2]

[1]Department of Health Care Management, Aksaray University, Aksaray, Turkey
[2]Department of Health Care Management, Süleyman Demirel University, Isparta, Turkey

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***Correspondence:**
Dr. Serap Taşkaya,
E-mail: seraptaskaya@yahoo.com

ABSTRACT

Background: Information on determinants of life expectancy has gained great importance due to the fact that life expectancy has been considered as the major health system outcome. Although social, economic and health-related factors of longevity have been investigated by some researchers, studies were undertaken on environmental determinants of lifespan are still inadequate. The aim of this study was to evaluate the environmental determinants of life expectancy at birth in Turkey.
Methods: The research population constitutes 81 provinces in Turkey. Data were gathered from the Turkey statistical institute for the year of 2015. Air pollution, forest area, safe water and noise pollution were indicators of environmental health. OLS regression analysis was performed to investigate the relationship between dependent and independent variables by using Eviews 9 program.
Results: At the end of analyses, it was found out that, the life expectancy at birth was affected by forest area per km^2. Also, the results indicated that air pollution, access to safe water and noise pollution were not associated with life expectancy at birth.
Conclusions: Forest area is one of the main issues for the healthy life of the country. These results are expected to provide evidence-based information to health policymakers to understand the environmental determinants of life expectancy at birth in Turkey.

Keywords: Life expectancy, Air pollution, Forest, Safe water, Noise pollution

INTRODUCTION

Over the last fifty years, life expectancy has been considered as the major health system outcome for measuring the health status of the countries.[1-4] It is defined as the number of years, a newborn infant would live if prevailing patterns of mortality at the time of its birth were to stay the same through the rest of its life.[5] In a health system, if life expectancy of a country is higher than the other countries with the same resources, it means that this country's health system is better than the others and also its population is healthier.[1,6,7]

In Turkey (Figure 1), the average life expectancy at birth increased from 48.3 years in 1960 to 76.6 years in 2013. The average annual longevity was 0.6 years between 1960 and 1990 and, was 0.4 years between 1991 and 2013. Although the differences between the life expectancy of Turkey and OECD countries are getting closer, Turkey has still one of the lowest life expectancy rates among OECD countries.[8]

Variations of this important outcome depend on various factors. However, there is no agreement in the literature of life expectancy on which are the most important factors causing health improvements. These various

factors can be classified as economic variables, social indicators, health related issues and, environmental determinants.[9-11]

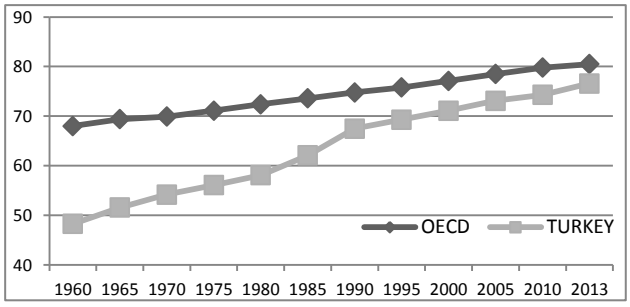

Figure 1: Life expectancy at birth in Turkey and OECD, 1960-2013.

The association between environmental effects and health has been known for a very long time.[12] The population's health is influenced by an appropriate state of the environment in a positive way.[13] Environmental determinants are the characters of space and place where the people live and work such as air pollution, forest area, access to safe water and noise pollution.[12,14] Improved environmental help to create a healthier place for people of the countries.[15]

Air pollution has a negative impact on life expectancy at birth. Especially reductions in particulate matter air pollution are associated with the reduction in both cardiopulmonary, asthma, and increase in life expectancy.[16,17] Correia et al found out that 10 µg/m^3 decrease in particulate matter (PM 2.5) was associated with an increase in life expectancy of 0.35 years in 545 United states counties for the period from 2000 to 2007.[18]

As an environmental factor, forests increase the life expectancy.[13] Green space has a lot of advantages and benefits of health status. Forest influences physical, psychological, emotional and mental health.[19] Moreover, Mitchell and Popham showed that green space was related with lower all-cause mortality and death from circulatory disease in low-income areas of England.[20]

Safe water or improved water means that it is the water piped into a dwelling, plot or yard and, standpipes, boreholes, protected dug wells, springs and rainwater collections are protected from exogenous contamination.[21] Safe drinking water is strongly correlated with child mortality and life expectancy rates due to the fact that millions of people die from diseases caused by poor quality water in every year.[22] Besides these, access to safe water can increase life expectancy at birth in order to it reduces infection rate.[23,24] In a multivariate linear regression analysis, Gulis to safe drinking water had statistically significant role in explaining life expectancy on data of 156 countries.[24]

Noise is another important source of environmental determinants of life expectancy. Noise pollution induces the release of stress hormones and increases the risk of cardiovascular diseases such as myocardial infarction and ischemic heart diseases.[25] According to WHO, every year, at least, one million healthy life years are lost from noise in the European countries.[26]

Healthy environment is very important for governments and policymakers.[27] Although there is a considerable volume of social, economic and health related factors of life expectancy, studies undertaken on environmental determinants of lifespan are still inadequate.[12] So this study was aimed to determinants of life expectancy at birth in Turkey with OLS regression analysis. These results are expected to provide evidence based information to health policymakers to understand the importance of environmental health on life expectancy at birth in Turkey.

METHODS

The sample consisted of all 81 provinces of Turkey. Quantitative secondary data were collected from statistical databases of Turkish statistic institute for the year of 2015.[28] In order to examine the relationship between environmental health indicators and life expectancy at birth, five variables were used; life expectancy, air pollution, forest area, water and noise pollution. In the model, all variables were converted into a natural logarithmic form due to the fact that there are non-linear relationships between the independent and dependent variables. Log transformations change the highly skewed variables into approximately normal to linear.[29,30] Definitions of variables were depicted in Table 1.

Table 1: Variables in research.

Variable	Description
Ln life	Log of life expectancy at birth
Ln air	Average of PM 10 values of the stations (air pollution) (µg/m^3)
Ln forest	Log of forest area per km^2 (%)
Ln water	Access rate of population to drinking water with pipe system (safe water) (%)
Ln noise	Log of percentage of households having noise problems from the streets (%)

The collected data were stored in a statistical package for social science (SPSS), version 17.0 for analysis. Descriptive statistics such as means and standard deviations and correlation analysis were calculated for data. OLS regression analysis was performed to evaluate the environmental determinants of life expectancy by using Eviews 9 program. In this study, life expectancy was considered as a function of environmental health variables, and these relationships could be written as:

LNLIFE = C(1) + C(2)*LNAIR + C(3)*LNFOREST + C(4)*LNWATER + C(5)*LNNOISE

RESULTS

Descriptive statistics of 81 provinces by human resources for health are outlined in Table 2. According to findings, the average life expectancy in the 81 provinces was about 78 years. The highest life expectancy was in Muğla and Tunceli and the lowest was in Kilis. Air pollution was the highest in Siirt. Access rate of the population to drinking water with pipe system is the lowest in Ardahan. Forest area per km^2 is the 69.7 in Karabuk. The highest noise pollution was in is Istanbul and the lowest was in Kutahya.

Correlation analysis results on the relationships between the main variables of the study have been presented in Table 3. According to this table, there is positive and significant relationship between the forest area and life expectancy (r=0.328; p=0.003). In addition, the relations between the life expectancy and air pollution, access to safe water and noise are weak (r=0.055; r=0.115; r=0.181 respectively). Moreover, there are also a positive relationships between the forest area and access to safe water (r=0.229; p=0.039) and between the access to safe water and noise pollution (r=0.346; p=0.002).

Table 2: Descriptive statistics of variables.

	Minimum	Maximum	Mean	Std. deviation
Life	75.00	80.50	78.1346	1.03636
Air	18.00	113.00	55.3358	20.29408
Forest	0.05	69.70	30.7117	19.29594
Water	31.10	100.00	74.3704	15.82308
Noise	6.40	33.80	15.6704	5.85409

OLS regression analysis was conducted to determine environmental determinants of life expectancy at birth. Linear and log-linear regressions analysis was performed to examine the significance of variable. Regression analysis results showed that only forest area explained 11%-14% variation in life expectancy at birth presented in Table 4. Both models were found significant (F=2.5170, p=0.048; F=3.0493, p=0.022) as a whole.

Table 3: Correlations among variables.

	Ln life	Ln air	Ln forest	Ln water	Ln noise
Ln life	1	0.055	0.328**	0.115	0.181
Ln air	0.055	1	-0.063	0.032	0.123
Ln forest	0.328**	-0.063	1	0.229*	0.045
Ln water	0.115	0.032	0.229*	1	0.346**
Ln noise	0.181	0.123	0.045	0.346**	1
** Correlation is significant at the 0.01 level (2-tailed)					
* Correlation is significant at the 0.05 level (2-tailed)					

Table 4: OLS Regression analysis results.

Linear model					Log-linear model				
Variable	Coefficient	SE	*t*	*p*	Variable	Coefficient	SE	*t*	*p*
C	77.180	0.637	121.144	0.000	C	4.329	0.030	149.203	0.000
Air	0.002	0.006	0.407	0.658	Ln air	0.002	0.003	0.515	0.607
Forest	0.016	0.006	2.675	0.001	Ln forest	0.003	0.001	-2.989	0.004
Water	-0.001	0.008	-0.095	0.924	Ln water	-0.001	0.0060	0.165	0.869
Noise	0.026	0.022	1.201	0.233	Ln noise	0.006	0.004	1.452	0.151
R-Squared					R-Squared	0.138			
Adjusted R Sq	0.117	Mean dep. var		78.124	Adjusted R Sq	0.092	Mean dep. var		4.358
SE. of reg.	0.071	SD dep.var		1.036	SE. of reg.	0.013	SD dep. var		0.013
Sum sq. resid	0.999	Aike info criter		2.895	Sum sq. resid	0.012	Aike info criter		-5.84
Log likelihood	75.872	Schwarz criter		3.043	Log likelihood	241.7	Schwarz criter		-5.70
F statistic	-112.3	Hennan-Quin		2.955	F statistic	3.049	Hennan-Quin		-5.78
Prob (F stat.)	2.517	Durbin-Watson		1.751	Prob (F stat.)	0.022	Durbin-Watson		1.757
	0.048								

The Durbin-Watson values showed that there were no autocorrelation problem in the model 1.75 and 1.76. As the VIF values were below 10 (1.023-1.280), there was no multi co-linearity problem between dependent and independent variables.

As a coefficient result, forest area had an impact on life expectancy in Turkey in 2015. According to this, the increase in forest area led to increase in life expectancy. An increase in 1-year life expectancy can be explained by increasing in 0.3% forest area per km^2. Life expectancy also affected by other environmental determinants such as air pollution, safe water and noise pollution, but these results were not significant. Regression model could be rewritten as;

LN Life = 4.32924255213 + 0.00194110731561*LN Air +0.00339954283919*LN Forest-0.00107589956795*LN Water+0.00590455173808*LN Noise

DISCUSSION

In this study, it was aimed to examine the environmental determinant of life expectancy in Turkey for the year of 2015. At the end of OLS regression analysis, it was found out that there were positive and significant relationships between forest area and life expectancy at birth.

Forest area was associated with life expectancy both in linear and log-linear models. Balogh, Lelovics and Seregi also indicated that life expectancy at birth showed an increase as the extent of the forests increased in European countries.[13] Blessi et al also showed that the urban green areas seemed to have little bearing on individual subjective well-being.[14] However, Potestio et al observed no associations between green space and cause-specific mortality in small urban areas of New Zeland.[31] MacKerron found that the urban green spaces were not related to the subjective well-being of city residents in London.[32]

In this study, the results indicated that air pollution, access to safe water and noise pollution were not associated with life expectancy at birth. Amjad and Khalil found out that although CO_2 emissions had negative impact on life expectancy at birth, there is an insignificant relationship between them in Sultanate of Oman.[27] Kabir also found that access to safe water was not significant effect on life expectancy for 91 developing countries using multiple regression models.[33] In contrast, some researches indicated that air pollution[16,17] and access to safe water had the significant impact on life expectancy at birth. [23,24]

The results have some policy implications for the Turkey. The government of Turkey should increase the forest area for the healthy life of the country. Access to safe water, air pollution, and noise pollution are undoubtedly important for life expectancy, but for 2015, these had not impacted on the increase in life expectancy. Further research is also recommended in order to identify environmental determinant of life expectancy in Turkey. These researchers need to include the other variables such as population, urbanization, waste pollution.

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