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Longitudinal analysis of the impact of emergency department numbers on healthy life expectancy and mortality levels

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Abstract

In this research, it was aimed to examine the impact of emergency department numbers on healthy life expectancy and mortality at the multivariate level. Ministry of Health Annual Reports, World Health Organization (WHO) Global Health Observatory database and the World Bank Country Reports were used as data gathering. Healthy Life (HALE) at birth and Healthy Life at age 60, suicide, disease and maternal mortality rates were used as dependent variables. The number of emergency services was used as an independent variable, whereas Gross Domestic Product per capita (GDP) and health expenditures were used as controlling variables. Number of emergency services was significantly correlated with HALE at birth ($r=0.936$; $p<0.01$), suicide mortality ($r=-0.793$; $p<0.01$), disease mortality ($r=-0.975$; $p<0.01$), health expenditure ($r=-0.778$; $p<0.01$) and GDP per capita ($r=0.993$; $p<0.01$). The number of emergency services was only positively affected on HALE at birth according to regression analysis ($B=0.003$; $p<0.01$). Its effects on HALE at age 60, suicide mortality, maternal mortality and disease mortality were statistically insignificant at the multivariate level ($p>0.05$). Although emergency services make a positive contribution to healthy life expectancy and mortality in the correlation analysis, this effect is not sufficient according to the regression analysis. Although there are improvements in emergency services in terms of numbers and the population addressed, the services given in the emergency services also must be improved.

Keywords: Emergency medicine, life expectancy, mortality

Introduction

An emergency medical service (EMS) network offers emergency medical resources, such as treating patients at the site of the rescue, tending to them to the hospital, and receiving and administering emergency treatment patients out of hospital [1,2]. For this reason, EMS has a crucial role in public health system [3]. For patients with significant, time-sensitive illnesses, severe injuries, and obstetric and medical emergencies, EMS is essential to provide health services [4]. In many developed nations, the need for emergency medical services has increased during the past few decades [5]. The majority of deaths from trauma, heart attacks, strokes, and other time-sensitive illnesses happen within the first hour and typically happen outside of the hospital [6]. Emergency situations account for a significant portion of the world's illness burden [7,8]. The services provided by emergency services, especially for diseases and emergencies, can be considered among the important precursors of the general health status and quality of life of the society and individuals.

Health is both an indicator of social development and one of the fundamental rights of individuals in a society [9]. Health is not only a duty and service provided by the public administration, but also a human right [10-12]. Therefore, health indicators are also indicators of the development levels of countries [13]. The most important of these indicators is Healthy Life Expectancy (HALE), measured by the WHO. HALE, in its most general definition, is an indicator of the average life expectancy of individuals in a country or region [14,15]. WHO compiles and publishes HALE in country health indicators as two indicators: at birth and after age 60. Another important issue that shows the level of healthy life or the quality of health services of a society

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is mortality rates [16,17]. Both WHO and World Bank Country reports determine and publish mortality rates for countries and regions around the world.

For all the above reasons, it is possible to argue that there is a direct relationship between HALE and mortality levels and EMS. Although there are different studies on EMS, HALE and mortality, there are not enough studies on the effects of the number of EMS on HALE and mortality. Thus, it was aimed to examine the impact of emergency department numbers on healthy life expectancy and mortality at multivariate level.

Material and Methods

Study Design

The research was designed in descriptive survey and relational manner, according to public data repositories. In the research, firstly, the number of emergency services and healthy life expectancy and maternal-disease mortality for Türkiye were defined, and then the relationship between them was analyzed.

In the study, the indicators selected with semiotic analysis methods for the analysis of data were analyzed with time-based statistical methods. In this context, the relational screening model was examined in two stages, with correlative and regression analyses.

Study Setting and Population

Life expectancy parameters were taken from WHO Global Health Observatory database as Healthy Life Expectancy at birth and Healthy Life Expectancy at age 60. The most recent database released by the Ministry of Health in 2022 contained the numbers for the population per emergency service and the number of emergency services for the years 2002–2021 were used as independent variables. In order to evaluate effects of emergency services on life expectancy and mortality, health service force must also be used as controlling variables, since health services are also related with financial and employee level of the country.

Since data of the study is public and available for all researchers or public, no ethical approval or informed consent is required for the research. Since the data is shared openly on the official websites of the relevant institutions, there is no need to obtain a separate institutional permission.

Dependent Variables

Mortality parameters were taken from the World Bank Country Report and WHO mortality database code as (https://data.worldbank.org/country):

- Suicide mortality: Suicide mortality rate (per 100,000 population)
- Maternal mortality: Maternal mortality ratio (national estimate, per 100,000 live births)
- Disease mortality: Mortality from Coronary Vascular Disease (CVD), cancer, diabetes or Chronic Renal Disease (CRD) between exact ages 30 and 70, (%)

Independent variables

The most recent database released by the Ministry of Health in 2022 contained the numbers for the population per emergency service and the number of emergency services for the years 2002–2021 were used as independent variables (https://www.saglik.gov.tr/TR-84930/saglik-istatistikleri-yilliklari.html).

Controlling variables

- Selected controlling variables from the World Bank Country Report were given as follows:
- Current health expenditure (% of Gross Domestic Product per capita (GDP)
- GDP per capita, purchasing power parity (PPP) (constant 2017 international $)

The research was conducted at a macro level and annual data from the Ministry of Health and the WHO, World Bank, which have proven to be reliable, were used.

The data used in the study, from the World Health Organization, the World Bank, and the Ministry of Health, covers the entire population and is accessible through the official website. Because the data is public and does not contain personal information, ethics committee approval is not required.

For each year, the study included all mortality rates reported by the Ministry of Health and the WHO. This allowed for the use of a complete census sampling method. Therefore, the study is significant because it includes all mortality rates within the studied time period. The study has highly generalizable results because all mortality parameters were obtained through complete count sampling and the data were published under the supervision of both the Ministry of Health and the WHO.

Data Analysis

Scale variables of the research were described with means, standard deviations, median and ranges. Kolmogorov Smirnov test was used for normality of research parameters. Pearson's Correlation was used for relationship analysis. Since distributions were accordance with normal distribution, linear regression analysis was used for each effect measurement [18]. SPSS 25.0 for windows was used at 95% Confidence Interval and 0.05 significance level.

Result

Number of emergency services was ranged from 481 to 3170 with 1815±837 mean value. HALE at birth mean was 66.52±1.36 and HALE at age 60 mean was 16.23±0.23. Suicide mortality range was 2.20-3.20 per 100.000 population, and maternal mortality range was 16.00-57.00 per 100.000 live births. Disease mortality mean was 17.33±1.22 with 15.60-19.90 range (Table 1).

According to data on the number of emergency services and the population per service over time, it is seen that the effectiveness of each emergency service unit has increased (Figure 1).

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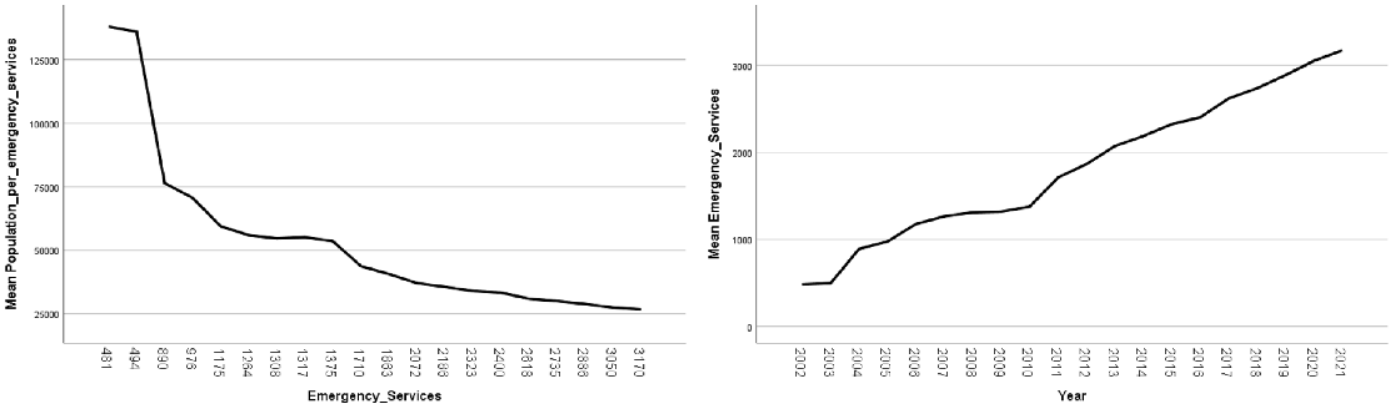

Figure 1. Number of emergency services and mean population per emergency services

Table 1. Descriptive statistics of number of emergency services. population per emergency. HALE. mortality and health related parameters (2002-2023)

Descriptive parameters	Mean ± Standard Deviation	Median	Minimum	Maximum
Emergency Services	1815±837	1787	481	3170
Population per emergency services	53369±32069	42146	26713	138050
HALE at birth, years	66.52±1.36	66.90	65.00	68.40
HALE at age 60, years	16.23±0.23	16.30	15.90	16.60
Suicide mortality, per 100.000 population	2.51±0.32	2.40	2.20	3.20
Maternal mortality, per 100.000 population	23.58±11.74	19.00	16.00	57.00
Disease mortality, %	17.33±1.22	17.35	15.60	19.90
Health expenditure, (% of GDP)	4.71±0.43	4.65	4.12	5.49
GDP per capita, constant 2017 international $	23180.17±5392.01	22452.84	14839.13	33149.50

HALE: Healthy life expectance. GDP: Gross domestic product

Correlation analysis results showed that number of emergency services were significantly correlated with HALE at birth (r=0.936; p<0.01), suicide mortality (r=-0.793; p<0.01), disease mortality (r=-0.975; p<0.01), health expenditure (r=-0.778; p<0.01) and GDP per capita (r=0.993; p<0.01) (Table 2).

Population per emergency services were significantly correlated with HALE at birth (r=-0.722; p<0.01), suicide mortality (r=0.913; p<0.01), disease mortality (r=0.914; p<0.01), health expenditure (r=0.565; p<0.05) and GDP per capita (r=-0.823; p<0.01) (Table 2).

Table 2. Pearson's correlation analysis between emergency services and research parameters

Research parameters	Emergency Services	Population per emergency services
HALE at birth, years	0.936**	-0.722**
HALE at age 60, years	0.210	0.057
Suicide mortality, per 100,000 population	-0.793**	0.913**
Maternal mortality, per 100,000 population	-0.541	0.559
Disease mortality, %	-0.975**	0.914**
Health expenditure, (% of GDP)	-0.778**	0.565*
GDP per capita, constant 2017 international $	0.993**	-0.823**

The values were presented as mean±standard deviation

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Despite of significant correlations, number of emergency services was only positively effect on HALE at birth according to regression analysis (B=0.003; p<0.01). Its effects on Hale at age 60, suicide mortality, maternal mortality and disease mortality were statistically insignificant at multivariate level (p>0.05). Regression analysis results also showed that explanatory level of HALE at birth parameter model has significant level with 89.2% R square value. In the models, effects of EMSs on HALE at birth were in positive direction (Table 3). ARIMA model (Autoregressive Integrated Moving Average) results also gave same statistics as linear regression (Table 4).

According to regression analysis results, there was a positive relation between HALE at birth and number of emergency services (Figure 2).

Table 3. Linear regression analysis on impact of emergency department numbers on healthy life expectancy and mortality levels

HALE and mortality parameters	Constant			Emergency Services			Health expenditure			GDP			R^2
	B	SE	p	B	SE	p	B	SE	p	B	SE	p	
HALE at birth	74.760	4.662	0.000	0.003	0.001	0.029	-1.297	0.466	0.014	0.001	0.001	0.162	0.892
HALE at age60	12.981	2.240	0.000	0.001	0.001	0.751	0.436	0.224	0.070	6.744	0.001	0.541	0.067
Suicide mortality	3.580	2.014	0.097	-0.001	0.001	0.137	-0.257	0.206	0.232	7.606	0.001	0.472	0.643
Maternal mortality	62.783	148.344	0.683	-0.078	0.052	0.167	-16.668	17.880	0.379	0.008	0.008	0.331	0.242
Disease mortality	25.479	2.805	0.000	-0.001	0.001	0.420	-0.566	0.286	0.068	0.001	0.001	0.185	0.954

B: regression coefficient, SE: Standard Error

Table 4. ARIMA (Autoregressive Integrated Moving Average) regression analysis on impact of emergency department numbers on healthy life expectancy and mortality levels

HALE and mortality parameters	Constant			Emergency Services			Health expenditure			GDP			R^2
	B	SE	p	B	SE	p	B	SE	p	B	SE	p	
HALE at birth	74.760	4.662	0.000	0.003	0.001	0.029	-1.297	0.466	0.014	0.001	0.001	0.162	0.892
HALE at age60	12.981	2.240	0.000	0.001	0.001	0.751	0.436	0.224	0.070	6.744	0.001	0.541	0.067
Suicide mortality	3.580	2.014	0.097	-0.001	0.001	0.137	-0.257	0.206	0.232	7.606	0.001	0.472	0.643
Maternal mortality	62.783	148.344	0.683	-0.078	0.052	0.167	-16.668	17.880	0.379	0.008	0.008	0.331	0.242
Disease mortality	25.479	2.805	0.000	-0.001	0.001	0.420	-0.566	0.286	0.068	0.001	0.001	0.185	0.954

B: regression coefficient, SE: Standard error

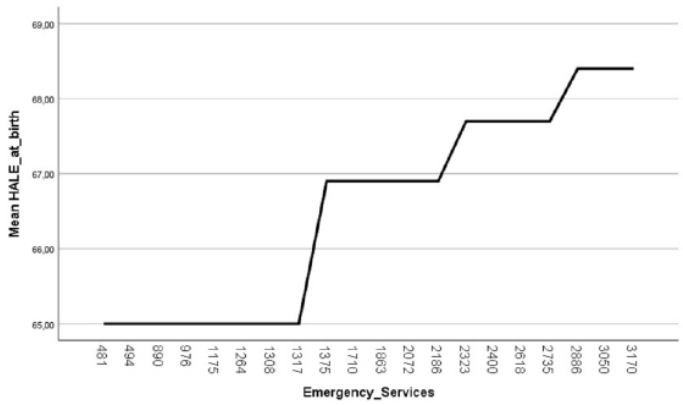

Figure 1. HALE at birth and number of emergency services relationship

Discussion

In this study, the effects of the number of emergency services on HALE and mortality as an indicator of healthy life were examined. In the research, the relationship and impact between Turkey's healthy life and mortality indicators given by WHO and the World Bank between 2002 and 2022 and the number of EMS provided by the Ministry of Health were analyzed. The results showed that although EMS numbers were associated with mortality and HALE, at the effect level, they were only associated with HALE at birth.

Both studies on EMS in the literature and field applications reveal that EMSs have a very important role in the healthcare system [19,20]. Especially in health situations that have a high mortality rate such as acute attack periods of diseases, traumas, accidents,

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injuries and which the body cannot overcome on its own, urgent medical justification is needed [21-23]. In this respect, EMSs have an important role in reducing both mortality and increasing healthy life expectancy and extending human life.

Although the relationship between EMS and healthy life expectancy is not directly examined in the literature, the importance and role of EMS in the health system can be indirectly associated with healthy life expectancy [24,25]. In our study, EMSs gave significant correlation analysis results both for those over 60 years of age and for healthy life expectancy from birth. However, in the regression analysis, the effect of HALE from birth was statistically significant. It is possible to argue that the fact that individuals are already under surveillance in hospitals or health institutions at older ages and that there are more factors such as accidents that cause mortality at younger ages have an impact on these results.

Studies on the effects of EMS on mortality are limited, but in general, in these studies, EMSs have a vital role in mortality cases that may occur due to reasons such as accidents, injuries, attacks. In our study, there was a statistically significant and negative relationship between suicide and disease mortality with EMS numbers. However, in regression analysis, this relationship was not significant. In order to reflect the correlation analyzes in the regression, conducting research with a wider time series in the future may provide useful results. In addition, advanced and multivariate analyzes may be performed on the effectiveness of EMSs in mortality cases.

Studies on mortality with EMS generally report high mortality rates in emergency departments for suicides, injuries, and accidents [26-29]. Therefore, examining the relationship between mortality and EMS alone may reveal high EMS mortality rates. However, when considering overall mortality, EMS appears to contribute significantly to population-based mortality.

Contributions of the Research to the Field

The most important contribution of the research to the field is that it is a pioneering study examining the activities of EMSs at the macro level and their direct contributions to the health system. Although studies have been conducted on EMS and its relationship with mortality, studies in the field are more focused on measuring and increasing EMS performance. In this research, the effect of EMS on different types of mortality was analyzed. In this way, further research and studies can be conducted on rare types of mortality.

Study Limitations

The most important limitation of the research is the limited data series. In Türkiye and the world in general, data regarding EMSs have started to be kept regularly in recent years. Therefore, although the data set is large enough to show significant activity in correlation analyses, larger time series are needed for multivariate and time-dispersed analyses. For this purpose, the research can be expanded and re-done in the coming years and cross-comparisons can be made with different countries.

Another important limitation of the study is that the data on mortality levels include many different causes, especially in diseases, so there is no more specific and distinctive data. In this regard, more advanced data recording and compilation systems are needed both in field applications and in health management.

Conclusion

Although correlation analysis showed that EMS numbers were associated with mortality, these associations were not significant according to regression analyses. This shows that although EMS numbers actually affect mortality, this effect is still limited.

Examining the relationship between EMS and mortality in both field research and high-level academic studies can improve the discipline and have a positive impact on public health because the data in the EMS database is gathered centrally and compiled in a challenging manner. Furthermore, research on the impact of errors made when utilizing emergency services on death rates might be carried out.

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Conflict of Interests
The authors declare that there is no conflict of interest in the study.

Financial Disclosure
The authors declare that they have received no financial support for the study.

Ethical Approval
Since data used in the research is public, ethical board is not applicable.

Data Availability Statement
Data are available from WHO Global Health Observatory database and Ministry of Health of Türkiye web sites publicly.

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