



Research Article

Evaluation of ethanol test analysis: The two years experience

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Abstract

Objectives: Compounds with hydroxyl (-OH) attached to the carbon atom in their structure are generally defined as alcohols. People have been producing, consuming, and enjoying alcohol for a very long time. The prevalence of alcohol use disorder in the world is 5.1%. Alcohol toxicity can be life-threatening, and blood alcohol levels must be measured.

Methods: The 19568 ethanol analysis results were included in this study, performed between 01.01.2021 and 31.12.2022, and were obtained from Ankara Bilkent City Hospital's laboratory information system. Serum ethanol levels <10 mg/dL were accepted as negative. Ethanol analysis results according to positive serum ethanol levels were designed as follows; <10 mg/dL, between 10 mg/dL and ≤30 mg/dl, between 30 mg/dl> and ≤50 mg/dl, between 50 mg/dl> and ≤100 mg/dl, and above 100 mg/dL. Ethanol analysis results according to age were designed as follows ≤10 years, 11–20 years, 21–30 years, 31–40 years, 41–50 years, 51–60 years, and above 60 years. The ethanol analyses were performed by Atellica Chemistry- XPT[®] (Siemens Healthineers, Erlangen, Germany) device.

Results: This study included a total of 19568 ethanol analysis results. The number of females and males was as follows: 5595 (%28.3), 13973 (%71.4) Ethanol positivity was higher in males 2735 (%76.5) than in females 839 (%23.5) (p<0.001). The results of the males were higher in each group (p<0.001) when evaluating the ethanol intervals among genders. When the ethanol intervals among age intervals were analyzed, the group aged between 21 to 30 years had the highest number while the group aged between 0 to 10 years had the least number (p<0.001).

Conclusion: Alcohol use is stated as a public health problem for the whole world. Our study, which evaluates alcohol analysis results according to gender, different age groups, and different ethanol intervals, may be helpful for future studies.

Keywords: Ethanol, ethanol toxicity, public health

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Compounds with a hydroxyl (-OH) group attached to a carbon atom in their structure are generally defined as alcohols. For a compound to be defined as an alcohol, no more than one -OH group should be bonded to the same carbon, and the carbon atom to which the -OH group is attached should not contain a pi bond [1].

People have been producing, consuming, and enjoying alcohol for a very long time [2]. The first evidence of alcohol use is pottery containing traces of wine, thought to date back to 7000 BC [3]. Views on the physical, mental, and social harms of alcohol use were put forward by Dr. Benjamin Rush in 1785. In the early 1900s, some anti-alcohol laws were passed [4].

It has been stated that approximately 5.1% of people over the age of 15 have an alcohol use disorder [5]. According to the World Health Organization (WHO) regions, alcohol use disorder is reported as 8.8% in the European region, 8.2% in the Americas, 4.7% in the Western Pacific region, 3.9% in the Southeast Asia region, 3.7% in Africa, and 0.8% in the Eastern Mediterranean region [6]. As reported by the Turkish Statistical Institute, there was an increase in the prevalence of alcohol use among individuals between the ages of 15 and 24 in Türkiye between 2010 and 2019. The rate of alcohol use was stated as 8.6% in 2010, 7.4% in 2012, 13.3% in 2014, 9.3% in 2016, and 11.4% in 2019 [7]. The rate of alcohol use is higher in men than in women [8].

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Some situations related to alcohol are stated in Articles 34/1, 34/2, and 57 of the Turkish Penal Code [9]. One per mille means the presence of 100 milligrams of alcohol in 100 milliliters of blood [10]. 0.2 per mille is the legal limit for vehicles other than private vehicles, and 0.5 per mille is the legal limit for private vehicles [11].

Alcohol is included under the heading "Substance-related disorders" in the Diagnostic and Statistical Manual of Mental Disorders [9]. Approximately 237 million men and 46 million women in the world suffer from alcohol use disorder [12]. Alcohol use may lead to alcohol addiction [13]. Long-term alcohol consumption causes various diseases, including both communicable and non-communicable ones [14]. Alcohol use plays a role in increased risks of tuberculosis and lower respiratory tract infections by suppressing the immune system; it also increases the likelihood of unprotected sexual intercourse, which may increase exposure to sexually transmitted infections [15]. Alcohol consumption causes approximately 4% of cancers in the world and increases the risk of colorectal, breast, liver, and digestive system cancers [16]. There is an association between alcohol and an increased risk of cardiovascular diseases [17], injuries, and some neurological conditions [18].

Foods taken with ethanol and medical procedures that delay gastric emptying slow down ethanol absorption. After absorption, 90% of the ethanol is eliminated from the body by enzymatic oxidation in the liver, and 5–10% is eliminated from the body through the kidneys, lungs, and sweating [19].

Alcohol toxicity can be life-threatening, and the best way to detect this condition is to measure blood alcohol levels [20]. As the blood alcohol level changes, different clinical findings occur. In individuals with blood alcohol levels between 20 and 30 mg/dL, motor skills slow down, thinking and judgment abilities are impaired, and motor and cognitive problems increase. Between 30 and 80 mg/dL, coordination and judgment disorders occur, and between 80 and 200 mg/dL, mood lability and impairment in cognitive functions are observed. Nystagmus, dysarthria, and memory disorders are observed in individuals with levels between 200 and 300 mg/dL, and confusion and stupor are observed in individuals with levels between 300 and 400 mg/dL. In individuals with blood alcohol levels between 400 and 500 mg/dL, coma may occur, and in individuals with blood alcohol levels >500 mg/dL, respiratory and circulatory centers may be affected, leading in some cases to death [5].

Ankara Bilkent City Hospital has one of the biggest biochemistry laboratories in Türkiye. In this study, we aimed to evaluate the ethanol test results of Ankara Bilkent City Hospital among different ethanol levels, genders, and different age groups, and to contribute to the literature.

Materials and Methods

The 19568 ethanol analysis results included in this study, performed between 01.01.2021 and 31.12.2022, were obtained from Ankara Bilkent City Hospital's laboratory information system.

Internal and external quality controls are carried out for ethanol testing in our hospital. Hemolysis causes a decrease in the measured ethanol concentration [21]. While ethanol samples are accepted to the laboratory, their compliance with the sample acceptance and rejection criteria determined by our hospital is evaluated, and test analyses are performed on the appropriate samples.

Only the first results of patients whose ethanol analysis was performed more than once were included in the study. Groups were designed according to gender, age, and serum ethanol levels. Serum ethanol levels were stated as negative or positive. Serum ethanol levels <10 mg/dL were accepted as negative. Ethanol analysis results according to positive serum ethanol levels were designed as follows: <10 mg/dL, between 10 mg/dL and ≤30 mg/dL, between 30 mg/dL and ≤50 mg/dL, between 50 mg/dL and ≤100 mg/dL, and above 100 mg/dL. Ethanol analysis results according to age were designed as follows: ≤10 years, 11–20 years, 21–30 years, 31–40 years, 41–50 years, 51–60 years, and above 60 years. The ethanol analyses were performed using the Atellica Chemistry-XPT® (Siemens Healthineers, Erlangen, Germany) device. Ethanol measurement depends on the enzymatic reaction using the Emit II Plus reagent. The measurement kit includes two reagents. Reagent 1 contains the buffer system, and Reagent 2 contains alcohol dehydrogenase (ADH), coenzyme nicotinamide adenine dinucleotide (NAD), buffer, preservatives, and stabilizers. ADH catalyzes the oxidation of ethyl alcohol to acetaldehyde. During this reaction, NAD is reduced to NADH. The increase in absorbance at 340 nm is proportional to the alcohol concentration in the sample. At every stage of the present study, all researchers worked under the Declaration of Helsinki.

Statistical analyses

Descriptive statistics were frequency, percent, median, 25th, and 75th percentile (Interquartile ranges; IQR). A chi-square test was used for categorical comparisons. The Mann-Whitney U test was performed to compare the groups, and a p-value <0.05 was defined as statistically significant. IBM SPSS Statistics for Windows, Version 27.0 (IBM Corp., Armonk, NY, USA), was used for statistical analyses.

Results

A total of ethanol analysis results, including a two-year time period, were included in this study. Atellica Chemistry-XPT® (Siemens Healthineers, Erlangen, Germany) device kit insert.

In the ethanol kit insert of the Atellica Chemistry-XPT® (Siemens Healthineers, Erlangen, Germany) device, it was stated that ethanol concentrations below 10 mg/dL should be reported as <10 mg/dL; therefore, in our study, ethanol concentrations below 10 mg/dL were reported as negative. A total of 5,595 (28.3%) results belonged to females, and 13,973 results belonged to males (71.4%). In the present study, a chi-square test was performed, and statistical differences in ethanol positivity between males, 2,735 (76.5%), and females, 839 (23.5%), ($p < 0.001$) were found.

A chi-square test was performed for the ethanol test analysis data among age intervals, and the 21–30 years age group had the highest number of positive ethanol results ($p < 0.001$).

The quantitative variables (Table 1) and the comparison of ethanol test analysis data of age intervals among genders were presented (Table 2). The Mann-Whitney U test was performed to compare ages among the genders, and the median and IQR were as follows: 34 (25–46) for females and 35 (26–47) for males, with statistically significant differences found among the groups ($p = 0.013$).

Ethanol test analysis data of age intervals among genders were evaluated with chi-square tests. No significant differences existed between genders in the 0–10 years, 11–20 years, and 21–30 years age groups. Males had a higher number of positive ethanol results in the following groups: 31–40 years ($p < 0.001$), 41–50 years ($p < 0.001$), 51–60 years ($p < 0.001$), and over 60 years ($p < 0.001$) (Table 2).

Discussion

Consuming alcohol is a worldwide public health problem [22]. Alcohol is an addictive substance and is used by many people for different reasons. More than 200 diseases are associated with alcohol use. It has been stated that 1 in every 3 people is an active alcohol drinker [23]. According to data, 30 to 45% of adults in the USA have experienced at least one temporary alcohol-related problem, and 3 to 5% of women and 10% of men have been diagnosed with alcohol addiction. The age of active alcohol use is 25–35 years, and alcohol use reaches its peak at the age of 35 [24].

As reported by a survey conducted on Kırıkkale University students with an average age of 20.9 ± 1.8 years, 64% of the stu-

Table 1. Quantitative variables

| | n | % |
|---------------------------|-------|-------|
| Gender | | |
| Female | 5595 | 28.6 |
| Male | 13973 | 71.4 |
| Age (years) | | |
| 0–10 | 49 | 0.3 |
| 11–20 | 1478 | 7.6 |
| 21–30 | 6181 | 31.6 |
| 31–40 | 4525 | 23.1 |
| 41–50 | 3385 | 17.3 |
| 51–60 | 1993 | 10.2 |
| Over 61 | 1957 | 10 |
| Ethanol Intervals (mg/dL) | | |
| Negative | 15994 | 81.74 |
| >10 mg/dL–≤ 30 mg/dL | 274 | 1.40 |
| >30 mg/dL–≤ 50 mg/dL | 252 | 1.29 |
| >50 mg/dL–≤ 100 mg/dL | 553 | 2.83 |
| Over 100 mg/dL | 2495 | 12.75 |

dents have tried drinking alcohol, and the rate of alcohol use is 74.8% among male students and 54.8% among female students ($p = 0.000$) [25]. In a study evaluating alcohol use among medical school students, with an average age of 21.03 years, it was found that alcohol use was higher in men [26].

According to a cross-sectional study held in Japan, a significant difference between males (74.9%) and females (59.6%) was reported [27]. As a result of a study whose sample consisted of individuals in the 15–18 age group in the rural area of Tekirdağ, it was stated that men consumed more alcohol than women [28].

Table 2. Ethanol test analysis data of age intervals among genders

| Age intervals (years) | Ethanol mg/dL | Gender | | | | p |
|-----------------------|---------------|--------|-------|------|-------|---------|
| | | Female | | Male | | |
| | | n | % | n | % | |
| 0–10 | Negative | 19 | 100 | 27 | 90 | 0.273 |
| | Positive | | | 3 | 10 | |
| 11–20 | Negative | 375 | 83.14 | 850 | 82.77 | 0.461 |
| | Positive | 76 | 16.86 | 177 | 17.23 | |
| 21–30 | Negative | 1429 | 79.34 | 3557 | 81.21 | 0.005 |
| | Positive | 372 | 20.66 | 823 | 18.79 | |
| 31–40 | Negative | 1087 | 84.39 | 2498 | 77.17 | <0.001* |
| | Positive | 201 | 15.61 | 739 | 22.89 | |
| 41–50 | Negative | 822 | 86.26 | 2498 | 77.17 | <0.001* |
| | Positive | 131 | 13.74 | 496 | 20.4 | |
| 51–60 | Negative | 506 | 93.19 | 1167 | 80.48 | <0.001* |
| | Positive | 37 | 6.81 | 283 | 19.52 | |
| Over 60 | Negative | 518 | 95.9 | 1203 | 84.9 | <0.001* |
| | Positive | 22 | 4.1 | 214 | 15.1 | |

*: $p < 0.05$: Statistically significant. p: Chi-square test.

Alcohol use among adolescents is increasing. In a study conducted in Southern Ireland, including parents and adolescents, it was stated that 47% of parents and 34.2% of adolescents engaged in hazardous drinking [29]. In a study that retrospectively evaluated the data of adolescent patients with an average age of 16.50 ± 0.70 years in a psychiatric ward, it was reported that alcohol use was higher in males than in females ($p=0.01$) [30]. It was reported that the prevalence of lifetime alcohol usage was 37.3%, while the prevalence of alcohol usage more than once was 24.3% in a study conducted with apprenticeship training students [31].

In a study that evaluated individuals aged 15–64 as young and those aged 65 and over as elderly, the ethanol positivity rate of young patients (24.4%) was found to be higher than that of older patients (5.5%) ($p<0.0001$) [32]. A study involving geriatric patients found no difference in alcohol use between men and women [33].

In the study by Akay et al. [34], it was stated that 341 (76.6%) of 445 patients included in the study had a blood alcohol level below 0.5 per mille (50 mg/dL), and 104 (23.4%) had a blood alcohol level of 0.5 per mille and above. In the study by Yılmaz et al. [35], which investigated the demographic and clinical features of blood ethyl alcohol level requests made from emergency services, it was reported that 63.6% of the results were below the legal limit and 36.4% were above the legal limit.

Our study includes a total of 19,568 ethanol analysis results. The number of females and males was as follows: 5,595 (28.3%) and 13,973 (71.4%) (Table 1).

The ethanol test analysis data among age intervals were revealed, and a statistical difference was observed; the 21–30 years age group had the highest number of positive ethanol results ($p<0.001$).

In Table 2, the ethanol test analysis data of age intervals among genders were evaluated. In all age groups, male results were higher in number. However, there were no statistical differences in the 0–10 years age group ($p=0.273$), 11–20 years age group ($p=0.461$), and 21–30 years age group ($p=0.005$); while there were statistical differences in the 31–40 years age group ($p<0.001$), 41–50 years age group ($p<0.001$), 51–60 years age group ($p<0.001$), and over 60 years age group ($p<0.001$).

The data of our study showed that ethanol positivity is higher in males than in females, in line with previous studies [25–28], and the 21–30 years age group had the highest number of ethanol-positive results.

Strengths and limitations

The strengths of the present study are as follows: conducting our study in Ankara Bilkent City Hospital, one of the largest hospitals in Türkiye, allowed the use of a wide range of data. Ethanol results were evaluated in different ethanol intervals, according to gender, and in seven different age groups based on decades.

The limitation of our retrospective study was that we could not access data on the frequency of alcohol use, whether

the alcohol use occurred with the free will of the individuals, and the clinical information of the patients related to alcohol through the laboratory information system.

Conclusion

Many data in the literature are sufficient to explain that alcohol use has dangerous consequences. Alcohol use, which is stated as a public health problem for the whole world, is higher in developed countries than in developing countries. The frequency of alcohol use in our country is lower than in most countries [19].

The data of our study showed that ethanol positivity is higher in males than in females, and the 21–30 years age group had the highest number of positive ethanol results. Our study, which evaluates alcohol analysis results according to gender, different age groups, and different ethanol intervals, may be helpful for future studies. Studies on the problems caused by alcohol use should continue, and activities to prevent alcohol use should be carried out.

Ethics Committee Approval: The study was approved by The Ankara Bilkent City Hospital No 1 Clinical Research Ethics Committee (No: E1-23-3775, Date: 12/07/2023).

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