

Effects of Alcohol on Pulmonary Function in a Healthy Population

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Abstract

Background: The lung can be the target of the harmful effects of alcohol, and to date, data on this matter are insufficient. The aim of this study was to evaluate the effects of alcohol on airway resistance in healthy individuals.

Methods: This was a cross sectional study conducted with 24 cases and 26 controls. The cases were alcohol consumers of more than 4 years with no comorbidity or disease. Pulmonary function tests and body plethysmography were performed to determine FEV₁, FVC, TLC, RV and FEV₁/FVC and participant's response to bronchodilators. The amount of alcohol consumption and its duration were measured by visual scales and portion size album.

Results: The mean values of FVC, FEV₁, TLC, and RV did not differ significantly between the two groups. In the case group, FEV₁ and age were significantly correlated ($r=-0.460$, $p=0.049$). There was an insignificant correlation value of -0.06 ($p=0.752$) between FEV₁ and age in the control group. Also, there was no significant correlation between age and FVC, TLC or RV in both groups.

Conclusion: Overall, there was a strong, negative correlation between FEV₁ and age in the case group of this study, and it appears that alcohol slightly enhanced the effect of age on pulmonary function tests.

Keywords: Alcohol, Airway resistance, Pulmonary function

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Introduction

Alcohol is one of the most commonly used and abused substances all over the world. With the rapidly growing number of people who drink alcohol, there is a coinciding increase in the number of people seeking medical attention for alcohol-induced problems (1). The lung, besides the brain and liver, can be a target for the harmful effects of alcohol. For example, alcohol greatly increases the risk of upper respiratory tract infections, pneumonia, and acute respiratory distress syndrome (2). Volatility of alcohol causes the movement of alcohol from the bronchial circulation across the ciliated airway epithelium into the conducting airways of the lung. The effects of alcohol on lung and airway functions depend on the concentration, duration, and route of exposure. Low concentrations and short-time exposure of alcohol may increase mucociliary clearance, stimulate bronchodilation and maybe attenuate airway inflammation in asthma and Chronic Obstructive Pulmonary Disease (COPD). But prolonged and heavy consumption of alcohol can impair mucociliary clearance, complicate asthma management and cause an increase in morbidity and mortality in COPD patients (3). Mechanisms of alcohol-mediated changes in airway functions include prominent roles for the calcium as the second messenger and nitric oxide, regulatory kinases such as PKG and PKA, alcohol and acetaldehyde-metabolizing enzymes, especially aldehyde dehydrogenase type 2 (3,4).

While there is much known about the effects of alcohol on lung clearance and susceptibility to infection, there is little information about the effects of alcohol on other airway functions, such as the regulation of bronchial motor tone, airway resistance, and bronchial hyper responsiveness. To date, there has been little agreement on exact benefits of alcohol on human airways and the simple question, drinking or not drinking, remains unanswered. The objective of this study was to investigate the effects of alcohol on pulmonary function in healthy individuals.

Materials and Methods

Study population and design

This was a cross sectional study conducted in 2012 over one year, which included 24 cases and 26 controls. The study was carried out at Rasoul Akram Hospital (with IR.IUMS.REC.1398.1119 ethical code),

which is associated with Iran University of Medical Sciences and is located in Tehran.

Cases enrolled in the study were alcohol consumers of more than one alcoholic drink per week, regardless of the type of drink.

According to the purpose of this study, *i.e.*, comparing the level of FEV₁ in 2 groups, the number of subjects in each group was calculated as in a previous study (5), using $\alpha=0.05$, power=0.8, $d=500$ and $\sigma=577$. With a 10% drop out rate, the required sample size was determined to be 24 individuals in each group.

Participants were from Rasoul Akram Hospital and another hospital who came for a physical examination for work. One alcoholic drink was defined as 12 oz (355 ml) of regular beer, 5 oz (148 ml) of wine (12% alcohol) or 1.5 oz (44 ml) of 80 proof distilled spirits. This amount of alcohol intake is considered moderate and may be beneficial in preventing cardiovascular diseases and high blood pressure. Each alcoholic drink contains 14 gr of alcohol (6).

Inclusion criteria were age over 35 years, consuming alcohol more than one drink/week, not having a history of respiratory diseases (for both groups) and not taking medication that would affect pulmonary function tests. Exclusion criteria were smoking, addiction to drug or substance, history of respiratory diseases such as asthma and COPD (for both groups).

The participants in the case group were recruited from the following sources; healthy individuals who were referred to the pulmonary clinic for a physical examination for work and persons who were referred to Loghman Hakim Hospital for various reasons, including acute alcohol intoxication.

Pulmonary function tests and body plethysmography were performed for each group to determine FEV₁, FVC, TLC, RV, FEV₁/FVC and participant's response to bronchodilators. The tests were carried out with a Masterlab Pro (105108-175101, Jaeger, Germany) which was calibrated at the start of each day, and all patients were seen by one pulmonary specialist (HR) to reduce bias.

The amount of alcohol consumption and its duration were measured by visual scales and portion size album. To determine the amount of alcohol in grams, the participants were asked about the type of drink and size of the cups, glasses and other drinking containers. The patient information is kept confidential.

Statistical analysis

Categorical data are reported as number [percentage], and continuous variables are presented as mean±SD. The Shapiro-Wilk test was used to determine the normality of the data. Differences in means of continuous variables between the 2 groups were evaluated using the t-test. Differences in frequency were evaluated with Fisher’s exact test. Univariate association between spirometry tests and other continuous variables was assessed with Pearson’s correlation coefficient.

The statistical software SPSS 18.0.0 (SPSS Inc. Chicago, IL, USA) was used for all data analyses. All tests were two-sided, and p<0.05 was considered statistically significant.

Results

Fifty subjects were evaluated and 24 subjects were in alcohol consumer group. Alcohol consumption was 5 to 50 g per week, and the history of consumption was from 4 to 40 years, with only 4 patients responding to bronchodilator. Basic information of participants is shown in table 1. There was no significant difference in

sex and age between two groups.

As shown, the mean values of FVC, FEV1, TLC, and RV between the two groups were not statistically significant (Table 2). In the case group, FEV1 and age were significantly correlated (r=-0.460, p=0.049). There was no significant correlation (r=-0.06, p=0.752) between FEV1 and age in the control group. It means that alcohol slightly enhanced the effect of age on decrease in FEV1 values. Also, there was no significant correlation between age and FVC, TLC and RV in both groups (Table 3).

Discussion

This was a cross sectional study on 50 healthy participants to evaluate the effects of alcohol on pulmonary function test in healthy individuals. Our results showed that alcohol consumers experienced negative effect (Insignificant) in terms of one of their pulmonary function tests (FVC%) and higher age was correlated with decreased FEV1.

Studies on healthy men and women have shown that alcohol may alter the sensory processing of respiratory

Table 1. Baseline characteristics of the participants

Characteristics	Cases n=24	Controls n=26	p-value
Gender, no. (%)			0.24
Female	4(16.7%)	8(30.8%)	
Male	20 (83.3%)	18(69.2%)	
Age, year	39.38±11.98	42.46±9.15	0.3
Data are expressed as mean±SD unless otherwise stated.			

Table 2. Spirometry findings in case and control groups

Spirometry variables	Cases n=24	Controls n=26	p value*
FEV ₁ %	95.21±19.73	100.23±11.70	0.27
FVC%	93.29±16.37	100.46±12.60	0.08
TLC%	101.73±19.89	101.54±18.78	0.97
RV%	113.81±17.97	113.31±17.59	0.92
* p-values based on two independent sample t-test Data are expressed as mean±SD			

Table 3. Correlation coefficient between age and spirometry findings

Spirometry variables	Cases n=24	Controls n=26
FEV ₁ %	-0.06 (0.752)	-0.460 (0.049)
FVC%	-0.17 (0.38)	-0.34 (0.103)
TLC%	-0.196 (0.36)	0.196 (0.34)
RV%	0.058 (0.803)	0.21 (0.29)
Data are expressed as correlation coefficient (p value) p values based on Pearson’s correlation coefficients test		

neural signals resulting in malfunction of the respiratory system and breathing during sleep (7). Alcohol abuse may be related to developing pulmonary edema in acute respiratory distress syndrome (8) and can also be a risk factor for pneumonia (9). On the other hand, the benefits of alcohol as a treatment for asthma have been reported in several studies. In 1863, Hyde Salter (10) reported improvement in asthma symptoms in three of his patients who drank large amounts of alcohol. One hundred years later, Herxheimer and Stresemann (11) showed an increase in the vital capacity of asthmatic patients after alcohol intake. In 2001, a review of clinical and experimental studies concluded that alcohol consumption must be avoided because of its exacerbating effects in asthma patients (12).

In 2014, a study was done for evaluation of the associations between lung function and alcohol consumption; the results from this study suggest that alcohol, particularly heavy drinking, has an independent additive negative effect on lung function in smokers (13). The result of the present study showed that the mean FVC% was not significantly different in the case and control groups, but the mean TLC and RV were very similar in the two groups. This can be in line with previous studies.

Overall, there was a strong, negative correlation between FEV1 and age in the case group of this study. Higher age was correlated with decreased FEV1. As shown in multiple studies to date, in healthy individuals, there is no change in FEV1 between 18-25 years and a plateau phase in early adulthood, followed by a decline afterward (14). This is compatible with our results. Also, aging has been found to be associated with pulmonary function in a growing negative trend in healthy people (15). In COPD patients, this rate of decline may be rapid or slow depending on the severity of the disease (16).

There was no statistically significant difference in FEV1% between case and control groups but our findings suggest that FEV1% in alcohol drinkers was lower than in controls. In a study by Siu *et al* on 177,637 members of a Northern California comprehensive health plan, pulmonary tests were performed, and participants were questioned about alcohol consumption and health history during the previous year. The data of this study showed that independent of the amount of smoking and evidence of lung or heart disease, light to moderate drinkers were less likely to have an abnormal FEV1/FVC (17). This

result is not in line with the results of our study.

Also in this study, FVC% decreased as the age of participant increased in both groups, but this trend was not significant. Reduction of FVC in alcohol group was greater than the control group. In the study by Stanton *et al*, heavy alcohol drinkers who were 60 to 69 years old had a lower FEV1/FVC ratio compared to the light drinkers <59 years old [16]. Therefore, alcohol may slightly enhance the effect of age on pulmonary function tests. Our result is in line with these authors' results.

Some limitations of this paper should be acknowledged. The sample size of this study was small and this could have affected the results. In addition, the amount of alcohol intake was self-reported, and people might have under-reported because of legal matters and living in an Islamic country.

Conclusion

As we know that a person with alcohol use disorder not only may show physical dependence but also may develop devastating long-term health problems. The lung is affected by alcohol abuse in addition to other organs include liver cirrhosis, pancreatitis, neuropathies, dementia, and cardiomyopathies. Lung involvements are more likely pneumonia, tuberculosis, and other pulmonary infection but about the role of alcohol in airway diseases and airway resistance, a little information exists especially in healthy person. The aim of this study is evaluating the effects of alcohol on airways and may have a relation in decreasing pulmonary function tests such as smoking and air pollution.

Alcohol consumption is a double-edged sword. It can have some health benefits or it can be harmful to multiple organs in the body or it may progress to alcoholism which may cause devastating long-term health problems. Due to the limited information about the effects of alcohol on lung function, especially in healthy persons, the results of this study may lead to future studies with larger sample sizes and better assessments.

Conflicts of Interest

All authors affirm that there are no conflicts of interest.

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References

1. Grant BF. Prevalence and correlates of alcohol use and DSM-IV alcohol dependence in the United States: results of the National Longitudinal Alcohol Epidemiologic Survey. *J Stud Alcohol* 1997;58(5):464-73.
2. Oldenburg PJ, Wyatt TA, Factor PH, Sisson JH. Alcohol feeding blocks methacholine-induced airway responsiveness in mice. *Am J Physiol Lung Cell Mol Physiol* 2009;296(1):L109-L14.
3. Sisson JH. Alcohol and airways function in health and disease. *Alcohol* 2007;41(5):293-307.
4. Matsuse H, Shimoda T, Fukushima C, Mitsuta K, Kawano T, Tomari S-y, et al. Screening for acetaldehyde dehydrogenase 2 genotype in alcohol-induced asthma by using the ethanol patch test. *J Allergy Clin Immunol* 2001;108(5):715-9.
5. Zureik M, Liard R, Kauffmann F, Henry C, Neukirch F. Alcohol consumption, gamma-glutamyl transpeptidase (GGT), and pulmonary function: A cross-sectional and longitudinal study in working men. *Alcohol Clin Exp Res* 1996;20(9):1507-11.
6. Catharine Ross A. *Modern Nutrition in Health and Disease*, eds. Baltimore: Wolters Kluwer Health/Lippincott Williams & Wilkins; 2014. 1616 p.
7. Eckert DJ, Elgar NJ, McEvoy RD, Catcheside PG. Alcohol alters sensory processing to respiratory stimuli in healthy men and women during wakefulness. *Sleep* 2010;33(10):1389-95.
8. Berkowitz DM, Danai PA, Eaton S, Moss M, Martin GS. Alcohol abuse enhances pulmonary edema in acute respiratory distress syndrome. *Alcohol Clin Exp Res* 2009;33(10):1690-6.
9. Samokhvalov A, Irving H, Rehm J. Alcohol consumption as a risk factor for pneumonia: a systematic review and meta-analysis. *Epidemiol Infect* 2010;138(12):1789-95.
10. Salter H. Treatment of the asthmatic paroxysm by full doses of alcohol. *Boston Med Surg J* 1863;69(19):379-83.
11. Herxheimer H, Stresemann E. Ethanol and lung function in bronchial asthma. *Arch Int Pharmacodyn Ther* 1963;144:310-4.
12. Cuddy R, Li G. The role of alcohol in asthma: a review of clinical and experimental studies. *The Am J Emerg Med* 2001;19(6):501-3.
13. Frantz S, Wollmer P, Dencker M, Engström G, Nihlén U. Associations between lung function and alcohol consumption Assessed by both a questionnaire and a blood marker. *Respir Med* 2014;108(1):114-21.
14. Kerstjens H, Rijcken B, Schouten JP, Postma DS. Decline of FEV1 by age and smoking status: facts, figures, and fallacies. *Thorax* 1997;52(9):820-7.
15. Sharma G, Goodwin J. Effect of aging on respiratory system physiology and immunology. *Clin Interv Aging* 2006;1(3):253-60.
16. Tashkin DP. Variations in FEV1 decline over time in chronic obstructive pulmonary disease and its implications. *Current Opinion in Pulmonary Medicine* 2013;19(2):116-24.
17. Siu ST, Iribarren C, Udaltsova N, Ranga R, Chen JL, Klatsky AL. Alcohol consumption and lung function. *Chest* 2007;132(4):614B.