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Effect of moderate alcohol intake on visual acuity and contrast sensitivity in healthy young adults: A controlled experimental study

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ABSTRACT

Alcohol consumption is currently increasing in developing nations and can lead to degradation in the quality of life. The aim of this study was to evaluate the effect of moderate alcohol consumption on distance visual acuity, near visual acuity, and contrast sensitivity in healthy young adults. This study was a randomized, single-blind, controlled experimental study. Sixty healthy university students (30 alcohols, 30 control) underwent baseline assessment of distance visual acuity (DVA), near visual acuity (NVA), and contrast sensitivity (CS). Study findings showed that alcohol group consumed 250 mL of 12% red wine, while the control group consumed a matched non-alcoholic beverage. Further, the visual assessments were repeated at 30 and 60 minutes post-consumption. Data were analyzed using repeated-measures statistics and between-group comparisons. In the alcohol group, mean DVA in the right eye worsened from –0.035 ± 0.15 to 0.052 ± 0.16 at 30 minutes and 0.017 ± 0.18 at 60 minutes, while the left eye declined from –0.054 ± 0.12 to 0.037 ± 0.13 and 0.149 ± 0.18, respectively. NVA also deteriorated (right eye: 0.130 ± 0.05 to 0.173 ± 0.06 and 0.230 ± 0.09; left eye: 0.145 ± 0.08 to 0.197 ± 0.07 and 0.247 ± 0.09). Contrast sensitivity showed a non-significant reduction (right eye: 2.10 ± 0.20 to 1.95 ± 0.20 and 1.82 ± 0.22). The control group showed greater time-related declines in acuity compared with the alcohol group, but similarly non-significant changes in CS. The study concludes that acute effects of moderate alcohol intake leads to measurable impairments in distance and near visual acuity within one hour of consumption, while contrast sensitivity shows a non-significant decline. These findings highlight alcohol's negative impact on essential visual functions and underscore the need for caution when performing visually demanding tasks after drinking.

Keywords: *Alcohol consumption, visual acuity, contrast sensitivity, visual performance, ocular effects, psychophysics, alcohol impairment, young adults.*

INTRODUCTION

Visual performance is an essential function in humans that is based on the integrity of the visual pathway. Several factors such as visual acuity and contrast sensitivity are used to evaluate the quality of retinal image formation and cortical processing. These parameters can be susceptible to slight changes in retinal function and neural processing, thereby making them important indicators of transitory and systemic effects on vision. Alcohol is a depressant of the central nervous system that can have an impact on various components of sensory processing, including vision. Several studies have reported loss of visual acuity, contrast sensitivity and interruption of binocular vision after moderate intake of alcohol. For instance, a study conducted in Spain reported reduced contrast sensitivity and impaired retinal image quality after participants drank to a breath alcohol concentration (BrAC) of ~0.25 mg/L (Casares-López et al., 2020). Alcohol changed the ocular motor control in another study conducted in China, resulting in deficits in fixation and dynamic acuity (Zhang et al., 2022). A study conducted in South Africa found that individuals with a BrAC of 0.1% experienced interruption of binocular vision (Munsamy et al., 2016). Additionally, a strong relationship between poor visual acuity and alcohol use was reported in a Nigerian study (Ovienria et al., 2015).

In simulated driving, greater lane deviation and slower reaction time can occur due to reduced contrast sensitivity under the influence of alcohol. In addition, ocular diseases such as optic neuropathies and maculopathies can be present in long term heavy drinkers. Alcohol affects both optical and neural pathways, thereby having an impact on visual performance (Casares-López et al., 2020; Zhang et al., 2022). Various researches have focused more on the cognitive and motor effects such as reaction time and attention of alcohol consumption compared to its sensory effects.

Martino et al., 2023 reported that alcohol affects visual acuity and stereopsis. However, screening tests are hardly conducted for these visual functions when individuals are under alcohol intoxication. A single moderate drink has been found to lower contrast sensitivity across multiple spatial frequencies which is as a result of increased neural noise (Zhang et al. (2022).Casares-López et al. (2020) have emphasized that contrast and glare sensitivity, key factors for driving at night, are not really incorporated in many driver licensing tests, despite evident data showing their degradation above the legal limit of BrAC.In particular, numerous alcoholic drinkers, and even some policymakers, do not recognize the visual risks associated with drinking.

Individuals usually attempt to underestimate their visual impairment: for example, in one randomized study, 39–53% of participants exceeded the legal limit for driving (BrAC =0.05%) although they still they believed that they were capable of driving (Köchling et al., 2021). This misperception is compounded by regular myths such as "My vision is clear, so it is okay to drive" and by tests that focus only on visual acuity. As such, education in drunk-driving focuses on slowed reactions or judgment without similarly stressing on blur or loss of night-vision. On the other hand, ophthalmologists insist that visual deficits need proper attention. In addition, the International Council of Ophthalmology advocates for contrast and glare tests to be included in screening tests for drivers (Casares-López et al., 2020).

The effects of alcohol consumption on cognitive and motor control have been widely investigated; nevertheless, its impact on fundamental visual functions such as visual acuity and contrast sensitivity has been insufficiently explored. There has also been availability and abuse of alcohol among young individuals, and its effects are of critical concern (Iwuagwu, et al., 2020). Therefore, there is a need to investigate the acute effects (within one hour) of moderate alcohol consumption on various sensory aspects of vision among young individuals to identify and create awareness of certain visual deficits that may occur with alcohol intake.

Therefore, the objectives of this study were:

i. To compare changes in distance visual acuity, near visual acuity, and contrast sensitivity between participants exposed to alcohol and those receiving a non-alcoholic control beverage.
ii. To assess the acute effects of moderate alcohol consumption on distance visual acuity, near visual acuity, and contrast sensitivity in healthy young adults by comparing baseline, 30-minute, and 60-minute post-consumption measurements.

METHODS

Study Design

This study employed a single-blind, randomized, controlled experimental design to investigate the acute effect of moderate alcohol consumption on visual acuity and contrast sensitivity. Participants were randomly assigned in a 1:1 ratio to an alcohol group or a placebo control group. The examiner conducting visual assessments was blinded to group allocation.

Study Setting and Duration

All procedures were conducted at the University of Benin Optometry Teaching Clinic, Benin City, Nigeria, between August and September 2025. Testing took place in a standardized examination room with ambient illumination maintained at 85 cd/m².

Participants

Participants were healthy university students aged 20–30 years. Eligibility criteria included:

a) Absence of ocular disease or visual impairment.

b) No systemic or ocular medications affecting vision or alcohol metabolism.

c) AUDIT score ≤8.

d) Adequate rest before testing and provision of informed consent.

Exclusion criteria included: refractive or ocular pathology, AUDIT >8, medications influencing CNS function, and unwillingness to consume alcohol or placebo.

Sample Size Determination

Sample size estimation was based on the formula for comparing two independent means, using previously reported effect sizes for alcohol-induced visual performance changes (Cohen's d = 0.8). With $\alpha = 0.05$ and power = 80%, a minimum of 25 participants per group was required. Accounting for 10% attrition, the target sample size was 56. Ultimately, 60 participants were enrolled (30 per group).

Randomization and Masking

The participants were randomly assigned via a computer-generated sequence to:

a) Alcohol group: 250 mL of 12% red wine (Toma®).

b) Control group: 250 mL of visually matched dealcoholized red wine.

Beverages were served in identical opaque containers to maintain examiner blinding. Consumption was supervised, and all the participants consumed their assigned drink within 10 minutes.

Baseline Assessment

Before intervention, all participants underwent:

a) Distance visual acuity (monocular) using an illuminated Snellen chart.

b) Near visual acuity using a near point card.

c) Contrast sensitivity (monocular) using the Pelli–Robson chart at 1 m.

Baseline measurements established pre-consumption visual acuity and contrast sensitivity for each participant.

Intervention and Alcohol Absorption Period

Following baseline evaluation, the intervention beverage was consumed. A 30-minute absorption period followed, during which participants remained seated quietly to avoid activity-related variations in blood alcohol absorption.

Breath Alcohol Concentration (BrAC) was measured using a calibrated LCD-based breathalyzer at:

a) 30 minutes, targeting BrAC 0.8–1.0 g/L

b) 60 minutes, targeting BrAC 0.7–1.1 g/L

Participants who fell within these ranges proceeded with post-consumption testing.

Post-Consumption Assessment

At 30 minutes and 60 minutes post-consumption, the following were repeated under identical lighting and testing conditions:

a) Distance visual acuity (LogMAR)

b) Near visual acuity (LogMAR)

c) Contrast sensitivity (LogCS)

The same examiner administered all tests, and the sequence of testing remained consistent to minimize learning effects.

Statistical Analysis

Data were analyzed using SPSS version 22.0 (IBM Corp.). Descriptive statistics (means ± SD) summarized all variables.

a) Independent t-tests compared parameters between groups at the different time points

b) Repeated Measures ANOVA evaluated within-group changes across time points (bassline, 30 min, 60 min). Statistical significance was set at $p < 0.05$.

c) Post-hoc analyses with Bonferroni-adjustment were performed to identify differences between different time points. The significance threshold was adjusted to $\alpha = 0.017$ (0.05/3 comparisons).

Ethical Considerations

Ethical approval was obtained from the Research and Ethics Committee of the Faculty of Optometry, University of Benin. All participants provided their consent to participate in this study. Personal identifiers were not collected because there was need to ensure anonymity.

RESULTS

A total of 60 participants completed the study with 30 (mean age 24.1 ± 2.7 years; 70% male and 30% female), assigned to the alcohol group and 30 (mean age 24.1 ± 2.8 years; 70% male and 30% female) to the control group.

Table 1. Distance Visual Acuity (LogMAR) at Baseline, 30 Minutes, and 60 Minutes

Variable	Baseline (M ± SD)		30 Minutes (M ± SD)		60 Minutes (M ± SD)	
	DVAR	DVAL	DVAR	DVAL	DVAR	DVAL
Alcoholic Group	-0.035±0.15	-0.054±0.12	0.052±0.16	0.037±0.13	0.017±0.18	0.149±0.18
Non-Alcoholic	0.053±0.22	0.056±0.18	0.149±0.20	0.170±0.20	0.282±0.16	0.300±0.16
p value	0.756	0.006	0.042	0.004	0.000	0.001

M: Mean, SD: Standard Deviation

DVAR: Distance Visual Acuity – Right Eye DVAL: Distance Visual Acuity – Left Eye

As shown in Table 1, the alcoholic group demonstrated slightly better distance visual acuity (DVA) in both eyes compared with the control group at all-time points. A significant difference in DVA was only observed in the left eyes (t=2.87, p=0.006) at baseline. Significant differences in DVA for left and right eyes were also observed between the two groups at 30 minutes (t=2.08, p=0.042; t= 3.03, p=0.004) and 60 minutes (t=3.79, p=0.000; t-3.48, p=0.001) post-consumption using an independent t-test.

Table 2. Near Visual Acuity (LogMAR) at Baseline, 30 Minutes, and 60 Minutes

Variable	Baseline (M ± SD)		30 Minutes (M ± SD)		60 Minutes (M ± SD)	
	NVAR	NVAL	NVAR	NVAL	NVAR	NVAL
Alcoholic Group	0.130±0.05	0.145±0.08	0.173±0.06	0.197±0.07	0.230±0.09	0.247±0.09
Non-Alcoholic	0.197±0.12	0.163±0.12	0.267±0.09	0.263±0.09	0.340±0.07	0.343±0.07
p value	0.005	0.492	0.000	0.001	0.000	0.000

NVAR: Near Visual Acuity – Right Eye   NVAL: Near Visual Acuity – Left Eye

Table 2 shows that the alcoholic group also demonstrated slightly better near visual acuity (NVA) in both eyes compared with the control group at all-time points. There was statistically significant differences in NVA for left and right eyes between the two groups at 30 minutes (t=4.68, p=0.000; t=3.28, p=0.001) and 60 minutes (t=5.16, p=0.000; t= 4.70, p=0.000)
post-consumption. However, a statistically significant difference in NVA between the two groups was only observed for the right eye at baseline (t= 2.92, p=0.005).

Table 3. Contrast Sensitivity (LogCS) at Baseline, 30 Minutes, and 60 Minutes

Variable	Baseline		30 Minutes		60 Minutes	
	CSR	CSL	CSR	CSL	CSR	CSL
Alcoholic Group	2.10 ±0.20	2.11 ± 0.17	1.95 ± 0.20	1.95 ± 0.19	1.82 ± 0.22	1.73 ± 0.15
Non-Alcoholic	2.13 ± 0.13	2.12 ± 0.11	1.94 ± 0.17	1.91 ± 0.16	1.82 ± 0.21	1.70 ± 0.19
p value	0.986	0.732	0.098	0.049	0.199	0.060

CSR: Contrast Sensitivity – Right Eye   CSL: Contrast Sensitivity – Left Eye

Table 3 shows that there was no statistically significant difference (p>0.05) in contrast sensitivity between the alcoholic and control group in both the right and left eyes at all-time points.

Table 4. Summary of Within-Group Changes in Visual Acuity and Contrast Sensitivity

	GROUP	(Mean ± SD) BASELINE	(Mean ± SD) 30 MINS	(Mean ± SD) 60 MINS	*p* value
DVAR	Alcohol	-0.035 ± 0.15	0.052 ± 0.16	0.117± 0.18	0.000
	Non-alcohol	0.053 ± 0.22	0.149 ± 0.20	0.282 ± 0.16	0.000
DVAL	Alcohol	-0.054 ± 0.12	0.037 ± 0.13	0.149± 0.18	0.000
	Non-alcohol	0.056 ± 0.18	0.170 ± 0.20	0.300 ± 0.16	0.000
NVAR	Alcohol	0.130 ± 0.05	0.173 ± 0.06	0.230 ± 0.09	0.000
	Non-alcohol	0.197 ± 0.12	0.267 ± 0.09	0.340 ± 0.07	0.000
NVAL	Alcohol	0.145± 0.08	0.197 ± 0.07	0.247 ± 0.09	0.000
	Non-alcohol	0.163 ± 0.12	0.263 ± 0.009	0.343 ± 007	0.000
CSR	Alcohol	2.10 ± 0.20	1.95 ± 0.20	1.82 ± 0.22	0.000
	Non-alcohol	2.13 ± 0.13	1.94 ± 0.17	1.73 ± 0.15	0.000
CSL	Alcohol	2.11 ± 0.17	1.95 ± 0.20	1.82 ± 0.21	0.000
	Non-alcohol	2.12 ± 0.11	1.91 ± 0.16	1.70 ± 0.19	0.000

Following alcohol ingestion as shown in Table 4, DVAR significantly deteriorated (-0.035 ± 0.15 to 0.117± 0.18) at post-consumption intervals (F= 27.98; *p* = 0.000). DVAR at baseline differed significantly from DVAR at 60 minutes (t= -3.59; *p* =0.001) whereas no significant differences were observed between DVAR at baseline and DVAR at 30minutes (t=-2.17; *p* = 0.034) and between DVAR at 30minutes and DVAR at 60 minutes (t=-1.49; *p* = 0.142).

There was also a significant reduction in DVAL (-0.054 ± 0.12 to 0.149 ± 0.18) at post-consumption intervals ($F = 54.89$; $p = 0.000$) in the alcohol group. DVAL at baseline differed significantly from DVAL at 30 minutes ($t = -2.79$; $p=0.007$). Statistically significant differences were also observed between DVAL at baseline and DVAL at 60 minutes ($t = -5.28$; $p = 0.000$) and between DVAL at 30 minutes and DVAL at 60 minutes ($t = -2.77$, $p = 0.001$).

The alcohol group demonstrated significant reduction in NVAR (0.130 ± 0.05 to 0.230 ± 0.09) at both post-consumption intervals ($F=20.90$; $p = 0.000$). NVAR at baseline differed significantly from NVAR at 30 minutes ($t=-2.71$; $p=0.009$). Statistical significant differences were also observed between NVAR at baseline and NVAR at 60 minutes ($t = -4.88$; $p = 0.000$) and between NVAR at 30 minutes and NVAR at 60 minutes ($t=-2.71$; $p = 0.009$).

There was significant reduction in NVAL (0.145± 0.08 to 0.247 ± 0.09) at both post-consumption intervals in the alcohol group ($F=22.89$; $p = 0.000$). NVAL at baseline differed significantly from NVAL at 30 minutes ($t = -2.59$; $p = 0.012$) and NVAL at 60minutes ($t = -4.73$; $p=0.000$). No statistical significant difference was observed between NVAL at 30 minutes and NVAL at 60 minutes ($t = -2.44$; $p = 0.018$). Contrast sensitivity also showed a significant downward trend from baseline to 60 minutes in the right eyes ($F = 33.21$; $p = 0.000$) and left eyes ($F = 30.94$; $p = 0.000$) in the alcoholic group. CS at 30 minutes differed significantly from CS at 60 minutes in both the right eyes ($t=4.02$; $p = 0.000$) and the left eyes ($t=5.35$; $p = 0.000$).

DISCUSSION

This study set out to evaluate the acute effects of moderate alcohol consumption on distance visual acuity, near visual acuity, and contrast sensitivity in healthy young adults. The findings demonstrate that alcohol intake leads to significant within-group deterioration in both distance and near visual acuity over time, while contrast sensitivity showed a consistent downward trend that became significant within the alcohol group but not when compared directly with controls.

Within the alcohol group, distance visual acuity deteriorated significantly following alcohol ingestion, particularly at 60 minutes post-consumption. Repeated-measures analysis confirmed significant time-dependent reductions in both right and left eyes, with the most pronounced decline observed between baseline and 60 minutes. These findings are consistent with Danborno et al. (2020) who reported significantly worse distance visual acuity among alcohol-consuming drivers compared with sober controls in a Nigerian population. In addition, another study reported that moderate alcohol intake significantly reduces visual acuity and degrades driving-related visual performance (Martino et al., 2021).

The absence of consistent bassline equivalence between groups, particularly for the left eye, suggests that between-group comparisons should be interpreted cautiously. However, the strong within-group deterioration following alcohol intake supports a causal effect of alcohol on distance vision. Physiologically, this reduction may be attributed to alcohol-induced pupil dilation, increased higher-order aberrations, and impaired retinal and cortical processing, all of which reduce retinal image quality and visual resolution (Martino et al., 2021). In contrast, Nkeremuzor et al. (2025), reported no significant change in distance visual acuity after consumption of Orijin beer, which may reflect differences in alcohol concentration, dosage, timing of assessment, or testing protocols.

Near visual acuity also showed a significant decline following alcohol ingestion, with repeated-measures analysis revealing progressive worsening from baseline to 60 minutes in both eyes. This is in accordance with previous studies that have reported interruption of accommodative and vergence mechanisms following alcohol consumption. Casares-López et al. (2021) demonstrated that moderate alcohol consumption significantly alters accommodative dynamics, including reduced response speed and accuracy, particularly under higher accommodative demands. In addition, Munsamy et al. (2016) stated that alcohol consumption can induce changes in binocular fusion and heterophoria, resulting in impairment of near vision and visual comfort when performing near tasks activities.

The deterioration in near visual acuity observed in this study likely reflects alcohol's depressant effects on the ciliary muscle and neural control of accommodation and convergence. Clinically, this suggests that individuals who consume alcohol may experience difficulty performing near-vision tasks such as reading, using digital devices, or engaging in precision work, even when distance vision appears relatively preserved.

Contrast sensitivity demonstrated a significant downward trend within the alcohol group across post-consumption time points, although between-group differences did not reach statistical significance. Repeated-measures analysis showed that contrast sensitivity continued to decline from 30 to 60 minutes post-consumption, indicating a time-dependent effect of alcohol on contrast perception. This pattern is consistent with prior studies reporting alcohol-related reductions in contrast sensitivity across multiple spatial frequencies. Casares-López et al. (2020) observed significant deterioration in contrast sensitivity and increased retinal straylight after alcohol intake, with implications for night driving performance. Zhang et al. (2022) further demonstrated that alcohol increases internal neural noise and degrades visual signal processing, leading to reduced contrast perception.

Earlier work by Cavalcanti-Galdino et al. (2014) also reported frequency-specific losses in contrast sensitivity following acute alcohol intake, whereas Pearson and Timney (1999) found that alcohol selectively affects high-frequency contrast discrimination without altering contrast gain mechanisms. The lack of statistically significant between-group differences in the present study may be related to the use of the Pelli–Robson chart, which primarily assesses low spatial frequencies and may not detect more subtle or frequency-dependent deficits. Nevertheless, even modest reductions in contrast sensitivity are functionally important, particularly under low-illumination or glare conditions, and have been linked to impaired driving performance and increased accident risk (Casares-López et al., 2020; Martino et al., 2023).

Overall, the findings demonstrate that moderate alcohol consumption produces measurable impairments in core visual functions, particularly distance and near visual acuity, within the first hour of ingestion. These results are consistent with growing evidence that alcohol affects not only cognitive and motor performance but also fundamental visual processes essential for safe task execution (Casares-López et al., 2020; Zhang et al., 2022). Importantly, individuals often underestimate their level of impairment following alcohol intake (Köchling et al., 2021), which may lead to engagement in visually demanding activities despite degraded visual performance.

Limitations of the study

There were several limitations in this study. Firstly, the sample consisted of young, healthy university students, limiting generalizability to older populations or individuals with ocular or systemic conditions. Secondly, contrast sensitivity assessment was limited to a single chart and did not evaluate spatial-frequency-specific changes. Furthermore, differences in alcohol metabolism among the young individuals may have affected the results even though standardized dosage was administered. Despite these limitations, the consistent within-group deterioration observed support the validity of the study findings.

CONCLUSION

In this study, there was a significant reduction of distance and near visual acuity after acute consumption of alcohol. In addition, there was a progressive decrease in contrast sensitivity. These visual changes, even when subtle, may compromise performance in activities requiring visual precision, particularly driving. Clinical counselors and public health educators emphasize on the need for caution following acute alcohol consumption as this can affect vision which can lead to difficulty in performing certain visual tasks.

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