TURKISH JOURNAL OF PUBLIC HEALTH

TURKISH JOURNAL OF PUBLIC HEALTH

Year: 2023 | Volume: 21 | Issue:3 | e-ISSN: 1304-1088

Turkish Journal of Public Health published by Cetus Publishing.

Publication Ethics
Turkish Journal of Public Health is a member of the Committee on Publication Ethics (COPE) and accepts the principles of publication ethics and evaluates all submitted manuscripts in this context. Readers and authors can access these rules and case examples at the following links:

Turkish Journal of Public Health

Volume: 21**, Issue:** 3, 2023

Owner: Prof. Dr. Bülent KILIÇ

Adress: Korkutreis Mahallesl, İlkız Sk. No:17 D:2, 06430 Çankaya/Ankara

E-mail: yucel.demiral@gmail.com

Release Date: December 23, 2023

Indexes: TR Dizin, EBSCO, ProQuest, Turkiye Atıf Dizini, ULAKBIM, DOAJ, SCOPUS

e-ISSN: 1304-1088

Turkish Journal of Public Health is published three times a year. The publication language of the journal is English.
Article submission address: https://dergipark.org.tr/tr/journal/814/submission/step/manuscript/new

JOURNAL BOARDS

Aims and Scope

The owner of the journal is the Turkish Public Health Specialists Association. Turkish Journal of Public Health is a peer-reviewed, English-only research journal published online three times a year, serving a wide audience in the field of public health and community medicine at national and international levels. Turk J Public Health aims to provide an environment for the rapid communication of developments and new information in this field. We welcome articles on public health theory and practice.

The editors anticipates receiving manuscripts from the following areas of public health, Health policy and management, Biostatistics, Epidemiology, Environmental health, Health economics, Demography, Social, sciences for health, Health education, Health promotion, Community nutrition, Infectious diseases, Disaster management, Injuries, Women's health, Reproductive health, Child health, Chronic diseases, Occupational health, Global health, Inequalities. Turkish Journal of Public Health is a member of Committee on Publication Ethics (COPE). Turk J Public Health is covered following national international indexing services: DOAJ, EBSCO, ProQuest, Turkiye Atıf Dizini, ULAKBIM, Google Scholar and SCOPUS.

Open Access Policy

Turkish Journal of Public Health is an online and an open access journal. All the manuscripts are fully accessible via a link at their relevant pages. Turkish Journal of Public Health do not ask any kind of author fees.

Peer-Review Policy

Turk J Public Health aims to publish the top-quality articles related to the theoretical and practical application of public health sciences. A qualified peer review process to achieve this goal is very crucial for Turk J Public Health. Objectivity, accuracy, and fairness are basic principles during the peer review and publishing stages for Turk J Public Health. The trust of all readers, authors, researchers, referees, public health experts, physicians, funding bodies that support the research and public health managers are very important to us. All of the manuscripts have been sent to at least two reviewers and reviewers are blind to authors identities. Authors are also blind to reviewers identities. (Double Blind Peer-Review)

Instructions for Authors

Instructions for authors page of the journal is available in the journal content.

Disclaimer

The statements and opinions expressed contained in the articles of the The Turkish Journal of Public Health are solely those of the individual authors and contributors not of the Turkish Society of Public Health Specialists or Cetus Publishing.

Publisher

Cetus Publishing
Address : Balıkesir Teknokent Çağış Mah. Çağış B.M.Sk. No:340/16 İç Kapı No:17 Altıeylül/Balıkesir
Phone : +90 532 605 56 85
E-mail : info@cetuspub.com

REVIEWER LIST

Ögr. Gör. Ahmet Can BİLGİN, Dokuz Eylul University, Faculty of Medicine, Department of Internal Medicine, Department of Public Health, İzmir, Türkiye.

Prof. Dr. Ahmet TOPUZOĞLU, Marmara University, Faculty of Medicine, Department of Internal Medicine, Department of Public Health, İstanbul, Türkiye.

Doç. Dr. Asya Banu BABAOĞLU, İİzmir Katip Çelebi University, Faculty of Medicine, Department of Internal Medicine, Department of Public Health, İzmir, Türkiye.

Dr. Öğr. Üyesi Ayşe COŞKUN BEYAN, Dokuz Eylül University, Vocational School of Health Services, Department of Medical Services and Techniques, Medical Imaging Techniques Program, İzmir Türkiye.

Prof. Dr. Belgin ÜNAL, Dokuz Eylul University, Faculty of Medicine, Department of Internal Medicine, Department of Public Health, İzmir, Türkiye.

Prof. Dr. Beyhan ÖZYURT, Manisa Celal Bayar Faculty of Medicine.

Dr. Buhara ÖNAL, Icoh- International Commission On Occupational Health.

Doç. Dr. Ceyda ŞAHAN, Dokuz Eylul University, Faculty of Medicine, Department of Internal Medicine, Public Health Department, İzmir, Türkiye.

Prof. Dr. Dilek ASLAN, Hacettepe University, Faculty of Medicine, Department of Internal Medicine, Department of Public Health, Ankara Türkiye.

Doç. Dr. İskender GÜN, Erciyes University, Faculty of Medicine, Department of Internal Medicine, Department of Public Health, Kayseri, Türkiye.

Dr. Öğretim Görevlisi İsmet ÇELEBİ, Gazi University, Vocational School of Health Services, Department of Medical Services and Techniques, First and Emergency Aid Program, Ankara, Türkiye.

Uzm. Dr. Neşe YAKŞİ, Nigde Central Community Health Center.

Uzm. Dr. Nureddin ÖZDENER, Adana Health Directorate.

Dr. Özge KARADAĞ, Columbia University, Earth Institute, Center for Sustainable Development.

Dr. Öğr. Üyesi Petek Eylül TANERİ, Bahçeşehir University.

Prof. Dr. Raika DURUSOY, Ege University, Faculty of Medicine, Department of Internal Medicine, Department of Public Health, İzmir, Türkiye.

Doç. Dr. Raziye ÖZDEMİR, Karabuk University, Faculty of Health Sciences, Department of Midwifery, Department of Midwifery, Karabük, Türkiye.

Prof. Dr. Sevgi CANBAZ, Istanbul University, Istanbul Faculty of Medicine, Department of Internal Medicine, Department of Public Health, İstanbul, Türkiye.

Dr. Seyfi DURMAZ, Ege University, Faculty of Medicine, Department of Internal Medicine, Department of Public Health, İzmir, Türkiye.

Prof. Dr. Sibel SAKARYA, Koç University, School Of Medicine, Department Of Public Health, İstanbul, Türkiye.

Prof. Dr. Türkan GÜNAY, Dokuz Eylul University, Faculty of Medicine, Department of Internal Medicine, Department of Public Health, İzmir, Türkiye.

Uzm. Dr. Yağmur KÖKSAL YASİN, Hatay Dörtyol District Health Directorate.

Doç. Dr. Zahide KOŞAN, Atatürk University, Faculty of Medicine, Department of Internal Medicine, Department of Public Health, Erzurum, Türkiye.

Turkish Journal of Public Health

VOLUME: 21 CONTENTS ISSUE: 3

Original Article

Short Report

Case Report

From the Editor

In this latest issue of 2023 of the Turkish Journal of Public Health, we present a compilation of ten interesting articles addressing different aspects of public health. The first article investigates the all-cause mortality rates among COVID-19 patients within a one-year follow-up period. The findings underline the significance of age, pre-existing conditions, smoking habits, and hospitalization status as key factors influencing mortality rates. The identification of these risk factors emphasizes the need for tailored policies, particularly for elderly individuals with chronic diseases. Another study examines infant mortality rates before and during the COVID-19 pandemic in Istanbul. The rise in postneonatal mortality, particularly due to infections, prompts a closer examination of healthcare accessibility and other contributing factors, highlighting the need for enhanced data accessibility for decision-making in challenging times. Adolescent pregnancies, a public health concern of all time, are explored in the third article. The authors stress the urgency of informing both adolescents and healthcare providers about these risks while advocating for preventive strategies. Childhood overweight and obesity, a growing issue in Turkey, are investigated in forth article. This study highlights the critical role of maternal health and appropriate infant nutrition in preventing childhood obesity by supporting well-known social determinants. Another study from Egypt evaluates the knowledge, attitude, and barriers to research participation among undergraduate medical students in line with fostering future researchers, Understanding and mitigating these barriers could enhance students' involvement and experience in research endeavors. Rational antibiotic use which is remains a key concern globally is investigated in a study. An educational program's impact on health technician students' knowledge and attitudes towards rational antibiotic use is thoroughly assessed, and emphasize the efficacy of tailored educational interventions. In another research article, occupational exposure to electromagnetic fields in dental health workers was investigated. Findings indicate that certain practices cause significant exposures. The authors emphasize the need for periodic exposure assessments to gain a comprehensive understanding of workplace exposures. The emergence of non-cholera vibriosis during heat wave events in Russia's regions is explored in a short report. The report underline the correlation between rising temperatures and disease incidence, prompting considerations in predicting and preventing outbreaks amidst warming tendencies. The other short report is a study investigating risk perception during the COVID-19 pandemic across different generations. Media exposure appears to be a significant influence on behavioral patterns, particularly vaccination behavior. In this context, it is important to encourage further research. Lastly, the hazards associated with traditional and complementary medicine practices are illuminated through a case study involving deliberate exposure to fig leaves. The case emphasizes the necessity for evidence-based recommendations in herbal treatments to ensure public safety. Sharing the negative results of such practices will contribute to preventing unrealistic trust behaviors in complementary and traditional medicine.

Each article in this issue contributes valuable insights that foster collective action toward informed policies, improved practices, and public health strategies. We hope these findings will inspire further research and initiatives. We extend our gratitude to all contributors, reviewers, and readers who have been an integral part of our Journal. As we celebrate the 100th anniversary of the Republic, we wish you a happy and healthy new year and enjoy reading our latest issue published together with our 25th Congress.

Yucel Demiral

Editor in Chief

Turk J Public Health
Available online at: http://dergipark.org.tr/tjph/
Doi: 10.20518/tjph.1293201

TURKISH JOURNAL OF PUBLIC HEALTH

ORIGINAL ARTICLE

Investigation of all-cause mortality and associated factors in patients diagnosed with COVID-19: A retrospective cohort study

Ahmet Furkan Süner[1] Ahmet Naci Emecen[2] Salih Keskin[1]
Neslişah Şiyve[1] Ecem Başoğlu Şensoy[1] Öykü Turunç[3] Belgin Ünal[4]

[1]Research Assist. Dr., Dokuz Eylul University Faculty of Medicine, Department of Public Health, İzmir, Türkiye
[2]Specialist, Dokuz Eylul University Faculty of Medicine, Department of Public Health, İzmir, Türkiye
[3]Specialist, Mardin Provincial Health Directorate, Mardin, Türkiye
[4]Prof. Dr., Dokuz Eylul University Faculty of Medicine, Department of Public Health, İzmir, Türkiye

Received: 11.05.2023, **Accepted:** 13.11.2023

Abstract

Objective: This study aims to investigate the extent and associated factors of all-cause mortality in patients diagnosed with COVID-19 in a hospital for over a one-year follow-up period.

Methods: This retrospective cohort study was conducted on the patients who applied and tested positive for SARS-CoV-2 in the Dokuz Eylul University Hospital which is a large tertiary healthcare facility in Izmir, Turkey, between 19.03.2020 and 31.05.2021. The study included 8955 adult patients with a positive SARS-CoV-2 PCR test. Kaplan-Meier survival analysis and Cox regression models were used to examine the relationships between demographic and clinical characteristics and mortality.

Results: The cumulative all-cause mortality rate was 4.7% in COVID-19 patients. Patients over 80 years old had a significantly higher risk of death compared to those younger than 50 years old (aHR:22.3; 95% CI: 10.4-47.7). Current or ex-smokers had a higher risk of death compared to non-smokers (aHR: 1.6; 95% CI: 1.1-2.4). Patients without any complaints before diagnosis had a higher risk of death compared to those with three or more complaints (aHR: 1.7; 95% CI: 1.2-2.6). Patients hospitalized in the intensive care unit had a significantly higher risk of death compared to outpatients (aHR: 62.3; 95% CI: 37.6-101.9).

Conclusions: In COVID-19 patients, the risk of all-cause mortality is higher in the elderly, smokers, individuals admitted to medical or intensive care services, and those with a decreasing number of pre-diagnostic complaints. Monitoring patients with long follow-up periods and determining the course of illness and cause of death are important for understanding the natural course of COVID-19.

Keywords: COVID-19, Mortality, Follow-Up Study

Correspondence: Research Assist. Dr. Ahmet Furkan Süner, Dokuz Eylul University Faculty of Medicine, Department of Public Health, İzmir, Türkiye. **E-mail:** furkanafs@hotmail.com, **Phone**: +90 539 413 89 54.
Cite This Article: Süner AF, Emecen AN, Keskin S, Şiyve N, Şensoy EB, Turunç Ö, Ünal B. Investigation of all-cause mortality and associated factors in patients diagnosed with COVID-19: A retrospective cohort study. Turk J Public Health 2023;21(3): 336-348.

INTRODUCTION

Since the emergence of COVID-19 up to October 8, 2023, there have been over 771 million confirmed cases and sadly, more than 6.9 million individuals have lost their lives to the disease [1]. Accurately measuring the number of deaths due to the COVID-19 pandemic is crucial to understand the magnitude of the pandemic's impact on public health for each country and region. COVID-19 poses a direct and indirect increased risk for all-cause mortality in patients [2]. All-cause mortality is considered to be higher than expected during the pandemic [3]defined as the increase in all-cause mortality relative to the expected mortality, is widely considered as a more objective indicator of the COVID-19 death toll. However, there has been no global, frequently updated repository of the all-cause mortality data across countries. To fill this gap, we have collected weekly, monthly, or quarterly all-cause mortality data from 103 countries and territories, openly available as the regularly updated World Mortality Dataset. This dataset was used to compute the excess mortality in each country during the COVID-19 pandemic. Data showed that several countries including Peru, Ecuador, Bolivia and Mexico were worst affected.

COVID-19 death is defined as, someone with positive PCR or antigen testing, who dies before full recovery and no alternative cause of death can be found [1]. Deaths in the first 28 days in COVID-19 patients have been studied extensively in the literature and reflect the acute situation [4,5]. The first 28 days mortality is defined as directly related to the COVID-19 disease and no other condition has intervened. Later deaths generally refer to a death of the person from any cause. Deaths over time may be from complications or long-term effects of COVID-19 but can also be caused by non-COVID-19 reasons.

The infection fatality rate refers to the probability of dying for an infected person and is one of the key features of the COVID-19 pandemic. The expected total death burden of COVID-19 is directly related to the infection fatality rate [6]. Initial data from China had a case fatality rate of 3.4%with the rapid progression of the epidemic after the first wave [7]. National health systems were regulated to reduce viral transmission and the number of cases. Over time, the number of hospitalized and deceased people has also decreased [8]. Later, mathematical models predicted that 40-81% of the world's population could be infected, and infection fatality rate of 1.0% or 0.9% [9].

It is essential to understand the magnitude of death quantitatively and determine the factors that influence death. In studies, advanced age [10], male gender, and non-white ethnicity are cited as the main risk factors for severe or fatal COVID-19 [11,12]Asian and Minority Ethnic (BAME. In addition, several comorbidities were reported as important risk factors for COVID-19 mortality including hypertension [13], cardiovascular diseases [14], kidney disease [15,16] and diabetes [15–17].

The relationship of death with lifestyle and metabolic factors such as obesity [18], smoking [15,19], vitamin D level [20,21] and environmental factors such as air pollutants [22] has been reported. In a study conducted in a national cohort in England, demographic covariates, being a healthcare worker, current smoking, cardiovascular disease, autoimmune diseases and oral steroid use were independently associated with COVID-19 mortality [15].

The effect of certain risk factors on mortality is known. The literature on COVID-19 and mortality is increasing day by day, a better understanding of extent and determinants of all-cause mortality in COVID-19 patients may help to develop better strategies to identify and protect groups that may be badly affected by the pandemic. This study aims to investigate the factors associated with all-cause mortality with an over one year of the follow-up period in patients diagnosed with COVID-19.

METHODS

This retrospective cohort study was conducted on the patients who applied and tested positive for SARS-CoV-2 in the Dokuz Eylul University Hospital, which is a large tertiary healthcare facility in İzmir, Turkey between 19.03.2020 and 31.05.2021. Dokuz Eylul University Hospital has been a designated pandemic public hospital since the beginning of the pandemic and people could admit to outpatient COVID-19 policlinic or emergency care unit with or without a referral. The study included 8955 patients with a positive SARS-CoV-2 PCR test. The study was approved by the Dokuz Eylul University Ethics Committee (Date: 23.03.2022- Decision No: 2022/11-01).

The data were collected through the COVID-19 Monitoring Center (COVIMER) established in the Dokuz Eylul University Hospital. In January 2021, COVIMER was established with the aim of monitoring the health status of people with a positive COVID-19 by PCR test. The center was coordinated by a faculty member from the Department of Public Health. The center's information technology infrastructure, data collection, and monitoring tasks were managed by an Epidemiologist and five residents from the Department of Public Health. Patient follow-up calls were conducted by five secretaries [23].

Participants were interviewed using a structured questionnaire by telephone calls on the 1st, 3rd, and 6th months after diagnosis. Data were collected using electronic interview forms and stored in separate databases in each follow-up. Patients were electronically followed up for death status on March 1, 2022, by the Hospital Information System.

All-cause death was the dependent variable, and it refers to patients who died in the hospital or during follow-up periods after being diagnosed with COVID-19. All-cause 'in hospital' death was defined as the death during the initial hospitalization of the patient with the diagnosis of COVID-19 or in the emergency room. Hospital death does not encompass any specific time frame. In the hospital setting, the majority of patients who died during the acute phase of admission are attributed to COVID-19-related mortality. The data of COVID-19 patients who died in the hospital were transferred to COVIMER from the hospital information system. The mortality status of these patients was later verified on March 1, 2022, during a system scan. Out-of-hospital death from all causes was defined as death in those who are hospitalized after being diagnosed with COVID-19 or in people who have never been hospitalized. Out-of-hospital deaths refer to mortality that occur at any healthcare facility or at home after discharge from Dokuz Eylul University Hospital following an acute COVID-19 admission. Out-of-hospital deaths refer to patients identified during the hospital information system's death screening on March 1, 2022, who were determined not to have died in the hospital during the acute phase. The information on

cause of death whether due to the long-term effects of COVID-19 or for any other reason was not available from the hospital records therefore we used all cause of death as the outcome variable of the study.

Independent variables were age, gender, educational status, perceived economic status, marital status, smoking, alcohol, presence of / number of chronic disease, presence of / number of initial symptoms, and inpatient and intensive care admission. Information on age, gender were obtained from the hospital information system, the information on other independent variables were collected through telephone interviews.

Statistical Analysis

Survival time for deceased patients was estimated as the duration between the date of diagnosis and the date of death; for surviving patients, from the date of diagnosis to March 1, 2022. Kaplan Meier analysis was used to investigate the association between the independent variables and all-cause mortality. Log-Rank test was used to compare survival functions calculated according to different factors. Predictive Cox Regression Models were created from the variables that were significant in the Log-Rank test. In the model obtained, crude and multivariable adjusted hazard ratios and %95 confidence intervals were determined separately for each variable. The statistical analyses were performed by Statistical Package for Social Sciences SPSS (version 26, Armonk, NY, USA). A two-sided $p < 0.05$ was considered statistically significant.

RESULTS

In total 8955 COVID-19 patients were included in the study. Mean age of the patients was 44.4 ± 16.5 years and 51.2% of the participants were women. Of the patients, 85.9% were treated as an outpatient, 10.2% were admitted to the hospital service only, and 3.9% were admitted to the intensive care unit. All-cause mortality was 0.8% in patients treated at home (outpatients), 12% in patients hospitalized in service, and 72.2% in intensive care admissions. During over one year follow-up period (mean: 426 days, min: 1 max: 713), 421 patients (4.7%) died; 261 (61.9%) deaths occurred in the initial admission to Dokuz Eylul University Hospital and 160 (39.1%) died after the discharge from the hospital. Overall, 259 (2.9%) patients died within 28 days (early), and 162 patients (1.8%) died after 28 days (late) (Table 1).

Table 1. Patient Characteristics and Mortality

Patient Characteristics	
Age (Mean ± SD)	44.4 ± 16.5
Gender (Women) (%)	51.2
Education level	
High education level (%)	63.6
Primary/secondary school level education (%)	32.0
Literate/Illiterate (%)	4.4
COVID-19 treatment	
Outpatient (%)	85.9
Hospitalized (Service) (%)	12.0
ICU Admission (%)	3.9
Mortality	
All-Cause Mortality	
Outpatients (%)	0.8
Hospitalized (Service) (%)	12
ICU Admission (%)	72.2
Mortality During Follow-up	
Total (%)	4.7
Initial Admission (%)	61.9
After Hospital Discharge (%)	39.1
Early (Within 28 days) (%)	2.9
Late (After 28 days) (%)	1.8
Follow-up Period (days) (Median (Min-Max))	426 (1-713)

The cumulative mortality rate was 6.0% in men and 3.5% in women (p<0.001). All-cause mortality in COVID-19 patients occurred mostly in the first 28 days and was more common in men (p<0.001) (Figure 1) The cumulative mortality rate increased with age; 0.2% under the age of 40, 0.7% aged 40-49, 3.1% aged 50-59, 9.2% aged 60-69, 25.0% aged 70-79, 47.9% aged 80-89 and 90 years above 59.1% (p<0.001).

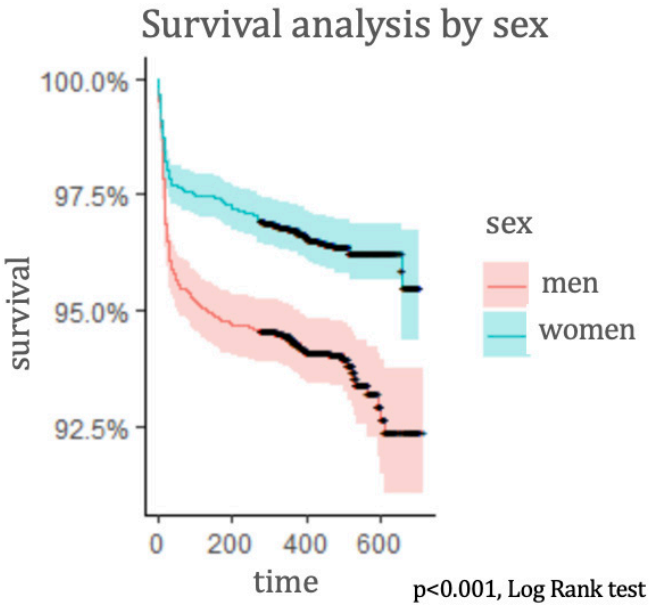

Figure 1. Survival curves of COVID- 19 patients by men and women

In Table 2, mean survival times were presented for men and women separately. Age, marital status, education, presence of chronic disease, number of chronic diseases, presence of pre-diagnosis complaints, number of pre-diagnosis complaints, admission status were associated with survival in both men and women (p<0.05 for all). Alcohol use made a difference in terms of survival in men (p<0.001). Perceived economic status was not associated with survival in either men (p=0.637) and women (p=0.223). Although smoking was associated with shorter survival in men (p<0.001), there was no association with survival in women (p=0.866).

In the study group, the association between all chronic disease and all-cause mortality was also examined using Kaplan-Meier analysis. Survival was significantly associated with having history of diabetes mellitus, hypertension, coronary artery disease, heart failure, cancer, kidney disease, chronic lung disease, cirrhosis, cerebrovascular disease, dementia (p<0.05), except patients with asthma history in men and women. There was no significant association between survival and high cholesterol (p=0.056) in women. There was no significant difference in survival for men with thyroid disease (p=0.927), but there was a significant difference for survival for women with thyroid disease (p=0.047) (Table 3).

Variables that were significantly associated with all-cause mortality in the Kaplan Meier analysis were included in the Cox regression model to estimate crude and multivariate adjusted HRs for all-cause mortality. We considered variables age, sex, marital status, education, number of chronic diseases, alcohol, smoking, number of complaints before diagnosis and hospital admission status for the multivariate Cox regression model.

Cox regression model showed that being a man increased the risk of mortality (HR:1.7; 95% Cl:1.4-2.1). Patients with increasing age had a higher risk of death. The risk of death over the age of 80 was 175 times higher (HR: 175.7; 95% CI: 112.1-275.3) compared to under the age of 50. Having lower literacy or being illiterate was associated with a higher risk of death compared to individuals with higher education (HR: 7.1; 95% CI: 4.7-10.5). Death risk was higher for people with three or more chronic diseases than for people without any

Table 2. Mean survival times in the categories of independent variables in men and women COVID-19 patients

Men					Women				
	Number of deaths	(%)	Mean survival time (days)	Log-Rank (p)		Number of deaths	%	Mean survival time (days)	Log-Rank (p)
Age groups									
Under 50 (n=2838)	15	0.5	701.7		Under 50 (n=2975)	7	0.2	702.6	
50-59 (n=731)	31	4.2	684.8		50-59 (n=737)	15	2.0	691.9	
60-69 (n=429)	55	12.8	616.8	<0.001	60-69 (n=449)	26	5.8	667.3	<0.001
70-79 (n=251)	86	24.3	473.5		70-79 (n=260)	42	16.2	601.6	
Over 80 (n=120)	74	61.7	301.6		Over 80 (n=165)	70	42.4	437.4	
Marital status									
Married (n=2674)	196	7.3	655.9	0.002	Married (n=2573)	65	2.5	662.6	<0.001
Not married (n=1104)	50	4.5	669.3		Not married (n=1391)	86	6.2	688.2	
Educational categories									
Higher education (n=2467)	60	2.4	689.2		Higher education (n=2370)	16	0.7	699.4	
Primary / secondary level education (n=1178)	97	8.2	648.2	<0.001	Primary / secondary level education (n=1251)	45	3.6	681.5	<0.001
Literate / illiterate (n=53)	8	15.1	605.1		Literate / illiterate (n=279)	28	10.0	636.2	
Perceived economic situation									
Bad (n=495)	17	3.4	677.9		Bad (n=442)	6	1.4	695.7	
Medium (n=2432)	105	4.3	676.1	0.637	Medium (n=2666)	65	2.4	688.5	0.223
Good (n=735)	29	3.9	679.4		Good (n=760)	13	1.7	692.3	
Chronic disease									
Yes (n=1263)	211	16.7	590.9	<0.001	Yes (n=1704)	149	8.7	648.3	<0.001
No (n=3106)	50	1.6	702.2		No (n=2282)	11	0.4	702.4	
Number of chronic diseases									
0 (n=3106)	50	1.6	702.2		0 (n=2882)	11	0.4	702.4	
1-2 (n=1003)	133	13.3	613.8	<0.001	1-2 (n=1338)	83	6.2	664.6	<0.001
3> (n=260)	78	30.0	501.8		3> (n=366)	66	18.0	586.1	
Alcohol									
Never used (n=1574)	95	6	460.0	<0.001	Never used (n=2349)	69	2.9	-	-
Used before / Currently using (n=1240)	35	2.8	473.1		Used before / Currently using (n=633)	0	0.0	-	
Smoking									
Never used (n=1625)	65	4.0	467.9	<0.001	Never used (n=2200)	55	2.5	475.0	0.866
Used before / Currently using (n=622)	56	9.0	445.5		Used before / Currently using (n=383)	10	2.6	474.5	
Presence of pre-diagnosis complaints									
Yes (n=2484)	133	5.4	504.0	<0.001	Yes (n=2729)	90	3.3	640.0	0.007
No (n=1855)	128	6.8	669.4		No (n=1857)	70	5.8	681.3	
Number of complaints before diagnosis									
0 (n=1885)	128	6.8	669.4		0 (n=1857)	70	3.8	681.3	<0.001
1-2 (n=920)	84	9.1	444.2	<0.001	1-2 (n=740)	52	7.4	616.3	
3> (n=1564)	49	3.1	515.1		3> (n=2025)	38	1.9	477.7	
Admission status									
Outpatient (n=3672)	42	1.1	696.8		Outpatient (n=4024)	20	0.5	701.0	
Service admission (n=466)	51	11.9	641.1	<0.001	Service admission (n=448)	59	13.2	633.9	<0.001
Intensive care admission (n=231)	168	72.7	211.1		Intensive care admission (n=114)	81	71.1	221.0	

such diseases (HR: 25.3; 95% CI: 18.8-34.2). The risk of death was higher in people who never used alcohol compared to those who used before / currently using (HR: 2.1; 95% CI: 1.4-3.0). The risk of death in ex-smokers or current smokers was higher than in non-smokers (HR: 2.1; 95% CI: 1.5-2.9). Death risk was higher for people without any symptoms than for people with three or more symptoms (HR:3.5; 95% Cl:2.7-4.6). The risk of death in patients hospitalized in the intensive care unit was (HR:170.8; 95% Cl: 128.9-226.2) higher than in outpatients (Table 3).

In the multivariate Cox regression model, the risk of death in patients over 80 years of age (aHR:22.3; 95% CI: 10.4-47.7) was higher than in patients younger than 50 years of age. The risk of death (aHR:1.6; 95% CI: 1.1-2.4) was higher in ex-smokers or current smokers compared to non-smokers. The risk of death in patients who had no complaints before diagnosis was (aHR:1.7; 95% Cl: 1.2-2.6) higher than those with 3 or more complaints. The risk of death in patients hospitalized in the intensive care unit was (aHR:62.3; %95 Cl: 37.6-101.9) higher than in outpatients (Table 4).

Table 3. Mean survival times in the categories of independent variables in men and women COVID-19 patients

Men					**Women**				
	Number of deaths	**%**	**Mean survival time (days)**	**Log-Rank (p)**		**Number of deaths**	**%**	**Mean survival time (days)**	**Log-Rank (p)**
Diabetes Mellitus									
No (n=3397)	190	5.6	667.5	<0.001	No (n=3517)	98	2.8	686.4	<0.001
Yes (n=421)	70	16.6	587.9		Yes (n=477)	61	12.8	617.7	
Hypertension									
No (n=3236)	159	4.9	672.2	<0.001	No (n=3272)	72	2.2	690.0	<0.001
Yes (n=582)	101	17.4	583.7		Yes (n=732)	87	12.0	627.0	
Coronary Artery Disease									
No (n=3501)	175	5.0	671.1	<0.001	No (n=3751)	123	3.3	683.1	<0.001
Yes (n=317)	85	26.8	524.0		Yes (n=243)	36	14.8	601.0	
Heart Failure									
No (n=3751)	227	6.1	664.0	<0.001	No (n=3940)	137	3.5	681.9	<0.001
Yes (n=67)	33	49.3	304.4		Yes (n=54)	22	40.7	372.3	
Cancer									
No (n=3718)	211	5.7	666.5	<0.001	No (n=3880)	120	3.1	683.9	<0.001
Yes (n=100)	49	49.9	397.0		Yes (n=114)	39	34.2	491.7	
High Cholesterol									
No (n=3675)	242	6.7	660.5	<0.05	No (n=3832)	148	3.9	679.4	0.056
Yes (n=143)	18	12.6	614.1		Yes (n=162)	11	6.8	656.5	

Table 3. Mean survival times in the categories of independent variables in men and women COVID-19 patients

Men					Women				
	Number of deaths	%	Mean survival time (days)	Log-Rank (p)		Number of deaths	%	Mean survival time (days)	Log-Rank (p)
Cirrhosis									
No (n=3787)	255	6.7	659.7	<0.05	No (n=3985)	157 (3.9)		678.8	<0.05
Yes (n=20)	5	25.0	536.2		Yes (n=9)	2 (22.2)		440.4	
Cerebrovascular Disease									
No (n=3787)	247	6.5	661.0	<0.001	No (n=3965)	151	3.8	670.5	<0.001
Yes (n=31)	13	41.9	420.0		Yes (n=29)	8	27.6	546.3	
Dementia									
No (n=3791)	243	6.4	661.9	<0.001	No (n=3942)	125	3.2	683.8	<0.001
Yes (n=27)	17	63.0	232.3		Yes (n=52)	34	63.4	296.8	

Table 4. Crude and adjusted hazard ratios for all cause mortality in patients with COVID-19

		HR (%95CI)	aHR (%95CI)
Gender	Women	Ref.	-
	Men	1.7 (1.4-2.1)	-
Age groups	Under 50	Ref.	Ref.
	50-59	8.4 (5.0-13.9)	3.3 (1.5-7.2)
	60-69	25.5 (15.9-41.0)	7.2 (3.5-14.7)
	70-79	75.8 (48.2-119.1)	11.8 (5.9-23.0)
	Over 80	175.7 (112.1-275.3)	20.9 (10.1-43.0)
Marital status	Married	Ref.	-
	Not married	0.9 (0.7-1.1.1)	-
Educational categories	Higher education	Ref.	-
	Primary / secondary level education	3.7 (2.8-5.0)	-
	Literate / illiterate	7.1 (4.7-10.5)	-
Number of chronic diseases	0	Ref.	-
	1-2	9.4 (7.1-12.6)	-
	3>	25.3 (18.8-34.2)	-
Alcohol	Used before / Currently using	Ref.	-
	Never used	2.1 (1.4-3.0)	-
Smoking	Never used	Ref.	Ref.
	Used before / Currently using	2.1 (1.5-2.9)	1.6 (1.2-2.3)
Number of complaints before diagnosis	3>	Ref.	Ref.
	1-2	2.0 (1.5-2.6)	2.5 (1.7-3.7)
	0	3.5 (2.7-4.6)	1.5 (1.1-2.2)
Admission status	Outpatient	Ref.	Ref.
	Service admission	14.5 (10.6-19.9)	5.5 (3.3-9.3)
	Intensive care admission	170.8 (128.9-226.2)	58.0 (36.5-92.1)

Note: aHR adjusted for gender, age, marital status, education, number of chronic diseases, alcohol, smoking, number of complaints before diagnosis, admission status.

DISCUSSION

In this retrospective cohort study, we investigated the magnitude and the predictors of all-cause mortality in COVID-19 patients over more than one year follow up. Age, smoking, number of pre-diagnostic complaints and admission status significantly increased the risk of death from all causes in COVID-19 patients.

In our study, the cumulative all-cause mortality rate was found to be 4.7%. Of the confirmed cases, 2.9% of the patients died due to the acute effects of COVID-19. When evaluating the total deaths in confirmed cases, the Case Fatality Rate (CFR) was 1.089 in the United States, which had the highest number of cases as of October 8, 2023, and 0.5 in Turkey [1]. The higher number of acute-phase deaths observed in our study may be attributed to our hospital's service area being specific to a certain region and its proximity to areas with a predominantly elderly population. Furthermore, the 4.7% cumulative all-cause mortality rate observed in our study encompasses all deaths without attributing them to any specific cause and results from a long-term follow-up. Therefore, deaths unrelated to the effects of COVID-19, occurring as a natural course in patients, may account for this difference.

In our study, mortality was found to be high in the elderly similar to other studies in the literature [24,25]. Mahendra et al. reported that being over 50 years of age and prolonged duration of symptoms were independent predictors of death [26]. In our study, the risk of death in individuals over the age of 80 was more than 20 times higher than in individuals under the age of 50. As comorbidity increases with age in the elderly, mortality may also be on the rise. In addition, the elderly have a high vulnerability and low immunity to infection. This may explain the disproportionate death toll from COVID-19 in older age groups [27].

Studies have confirmed that male gender is a major risk factor for all-cause mortality in COVID-19 patients [24,28]. In our study, men were 1.7 times more likely to die from COVID-19 compared to women, but this association disappeared when adjusted to other variables. In a study conducted in Mexico, both gender and old age increased the risk of death. The risk was 16 times higher for men in the oldest group in the same study [29].

Chronic diseases also have a significant impact on mortality outcomes. In our study, diabetes mellitus, hypertension, coroner artery disease, heart failure, cancer, kidney disease, chronic lung disease, cirrhosis, cerebrovascular disease, dementia in men and women were significantly associated with all cause. High cholesterol only in women and thyroid disease only in men was associated with death. These findings are similar in terms of mortality for diabetes mellitus [30], hypertension, cardiovascular and cerebrovascular diseases [31,32], chronic liver disease [33], chronic lung disease [34], chronic kidney disease [35] in the literature. On the other hand, there was no significant between all cause of death and asthma, as also reported in the study of Matsumoto et al [36].

Mild symptoms occur in 81% of COVID-19 cases [37] and the mortality rate in these cases is low. However, mortality rates increase in hospitalized cases [38]. In our study, the highest mortality rates were found in patients admitted to the intensive care unit. Most of the patients admitted to the intensive care unit died within the first 28 days. Only 17.6%

of the patients admitted to the intensive care unit died after 28 days. These findings are also compatible with the literature [29,39,40].

Some lifestyle factors may also be risk factors for all-cause mortality. In the study of Zheng et al., smoking was found to be one of the important risk factors for death [41]. In our study, smoking was associated approximately 2-time increased risk of death after multivariate adjustments. However, this relationship was not found in some studies [24]. In our study, this risk was not found in women either (p=0.866). Alcohol use is also an important behavioral condition, but alcohol was not a significant factor for all cause of death in our study.

Our study has several strengths. This study has a large sample size from a single center that serves a population of around half a million living mostly urban and rural communities. Our findings are more generalizable because this hospital was designated as a public pandemic hospital that serves the general population. In our study, patients were followed up in average more than a year, and death due to all causes suggested by WHO was investigated. However, the study has some limitations. Missing data in the questionnaire because of recall bias is a problem in self-reported disease history or symptoms. If the patient died in the early days of COVID-19 some of the data on the independent variables could not be obtained from the relatives. In such cases hospital records were checked. The mortality data of our study are only related to whether the person died or not. The causes of death of the persons could not be reached. The identification of mortality rates exceeding those observed in all-time COVID-19 data may potentially be attributed to the inclusion of deaths due to causes unrelated to the disease, such as accidents, without any specific underlying reasons.

CONCLUSIONS

In this retrospective cohort study, in COVID-19 patients, the risk of all-cause mortality is higher in the elderly, smokers, individuals admitted to medical or intensive care services, and those with a decreasing number of pre-diagnostic complaints. Having a chronic disease was a significant risk factor for all-cause mortality. Monitoring patients with long follow-up periods and determining the course of illness and cause of death are important for understanding the natural course of COVID-19.

ACKNOWLEDGEMENTS

We thank all DEU-COVIMER staff and all of the participating individuals in the study.

Conflict of Interest: We declare no competing interests.

Financial Support: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Ethical Declaration: The study was approved by the Dokuz Eylul University Non-Interventional Research Ethics Committee (Date: 23.03.2022- Decision No: 2022/11-01).

Authorship Contributions: Concept: AFS, ANE, BÜ, Design: SK, ANE, Supervising: AFS, BÜ, ANE, Data collection and entry: ANE, AFS, SK, ÖT, NŞ, EBS, Analysis and interpretation: AFS, ANE, SK, BÜ, Literature search: AFS, BÜ, Writing: AFS, BÜ, Critical review: ANE, ÖT, BÜ.

REFERENCES

1. WHO. Coronavirus (COVID-19) Dashboard. Published October 8, 2023. Accessed October 8, 2022. https://covid19.who.int
2. Natasha H, Egbert S, Annemarie TV. Conflict And Health. McGraw-Hill Education (UK); 2012.
3. Karlinsky A, Kobak D. Tracking excess mortality across countries during the COVID-19 pandemic with the World Mortality Dataset. eLife. 2021;10:e69336. doi:10.7554/eLife.69336
4. Alharthy A, Aletreby W, Faqihi F, et al. Clinical characteristics and predictors of 28-day mortality in 352 critically ill patients with COVID-19: a retrospective study. J Epidemiol Glob Health. 2021;11(1):98.
5. Wang S, Ma P, Zhang S, et al. Fasting blood glucose at admission is an independent predictor for 28-day mortality in patients with COVID-19 without previous diagnosis of diabetes: a multi-centre retrospective study. Diabetologia. 2020;63(10):2102-2111.
6. Ioannidis JPA. Infection fatality rate of COVID-19 inferred from seroprevalence data. Bull World Health Organ. 2021;99(1):19-33F. doi:10.2471/BLT.20.265892
7. WHO. WHO Director-General's opening remarks at the media briefing on COVID-19 - 3 March 2020. Published March 3, 2020. Accessed May 19, 2022. https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---3-march-2020
8. Verduri A, Short R, Carter B, et al. Comparison between first and second wave of COVID-19 outbreak in older people. The COPE multicentre European observational cohort study. Eur J Public Health. Published online August 23, 2022:ckac108. doi:10.1093/eurpub/ckac108
9. Ferguson N, Laydon D, Nedjati Gilani G, et al. Report 9: Impact of Non-Pharmaceutical Interventions (NPIs) to Reduce COVID19 Mortality and Healthcare Demand. Imperial College London; 2020. doi:10.25561/77482
10. Woorim K, Ji Min H, Kyung. Predictors of Mortality in Patients with COVID-19: A Systematic Review and Meta-analysis. 2020;30(3):169-176.
11. Aldridge RW, Lewer D, Katikireddi SV, et al. Black, Asian and Minority Ethnic groups in England are at increased risk of death from COVID-19: indirect standardisation of NHS mortality data. Wellcome Open Res. 2020;5:88. doi:10.12688/wellcomeopenres.15922.2
12. Docherty AB, Harrison EM, Green CA, et al. Features of 20 133 UK patients in hospital with covid-19 using the ISARIC WHO Clinical Characterisation Protocol: prospective observational cohort study. BMJ. 2020;369:m1985. doi:10.1136/bmj.m1985
13. Zuin M, Rigatelli G, Zuliani G, Rigatelli A, Mazza A, Roncon L. Arterial hypertension and risk of death in patients with COVID-19 infection: Systematic review and meta-analysis. J Infect. 2020;81(1):e84-e86. doi:10.1016/j.jinf.2020.03.059
14. Chen R, Liang W, Jiang M, et al. Risk Factors of Fatal Outcome in Hospitalized Subjects With Coronavirus Disease 2019 From a Nationwide Analysis in China. Chest. 2020;158(1):97-105. doi:10.1016/j.chest.2020.04.010
15. Elliott J, Bodinier B, Whitaker M, et al. COVID-19 mortality in the UK Biobank cohort: revisiting and evaluating risk factors. Eur J Epidemiol. 2021;36(3):299-309. doi:10.1007/s10654-021-00722-y
16. Henry BM, Lippi G. Chronic kidney disease is associated with severe coronavirus disease 2019 (COVID-19) infection. Int Urol Nephrol. 2020;52(6):1193-1194. doi:10.1007/s11255-020-02451-9
17. Hussain A, Bhowmik B, do Vale Moreira NC. COVID-19 and diabetes: Knowledge in progress. Diabetes Res Clin Pract. 2020;162:108142. doi:10.1016/j.diabres.2020.108142
18. Palaiodimos L, Kokkinidis DG, Li W, et al. Severe obesity, increasing age and male sex are independently associated with worse in-hospital outcomes, and higher in-hospital mortality, in a cohort of patients with COVID-19 in the Bronx, New York. Metabolism. 2020;108:154262. doi:10.1016/j.metabol.2020.154262
19. Vardavas CI, Nikitara K. COVID-19 and smoking: A systematic review of the evidence. Tob Induc Dis. 2020;18:20. doi:10.18332/tid/119324
20. Hastie CE, Mackay DF, Ho F, et al. Vitamin D concentrations and COVID-19 infection in UK Biobank. Diabetes Metab Syndr. 2020;14(4):561-

565. doi:10.1016/j.dsx.2020.04.050

21. Ilie PC, Stefanescu S, Smith L. The role of vitamin D in the prevention of coronavirus disease 2019 infection and mortality. Aging Clin Exp Res. 2020;32(7):1195-1198. doi:10.1007/s40520-020-01570-8

22. Martelletti L, Martelletti P. Air Pollution and the Novel Covid-19 Disease: a Putative Disease Risk Factor. SN Compr Clin Med. 2020;2(4):383-387. doi:10.1007/s42399-020-00274-4

23. Ünal B. Dokuz Eylul University hospital COVID-19 follow-up center: Performance and preliminary findings. Journal of Dokuz Eylul University Medical Faculty. 2021;35(3):343-350.

24. Petrilli CM, Jones SA, Yang J, et al. Factors associated with hospital admission and critical illness among 5279 people with coronavirus disease 2019 in New York City: prospective cohort study. BMJ. 2020;369:m1966. doi:10.1136/bmj.m1966

25. Zhou F, Yu T, Du R, et al. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. The Lancet. 2020;395(10229):1054-1062. doi:10.1016/S0140-6736(20)30566-3

26. Mahendra M, Nuchin A, Kumar R, Shreedhar S, Mahesh PA. Predictors of mortality in patients with severe COVID-19 pneumonia - a retrospective study. Adv Respir Med. 2021;89(2):135-144. doi:10.5603/ARM.a2021.0036

27. Kang SJ, Jung SI. Age-Related Morbidity and Mortality among Patients with COVID-19. Infect Chemother. 2020;52(2):154-164. doi:10.3947/ic.2020.52.2.154

28. Galbadage T, Peterson BM, Awada J, et al. Systematic review and meta-analysis of sex-specific COVID-19 clinical outcomes. Front Med. 2020;7:348.

29. Salinas-Escudero G, Carrillo-Vega MF, Granados-García V, Martínez-Valverde S, Toledano-Toledano F, Garduno-Espinosa J. A survival analysis of COVID-19 in the Mexican population. BMC Public Health. 2020;20(1):1-8.

30. Alguwaihes AM, Al-Sofiani ME, Megdad M, et al. Diabetes and Covid-19 among hospitalized patients in Saudi Arabia: a single-centre retrospective study. Cardiovasc Diabetol. 2020;19(1):1-12.

31. Imai Y, Kuba K, Penninger JM. The discovery of angiotensin-converting enzyme 2 and its role in acute lung injury in mice. Exp Physiol. 2008;93(5):543-548.

32. Kreutz R, Algharably EAEH, Azizi M, et al. Hypertension, the renin–angiotensin system, and the risk of lower respiratory tract infections and lung injury: implications for COVID-19: European Society of Hypertension COVID-19 Task Force Review of Evidence. Cardiovasc Res. 2020;116(10):1688-1699.

33. Li C, Chen Q, Wang J, et al. Clinical characteristics of chronic liver disease with coronavirus disease 2019 (COVID-19): a cohort study in Wuhan, China. Aging. 2020;12(16):15938.

34. Balkissoon R. Journal Club—Severe Acute Respiratory Syndrome Coronavirus-2: Impact on COPD Patients. Chronic Obstr Pulm Dis J COPD Found. 2020;7(4):413.

35. Lu R, Zhao X, Li J, et al. Genomic characterisation and epidemiology of 2019 novel coronavirus: implications for virus origins and receptor binding. Lancet Lond Engl. 2020;395(10224):565-574. doi:10.1016/S0140-6736(20)30251-8

36. Matsumoto K, Saito H. Does asthma affect morbidity or severity of COVID-19? J Allergy Clin Immunol. 2020;146(1):55-57.

37. Wu Z, McGoogan JM. Characteristics of and Important Lessons From the Coronavirus Disease 2019 (COVID-19) Outbreak in China: Summary of a Report of 72 314 Cases From the Chinese Center for Disease Control and Prevention. JAMA. 2020;323(13):1239-1242. doi:10.1001/jama.2020.2648

38. Finelli L, Gupta V, Petigara T, Yu K, Bauer KA, Puzniak LA. Mortality Among US Patients Hospitalized With SARS-CoV-2 Infection in 2020. JAMA Netw Open. 2021;4(4):e216556. doi:10.1001/jamanetworkopen.2021.6556

39. Alwafi H, Naser AY, Qanash S, et al. Predictors of Length of Hospital Stay, Mortality, and Outcomes Among Hospitalised COVID-19 Patients in Saudi Arabia: A Cross-Sectional Study. J Multidiscip Healthc. 2021;14:839-852. doi:10.2147/JMDH.S304788

40. Zareifopoulos N, Lagadinou M, Karela A, Platanaki C, Karantzogiannis G, Velissaris D. Management of COVID-19: the risks associated with treatment are clear, but the benefits remain uncertain. Monaldi

Arch Chest Dis. 2020;90(2).

41. Zheng Z, Peng F, Xu B, et al. Risk factors of critical & mortal COVID-19 cases: A systematic literature review and meta-analysis. J Infect. 2020;81(2):e16-e25. doi:10.1016/j.jinf.2020.04.021

Turk J Public Health
Available online at: http://dergipark.org.tr/tjph/
Doi: 10.20518/tjph.1274068

TURKISH JOURNAL OF PUBLIC HEALTH

ORIGINAL ARTICLE

Evaluation of infant mortality before and during COVID-19 pandemic in a district of Istanbul

Sabanur Çavdar[1,2,3] Ayşe Zülal Tokaç Farımaz[4,5] Hüseyin Küçükali[4,6]
Ayşe Seval Palteki[7] Ömer Ataç[2,8] Osman Hayran[4]

[1]MD, Public Health Specialist, Emory University, Hubert H. Humphrey Fellowship Program, Rollins School of Public Health, Atlanta, Georgia, USA
[2]Istanbul Medipol University, Department of Public Health, International School of Medicine, Istanbul, Türkiye
[3]Uskudar University, Health Management Program, Graduate School of Health Sciences, Istanbul, Türkiye
[4]MD, Istanbul Medipol University, Department of Public Health, School of Medicine, Istanbul, Türkiye
[5]Istanbul University, Public Health Program, Institute of Health Sciences, Istanbul, Türkiye
[6]MD, PhD, Queen's University Belfast, Centre for Public Health, Belfast, UK
[7]MPH, PhD, Istanbul Medipol University, Department of Public Health, School of Medicine, Istanbul, Türkiye
[8]MD, PhD, University of Kentucky, Department of Health Management and Policy, College of Public Health, Lexington, Kentucky, USA

Received: 31.03.2023, **Accepted:** 15.10.2023

Abstract

Objective: The aim of this study is to evaluate infant mortality in 2019 and 2020 years at the local level, considering the beginning of the pandemic period.

Methods: The population of this cross-sectional study are infants registered in a district of Istanbul in 2019 and 2020. Infant mortality rates before and during the COVID-19 pandemic were calculated. Antenatal healthcare and delivery practices in addition to the underlying risk factors for infant deaths were identified and compared by the year of mortality.

Results: Infant mortality rates were calculated as 4.8 and 5.1; neonatal mortality rates were 3.9 and 2.7; postneonatal mortality rates were 0.9 and 2.4 per thousand live births, respectively by the years. No statistically significant difference was found between maternal and infant characteristics of the two years. The number of pregnancy follow-up records was significantly higher for the infants that died in 2020 compared to 2019. Yet, there wasn't any difference in number of prenatal physician visits.

Conclusion: Increase in the infant mortality rate during the pandemic compared to the pre-pandemic period is due to postneonatal mortality. The increase in postneonatal mortality is related to deaths caused by infections. This should be investigated with the characteristics of infants and healthcare accessibility features. No disruption was identified in access to antenatal care in cases of infant mortality during the research period. This continuity in health services must be preserved. Our experience during the study revealed a room for improvement in data access on always-important public health indicators for evidence-based decision-making.

Keywords: Infant Mortality, COVID-19, Prenatal Care, Maternal-Child Health Services, Routinely Collected Health Data

Correspondence: MD Sabanur Çavdar, Emory University, Hubert H. Humphrey Fellowship Program, Rollins School of Public Health, Atlanta, Georgia, USA. **E-mail:** sabanur.cavdar@medipol.edu.tr, **Phone**: +90216 681 51 00- (2203).
Cite This Article: Çavdar S, Tokaç Farımaz AZ, Küçükali H, Palteki AS, Ataç Ö, Hayran O. Evaluation of infant mortality before and during COVID-19 pandemic in a district of Istanbul. Turk J Public Health 2023;21(3): 349-360.

INTRODUCTION

Infant mortality rate is one of the most important health indicators used to evaluate population health status as well as providing information about maternal and infant health. The infant mortality rate is defined as the number of children deaths under one year of age for every 1,000 live births. The infant mortality rate has two components: the neonatal mortality rate, which refers to the number of infant deaths in the first four weeks of their life per 1000 live births, and the post-neonatal mortality rate, which includes the remaining deaths after the first four weeks.[1] High infant mortality rate is closely related to low birth weight and premature birth besides child healthcare services during infancy.[2] According to CDC (Centers for Disease Control and Prevention) the five leading causes of infant death in 2020 are birth defects, preterm birth and low birth weight, sudden infant death syndrome, injuries, and maternal pregnancy complications.[1] In 2019, WHO (World Health Organization) reported preterm birth, childbirth-related complications (birth asphyxia or lack of breathing at birth), infections, and birth defects caused most neonatal deaths.[2] Low birth weight can be caused by many factors, especially socioeconomic status, low education level, childbearing in the very early or late stages of the reproductive years, and malnutrition. Pregnancy follow-ups play an important role in providing the necessary care to pregnant women and reducing the risks, helping to prevent low birth weight and other undesirable consequences of pregnancy.[3]

Negative effects of new or re-emerging infections on pregnant women were observed during the H1N1 influenza epidemic in 2009 and the Zika virus outbreak in 2015.[4] During the COVID-19 pandemic, it is stated that pregnant women can have the disease severely, especially if they have underlying risk factors such as advanced age, overweight, hypertension, and diabetes, and the need for intensive care may develop more frequently than women who are not pregnant at reproductive age.[5] Maternal and child health might be neglected during the COVID-19 pandemic due to the allocation of limited resources primarily to those who have high risk of infection, mostly men or elders.[6]

Infant mortality rate had a declining trend in Istanbul, it fell from 11.4 in 2009 to 7.4 in 2019.[7] This was generally attributed to improvement in primary healthcare services. On 10 March 2020, the first confirmed COVID-19 case in Turkey was identified in Istanbul. As a pandemic control measure, the city faced two curfews each lasted approximately three months and had a serious impact on both admission and provision of primary healthcare services throughout 2020.[8]

The aim of this study is to examine infant deaths and the factors affecting these deaths in a district of Istanbul in 2019 and 2020, covering the onset of the COVID-19 pandemic. This study was conducted as the pilot of a national study.

METHOD

This cross-sectional study is conducted at June-July of 2021. The population of the study is all infants registered in a district of Istanbul in 2019 and 2020. Istanbul, the most populated and urbanized city in Türkiye, consists of 39 districts. The population of the district is over half a million. It is one of the developed districts of the province[9], where

many public and private health institutions are located both within and in the nearby districts, and family health centers are common as primary care. Data for the whole population were routinely collected in the district health directorate for infant mortality evaluation and the death registration. The total number of births in the district was retrieved from the national institution for statistics (TÜİK=TURKSTAT). Death records in Türkiye are collected in an electronic, real-time, and centralized information system called "Death Reporting System" (in Turkish, Ölüm Bildirim Sistemi). Infant deaths and stillbirths are reported to the public health departments of the provincial and district health directorates. Prenatal and postnatal health records are gathered from healthcare facilities and health information systems for evaluation. "Infant mortality commissions" evaluate each death and stillbirth in terms of prevention and the causes of deaths. They re-evaluate the diagnoses, revise and reorder the ICD codes if it's needed. The evaluation results of the commission at district level are checked at the provincial level and finally at the national level in the Ministry of Health (MoH). In this study, the data retrieved from both information systems and commission records.

The inclusion criteria are infants born alive, died in 2019 and 2020, who were residents of the district. The exclusion criteria are infants with foreign nationality (n=10), whose usual place of residence is outside the district (n=10), and stillbirths (n=49). The independent variable in the study is the year of infant death (2019 vs 2020) and the dependent variables are infant mortality rates along with the maternal and infant characteristics. Data regarding the maternal variables such as age, last menstrual period date, multiple pregnancy status, pregnancy follow-ups, hospital admissions/visits; and variables related to the infant such as sex, date of birth, place of birth, type of birth, week of birth, birth weight, presence of congenital anomaly, date of death, and diagnosis of death are obtained for these dependent variables.

Guidelines of WHO are used for definitions of live birth, stillbirth or fetal death, neonatal period (birth up to 28 complete days), postneonatal period, early neonatal deaths (first 7 days of life, 0-6 days), and late neonatal deaths (7-27 days).[10] Mortality rates are calculated for 1000 live births, and any live birth included in calculation regardless of gestational week. Births that happened at 37 weeks and later are considered as "term", otherwise grouped as "preterm" births. Pregnancies before the age of 18 years and after 35 years are defined as "risky pregnancies". There was no pregnancy before 18 years of age. Birth weights of the infants are classified as low birthweight (≤2500 grams) and normal weight (>2500 grams). Infant mortality causes are classified according to the major cause of death: "Congenital malformations", "Prematurity", "Infections", and "Other". Hospital visits at the day of birth are excluded while calculating the visit numbers during the pregnancy. The number of follow-up visits are obtained from the system where the records are labeled as "pregnancy follow-up" - these may or may not include the visits to a physician (family physician or OB/GYN). The "pregnancy follow-ups" are grouped as "real-time prenatal follow-up" and "statement-based follow-up". Real-time pregnancy follow-up means that the pregnant woman was in the health facility during this follow-up, so it was an in-person

follow-up. Statement-based pregnancy follow-up is the one based on a phone-call with pregnant women, or based on reviewing the health records of the pregnant woman who is seen by another physician, probably by an obstetrician/gynecologist (OB/GYN specialist). In the Health Statistics Yearbooks of the Ministry of Health, the infant mortality rates are calculated in two methods: 1- "deaths of live births (show any evidence of life) with minimum threshold of 28 weeks or 1.000 gr and more" 2- "deaths of live births (show any evidence of life) regardless of gestational age and birth weight (No Threshold)".[11] The rates which are calculated without a threshold are considered when comparing the results of our study with national and provincial rates, since there wasn't any threshold in our study.

The data is edited in Microsoft Excel and analyzed with the IBM SPSS Statistics version 28 (IBM Corp, Armonk, NY, USA.) Descriptive statistics are presented as number, percentage, median, interquartile range (IQR). Chi-square test and Mann-Whitney U test are used as significance tests. The statistically significant level is accepted as $p< 0.05$.

Research permission is obtained from the Health Services General Directorate of the Ministry of Health (24/12/2020), and the ethical approval is obtained from Istanbul Medipol University Non-Invasive Clinical Studies Ethics Committee (21/01/2021, No: 65).

RESULTS

The number of total births was 5,396 in 2019 and 4,928 in 2020. Fifty-one infant deaths were observed, 26 (51.0%) in 2019 and 25 (49.0%) in 2020. Infant deaths and mortality rates by years in the district are summarized in Table 1. As it is seen from the Table infant mortality rates are calculated as 4.84‰ and 5.10‰ for 2019 and 2020 respectively. Infant, neonatal and postneonatal mortality rates of the study group in comparison with the national and provincial rates are presented in Figure 1.

Table 1. Infant mortality by years

	2019		2020	
Deaths	n	Mortality rate (‰)	n	Mortality rate (‰)
Infant deaths (0-365 days)	26	4.84	25	5.10
Neonatal deaths (0-27 days)	21	3.91	13	2.65
Early neonatal deaths (0-6 days)	15	2.79	11	2.25
Late neonatal deaths (7-27 days)	6	1.12	2	0.41
Postneonatal deaths (28-365 days)	5	0.93	12	2.45

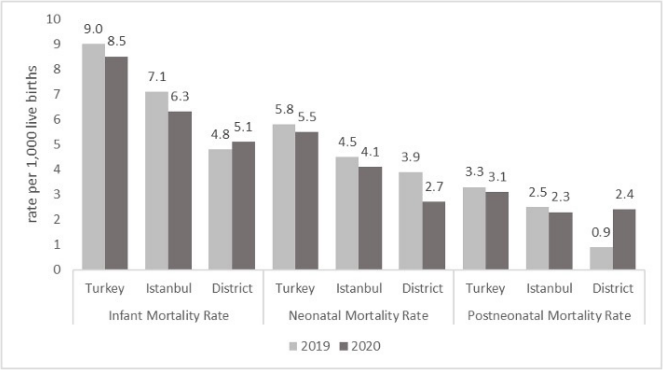

Figure 1. Infant mortality rates in comparison with national and provincial rates

(National and provincial data are from The Ministry of Health of Türkiye Health Statistics Yearbook 2020)[11]

All infants subject to infant death (n=51) were born in a hospital. There was no infant who registered in the district and died in another province. There wasn't any statistically significant difference between deaths in

two years by the maternal, birth and death characteristics of the infants, besides the time of death (Table 2). The proportion of postneonatal deaths were significantly higher in the year 2020 (48.0%) than the year 2019 (19.2%) (p=0.029).

Table 2. Characteristics of the infant deaths and their mothers

	2019 (n=26)		2020 (n=25)		p*
Sex, *n (%)*					
Female	11	(42.3)	11	(44.0)	0.903
Male	15	(57.7)	14	(56.0)	
Multiple pregnancy, *n (%)*					
Yes	5	(19.2)	3	(12.0)	0.478
No	21	(80.8)	22	(88.0)	
Type of birth, *n (%)*					
Vaginal	5	(19.2)	5	(20.0)	0.945
Caesarean section	21	(80.8)	20	(80.0)	
Prematurity, *n (%)*					
Preterm (<37 weeks)	21	(80.8)	14	(56.0)	0.057
Term (≥37 weeks)	5	(19.2)	11	(44.0)	
Birth weight, *n (%)*					
<1500 gr	14	(53.8)	8	(32.0)	0.213
1500-2500 gr	6	(23.1)	6	(24.0)	
>2500 gr	6	(23.1)	11	(44.0)	
Congenital anomaly, *n (%)*					
No	19	(73.1)	16	(66.7)	0.621
Yes	7	(26.9)	8	(33.3)	
Maternal age, *n (%)*					
<35 years	13	(50.0)	19	(76.0)	0.055
≥35 years	13	(50.0)	6	(24.0)	
Hospital that reported death, *n (%)*					
Public Hospital	10	(38.5)	14	(56.0)	0.210
Private/Foundational Hospital	16	(61.5)	11	(44.0)	
Location of hospital, *n (%)*					
Same district	13	(50.0)	12	(48.0)	0.886
Another district	13	(50.0)	13	(52.0)	
Time of death, *n (%)*					
Neonatal period (0-27 days)	21	(80.8)	13	(52.0)	**0.02**9
Postneonatal period (28-365 days)	5	(19.2)	12	(48.0)	
Cause of the death, *n (%)*					
Congenital malformations	6	(23.1)	7	(28.0)	NA
Prematurity	15	(57.7)	9	(36.0)	
Infections	2	(7.7)	6	(24.0)	
Other specific reasons	3	(11.5)	3	(12.0)	
					p**
Maternal age (years), *Median (IQR)*	34.5	(26.8-39.0)	29	(26.5-34.5)	0.128
Gestational week at birth, *Median (IQR)*	30.5	(25.0-35.3)	34	(28.5-37.5)	0.096
Birth weight (grams), *Median (IQR)*	1440	(775-2542.5)	2250	(1075-2912.5)	0.129
Duration of life (days), *Median (IQR)*	4	(0.8-16.5)	27	(2-145)	0.075

*Chi-square test, **Mann-Whitney U test, IQR: Interquartile range

Antenatal care characteristics are summarized in Table 3. Only one mother whose baby died in 2019 had only 2 prenatal visits (both to OB/GYN specialists), and all others had at least 8 or more prenatal visits by a family physician or OB/GYN specialist.

(pneumonia+septicemia) in 2019. Among 6 postneonatal deaths due to infections in 2020, one was down syndrome with pneumonia + septicemia, one major congenital anomaly with septicemia, one asphyxic birth history with septicemia and no underlying cause could be identified for 3 deaths due to pneumonia.

Table 3. Antenatal care characteristics

	2019 (n=26)		2020 (n=24)*		p**
Prenatal records, *Median (IQR)*					
Visits to Family physician	7	(4-13)	7	(4.3-8)	0.266
Visits to OB/GYN specialist	10	(7.8-14.3)	10	(8-12.8)	0.869
Visits to ER	1	(0-5)	1	(0-4)	0.600
Percentage of OB/GYN visits to private hospitals	67.5	(17.8-100)	71.1	(21.3-83.3)	0.725
No. of pregnancy follow-up#	3.0	(2.0-3.3)	5.0	(4.0-7.8)	**<0.001**
No. of real-time pregnancy follow-up	2.0	(1.0-3.0)	3.0	(2.0-4.0)	**0.041**
No. of statement-based pregnancy follow-up	0	(0-1.3)	2.5	(0.3-4.0)	**0.004**
					p* **
Frequency of antenatal follow-ups, *n (%)*					
<4	20	(76.9)	4	(16.7)	**<0.001**
≥4	6	(23.1)	20	(83.3)	
Frequency of real-time follow-ups, *n (%)*					
<4	22	(84.6)	16	(66.7)	0.138
≥4	4	(33.3)	8	(24.0)	
Frequency of physician visits, *n (%)*					
<4	1	(3.8)	0	(0)	NA
≥4	25	(96.2)	24	(100)	

*No health data was available for one non-citizen mother. (Infant has citizenship due to father)
**Mann-Whitney U test, ***Chi-square test, IQR: Interquartile range, OB/GYN: Obstetrics and gynecology, ER: Emergency room

The most common causes of neonatal deaths are prematurity (66.7% in 2019 and 53.8% in 2020) and congenital malformations (23.8% in 2019 and 30.8% in 2020). Major causes of postneonatal deaths were infections (40.0% (n=2) in 2019 and 50.0% (n=6) in 2020, Figure 2) and so postneonatal mortalities due to infection were evaluated in detail. The underlying risk factors for 2 postneonatal deaths were asphyxic birth history (septicemia) and Down syndrome

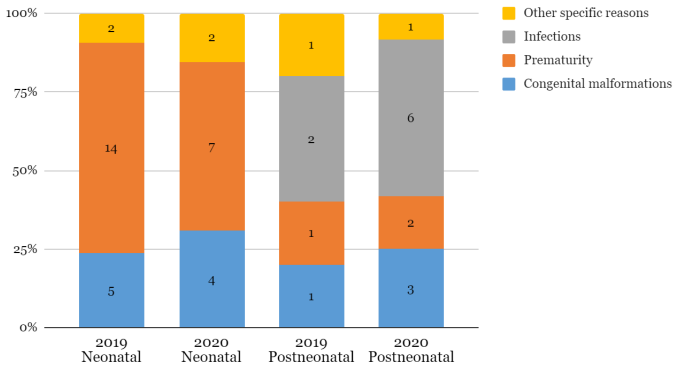

Figure 2. Neonatal and postneonatal mortality causes by years

DISCUSSION

This study analyzes the infant mortality for 2019 and 2020 in a district of Istanbul. This study analyzes infant mortality rates in a district of Istanbul for the years 2019 and 2020. Infant mortality rates were calculated as 4.8 and 5.1 per thousand live births; neonatal mortality rates were 3.9 and 2.7 per thousand live births; postneonatal mortality rates were 0.9 and 2.4 per thousand live births, respectively, for the years mentioned. No statistically significant difference was found between the maternal and infant characteristics of the two years. The number of pregnancy follow-up records was significantly higher for infants who died in 2020 compared to 2019. Yet, there was no difference in the number of prenatal physician visits.

Infant mortality rates have been reported by Turkish Statistical Institute (TURKSTAT) as 9.1 and 8.7 at national level, and 7.4 and 6.6 for Istanbul for the years 2019 and 2020 respectively.[12] Infant mortality rates in 2020 were lower than the previous year, both at national and provincial level (Figure 1). Also, infant mortality rates of the district were lower than national and provincial rates both years, this is expected since the district is a developed district of the country. On the other hand, in our study the infant mortality in the district, specifically postneonatal mortality rate was higher in 2020 than the previous year. Since there was a decrease in neonatal mortality in the district in 2020 compared to 2019, the increase in infant mortality rate was due to increased postneonatal mortality. Neonatal mortalities are related to maternal health, antenatal care, delivery complications and newborn care.[10] In our study, decrease in neonatal mortality in the district can be associated with the continuity of antenatal care and delivery care services during the study period (Table 3). This might be explained by the urgent and non-deferrable nature of birth, the absence of disruption in antenatal services during the study period may have decreased the neonatal death rate. Conversely, postneonatal mortality is considered related to infant's interaction with material and social environment, rather than birth outcomes.[13] A case-control study from Kars-Türkiye underlines the effects of social determinants of health on postneonatal deaths.[14] In a study conducted in Adiyaman province of Türkiye, the researchers investigated the infant mortality rates in 2020 and 2021, and they reported that 32% (33.9% for 2020 and 30.9% for 2021) of the infant mortalities were in postneonatal period. [15] In a study from Sivas province of Türkiye, postneonatal mortality rates were reported with a decrease as 2.37 and 1.84 (33.3% and 26% in all infant mortalities) for the years 2019 and 2020.[16] In our study, postneonatal mortality rates in the district were 0.9 and 2.4 (19.2% and 48.0% of the infant mortalities) for 2019 and 2020 respectively. According to the Health Statistics Yearbook of the Ministry of Health, there are differences in infant mortality rates by the region of the country.[11] These might explain the difference in the rates reported by these various studies from different regions. So, the increase in postneonatal mortality rate can be investigated considering social determinants of health.

The COVID-19 pandemic carries the risk of potential disruptions in maternal and child health services due to the overload in health systems. However, in the neonatal mortality estimates for 2030 in the GBD study, similar estimates were obtained with the reference

scenario in the absence of a COVID-19 pandemic.[17] In a meta-analysis investigating the effect of the pandemic period on maternal and child health although an increase in infant mortality was detected in one study it was reported that no significant change could be detected when all studies were evaluated together (pooled OR: 1.01 (0.38–2.67)). Yet, an increase in maternal mortality and stillbirths in middle-income and low-income countries, and a decrease in preterm birth in high income countries, which is one of the important causes of neonatal death, were reported at this meta-analysis research.[18] In the meta-analysis study by Yang et al., there was a decrease in preterm births according to the pooled results of single center studies, but no significant difference was found other than that.[19]

Causes of Infant Death

According to the American Mortality Statistics, the most common causes of neonatal death are disorders due to gestational age and low birth weight, and congenital malformations. The most common causes of postneonatal deaths have been reported as congenital malformations, accidents and sudden infant death syndrome.[20] At a global perspective, pneumonia, diarrhea, birth defects, malaria, and acquired immunodeficiency syndrome (AIDS) are known as the reasons for postneonatal mortality.[13] In the infant mortality research conducted in Sivas in Türkiye, in the last year of the study period (2020), an increase in early (54.0%) neonatal deaths and a decrease in late (20.0%) and post (26.0%) neonatal deaths were observed compared to the previous year. The most common causes of death were found to be congenital anomalies and lung failure. It has been determined that neonatal deaths are more frequent as the gestational week and birth weight decrease.[16] In our study, there was no neonatal deaths due to infection and there was a decrease in the rate of prematurity related neonatal deaths in 2020. On the other hand, infections have the leading role among the postneonatal mortality causes. While there were underlying reasons in 2 postneonatal deaths due to infection in 2019, there were underlying risk factors in 3 of 6 postneonatal deaths due to infection in 2020. Any cause other than infection was not recorded as an additional diagnosis in 3 of them. Hypothetically, if these 3 cases of pneumonia were prevented, all mortality rates would be lower than the previous year in the district.

Access To Healthcare

We have also evaluated the mothers' access to health services during their pregnancy and at the delivery. The results of the analysis of the prenatal visits and pregnancy follow-ups of the mothers in the study group suggested that there wasn't any barrier to the healthcare services and median number of the visits to an OB/GYN specialist was 10 for each year. Only one infant's mother whose baby died only in 2019 had less than 4 visits, which is under the recommended pregnancy follow-up/visit number in the guidelines of WHO.[3] In a study conducted in Trabzon in Türkiye, the mortality and morbidity data of the infants who were treated at neonatal intensive care units at the early period of the pandemic were compared to the previous year (2019) and no difference on the mortality was reported while there was a decrease on the pregnancy follow-ups in 2020.[21] In our study, 4 or more pregnancy follow-ups were significantly higher in 2020

than in 2019. Pregnancy follow-ups are the specific records -usually entered by family health centers- that are required by the MoH's standards. Because of that, sometimes the health professionals at the family health centers conduct these follow-ups via phone-calls with the pregnant woman or according to their hospital visit records in the system, and those follow-ups are labeled as "statement-based". Even though there was an ongoing pandemic in 2020, the follow-ups (both real-time and statement-based) seem to be higher compared to the previous year. This might be a real increase or just because of the change in recording habits of the healthcare providers. This study cannot explain the reasons for this increase in the follow-ups.

Literature reviews examining the restructuring of maternal services during the pandemic indicate that the number of face-to-face antenatal care visits has been decreased by 38.6% in general, and services were continued by using technological applications such as telecare/telehealth.[22, 23] The decrease in the number and duration of face-to-face visits is more common worldwide, as a consequence of the transfer of staff working in antenatal care services to other COVID-19 services. Additionally, differences are observed worldwide in terms of access and quality of telecare applications and in some regions, this access was reported to be more limited.[24, 25] During the COVID-19 pandemic period, general curfews, travel restrictions and possible inadequate service reception, and thus the fear of admission to health facilities, are thought to have an indirect effect on the health of pregnant women and infants. During the general curfew in Nepal, births in the hospital decreased by half compared to before the restrictions.[26] A study conducted in Israel observed that the number of stillbirths increased and there was a decrease in admissions to emergency maternity services during the first peak of the COVID-19 pandemic.[26] Both studies concluded that the probable cause was the women's avoidance of admission to the health facility for fear of being infected.[26, 27] In order to reduce mobility and contact during the COVID-19 pandemic, routine pregnant and child follow-ups, as well as the follow-up of infected patients, are carried out remotely in Türkiye.[28]

Future studies should investigate infants' access to healthcare services since the increase in the postneonatal mortality rate may be related with access problems during the pandemic.

A Takeaway for Data Readiness on Essential Public Health Indicators

Even though most of the infant mortality records are electronic, real-time, and paperless, the evaluation process can take time since it requires additional information from the hospitals, primary care centers, etc.; and the evaluation is made by the commission members who discuss the cases at in person meetings. Also, in cases of forensic investigation, the timeline is expected to be longer than the others. Eventually, these processes take time and health directorates (district/provincial) may wait for months to see the consensus on the preventability of the deaths or the description of the final causes of the death. Beside these, the infant mortality commissions' studies are managed with non-integrated processes.

Although health records are mostly digitized in Türkiye, in our study we saw that it was very time consuming to correlate data

held in different information systems (and sometimes paper) to calculate a key public health indicator such as infant mortality rate. This study revealed the need for the integration of the information systems and the epidemiological data to be more accessible to the public health practitioners and decision makers at local level, specifically for the essential public health indicators such as infant mortality rates. Health directorates should be able to monitor and evaluate the level of these indicators in a timely manner and, without additional effort. By doing so, directorates can be able to plan and implement preventive interventions as soon as possible.

In a recent scoping review, it's stated that the usage of routine health information system data on maternal and neonatal health is helpful to analyze the effects of public health emergencies and monitoring disruptions on health services.[29] The health informatics infrastructure of the Ministry of Health has demonstrated its ability to automatically integrate data from many different sources in the detection of COVID-19 cases. Such solutions need to be established for key public health indicators as well, and for them in the first place. We advocate that public health indicators should be made near real-time and automatically available to local health administrators and public health professionals to strengthen community health services and make them resilient to public health emergencies such as the COVID-19 pandemic. In this way, they can make evidence-based decisions and develop timely interventions.

Limitations

There are some limitations of this study. Firstly, the data includes the limitations of the information systems, such as data entry errors, underreporting, misclassification of the causes, inconsistent definitions, limited demographic insights. In addition, prenatal follow-up/visit numbers are expected to be lower for babies born at early gestational weeks and the fact that no correction was made according to the gestational week while evaluating prenatal follow-up and visits in our study is another limitation of the study. Some of the infants who died in 2020 were born and died before the pandemic started in the country. For this reason, when comparing the data of infants who died in 2019 and infants who died in 2020, it should be kept in mind that the grouping is made according to the date of death, not as 'born-died before the pandemic' or 'born-died after the pandemic'. Therefore, in this study, it is not possible to make causal inference about the effect of the pandemic.

CONCLUSION

Despite the decrease in the neonatal death rate which may indicate an improvement in antenatal healthcare services, there was an increase in the postneonatal death rate in the study region during the pandemic. No disruption was identified in access to antenatal care in infant mortality cases during the research period. But infants' access to health care should be investigated in future studies. Our experience in this study underscored the necessity of facilitating access to the data on essential public health indicators and ability to use that in evidence-based decision making.

ACKNOWLEDGEMENT

Note: Preliminary findings of this study were presented at the 5th International 23rd National Public Health Congress.

Conflict of Interest: The authors declare no

conflicts of interest.

Financial Support: There is no funding for the study.

Ethical Declaration: The ethical approval is obtained from Istanbul Medipol UniversityNon-Invasive Clinical Studies Ethics Committee (21/01/2021, No: 65).

Authorship Contributions: Concept: ÖA, HK, AZTF, ASP, SÇ, Design: ÖA, HK, AZTF, ASP, SÇ, Supervising: ÖA, HK, OH, Data collection and entry: SÇ, AZTF, Analysis and interpretation: SÇ, AZTF, Literature search: ASP, AZTF, SÇ, Writing: SÇ, AZTF, ASP, HK, Critical review: ÖA, OH.

REFERENCES

1. Centers of Disease Control and Prevention. CDC-Reproductive Health, 2020, Dec 12 [online]. Available at https://www.cdc.gov/reproductivehealth/maternalinfanthealth/infantmortality.htm Accessed March 27, 2023.
2. World Health Organization. Newborn Mortality: Factsheets, 2022, Jan 22 [online]. Available at https://www.who.int/news-room/fact-sheets/detail/levels-and-trends-in-child-mortality-report-2021 Accessed March 27, 2023.
3. World Health Organization. WHO recommendations on antenatal care for a positive pregnancy experience, 2016, Nov 28 [online]. Available at https://www.who.int/publications/i/item/9789241549912 Accessed March 27, 2023.
4. Çağlar M, Oskay Ü. Pregnancy and Birth Management in COVID-19 Pandemic Process. Sağlık Bilimleri Üniversitesi Hemşirelik Dergisi, 2020;2(2):99-104.
5. World Health Organization. Coronavirus disease (COVID-19): Pregnancy and childbirth, 2020, Dec 12 [online]. Available at https://www.who.int/news-room/q-a-detail/coronavirus-disease-covid-19-pregnancy-and-childbirth Accessed March 27, 2023.
6. Jacob CM, Briana DD, Di Renzo GC, et al. Building resilient societies after COVID-19: the case for investing in maternal, neonatal, and child health. The Lancet. Public health, 2020;5(11): e624–e627.
7. Bora Başara B, Soytutan Çağlar İ, Aygün A, et al. The Ministry of Health of Turkey Health Statistics Yearbook 2019, General Directorate of Health Information Systems, Ministry of Health, Ankara, 2021 [online]. Available at https://sbsgm.saglik.gov.tr/Eklenti/40566/0/health-statistics-yearbook-2019pdf.pdf Accessed March 27, 2023.
8. Demirbilek Y, Pehlivantürk G, Özgüler ZÖ, Alp Meşe E. COVID-19 outbreak control, example of ministry of health of Turkey. Turk J Med Sci. 2020;50(SI-1):489-494.
9. [Republic of Türkiye Ministry of Industry and Technology. Research on the socioeconomic development order of districts SEGE-2022.] T.C. Sanayi ve Teknoloji Bakanlığı. İlçelerin Sosyo-Ekonomik Gelişmişlik Sıralaması Araştırması SEGE-2022. Kalkınma Ajansları Genel Müdürlüğü Yayını, Sayı: 35, Araştırma Raporu Sayı: 8, Şubat 2022, Ankara, ISBN: 978-605-7679-34-5.
10. World Health Organization. Neonatal and perinatal mortality: country, regional and global estimates. World Health Organization, 2006 [online]. Available at https://apps.who.int/iris/handle/10665/43444 Accessed March 27, 2023.
11. Bora Başara B, Soytutan Çağlar İ, Aygün A, et al. Ministry of Health of Turkey Health Statistics Yearbook 2020, General Directorate of Health Information Systems, Ministry of Health, Ankara, 2022 [online]. Available at https://sbsgm.saglik.gov.tr/Eklenti/43400/0/siy2020-eng-26052022pdf.pdf Accessed March 27, 2023.
12. Turkish Statistical Institute - TURKSTAT "İstatistiki Bölge Birimleri Sınıflamasına Göre Bebek Ölüm Hızı" in: 23.02.2023, Ölüm ve Ölüm Nedeni İstatistikleri, 2023 [online]. Available at https://data.tuik.gov.tr/Bulten/Index?p=Olum-ve-Olum-Nedeni-Istatistikleri-2021- Accessed March 27, 2023.
13. Wise, P. Infant Mortality/Neonatal Disease In: Quah SR, editor. International encyclopedia of public health. Academic Press, 2016.
14. Çatak B, Öner C, Bekis Bozkurt H. Social

Determinants of Health Affect Postneonatal Infant Mortality: A Case–Control Field Study. The Anatolian Journal of Family Medicine, 2022;5(2):85–91.

15. Öz E, Küçükkelepçe O, Almış H, Parlak M, Kurt O. Evaluation of infant deaths during Covid-19 pandemic in Adıyaman, a southeastern province of Turkey. Adıyaman Üniversitesi Sağlık Bilimleri Dergisi, 2023;9(1):1-9.

16. Akova İ, Güneş Bal Ş, Arslaner S et al. Investigation of Infant Mortality and Causes in Sivas, Turkey. ESTÜDAM Halk Sağlığı Dergisi. 2022;7(3):436-443.

17. GBD 2019 Under-5 Mortality Collaborators. Global, regional, and national progress towards Sustainable Development Goal 3.2 for neonatal and child health: all-cause and cause-specific mortality findings from the Global Burden of Disease Study 2019. Lancet (London, England), 2021;398(10303):870–905.

18. Chmielewska B, Barratt I, Townsend R, et al. Effects of the COVID-19 pandemic on maternal and perinatal outcomes: a systematic review and meta-analysis. The Lancet. Global health, 2021;9(6): e759–e772.

19. Yang J, D'Souza R, Kharrat A, Fell DB, Snelgrove JW, Shah PS. COVID-19 pandemic and population-level pregnancy and neonatal outcomes in general population: A living systematic review and meta-analysis (Update#2: November 20, 2021). Acta obstetricia et gynecologica Scandinavica, 2022;101(3):273–292.

20. Heron M. Deaths: Leading Causes for 2019. National vital statistics reports: from the Centers for Disease Control and Prevention, National Center for Health Statistics, National Vital Statistics System, 2021;70(9):1–114 [online]. Available at https://www.cdc.gov/nchs/data/nvsr/nvsr70/nvsr70-09-508.pdf Accessed March 27, 2023.

21. Hekimoğlu B, Acar FA. Effects of COVID-19 pandemic period on neonatal mortality and morbidity. Pediatrics & Neonatology, 2022;63(1):78-83.

22. Townsend R, Chmielewska B, Barratt I, et al. Global changes in maternity care provision during the COVID-19 pandemic: A systematic review and meta-analysis. EClinicalMedicine, 2021;37:100947.

23. Montagnoli C, Zanconato G, Ruggeri S, Cinelli G, Tozzi AE. Restructuring maternal services during the covid-19 pandemic: Early results of a scoping review for non-infected women. Midwifery, 2021;94:102916.

24. Kotlar B, Gerson E, Petrillo S, Langer A, Tiemeier H. The impact of the COVID-19 pandemic on maternal and perinatal health: a scoping review. Reproductive health, 2021;18(1):10.

25. Coxon K, Turienzo CF, Kweekel L, et al. The impact of the coronavirus (COVID-19) pandemic on maternity care in Europe. Midwifery, 2020;88:102779.

26. Ashish KC, Gurung R, Kinney MV, et al. Effect of the COVID-19 pandemic response on intrapartum care, stillbirth, and neonatal mortality outcomes in Nepal: a prospective observational study. The Lancet. Global health, 2020;8(10): e1273–e1281.

27. Mor M, Kugler N, Jauniaux E, et al. Impact of the COVID-19 Pandemic on Excess Perinatal Mortality and Morbidity in Israel. American journal of perinatology, 2021;38(4):398–403.

28. Güler S, Topuz İ, Ulusoy F. The experiences of family health center workers in the Covid-19 pandemic. Halk Sağlığı Hemşireliği Dergisi, 2020;2(3):143-151.

29. Jackson D, Katwan E, Boehm C, Diaz T. Use of routine health information systems to monitor disruptions of coverage of maternal, newborn, and child health services during COVID-19: A scoping review. Journal of global health, 2023;13:06002. ISSN 2047-2978.

Turk J Public Health
Available online at: http://dergipark.org.tr/tjph/
Doi: 10.20518/tjph.1274068

TURKISH JOURNAL OF PUBLIC HEALTH

ORIGINAL ARTICLE

A hidden burden on public health: Adolescent pregnancy and increased adverse perinatal outcomes

Fatma Tuba Engindeniz[1] Deniz Şimşek[2] Burcu Dinçgez[3]

[1] MD, University of Health Sciences, Bursa Yuksek Ihtisas Research and Training Hospital, Public Health, Bursa, Türkiye.
[2]MD, University of Health Sciences, Bursa Yuksek Ihtisas Research and Training Hospital, Department of Obstetrics and Gynecology, Bursa, Türkiye.
[3]Assoc. Prof., University of Health Sciences, Bursa Yuksek Ihtisas Research and Training Hospital, Department of Obstetrics and Gynecology, Bursa, Türkiye.

Received: 19.04.2023, **Accepted:** 05.12.2023

Abstract

Objective: Adolescent pregnancy, associated with increased adverse pregnancy outcomes, is a major public health problem. We aimed to assess adverse perinatal outcomes in adolescent pregnanciesto develop preventive strategies or treatment options.

Methods: A total of 37248 births were registered between 2017 and 2020. Random numbers table was used to choose participants. Patients who had unavailable records,different ethnicity, education level, marital status,insurance type were excluded and3567 pregnant were included in the study. The adolescent pregnant group comprised 1104 women whileadults comprised 2463 pregnan.Fetal anomaly, gestational diabetes, preeclampsia-eclampsia, intrauterine growth restriction, intrahepatic cholestasis, polyhydramnios, placenta previa, inutero mort fetus, uterine rupture, placenta abruption, umbilical cord prolapse, acute fetal distress, preterm birth, cesarean section, labor arrest, birth weight, macrosomia, dystocia, birth trauma, APGAR scores, neonatal intensive care unit admission, postpartum hemorrhage, hysterectomy, blood transfusion, and postpartum infection were recorded.

Results: Rates of acute fetal distress, preterm birth, low birth weight, neonatal intensive care unit admission, postpartum hemorrhage, and blood transfusion were higher while birth weight, APGAR scores, the rates of cesarean section, prolonged and arrested labor, gestational diabetes,and macrosomia were lower in adolescents. Being adolescent increase the risk of acute fetal distress by 1.4 times (aOR=1.44;95%CI=1.03-2.01,p=0.033), preterm birth by 1.7 times(aOR=1.69;95%CI=1.10-2.60,p=0.016) and decrease the risk of gestational diabetes(aOR=0.18;95%CI=0.12-0.29,p<0.001),macrosomia(aOR=0.59;95%CI=0.40-0.9,p=0.08),labor arrest(aOR=0.50;95%CI=0.27-0.95,p=0.033) and cesarean section(aOR=0.33;95%CI=0.27-0.39,p<0.001) after adjusting for confounders.

Conclusion: Considering increased acute fetal distress, preterm birth, low birth weight, neonatal intensive care unit admission, postpartum hemorrhageblood transfusion risk for adolescent pregnancies, adolescents and healthcare providers should be informed and follow-ups must be performed in well-equipped centers.

Keywords: Adolescent Pregnancy, Cesarean Section, Gestational Diabetes, Labor Arrest, Preterm Birth

Correspondence: MD, Fatma Tuğba Engindeniz, University of Health Sciences, Bursa Yuksek Ihtisas Research and Training Hospital, Public Health, Bursa, Türkiye. **E-mail:** mtengindeniz@gmail.com, **Phone**: +90 (532) 510 48 00
Cite This Article: Engindeniz FT, Şimşek D, Dinçgez B. A hidden burden on public health: Adolescent pregnancy and ıncreased adverse perinatal outcomes. Turk J Public Health 2023;21(3): 361-370.

INTRODUCTION

Adolescent pregnancy is defined as a pregnancy that occurs between 10-19 years old[1]. The prevalence of these pregnancies was reported to be 11% of all births worldwide[2]. In Türkiye, the frequency of adolescent pregnancies was 4.6% in 2013, it increased to 7.9% between 2015 and 2017. In 2018, The Demographic and Health Survey for Türkiye notified that 3.5% of adolescents had children and 0.2 % of women had children before the age of 15 [3,4].

Adolescent pregnancy is a major public health problem, especially in low and middle income countries. It is known that gender inequality poses a big role in this condition. Adolescent girls tend to marry and have pregnancy at younger ages. Mostly, they are pressured to have sexual intercourse to please their partners. When they become pregnant, they are blamed. Mostly, they take the risk of an abortion under inappropriate conditions. Adolescent pregnancies are still one of the leading causes of perinatal mortality, especially in low and middle income countries[5]. Furthermore, it is associated with increased adverse pregnancy outcomes when it is compared with adult pregnancies[6]. The main reason for this risk is not fully elucidated. It could be related to physiological and psychological immaturity, inadequate antenatal care, and insufficient knowledge of sexual issues[7].

In the literature, many studies have searched for the relationship between adolescent pregnancy and perinatal outcomes. Unfortunately, conflicting results were reported in these studies[7,8]. Similarly, a limited number of studies from Türkiye have inconsistent findings. In a meta-analysis from Türkiye, Karacam et al showed that preterm birth, early membrane rupture, anemia, low birthweight/intrauterine growth retardation and fetal distress were more common in adolescents while cesarean section, gestational diabetes, placenta previa, polyhydramnios and macrosomia were less common among adolescents compared to adults. In the studies involved in meta-analysis, some reports have concluded that preeclampsia has an higher rate while some of them report contrary results. Other conflicting results in the meta-analysis are about breech presentation, postpartum hemorrhage, amniotic fluid abnormalities, and neonatal death[3].

This study aimed to assess adverse perinatal outcomes in adolescent pregnancies at a tertiary reference hospital, in Bursa, Türkiye to develop preventive strategies for adolescent pregnancies or treatment options for common adverse outcomes.

METHODS

This is a retrospective, cohort study conducted in a university-affiliated research and training hospital between January 1, 2017, and December 2020. SBU Bursa Yuksek Ihtisas Training and Research Hospital ethics committee approved the study (approval number: 2011-KAEK-25 2021/10-06) and it was in accordance with the Declaration of Helsinki.

A total of 37248 births were given between 1 January 2017 and December 2020. Random numbers table were used to choose participants. The inclusion criteria consisted of singleton and nulliparous pregnancies below 35 years old. All patients had regular antenatal visits and gave birth in our clinic. Patients who had unavailable antepartum

and peripartum records were excluded from the study. Also, patients who had a different ethnicity, education level, marital status, and insurance type were excluded. Consequently, a total of 3567 pregnant women were included in the study. The adolescent pregnant group comprised 1104 women while the adult group comprised 2463 pregnant women.

Age, maternal, fetal, and neonatal data were collected from medical records. Antepartum features were composed of fetal anomaly, gestational diabetes, preeclampsia, eclampsia, intrauterine growth restriction, intrahepatic cholestasis of pregnancy, polyhydramnios, placenta previa, and in utero mort fetus. Peripartum characteristics that were recorded were uterine rupture, ablatio placenta, umbilical cord prolapse, acute fetal distress, preterm birth, cesarean section, prolonged or arrested labor, birth weight, low birth weight, macrosomia, dystocia, birth trauma, APGAR scores, neonatal intensive care unit (NICU) admission, postpartum hemorrhage, peripartum hysterectomy, blood transfusion, and postpartum infection.

Gestational age was calculated from the last menstrual period and confirmed by sonography. Adverse perinatal outcomes were confirmed as explained below. The deliveries that occurred before the 37th gestational week were accepted as preterm birth[9]. Low birth weight was used to define birth weights below 2500 grams while macrosomia was used for babies over 4500 grams[10]. For the diagnosis of gestational diabetes mellitus, 75 grams of oral glucose tolerance test was performed. The presence of any of the following parameters in the measurements was considered as GDM: i) Fasting glucose ≥92 mg/dL, ii) 1-hour glucose ≥180 mg/dL, and iii) 2nd-hour glucose ≥153 mg/dL[11]. Preeclampsia presents the condition which hypertension after 20 weeks of gestation accompanied by at least one of the followings: proteinuria, liver, kidney failure, and hematological or neurological complications. Eclampsia was accepted as a form of preeclampsia complicated by generalized convulsions[12]. Intrauterine growth restriction was diagnosed when the estimated fetal weight was lower than 10 percentile with the deceleration of intrauterine growth in routine antenatal visits[13]. Intrahepatic cholestasis of pregnancy was defined when the pregnancy was complicated by pruritus and elevated bile acids[14]. The diagnosis of polyhydramnios was made by ultrasound with an amniotic fluid index ≥25 cm or a single deepest measure fluid pocket >8 cm[15]. Placenta previa was defined as the implantation of the placenta over the cervical os and abruptio placenta was defined as the early separation of a normally implanted placenta[16]. When additional delivery maneuvers were required in delivery, dystocia was diagnosed[17]. Postpartum hemorrhage was defined as blood loss greater than 1000 ml within 24 hours of birth[18]. NICU admission indications were severe jaundice, early prematurity, extremely low birth weight, the necessity of cardiorespiratory monitoring, and neonatal sepsis.

Statistical Analysis

The Shapiro Wilk test was used to assess the normality of the distribution. The continuous variables did not distribute normally, hence descriptive statistics were given as median (minimum-maximum) and groups were compared by Mann-Whitney U test. For categorical variables, Chi-square or Fisher's exact test was used for group comparisons and the variables were expressed as frequencies

and percentages. Regression analysis was performed to determine the effect of being adolescent on antepartum and peripartum characteristics. Statistical analysis was performed by using SPSS Version 21.0. (IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Armonk, NY: IBM Corp.) software. The level of significance was set at p<0.05.

RESULTS

A total of 3567 pregnant women were included in the study. The adolescent pregnant group was composed of 1104 women while the adult group consisted of 2463 pregnant women. The median age of all study groups was 26, the youngest patient was 13 and the oldest patient was 30 years old. The median age was 18 (13-19) in the adolescent group and 27 (25-30) in the adult group.

The antepartum features of adolescent and adult pregnancies were demonstrated in Table 1. According to the table, there was no significant difference between adolescent and adult groups in terms of fetal anomaly, insulin usage for gestational diabetes, preeclampsia, eclampsia, intrauterine growth restriction, polyhydramnios, intrahepatic cholestasis of pregnancy, placenta previa and in utero mort fetus. Gestational diabetes mellitus was significantly lower in adolescent pregnant women as compared to adult ones (1.9% vs 9.6%, p<0.001).

Table 1: Antepartum features of adolescent and adult pregnancies

	Adolescent pregnancies (n=1104)	%*	Adult pregnancies (n=2463)	%**	p
Fetal anomaly	2	0.2	11	0.4	0.367
Gestational diabetes	21	1.9	237	9.6	**<0.001**
Insulin usage for GDM	1	4.8	14	5.9	1.000
Preeclampsia	17	1.5	32	1.3	0.568
Eclampsia	0	0	0	0	1.000
IUGR	21	1.9	37	1.5	0.383
Intrahepatic cholestasis	0	0	5	0.2	0.333
Polyhydramnios	2	0.2	6	0.2	1.000
Placenta previa	13	1.2	22	0.9	0.540
In utero mort fetus	13	1.2	27	1.1	0.967

GDM: Gestational diabetes mellitus, IUGR: Intrauterine growth restriction

(%)*: Line percentage of Adolescent pregnancies (%)**: Line percentage of Adult pregnancies

The peripartum characteristics of adolescent and adult groups were shown in Table 2. No significant difference was found between adolescent and adult pregnant groups with regards to uterine rupture, ablatio placenta, umbilical cord prolapse, dystocia, birth trauma, APGAR scores of first minutes, peripartum hysterectomy, and postpartum infection. The rates of acute fetal distress (5.3% vs 3.8%, p=0.032), preterm birth (4% vs 2.2%, p=0.002), low birth weight (9.2% vs 7.1%, p=0.031), NICU admission (7% vs 5%, p=0.016), postpartum hemorrhage (1.2% vs 0.2%, p<0.001) and blood transfusion (2.2% vs 1.2%, p=0.044) were significantly higher in adolescent pregnant women as compared to adult pregnant women. Contrary to these, the rates of cesarean section (21.2% vs 40.2%, p<0.001), prolonged and arrested labor (1.1% vs 2.1%, p=0.033) and macrosomia

(3% vs 5.8%, p<0.001) were significantly lower in adolescent group. Furthermore, birth weight (3125 (600-4885) vs 3250 (500-4900), p<0.001) and APGAR scores of fifth minutes (9 (0-10) vs 10(0-10), p<0.001) were significantly lower in the adolescent group.

Table 2: Peripartum features of alescent and adult pregnancies

	Adolescent pregnancies (n=1104)	%*	Adult pregnancies (n=2463)	%**	p
Uterine rupture	0	0	5	0.2	0.333
Ablatio placenta	3	0.3	10	0.4	0.765
Umbilical cord prolapse	1	0.1	4	0.2	1.000
Acute fetal distress	59	5.3	93	3.8	0.032
Preterm birth	44	4	54	2.2	0.002
Cesarean section	234	21.2	991	40.2	<0.001
Prolonged and arrested labor	12	1.1	52	2.1	0.033
Birth weight (gram)	3125 (600-4885)		3250 (500-4900)		<0.001
Low birth weight	102	9.2	176	7.1	0.031
Macrosomia	33	3	142	5.8	<0.001
Dystosia	7	0.6	5	0.2	0.057
Birth trauma	1	0.1	5	0.2	0.673
APGAR 1. minutes	8 (0-9)		9 (0-9)		0.130
APGAR 5. minutes	9 (0-10)		10 (0-10)		<0.001
NICU admission	76	7	122	5	0.016
Postpartum hemorrhage	13	1.2	4	0.2	<0.001
Peripartum hysterectomy	1	0.1	4	0.2	1.000
Blood transfusion	24	2.2	30	1.2	0.044
Postpartum infection	4	0.4	12	0.5	0.788

(%)*: Line percentage of Adolescent pregnancies (%)**: Line percentage of Adult pregnancies

In regression analysis, confounding factors were determined for each adverse outcomes and regression models were constructed according to each condition. A p value <0.05 was considered significant for regression models. Searching the effect of being adolescent on preterm birth after adjusting for preeclampsia, eclampsia, gestational diabetes, macrosomia, polyhydramnios, intrauterine growth restriction, ablatio placenta, umbilical cord prolapse, and intrahepatic cholestasis of pregnancy, it was found that being adolescent increased the risk of preterm birth nearly 1.7 fold (aOR=1.69; 95% CI=1.10-2.60;p=0.016). Moreover, being adolescent increased the risk of acute fetal distress by 1.4 times (aOR=1.44; 95%CI=1.03-2.01;p=0.033). Contrary to these, adolescents had decreased risk of gestational diabetes (aOR=0.18; 95% CI=0.12-0.286; p<0.001), macrosomia (aOR=0.59; 95% CI=0.40-0.87; p=0.08), prolonged and arrested labor (aOR=0.50; 95% CI=0.27-0.95; p=0.033) and cesarean section (aOR=0.33; 95% CI=0.27-0.39; p<0.001) after excluding the effects of possible confounders. No significant effect of being adolescent on low birth weight (p=0.731), postpartum hemorrhage (p=0.977), blood transfusion (p=0.448), and neonatal intensive care unit admission (p=0.104) was detected after adjusting for confounding factors.

DISCUSSION

The present study showed that pregnant

adolescents had a higher incidence for acute fetal distress, preterm birth, low birth weight, neonatal intensive care unit admission, and postpartum hemorrhage. Contrary to these, they had a lower incidence for cesarean section, labor arrest, gestational diabetes, and macrosomia. After adjusted for confounding factors, we found that the risk of preterm birth was increased while the risk of gestational diabetes and cesarean section was decreased.

Adolescents are one of the most important populations for reproductive problems. First, they have increased adverse pregnancy risk due to their structural immaturity and inadequate sexual knowledge. Moreover, adolescent pregnancies are usually unwanted due to early sexual intercourse, cultural beliefs, marriage at an early age, and inadequate contraception knowledge[1,2,5,10]. The available literature on adverse perinatal outcomes in adolescent pregnancies has reported an increased risk for eclampsia, puerperal infection, low birth weight, preterm birth, and stillbirth[2,6,10,19-21].

Peripartum complications are still one of the leading causes of maternal and fetal mortality and morbidity. In low- and middle-income countries, nearly half of maternal and fetal mortality is due to hemorrhage and hypertensive disorders in pregnancy[22,26]. Unfortunately, adolescent pregnancies are more prone to these complications than adults. A study from Zambia reported a higher risk of vaginal bleeding and anemia in adolescent pregnant women[23,26]. The study from Nigeria and Latin America showed a higher incidence of postpartum hemorrhage in adolescent pregnancies[6,15,24]. This risk can be attributed to an increased risk of placental abruption, uterine rupture, and amnion fluid abnormalities in adolescents. Contrary to these, another study conducted in Thailand showed a decreased risk of postpartum hemorrhage[25,26]. Kassa et al reported no difference in the incidence of postpartum hemorrhage between adolescents and adults[26]. Likewise, a study conducted in Nepal found a nonsignificant difference in terms of postpartum hemorrhage[27]. In our study, increased rates for postpartum hemorrhage and blood transfusion were detected while no difference was found in terms of placental abruption, uterine rupture, and polyhydramnios. When the risk was evaluated after excluding confounding factors, being adolescent was not found to be a risk factor for postpartum hemorrhage. We suggest that these inconsistent results between studies can relate to race, study population characteristics, and medical skills of healthcare personnel. A meta-analysis of 38 Turkish studies concluded that adolescents and adults were similar in terms of the prevalence of postpartum hemorrhage[3]. This result supports our explanation about race and study population characteristics.

Preeclampsia is another debating and common adverse perinatal outcome for adolescent pregnancies. A study searching 51142 adult and 7305 adolescent pregnant women demonstrated higher rates of preeclampsia and eclampsia in adolescents[28]. Similarly, Demirgöz et al and Medhi et al found an increased risk for preeclampsia in the Turkish population[29,30] Immaturity of the immune system and decreased blocking antibody levels of chorion villus are claimed to be a critical role in this increased risk[31]. Contrary to these studies, a multicenter study reported a lower risk of preeclampsia among

adolescents[2,26]. Moreover, studies from Wales and India showed a lower risk of pregnancy-induced hypertension in adolescents [26,32-34]. Besides these, some studies found no difference in the proportion of preeclampsia in adolescent pregnancies[20,26,35]. Likewise, we found no difference in the incidence of preeclampsia in adolescents as compared to adult pregnancies. We suggest that the differences in the incidence of preeclampsia can be due to confounding factors such as primiparity and maternal age. Also, adolescents in the present study were older adolescents and no data were present for very early ages. Supporting our results, the meta-analysis from Türkiye reported no significant increased risk for preeclampsia in adolescents[3].

Although the immature pelvic structure can be a candidate for prolonged and arrested labor, it is known that adolescents tend to have vaginal delivery[1,2,36,37]. This condition seems to be preventive for future cesarean sections and complications such as placenta invasion abnormalities. Zhang et al reported that adolescents had reduced cesarean risk by 25% than adults[20]. Consistent with the literature, we found decreased cesarean section rates in our study in adolescents. This condition could be explained by the delivery of more preterm and low birth weight fetuses owing to less weight gain, malnutrition and concomitant diseases in adolescents. Another explanation could be having a better myometrial function and tissue elasticity of adolescents[6,26,38].

The frequency of GDM would be expected to be higher due to a non-developed endocrine regulating system in adolescents, but we found a lower incidence of GDM in our study. This result was consistent with the study of Zhang et al and Wang et al[20,39]. We suggest that future studies searching for the underlying reason for reduced risk in GDM are needed.

Many studies are showing higher incidences of preterm birth in adolescent pregnancies. These studies reported a relative risk varying from 1.18 to 2.15[1,2,20,39,40]. Kassa et al found 1.65 times increased risk of preterm birth in adolescent pregnancies. In our study, we found 1.7 times increased risk of preterm birth in adolescents after excluding confounding factors. Impaired prostaglandin production due to the immaturity of decreased cervical blood supply and anatomical immaturity of adolescents could be a contributor to preterm birth[41].

The babies born to adolescent pregnant women are prone to have low birth weight [26,42]. Ganchimeg et al found that adolescent pregnancies have low birth weight fetuses with low Apgar scores[2]. In another study, 2.14 times increased risk was reported for low birth weight in adolescent pregnancies. We found higher incidence of low birth weight in adolescents which was consistent with the literature. After the effect of confounding factors was excluded, the risk of low birth weight was not different than adults. This condition could be related to preterm birth, micronutrient deficiencies, and immaturity[41]. Moreover, depressive mood, commonly seen in teenagers, could stimulate releasing of placental corticotropin releasing hormone and results in preterm birth[43].

This study also found a significant difference in Apgar score and neonatal intensive care unit admission between adolescent and adult pregnancies. Previous studies conducted in USA and Thailand showed consistent findings for neonatal intensive care unit admission with

our study[1,41,44]. These increased risks could be associated with increased adverse outcomes, different sociodemographic features, small sample size, and access to health care services.

In a study by Shrim et al, higher congenital anomaly rates were reported while no significant difference was reported in other studies[45,46]. In our study, we did not find any difference in terms of fetal anomaly. However, inconsistent findings are present in the literature about stillbirth, intrauterine growth restriction, intrahepatic cholestasis of pregnancy, polyhydramnios, postpartum infection, placental anomalies, uterine rupture, and birth trauma. We did not find a significant difference in the incidence of these outcomes.

Strengths of the Study

Assessing adverse perinatal outcomes in adolescent pregnancies at a tertiary reference hospital can provide local but valuable data for developing preventive strategies for adolescent pregnancies or treatment options for common adverse outcomes. By this way, it can be concluded which patients will be followed in well-equiped tertiary centers. Besides this, our study had a big sample size. The regression analysis was performed by taking account confounders for each outcome.

Limitations

The present study had some limitations. First, the median age for adolescents was 18 which shows that the majority of the study group was composed of older adolescents. Second, factors that might affect pregnancy outcomes such as smoking, etnicity, education, economic status, and body mass index were not taken into account in this study. Third, this was a retrospective study and lack of the effects of psychological challenges posed a negative effect on well-being in adolescent pregnancies which could change both prevention and treatment.

CONCLUSION

Preventing adolescent pregnancies is more difficult but more necessary than preventing the medical problems that can arise from such pregnancies. Prevention of adolescent pregnancies should be considered one of the main health policy strategies to improve the socio-economic development of a country. Optimal perinatal care, sufficient support from both family and physicians, and promotion of education programs for the safe sexual practice among adolescents seems to be crucial for low and middle income countries. Moreover, encouragement of adolescents to avoid unwanted pregnancies via contraceptive methods should be a main focus. Additionally, we must keep in mind that the incidence of adverse perinatal outcomes of adolescent pregnancies could be minimized with optimal, multidisciplinary prenatal care.

Besides all of these, one of the main points about adolescent pregnancies are psychosocial challenges which were ignored in the present study. Pregnant adolescents might be more prone to depression, anxiety, suicide, alcohol and substance abuse. Adolescents feel ashamed, are stigmatised by their family and rejected by friends and partners because of the pregnancy. Their academic performance is damaged. While all of these are happening, the pregnant adolescent must be healthy for herself and her baby. Thus, public health professionals must focus on this issue. We suggest that, studies searching the effects of psychosocial challanges in adolescent pregnancies are needed to clarify the adverse

outcomes in adolescent pregnancies.

ACKNOWLEDGEMENT

Conflict of interest: The authors declare no conflict of interest.

Financial Support: the study had no external financial support.

Ethical Approval: SBU Bursa Yuksek Ihtisas Training and Research Hospital ethics committee approved the study (approval number: 2011-KAEK-25 2021/10-06).

Authorship Contributions: Concept: EFT, DB, SD Design: EFT, DB, SD, Supervising: EFT, DB, SD Data collection and entry: SD, Analysis and interpretation: EFT, BD, Literature search: EFT, DB, SD Writing: EFT, SD, Critical review: EFT, DB, SD.

REFERENCES

1. Kawakita T, Wilson K, Grantz KL, et al. Adverse maternal and neonatal outcomes in adolescent pregnancy. J Pediatr Adolesc Gynecol. 2016;29(2):130–6.
2. Ganchimeg T, Ota E, Morisaki N, et al. Pregnancy and childbirth outcomes among adolescent mothers: a World Health Organization multicountry study. Bjog. 2014;121(Suppl 1):40–8.
3. Karacam Zekiye, Damla Kizilca Cakaloz, and Rukiye Demir. "The impact of adolescent pregnancy on maternal and infant health in Turkey: Systematic review and meta-analysis. Journal of Gynecology Obstetrics and Human Reproduction 50.4 2021:102093.
4. Hacettepe University Institute of Population Studies. Turkey Demographic and Health Survey 2013. Ankara, Turkey: Hacettepe University Institute of Population Studies, Ministry of Health General Directorate of Mother and Child Health and Family Planning, T.R. Prime Ministry Undersecretary of State Planning Organization and TUBİTAK; 2014. www.hips.hacettepe.edu.tr/eng/tdhs08/TDHS-2008_Main_Report.pdf.
5. WHO. Adolescent Pregnancy: World Health Organization; 2014. Available from: http://www.who.int/mediacentre/factsheets/fs364/en/.
6. Conde-Agudelo A, Belizán JM, Lammers C. Maternal-perinatal morbidity and mortality associated with adolescent pregnancy in Latin America: Cross-sectional study. American journal of obstetrics and gynecology. 2005;192(2):342–9. 10.1016/j.ajog.2004.10.593
7. Amjad S, MacDonald I, Chambers T, et al. Social determinants of health and adverse maternal and birth outcomes in adolescent pregnancies: a systematic review and meta-analysis. Paediatr Perinat Epidemiol. 2019;33(1):88–99.
8. Westenberg L, van der Klis KA, Chan A, et al. Aboriginal teenage pregnancies compared with non-aboriginal in South Australia 1995-1999. Aust NZJ Obstet Gynaecol. 2002;42(2):187–92.
9. Munim S, Islam Z, Zohra N, Yasmin H, Korejo R. Guidelines on prevention of preterm birth. The Journal of Maternal-Fetal & Neonatal Medicine. 2022;35(25): 9527-9531.
10. Chen X-K, Wen SW, Fleming N, Demissie K, Rhoads GG, Walker M. Teenage pregnancy and adverse birth outcomes: a large population based retrospective cohort study. International journal of epidemiology. 2007;36(2):368–73.
11. White SL, Ayman G, Bakhai C, Hillier TA, Magee LA. Screening and diagnosis of gestational diabetes. BMJ. 2023; 2:381:e071920.
12. Gupta S, Petras L, Tufail MU, Rodriguez Salazar JD, Jim B. Hypertension in pregnancy: what we now know. Current opinion in nephrology and hypertension 2023;32(2):153-164.
13. ACOG Practice Bulletin No. 204: fetal growth restriction. et al. Obstet Gynecol 2019;133:0.
14. Smith DD, Rood KM. Intrahepatic Cholestasis of Pregnancy. Clin Obstet Gynecol. 2020 Mar;63(1):134-151.
15. Hwang DS, Mahdy H. Polyhydramnios. 2022 Mar 2. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 Jan–. PMID: 32965811.
16. Jain V, Bos H, Bujold E. Guideline No. 402: diagnosis and management of placenta previa. Journal of Obstetrics and Gynaecology Canada. 2020;42(7): 906-917.
17. Davis DD, Roshan A, Canela CD, Varacallo M. Shoulder Dystocia. 2022 Jun 21. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 Jan–. PMID: 29261950).
18. Bienstock JL, Eke AC, Hueppchen NA. Postpartum hemorrhage. New England Journal of Medicine. 2021;384(17):1635-1645.
19. Indarti J, et al. Teenage pregnancy: Obstetric and perinatal outcome in a tertiary centre in Indonesia. Obstet. Gynecol. Int. 2020;2020:2787602. doi: 10.1155/2020/2787602.

20. Zhang T, et al. The adverse maternal and perinatal outcomes of adolescent pregnancy: A cross sectional study in Hebei, China. BMC Pregnancy Childbirth. 2020;20:339. doi: 10.1186/s12884-020-03022-7.

21. Ogawa K, et al. Association between adolescent pregnancy and adverse birth outcomes, a multicenter cross sectional Japanese study. Sci. Rep. 2019;9:2365. doi: 10.1038/s41598-019-38999-5.

22. Say L, Chou D, Gemmill A, Tuncalp O, Moller AB, Daniels J, et al. Global causes of maternal death: a WHO systematic analysis. The Lancet Global health. 2014;2(6):e323–33.

23. Moraes AN, Likwa RN, Nzala SH. A retrospective analysis of adverse obstetric and perinatal outcomes in adolescent pregnancy: the case of Luapula Province, Zambia. Maternal Health, Neonatology and Perinatology. 2018;4(1):20.

24. Ayuba II, Gani O. Outcome of teenage pregnancy in the niger delta of Nigeria. Ethiop J Health Sci. 2012;22(1):45–50.

25. Narukhutrpichai P, Khrutmuang D, Chattrapiban T. The Obstetrics and Neonatal Outcomes of Teenage Pregnancy in Naresuan University Hospital. J Med Assoc Thai. 2016;99(4):361–7.

26. Getachew Mullu Kassa, Ayodele O. Arowojolu, Akin Tunde A. Odukogbe, Alemayehu Worku Yalew. Adverse maternal outcomes of adolescent pregnancy in Northwest Ethiopia: A prospective cohort study. PLoS One. 2021; 16(9): e0257485.

27. Kayastha S, Pradhan A. Obstetric Outcome of Teenage Pregnancy. Nepal Journal of Obstetrics and Gynaecology. 2014;7(2):29–32.

28. Leppälahti S, Gissler M, Mentula M, Heikinheimo O et al. Is teenage pregnancy an obstetric risk in a welfare society? A population-based study in Finland, from 2006 to 2011. BMJ Open, 2013;19; 3:e003225.

29. Demirgöz M, Canbulat N. Adolescent Pregnancy, Review, Turkiye Klinikleri J Med Sci. 2008; 28: 947-52.

30. Medhi R, Das B, Das A, et al. Adverse obstetrical and perinatal outcome in adolescent mothers associated with first birth: a hospital-based case–control study in a tertiary care hospital in North-East India. Adolesc Health Med Ther. 2016; 7: 37-42.

31. Canbaz S, Sunter AT, Cetinoglu CE, Peksen Y. Obstetric outcomes of adolescent pregnancies in Turkey. Adv Ther 2005; 22:636-41

32. Fleming N, Ng N, Osborne C, Biederman S, Yasseen AS 3rd, Dy J, et al. Adolescent pregnancy outcomes in the province of Ontario: a cohort study. J Obstet Gynaecol Can. 2013;35(3):234–45.

33. Gupta N, Kiran U, Bhal K. Teenage pregnancies: obstetric characteristics and outcome. Eur J Obstet Gynecol Reprod Biol. 2008;137(2):165–71.

34. Paladugu RK, Donipudi PC, Chimata D, Jasti M. Adolescent pregnancy and its outcomes: a cross-sectional study. International Journal of Community Medicine and Public Health. 2018;5(10):4408–14.

35. Minjares-Granillo RO, Reza-Lopez SA, CaballeroValdez S, et al. Maternal and perinatal outcomes among adolescents and mature women: a hospital-based study in the North of Mexico. J Pediatr Adolesc Gynecol. 2016; 29: 304-11.

36. Jolly MC, Sebere MN, Harris J, et al. Obstetric risks of pregnancy in women less than 18 years old. Obstet Gynecol. 2000;96:962–6.

37. Torvie AJ, Callegari LS, Schiff MA, et al. Labor and delivery outcomes among young adolescents. Am J Obstet Gynecol. 2015;213 d.ed-x.ex.

38. Vivatkusol Y, Thavaramara T, Phaloprakarn C. Inappropriate gestational weight gain among teenage pregnancies: prevalence and pregnancy outcomes. International journal of women's health. 2017;9:347–52.

39. Wang C, Wang XY, Yang HX. Effect of maternal age on pregnancy outcomes in Beijing. Zhonghua Fu Chan Ke Za Zhi. 2017;52(8):514–20

40. Marvin-Dowle K, Kilner K, Burley VJ, et al. Impact of adolescent age on maternal and neonatal outcomes in the born in Bradford cohort. BMJ Open. 2018;8(3):e016258.

41. Getachew Mullu Kassa, Ayodele O. Arowojolu, Akin Tunde A. Odukogbe, Alemayehu Worku Yalew. Adverse maternal outcomes of adolescent pregnancy in Northwest Ethiopia. PLoS One. 2019; 14(6): e0218259.

42. Naz U. Comparison of obstetric outcome in terms of the risk of low birth weight, preterm delivery, cesarean section rate and anemia in primigravid adolescents and older primigravida. Journal of the College of Physicians and Surgeons—Pakistan: JCPSP. 2014;24(2):131–4.

43. Stevens-Simon C, Beach RK, McGregor JA. Does incomplete growth and development predispose teenagers to preterm delivery? A template for research. J. Perinatol. 2002;22:315–323.

44. Thaithae S, Thato R. Obstetric and Perinatal Outcomes of Teenage Pregnancies in Thailand. Journal of pediatric and adolescent gynecology. Longitu

Turk J Public Health
Available online at: http://dergipark.org.tr/tjph/
Doi: 10.20518/tjph.1299861

TURKISH JOURNAL OF PUBLIC HEALTH

ORIGINAL ARTICLE

Early-life exposures and childhood obesity and overweight in Türkiye

Rengin Aktar[1]

[1]Postdoctoral Researcher, Hacettepe University, Institute of Population Studies, Ankara, Türkiye

Received: 20.05.2023, **Accepted:** 29.11.2023

Abstract

Objective: Childhood overweight and obesity have seen a dramatic increase in Turkey and other middle-income countries over the last decades. By using anthropometric data, this study examines the influence of early-life exposures during pregnancy and infancy on young children's risk of developing overweight and obesity.

Methods: Study uses five cross-sections of Demographic and Health Surveys (DHS) conducted in Turkey between 1993 and 2013. A total of 9719 children between the ages of 2 and 5 are used to estimate the prevalence rates of obesity and overweight. In addition, a logistic regression model is applied to 5013 children in order to assess the main determinants of obesity and overweight.

Results: There is a notable increase in the prevalence rates of obesity and overweight in children between 1993 and 2013, the peak prevalence has been reached in 2008. Results of the logistic regression reveal that early-life factors; maternal obesity and high birth weight are significantly associated with the risk of obesity and overweight in young children. Among socio-economic variables, living both in the richest and poorer households are positively and significantly associated with the risk of obesity and overweight.

Conclusion: Public health efforts to prevent childhood obesity and overweight would be incomplete without considerations of maternal health and nutrition during pregnancy.

Keywords: Childhood Obesity, Childhood Overweight, Fetal Programming, Breastfeeding, Chronic Diseases

Correspondence: Postdoctoral Researcher Rengin Aktar, Hacettepe University, Institute of Population Studies, Ankara, Türkiye. **E-mail:** renginaktar@gmail.com, **Phone**: +90 536 979 02 42.
Cite This Article: Aktar R. Early-life exposures and childhood obesity and overweight in Türkiye. Turk J Public Health 2023;21(3): 371-382.

INTRODUCTION

Childhood overweight and obesity constitute a serious health problem. Excess body fat have immediate consequences on children's physical health, including insulin resistance and metabolic syndrome, Type 2 diabetes mellitus, high blood pressure and raised markers of inflammation.[,,] Discrimination, low self-esteem, anxiety and depression are commonly experienced psycho-social consequences. [,] From a population health perspective, however, the real impact of rising overweight and obesity prevalence rates manifests only after a time lag, when children reach adulthood and face elevated risks of premature illness and death: Studies have repeatedly shown that children with excess weight are more prone to staying overweight and obese into adulthood,[,] and more likely to develop serious chronic diseases such as hypertension, diabetes, heart disease and some types of cancer.[,,,]

Previous studies have drawn attention to a dramatic increase in childhood overweight and obesity in developing countries, [1,3,,,,] and in Turkey.[,,,] Recent data published by UNICEF, WHO and World Bank show that the percentage of children under the age of 5 affected by excess body weight increased from 6.7 to 8.8 in upper-middle income countries between 2000 and 2020. [23] The increase in percentage of young children with excess body weight was much larger in Turkey during the same period and in fact it was by more than twofold: The prevalence rate that was equal to 3.8 in 1998 reached 11.1 in 2013, albeit decreasing to 8.1 in 2018. [24]

This study approaches the problem of childhood overweight and obesity from the perspective of the Developmental Origins of Health and Disease (DOHaD) theory. Recent years have seen an explosive growth in DOHaD, a field of research that is best, but only incompletely, associated with the work of Barker and his group.[25] The main conjectures put forward in this literature revolve around the idea that early life environment can impact the risk of chronic diseases from childhood to adulthood. Thus, child growth problems manifested as short gestation, low birthweight, growth-faltering, stunting, and overweight and obesity, are in fact imprints of nutrition and other environmental factors during prenatal and postnatal development, which have influenced developmental plasticity and this way altered susceptibility to adult chronic disease.

With regard to the risk of obesity, previous studies explored a number of prenatal exposures that influence the satiety, food preference, muscle mass and insulin resistance in the offspring through intrauterine programming.[26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36] For instance, maternal undernutrition during pregnancy is linked to the fetal programming of obesity: When fetal nutritional insufficiency triggers a set of anatomical, hormonal and physiological changes to enhance survival in resource-poor environments, and when these early nutritional deficits and their developmental adaptations are followed by excesses in the postnatal environment with plentiful resources, they do increase the risk of developing obesity. [31]

Second, like fetal undernutrition, fetal overnutrition also contributes to the intrauterine programming of adiposity: Evidence shows that maternal diabetes and gestational diabetes expose the fetus to an excess of nutrients, an important risk factor

for later obesity.[27, 33] In addition, studies have shown that the newborns of obese mothers have more body fat and there is a link between higher maternal BMI (or maternal obesity during pregnancy) and a greater risk of overweight and obesity in children, which suggest that maternal obesity programs obesity in children through an effect on fetal nutrition.[36,37,38]

In the post-natal environment, it is suggested that lack of breastfeeding increases the risk of obesity for at least two reasons: First, infants who are fed formula have a higher energy intake and greater early gain in body weight than breast-fed infants, increasing the risk of obesity in early childhood.[39, 40] Second, breastfeeding is well known to contribute to healthy development and a reduced risk of stunting, not raising the weight to height proportions in children. Other early life exposures that are known to lead to programming of adiposity include maternal smoking and alcohol consumption, maternal stress and exposure to environmental pollutants or chemical toxins during pregnancy. [27, 28,29,34]

This study examines the role of some of the key maternal exposures during pregnancy and infancy in determining young children's risk of obesity and overweight. These exposures are maternal obesity, birth weight, and breastfeeding during infancy. Using five cross-sections of Demographic and Health Surveys (DHS) conducted in Turkey between 1993 and 2013, the paper first decribes the prevalence rates of excess weight in children between the ages of 2 and 5. Having established an increasing trend in both childhood overweight and obesity , logistic regression models are employed to assess the relative significance of early-life exposures and socio-economic factors, such as maternal education, urban or rural place of residence, or household wealth, as the determinants of obesity and overweight. Results reveal that maternal obesity, high birth weight, and duration of breastfeeding, as well as household wealth, geographical region and place of residence, are significant determinants of childhood overweight and obesity. In the final section, the paper discusses the implications of these findings for public health efforts to combat overweight and obesity.

METHODS

This study uses five cross-sections of DHS conducted in Turkey between 1993 and 2013. DHS are nationally representative surveys of on fertility, family planning, and maternal and child health. Each cross-sectional sample consists of ever-married women in their reproductive ages, that is available with social and economic background variables at the individual and household level. Even though each ever married woman aged 15-49 reports data about all her live-born births starting from the first to the most recent birth, detailed pregnancy, birth and postnatal histories are only available for children born in the last 5 years before the time of the survey. These histories include the antenatal and delivery care information and the problems encountered in accessing health care, child size and weight at birth, vaccination reports based on the national schedule of vaccines, and breastfeeding information. DHS Data additionally include current anthropometric data for mothers and children, making it ideal to study the influence of maternal BMI and other conditions, exposures and environments on children's risk of overweight and obesity.

The main variables of interest from DHS are height and weight for both mothers and children, that enable us to calculate Body Mass Index (BMI) scores. This information is available in the Individual Recode file of mothers, which is reformatted from wide to long format so that each observation represents a child. Those children for whom current weight and height information is unavailable are excluded from analysis, and only children between the ages of 2 and 5 are kept. After these exclusions, the sample consists of 6285 mothers and 9719 children born to these mothers. The BMI scores calculated for children (in kg/m^2) are then adjusted for age and sex, to construct three BMI categories (normal weight, overweight and obese). In the last step, the categories of obesity and overweight are collapsed to create a binary variable that indicates whether a child is obese or overweight, or not. In the case of mothers, maternal obesity is defined as a BMI $\geq 30kg/m^2$, and similarly constructed as a binary measure.

The variable 'birthweight' is constructed from the reports of mothers on the birth weight of their children in grams. It is a categorical variable that measures whether a given child is born with 'Low birth weight', 'Normal birth weight' or 'High birth weight'. If birth weight is less than 2500 grams, it is considered 'Low birth weight'. If birth weight is equal to or more than 2500 grams and less than 4000 grams, it is considered "Normal birth weight". If a child is born with a birth weight that is equal to or more than 4000 grams, it indicates a "High birth weight". Breatsfeeding is represented by a continuous variable that indicates the duration of breastfeeding in months.

Other independent variables include maternal age and education, urban - rural type of residence, geographical region and wealth index. Mothers' education is constructed as a categorical variable that differentiates between women who have no education, women with primary education, and women with secondary education or higher. The place of residence is a binary variable taking a positive value if the residence is urban. Household wealth differentiates between five categories of household economic status: "Poorest households", "Poorer Households", "Middle-wealth households", "Richer households" and "Richest households". Finally, control variables for the age, sex, birth year, and birth order of children are added to the estimation.

Logistic regression model is used to estimate the main determinants of child overweight and obesity. All analyses are performed using the software STATA 13. Type I error is set to 0.05.

RESULTS

Estimations of childhood overweight and obesity prevalence rates reveal that both increased notably between 1993 and 2013, even though the relative increase in childhood obesity is larger than the increase in childhood overweight: Childhood obesity prevalence rate increased from 3.1 percent in 1993 to 4.5 percent in 2013, and childhood overweight prevalence rate increased from 9.8 percent in 1993 to 10.8 in 2013. If one collapses the two categories of childhood overweight and obesity together, these numbers suggest that the total prevalence rate of excess body weight in young children increased from 12.9 percent in 1993 to 15.3 percent in 2013. In addition, the peak prevalence of obesity and overweight was witnessed in the year 2008,

reaching 20.5 percent, and indicating that more than 1/5 of children were either obese or overweight at that time.

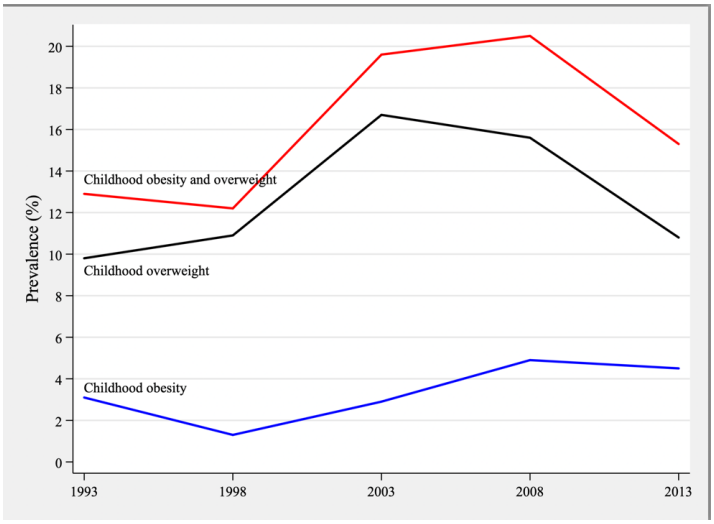

Figure 1. Prevalence rates of childhood overweight and obesity in Turkey between 1993 and 2013.

Notes:

i. Prevalence rates are calculated with Turkey DHS data, 1993, 1998, 2003, 2008 and 2013. ii. DHS sample weights are used in the calculation of prevalence rates.

Results of the logistic regression model suggest that there are several signficant determinants of excess body weight in children. For children of obese mothers, the odds of obesity and overweight are 1.57 times higher than for children of non-obese mothers (95% CI: 1.33-1.86). In addition to maternal obesity, birthweight is another significant predictor of obesity and overweight: The odds for children born with high birth weight is 1.49 times higher than for children born with normal birthweight (95% CI: 1.33-1.86). Finally, one month increase in the duration of breastfeeding decreases the likelihood of childhood overweight and obesity by 1 percent.

Among socio-economic variables, two categories of household wealth are significantly and positively associated with the risk of childhood overweight and obesity: For children in poorer households and children in the richest households, the odds of obesity and overweight are 1.34 times (95% CI: 1.06-1.69) and 1.38 times (95% CI: 1.06-1.78) greater than for children in middle-wealth households, respectively. Two geographical regions, and urban areas, are significantly and negatively associated with the risk of obesity and overweight: For children living in the southern and eastern regions, the odds are 0.60 times (95% CI: 0.47-0.78) and 0.76 times (95% CI: 0.61-0.95) lower than the western region, respectively. For children living in urban areas, the odds of obesity and overweight is 0.80 times lower than for children living in rural areas (95% CI: 0.65-0.97).

Among control variables, child's age, sex and birth year are significantly related to the risk of obesity and overweight. For female children, the odds of obesity and overweight is 1.41 times greater than for male children (95% CI: 1.21-1.64). The odds of obesity and overweight is 0.99 times lower for one month increase in age (95% CI: .98-1.00). Lastly, the odds of obesity and overweight is 1.03 times greater for one year increase in the year of birth (95% CI: 1.01-1.04).

Table 1. Descriptive statistics for the analysis of childhood overweight and obesity (DHS 1993-2013)

		1993		1998		2003		2008		2013	
Child variables		**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Childhood obesity	Obese children	3.0	55	1.4	23	3.3	83	4.8	80	3.4	71
Childhood overweight	Overweight children	9.7	180	10.1	165	17.7	444	15.4	259	9.8	203
Total			1847		1624		2506		1680		2062
Birthweight	Low birth weight	N/A	N/A	12.8	127	11.7	182	12.3	157	12.0	229
	Normal birth weight	N/A	N/A	68.8	683	75.0	1168	75.2	959	78.6	1502
	High birth weight	N/A	N/A	18.4	183	13.3	208	12.4	158	9.4	179
Total			-		993		1558		1274		1910
Duration of breastfeeding (months)	Mean	12.1		12.2		12.9		14.5		16.8	
	SD	9.1		9.2		9.2		9.3		10.0	
Total		1846		1616		2496		1676		1415	
		%	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Birth order	1	30.4	561	32.9	535	30.6	767	31.2	524	34.5	712
	2	27.0	498	27.0	439	26.0	651	29.9	502	32.3	666
	3+	42.7	788	40.0	650	43.4	1088	38.9	654	33.2	684
Total			1847		1624		2506		1680		2062
Child sex	Female	49.2	909	47.0	763	48.8	1222	48.4	813	47.2	973
Total			1847		1624		2506		1680		2062
Child age (months)	Mean	41.7		42.0		41.8		41.7		41.9	
	SD	10.2		10.3		10.3		10.5		10.4	
Total		1847		1624		2506		1680		2062	
Birth year	Min	1988		1993		1999		2003		2008	
	Max	1991		1996		2002		2006		2011	
Total		1847		1624		2506		1680		2062	
Maternal and SES variables		**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Maternal obesity	Obese mothers	23.0	267	21.0	212	27.6	434	25.9	290	28.8	366
Total			1159		1007		1574		1120		1269
Urban or rural place of residence	Urban	65.6	763	69.6	705	73.3	1157	72.9	825	73.8	1032
Total			1163		1013		1579		1132		1398
Geographical region	West	26.0	303	23.4	237	26.0	410	21.5	243	23.7	332
	South	21.3	248	20.1	204	13.5	214	16.3	185	13.9	194
	Central	21.0	244	19.5	198	18.0	284	19.1	216	18.7	262
	North	15.3	178	13.0	132	9.2	146	9.5	108	14.4	202
	East	16.3	190	23.9	242	33.2	525	33.6	380	29.2	408
Total			1163		1013		1579		1132		1398
Wealth index	Poorest households	16.7	194	18.1	183	19.2	303	24.3	275	24.3	340
	Poorer households	18.4	214	18.6	188	21.1	334	24.7	280	23.1	323
	Middle-wealth households	22.4	261	23.8	241	18.7	295	20.2	229	20.6	288
	Richer households	22.0	256	21.4	217	22.0	347	17.7	200	17.2	240
	Richest households	20.5	238	18.2	184	19.0	300	13.1	148	14.8	207
Total			1163		1013		1579		1132		1398
Maternal education	No education	23.6	274	21.4	217	18.6	293	16.6	188	12.3	172
	Primary education	56.1	653	54.5	552	54.2	856	54.3	615	44.2	618
	Secondary education and Higher	20.3	236	24.1	244	27.2	430	29.1	329	43.5	608
Total			1163		1013		1579		1132		1398
Maternal age	Mean	29.2		29.5		30.1		30.4		31.3	
	SD	5.8		5.9		5.8		5.9		5.6	
Total		1163		1013		1579		1132		1398	

Table 2. Results of the Logistic Regression Predicting Childhood Obesity and Overweight in Turkey (1998-2013)

	Dependent Variable	Childhood Obesity and Overweight						
	Number of Observations	5013						
	LR chi2(18)	118.9						
	Prob>chi2	0.000						
	Preudo R2	0.03						
		Coefficient	S.E	Odds Ratio	[95% Conf. Interval]		z	*P-value*
Maternal obesity		0.45	0.09	1.57	1.33	1.86	5.2	*P < .001*
Birthweight	Low birth weight	-0.14	0.13	0.87	0.68	1.12	-1.1	*P = .28*
	Normal birth weight	-	-	-	-	-	-	-
	High birth weight	0.40	0.11	1.49	1.20	1.84	3.7	*P < .001*
Duration of breastfeeding (in months)		-0.01	0.00	0.99	0.98	1.00	-2.6	*P = .009*
Maternal age		0.01	0.01	1.01	0.99	1.02	0.8	*P = .40*
Maternal education	No education	0.19	0.14	1.21	0.92	1.59	1.4	*P = .17*
	Primary education (Omitted)	-	-	-	-	-	-	-
	Secondary education and Higher	0.08	0.10	1.08	0.89	1.30	0.8	*P = .42*
Place of residence = Urban		-0.23	0.10	0.80	0.65	0.97	-2.3	*P = .02*
Geographical region	West (Omitted)	-	-	-	-	-	-	-
	South	-0.51	0.13	0.60	0.47	0.78	-3.9	*P < .001*
	Central	-0.03	0.11	0.97	0.78	1.20	-0.3	*P = .76*
	North	-0.09	0.13	0.92	0.72	1.17	-0.7	*P = .49*
	East	-0.28	0.11	0.76	0.61	0.95	-2.4	*P = .02*
Wealth index	Poorest households	0.06	0.14	1.06	0.80	1.40	0.4	*P = .68*
	Poorer households	0.29	0.12	1.34	1.06	1.69	2.4	*P = .01*
	Middle-wealth Households	-	-	-	-	-	-	-
	Richer Households	0.21	0.12	1.23	0.97	1.56	1.7	*P = .09*
	Richest Households	0.32	0.13	1.38	1.06	1.78	2.4	*P = .01*
Child age (in months)		-0.01	0.00	0.99	0.98	1.00	-2.3	*P = .02*
Child sex = Female		0.34	0.08	1.41	1.21	1.64	4.5	*P < .001*
Birth order	1 (Omitted)	-	-	-	-	-	-	-
	2	0.01	0.10	1.01	0.84	1.22	0.2	*P = .88*
	3+	-0.14	0.12	0.87	0.69	1.10	-1.2	*P = .24*
Birth year		0.03	0.01	1.03	1.01	1.04	3.2	*P = .001*
Constant		-54.29	15.80	-	-	-	-	*P = .001*

DISCUSSION

Results presented in the previous section demonstrate the role of prenatal and postnatal exposures on the risk of childhood overweight and obesity, and thus identify intergenerational pathways of the risk of obesity and related chronic diseases. Findings support the arguments of the DOHaD theory with one exception: Fetal undernutrition (indicated by 'low birth weight' in estimation) does not increase the likelihood of obesity and overweight. On the other hand, other early-life factors maternal obesity and excess weight gain during pregnancy (indicated by 'high birth weight') are significant and strong predictors of childhood overweight and obesity. The protective effect of breastfeeding against the risk of obesity and overweight is statistically meaningful but weak in comparison to magnitude of other early-life effects. Given that mixed feeding is a common problematic practice in Turkey, we would expect the effect of this variable to be greater if it measured the duration of 'exclusive breastfeeding' instead.

From a public health perspective, these findings suggest that maternal health and nutrition during peri-conceptional and pregnancy periods, and fetal nutrition during pregnancy, should be incorporated into future strategies to prevent obesity and overweight in children. They show that it will not suffice to exclusively focus on childhood environments and patterns of unhealthy diet and low physical activity in the fight against obesity as without promotion of good maternal health and nutrition before and during pregnancy, health risks from obesity and associated chronic diseases cannot be averted to a meaningful extent.

The results of logistic regression did not only show that maternal obesity and high birth weight are significant predictors of childhood overweight and obesity, but that they are as important as some of the key socio-economic determinants of child health, such as household wealth, the place of residence and geographical region. It is also important to note that even though maternal education was not found to be significantly associated with the risk of obesity and overweight in children, the most significant early-life exposure in the model, maternal obesity, has an education gradient. In the peak prevalence year of 2008, for example, the prevalence of obesity among mothers who have at least a secondary education is 13.8 percent, whereas the prevalence is in the range of 26.1-31.3 percent in lower education categories. Similarly, the proportion of children who were born with excess weight (with a birth weight that is equal to or more than 4000 grams) is the highest among women with no education at 27.3 percent in 2008. This proportion is in the range 8.3-9.8 percent in higher education categories. Thus, public health efforts have more to gain if they prioritize low-educated mothers and their children.

Limitations of Research

Maternal obesity, high birth weight, and infant breastfeeding are not the only early life exposures that might increase children's risk of overweight and obesity. There are other factors identified by DOHaD that might increase this risk, including gestational diabetes, tobacco use and exposure to harmful toxins during pregnancy.[27,33,36,37,38] Children born after a gestational diabetes mellitus-affected pregnancy, for instance, are more likely to have excess weight suggesting

that fetal exposure to hyperglycemia might also be responsible for increased adiposity in children. Unfortunately, these early exposures are not available as DHS measures during the time window of this study and therefore could not be integrated into analyses.

Another major limitation is our inability to directly measure the immediate environmental factors of childhood overweight and obesity, which specifically refer to daily nutritional energy intake and levels of physical activity. These are the most important obesogenic factors in modern human environment characterized by unhealthy dietary behaviors and physical inactivity, which undoubtly contributes to excess weight gains during the very early years of life.[18] DHS data do not have this information for 2-5 years old. Despite this limitation, however, socio-economic indicators in the analyses such as maternal education and household income can be viewed as strong correlates of nutritional quality and physical exercise: Children of educated mothers and children of high-income households have better diet and lifestyles, whereas children of uneducated mothers who live in poor households are more likely to suffer from unhealthy dietary patterns and low levels of physical activity.

A final limitation concerns our inability to measure *exclusive breastfeeding* during infancy. DHS has information to distinguish exclusive breastfeeding from mixed feeding (consuming plain water, non-milk liquids, other milk, and solid or semi-solid foods in addition to breastfeeding), however, it is available only for the youngest children under 2 years of age for the time period 24 hours before the survey. Therefore, if mixed feeding is a common practice in Turkey and associated with an increased risk of obesity and overweight in children, then the variable "duration of breastfeeding" in this analysis does not adequately exclude the risk.

Despite these limitations, the study has important policy implications for Turkey and other developing countries, where nutritional deficits that continue to contribute to most of the growth and development problems in children have been in fact a chronic population problem spanning over generations. The emphasis of this study on early-life exposures does not contradict with current public health efforts and their serious dietary challenges but imply that we can expect only limited success if we ignore these factors.

CONCLUSION

There are many factors behind the global rise of obesity and overweight in children, but Turkey has been disproportionately affected by this trend and displayed higher prevalence rates than most other developing countries during the last decades. This study was theoretically built on the concepts and mechanisms identified by DOHaD researchers on how early life exposures in utero and during infancy shape the obesity and overweight risk in young children. According to this theory, obesity evolves as an adjustment to immediate or predicted environmental threats, affects early physical growth and development, and ultimately generates excess risk of adult chronic conditions.

This study used logistic regression modeling in order to capture the most important determinants of child obesity and overweight in Turkey with DHS data. The independent variables consisted of well-established socio-economic determinants of child health,

such as maternal education, urban or rural place of residence, geographical region, and household wealth, in addition to the indicators of early-life exposures in the prenatal and postnatal environments. The results suggest strong evidence to support a role for early-life exposures in the development of obesity and overweight risk in children, in addition to the role of socio-economic variables: Maternal obesity and high birth weight significantly increase the risk of excess body weight in young children, and breastfeeding modestly protects against the risk of obesity and overweight. Household wealth status, type of residence and geographical region are significantly associated with the risk of obesity and overweight.

These findings have several important implications for public health efforts that target obesity. In the first place, they warn against the intergenerational (mother-offspring) pathways of obesity risk in developing countries, where larger numbers of women malnourished as children and now at an increased risk of being obese experience pregnancy conditions that expedite the onset of obesity in the offspring to younger and younger ages. Secondly and more specifically, they stress the importance of maternal health and nutrition in the periconceptional and pregnancy periods. An obvious goal is encouraging women to attain a healthy weight before conception, while another is avoiding excess weight gain during pregnancy in order to prevent high birth weight. Thirdly, they reassert the importance of socio-economic conditions as significant determinants of child health, demonstrated in this study with an analysis of obesity and overweight.

ACKNOWLEDGEMENT

Conflict of Interest: I have no conflicts of interest/disagreements to disclose.

Financial Support: No financial support was used by the author during this study.

Ethical Declaration: Ethics committee approval is not required for this type of study.

Author Contribution: Concept: RA, Design: RA, Supervising: RA, Data collection and entry: RA, Analysis and interpretation: RA, Literature search: RA, Writing: RA, Critical review: RA.

REFERENCES

1. Williams DP, Going SB, Lohman TG, et al. Body fatness and risk for elevated blood-pressure, total cholesterol, and serum-lipoprotein ratios in children and adolescents. Am J Public Health 1992;82(3): 358-363.

2. Black RE, Victora CG, Walker SP, et al. Maternal and child undernutrition and overweight in low-income and middle-income countries. The Lancet 2013;382(9890): 427-451.

3. Gupta N, Goel K, Shah P, Misra A. Childhood obesity in developing countries: epidemiology, determinants, and prevention. Endocrine Reviews 2012;33(1): 48-70.

4. Cornette RE. The emotional impact of obesity on children. In: Debasis Bagchi, editor. Global perspectives on childhood obesity. Academic Press; 2011, p. 257-264.

5. Hesketh K, Wake M, & Waters E. Body mass index and parent reported self esteem in elementary school children: Evidence of a causal relationship. Int J of Obesity 2004;28: 1233-1237.

6. Sahoo K, Sahoo B, Choudhury AK, Sofi NY, Kumar R, & Bhadoria AS. Childhood obesity: causes and consequences. J Family Medicine and Primary Care 2015;4(2): 187-192.

7. Freedman DS, Khan LK, Serdula MK, Dietz WH, Srinivasan SR, & Berenson GS. The relation of childhood BMI to adult adiposity: the Bogalusa Heart Study. Pediatrics 2005;115(1), 22-27.

8. Power C, Lake JK, Cole TJ. Measurement and long-term health risks of child and adolescent fatness. Int J Obes Relat Metab Disord 1997;21: 507–526.

9. Whitaker RC, Wright JA, Pepe MS, Seidel KD, & Dietz WH. Predicting obesity in young adulthood

from childhood and parental obesity. New Eng J Med 1997;337(13): 869-873.

10. Eriksson J, Forsen T, Osmond C, & Barker D. Obesity from cradle to grave. Int J Obes 2013;27(6): 722-727.

11. Freedman DS, Khan LK, Dietz WH, Srinivasan SR, & Berenson GS. Relationship of childhood obesity to coronary heart disease risk factors in adulthood: the Bogalusa Heart Study. Pediatrics 2001;108(3): 712-718.

12. Must A. Does overweight in childhood have an impact on adult health? Nutr Rev 2003;61: 139–142.

13. Must A, Strauss RS. Risks and consequences of childhood and adolescent obesity. Int J Obes Relat Metab Disord 1999;23: S2–S11.

14. Maffeis C, Tato L. Long-term effects of childhood obesity on morbidity and mortality. Horm Res 2001;55: 42–45.

15. De Onis M, Blössner M, & Borghi E. Global prevalence and trends of overweight and obesity among preschool children. Am J Clinic Nutrit 2010;92(5): 1257-1264.

16. Martorell R, Khan LK, Hughes ML, & Grummer-Strawn LM. Obesity in Latin American women and children. J Nutrit 1998;128(9): 1464-1473.

17. Martorell R, Khan LK, Hughes ML, & Grummer-Strawn LM. Overweight and obesity in preschool children from developing countries. Int J Obes 2000;24(8): 959-967

18. Popkin BM, Adair LS, & Ng SW. Global nutrition transition and the pandemic of obesity in developing countries. Nutrit Rev 2012;70(1): 3-21.

19. Bereket A, Atay Z. Current status of childhood obesity and its associated morbidities in Turkey. J Clin Res Pediatr Endocrinol 2012;4(1):1–7.

20. Atay Z, Turan S, Guran T, Haliloglu B, & Bereket A. The change in obesity prevalence in 8 year-interval in 6–16 years old girls living in Istanbul. Proceedings of XIV. National Pediatric Endocrinology Congress. P54, Sarigerme-Mugla, 2010.

21. Kondolot M, Balci E, Ozturk A, et al. Body mass index percentiles for Turkish children aged 0–84 months, Ann. Hum. Biol 2011;38: 676–680.

22. Yardim M, Ozcebe L, Araz O, et al. Prevalence of childhood obesity and related parental factors across socioeconomic strata in Ankara, Turkey. Eastern Mediter Health J 2019;25(6): 374-384.

23. UNICEF/WHO/World Bank Joint Child Malnutrition Estimates Expanded Database: Overweight (Survey Estimates), May 2023, New York. Available at: https://data.unicef.org/resources/dataset/malnutrition-data/

24. UNICEF/WHO/World Bank Joint Child Malnutrition Estimates Expanded Database: Overweight (Survey Estimates), May 2023, New York. Available at: https://data.unicef.org/resources/dataset/malnutrition-data/

25. Barker DJ. The fetal and infant origins of adult disease. Brit Med J 1990;301(6761): 1111.

26. Barker DJ, Clark PM. Fetal undernutrition and disease in later life. Reviews of reproduction 1997;2(2): 105-112.

27. Fall CH. Evidence for the intra-uterine programming of adiposity in later life. Annals Human Bio 2011;38(4): 410-428.

28. Gluckman PD, Hanson M, Zimmet P, & Forrester T. Losing the war against obesity: the need for a developmental perspective. Sci Trans Med 2011; 3(93): Commentary 1-4.

29. Gluckman PD, Hanson MA. Developmental and epigenetic pathways to obesity: an evolutionary-developmental perspective. Int J Obes 2009;32(7): S62-S71.

30. Godfrey KM, Gluckman PD, & Hanson MA. Developmental origins of metabolic disease: life course and intergenerational perspectives. Trends Endocrinol & Metab 2010;21(4): 199-205.

31. Schroeder DG, Martorell R. Poor fetal and child growth and later obesity and chronic disease: relevance for Latin America. Scientific Publication – PanAmerican Health Org 2000; 103-116.

32. Catalano PM, Shankar K. Obesity and pregnancy: mechanisms of short term and long term adverse consequences for mother and child. Bmj, 2017, 356.

33. Baidal JAW, Locks LM, Cheng ER, Blake-Lamb TL, Perkins ME, & Taveras EM. Risk factors for childhood obesity in the first 1,000 days: a systematic review. American J Prev Med 2016; 50(6): 761-779.

34. Larqué E, Labayen I, Flodmark CE, Lissau I, Czernin S, Moreno LA, ... & Widhalm K. From conception to infancy—early risk factors for childhood obesity. Nature Rev Endoc 2019; 15(8): 456-478.

35. Kelly AC, Powell TL, & Jansson T. Placental function in maternal obesity. Clinical Sci 2020; 134(8): 961-984.

36. Gaudet L, Ferraro ZM, Wen SW, & Walker M. Maternal obesity and occurrence of fetal macrosomia: a systematic review and meta-analysis. BioMed Res Int 2014.

37. Catalano PM, Farrell K, Thomas A, et al. Perinatal risk factors for childhood obesity and metabolic dysregulation. Am J Clinic Nutrit 2009;90(5): 1303-1313.

38. Oken E. Maternal and child obesity: the causal link. Obstet Gynec Clinics 2009;36(2): 361-377

39. Harder T, Bergmann R, Kallischnigg G, & Plagemann A. Duration of breastfeeding and risk of overweight: a

meta-analysis. Am J Epidemio 2005;162(5): 397-403

40. Arenz S, Rückerl R, Koletzko B, & von Kries R. (2004). Breast-feeding and childhood obesity—a systematic review. Int J Obes 2004;28(10): 1247-1256

Turk J Public Health
Available online at: http://dergipark.org.tr/tjph/
Doi: 10.20518/tjph.1093570

TURKISH JOURNAL OF PUBLIC HEALTH

ORIGINAL ARTICLE

Knowledge, attitude, and practice of medical students about medical research in Mansoura University, Egypt

Sara Marhoon[1] Miada Elmetwaly[2] Asmaa Samy[3]
Ahmed Elsayyad[1] Abdel-Hady El-Gilany[4]

[1]Student, Mansoura University, Faculty of Medicine, Egypt
[2]MD, Mansoura University, Faculty of Medicine, Department of Public Health and Community Medicine, Egypt
[3]Student, Mansoura University, Faculty of Sciences, Egypt
[4]Prof. Dr., Mansoura University, Faculty of Medicine, Department of Public Health and Community Medicine, Egypt.

Received: 25.03.2022, **Accepted:** 05.12.2023

Abstract

Objectives: Medical students are the bright future researchers and giving priority to their early research experiences will have its remarkable effect on research evolution. Recent advances in medical fields are challenging and increase the importance of attracting new researchers. This study describes knowledge, attitude, practice, and barriers to participation in research among undergraduate medical students.

Methods: This is a cross-section study on 260 medical students. Data collected included: knowledge about research (nine multiple questions); attitude towards medical research (eight questions); practice of research (five questions) and barriers against participation in research (nine questions).

Results: Some aspects of research knowledge were affected by students' sex, previous year grade, academic phase, and premedical school type. About 44.6% gave right answers about parts of scientific papers. Academic phase medical students had better research knowledge than clinical phase students. More than 80% of study participants agree on the importance of being oriented about clinical research methodology. Lack of time was the most addressed barrier against participation in research projects by the students (50.5% of clinical phase students).

Conclusions: Students' research knowledge needs improvement. Creating customized curricula will lead to increased involvement and significant contributions from medical students in the field of research. Barriers addressed can be targeted to uplift students' contributions to research process.

Keywords: Attitude, Barriers, Knowledge, Medical students, Practice

Correspondence: MD, Miada Elmetwaly, Mansoura University, Faculty of Medicine, Department of Public Health and Community Medicine, Egyp. **E-mail:** m_fahmi@mans.edu.eg, **Phone**: 00 201 068 998 558

Cite This Article: Marhoon S, Elmetwaly M, Samy A, Elsayyad A, El-Gilany AH. Knowledge, attitude, and practice of medical students about medical research in Mansoura University, Egypt. Turk J Public Health 2023;21(3): 383-393.

INTRODUCTION

Notably, medical students do not always have the privilege to participate in research projects during their undergraduate medical education. This generated a need to investigate knowledge and attitude of medical students to the concepts of medical research and their reflection on practice [1].

Conducting research by a student can affect the published output not only of the institution but also of the country. In medical education, undergraduate training on basic research skills is crucial to improve the physician's research skills including literature search, critical appraisal, independent learning, and writing research papers [2]. Previous reports showed limited students' participation in medical research activities, which is attributed to many barriers such as lack of mentorship, lack of research training, and lack of extracurricular time. These barriers are more common in developing countries [3]. A good starting point in getting the students involved in research is to introduce students to research and publishing. Mabvuure (2012) mentioned 12 tips for this including highlighting the importance of research to students, motivation to create research opportunities, encouraging students to participate in extra-curricular research and interact with other research teams, attend scientific events and apply for research projects, and viewing research as an educational process not only focusing on the output [4]. Choosing a research interest, choosing own research mentor, defining a personal statement, following and contacting relevant research teams, formulating a realistic approach, and developing academic and writing skills were among the important tips mentioned in another research that was conducted by two medical students [5].

To the best of authors' knowledge, data about the knowledge, attitude, practice, and barriers against undergraduate medical research in Mansoura Faculty of medicine, Egypt are limited. This study aims to describe the research knowledge, attitude, and practice, also barriers against participation in research activities among undergraduate medical students and its social demographic features. The findings of this study can potentially be used for creating an evidence-based approach to promote research practice among medical students.

MATERIALS AND METHODS

Study Design

The current study is an institution-based observational descriptive cross-sectional study.

Place and duration of the study:

Data collection process took about 3 months during 2020. Subjects were students enrolled in Mansoura University Faculty of Medicine in the academic year 2019-2020.

Sampling

Sample size was calculated using Open Epi, Version 3 (https://www.openepi.com/) where population size (N) was 6900 according to the official report of the Student Affair Department. The hypothesized percent of good attitude towards undergraduate student's research was at least (p) 21.8% [8], $\alpha = 0.05$ (d): 0.05 precision and confidence level to be 95%. The estimated sample size was at least 253.

Data Collection Tool

Data were collected using an anonymous

English questionnaire that was created as a Google form and posted on medical students' groups only to ensure that only them will contribute. The questionnaire was constructed after an extensive literature review to collect relevant data about undergraduate medical research [6-9], it included: 1) Personal data: sex, previous year grade, academic phase, and premedical school type. 2) Nine multiple choice questions about research to measure students' knowledge. 3) Eight questions that measure attitude towards medical research. 4) Five questions about students' practice of research. 5) Nine questions about personal and institutional barriers against participation in research from the students' perspective.

Data Analysis

Data were analysed using Statistical Package for Social Science Program (SPSS 23 for windows). Categorical variables were presented as number and percent. Chi-square and Fischer exact tests were used for comparison between groups, as appropriate. P ≤ 0.05 was considered statistically significant.

Ethical Approval

Study proposal was approved by the Institutional Research Board (IRB), Faculty of Medicine, Mansoura University. Proposal code is R.20.08.973.R1. Date: 31/8/2020.

Informed Consent

An informed consent was obtained from each participant in the study through a statement in the beginning of the questionnaire; this statement emphasised that if the student is willing to participate, they are asked to answer all the questions. They were allowed to respond anonymously to the questionnaire in their own time and privacy after ensuring their freedom to accept or refuse to participate. Google form settings were adjusted so that each participant will fill the questionnaire only once.

RESULTS

Out of 260 students, 38.5 % were males. 66.5 % had a "Very good" or "Excellent" grade in the previous year (this did not apply to first year students), and 20.0 % had a "Good" grade. More than half (53.5%) of participants were in preclinical phase. 85.4 % were in public schools before joining faculty of medicine (data not shown in tables).

Table 1 shows that students are more knowledgeable about parts of scientific paper (44.6% gave right answers) and rules of writing (43.8% gave right answers). The vast majority (97.7%) agree that managing clinical problems can be easier if the scientific approach is properly followed. More than 80% agree on the importance of being oriented about clinical research methodology, undergraduates' participation in research, and the importance of clinical research skills in improving clinical practice of physicians. The table shows relatively low research practice scores, with presentation in scientific conferences being the most achieved activity by the students (38.8%). The table shows that the most addressed research barrier is time limitations followed by difficulty in getting permissions from review boards ad difficulty in choosing research topics. Table 2 is showing the right answers of the 9 research knowledge questions used in the study. Knowledge about scientific theory showed significant difference between males and females in the favour of females (28.2% vs. 71.8%). Knowledge about the scientific truth showed significant difference between

students with different previous year grade, in the favour of those with a "very good" or "excellent" grade. Public schools' student showed significantly higher knowledge about how to know citations of a published research article. Preclinical students and public schools' students showed significantly higher knowledge about rules of writing of a scientific introduction. Table 3 shows medical students' attitudes towards scientific research with a statistically significant difference between preclinical and clinical students as regards agreement that all medical advances are based on the proper application of the scientific methodology (60.7% vs. 39.3%). Table 4 is about medical students' research practice and shows a significant difference between public schools' students and private schools'

Table 1: Number and percent of overall answers to knowledge, attitude, practice, and barriers.

Question stem		Total	
		n	%
Knowledge (correct answer)	How would you define the scientific hypothesis?	84	32.3
	How would you define scientific theory?	103	39.6
	How would you define the scientific truth?	16	6.2
	The essential characteristic of science is:	62	23.8
	Representativeness is a key characteristic of a:	93	35.8
	MEDLINE is:	99	38.1
	If you have published a paper in a prestigious Journal of Immunology, and want to check the number of citations your paper has received, you should search the:	99	38.1
	The following is a part of a scientific paper is:	116	44.6
	All listed rules apply to the process of writing an Introduction section of a scientific paper EXCEPT:	114	43.8
Attitude (agree)	Managing clinical problems can be easier if the scientific approach is properly followed.	254	97.7
	Clinical research skills can significantly improve the physician's clinical practice.	225	86.5
	All medical advances are based on the proper application of the scientific methodology.	183	70.4
	Clinical research methodology should be a mandatory knowledge requirement for all physicians.	189	72.0
	Being oriented with the clinical research methodology is necessary to obtain accurate clinical data.	229	88.1
	Limiting medical practice to scientific findings only makes the practicing physicians narrow-minded.	169	65.0
	Following the scientific research methodology adds difficulty to clinical research practice.	101	38.8
	Undergraduate students should participate in clinical research projects.	229	88.1
Practice	Participation in research methodology workshops	79	30.4
	Writing a research protocol	61	23.5
	Conducting medical research	86	33.1
	Scientific presentation in a conference	101	38.8
	Publication of research study in a journal	32	12.3
Barriers	Difficulty in choosing topic	170	65.4
	Getting permission from review boards	171	65.8
	Difficulty in writing proposal	161	61.9
	Difficulty in collecting data	133	51.2
	Difficulty in analysis	139	53.5
	Difficulty in writing report	126	48.5
	Time barriers	184	70.8
	Budget-related barriers	157	60.4
	Other barriers	152	58.5

students as regards presentation in scientific conferences in the favour of the former (91.1% vs. 8.9%). Table 5 presents research barriers addressed by the study participants. Difficulty in collecting data and in analysis showed a statistically significant difference as regards students' sex. Difficulty in collecting data was significantly more addressed by public schools' students (81.2%) than private schools' students (18.8%). Previous year's grade significantly affected considering difficulty of writing a scientific report as a research barrier. It was more addressed by the students with higher grades. Academic phase of the students significantly affected viewing time and budget as research barriers.

Test of significance used: Chi-square test.

Table 2: Student's knowledge of research (right answers).

Question stem [a)]	Sex				Previous year grade						Academic Phase				Premedical school type			
	Males		Females		F./P.		G.		V.G./E.		Pre.		Clin.		Pub.		I./Priv.	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
How would you define the scientific hypothesis?	26	31.0	58	69.0	10	11.9	15	17.9	59	70.2	45	53.6	39	46.4	75	89.3	9	10.7
How would you define scientific theory?	**29**	**28.2**	**74**	**71.8**	12	11.7	23	22.3	68	66.0	60	58.3	43	41.7	85	82.5	18	17.5
How would you define the scientific truth?	7	43.8	9	56.3	**2**	**12.5**	**3**	**18.8**	**11**	**68.8**	10	62.5	6	37.5	12	75.0	4	25.0
The essential characteristic of science is:	28	45.2	34	54.8	8	12.9	17	27.4	37	59.7	31	50.0	31	50.0	50	80.6	12	19.4
Representativeness is a key characteristic of a:	39	41.9	54	58.1	13	14.0	19	20.4	61	65.6	49	52.7	44	47.3	73	78.5	20	21.5
MEDLINE is:	38	38.4	61	61.6	11	11.1	20	20.2	68	68.7	59	59.6	40	40.4	81	81.8	18	18.2
If you have published a paper in a prestigious Journal of Immunology, and want to check the number of citations your paper has received, you should search the:	38	38.4	61	61.6	15	15.1	19	19.2	65	65.7	51	51.5	48	48.5	**78**	**78.8**	**21**	**21.2**
The following is a part of a scientific paper is:	48	41.4	68	58.6	13	11.2	25	21.6	78	67.2	60	51.7	56	48.3	98	84.5	18	15.5
All listed rules apply to the process of writing an Introduction section of a scientific paper EXCEPT:	49	43.0	65	57.0	19	16.7	18	15.8	77	67.5	**69**	**60.5**	**45**	**39.5**	**86**	**75.4**	**28**	**24.6**

Tests of significance used: Chi-square and Fischer exact (in cell values less than 5).
Bold indicates significant differences between categories of the same variable.
F./P., Fail or pass. G., Good. V.G./E., Very good or excellent.
Pre., Preclinical phase. Clin., Clinical phase.
Pub., Public schools. I./P., International or private schools.
[a)], Students were given choices

Table 3: Students attitude towards research (agree answers).

Question	Sex				Previous year grade						Academic Phase				Premedical school type			
	Males		Females		F./P.		G.		V.G./E.		Pre.		Clin.		Pub.		I./Priv.	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Managing clinical problems can be easier if the scientific approach is properly followed.	99	39.0	155	61.0	33	13.0	51	20.1	170	66.9	137	53.9	117	46.1	217	85.4	37	14.6
Clinical research skills can significantly improve the physician's clinical practice.	85	37.8	140	62.2	30	13.3	45	20.0	150	66.7	122	54.2	103	45.8	193	85.8	32	14.2
All medical advances are based on the proper application of the scientific methodology.	66	36.1	117	63.9	20	10.9	37	20.2	126	68.9	**111**	**60.7**	**72**	**39.3**	158	86.3	25	13.7
Clinical research methodology should be a mandatory knowledge requirement for all physicians.	71	37.6	118	62.4	21	11.1	35	18.5	133	70.4	105	55.6	84	44.4	165	87.3	24	12.7
Being oriented with the clinical research methodology is necessary to obtain accurate clinical data.	84	36.7	145	63.3	31	13.5	43	18.8	155	67.7	127	55.5	102	44.5	195	85.2	34	14.8
Limiting medical practice to scientific findings only makes the practicing physicians narrow-minded.	60	35.5	109	64.5	18	10.7	35	20.7	116	68.6	91	53.8	78	46.2	143	84.6	26	15.4
Following the scientific research methodology adds difficulty to clinical research practice.	38	37.6	63	62.4	10	9.9	25	24.8	66	65.3	48	47.5	53	52.5	87	86.1	14	13.9
Undergraduate students should participate in clinical research projects.	90	39.3	139	60.7	32	14.0	45	19.7	152	66.4	127	55.5	102	44.5	194	84.7	35	15.3

Bold indicates significant differences between categories of the same variable.
M., Males. F., Females.
F./P., Fail or pass. G., Good. V.G./E., Very good or excellent.
Pre., Preclinical phase. Clin., Clinical phase.
Pub., Public schools. I./P., International or private schools.

Table 4: Students practice of research.

Practice	Sex				Previous year grade						Academic Phase				Premedical school type			
	Males		Females		F./P.		G.		V.G./E.		Pre.		Clin.		Pub.		I./Priv.	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Participation in research methodology workshops	32	40.5	47	59.5	15	19.0	17	21.5	47	59.5	45	57.0	34	43.0	71	89.9	8	10.1
Writing a research protocol	25	41.0	36	59.0	11	18.0	12	19.7	38	62.3	36	59.0	25	41.0	49	80.3	12	19.7
Conducting medical research	27	31.4	59	68.6	9	10.5	21	24.4	56	65.1	51	59.3	35	40.7	75	87.2	11	12.8
Scientific presentation in a conference	38	37.6	63	62.4	14	13.9	22	21.8	65	64.4	54	53.5	47	46.5	**92**	**91.1**	**9**	**8.9**
Publication of research study in a journal	11	34.4	21	65.6	5	15.6	9	28.1	18	56.3	21	65.6	11	34.4	30	93.8	2	6.3

Tests of significance used: Chi-square and Fischer exact (in cell values less than 5).
Bold indicates significant differences between categories of the same variable.
M., Males. F., Females.
F./P., Fail or pass. G., Good. V.G./E., Very good or excellent.
Pre., Preclinical phase. Clin., Clinical phase.
Pub., Public schools. I./P., International or private schools.

Table 5: Barriers against students' research.

Barrier	Sex				Previous year grade						Academic Phase				Premedical school type			
	Males		Females		F./P.		G.		V.G./E.		Pre.		Clin.		Pub.		I./Priv.	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Difficulty in choosing topic	65	38.2	105	61.8	25	14.7	35	20.6	110	64.7	91	53.5	79	46.5	144	84.7	26	15.3
Getting permission from review boards	66	38.6	105	61.4	24	14.0	36	21.1	111	64.9	96	56.1	75	43.9	145	84.8	26	15.2
Difficulty in writing proposal	56	34.8	105	65.2	24	14.9	28	17.4	109	67.7	86	53.4	75	46.6	138	85.7	23	14.3
Difficulty in collecting data	**43**	**32.3**	**90**	**67.7**	18	13.5	21	15.8	94	70.7	72	54.1	61	45.9	**108**	**81.2**	**25**	**18.8**
Difficulty in analysis	**44**	**31.7**	**95**	**68.3**	16	11.5	28	20.1	95	68.3	67	48.2	72	51.8	121	87.1	18	12.9
Difficulty in writing report	43	34.1	83	65.9	**14**	**11.1**	**18**	**14.3**	**94**	**74.6**	62	49.2	64	50.8	109	86.5	17	13.5
Time barriers	71	38.6	113	61.4	23	12.5	41	22.3	120	65.2	**91**	**49.5**	**93**	**50.5**	160	87.0	24	13.0
Budget-related barriers	65	41.4	92	58.6	20	12.7	34	21.7	103	65.6	**70**	**44.6**	**87**	**55.4**	137	87.3	20	12.7
Other barriers	54	35.5	98	64.5	20	13.2	34	22.4	98	64.5	76	50.0	76	50.0	132	86.8	20	13.2

Test of significance used: Chi-square test.
Bold indicates significant differences between categories of the same variable.
M., Males. F., Females.
F./P., Fail or pass. G., Good. V.G./E., Very good or excellent.
Pre., Preclinical phase. Clin., Clinical phase.
Pub., Public schools. I./P., International or private schools.

DISCUSSION

This study included students from Mansoura University Faculty of Medicine. Research related curricula taught to them include Research Methodology / Biostatistics, and Evidence-Based Medicine courses. Basic medical sciences in Mansoura University Faculty of Medicine include Human Anatomy and Embryology, Medical Physiology, Medical Biochemistry, Histology, Pathology, Clinical Pharmacology, Medical Microbiology, and Medical Parasitology. Clinical sciences include Public Health, Occupational Medicine, Forensic Medicine, Toxicology, Ophthalmology, Ear / Nose / Throat, Paediatrics, Obstetrics / Gynaecology, Internal Medicine, and Surgery. The mentioned disciplines are integrated together, and the study is module-based. Additional elective courses are required to be fulfilled by students through their study years.

The current study suggests that some aspects of medical student's knowledge about scientific research are significantly related to their general characteristics such as sex, previous year grade, academic phase, and premedical school type. Knowledge about the concept of scientific theory was significantly in the favour of female rather than male students. The answers to a multiple-choice question about definition of scientific truth showed significant difference between students who achieved a "Very Good" or an "Excellent" grade and those who achieved less in the previous year of medical study. Knowledge about rules of scientific writing showed significant difference as regards academic phase, where preclinical students were better than clinical phase students. That might be attributed to the scope of courses studied in academic phase which they focus more on basics rather than applied knowledge. The current study reports significant difference between medical students who attended public premedical schools and those who attended private or international schools regarding some aspects of knowledge domain. The difference is in the favour of public schools. The meant knowledge aspects are representativeness of a sample, how to know citations of an authored scientific paper, and basics of scientific writing.

Some Egyptian studies reported generally low knowledge among medical students about scientific research [6]. Another study was based on three Arab universities and concluded also that medical students had lower than expected research knowledge without any significant difference between the three universities [7]. A Pakistani study affirmed that research knowledge and attitude improve with advancement in study years of medical school [8].

There is significant difference between preclinical and clinical phase students regarding their attitude towards medical research; more specifically, agreement that all medical advances are based on proper application of scientific methodology. A south African study showed that more than half of the medical students have good attitude towards scientific research and that was significantly reflected on their participation of different research activities [9]. Another Pakistani work showed low positive attitude of students towards research activities but within the context of self-learning rather than scientific articles production process [10].

In practice of scientific research domain, there is a significant difference between those who attended public premedical schools and

those who attended private or international schools regarding scientific participation in conferences and insignificant difference regarding sex in the favour of females. A Saudi research proved that research practice among medical students showed significant differences as regards sex (in the favour of males), previous year grade, and academic phase [11].

Some barriers against scientific research showed significant differences. Difficulty in data collection as a barrier showed significant differences regarding students' sex and premedical school type, being more reported by females and by those who attended premedical public-school type. Difficulty in data analysis was significantly associated with female sex. Difficulty in writing was significantly associated with previous year grade, more reported by those who got a "Very Good" or an "Excellent" grade. Time and budget related barriers were significantly associated with academic phase, and more reported by clinical phase students. The most reported barriers were time barriers, followed by administrative barriers such as getting permission from review boards. A Kuwaiti study reported that time barriers were the most commonly encountered among medical students followed by lack of interest among some research team members [12]. A Pakistani study concluded that lack of medical student's research knowledge was the most commonly reported barrier followed by unavailability of time to conduct research [13].

Preparing a competent medical student that is able to contribute significantly to research is viewed as an important target in the context of recent innovations in medical education. Student Selected Components (SSCs) is a recent approach that allows students develop their research skills, have more control over their learning and being able to study in-depth more topics of interest, and present their work results more flexibly. This approach was conceptualized and developed by Association for Medical Education in Europe (AMEE) [14]. Integrating the SSCs and similar approaches in the medical education process will build an encouraging research environment for students.

Study limitations include being a cross section, with no comparative groups, and being based only on one institute. Data collection was conducted online, and this has some limitations, such as non-random nature of selection of the sample, and technical issues that may hinder full participation of those who are willing to participate.

The current study is emphasizing on the importance in increasing research knowledge among medical students. This will have a remarkable effect on attitude and practice of research. Time barriers should be addressed and reframing of study curricula can be performed to enable the students to be more engaged in research activities. Administrative barriers issued by the students should be investigated for better understanding to its root reasons.

CONCLUSION

Research knowledge needs improvement. This research highlighted the points that needed improvement that can be targeted through tailored curricula. This will foster a more positive attitude towards research and encourage greater participation in various research activities that ends in uplifting students' meaningful participation in different

research activities. Working to overcome barriers against students' involvement in research will improve the outcomes.

Recommendations

Increasing research knowledge among undergraduates by increasing the share of research in study curricula (improving theoretical background).

Practical training on research via workshops and supervised participation in research.

Removal of barriers against research and provision of personalised student assistance.

ACKNOWLEDGEMENTS

Conflict of Interest

Authors declare there are no competing interests.

Financial Support

This research did not receive any specific grant from funding agencies in the public, commercial, or from non- profit sectors.

Ethical Declaration

Study proposal was approved by the Institutional Research Board (IRB), Faculty of Medicine, Mansoura University. Proposal code is R.20.08.973.R1. Date: 31/8/2020. An informed oral consent was obtained from each participant in the study. They were allowed to respond anonymously to the questionnaire in their own time and privacy after ensuring their freedom to accept or refuse to participate.

Authors Contributions

Concept: SM, AA, Design: SM, Supervising: AG, Data collection and entry: SM, AA, AE, ME, Analysis and interpretation: ME, AG, Literature search: AG, Writing: ME, Critical review: ME, AG. All authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript.

REFERENCES

1. Stone C, Dogbey GY, Klenzak S, Van Fossen K, Tan B, and Brannan GD. Contemporary global perspectives of medical students on research during undergraduate medical education: a systematic literature review. Med Educ Online 2018; 23(1):537430. DOI: 10.1080/10872981.2018.1537430.

2. Soe HH, Than NN, Lwin H, Htay MN, Phyu KL, and Abas AL. Knowledge, attitudes, and barriers toward research: The perspectives of undergraduate medical and dental students. J Educ Health Promot 2018; 7:1-8. DOI: 10.31901/24566322.2019/25.1-3.1082.

3. AlGhamdi KM, Moussa NA, AlEssa DS, AlOthimeen N, and Al-Saud AS. Perceptions, attitudes and practices toward research among senior medical students. Saudi Pharm J 2014;22(2):113-117. DOI: 10.1016/j.jsps.2013.02.006.

4. Mabvuure NT. Twelve tips for introducing students to research and publishing: a medical student's perspective. Med Teach J. 2012;34(9):705-9. DOI: 10.3109/0142159X.2012.684915

5. Vasilica AM, Kumar NS. Twelve tips for successfully getting involved in research as a medical student. Med Teach J. 2022;44(9):962-6.

6. Abushouk AI, Hatata AN, Omran IM, Youniss MM, Elmansy KF, and Meawad AG. Attitudes and perceived barriers among medical students towards clinical research: A cross-sectional study in an Egyptian medical school. J Biomed Educ 2016;1-7.

7. Amin TT, Kaliyadan F, Al Qattan EA, Al Majed MH, Al Khanjaf HS, and Mirza M. Knowledge, attitudes and barriers related to participation of medical students in research in three Arab Universities. Educ Med J 2012;4(1):47-55.

8. Khan H, Khawaja MR, Waheed A, Rauf MA, and Fatmi Z. Knowledge and attitudes about health research amongst a group of Pakistani medical

students. BMC Med Educ 2006;6(1):1-7. DOI: 10.1186/1472-6920-6-54.

9. Nel D, Burman RJ, Hoffman R, and Randera-Rees S. The attitudes of medical students to research. S Afr Med J 2014;104(1):32-36.

10. Mahmud W, Haroon M, Munir A, Hyder O. Self-directed learning and research attitudes among medical students. J Coll Physicians Surg Pak 2014;24(3):173-177.

11. Mina S, Mostafa S, Albarqawi HT, Alnajjar A, Obeidat AS, Alkattan W, Abu-Zaid A. Perceived influential factors toward participation in undergraduate research activities among medical students at Alfaisal University—College of Medicine: A Saudi Arabian perspective. Med teach 2016;38:S31-S36. DOI: 10.3109/0142159X.2016.1142508.

12. Becher Al-Halabi YM, Hasan M, Alkhadhari S. Extracurricular research activities among senior medical students in Kuwait: experiences, attitudes, and barriers. Adv Med Educ Pract 2014;5:95.

13. Kumar J, Memon A, Kumar A, Kumari R, Kumar B, Fareed S. Barriers experienced by medical students in conducting research at undergraduate level. Cureus 2019;11(4).

14. Riley SC. Student selected components (SSCs): AMEE guide no 46. Med Teach J. 20091;31(10):885-94.

Turk J Public Health
Available online at: http://dergipark.org.tr/tjph/
Doi: 10.20518/tjph.1141374

TURKISH JOURNAL OF PUBLIC HEALTH

ORIGINAL ARTICLE

The effect of the educational program on rational antibiotic use on the knowledge and attitude levels of health technician students

İsmet Çelebi[1] İskender Gün[2]

[1]PhD, Gazi University, Department of Paramedic, Ankara, Türkiye
[2]Prof. Dr., PhD, Erciyes University, Department of Public Health, Kayseri, Türkiye

Received: 06.07.2022, **Accepted:** 19.11.2023

Abstract

Objectives: The aim of this study is to measure the effect of the education program concerning rational antibiotic use on the knowledge-attitude levels of health technician students towards rational antibiotic use.

Method: This intervention study has been conducted with vocational school students (control group: 437, intervention group: 403) enrolled in the same health services program at two universities. The dependent variable of the study was the Knowledge-Attitude Scale towards Rational Antibiotic Use and the independent variables were the control and intervention groups. The educational program applied in this study included the definitions and distinction between infections, flu and cold, the mechanism of action and types of antibiotics, the consequences of irrational antibiotic use, antibiotic resistance and rational and irrational use of antibiotics.

Result: Both the knowledge and attitude mean scores of the intervention group on the final test were found to be statistically significant and higher than the mean scores of the pre-test. When the final test and retention test score averages of the intervention group were examined, it was found that there was no statistically significant difference between the mean knowledge score and mean attitude score on the final tests and retention tests

Conclusion: This study is the first educational intervention study in Turkey concerning the rational use of antibiotics by health technician candidates. As a result of this study, a significant increase was observed in knowledge-attitude levels on rational antibiotic use after the intervention training concerning rational antibiotic use and in terms of retention.

Keywords: Antibiotics, Attitute, Education, Health Workers, Knowledge

Correspondence: PhD İsmet Çelebi, Gazi University, Department of Paramedic, Ankara, Türkiye. **E-mail:** ismetcelebi@gazi.edu.tr , **Phone**: +90 552 230 01 12.
Cite This Article: Çelebi İ, Gün İ. The effect of the educational program on rational antibiotic use on the knowledge and attitude levels of health technician students. Turk J Public Health 2023;21(3): 394-402.

INTRODUCTION

Antibiotics are drugs used to prevent and treat bacterial infections.[1-3] The World Health Organization (WHO) defines the appropriate use of antibiotics as "the effective use of antibiotics with maximum clinical therapeutic effects, minimum risk of drug-related side effects and the development of antimicrobial resistance (AMR)".[4] The use of antibiotics for the wrong reasons or incorrect use thereof causes bacteria to become resistant to subsequent treatments.[5] Resistant bacteria can reproduce and cause infections despite the presence of antibiotics. This situation poses a danger not only for the person using the antibiotic inappropriately, but also for everyone who is at risk of contracting resistant bacteria at a later stage.[2]

AMD is one of the biggest public health challenges facing humanity at the global level.[6-7] According to the 2016 report of the Antimicrobial Review Committee, 700,000 people worldwide die from infections caused by antibiotic-resistant pathogens and it is estimated that 10 million people a year will be at risk if solutions are not developed to slow down the emergence of antibiotic resistance by 2050.[8] AMR's burden on the economy can also not be ignored. In this context, long-term illnesses and longer hospital stays lead to the need for more expensive drugs and to financial difficulties for those affected, in addition to death and disability.[9]

Irrational use of antibiotics and antibiotic resistance is an important health problem in Turkey, as is also the case for the rest of the world.[10] In Turkey, the daily use of antibiotics is 38.18 per 1000 individuals. With this ratio, Turkey and Greece rank first in Europe.[11]

Antibiotics are called "miracle drugs" because they cure diseases and save lives within a few days. However, the development of resistance of pathogenic bacteria to these drugs currently threatens this miracle.[12] The training program, which was developed with "the first step towards reducing antibiotic resistance is to raise awareness about the importance of antibiotic resistance" [9] in mind, aims to prevent antibiotic resistance and reduce the use of antibiotics. It is thought that increasing the quality of life by decreasing the use of antibiotics, reducing the length of hospital stays and outpatient treatment, decreasing the total costs of treatments and reducing the frequency of antibiotic-resistant bacteria will provide indispensable benefits for the healthcare system, increase efficiency and directly benefit the country's economy.

Considering that healthcare professionals will be more knowledgeable and sensitive about the rational use of antibiotics than other members of the society, it is predicted that they will use less antibiotics.[13] The training process of health technicians consists of a period in which their knowledge, attitudes and behaviors towards healthy behaviors are shaped. For this reason, educating healthcare professionals on the rational use of antibiotics during this time will be significantly effective in reducing antibiotic resistance.[14] However, most of the intervention trainings on antibiotic use to date have been developed for medical doctors and adults.[14-18] Although they play a vital role in raising awareness on health-related issues such as nutrition, adequate physical activity and rational use of medication, there is not enough information in the literature about their perceptions of rational antibiotic use.[7] In this context, this

study will provide training to health technician candidates on rational antibiotic use, due to which their knowledge and attitudes towards the rational use of antibiotics will increase and an important gap in the literature will be filled, since they will become good role models when they start their profession. In addition, it should also be noted that this training program will contribute to and serve as a guide in the formation of a national program and integration into pre-service training. Lastly, it is also important in terms of shedding light on studies to be carried out regarding the more rational use of antibiotics throughout the country.

The aim of this study is to measure the effect of the education program concerning rational antibiotic use on the knowledge-attitude levels of health technician students towards rational antibiotic use.

METHOD

Research Type and Sampling

This intervention study has been conducted with vocational school students (control group: 473, intervention group: 529) enrolled in the same health services program at two universities between October 2019 and March 2020. A total of 92 of the 529 participants in the intervention group who were pre-tested and 70 of the 473 participants in the control group, who were pre-tested were not included in the study due to various reasons (not being able to attend the training, not making the final test or retention test, missing data). Therefore, the data of 437 people in the intervention group and 403 people in the control group were evaluated.

Table 1: Socio-demographic characteristics of participants

		Intervention group (n=437)		Control group (n=403)	
		Number	%	Number	%
Program †	ODH	59	13.5	65	16.1
	PRM	110	25.2	85	21.1
	MLT	97	22.2	63	15.6
	MIT	104	23.8	81	20.1
	MDS	67	15.3	109	27.0
Age	19 years and younger	260	59.5	181	44.9
	20 years and older	177	40.5	222	55.1
Grade	First grade	270	61.8	213	52.9
	Second grade	167	38.2	190	47.1
Sex	Male	82	18.8	110	27.3
	Female	355	81.2	293	72.7
Marital status	Unmarried	429	98.2	388	96.3
	Married	8	1.8	15	3.7
Antibiotic use	Yes	236	54.0	125	31.0
	No	201	46.0	278	69.0

†ODH: Oral and dental health, PRM: Paramedic, MLT: Medical laboratory technician, MIT: Medical imaging technician, MDS: Medical documentation and secretariat

A rate of 25.2% of the participants in the intervention group was enrolled in the PRM program, 59.5% was 19 years of age and younger, 61.8% was in the first grade, 81.2% was female and 98.2% was unmarried. In the control group, 27.0% of the participants was enrolled in the TDS program, 55.1% was older than 20 years of age, 52.9% was in first grade, 72.7% was female and 96.3% was unmarried (Table 1).

Data Collection Form and Variables

Data were collected by face-to-face interviews using a data collection form consisting of two parts. In the first part of the data collection form, six questions about the socio-demographic characteristics of participants and antibiotic use were asked and in the second part, the knowledge-attitude scale for rational antibiotic use developed by Çelebi and Gün (2021)[19] was applied. The scale consisted of knowledge questions about antibiotics consisting of 12 items (item 4 adverse effect) and attitude questions regarding antibiotic use, consisting of 16 items (item 7, item 12, item 13 adverse effect). The knowledge score for rational antibiotic use was calculated between 12 and 60 points and the attitude score for rational antibiotic use was calculated between 16 and 80 points, in which case it could be concluded that the knowledge and attitude are better with a higher mean score. The items in the information part of the knowledge-attitude scale on rational antibiotic use were in accordance with the Likert scale and have been evaluated with the following statements: "strongly agree (1)", "agree (2)", "undecided (3)", "disagree (4)" and 'strongly disagree (5)'. The items in the attitude part of the knowledge-attitude scale on rational antibiotic use were also in accordance with the Likert scale and have been evaluated with the following statements: "Always (1)", "often (2)", "sometimes (3)", "rarely (4)" and 'never (5)'. The Cronbach's alpha coefficient calculated for the reliability of the scale's knowledge questions was 0.87 and the Cronbach's alpha coefficient calculated for the reliability of the attitude questions was 0.89.[19] These values showed that the scale was reliable. The pre-test, final test and retention tests took an average of 15 minutes. The dependent variable of the study was the Knowledge-Attitude Scale towards Rational Antibiotic Use and the independent variables were the control and intervention groups.

Educational Program

The educational program applied in this study included the definitions and distinction between infections, flu and cold, the mechanism of action and types of antibiotics, the consequences of irrational antibiotic use, antibiotic resistance and rational and irrational use of antibiotics.

For each program in the intervention group the trainings were given during five classes (5 x 40 minutes). The education was interactive due to the use of presentations and distribution of a brochure on rational antibiotic use by the researcher. In addition, videos on rational antibiotic use published by the Ministry of Healthcare of the Republic of Turkey were shown to participants.

The intervention group was given a pre-test before the training, a final test after the training and a retention test 30 days after the training. The control group was given a pre-test and a final test 30 days after the pre-test.

Evaluation of Data

The data were analyzed with the SPSS 21.0 package program. The Cronbach's alpha coefficient was calculated to determine the internal consistency reliability level of the scales.

The distribution of participants' personal characteristics is shown as frequency and percentages. As a result of the collected data, it was observed that the data obtained from the pre-tests, final and retention tests showed a normal distribution. The repeated sample t-test was used to analyze whether the data of the students in the intervention and control groups differed according to the total scores of the pre-tests and final tests. In the analysis of whether the total scores of the pre-tests and final tests differed between the intervention and control groups the independent sample t-test was applied. In the analysis of the difference between the final and retention test scores of the intervention group, the repeated sample t-test was applied. A significance level of 0.05 was taken into account and a level of p< 0.05 was found to show a significant difference.

Limitations of the Study

There are three important limitations in this study. These are as follows; the intervention training was given in five different time periods causing a decrease in the number of participants, the study was limited to only health technician students and this study only examined knowledge and attitude but not behaviors.

RESULTS

The independent sample t-test results of the knowledge-attitude scale pre-test and final test scores for rational antibiotic use in the intervention and control groups are given in Table 2.

Table 2: Independent Sample T-Test Results Concerning Rational Antibiotic Use of the Knowledge-Attitude Scale Pre-Test and Final Test Scores in the Intervention - Control Groups

	Group	n	Average	SS	Standard error of the mean	t	p
Pre-test Knowledge score	**Control**	403	38.3	8.8	0.44	-2.913	0.004
	Intervention	437	39.8	5.3	0.21		
Pre-test Attitude score	**Control**	403	54.5	11.3	0.56	-5.884	<0.001
	Intervention	437	58.3	7.3	0.25		
Final test Knowledge score	**Control**	403	38.2	8.6	0.41	-19.044	<0.001
	Intervention	437	47.6	4.9	0.19		
Final test Attitude score	**Control**	403	53.2	11.0	0.55	-28.955	<0.001
	Intervention	437	70.4	5.5	0.26		

When Table 2 is examined, both the knowledge and attitude mean scores of the pre-test and final test of participants in the intervention group were found to be statistically significant and higher than the knowledge and attitude mean scores on the final test of the control group (p<0.001).

Table 3: Repeated T-Test Results Concerning Rational Antibiotic Use of the Knowledge-Attitude Scale Pre-Test and Final Test Scores in the Intervention - Control Groups

	Application	n	Average	SS	Standard error of the mean	t	p
Knowledge score intervention group	**Pre-test**	437	39.8	5.8	0.23	-22.732	<0.001
	Final test	437	47.6	4.9	0.27		
Attitude score intervention group	**Pre-test**	437	58.3	7.3	0.35	-28.494	<0.001
	Final test	437	70.4	5.5	0.26		
Knowledge score control group	**Pre-test**	403	38.3	8.8	0.44	0.190	0.846
	Final test	403	38.2	8.6	0.43		
Attitude score control group	**Pre-test**	403	54.5	11.3	0.56	7.942	<0.001
	Final test	403	53.2	11.0	0.54		

According to Table 3, both the knowledge and attitude mean scores of the intervention group on the final test were found to be statistically significant and higher than the mean scores of the pre-test ($p<0.001$). No statistically significant difference was found between the knowledge mean scores on the pre-test and post-test of the control group. The attitude mean scores of the final test of the control group were found to be statistically significant and lower than the attitude pre-test scores ($p<0.001$).

Table 4: Repeated T-Test Concerning Rational Antibiotic Use of the Knowledge-Attitude Scale Final Test and Retention Test Scores in the Intervention Group

	Application	n	Average	SS	Standard error of the mean	t	p
Knowledge score	Final test	437	47.6	4.9	0.27	0.353	0.098
	Retention Test	437	47.5	7.2	0.23		
Attitude score	Final test	437	70.4	5.5	0.26	0.847	0.056
	Retention Test	437	69.1	6.2	0.26		

When the final test and retention test score averages of the intervention group were examined, it was found that there was no statistically significant difference between the mean knowledge score and mean attitude score on the final tests and retention tests ($p>0.05$).

DISCUSSION

The training given within the scope of this study which was developed to measure the effect of the education program concerning rational antibiotic use provided to health technician students on the level of knowledge-attitude towards rational antibiotic use, increased both the level of knowledge on and attitude towards antibiotics of health technician candidates in the intervention group.

When the final test scores of the control group and intervention group were examined, both the level of knowledge on rational antibiotic use and the level of attitude towards rational antibiotic use were found to be significantly higher in the intervention group than control. In this context, it can be said that the training program concerning rational use of antibiotics is effective in improving the knowledge levels of students and attitudes towards rational antibiotic use. It is assumed that this increase is due to the fact that the educational program included the learning outcomes related to the distinction between flu and cold, the purpose of antibiotic use, antibiotic resistance and rational and irrational use of antibiotics. Similar studies are present in the literature. Trepka et al. (2001) conducted intervention training in Northern Wisconsin by randomly dividing the parents of children younger than four years into experimental and control groups. The antibiotic indication score was applied to the participants before and after the intervention. After the study, the mean antibiotic indication score of the intervention group was found to be significantly higher than that of the control group.[20] Similarly, in a randomized intervention study conducted by Croft et al. (2001) in the USA, the effect of a child care center staff's intervention concerning the knowledge about and attitudes towards appropriate antibiotic use of 659 parents was evaluated. The effectiveness of intervention training was measured with a nine-point knowledge score and a three-point attitude item. As a result of the study, the knowledge about and attitudes towards antibiotics of the intervention group were found to be significantly higher than that those of the control group ($p<0.05$).[21] These results once again revealed that education

had a positive effect on the level of knowledge about and attitude towards antibiotics.

When the analysis results of the pre-test and final test scores of the level of knowledge on rational antibiotic use and attitudes towards rational antibiotic use of the intervention group are examined, there is a statistically significant difference in favor of final test scores. Therefore, it is emphasized once more that education is the pillar for preventing antibiotic resistance and optimization of antibiotic use. Half of inappropriate antibiotic use is due to the lack of knowledge on correct antibiotic use.[22] Pavese et al. (2009) concluded that a one hour education about antibiotic use given to hospitalized patients in a university hospital in the United Kingdom changed their thoughts on antibiotic use but the lasting effects of this training have not been examined.[23] In the intervention study conducted by Razon et al. (2005) with regard to community pediatricians in Israel, multi-dimensional trainings on rational antibiotic use were provided (brochure, small group studies, seminar, etc.) and changes in the frequency of pre- and post-intervention antibiotic prescriptions by community pediatricians were evaluated from the records. As a result of this research a significant decrease in antibiotic prescriptions by pediatricians, who received small-scale group study training, was observed.[14] Furthermore, in the study conducted by Cebotarenco and Bush (2008) with students in Moldova, it was found that after six hours of training on antibiotic use, the level of antibiotic knowledge increased and usage decreased significantly.[5] In this context, it is observed once again that education on the use of antibiotics increases the knowledge and the attitude of the participants.

A significant decrease was observed in the mean score of the final test concerning the rational antibiotic attitude level of the control group. The reason for this difference is thought to be due to the fact that some participants in the control group did not have a clear idea about some of the questions and could have selected different statements in the pre-tests and final tests.

There was no statistically significant difference between the retention and final test scores of the intervention group on the knowledge about and attitude towards rational antibiotic use. Therefore, it can be said that the educational program is lasting. In a study conducted by Azevedo et al. (2013) the effect of intervention training on healthcare students in Portugal was determined and it was concluded that two months after three thirty-minute classes there was a permanent increase in antibiotic knowledge levels.[18] In the intervention study conducted by Lecky et al. (2010) with secondary and high school students in the Czech Republic, France and the United Kingdom, intervention training on antibiotic use was provided through the e-Bug training package. There was no significant decrease in student knowledge in the retention test after a six-week period after the training.[17] In a study conducted in the USA by Taylor et al. (2005), it was observed that the attitudes of parents did not change six weeks after the one-hour intervention training on parental use of antibiotics. In a study conducted one year later, it was concluded that the rate of parents having antibiotics prescribed to their children was the same as before the training.[15] We are of the opinion that the reason why the training program in our study had lasting effects is due to the fact

that the training program was longer and that participants had a better understanding of antibiotic resistance, since they were health services vocational school students. In the study conducted by Mazinski et al. (2017), in which the effects of antibiotic awareness day campaigns on the knowledge and attitudes of the Polish public towards antibiotics were examined, it was observed that the permanent levels of knowledge about and attitudes towards antibiotics of participants increased after the training.[6]

CONCLUSION AND RECOMMENDATIONS

This study is the first educational intervention study in Turkey concerning the rational use of antibiotics by health technician candidates. As a result of this study, a significant increase was observed in knowledge-attitude levels on rational antibiotic use after the intervention training concerning rational antibiotic use and in terms of retention. While the international literature focuses mainly on physicians and the society, our study is the first one in which the importance of training healthcare technicians, who are an important part of the healthcare system, is emphasized. It is recommended that the training program be applied in different sample groups. In addition, it is advised that brochures on the rational use of antibiotics are put up in school libraries and more public service announcements are made.

ACKNOWLEDGEMENTS

The authors would like to thank all participants of the study. This research constitutes a part of the doctoral thesis of one of the authors.

Conflict of Interest: No potential conflict of interest was reported by the authors

Financial Support: No support was received for this study.

Ethics Declaration: Ethical Permission to conduct the study was obtained from the Erciyes University Clinical Research Ethics Committee on 22.05.2019 under reference number five. In addition, verbal consent was obtained from the participants at the beginning of each training session and before each questionnaire.

Author Contributions: Concept: İÇ, İG, Design: İÇ, İG, Supervising: İÇ, İG, Financing and equipment: İÇ, Data collection and entry: İÇ, İG, Analysis and interpretation: İÇ,İG, Literature search: İÇ, Writing: İÇ, Critical review: İG.

REFERENCES

1. Struzycka I, Mazinska B, Bachanek T, Boltacz-Rzepkowska E, Drozdzik A, Kaczmarek U, Hryniewicz W. Knowledge of antibiotics and antimicrobial resistance amongst final year dental students of Polish medical schools—A cross-sectional study. *European Journal of Dental Education*, 2019;*23*(3), 295-303.

2. Widayati A, Suryawati S, De Crespigny C, Hiller JE. Knowledge and beliefs about antibiotics among people in yogyakarta city ındonesia: A cross sectional population-based survey. *Antimicrobial Resistance And İnfection Control*, 2012;*1*(1), 38.

3. Zhu X, Pan H, Yang Z, Cui B, Zhang D, Ba-Thein W. Self-Medication practices with antibiotics among chinese university students. *Public Health*, 2016; *130*, 78-83.

4. World Health Organization. Antimicrobial resistance: a threat to global health security. Rational use of medicines by prescribers and patients, Apr 2005; A58/14. http://apps.who.int/gb/archive/ pdf_files/WHA58/A58_2-en.pdf Accessed 01 Ferbuary 2021

5. Cebotarenco N, Bush PJ. Reducing antibiotics for colds and flu: a student-taught program. *Health education research*, 2008;*23*(1), 146-157.

6. Mazińska B, Strużycka I, Hryniewicz W. Surveys of public knowledge and attitudes with regard to

antibiotics in Poland: Did the European Antibiotic Awareness Day campaigns change attitudes?. *PloS one*, 2017;*12*(2), e0172146.

7. Zaidi SF, Alotaibi R, Nagro A, Alsalmi M, Almansouri H, Khan MA, Memon I. Knowledge and Attitude Towards Antibiotic Usage: A Questionnaire-Based Survey Among Pre-Professional Students at King Saud bin Abdulaziz University for Health Sciences on Jeddah Campus, Saudi Arabia. *Pharmacy*, 2020;*8*(1), 5.

8. O'Neill J. Tackling Drug-Resistant Infections Globally: Final Report and Recommendations: The Review on Antimicrobial Resistance; 2016. Available from: https://amr-review.org

9. World Healht Organization. Antibiotic Resistance URL: https://www.who.int/news-room/fact-sheets/detail/antibiotic-resistance Accessed 15 Ferbuary 2019

10. Keçik M. Rational use of antibiotics, Turkey and data objectives. Turkey Rational Drug Use Newsletter, 2017;4(9)

11. Kılıç E, Yenilmez, F. An Evaluatıon on antıbıotıc use, antıbıotıc resıstance and trade balance ın turkey and eu countrıes. ESTUDAM Public Health Journal 2019;4(1):45-54

12. Shlaes DM, Bradford PA. Antibiotics—From There to Where?: How the antibiotic miracle is threatened by resistance and a broken market and what we can do about it. *Pathogens & immunity*, 2018;*3*(1), 19.

13. Önlen Y, Özer C, Akoğlu E, Sangün Ö, Özer B, Savaş L, et al. Antıbıotıc Use In Acute Respıratory Infectıons In Health Care Pro-Vıders And Theır Famıly Members. 2006;26:364–

14. Razon Y, Ashkenazi S, Cohen A, Hering E, Amzel S, Babilsky H, Levy I. Effect of educational intervention on antibiotic prescription practices for upper respiratory infections in children: a multicentre study. *Journal of antimicrobial chemotherapy*, 2005; *56*(5), 937-940.

15. Taylor JA, Kwan-Gett TS. C, McMahon EM. Effectiveness of a parental educational intervention in reducing antibiotic use in children: a randomized controlled trial. *The Pediatric infectious disease journal*, 2005;*24*(6), 489-493.

16. Lee C. Ventola The Antibiotic Resistance CrisisPart 1: Causes and Threats.2015;40(4): 277–283.

17. Lecky DM, McNulty CA, Touboul P, Herotova TK, Beneš J, Dellamonica P, Goossens H. Evaluation of e-Bug, an educational pack, teaching about prudent antibiotic use and hygiene, in the Czech Republic, France and England. *Journal of Antimicrobial Chemotherapy*, 2010;*65*(12), 2674-2684.

18. Azevedo MM, Pinheiron C, Yaphe J, Baltazar F. Assessing the impact of a school intervention to promote students' knowledge and practices on correct antibiotic use. *International Journal of Environmental Research and Public Health*, 2013;*10*(7), 2920-2931.

19. Çelebi, İ, Gün İ. Akılcı Antibiyotik Kullanımı Bilgi-Tutum Ölçeğinin Geliştirilmesi. In *3. International 21. National Public Health Congress*. (2019, September).

20. Trepka MJ, Belongia EA, Chyou PH, Davis JP, Schwartz B. The effect of a community intervention trial on parental knowledge and awareness of antibiotic resistance and appropriate antibiotic use in children. *Pediatrics*, 2001; *107*(1)

21. Croft DR, Knobloch MJ, Chyou P, Elzen DV, Janette C, Davis JP, Belongia EA. Impact of a child care educational intervention on parent knowledge about appropriate antibiotic use. *WMJ-MADISON-*, 2007;*106*(2), 78.

22. Cisneros JM, Cobo J, San Juan R, Montejo M, Fariñas MC. Education on antibiotic use. Education systems and activities that work. *Enfermedades Infecciosas y Microbiología Clínica*, 2013; *31*, 31-37.

23. Pavese P, Saurel N, Labarère J, Decouchon C, Vittoz JP, Foroni L, François P. Does an educational session with an infectious diseases physician reduce the use of inappropriate antibiotic therapy for inpatients with positive urine culture results? A controlled before-and-after study. *Infection Control & Hospital Epidemiology*, 2009; *30*(6), 596-599.

Turk J Public Health
Available online at: http://dergipark.org.tr/tjph/
Doi: 10.20518/tjph.1321257

TURKISH JOURNAL OF PUBLIC HEALTH

ORIGINAL ARTICLE

Occupational exposure to electromagnetic fields from dental devices: A descriptive study

Ayşe Bulut[1] Arzu Fırlarer[2,3] Nevra Karamüftioğlu[4]

[1]Assist. Prof. Dr., Physiology, Private Practice, Ankara, Türkiye
[2]Lecturer & Senior Researcher, Başkent University, Department of Molecular Biology and Genetics, Ankara, Türkiye
[3]Başkent University, Innovation and Technology Transfer Office, Ankara, Türkiye
[4]Assist. Prof. Dr., Pedodontics, Private Practice, Ankara, Türkiy

Received: 30.06.2023, **Accepted:** 14.09.2023

Abstract

Objective: Electromagnetic Field sources, which are widely used as part of the operating mechanism, cause occupational exposure when electricity is generated, distributed, or usage in the everyday environment. We aimed to obtain the Extremely Low Frequency-Magnetic Field exposure profile for dental health workers from electrical devices used in dentistry.

Method: Measurements were performed while appliances were under working conditions at a 10 cm distance from the device for 6 minutes and for 7 days. The highest measured value in every 10 second was recorded. The mean ± SD of the minimum and maximum Extremely Low Frequency-Magnetic Field for high-speed dental handpiece with LED, low-speed dental handpiece, model-trimming machine, automatic boil-out unit, steam machine, vacuum device, and polishing machine were recorded in milliGauss.

Results: The values obtains from model-trimming machine and polishing machine were remarkable (809.1 ± 37.7 / 975.0 ± 10.2, 649.3 ± 201.3 / 1367.0 ± 32.1, respectively).

Conclusion: The results show that periodic Electromagnetic Field exposure measurements should be conducted to obtain more detailed information about workplace exposures and sources.

Keywords: Health, Electromagnetic Field, Extremely Low-Frequency Field, Exposure, Occupational

Correspondence: Assist. Prof. Dr. Ayşe Bulut, Physiology, Private Practice, Ankara, Türkiye. **E-mail:** draysebulut@gmail.com, **Phone**: +90 532 551 91 71.

Cite This Article: Bulut A, Fırlarer A, Karamüftüoğlu N. Occupational exposure to electromagnetic fields from dental devices: A descriptive study. Turk J Public Health 2023;21(3): 403-411.

INTRODUCTION

Electromagnetic Field (EMF) sources, which are widely used as part of the operating mechanism, cause occupational exposure when electricity is produced, emitted, or used in the daily working area. EMF can be defined by its frequency fields and the electric and magnetic field magnitudes. The sufficient frequency of the EMF source can have biological effects, and the electric or magnetic field magnitude determines the potential biological response.[1] Recent studies have shown an association between exposure to EMF and conditions such as childhood leukemia, cancer, fatigue, and depression. In addition, sensory organs and nerve damage, vestibular disorders, tingling sensations, pain, or muscle contractions may occur depending on the strength of the fields.[1-4] Due to the increasing number of technologic devices, personnel are exposed to more EMF sources in the working area, and thus occupational safety questions are increased. Extremely low-frequency (ELF) fields contain alternating current (AC) fields used by home and office devices and industrial and commercial instruments. Micro-Tesla (μT) or milli-Gauss (1mG = 0.1 μT) are ELF magnetic field units in the International System of Units (SI).[5] In measuring radiofrequency magnetic fields, volt per meter (V/m) for electric fields or ampere per meter (A/m) for magnetic fields are used.[6]

A guideline has been published by the International Committee on Non-Ionizing Radiation Protection (ICNIRP 2010) to limit exposure to EMF.[7] In 2002, the International Society for Research on Cancer (IARC) classified ELF-MF (Extreme Low Frequency Magnetic Fields) as possible carcinogens.[8] In the literature, the risk limit for long-term exposure is accepted as 2 mG (0.2 μT, 50 Hz).[6]

The magnitude of a magnetic field (MF), which is generated by an electric current, is directly changed by the current flow, where the frequency range is between 0-300 Hz, including power frequencies (50/60 Hz).[4] EMF formed by medical sources can be divided into two categories: sources of static and low-frequency fields (0 Hz-100 kHz) and sources of high-frequency fields (100 kHz - 300 GHz). A sufficiently strong low frequency EMF can stimulate sensory organs and nervous or muscle tissue via magnetic induction of internal electric fields. It can also cause overheating and tissue damage with sufficiently strong, high-frequency EMF.[3]

Dental instruments are devices connected to the electrical network that generate ELF in the 50 or 60 Hz power frequency range.[3,9] Exposure to ELF-MF during dental training can be defined as workplace exposure, which has been reported to be overexposure on a given day.[9,10]

The magnetic fields associated with various clinical and laboratory equipments should be measured to define the profiles of ELF-MF exposure of dental students, technicians, and trainers. With the study, we aimed to obtain the ELF-MF exposure profile for dental students, dental laboratory technicians, and trainers in prosthetic laboratuary and clinical applications. Dental students usually practice in either laboratories or clinics, and these two enviroments are very different in academic institutes. We separately measured ELF-MF values in those working areas, which can be useful for addressing overall occupational exposure to ELF-MF.

METHODS

In the current study, ELF-MF values of the frequently used equipment in the prosthetic laboratory and dental clinics, such as low-speed dental handpiece/contra-angle (NSK/Nakanishi INC., Tochigi, Japan), high-speed dental handpiece with LED (Ekemed, Aymeray Ltd., NCTR), model-trimming machine (Rotaks-Dent, Plaster Cutting Machine, İstanbul, Türkiye), automatic boil-out unit (Ermetal, Ankara, Türkiye), steam machine (Gazella, Gold Dental, Steam Cleaning Robot, Türkiye), vacuum device (Ermetal, Ankara, Türkiye), polishing machine (Universal, İstanbul, Türkiye), and dental vibrator (Rotaks-Dent, Pulse 4 Type Vibrator, İstanbul, Türkiye) were investigated. The fields were evaluated with an manual magnetic field meter device (Tenmars Electronics Co.Ltd., Taipei City, Taiwan). The TENMARS TM-191 Magnetic Field Meter is designed for measuring electromagnetic fields of extra low frequency (ELF) of 30/300 Hz ranging of 200/2000 mG or 20/200 µT, with a resolution of 0.1/1 mG or 0.01/0.1 µT and accuracy of ± (3% + 3 dgt) at 50/60 Hz.

The devices were measured in the most commonly used places: dental clinics, prosthetic laboratories, and clinical education areas. All nearby tools except the measuring device were powered off to minimize background intervention. "Spot" measurements were performed every day at the same time (between 08:00-09:00 a.m.). Measurements of the low-speed dental handpiece/contra-angle, high-speed dental handpiece with LED, model-trimming machine (one device and two devices), and polishing machine (one device), were made at a distance of 10 cm from the device for 6 minutes each day for 7 days. The polishing machine measurements (three devices) were performed at a distance of 10 cm from the device for 3 minutes each day for 7 days. The measurements of the steam machine and vacuum device from a distance of 10 cm were carried out for 1 minute each day for 7 days. In addition, ELF-EMF intensity was measured at a 10 cm distance for one minute each day for 7 days when the automatic boil-out unit was started up and its temperature reached 55^0C. The highest measured value for each device was recorded every 10 seconds under operating conditions. In addition, dental vibrator (one device and two devices) and a high-speed dental handpiece without LED were also measured. However, since the values of the dental vibrator ELF-MF intensity were overload and the values of the high-speed dental handpiece without LED values were about zero (between 0-0.2 mG), they were not taken into consideration. A total of 1554 measurements were performed for the nine devices that were evaluated during the runtime. Data are presented as average magnetic field strength ± standard deviations (SDs).

RESULTS

Table 1 shows ELF-EMF intensity of the high-speed dental handpiece with LED, low-speed dental handpiece, the model-trimming machine, the automatic boil-out unit, the steam machine, the vacuum device, and the polishing machine.

ELF-MFs in milliGauss plotted with respect to time produced by devices used in dental clinics (high-speed dental handpiece with LED and low-speed dental handpiece) are shown in Figure 1.

Table 1. Average magnetic field strength of the devices used in dentistry.

Devices	Usage area	Average Magnetic Fields Strength ± SD (milliGauss)						
		1st day	2nd day	3rd day	4th day	5th day	6th day	7th day
High-Speed Dental Handpiece with LED	clinical area	547.4 ± 43.9	593.5 ± 47.4	570.3 ± 41.8	566.3 ± 79.9	631.8 ± 13.7	584.0 ± 39.1	603.5 ± 68.2
Low-Speed Dental Handpiece	clinical area	5.5 ± 0.5	5.4 ± 0.3	6.7 ± 0.2	5.8 ± 0.9	5.6 ± 0.9	6.0 ± 0.4	6.1 ± 0.3
Model-Trimming Machine (One device)	prosthetic laboratory	839.7 ± 9.6	906.6 ± 17.5	838.8 ± 7.3	809.1 ± 37.7	860.5 ± 53.5	975.00 ± 10.2	932.5 ± 13.5
Model-Trimming Machine (Two devices)	prosthetic laboratory	863.0 ± 9.9	977.0 ± 8.6	867.6 ± 14.2	818.0 ± 16.7	935.6 ± 8.8	990.3 ± 10.2	1015.8 ± 13.5
Automatic Boil-Out Unit	prosthetic laboratory	9.4 ± 0.8	68.4 ± 3.1	46.2 ± 2.6	46.8 ± 0.04	52.6 ± 3.4	48.9 ± 5.7	46.9 ± 2.1
Steam Machine	prosthetic laboratory	42.5 ± 4.7	60.9 ± 3.9	53.1 ± 7.1	45.1 ± 5.8	41.0 ± 1.0	58.5 ± 0.5	42.4 ± 1.1
Vacuum Device	prosthetic laboratory	90.7 ± 40.2	68.1 ± 13.6	66.4 ± 3.6	79.4 ± 2.7	83.3 ± 0.8	99.7 ± 1.1	105.6 ± 1.0
Polishing Machine (One device)	prosthetic laboratory	1046.6 ± 36.7	1225.6 ± 55.4	1048.3 ± 52.6	1099.3 ± 48.4	649.3 ± 201.3	1367.0 ± 32.1	1076.8 ± 77.7
Polishing Machine (Three devices)	prosthetic laboratory	1653.0 ± 45.8	1715.3 ± 35.8	1466.3 ± 205.3	1420.6 ± 72.6	1606.6 ± 122.1	1727.3 ± 14.0	1696.6 ± 23.4

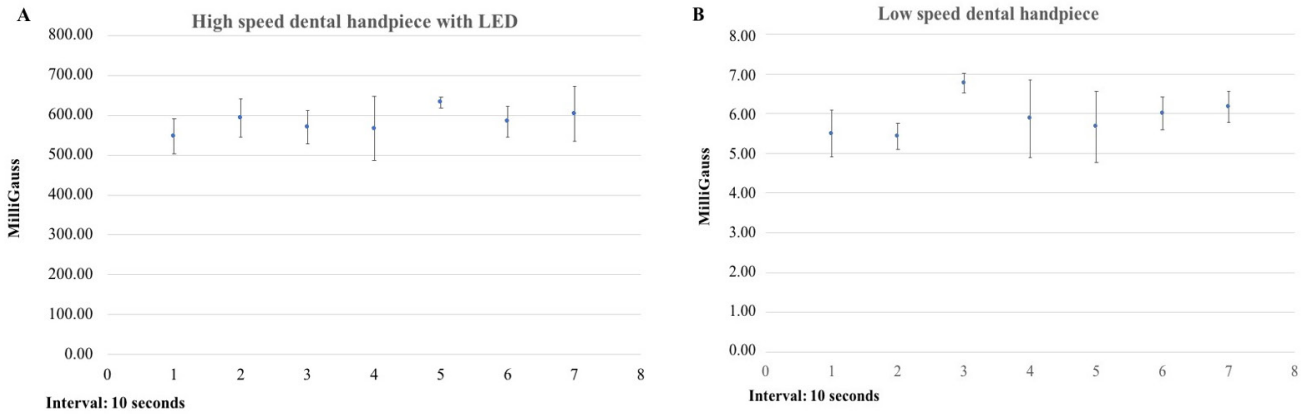

Fig. 1. ELF-MFs in milliGauss plotted with respect to time produced by devices used in dental clinics

A: High speed dental handpiece with LED; **B:** Low speed dental handpiece.

Also, ELF-MFs in milliGauss plotted with respect to time produced by devices used in prosthetic laboratories (model trimming machine, polishing machine, automatic boil-out unit, steam machine and vacuum device) are shown in Figure 2.

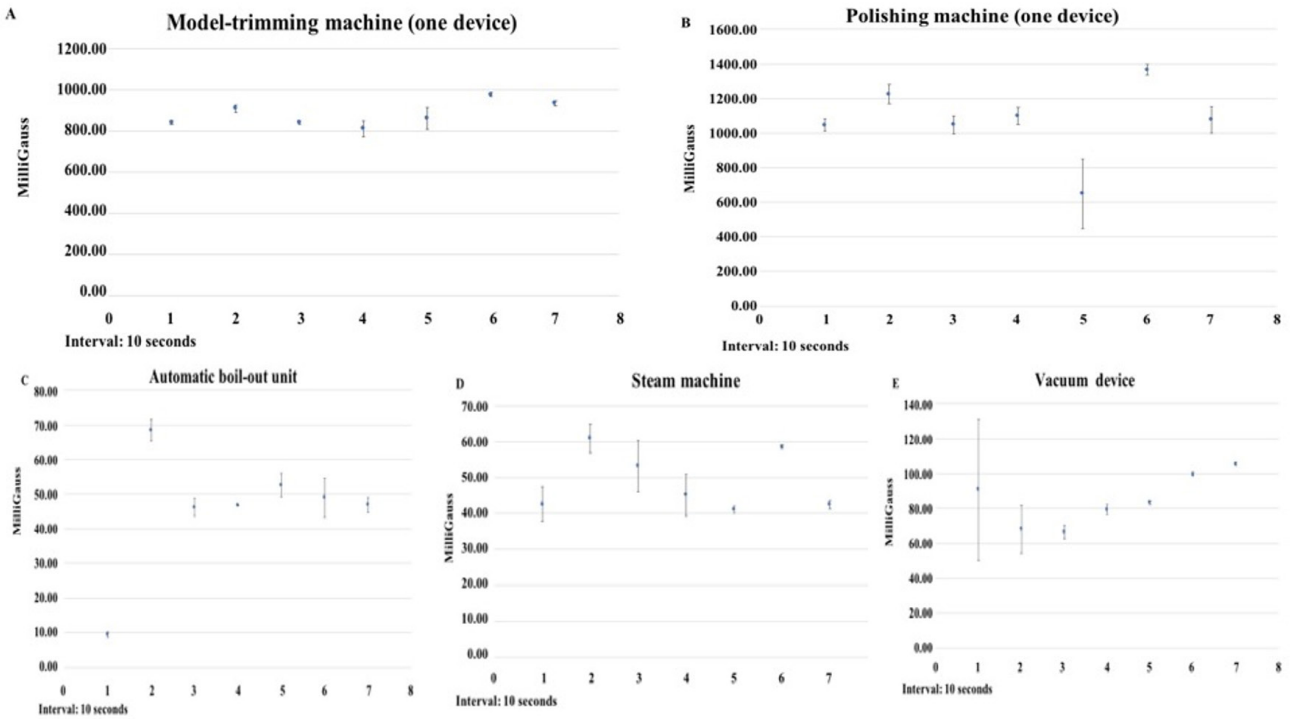

Fig. 2. ELF-MFs in milliGauss plotted with respect to time produced by devices used in prosthetic laboratory

A: Model-trimming machine (one device); **B:** Polishing machine (one device); **C:** Automatic boil-out unit; **D:** Steam machine; **E:** Vacuum device.

DISCUSSION

Dental equipments are used in undergraduate dental education programs at universities for both clinical and educational purposes. Dental staff and students in both dental clinics and prosthetic laboratories may be exposed to EMF from more than one source simultaneously, potentially resulting in higher exposure in dental laboratories and clinical education areas.

In this study, we aimed to measure the ELF-MF values of some selected devices used in the dental clinic and prosthetic laboratory and to evaluate the exposure levels of dental staff.

The minimum and maximum mean magnetic field strength ± SD values for the devices used in the clinic were found te be 5.4 ± 0.3 and 631.8 ± 13.7 mG, respectively. Mean magnetic field strength ± SD values for the devices used in the prosthetic laboratory varied between 9.4 ± 0.8 and 1727.3 ± 14.0 mG. The maximum ELF-MFs were measured in polishing machine (one device; between 649.3 ± 201.3 and 1367.0 ± 32.1 mG; three devices; between 1420.6 ± 72.6 and 1727.3 ± 14.0 mG). And also, the minimum ELF-MFs were measured in low-speed dental handpiece (between 5.4 ± 0.3 and 6.7 ± 0.2 mG).

In current study, since the values of the dental vibrator device were too high, they could not be measured. ELF-MF measurements of high-speed dental handpiece without LED remained below the risk limit for long-term exposure. These devices were therefore not included in the assessment.

According to the results of this study, we observed that ELF-MF measurements of all devices were higher than the risk limit of 2 mG (0.2 μT, 50 Hz) for long-term exposure.

Besides, the current analysis shows that there is a considerable potential that increasing the number of the devices may increase the level of exposure. Dental staff and dental students may have simultaneous exposure to EMF from multiple sources, potentially resulting in higher exposure in clinical education areas.

Newton et al. reported that dentists spend an average of 44 hours per week in their clinics.[11] In addition, it has been reported that while dental students spend one hundred and ten hours in class laboratory, they practice for an average of eighty-three hours outside the classroom in an eight-month period.[12] According to these reports, dental students spend quite a long time working with various dental devices throughout the year in the classroom laboratory and outside of the classroom, and ELF-MF exposure values of the dental students may increase because they work simultaneously with other students in the dental clinic and prosthetic laboratory. Additionally, dentists may have long-term ELF-MF exposure both in their clinics and during training.

van Tongeren et al. found that dental practitioners had the third highest average exposure (arithmetic mean, AM: 0.4 μT) among various job titles, and dental nurses (0.3 μT) had mean exposures higher than 0.2 μT.[13] Huang et al. showed that the average environmental ELF-MF exposure was 0.55 μT in dental clinic offices, and ELF-MF was above than 0.4 μT at 30 cm from the selected equipments in their study. They also reported that dentists worked in their clinics 35.7 and 19.3% of their time. They suggested that dentists, when treating their patients, may over-exposure themselves to ELF-MF. ELF-MF levels produced by dental equipment were consistent with the present study.[10] Contrary to their hypotheses, Kim et al. reported that dental staff working in endodontic clinics were not exposed to high electric and magnetic fields in their findings. They attributed this to the distance between the measuring device on the left upper arm and the equipment used. The researchers observed that the effect decreased as the distance increased.[9]

In a study conducted by Green et al in Canada investigating the relationship between magnetic field exposures and childhood leukemia, information was obtained that occupational exposure level and duration increase the risk of acute non-lymphocytic leukemia, particularly acute myelogenous leukemia.[14]

In the current study, it was observed that the selected devices used in the prosthetic laboratory had a higher level of ELF-MF intensity than the dental handpieces used in the clinic. However, no reports of ELF-MF levels in laboratory devices could be found to compare the results.

The literature on exposure contains several limitations. Measurements listed in the study by Mair et al. were carried out in a limited number of locations and workplaces.[15] In our study, some measurements were carried out at a standard 10 cm distance from the source. Therefore, exposure may be higher for measured sources.

Simultaneous exposure to different frequencies of sources can increase overall exposure. These exposures contribute to their effects.[7] Another important limitation is that measurement uncertainty such as methodological variability and inter-individual, inter-species, and inter-strain

differences is not taken into account. These pathways have different implications for the number of businesses that need to take action. For these reasons, further specification or guidance on uncertainty management is important.[16,17] Some studies have taken measurement uncertainties into account in their exposure assessments.[4,9]

The main limitation of this study is that it is a descriptive study, so there is no comparison group. Therefore, the relationship between a risk factor and disease was not identified in this study to support a hypothesis.

Exposure to ELF-MF during dental training can be defined as workplace exposure reported to be one of the highest in daily exposure. In addition, dentists work for a long time with devices that produce ELF-MF in their own clinics. In this study, ELF-MF values were measured separately at working areas to address occupational exposure to ELF-MF. The results of the current study indicated that the occupational exposure limit values to EMF in the revised European Directive can be exceeded in some of the prosthetic laboratory and clinical devices. This result suggests that exposure to dental devices may cause long-term advers health effects as well as short-term effects. The present study serves this purpose and is valuable in this respect.

When all possible technical and organizational precautions are taken for dental staff, they will be protected against safety risks and adverse health effects. Guidance on security measures at the national or European level will help in this regard. It is clear that a more comprehensive and widespread risk assessment is needed in dental sector. Few studies have evaluated occupational EMF exposure due to dental equipment and dental clinics.[6,9,10,12,18]

First of all, mitigation measures can be taken to reduce exposure below reference levels. If this possibility is implemented, exposure reduction measures will be necessary in dental clinics, prosthetic laboratories, and clinical education areas. Alternatively, expert advice on the electric field can be sought. Numerical dosimetry specialists can usually perform the necessary calculations and computer simulations.[15,17]

In the event that all possible precautions are taken in dentistry and protection against safety risks and adverse health effects continues, the exposure limit values in the Annexes of the Revised Directive will not be valid.[19]

As a result, periodic measurements should be made to obtain more detailed information about workplace exposures and resources in dentistry, and dental staff and students should be aware of the critical EMF level to protect their health. In addition, one of the responsible authorities, such as World Health Organization (WHO) or the International Labor Organization (ILO), should inform workers that EMF levels are important for maintaining health.

CONCLUSIONS

Dentists, trainers, prosthetic technicians, and dental students are likely to be overexposed to ELF-MF during the treatment of patients and the training. Despite the controversy about the potential adverse health effects of ELF-MF exposure on adults, it is important to reduce dentists' occupational exposure to ELF-MF as their daily exposure is high.

The size of the ELF-MF has been found to differ

between different models and types of dental instruments. An appropriate way to limit exposure to low-frequency electromagnetic fields is thought to be to eliminate their occurrence with dental devices. For this reason, MF levels generated by dental devices can be reduced by removing devices that generate MFs or by developing dental devices with low MF production.

In conjunction with existing conventional EMC (electromagnetic compatibility) standards such as ISO standards, new regulatory standards specific to human health are also needed.

Periodic exposure measurements are required to obtain more detailed information about EMF sources and exposures resulting from these sources. Measures against exposure can be taken by carrying out these measurements regularly. Dental sector employees should be aware of their EMF levels to maintain their health.

In conclusion, a broader risk assessment is clearly needed to provide methods of EMF protection in dentistry, to effectively exploit these effects, and to explore whether counter measures can be developed.

ACKNOWLEDGMENTS

This research received no external funding.

Conflicts of Interest: The authors declare no conflict of interest.

Financial Support: This research received no external funding.

Ethics Declaration: Ethics committee approval is not required for this study.

Author Contributions: Concept: BA, FA Design: FA, BA Supervising: FA, BA Data collection and entry: FA, BA Analysis and interpretation: FA, BA, KN Literature search: FA, BA, KN.

Data Ailability

Information on the approval processes involved to access data from this study is available from the corresponding author.

This study was presented at the 9. International GAP SUMMIT Scientific Research Congress in Adıyaman, Turkey, July 2022.

REFERENCES

1. Röösli M. Epidemiology of electromagnetic fields. Boca Raton, London, New York: 343, CRC Press. Taylor & Francis Group, LLC, 2014.
2. Belyaev I, Dean A, Eger H et al. EUROPAEM EMF Guideline 2016 for the prevention, diagnosis and treatment of EMF-related health problems and illnesses. Rev Environ Health 2016;31(3):363–397.
3. Stam R, Yamaguchi-Sekino S. Occupational exposure to electromagnetic fields from medical sources. Ind Health 2018;56:96–105.
4. Portier CJ, Wolfe MS. Assessment of health effects from exposure to power-line frequency electric and magnetic fields. Working group report. Research Triangle Park, NC: National Institute of Environmental Health Sciences. Portier CJ, Wolfe MS, editors. 1998 [online]. Available at: http://niremf.ifac.cnr.it/docs/niehs98.pdf. Accessed January, 2023.
5. The International System of Units (SI), Bureau International des Poids et Mesures, 2019 [online]. Available at: https://www.bipm.org. Accessed January, 2023.
6. Vila J, Bowman J D, Richardson L et al. A Source-based measurement database for occupational exposure assessment of electromagnetic fields in the INTEROCC study: A literature review approach. Ann Occup Hyg 2016;60(2):184–204.
7. International Commission on Non-Ionizinig Radiation Protection. Guidelines for limiting exposure to time-varying electric and magnetic

fields (1 Hz to 100 kHz). International Commission on Non-Ionizing Radiation Protection. Health Physics 2010;99:818-836.

8. IARC Working Group on the Evaluation of Carcinogenic Risks to Humans. Non-Ionizing Radiation, Part 2: Radiofrequency Electromagnetic Fields. Lyon (FR): International Agency for Research on Cancer (IARC) May 2011. IARC Monographs on the Evaluation of Carcinogenic Risks to Humans, Vol 102 [online]. Available at: http://monographs.iarc.fr/ENG/Monographs/vol102/. Accessed December, 2022.

9. Kim DW, Choi JL, Kwon MK et al. Assessment of daily exposure of endodontic personnel to extremely low frequency magnetic fields. Int Endod J 2012;45(8):744-748.

10. Huang SM, Lin YW, Sung FC et al. Occupational exposure of dentists to extremely-low-frequency magnetic field. J Occup Health 2011;53(2):130-136.

11. Newton JT, Thorogood N, Gibbons DE. A study of the career development of male and female dental practitioners. Br Dent J 2000;188(2):90-94.

12. LeBlanc VR, Urbankova A, Hadavi F et al. A preliminary study in using virtual reality to train dental students. J Dent Educ 2004;68(3):378-383.

13. van Tongeren M, Mee T, Whatmough P et al. Assessing occupational and domestic elf magnetic field exposure in the uk adult brain tumour study: results of a feasibility study. Radiat Prot Dosimetry 2004;108(3):227-236.

14. Green LM, Miller AB, Agnew DA et al. Childhood leukemia and personal monitoring of residential exposures to electric and magnetic fields in Ontario, Canada. Cancer Causes & Control 1999;10:233-243.

15. Mair P. Electromagnetic fields in welding applications – the current and the conceivable future situation with regard to legal, technical and biological aspects of workers protection. Welding in the World 2008;52(Special Issue):381-388.

16. Chadwick P. Assessment uncertainties relating to electromagnetic fields (EMF) measurement and computation. London, UK: Health and Safety Executive, 2008.

17. Mild KH, Alanko T, Decat G et al. Exposure of workers to electromagnetic fields. A review of open questions on exposure assessment techniques. Int J Occup Saf Ergon (JOSE) 2009;15(1):3–33.

18. Bukovic D, Carek V, Durek D et al. Measurement of magnetic field in dentistry. Coll Antropol 2000;1:85–89.

19. Stam R, Bijwaard H. Recent developments in medical techniques involving ionising or non-ionising radiation. RIVM Report 300080010/2011, National Institute for Public Health and the Environment, Bilthoven 2011 [online]. Available at: https://rivm.openrepository.com/bitstream/handle/10029/260929/300080010.pdf?sequence=3&isAllowed=y. Accsessed February, 2023.

Turk J Public Health
Available online at: http://dergipark.org.tr/tjph/
Doi: 10.20518/tjph.1316091

SHORT REPORT

Heat-wave associated vibriosis in Russia, 2003-2021

Vadim Leonov[1]

[1]MSc, PhD, Södertörn University, Department of Natural Sciences, Technology and Environmental Studies, Stockholm, Sweden

Received: 17.06.2023, **Accepted:** 13.11.2023

Abstract

Objectives: Noteworthy peaks of non-cholera vibriosis occurred in Russia's Rostov and Volgograd regions in 2007 and 2010. The origins of these emergent vibrio cases have not been fully understood. Here, we investigate a possible link between the heat wave event and disease emergence.

Methods: This study employed Pearson correlation and regression analyses to identify the linkage between ambient temperature and Vibrio cases.

Results: The correlation test between the mean summer air temperatures for both regions and the *Vibrio*-infectious cases per year, shows a significant correlation between the mean summer temperature and the infection: r= 0.62 (p=0.023) for the Rostov region and r = 0.78 (p=0.012) for the Volgograd region.

Conclusion: The heat waves in the summers of 2007 and 2010 suggest having facilitated the upsurge of *V. cholerae* non-cholera diseases. The warming tendency has to be considered in predicting outbreaks.

Keywords: Global Warming, Vibrio Infections, Vibrio, Russia

Correspondence: MSc, PhD, Vadim Leonov, Södertörn University, Department of Natural Sciences, Technology and Environmental Studies, Stockholm, Sweden. **E-mail:** 22vale@suni.se, **Phone**: +46733526640.

Cite This Article: Leonov V. Heat-wave associated vibriosis in Russia, 2003-2021. Turk J Public Health 2023;21(3): 412-416.

INTRODUCTION

Non-imported Vibrio infections are rare in the whole of Russia even in territories with suitable for *V. cholerae ctx*- marine climatic conditions and brackish water basins, and the peaks in recorded cases of vibriosis in 2007 and 2010 are noteworthy. The origins of these emergent Vibrio cases in the Rostov and Volgograd regions have not been fully understood. Here, the result of the investigation of a possible link between the heat wave event and disease emergence is presented for Russia. The study is not novel and much more comprehensive research has been conducted in Europe [1-3], Canada[4], and Israel[5], they observed a rise in Vibrio infectious rate in association with high ambient temperature and heat waves. Following these studies, we retrospectively analyzed the Vibrio cases in Russia. This was done to supplement the data on the occurrence of climatic-associated vibriosis in unusual territories to raise awareness among professionals and the public about the consequences of global warming.

METHODS

Infections caused by *V. cholerae* (non-O1/O139 and *V. cholerae* serotype O1 or O139, which are non-toxigenic) and other vibrio species (*V. parahaemolyticus, V. vulnificus,* and *V. alginolyticus)* are not notifiable diseases according to the Russian disease surveillance system. We had to send an official request to the local centers of the Rospotrebnadzor to receive access to the listing of clinically and laboratory-confirmed cases of vibriosis. We only obtained data sets from two neighboring regions where they have voluntarily executed vibriosis active surveillance systems in the Rostov (2003-2011) and Volgograd (2006-2021) regions.

The Rostov (100 967 km^2, 41.5 population per km^2) and Volgograd (112 877 km^2, 22.1 population per km^2) regions have developed infrastructure with a balanced economic structure. Major industries of the Rostov and Volgograd regions are agriculture, food processing, heavy industry, coal, and automobile manufacturing. Both regions lie in the southeastern part of the East European Plain not far from the sea Azov with a hot-summer humid continental climate (Dfa) according to the Köppen-Geiger climate zone classification.[6] The Volga and the Don with their tributaries are the main rivers; there are more than 300 small rivers and other water reservoirs in total. The Rostov region is a coastline along the Taganrog Bay on the Sea of Azov in the southwest. Thus, both regions have favorable geographical conditions for *V. cholerae* and belong to high-risk areas for imported cholera outbreaks in Russia.

We obtained monthly data on surface air temperature in summer and temperature anomalies from local weather stations – Rostov-on-Don airport (34730, 47.23°N, 39.72°E) and Volgograd airport (34560, 48.72°N, 44.50°E) (www.meteorf.gov.ru). Pearson correlation test (r) was used to find an association between *Vibrio* cases and the mean summer air temperature respectively. The annual dynamics of *Vibrio* morbidity were studied using simple linear regression. These statistical analyses were performed in R (version 2023.03.1+446) and Microsoft Excel 2019 was used to produce diagrams.[7]

RESULTS

Between 2003 and 2021, 102 *Vibrio* cases of diarrheal diseases were identified in the capital cities Rostov-on-Don and Volgograd during the summer months of each year.

A more accurate number of such illnesses than the rest of Russia was believed to be recorded in the Rostov and Volgograd regions, partially due to better awareness among the local public health workers and the high probability of cholera outbreaks in these regions. The vast majority of cases were attributed to *V. cholerae ctx*- negative strains, no other species were reported. The datasets contained limited information regarding potential transmission, but it was noted that the majority of cases between 2007 and 2010 were among individuals who reported recreational water exposure.

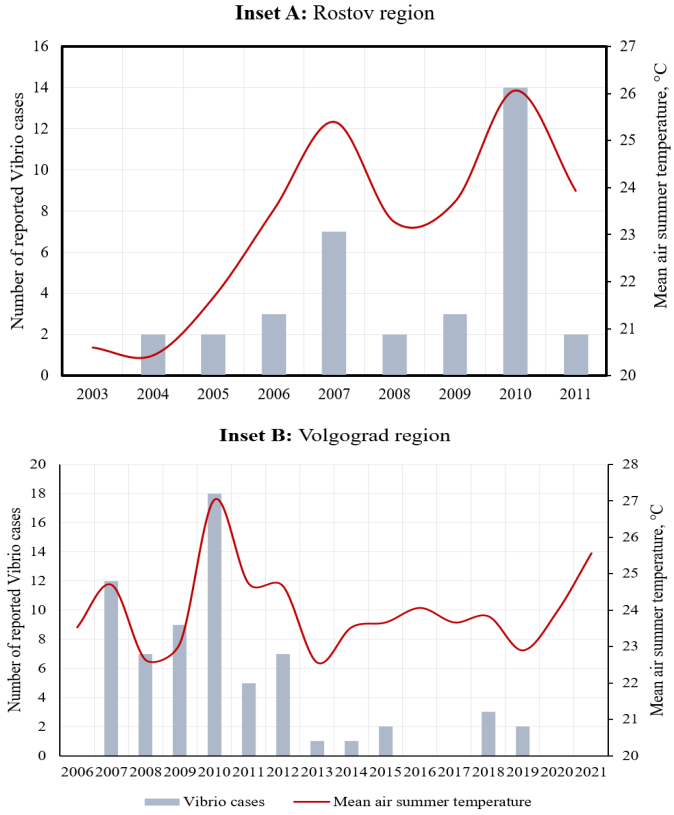

Figure 1. Vibrio cases (all types) and yearly mean summer air temperature in Russia. The chart inset A: The Volgograd region between 2006 and 2021. The chart inset B: The Rostov region between 2003 and 2011

The morbidity trends are not consistent in the annual number of reported *Vibrio* cases for both regions (Fig. 1). After 2007, the number of cases increased every year reaching a peak of 18 and 14 cases in 2010 for the Volgograd and Rostov regions. However, the slopes of the upward trends were insignificant given the small sample size for both regions - the Volgograd region 2005-2010: slope = +3.30 ($p = 0.112$); the Rostov region 2003–2011: slope = +0.75 ($p = 0.185$). Interestingly, 30 cases of vibriocarrier of O1 *V. cholerae* El Tor Ogawa were confirmed in the Rostov region according to the official report from the local authorities in 2005. Following the outbreak years (2007 and 2010), numbers dropped to 2 cases in 2011 for the Rostov region and to 5 cases in the Volgograd region, the former *Vibrio* cases slightly fluctuated between 0 to 3 cases for the rest of the study period.

The yearly number of *Vibrio* cases closely followed the mean air summer temperature. Each surge in *Vibrio* cases coincided with a period of heightened mean summer temperature, which corresponded to heat waves (Fig. 1). We defined heat weaves as a sharp increase more than 4 times the value of temperature anomaly associated with the advection of a warm air mass.[8] There was a pronounced increase in temperature in both cities in the summer of 2007 and 2010. Two severe heat waves occurred in August 2007 and 2010 with maximum temperature anomalies of 4.5 and 4.6 ($p<0.05$) for Rostov-on-Don; 4.9 and 5.4 ($p<0.05$) for Volgograd respectively (Fig. 2). August 2010 was the hottest ever recorded month for the last 500 years in Eastern Europe/Western Russia.[9] The occurrence of these extreme weather conditions may be a consequence of the global warming effects on the South territory of Russia situated mainly in the Pontic–Caspian steppe zone.

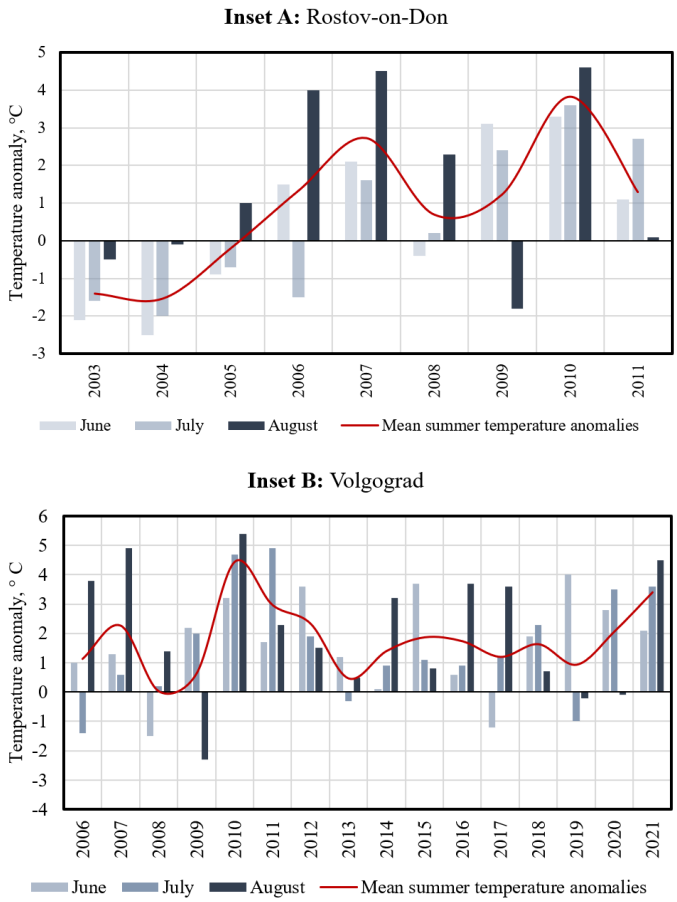

Figure 2. Summer monthly temperature anomalies in Rostov-on-Don airport (2003-2011, A) and Volgograd airport (2006-2021, B) weather stations tious diseases should be taken into account by

The Pearson correlation analysis between the mean summer air temperatures for both regions and the *Vibrio*-infectious cases per year, shows a significant correlation between the mean summer temperature and the infection: r= 0.62 (p=0.023) for the Rostov region and r = 0.78 (p=0.012) for the Volgograd region. We hypothesize that an extreme rise in temperature increases the growth rate of *Vibrio* and the burden of vibriosis.[10] The high temperature might force people to exposure outdoor activities in local water reservoirs and stimulate the blossom of plankton that positively affects on replication and survival of *V. cholerae*. Indeed, within these regions, there are several small rivers with hydrophilous vegetation along the banks, many ponds, and a ravine and gully network as well as artificial water bodies of various sizes[11]. The water estuaries in the vicinity of the Rostov and Volgograd regions are crossed by many river channels, lakes, and bogs that are often used by locals for leisure activities.

CONCLUSIONS

Heat waves and probably other climatic events linked with global warming highly influence the geographical distribution of waterborne pathogens. This relatively new phenomenon in the contemporary epidemiology of infectious diseases should be taken into account by Public Health authorities to improve surveillance systems, particularly in some countries with unusual cases of (re) emerging infectious diseases.

ACKNOWLEDGMENTS

This study has been performed during my scholarship period at Södertörn University, funded by the Swedish Institute. I thank the local centers of Infectious Disease Control and Prevention of the Rospotrebnadzor in the Rostov and Volgograd regions for providing missing initial information on vibriosis for several years after official requests.

Conflicts of Interest: The author declares no conflicts of interest.

Financial Support: There is no funding for the study.

Ethical Declaration: This study was conducted based on administrative register data. According to Russian law, ethics approval is not needed for such research.

Author Contribution: Concept: VL, Design: VL, Supervising: VL, Data Collection and Processing: VL, Analysis and/or Interpretation:

VL, Writing: VL, Critical Review: VL.

REFERENCES

1. Baker-Austin C, Trinanes J, Salmenlinna S, Löfdahl M, Siitonen A, Taylor N, et al. Heat Wave–Associated Vibriosis, Sweden and Finland, 2014. Emerg Infect Dis. 2016; 22(7):1216-1220. https://doi.org/10.3201/eid2207.151996

2. Galanis E, Otterstatter M, Taylor M. Measuring the impact of sea surface temperature on the human incidence of Vibrio sp. infection in British Columbia, Canada, 1992–2017. Environ Health. 2020; 9, 58. https://doi.org/10.1186/s12940-020-00605-x

3. Gildas Hounmanou Y, Engberg J, Bjerre K, Holt H, Olesen B, Voldstedlund M, et al. Correlation of High Seawater Temperature with Vibrio and Shewanella Infections, Denmark, 2010–2018. Emerg Infect Dis. 2023; 29(3):605-608. https://doi.org/10.3201/eid2903.221568

4. Martinez-Urtaza J, Trinanes J, Abanto M, Lozano-Leon A, Llovo-Taboada J, Garcia-Campello M, et al. Epidemic Dynamics of Vibrio parahaemolyticus Illness in a Hotspot of Disease Emergence, Galicia, Spain. Emerg Infect Dis. 2018;24(5):852-859. https://doi.org/10.3201/eid2405.171700

5. Paz S, Bisharat, N, Paz E., Kidar O, Cohen D. Climate change and the emergence of Vibrio vulnificus disease in Israel. Environ Res. 2007;103(3):390-6. doi: 10.1016/j.envres.2006.07.002.

6. RStudio Team RStudio: Integrated Development for R. RStudio, PBC, Boston, MA, 2020 URL http://www.rstudio.com/

7. Beck H, Zimmermann N, McVicar T. et al. Present and future Köppen-Geiger climate classification maps at 1-km resolution. Sci Data. 2018; 5, 180214 https://doi.org/10.1038/sdata.2018.214

8. Bedritsky AI. (Ed.) Russian Hydrometeorological Encyclopedia; Letnii Sad SPB: Moscow, Russia; 2008;1: 336p. [In Russ.]

9. Barriopedro D, Fischer EM, Luterbacher J, Trigo RM, García-Herrera R. The hot summer of 2010: redrawing the temperature record map of Europe. Science. 2011;332(6026), 220–224, doi:10.1126/science.1201224

10. Vezzulli L. Global expansion of Vibrio spp. in hot water. Environ Microbiol. Rep. 2022; 15(2):77-79. doi: 10.1111/1758-2229.13135. 151996

11. Shartova N, Mironova V, Zelikhina S, Korennoy F, Grishchenko M Spatial patterns of West Nile virus distribution in the Volgograd region of Russia, a territory with long-existing foci. PLoS Negl Trop Dis. 2022; 16(1): e0010145. https://doi.org/10.1371/journal.pntd.0010145

Turk J Public Health
Available online at: http://dergipark.org.tr/tjph/
Doi: 10.20518/tjph.1266119

TURKISH JOURNAL OF PUBLIC HEALTH

SHORT REPORT

The effect of media use on the intergenerational perception of health risks during the COVID-19 pandemic

Gökçesu Akşit Dudaklı[1] İlknur Yazıcıoğlu[2]

[1]Assoc. Prof., Maltepe University, Faculty Of Humanities And Social Sciences, Department Of Social Work, Istanbul, Türkiye
[2]Research Assistant, Maltepe University, School of Nursing, Istanbul, Türkiye

Received: 16.03.2023, **Accepted:** 15.10.2023

Abstract

Objective: This research was carried out in order to show the effect of the use of media tools on the risk perception of the society and behaviors, including society's tendency to get vaccinated in the context of generations during the Covid-19 pandemic.

Methods: The research was conducted with mixed method in which quantitative and qualitative research techniques were used together. The "Converging Parallel Mixed Method" was used and the findings obtained from the both methods were combined. For the quantitative part, 469 people were reached with the "purposeful sampling method" and Media Exposure Scale, Risk Perception Scale, The Behavior Scale and The Believability Scale were used. In-depth interviews were conducted for the qualitative part.

Results: In the quantitative part of this study, it was found that the most important behavioral difference is that the use of media directly affects vaccination behavior in all generations. It has been also determined that the media use variable doesn't differ according to age groups, thus all generational groups were found to use media invariably from each other.

Conclusion: It is of great significance that the information that both the whole society and individuals over the age of 65, who are in the risk group in terms of Covid-19 contamination and adverse process, need or may need, should be given in the most perspicuous, accurate and current manner in the media.

Keywords: COVID-19, Explanatory Model, Health Communication, Risk Perception, Stigma

Correspondence: Research Assistant İlknur Yazıcıoğlu, Maltepe University, School of Nursing, Istanbul, Türkiye. **E-mail:** ilknuryazicioglu@maltepe.edu.tr, **Phone**: +90 216 626 10 50-2162.
Cite This Article: Dudaklı GA, Yazıcıoğlu İ. The effect of media use on the intergenerational perception of health risks during the COVID-19 pandemic. Turk J Public Health 2023;21(3): 417-423.

INTRODUCTION

The Covid-19 epidemic, which emerged in December 2019 and although highly defeated is still in effect, has caused a major health crisis and the loss of millions of lives worldwide.[1] When the historical background of the previous epidemics was examined, it is seen that besides the fatal consequences, the pandemics have critical results that affect societies and individuals in economic, social and political terms. For this reason, it is clear that Covid-19 is a situation that requires multi-dimensional communication planning concerning effective health, risk and crisis management.

Today, with the developing technology as a communication tool, media organs are used on a large scale effectively. For this reason, the role of the media, which provides the information flow between the governments and scientists who manage the crises in society, increased visibly during the Covid-19 pandemic, and the ways in which individuals are affected vary in terms of fundamental differences between generations. Similarly, differences can be seen in the media organs used by the generations in the flow of information.[2] Generation classification is as follows; The Silent Generation or War Generation (born 1925-1945), Baby Boomers (born 1946-1964), Generation X (born 1965-1982), Generation Y (born 1983-1999), and Generation Z (born 2000 and born after). The silent generation is respectful to the rules and authority, business-oriented, hardworking and contented; The baby boom generation lives to work, is adaptable and optimistic; Generation X establishes a work-life balance, is results-oriented, competitive and cares about personal development; Generation Y follows technology, is individual, entrepreneurial, self-confident and challenging; Generation Z, on the other hand, consists of people who live very individually.[3]

Our research project was carried out in order to show the effect of the use of media tools on the risk perception of society, in the context of generations during the Covid-19 pandemic.

Throughout the research, it was aimed to measure risk perception and its impact on behaviors, including tendencies to vaccine with the quantitative method within the framework of the use of media tools and to determine daily life concepts such as the perception of freedom, and the perception of health and illness by the qualitative method.

In past health crises, many countries have published communication strategy reports on health crises.[4,5] Considering that there is no such study in Türkiye, it is thought that the research results can play an important role in creating a communication report or model on the subject for future unfortunate situations.

METHODS

The sample of the research carried out between June 2020 and May 2021. Within the scope of the quantitative research, 469 people who were determined by the "purposeful sampling method" and met the inclusion criteria were reached. The sample consisted of people who lived in Türkiye, knew and understood Turkish, were adults (18 years of age and over), were not Covid-19 positive at the time of the research, and volunteered to participate in the research. Within the scope of qualitative research, on the other hand, 24 participants were reached by snowball sampling method. Within the scope of this research, the "Converging Parallel Mixed

Method", one of the mixed methods, was used and the findings obtained from the quantitative and qualitative methods were combined. The Convergent Parallel Mixed Method is defined as a form of mixed method in which the researcher combines or fuses qualitative and quantitative data in order to provide a basis for a comprehensive analysis of the research problem. [6] Although the research was conducted with such a mixed method, here in this short report only the quantitative results will be affected.

In order to obtain quantitative data, a participant identification form consisting of 16 questions about sociodemographic characteristics, employment status, Covid-19 positive diagnosis, and quarantine status was prepared by the researchers. Then Media Exposure Scale, Risk Perception Scale, The Behavior Scale and The Believability Scale were used. The scales were constituted via Google Forms and shared with the participants online. The questions took an average of 25 minutes to complete.

The Media Exposure Scale developed by Li (2018) consists of two questions measuring the frequency and scope of media use.[7] Individuals' exposure to the media during the Covid-19 pandemic, by scale; was aimed to measure the frequency and the scope of using media. In this study, Cronbach's Alpha coefficient on this scale was found 0.74. The Risk Perception Scale, on the other hand, is applied to measure the risk perception of individuals after exposure to the media and consists of topics such as "voluntary risk", "suddenness of the effect", "level of knowledge about risk", "level of controlling risk", "newness of risk" and "chronic risk". It eventuates 9 questions covering items such as "chronically destructive/destructive", "familiar/frightening risk" and "severity of consequences".[8] In this study, Cronbach's Alpha coefficient of this scale was found to be 0.80.

Furthermore, The Behavior Scale consisting of 3 questions was applied to the participants regarding the intention to get the Covid-19 vaccine and the vaccination behaviors planned by the individuals.[9] In this study, Cronbach's Alpha coefficient of this scale was 0.94. Thus, finally The Believability Scale was applied to the individuals' state of understanding and believing the information in the media.[10] In the study, the scale was used to reach the opinions of the participants about the Covid-19 disease and its vaccine. The scale was administered to the participants with the media and vaccine sub-dimension consisting of two questions each. In this study, Cronbach's Alpha coefficient of this scale was 0.84. The scales were translated into Turkish with the support of a language translation expert and then a pilot application was carried out. In the statistical analysis performed after the pilot application, it was determined that the use of the scales was appropriate.

The data obtained from the quantitative research were analyzed with the SPSS 23.0 program. The reliability of the scales was evaluated with the Cronbach's Alpha test and the descriptive data was evaluated by frequency, mean and standard deviation. Furthermore, the question of whether the data obtained from the scales were suitable for normal distribution was evaluated with the Kolmogorov-Smirnov test. It was found that the data were not suitable for normal distribution ($p<0.05$), then in the analysis of the data, the Mann-Whitney U test was

used in the comparisons between the two groups. Kruskal Wallis-H test was used for comparisons between more than two groups and Spearman's Rho Correlation test was used for the relationship between the two scores. Analysis of variance (ANOVA) was used to explain media exposure and risk perception on the intention to get vaccinated. When evaluating the data, the confidence interval was accepted as 95% and statistical significance was accepted as $p<0.05$.

The qualitative data of the research were obtained through online interviews via the Blackboard System and audio recording systems and the data were deciphered manually. In both stages, consent was obtained from the participants and the confidentiality of personal data was ensured.

RESULTS

As it is said above, in this short report, only the results of the quantitative data of the research are included.

When the demographic characteristics of the participants were evaluated, It was found that 8.3% of the participants were 65 years or older, 71.6% were women, 50.7% were married, 49.3% had a university education, 52.2% were working and 23% had a chronic disease. By general demographic data of 65+, more than half (51.3%) of the participants were women, 84.6% were married, 71.8% lived with their families and all had health insurance. However, our participants differed with the population over education ratios, where 30.8% of our 65+ participants were university graduates, 94.9% had income more than the minimum wage and 25.6% were still working when the survey took place. In addition, and with parallels with the population, 48.7% had chronic diseases, 7.7% had Covid-19 positive diagnosis before and 12.8% had been taken into quarantine on Covid-19 suspicion. They reported that 28.2% of their relatives were diagnosed with Covid-19 and 61.5% were relatives of a healthcare worker. 61.5% of our group were vaccinated for influenza and pneumonia at least once in the last 5 years.

From the quantitative data, it is found that the most important behavioral difference is that the use of media directly affects vaccination behavior in all generations. Although the Covid-19 vaccines have not yet been used in Türkiye at the time of the quantitative part of the study, we predicted that in the future the vaccines will be developed soon. Thus to be able to look at the Covid-19 vaccine behavior of the participants, we asked them about their use of previous vaccinations for similar diseases (the flu and pneumonia vaccines). In addition to their early vaccine preferences, we also asked if they would be vaccinated or not when the Covid-19 vaccines were available. In this context, we found that the independent variables of our model (which are media exposure and risk perception through that exposure) explain the dependent variable of the behavioral intention of being vaccinated at a ratio of 51%, which is very significant. Therefore it can be said that as people's media use increases, their behavioral intentions (to be vaccinated) have also increased since there is a substantial relationship between vaccine intention and media risk perception (Figure 1).

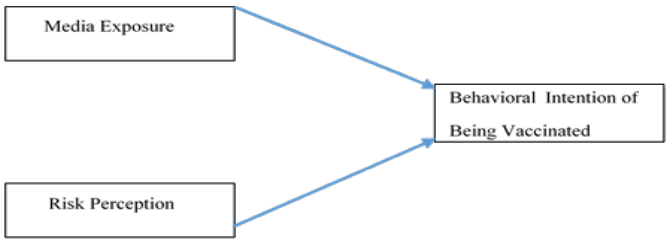

Figure 1: The Research Model

When we looked at the generational differences in the effects of media on vaccine uptake, individuals over 65 were detected as the most affected group by their media exposure. In the scale score distribution of ages, the mean value of the Media Exposure Scale Score of the participants aged 65 and over was 40.5±7.4. The mean value of the Risk Perception Scale Score was 73.7±9.3 and the mean value of the Believability Scale Score was 14.3±2.1. The mean value of the Media Sub-dimension Score of the Believability Scale was 3.1±0.7 and the mean value of the Vaccine Sub-dimension Score of the Believability Scale was determined to be 2.8±0.8. When these results were compared with other generations (18-24, 25-44, 45-64), they were found to be the highest (Table 1).

When the relationship between the scores of participants aged 65 and over from the scales used in the research is examined; a statistically significant relationship between The Risk Perception Scale and The Behavior Scale (rs=0.07; p<0.05), and a statistically significant relationship between Media sub-dimension and Vaccine sub-dimension of The Believability Scale (rs=0.07; p< 0.05) was detected (Table 2).

Table 1: Distribution of Participants' Media Exposure, Risk Perception, The Behavior and The Believability Scale Scores by Age Range

Participant age range	Scales	mean ±sd
18-24 (n=122)	Media Exposure Scale	38.5 ± 6.3
	Risk Perception Scale	67.6 ± 13.9
	The Behavior Scale	12.4 ± 4.8
	The Believability Scale Media sub-dimension	2.9 ± 0.7
	The Believability Scale Vaccine sub-dimension	2.8 ± 0.8
25-44 (n=159)	Media Exposure Scale	38.4 ± 6.6
	Risk Perception Scale	71.7 ± 10.7
	The Behavior Scale	13.8 ± 4.4
	The Believability Scale Media sub-dimension	2.9 ± 0.6
	The Believability Scale Vaccine sub-dimension	2.7 ± 0.7
45-64 (n=149)	Media Exposure Scale	39.1 ± 6.5
	Risk Perception Scale	70.2 ± 12.4
	The Behavior Scale	13.6 ±3.6
	The Believability Scale Media sub-dimension	3.03 ± 0.7
	The Believability Scale Vaccine sub-dimension	2.9 ± 0.7
65 plus (n=39)	Media Exposure Scale	40.5 ± 7.4
	Risk Perception Scale	73.7 ± 9.3
	The Behavior Scale	14.4 ± 2.2
	The Believability Scale Media sub-dimension	3.1 ± 0.7
	The Believability Scale Vaccine sub-dimension	2.8 ± 0.8

`x: mean, sd: standard deviation

It has been determined that the media use variable did not differ according to age groups, thus all generational groups were found to use media invariably from each other. Likewise, no difference was found between educational status and media use. At all educational levels, our participants used media consistently. In addition, it has been determined that the intention to be vaccinated did not make a difference in the group with and without Covid-19 positive diagnosis. On the other hand, it has been found that women (5.70) were more likely to be vaccinated than men (5.03). Therefore as a

Table 2: Correlation Between Scale Scores of Participants Aged 65 and Plus

Age range	Interscale correlation	Media Exposure Scale		Risk Perception Scale		The Behavior Scale		The Believability Scale Media sub-dimension		The Believability Scale Vaccine sub-dimension	
		r_s	p	r_s	p	r_s	p	r_s	p	r_s	p
65 plus	Media Exposure Scale	-	-	0.28	0.07	0.07	0.66	0.25	0.12	0.06	0.71
	Risk Perception Scale	0.28	0.07	-	-	0.64	**<0.001**	0.30	0.05	0.17	0.29
	The Behavior Scale	0.07	0.66	0.64	**<0.001**	-	-	0.05	0.76	0.07	0.64
	The Believability Scale Media sub-dimension	0.25	0.12	0.30	0.06	0.05	0.76	-	-	0.71	**<0.001**
	The Believability Scale Vaccine sub-dimension	0.06	0.71	0.17	0.29	0.07	0.64	0.71	**<0.001**	-	-

'Data were analyzed by Sperman's Rho test

result of the quantitative part of our project, we concluded that, although all generations independent from their education, use media invariably, their risk perception varies, and not surprisingly the elderly were the most affected group –since from the beginning of the pandemic 65+ were seen as the main group at risk. In addition (surprisingly) while having a Covid-19 positive diagnosis didn't have a significant impact on the vaccine behavior, being a female slightly does.

Limitations and Strengths of The Study

In this study, most of the participants had medium or high education and economic levels. This situation and number of the participants makes it difficult to generalize the research results. On the other hand, although the vaccine applications did not start at the time of the research, the researchers predicted this application and added the research of the participants' tendencies to the study, which constituted the strength side of the research.

CONCLUSION

As a conclusion to this short report, we want to assert that, although more than three years have passed since the pandemic first emerged, unfortunately, it wasn't over yet. Both for the Turkish Ministry of Health and other health institutions (such as the World Health Organization, or other national ministries of health), the issue of vaccine rejection and media relations has been a problem that has been discussed and tried to overcome. Here, in this humble project, we tried to highlight the main issues in this relation, for we believe there would be times in the future the conclusions we arrived at would gain importance again, so as they are still.

The belief of individuals in science is one of the cornerstones in overcoming this health crisis, as it was in the past. The attitudes of

individuals towards the media, which is one of the sources that we can follow what scientists offer us, need to be conscious. In addition, it is of great significance that the information that both the whole society and individuals over the age of 65, who are in the risk group in terms of Covid-19 contamination and adverse process, need or may need, should be given in the most perspicuous, accurate and current manner in the media.

As our awareness of the age we live in and its developments increases, we believe that we will be able to overcome better this or possible future health crises.

ACKNOWLEDGEMENTS

The authors thank all the participants and also Ezgi Eyüboğlu, Dilge Kodak and Ali Haydar Dudaklı for the contribution to the study process.

Concflict of Interest: The authors declare no conflicts of interest.

Financial Support: This study was funded by Maltepe University Scientific Research Projects.

Ethical Declaration: This study was approved by Maltepe University Ethical Committee (Approval No. 2020/03-08).

Author Contrubition: Concept: GAD; Design GAD, İY; Data collection: GAD, İY; Data Analysis: İY; Literature search: GAD, İY; Writing: GAD, İY; Final approval: GAD, İY.

REFERENCES

1. World Health Organisation. WHO Coronavirus Disease (COVID-19) Dashboard [online]. Available at: https:// covid19.who.int . Accessed February 27, 2023.
2. Visual Capitalist. How COVID-19 Has Impacted Media Consumption, by Generation [online]. Available at: https://www.visualcapitalist.com/media-consumption-covid-19/ . Accessed February 27, 2023.
3. Gündüz Ş, Pekçetaş T. Kuşaklar ve Örgütsel Sessizlik/Seslilik. JOBS. 2018; 6(1):89-115.
4. Henry B. Canadian Pandemic Influenza Preparedness: Communications strategy. Can Commun Dis Rep. 2018;44(5):106-109. doi:10.14745/ccdr.v44i05a03
5. Department of Health, England and Health Departments of the Devolved Administrations of Scotland, Wales and Northern Ireland. UK Pandemic Influenza Communications Strategy [online]. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/213268/UK-Pandemic-Influenza-Communications-Strategy-2012.pdf .Accessed February 27, 2023.
6. Creswell J W. Araştırma Deseni Nicel, Nitel ve Karma Yöntem Yaklaşımları. 3rd ed. Eğiten Kitap Press; 2017.
7. Li X. Media Exposure, Perceived Efficacy, and Protective Behaviors in a Public Health Emergency. Int. J. Commun. 2018;12, 2641–2660.
8. Witte K, Cameron KA, McKeon JK, & Berkowitz JM. Predicting risk behaviors: Development and validation of a diagnostic scale. Journal of Health Communication. 1996;1: 317-341.
9. Fishbein M, Bowman CH, Thomas K, Jaccard J, Ajzen I. Predicting and understanding voting behavior in British and American elections. In I. Ajzen, & M. Fishbein (Eds.), Understanding attitudes and predicting social behavior Prentice Hall. 1980.
10. Beltramini, F and Stafford, ER. Comprehension and Perceived Believability of Seals of Approval Information in Advertising. Journal of Advertising. 1993;22(3): 3-13.

Turk J Public Health
Available online at: http://dergipark.org.tr/tjph/
Doi: 10.20518/tjph.1227964

TURKISH JOURNAL OF PUBLIC HEALTH

CASE REPORT

Fig tree leaf caused phytodermatitis: A case report

Bülent Çağlar Bilgin[1] Zeynep Irmak Kaya[2] Sinem Gürcü[3]

[1]MD, Eskişehir City Hospital, Burn Center, Eskişehir, Türkiye
[2]MD, Eskişehir City Hospital, Internal Medicine Clinic, Eskişehir, Türkiye
[3]PhD, Eskişehir City Hospital, Department of Pharmacy, Eskişehir, Türkiye

Received: 02.01.2023, **Accepted:** 20.10.2023

Abstract

Objective: Traditional and complementary medicine practices, which are becoming more and more widespread in the world, appear as a global problem in particular. The leaves of the fig tree (Ficus carica) contain furocoumarin and this may cause phytodermatitis. In this study, it is aimed to present the medical condition of a family of four who were deliberately exposed to fig leaves.

Method: Patient records were reviewed retrospectively.

Results: The complaints of the patients started on the second day of exposure and the patients applied to the hospital on the fifth day. After their treatment, the patients were discharged with full recovery.

Conclusion: Herbal treatment is widely used in our country as well as all over the world. Making evidence-based recommendations for the medical treatment of medicinal plants and phytotherapy products without providing adequate standardization and determining indications and contraindications poses a danger to public health.

Keywords: Ficus Carica**,** Poisoning, Phytodermatitis, Case Report

Correspondence: PhD Sinem Gürcü, Eskişehir City Hospital, Department of Pharmacy, Eskişehir, Türkiye.
E-mail: sinemgurcu@yahoo.com.tr, **Phone**: +90 530 294 86 58.

Cite This Article: Bilgin BÇ, Kaya ZI, Gürcü S. Fig tree leaf caused phytodermatitis: A case report. Turk J Public Health 2023;21(3): 424-429.

INTRODUCTION

Traditional medicine practices are becoming more common around the world day by day, and this may lead to some complications. Many plant families include species that can cause phytophotodermatitis. The photoreactivity of plants depends on their furocoumarin (psoralens) content. These, when activated by long-wave ultraviolet radiation (UVA), cause skin damage through phototoxic mechanisms. Clinical changes such as erythema, bullae, and then hyperpigmentation appear on the skin 24-72 hours after exposure. Fig tree leaf (*Ficus carica*) is one of the plant species with a strong phototoxic effect.[1]

METHODS

The records of the mentioned family were scanned retrospectively from the hospital database. Case report consent was obtained from the patients.

RESULTS

This case covers a family of 4, whose feet were kept in a bucket, on the same day, at the same time, for half an hour, in a water container containing boiled fig leaves, which became lukewarm. The patients stated that they used this traditional method to treat the fungus between the toes and to relieve the pain caused by rheumatism. Complaints that developed in the form of burning and pain emerged in the first 24 hours after exposure, and the patients applied to the hospital after the development of vesicles and bullae approximately 48 hours after exposure. Two of the patients are women and two are men, and their ages are shown in Table 1. Patient 1's burn images at admission are shown in Images 1, 2, and 3.

Table 1. Blood findings of the patients (Day 1 and Day 4).

Test	Patient 1	Patient 2	Patient 3	Patient 4
(Days 1 and 4)	(57 y, Female)	(41 y, Male)	(37 y, Female)	(35 y, Male)
AST (11-25)	14 / 20	**108 / 172**	25 / **110**	**35/125**
ALT (7-28)	16 /19	**109 / 213**	12 / 82	23/**235**
CPK (34-131)	60 / 96	**639 / 1616**	**729 / 2903**	**1324/2489**

Image 1. Left foot view of a 57-year-old female patient.

Image 2. Right foot view of a 57-year-old patient.

Image 3. Left foot view of a 57-year-old female patient.

There was also mild hyperpigmentation appearance at the feet of all. On the 8th day, escarectomy, escharotomy, and debridement operations were performed on the feet of the patients under general anesthesia. It was not possible to remove the scars of the patients who were admitted to the hospital lately, with only bullae debridement of circular foot burns. Therefore, it was decided to perform surgery on the patients. In the surgeries, escharotomy was performed primarily, and intact skin depth was found. Afterward, escarectomies were performed. In these cases, escharotomy was performed not for compartment blocking, but for determining the scar excision margin. Local bacitracin ointment, oral paracetamol tablet, and oral pantoprazole tablet were used in the treatment of all patients. The reason for not using local silver silvadiazine is to prevent the increase of hyperpigmentation caused by a fig leaf. For this reason, bacitracin ointment, which is the cheapest topical antimicrobial agent used in burn wounds, was preferred. Oral paracetamol was administered to relieve pain, and oral pantoprazole was administered to prevent bleeding. The patients continued their polyclinic controls after discharge, and the follow-up ended with full recovery on the 35th day after discharge. Antiscar ointment topical treatment was recommended for the burn scar for 3 months. It was also supported by antihistamine treatment for itching. Medical treatments were stopped at the end of the 4th month. The scars healed as lightly pigmented lesions at the end of the 6th month.

In three of the patients, the increments of liver function tests (AST, ALT) and creatinine phosphokinase (CPK), a muscle breakdown enzyme, were observed at the time of hospitalization and during follow-up.

DISCUSSION

The leaves and immature fruits of *Ficus carica*, which belongs to the mulberry family (Moraceae), contain furocoumarins, psoralen, and bergapten, as well as coumarins, umbelliferone, 4',5' dihydro psoralen and marmesin. Furocoumarins are fat soluble and can easily penetrate the epidermis. In fig latex, there are other enzymes with keratolytic effects that increase the effect of furocoumarins, such as lipodiastase, amylase, and lipase. When it comes into contact with the skin, it can cause cell death by disrupting cell division, deoxyribonucleic acid (DNA) repair and DNA synthesis, and DNA cross-linking after exposure to UV light. These deleterious changes are more common in epidermal DNA and it is characterized by blistering and vesicle formation. The main

symptoms of phytodermatitis are burning sensation and pain, itchy erythema, and edema, which usually start 24 hours after exposure. [1, 2] Our patients also had a burning sensation and pain. Saeed et al. published a study in 2002 stating that *Ficus carica* has irritant properties.[3] In addition, in a case report published by Imen et al. in 2019, four pediatric patients who were admitted to the hospital with burn symptoms eight hours after contact with fig leaves are discussed. Phytophotodermatitis was also seen in these cases and the burns were second-degree.[4]

In a case report reported from our country in 2003, a 22-year-old female patient used a fig tree leaf bath to treat another dermatitis on her body, burning, itching, and erythema occurred within the first 24 hours, 2nd degree burn occurred and local treatment was applied to the area, burning 72 hours after exposure. It has been reported that hyperpigmented appearances and raised lesions develop at the lesion sites, although there is no exposure to direct sunlight with an increase in sensation. [5] In a case series of 3 cases reported from Turkey in 2012, a 13-year-old child with mental retardation developed erythema, pruritus, and bullae 24 hours after taking a bath with boiled fig tree leaves to improve cognitive impairment. Due to the contact of his parents, 2nd degree burns developed on his hands and his child's body. [6] In a case report reported by Dölek et al. in 2021, it was mentioned that a 72-year-old female patient applied to the hospital due to a burn that developed after boiling fig tree leaves and washing her feet with water. [7]

In the literature review, in case reports describing the phototoxic effects of Ficus carica, there are no findings related to elevated AST and ALT values, which are liver function tests, and elevated creatinine phosphokinase levels.

In a study on mice conducted by Zhou et al. in 2018, it was shown that psoralen causes liver toxicity.[8] In this case, high liver enzymes in our patients pointed out liver damage. However, the reason for the elevation of creatinine phosphokinase in our cases is not fully understood. CPK has isoenzymes found in the heart, lung, skeletal muscle, and brain tissues. The CPK elevation in patients may be due to local tissue destruction of burns reaching the 2nd degree. Elevated levels of AST and ALT may also be secondary to liver toxicity of psoralen or tissue damage and hypoxia due to its local effect.

The concept of phytotherapy, defined in the field of traditional and complementary medicine, means treatment with herbs.[9] Traditional medicine is rapidly spreading all over the world. Not only in our country but also in Europe, North America, and even in developed countries, more than 50% of the society turns to complementary medicine practices. Traditional and complementary treatment practices should be supported by scientific studies that determine their safety and effectiveness. In the same way, there is a need for the evaluation of medicinal plants by researching their effects, side effects, and safety, and the creation of application-oriented use schemes such as their use. The purpose of safety and calculation of the amount of the active substance used in the product is the provision of a certain standard. Otherwise, as seen in this case, treatments that are believed to be safe but have no or limited evidence cause harm.

Nearly one-third of pharmaceutical drugs are derived from plants. There have been reports of very dangerous and fatal side effects from the use of herbal products. These side effects may be due to several different mechanisms. For example; direct toxic effects of the plant, allergic reactions, effects due to contamination, and interactions with drugs and other plants. Some studies have shown that existing herbal products vary depending on the amount of various active markers they contain. [10] In Turkey, the Ministry of Health published the "Regulations on Traditional and Complementary Medicine Practices" in 2014. [11] However, such regulations are open to discussion in terms of benefit/possible harm assessment. In addition, any deviation from evidence-based information threatens both the patient and public health. [12]

In survey studies investigating which treatment method the patients think is more effective about modern medicine and GETAT (Traditional and Complementary Medicine) methods, the opinion that GETAT methods are as effective as modern medicine is dominant at rates between 37% and 67.8%. It is understood from the answers in the studies that the patients have great hopes of recovery with the GETAT methods. The majority of patients using herbal medicine prepare and use the herbal treatment they will use with their means from plants or plant parts obtained from herbalists. At this point, the main problem is that millions of people trust plants so easily, and as a result of this trust, unconscious widespread use can cause many problems that will endanger public health. [11] Despite its widespread use, the lack of a specific protocol creates uncertainty.

As a result, herbal treatment is an issue that should be emphasized by healthcare professionals as it causes many health problems as a result of its widespread use all over the world and in our country. The indiscriminate use of plants without sufficient evidence-based studies on their safety is an important public health problem.

The use of traditional and complementary medicine is prevalent throughout all segments of society in our country. [13] In the use of herbal products, it is very important to convey the perspective of "herbal product is good, it is harmless, it is useful" to the public with correct information. Because science is based on evidence; It cannot be guided by thoughts or beliefs. It is very important to replace the wrong with the right ones according to the attitudes and behaviors of the society, to provide training to raise public awareness, and to observe the effects on the attitudes and behaviors of the society.

CONCLUSION

Herbal and complementary treatments are widely used, but their use may be risky due to the lack of scientific evidence. There are many case reports in our country showing that phytodermatitis develops due to boiling fig tree leaves. It is of great importance to standardize the use of phytotherapy agents, conduct phase 2 and phase 3 studies on indications and contraindications, and make evidence-based recommendations for medical treatments.

ACKNOWLEDGMENT

Conflict of Interest: There are no conflicts of interest or disagreements between the authors.

Financial Support: The authors declared that this study has received no financial support

Ethical Declaration: Informed consent was obtained from the patients for this study. It can be offered if requested.

Author Contributions: Concept: BÇB, Design: BÇB, ZIK, Supervising: BÇB, Financing and equipment: BÇB, ZIK, SG, Data collection and entry: ZIK, SG, Literature search: ZIK, SG, Writing: ZIK, SG, Critical review: BÇB, ZIK, SG.

REFERENCES

1. Bonamonte D, Foti C, Lionetti N, et al. Photoallergic contact dermatitis to 8-methoxypsoralen in Ficus carica. Contact Dermatitis. 2010;62(6):343-348.
2. Bonamonte D, Foti C, Gullo G, et al. Plant Contact Dermatitis. Clinical Contact Dermatitis 2021; 319-352.
3. Saeed MA, Sabir AW. Irritant potential of triterpenoids from Ficus carica leaves. Fitoterapia 2002;73: 417–420.
4. Imen MS, Ahmadabadi A, Tavousi SH, Sedaghat A. The curious cases of burn by fig tree leaves. Indian J Dermatol 2019;64:71-73.
5. Ozdamar E, Ozbek S, Akin S. An unusual cause of burn injury: fig leaf decoction used as a remedy for a dermatitis of unknown etiology. J Burn Care Rehabil. 2003;24(4):229-33.
6. Abali AE, Aka M, Aydogan C et al. Burns or phytophotodermatitis, abuse or neglect: confusing aspects of skin lesions caused by the superstitious use of fig leaves. J Burn Care Res. 2012;33(6):309-12.
7. Dölek MÜC. Kaynatılmış İncir Ağacı Yaprağı Terapisi Komplikasyonu, Fitodermatit: Olgu Sunumu. Turkish Journal of Family Medicine and Primary Care. 2021; 15(3): 645-647.
8. Zhou W, Chen X, Zhao G et al. Psoralen Induced Liver Injury by Attenuating Liver Regenerative Capability. Front Pharmacol. 2018;9:1179.
9. T.C. Sağlık Bakanlığı, Sağlık Hizmetleri Genel Müdürlüğü, Geleneksel, Tamamlayıcı ve Fonksiyonel Tıp Uygulamaları Daire Başkanlığı, Fitoterapi [online]. Available at: https://shgmgetatdb.saglik.gov.tr/TR,8509/fitoterapi.html Accessed January 17, 2023.
10. Şarışen Ö, Çalışkan D. Fitoterapi: bitkilerle tedaviye dikkat (!). Sted, 2005;14(8), 182-187.
11. T.C. Sağlık Bakanlığı, Geleneksel ve tamamlayıcı tıp uygulamaları yönetmeliği. Available at: www.resmigazete.gov.tr/eskiler/2014/10/20141027-3.htm Accessed Junuary 17, 2023.
12. Taneri PE, Civaner MM. What do we know about some popular methods of complementary and alternative medicine: An overview of Cochrane systematic reviews. Turk J Public Health 2023;21(2):261-336.
13. Ceylan S, Hamzaoğlu O, Kömürcü S et al. Survey of the use of complementary and alternative medicine among Turkish cancer patients. Complement Ther Med. 2002;10(2):94-9.