Trends in Ethanol Positivity by Age and Gender: A Laboratory-Based Study

Yaş ve Cinsiyete Göre Etanol Pozitifliğindeki Eğilim: Laboratuvar Tabanlı Bir Çalışma

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ABSTRACT

Aim: This study aimed to evaluate the distribution and trends of ethanol analysis results according to age, gender, and ethanol concentration levels over a four-year period.

Materials and Methods: In this retrospective study, a total of 11,684 ethanol analysis results performed between January 1, 2021, and December 31, 2024, at our hospital laboratory were extracted from the laboratory information system. Ethanol test results were categorized by age groups (≤19 years, 20–34 years, 35–50 years, and >50 years), gender, and ethanol concentration levels (<10 mg/dL, 10–50 mg/dL, and >50 mg/dL). Ethanol levels ≥10 mg/dL were considered positive.

Results: Ethanol positivity was detected in 1,355 of 10,868 male cases (12.5%) and 94 of 816 female cases (11.5%). The highest number of tests and the highest positivity rate (13.7%) were observed in the 20–34 age group, which accounted for 56.3% of all positive cases. Of the 1,449 ethanol-positive cases identified over the four-year period, 93.5% were male and 6.5% were female. The number of cases with ethanol concentrations <10 mg/dL, 10–50 mg/dL, and >50 mg/dL were 10,235 (87.6%), 365 (3.1%), and 1,084 (9.3%), respectively.

Conclusion: Ethanol positivity was most frequently observed among young adults aged 20–34 years. Over the four-year period, the ≤19, 35–50, and >50 age groups demonstrated a consistent decline in ethanol positivity rates.

Keywords: Ethanol, Alcohol screening, Laboratory analysis

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ÖZET

Amaç: Bu çalışmada, dört yıl boyunca analiz edilen etanol sonuçlarının yaş, cinsiyet ve etanol konsantrasyon düzeylerine göre dağılımlarını ve pozitiflik eğilimlerini değerlendirmeyi amaçladık.

Gereç ve Yöntem: Bu retrospektif çalışmada, 1 Ocak 2021 ile 31 Aralık 2024 tarihleri arasında hastanemiz laboratuvarında gerçekleştirilen toplam 11.684 etanol analiz sonucu laboratuvar bilgi sisteminden elde edildi. Etanol sonuçları yaş gruplarına (≤19 yıl, 20-34 yıl, 35-50 yıl ve >50 yıl), cinsiyete ve etanol konsantrasyon düzeylerine (<10 mg/dL, 10-50 mg/dL ve >50 mg/dL) göre kategorize edildi. ≥ 10 mg/dL etanol düzeyleri pozitif olarak kabul edildi.

Bulgular: 10.868 erkek vakanın 1.355'inde (%12,5) ve 816 kadın vakanın 94'ünde (%11,5) etanol pozitifliği saptandı. En fazla test sayısı ve en yüksek pozitiflik oranı (%13,7) tüm pozitif vakaların %56,3'ünü oluşturan 20-34 yaş grubunda görüldü. Dört yıllık süreçte saptanan 1.449 etanol pozitif vakanın %93,5'i erkek, %6,5'i kadındı. Etanol konsantrasyonu <10 mg/dL olan vakaların sayısı 10.235 (%87,6), 10-50 mg/dL arasında olan vakaların sayısı 365 (%3,1) ve >50 mg/dL olan vakaların sayısı ise 1.084 (%9,3) olarak bulundu.

Sonuç: Etanol pozitifliği en sık 20-34 yaş aralığındaki genç yetişkinlerde gözlendi. Dört yıllık süre boyunca, ≤19, 35-50 ve >50 yaş gruplarında etanol pozitifliği oranlarında istikrarlı bir düşüş görüldü.

Anahtar Kelimeler: Etanol, Alkol taraması, Laboratuvar analizi

INTRODUCTION

Alcohol poses significant public health risks due to its psychoactive properties, toxicity, and potential for addiction. According to the World Health Organization (WHO), alcohol consumption accounted for 4.7% of all global deaths in 2019, corresponding to approximately 2.6 million fatalities (1). Alcohol use is a risk factor for the development of cardiovascular diseases, diabetes, liver disorders, and cancers (2). Beyond its detrimental effects on the individual, alcohol consumption also contributes to a range of physical, psychological, and social harms, including violence, traffic accidents, family breakdown, reduced economic and emotional well-being of families, increased crime rates, and both direct and indirect economic burdens on societies (3).

Despite ongoing public health efforts, the health and social burden related to alcohol consumption remains unacceptably high worldwide (1). To develop effective preventive and protective strategies that reduce alcohol-related harm, reliable and objective data are essential (4). In this study, we aimed to retrospectively evaluate changes in laboratory ethanol test results over a four-year period according to age, gender, and different ethanol levels.

MATERIAL AND METHODS

Data Collection and Evaluation

In this retrospective study, all ethanol test results performed in the emergency laboratory of Mehmet Akif İnan Training and Research Hospital between January 2021 and December 2024 were retrieved from the hospital information system. No exclusion criteria were applied, and all available results were included in the analysis. The data were categorized by age group [children and adolescents (≤19 years), young adults (20–34 years), middle-aged adults (35–50 years), and older adults (>50 years)], gender, and ethanol concentration ranges (<10 mg/dL, 10–50 mg/dL, and >50 mg/dL). Ethanol levels ≥10 mg/dL were considered positive.

In Türkiye, the Road Traffic Act sets the maximum allowable blood alcohol concentration for private vehicle drivers at 50 mg/dL (5). Therefore, ethanol-positive samples were evaluated separately as 10–50 mg/dL and >50 mg/dL.

Ethanol levels were determined using an enzymatic method. From January 2021 to December 2021, analyses were performed using the Indiko Plus analyzer (Thermo Fisher Scientific, Vantaa, Finland), and from January 2022 to December 2024 using the Cobas c501 analyzer (Roche Diagnostics,

Mannheim, Germany), all operated with the respective reagent kits. According to the manufacturers' datasheets, the analytical measurement ranges were 10–600 mg/dL for the Indiko Plus analyzer and 10.1–498 mg/dL for the Cobas c501 analyzer.

In our laboratory, internal quality control was performed daily, and external quality assessment was conducted monthly through the Bio-Rad External Quality Assurance Services program.

Statistical Analysis

All analyses were performed using IBM SPSS Statistic software. Continuous variables were expressed as median [interquartile range], and categorical variables as number (percentage). Comparisons between categorical variables (ethanol positivity by gender) were performed using chi-square test. All statistical tests were two-tailed, with a significance level set at $p < 0.05$.

Ethical Considerations

This study was approved by the Clinical Research Ethics Committee of Harran University (Decision Number: HRÜ/24.21.08, Date: 30.12.2024).

RESULTS

A total of 11,684 ethanol test results were included in the study, comprising 10,868 results from 10,295 male individuals and 816 results from 799 female individuals. The ≤19 years, 20–34 years, 35–50 years, and >50 years age groups accounted for 1,998, 5,947, 2,593, and 1,146 results, respectively. The median (IQR) ages for these groups were 18 (16–19), 26 (22–30), 41 (37–45), and 58 (54–64) years, respectively. The distribution of results by year was as follows: 2,007 in 2021; 2,116 in 2022; 3,897 in 2023; and 3,664 in 2024.

Table 1 and Figures 1 and 2 summarize the ethanol analysis results by year across different age and gender groups. Among the male cases, 1,355 (12.5%) tested positive for ethanol, whereas 94 (11.5%) of the female cases showed ethanol positivity. The highest

number of ethanol tests was performed in the 20–34 age group, which also had the highest positivity rate at 13.7%.
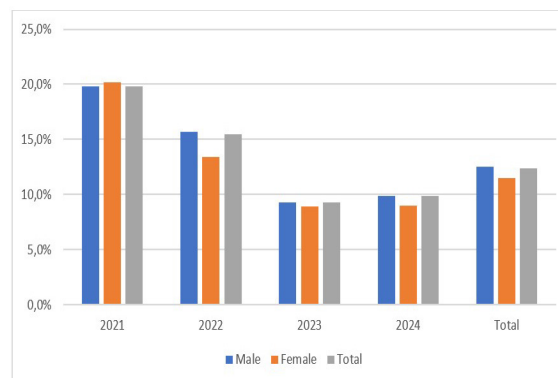

Figure 1. Change in Alcohol Positivity Rates by Gender Over The Years
Şekil 1. Cinsiyete Göre Alkol Pozitiflik Oranlarındaki Değişim
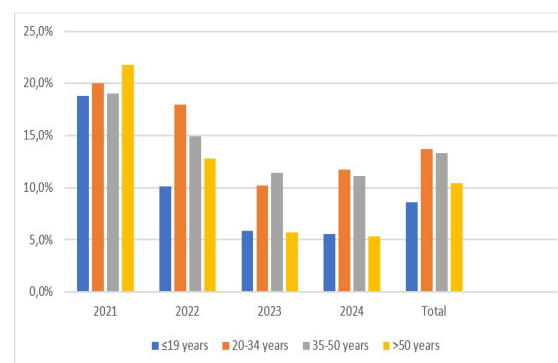

Figure 2. Change in Alcohol Positivity Rates by Age Groups Over The Years
Şekil 2. Yaş Gruplarına Göre Alkol Pozitiflik Oranlarındaki Değişim

Table 2 presents the distribution of ethanol levels across different concentration ranges by year. The number of cases with ethanol levels below 10 mg/dL, between 10 and 50 mg/dL, and above 50 mg/dL were 10,235 (87.6%), 365 (3.1%), and 1,084 (9.3%), respectively.

Table 3 shows ethanol positivity rates by gender across different age groups. In the 35–50 age group, ethanol positivity was significantly higher among males compared to females ($p < 0.05$). In the other age groups (≤19, 20–34, and >50 years), no statistically significant gender differences were observed in ethanol positivity rates ($p > 0.05$).

Table 1. Ethanol Analysis Results of Different Age and Gender Groups by Year
Tablo 1. Farklı Yaş ve Cinsiyet Gruplarının Yıllara Göre Etanol Analiz Sonuçları

	2021		2022		2023		2024		Total	
	Negative	Positive	Negative	Positive	Negative	Positive	Negative	Positive	Negative	Positive
Age Groups, n (%)										
≤19 years	260 (81.2)	60 (18.8)	303 (89.9)	34 (10.1)	621 (94.1)	39 (5.9)	643 (94.4)	38 (5.6)	1827 (91.4)	171 (8.6)
20-34 years	789 (80)	197 (20)	891 (82)	196 (18)	1786 (89.8)	202 (10.2)	1666 (88.3)	220 (11.7)	5132 (86.3)	815 (13.7)
35-50 years	375 (81)	88 (19)	389 (85.1)	68 (14.9)	795 (88.6)	102 (11.4)	690 (88.9)	86 (11.1)	2249 (86.7)	344 (13.3)
>50 years	186 (78.2)	52 (21.8)	205 (87.2)	30 (12.8)	332 (94.3)	20 (5.7)	304 (94.7)	17 (5.3)	1027 (89.6)	119 (10.4)
Gender, n (%)										
Male	1515 (80.2)	375 (19.8)	1639 (84.3)	305 (15.7)	3309 (90.7)	341 (9.3)	3050 (90.1)	336 (9.9)	9513 (87.5)	1355 (12.5)
Female	95 (79.8)	24 (20.2)	149 (86.6)	23 (13.4)	225 (91.1)	22 (8.9)	253 (91)	25 (9)	722 (88.5)	94 (11.5)
Total	1610 (80.2)	397 (19.8)	1788 (84.5)	328 (15.5)	3534 (90.7)	363 (9.3)	3303 (90.1)	361 (9.9)	10235 (87.6)	1449 (12.4)

Table 2. Distribution of Ethanol Analysis Results by Concentration Ranges and Year
Tablo 2. Konsantrasyon Aralıkları ve Yıla Göre Etanol Analiz Sonuçlarının Dağılımı

Ethanol Level	2021 (n/%)	2022 (n/%)	2023 (n/%)	2024 (n/%)	Total (n/%)
<10 mg/dL	1,610 (80.2%)	1,788 (84.5%)	3,534 (90.7%)	3,303 (90.1%)	10,235 (87.6%)
10–50 mg/dL	178 (8.9%)	48 (2.3%)	60 (1.5%)	79 (2.2%)	365 (3.1%)
>50 mg/dL	219 (10.9%)	280 (13.2%)	303 (7.8%)	282 (7.7%)	1,084 (9.3%)

Table 3. Ethanol Positivity by Gender Across Different Age Groups
Tablo 3. Farklı Yaş Gruplarında Cinsiyete Göre Etanol Pozitifliği

Age Group (years)	Ethanol Level	Female, n (%)	Male, n (%)	p-value
≤19 years	Negative	80 (88.9%)	1,747 (91.6%)	0.376
	Positive	10 (11.1%)	161 (8.4%)	
20–34 years	Negative	402 (86.1%)	4,730 (86.3%)	0.888
	Positive	65 (13.9%)	750 (13.7%)	
35–50 years	Negative	194 (92.4%)	2,055 (86.2%)	**0.012***
	Positive	16 (7.6%)	328 (13.8%)	
>50years	Negative	46 (93.9%)	981 (89.4%)	0.318
	Positive	3 (6.1%)	116 (10.6%)	

Chi-square test was used, *indicates statistically significant difference.

DISCUSSION

In 2019, the WHO European Region had the highest per capita alcohol consumption worldwide. However, recent reports have indicated a decline in per capita alcohol intake among adults in the European Region (1). A study evaluating alcohol consumption trends in Germany between 1995 and 2018 demonstrated a gradual decrease in prevalence among both males and females (6). Similarly, a study assessing alcohol consumption patterns in Spain from 1990 to 2019 reported reductions during specific periods (7).

According to data from the Turkish Statistical Institute, the past-year alcohol use prevalence among individuals aged 15 years and older in Türkiye was 12.1% in 2022 (18.4% in males and 5.9% in females), compared with 14.9% in 2019 (23.3% in males and 6.6% in females), indicating a decline in alcohol consumption over this period (8). In a survey conducted by İlhan et al. in the province of Şanlıurfa, the lifetime prevalence of alcohol use among the local population was 3.5%, while the past-year alcohol use prevalence was 1.9% (9).

Our study, based on the analysis of laboratory data, revealed that between 2021 and 2024, ethanol positivity rates ranged from 8.9% to 20.2% in females and from 9.3% to 19.8% in males, with overall positivity rates ranging from 9.3% to 19.8%. Over the four-year period, the overall ethanol positivity rate was 11.5% in females, 12.5% in males, and 12.4% in total. Notably, during the final two years of the study period, ethanol positivity rates declined to their lowest levels in both sexes and overall. In addition, 93.5% of all positive results were observed in male individuals, whereas only 6.5% occurred in females.

A similar study conducted by Gök et al., based on laboratory ethanol data from 2021 and 2022, reported positivity rates (≥10 mg/dL) of 15.0% in females, 18.82% in males, and 18.26% overall. In that study, 71.4% of the analyzed samples were obtained from males and 28.6% from females (10). Many countries implement public health policies aimed at minimizing alcohol-related harms, and strong alcohol control policies represent the first line of defense against such harms (1). The decrease in ethanol positivity observed in recent years in our study may therefore be associated with the implementation of these alcohol control policies.

Alcohol consumption is highly prevalent among adolescents, with rates varying considerably across countries. Using data from the Global School-based Student Health Survey (2003–2018), one study reported a prevalence of alcohol consumption of 25.2% among adolescents aged 11–16 years (11). In Thailand, 31.01% of adolescents aged 10–14 years were reported to have experienced alcohol use (12). Similarly, a study from

Ethiopia found that 29% of adolescents aged 13–19 years had consumed alcohol at least once (13).

In Türkiye, a 2012 survey conducted by Evren et al. reported that 34.2% of 10th-grade students had consumed alcohol at least once in their lifetime (females: 33.8%, males: 35.6%) (14). Likewise, a survey by Ünlü et al. conducted in 2010 found the lifetime prevalence of alcohol use among high school students to be 34.8% in males and 30.6% in females (15).

According to our study results, 8.6% of ethanol analyses in the ≤19 age group were positive, accounting for 11.8% of all ethanol-positive results. No statistically significant difference in ethanol positivity was observed between males and females in this age group (p > 0.05). Consistent with our findings, a study by Gök et al. based on laboratory data reported alcohol positivity rates of 6.12% in the 1–10 age group (females: 0%, males: 10%) and 17.12% in the 11–20 age group (females: 16.86%, males: 17.23%), with no significant gender differences observed in these age categories (10).

Among young adults, a study conducted in Türkiye between 2019 and 2020 among university students aged 18–35 years found that 34.7% reported never having consumed alcohol, while the lifetime prevalence of alcohol use was 65.3% (16). Similarly, a 2020 survey by Bahar et al. reported that 17.6% of university students were active alcohol users, whereas 69.1% reported never having consumed alcohol (17).

In line with these findings, our data showed that the highest number of ethanol analyses was performed in individuals aged 20–34 years, followed by those aged 35–50 years. These age groups also exhibited the highest ethanol positivity rates (13.7% and 13.3%, respectively). Specifically, 56.3% of all ethanol-positive cases occurred in individuals aged 20–34 years, while 23.7% were observed in the 35–50 age group, indicating that approximately 80% of all positive cases were among individuals aged 20–50 years.

When trends in ethanol positivity over the four-year study period were evaluated, the lowest rates were observed during the final two years, particularly among individuals aged 35–50 years, in whom a consistent annual decline was noted. No statistically significant gender difference was observed in ethanol positivity rates within the 20–34 age group (p > 0.05). However, in the 35–50 age group, ethanol positivity rates were significantly higher in males than in females (p < 0.05).

Similarly, in the study by Gök et al., the majority of ethanol tests were conducted in the 21–30 and 31–40 age groups, which also exhibited the highest positivity rates. The overall positivity rates in these groups were 19.33% (females: 20.66%, males: 18.79%) and 20.77% (females: 15.6%, males: 22.89%), respectively. While no statistically significant gender difference was reported in the 21–30 age group, males demonstrated significantly higher ethanol positivity rates than females in the 31–40 age group (10).

In our study, the overall ethanol positivity rate among older adults (>50 years) was 10.4% (females: 6.1%, males: 10.6%), and this age group accounted for 8.2% of all ethanol-positive cases. No statistically significant difference in ethanol positivity was observed between males and females in this age group (p > 0.05). The lowest positivity rate in this group was recorded in the final year of the study period, with a consistent annual decline observed.

According to the findings of Gök et al., ethanol positivity rates were 16.06% among individuals aged 51–60 years (females: 6.81%, males: 19.52%) and 12.06% among those aged over 60 years (females: 4.1%, males: 15.1%). In both older age groups, ethanol positivity rates were significantly higher in males compared to females (10).

One of the main limitations of our study is its single-center design, which restricts the

generalizability of the findings. Another limitation is that the dataset is result-based rather than person-based, which may partially introduce bias. An additional methodological limitation is the use of two different analyzers during the study period without evaluating potential differences in their analytical performance. Previous studies on measurement uncertainty (MU) in ethanol testing indicate that MU can vary between different analyzer brands due to factors such as calibrator uncertainty, reagent stability, and analytical repeatability (18–20). We did not assess the potential impact of MU on results near the defined threshold values. Ethanol levels ≥10 mg/dL were considered positive, and positive samples were evaluated separately as 10–50 mg/dL and >50 mg/dL. Accounting for MU, particularly for results close to 10 mg/dL and 50 mg/dL, would have provided a more robust assessment.

Nevertheless, the strengths of our study include its large sample size and the analysis of a continuous four-year dataset, which enabled the evaluation of temporal trends.

CONCLUSIONS

In Türkiye, many studies on alcohol use prevalence are based on self-reported survey data, which have inherent limitations in accurately assessing alcohol consumption. In this context, laboratory-based ethanol measurements obtained from biological samples may provide more objective and reliable insights (4). According to our findings, the highest number of ethanol analyses and the highest positivity rate were observed in the 20–34 age group. Overall, 93.5% of all ethanol-positive cases were male, while only 6.5% were female. A statistically significant gender difference in ethanol positivity was observed only in the 35–50 age group, with higher rates among males, whereas no significant gender differences were detected in other age groups. Over the four-year period, the ≤19, 35–50, and >50 age groups demonstrated a consistent decline in ethanol positivity rates, with the lowest rates recorded in the final two years of the study. This decline may be associated with alcohol control policies; however, further up-to-date and multi-center studies are required to elucidate the underlying causes.

Research Funding

Conflict of Interest

The authors declare no conflicts of interest.

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