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EFFECT OF ALCOHOL ON AMPLITUDE OF ACCOMMODATION (AA) OF UNDERGRADUATE STUDENTS OF MADONNA UNIVERSITY, ELELE CAMPUS, RIVERS STATE NIGERIA

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ABSTRACT
Alcohol is a known central nervous system (CNS) depressant, having properties in common with general anesthetic agents, appearing to depress the midbrain reticular activating system. This experimental study ascertained the effect of alcohol (Brandy) on amplitude of accommodation (AA) of undergraduate students of Madonna University, Elele, Rivers state, Nigeria. A total of 53 young adults between the ages of 18 – 29 years with a mean age of 22.13 ± 2.49 years were involved in this study out of which 30 (56.60%) were males with mean age of 22.27 ± 2.92 years and 23 (43.40%) were females with mean age of 21.96 ± 1.82 years. The AA was measured before the ingestion of 40ml of alcoholic beverage after which same measurement was repeated three times consecutively after 15, 30 and 45 minutes respectively. Data collected were analyzed using statistical package for social science (SPSS version 25). The Friedman's test was used to test for significance on the effect of alcohol on AA across the various periods of measurements. Gender influence on the effect of alcohol on AA was analyzed using Kruskal-Wallis test. Statistical significance was considered at p-value ≤ 0.05 (level of significance). The findings showed a slight reduction in mean AA after 15mins (10.81± 2.19), 30minutes (9.51 ± 2.18) and 45 minutes (8.74 ± 2.27) when compared to the mean baseline (12.60± 2.51) for the right eye (OD). There was also a slight reduction of mean AA after 15minutes (10.75± 1.76), 30minutes (9.66 ± 1.76) and 45 minutes (8.91 ± 1.99), when compared to the mean baseline (12.49± 2.13) for the left eye (OS). There was no statistically significant association between gender and the effect of alcohol on AA. The study concluded that concentrated alcoholic beverages are capable of causing a slight decrease in AA lasting over 45 minutes and recommended that alcohol intake should be avoided at least 60 minutes prior to engaging in visually tasking activities especially among individuals with accommodative or convergence anomalies.

Key words: Alcohol, accommodation, convergence, visual task.

INTRODUCTION
Alcoholic beverages have been used in human societies since the beginning of recorded history. The patterns of alcohol intake around the world are constantly evolving as alcohol is ubiquitous today (Das, *et al.*, 2008). Alcoholism has become a perennial and pervasive problem gradually among people because Ethanol which is the major component is a small molecule soluble in both water and lipids and can permeates all tissues of the body and

affects vital functions. Alcohol related medical disorders basically affects almost all organs of the body (Das,*et al.*, 2009). According to Nic, *et al*, (2009) its effect on the CNS is either inhibitory or excitatory, hence it depresses behavioral centers and increases self-confidence; slows down sense processing activities resulting in blurred vision, poor smell, touch and impaired thought process.

The amplitude of accommodation (AA) is the maximum amount of accommodation or focusing ability one can exert in response to a near target (Elliot, 2008). The amplitude of accommodation is greatest in childhood and gradually reduces with age, resulting in most persons after the age of 40 years (presbyopic age) to have difficulty with near visual tasks like reading fine (small) prints or threading a needle. It is routinely measured in the clinics with the aid of a Royal air force (RAF) rule.

Duane-hoffsetter derived a formula for probable amplitude of accommodation.
Maximum amplitude = 25.0 – 0.40 x age
Average amplitude = 18.5 – 0.30 x age
Minimum amplitude = 15.0 – 0.25 x age

Amplitude of accommodation can be measured in the clinic using two methods: The push-up/push-down test is the easiest and quick to perform. The near target is moved towards the patient's eyes until it becomes blur (the push-up amplitude) and then moved away from the eyes until it becomes clear (push-down amplitude). An average of these two threshold values provides an indication of the amplitude of accommodation. (Elliot, 2008). A combination of push-up and push-down measurements is preferred as it provides a useful compromise between the slight over estimate of the push-up technique and slight under estimate of the push-down technique (Rosenfied, 2011).

According to Henry *et al.* (2009), accommodative convergence is the simultaneous inward movement of both eyes toward each other, usually in an effort to maintain single binocular vision when viewing an object. The Near Point of Convergence (NPC) is a basic visual measure performed by eye care practitioners in Nigeria (Uzodike and Ndukwe, 2010). Accommodative Convergence is one of three processes an eye does to properly focus an image on the retina. In each eye, the visual axis will point towards the object of interest in order to focus it on the fovea (Saladin and Kenneth, 2012).

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Uloneme *et al.*, (2014), observed that large volume of fresh palm wine(Elaeis guinensis) causes a reduction of the accommodative amplitude of healthy adults (18 – 30 years) by 10.7% after 30minutes, 6.0% after 40 minutes and < 1% after 60 minutes and concluded that the effect of the fresh palm wine on AA was significantly associated with the dose consumed. Similarly, Megwas *et al.*,(2012) conducted a study and observed that 60cl of a certain alcoholic beverage containing 51% alcohol and fresh palm wine (5-6% alcohol) causes a comparative variation in amplitude of accommodation (AA), negative relative accommodation (NRA) and positive relative accommodation (PRA) by as much as 13.5%, 16.7% and 21.3% after 15minute of ingestion of both alcoholic beverages after two days interval. In a research carried out by Jantti *et al.*, (2009), to check the effects of intravenous alcohol on saccadic eye movement, they observed an increase in the duration of saccades during the period of intoxication. The latency of saccades also increased, but there was however, a slight decrease in latency due to alcohol, 15minutes after the start of infusion, suggesting a biphasic effect of alcohol on saccade latency.

METHODS

This was an experimental study which took place between June –July 2018 in the Madonna University, Elele Campus, Ikwerre Local Government Area of Rivers State Nigeria. Madonna University is one of the pioneer private universities in Nigeria attracting students from all parts of Nigeria as well as some West African countries. Elele campus is one of the three campuses of the university, the other two are Okija and Akpugo campus located in Anambra and Enugu state respectively in South Eastern Nigeria. The Elele campus play host to the health science based faculties/ colleges among which include Medicine, Health Sciences, Basic Medical Sciences, Natural Sciences, Physical Sciences and Pharmaceutical sciences.

Ethical consent was obtained from the Research and Ethics committee of the Department of Optometry, Madonna University, Elele Campus, and the institution's Centre for Research. Consent forms were obtained from all participants after clear explanation of the study and the purpose for which the research was to be conducted had been made clear to them before data collection. Confidentiality of participant's data was also guaranteed.

This experimental study ascertained the effect of alcoholic beverage (Cognac Brandy containing 40% ABV) intake on amplitude of accommodation (AA) of

young adults. All subjects who consented to be a part of the study were assigned study numbers and included in the balloting pool. A total of 61 (sixty one) subjects were randomly picked from the voluntary participants and screened based on the inclusion/exclusion criteria. After sampling a total of 53 subjects comprising of 30 males and 23 females were involved in the study.

Detailed case history of the final study participants was taken, visual acuity (VA) was measured using the Snellen distance visual acuity (VA) chart. External/internal eye examinations were also conducted to ascertain the ocular integrity with the aid of the pen torch and ophthalmoscope respectively. Baseline (0 minute) measurement of AA was done before commencement after which each subject was made to ingest 40ml of brandy (containing 40% alcohol), The AA measurement was repeated after 15, 30 and 45 minutes of alcohol ingestion .

Data collected were entered into Microsoft excel spread sheet (2016 version) for inspection of variables and then exported to statistical package for social sciences (SPSS version 25). The Kolmogorov-Smirnov test for normality was used to evaluate the data sets and the Friedman's test was used to test for significance of the effect of alcohol consumption on AA across the various periods of measurements. Gender and age influence on the effect of alcohol on AA was analyzed using Kruskal-Wallis test. Statistical significance was considered at an alpha level of $p \leq 0.05$.

RESULTS

The study involved a total of 53 participants whose ages range from 18 – 29 years with a mean age of 22.13 ±2.49. Out of the 53 participants, 30 (56.60%) were males and 23 (43.40%) were females, with ages of 22.27 ±2.92 and 21.96 ± 1.82 years respectively.

Table 1: Gender Profile of Participants.

Gender	Number/percentages (%)	Age (years)		
		Range	Mean	Std. Deviation
Male	30(56.6%)	18 – 28	22.27	2.924
Female	23(43.4%)	19 – 27	21.96	1.821
Total	53(100.0%)	18 – 28	22.13	2.489

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Table 2: Distribution of participants in relation to age groups.

Age group	Number/percentages (%)	Age (years)		
		Range	Mean	Std. Deviation
18 – 21	20 (37.7%)	18 – 21	19.60	1.142
22 – 25	27 (50.9%)	22 – 25	23.00	.920
26 – 29	6(11.3%)	26 – 28	26.67	.816
Total	53 (100.0%)	18 – 28	22.13	2.489

Table 2 shows that age group 22-25 years constituted the majority with 27(50.9%) participants while the 26- 29 years group constituted the least with 6(11.3%) participants.

Table 3: Range/Mean/Standard deviation of amplitude of accommodation (AA) for the right eye (OD) and left eye (OS) at different intervals after alcohol ingestion.

Amplitude of Accommodation	AA (OD)			AA (OS)		
	Range	Mean	SD	Range	Mean	SD
Before Alcohol ingestion	8 – 18	12.60	2.51	9 – 17	12.49	2.13
After 15 minutes	7 – 15	10.81	2.19	7 – 15	10.75	1.76
After 30 minutes	6 – 15	9.51	2.18	6 – 14	9.66	1.79
After 45 minutes	6 – 15	8.74	2.27	6 – 14	8.91	1.99

Effect of Alcohol on Mean AA of the Right Eye (OD)

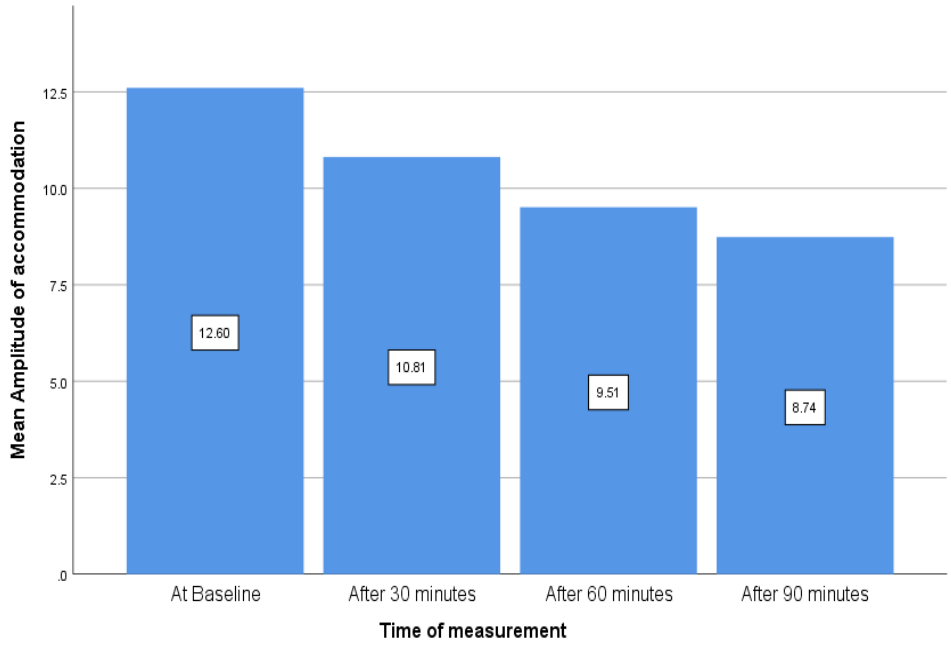

Figure 1: Comparison [illegible] Mean AA at different periods of measurement.

Figure 1 above shows a recession in the mean amplitude of accommodation of the right eye at various periods of alcohol ingestion when compared to the baseline mean amplitude of accommodation. The mean AA at baseline reduced after 15minutes and further declined after 30 and 45 minutes respectively.
The Friedman's test indicated that there were statistically significant differences in the baseline mean AA and the AA at various intervals of measurement (15, 30 and 45 minutes) after alcohol ingestion, X^2 (3) = 102.104, p < 0.001, as shown in Table 4. Thus, the null hypothesis (: There is no significant difference in Amplitude of accommodation of young adults before and after ingestion of alcohol) was rejected.

Table 4: Mean Ranks and Test statistics of Friedman's test for the Right eyes.

Mean Rank of Amplitude of Accommodation				N	Chi-square (X^2)	Degree of freedom (df)	Exact Sig. (2-tailed)
Before Alcohol intake	After 15 minutes	After 30 minutes	After 45minutes				
3.60	2.88	2.05	1.47	53	102.104	3	0.000*

* Statistical significance is considered at a level of 0.05

A Post hoc test with Wilcoxon signed-rank tests was conducted with a Bonferroni adjustment for multiple comparisons applied. For the right eyes, results of this analysis indicated that mean AA before alcohol intake (M=12.60) was significantly higher than the mean AA after 15 minutes of alcohol intake (M=10.81), (z = -5.820, p<0.001), mean AA after 30 minutes (M=9.51), (z = -5.852, p<0.001), and the mean AA after 45 minutes after alcohol intake (M=8.74), (z = -5.802, p<0.001), as shown in Table 5.

Table 5: Comparison of the Right Eye baseline Mean AA and AA at different intervals after alcohol ingestion

	N	Mean amplitude of accommodation		
		After 15 minutes	After 30 minutes	After 45 minutes
Mean ± SD	53	10.81 ± 2.19	9.51±2.18	8.74±2.27
Before Alcohol ingestion	53	12.60 ± 2.51	12.60 ± 2.51	12.60 ± 2.51
P – value		0.000	0.000	0.000

* Significance level is considered at a level of p ≤ 0.05.

Effect of Alcohol on Mean Amplitude of Accommodation of the Left Eye (OS)

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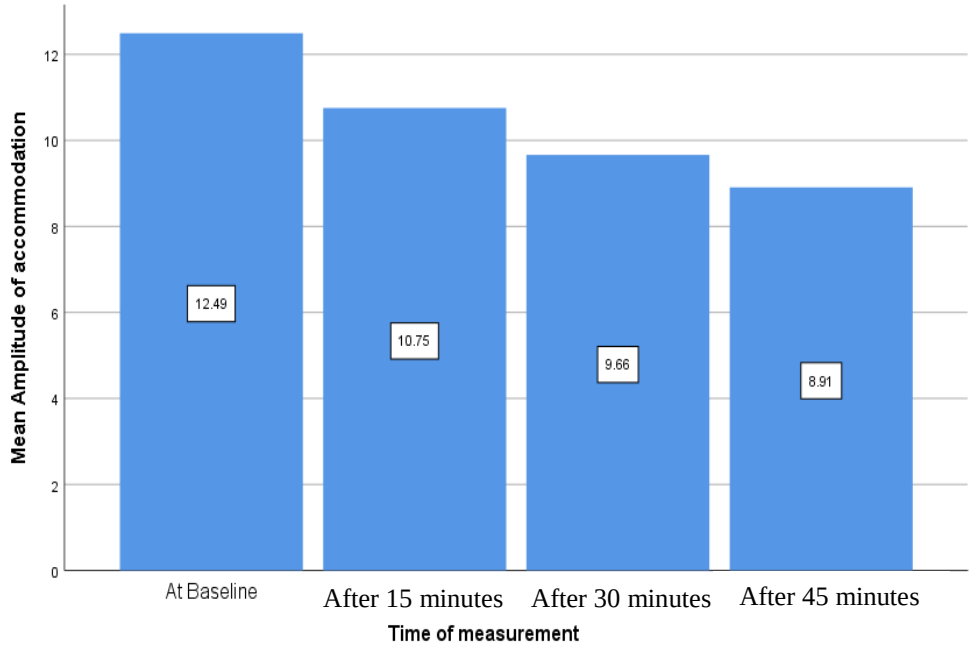

Figure 2: Comparison of the Left Eye baseline mean AA and AA at different intervals after alcohol ingestion

Figure 2 above shows a recession in the mean amplitude of accommodation of the left eye at different periods after alcohol ingestion when compared to the baseline mean AA. The mean AA at baseline reduced after 15minutes, it further reduced after 30 minutes and 45 minutes respectively.
The Friedman's test revealed that there were statistically significant differences in amplitude of accommodation before and after 30 minutes intervals of alcohol intake, X^2 (3) = 100.421, $p < 0.001$, with significance level considered at $p < 0.05$, as shown in Table 6.

Table 6: Mean Ranks and Test statistics of Friedman's test for the Left eyes.

Mean Rank of Amplitude of Accommodation				N	Chi-square (X^2)	Degree of freedom (df)	Exact Sig. (2-tailed)
Before Alcohol intake	After 15 minutes	After 30 minutes	After 45minutes				
3.60	2.86	2.08	1.45	53	100.421	3	0.000

*Statistical significance is considered at a level of 0.05

For the left eyes, results of the Wilcoxon signed ranks test analysis indicated that mean AA before alcohol intake (M=12.49) was significantly higher than the mean AA after 15 minutes of alcohol intake (M=10.75), (z = -5.801, p<0.001). Also, the mean AA before alcohol intake (M=12.49) was significantly higher than the mean AA after 30 minutes (M=9.66), (z = -5.738,

p<0.001) and the mean AA after 45 minutes of alcohol intake (M=8.91), (z = -5.812, p<0.001), Exact Sig. (1-tailed). Table 7 shows a Comparison between baselines mean AA of the left eye and after 30 minutes intervals of alcohol ingestion.

Table 7: Comparison of the Left Eye baseline mean AA and AA at different intervals after alcohol ingestion

	N	Mean amplitude of accommodation		
		After 15 minutes	After 30 minutes	After 45 minutes
Mean ± SD	53	10.75±1.76	9.66±1.79	8.91±1.99
Before Alcohol ingestion	53	12.49±2.13	12.49±2.13	12.49±2.13
P – value		0.000	0.000	0.000

* Significance level is considered at a level of p ≤ 0.05.

GENDER INFLUENCE ON THE EFFECT OF ALCOHOL ON AMPLITUDE OF ACCOMMODATION

A Kruskal-Wallis test was conducted to determine whether there exist statistical significant differences in AA before and after alcohol ingestion with reference to gender (male vs female). The result from this analysis indicated that there is no statistically significant difference in gender variations of AA measured before and at different intervals (15, 30 and 45 minutes) after alcohol ingestion, p > 0.05.

At baseline, the mean AA for males (M = 12.17 ± 2.71) was not significantly different from the mean AA for females (M = 12.60 ± 2.51), p = 0.215. After 15 minutes of alcohol ingestion, the mean AA for males (M = 10.60 ± 1.78) was not significantly different from the mean AA for females (M = 10.81 ± 2.19), p = 0.419. After 30 minutes of AA ingestion, the mean AA for males (M = 9.47 ± 1.73) was not significantly different from the mean AA for females (M = 9.51 ± 2.18), p = 0.714. After 45 minutes of alcohol ingestion, the mean AA for males (M = 8.61 ± 2.06) was not significantly different from the mean AA for females (M = 8.74 ± 2.271), p = 0.917. It can thus be inferred that there were similar AA values before alcohol ingestion for both males and females. Also, there were no significant differences occurring in the changes in mean AA after different intervals of alcohol ingestion. In other words the mean AA decreased similarly for both males and females as shown in Table 8. Thus, the null hypothesis was accepted.

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Table 8: Mean AA of the right eye before and after ingestion of alcohol by gender.

AA	Male	Female	P
At Baseline	12.17 ± 2.71	12.60 ± 2.51	0.215
After 15 minutes	10.60 ± 1.78	10.81 ± 2.19	0.419
After 30 minutes	9.47 ± 1.73	9.51 ± 2.18	0.714
After 45 minutes	8.61 ± 2.06	8.74 ± 2.271	0.917

*Significance level is considered at a level of $p \leq 0.05$.

DISCUSSION

This study determined the effect of alcoholic beverage (Brandy) on amplitude of accommodation (A.A) and also ascertained whether gender influences the effect of alcohol on amplitude of accommodation. Accommodation involves the ciliary muscles of the eyes, which consists of smooth muscle fibers whose actions regulates the eye's focusing ability (accommodation) in order to capture targets at different distances with relative clarity without the need to move towards or away from the fixation point. The study involved a total of 53 participants comprising of 30 males and 23 females whose ages range from 18 – 29 years with a mean age of 22.13 (SD = ± 2.49). This demographic profile (See table 1 and 2) is similar to a study carried out by Azuamah *et al.* (2014), who conducted a study comprising of 50 participants (22 males and 28 females) whose ages ranged from 18 - 29 years with a mean age of 22.9 (± 2.23).

The study observed that the mean baseline amplitude of accommodation (AA) declined slightly at the different intervals (15, 30 and 45 minutes) after ingestion of 40ml of alcohol (Brandy). The results were statistically significant when tested with the Friedman's test using SPSS version 25.

For the right eyes, the mean baseline AA (M=12.60) was significantly higher than the mean AA after 15 minutes of alcohol intake (M=10.81), this was found to be significantly higher than the mean AA after 30 minutes of alcohol intake (M=9.51), which was also higher than the mean AA after 45 minutes of alcohol intake. (See table 3)

For the left eyes, the mean baseline AA (M=12.49) was significantly higher than the mean AA after 15 minutes of alcohol intake (M=10.75), this was significantly higher than the mean AA after 30 minutes of alcohol intake (M=9.66), which was also significantly higher than the mean AA after 45 minutes of alcohol intake (M=8.91). (See table 3)

The study findings revealed that, alcohol had similar effect on both eyes of the participants as the mean baseline AA declined slightly for both eyes when compared to the values at 15, 30 and 45 minutes after the ingestion of alcoholic beverage. Similar studies by Odjimogho, & George, (2009), Megwas *et al.,* (2012), Uloneme *et al.,* (2014), also supports this claim that there is a decline in mean AA following alcohol ingestion. However, this was not in conformity with a study by Hogan & Linfield, (1983) which reported that alcohol didn't have any significant effect on the amplitude of accommodation. The difference in results could have been as a result of difference in the percentage concentration of alcohol in the alcoholic beverage administered to participants or the difference in methodology used. The study also observed that the AA continue to decrease despite a probable reduction in the level of intoxication for both genders and that there is no significant difference in the effect of alcohol on mean Amplitude of accommodation of young male and female adults.

Alcohol readily crosses the blood barrier to interfere temporarily with the communication signals of the nerve cells in the brain. This is because it acts as an antimuscarinic agent thus blocking the release of neurotransmitter (Acetylcholine) at the cholinergic receptor that innervates the cholinergic receptor that innervates the ciliary muscle, medial rectus and sphincter, thereby inhibiting accommodation, convergence and pupil constriction (Megwas *et al.,* 2012). This action results in the relaxation of the ciliary muscles and consequent decrease in accommodation with resultant effect on other visual functions such as accommodative convergence, binocularity, depth perception (stereo-acuity), visual acuity, hand – eye coordination, among others.

CONCLUSION/RECOMMENDATIONS

This study ascertained the effect of alcohol (brandy) on the amplitude of accommodation (AA) of young adults and observed that the mean baseline AA for both the right and left eye declined slightly when compared to the various periods of 15, 30 and 45 minutes after ingestion of 40ml of an alcoholic beverage containing 40% alcohol. The study also observed that there is no significant difference on the effect of alcohol on the A of both male and female. This effect of alcohol on AA will ultimately affect visual functions and coordination which makes it nearly impossible to conduct high demand visual activities (such as driving, heavy duty machine operation among others) efficiently and effectively without an accident occurring.

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In line with this study on the effect of alcohol on amplitude of accommodation among young adults (18-29 years), the following recommendations were made:

i. Public awareness should be created especially among drivers and machine operators on the effect of consumption of alcoholic beverages on the visual system...
ii. People should be advised not to engage in any accident prone visual task such driving, operating a factory machine until the effect of alcohol wears off completely
iii. Further studies in this area concerning the effect of alcohol on these visual parameters as well as other visual functions should be conducted using a large and more widespread population.
iv. Sale and consumption of alcoholic beverages should be banned in motor parks and factory premises and individuals with accommodative or convergence anomalies that engages in visually tasking activities should be advised to stay clear of alcoholic beverages during the work period.

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CONFLICT OF INTEREST.

The researchers hereby declare that there is no conflict of interest in the study and its reported findings

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