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Using Coconut Water to Control Addiction in Nigeria

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Abstract: Introduction: Relapse from nicotine and other addictive substances prevented people from quitting and contributed to mental-health problems, academic decline, and increased risk-taking. Objective: To determine whether coconut juice could help individuals addicted to drugs or alcohol quit successfully. Methods: This was a quasi-experimental study because it was a clinical trial: a control group (I) and one treatment group II. Group II received coconut water, and Group I did not receive treatment; Group I served as a comparison group. Participants used journals to record treatments received and amounts of addictive substances consumed. Only individuals willing to quit were included to reduce attrition. Data were analyzed with Microsoft Excel and SPSS. ANOVA assessed within- and between-group differences; MANOVA and Tukey HSD tested significance; and bivariate regression examined relationships and causal direction. Participants received 30 ml of coconut water 3 times daily (30 ml x 3/daily), and control group, 200 ml x 3/daily. Results: With a 5% error margin and 95% CI, p-value was set at .05. So, values ≥ .05 H0 to be accepted meaning no relationship, and values ≤ .05 H0 to be rejected. Results showed that p-values were far less than .0001 < .05; thus, H_0 was rejected and H_a accepted because there was a very strong relationship. Conclusion: Coconut-water treatment showed a very strong statistical and practical significant difference and a meaningful relationship with addiction control.

Keywords: Using coconut water to control addiction, addiction control, coconut water and nicotine treatment, coconut water and drug addiction management, coconut water and alcohol addiction control, experimental research, addictive component of drug, common drugs persons are addicted to

1. Introduction

Nicotine, the primary psychoactive substance in tobacco, is highly addictive, and tobacco use is prevalent among children, adolescents, and adults (Anggadiredja et al., 2011; Ebisike et al., 2004; Hanafi, 2025; Mohamud, 2021; Nwokorie, 2024a; Jibrin et al., 2023; Ezekwem & Aina, 2021; Salihu & Khalied, 2015; Abdulmudallib et al., 2024; Adu & Oluwatusin, 2024; Ndu et al., 2024; Nwokorie, 2024b; Olatuyi & Abulude, 2021; Bouchard et al., 2022; CDC, 2023; Health Canada, 2021). The addictive substance in alcohol is ethanol, and that of Indian hemp, marijuana, and cannabis is tetrahydrocannabinol (THC). This experimental study examined whether consumption of coconut juice could support individuals with tobacco-, drug-, or alcohol-related addictions in preventing

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relapse and achieving successful cessation, thereby reducing the social, clinical, and economic burdens of addiction and mental health challenges at both local and global levels. Current cessation treatments have demonstrated limited effectiveness and long-term unsustainability (Ahajumobi, 2025; UNODC, 2025; Vanguard, 2025; WHO, 2024; NIDA, 2023).

Participants were recruited on a voluntary basis for this clinical experiment. The 14-day intervention employed questionnaires and daily journals to collect data. Descriptive statistics were determined, and Null (H_0) and alternative (H_a) hypotheses were tested using analysis of variance (ANOVA), MANOVA and MANCOVA with mean squares and degrees of freedom calculated for between-group, within-group, and (Creswell, 2011). When required, totals were adjusted by subtracting any nonzero intercept. Statistical analyses were conducted using Microsoft Excel and SPSS, with the level of significance set at $p = .05$; values of $p \geq .05$ resulted in retention of H_0 (no association), whereas $p \leq .05$ led to acceptance of H_a (evidence of an association). The study was conducted at a 95% confidence level with a 5% margin of error (Creswell, 2011; Ahajumobi, 2025).

Given the presence of multiple independent variables, Tukey's HSD post hoc test was used to evaluate the significance of differences between groups. Additionally, Bonferroni pairwise t-tests compared outcomes on non-treatment days at baseline Day 0, representing 14 days without treatment and 14 days of actual treatment from Day 1 to Day 14, as well as follow-up points on Days 3, 7, and 14 to determine the extent of improvement. Effect sizes were determined through multivariate and univariate analyses to determine the magnitude of treatment effect. The findings indicated an association between optimal coconut water intake and improvements in addiction outcomes, including reductions in psychosocial, physical, and cognitive symptoms.

1.1. Background

Coconut, a tropical plant known botanically as Cocos nucifera of the Arecaceae family, was shown in multiple studies to have significant nutritional and pharmaceutical value (Bahgya et al., 2010; Alleyne et al., 2005; Ge et al., 2009; Zulaikhah et al., 2021; Rao & Najam, 2016; Burns et al., 2024). Research on coconut water found that it contained diverse minerals, vitamins, electrolytes, and phytochemical compounds, giving it strong therapeutic potential, including benefits for cancer and high blood pressure. Coconut water was also identified as an effective antidote (Bahgya et al., 2010; Elijah et al., 2010). Individuals addicted to smoking, drugs, and alcohol struggled to quit because these substances - especially nicotine - were highly addictive (DiFranza et al., 2007). Since many attempting to quit experienced relapse (DiFranza et al., 2007), researchers have obligations to explore ways to support sustainable recovery of individuals addicted to substances. In Nigeria, coconut water had long been used to counteract poison and adverse drug reactions. Therefore, this study aimed to determine quantitatively whether coconut water could help people addicted to substances and desiring to quit overcome dependence and do so sustainably (Ahajumobi, 2025).

[Figure 1: Image of Coconut and Coconut Water]

1.2. Statement of the Problem

Coconut, Cocos nucifera (Arecaceae), has well-documented nutritional and pharmaceutical properties (Alleyne et al., 2005; Ge et al., 2009; Zulaikhah et al., 2021; Rao & Najam, 2016; Burns et al., 2024). Coconut water contains minerals, vitamins, electrolytes, and phytochemical compounds, giving it therapeutic potential for conditions such as cancer, hypertension, and adverse drug reactions (Elijah et al., 2010; Ahajumobi, 2025). In Nigeria, coconut water has traditionally been used to counteract poisons and drug toxicity. Given the high relapse rates among individuals

addicted to nicotine, alcohol, and other substances (DiFranza et al., 2007), researchers have sought interventions to support sustainable recovery. This study investigates whether coconut water can assist individuals in overcoming substance dependence and quitting addiction permanently.

1.3. Addiction, Public Health, and Academic Outcomes

Substance use often begins in childhood, with drugs including alcohol, marijuana, cocaine, heroin, methamphetamines, opioids, stimulants, hallucinogens, and solvents (Wylie, 2005). Highly addictive substances such as nicotine, barbiturates, cocaine, alcohol, and heroin (Juergens, 2016) contribute to unemployment, criminal activity, reliance on social support, and engagement in high-risk behaviours (Wylie, 2005). Globally, addiction has severe health and social consequences: in Manitoba, 400 deaths occurred in 2023, with over 1,000 hospitalizations in early 2019 (Sobriety.ca Foundation, 2023; CBC News, 2023; Government of Manitoba, 2019); in the US, 22.7 million people are addicted to alcohol or drugs (Juergens, 2016); and worldwide, smoking kills one person every eight seconds (Bademosi & Chijioke, 2021). Addiction also increases risks for cancer, cardiovascular disease, stress, and depression (Anggadiredja et al., 2011; Carvajal et al., 2000; Bouchard et al., 2022; CDC, 2023; Health Canada, 2021). Substance use contributes to moral decline, school dropout, and poor academic performance in Canada, Nigeria, and the US (Abernathy et al., 1995; Bademosi & Chijioke, 2021; Hanafi, 2025; Mohamud, 2021; Nwokorie, 2024a; Jibrin et al., 2023; Ezekwem & Aina, 2021; Salihu & Khalied, 2015; Abdulmudallib et al., 2024; Adu & Oluwatusin, 2024; Ndu et al., 2024; Nwokorie, 2024b; Olatuyi & Abulude, 2021; Bouchard et al., 2022; CDC, 2023; Health Canada, 2021).

1.4. Mental Health, Stigma, and Policy Imperatives

Mental illness and discriminatory attitudes exacerbate the negative effects of addiction on student performance. In Nigeria, stigma discourages help-seeking, worsening absenteeism, poor concentration, and dropout rates (Hanafi, 2025). In Canada, students with mental health disorders report bullying and exclusion, correlating with higher anxiety, depression, and lower engagement (Bouchard et al., 2022). In the US, stigma leads to underreporting and untreated conditions, intensifying academic failure (CDC, 2023). Therefore, controlling addiction, addressing mental illness, and eliminating discrimination in schools must be a global priority. Governments and public health institutions should implement evidence-based prevention, early intervention, accessible counselling, education on substance risks, and anti-stigma initiatives to safeguard academic outcomes, promote psychosocial health, and ensure equity (Bademosi & Chijioke, 2021; Nwokorie, 2024b; Health Canada, 2009; Health Canada, 2025; Health Canada, 2024; CDC, 2023). Failure to act perpetuates cycles of disadvantage, poor health, and social inequality. Authors took this bold novel step to lead all stakeholders to intervention and save the world from the addiction and mental illness menace.

1.5. Purpose

The purpose of this research is to help individuals addicted to smoking, drugs, and alcohol to permanently overcome addictive substances whenever they desire to do so, with the aid of nutritious, affordable, and universally accessible coconut water.

1.6. Research Questions

Is there a relationship between coconut water consumption and overcoming addiction?

Is the treatment dose dependent?

Is there an optimum dose for treatment?

What is the effect on craving for the addicted substances?

Any effect on sleep?

Any effect on weakness?

Any effect on concentration?

Any effect on stress?

1.6.1 Statement of Hypotheses

Null Hypothesis: H_0 H_{01}: There is no relationship between consumption of coconut water and overcoming addiction, and it has no effect on neurotransmission, namely: 1. Craving for substances: smoke, drugs, cocaine, marijuana, Indian hemp, alcohol; 2. Concentration and focus; 3. Sleep; 4. Stress; 5. Sadness; 6. Weakness.

Alternate Hypothesis: H_a H_a: There is a relationship between consumption of coconut water and overcoming addiction, and it has an effect on neurotransmission, namely: 1. Craving for substances: smoke, drugs, cocaine, marijuana, Indian hemp, alcohol; 2. Concentration and focus; 3. Sleep; 4. Stress; 5. Sadness; 6. Weakness.

1.7. Design of the Study

This quantitative experimental study initially planned to use random sampling to assign participants to treatment and control groups but adopted a quasi-experimental design due to the small sample size and the clinical aim of establishing causality. The dependent variable was recovery from substance addiction, and the independent variable was coconut-juice consumption. There were control and treatment groups, treatment was manipulated, and the effect of treatment was established (Ahajumobi, 2025).

1.7.1 Definition of Terms

Smoking/smoke: Tobacco consumption.

Addiction: Chemical composition of tobacco, alcohol, and drugs that cause relapses, making it difficult for people to give up addiction permanently even when they are determined to quit.

Overcome: Able to get over or stop smoking.

Consumption: To take into the body by way of eating, drinking, smoking, inhaling, or injection.

Permanently: Forever stop smoking as desired.

Coconut water: The fluid, or water found inside the coconut when it is cracked open.

1.8. Theoretical Perspective

This study is grounded in traditional medicine theory, particularly frameworks derived from Traditional Chinese Medicine (TCM), which conceptualize health as a dynamic state of balance across multiple dimensions, including an individual's emotions, lifestyle, social relationships, and interaction with the natural environment (Bhattacherjee, 2012; Marques et al., 2021; He, 2019; Wang et al., 2019; Lu et al., 2004; Ross, 2023). Within this framework, the human body (microcosm) is

interconnected with larger cosmological, spiritual, and ecological systems (macrocosm), emphasizing the holistic nature of health and disease (Bhattacherjee, 2012; Marques et al., 2021). As such, this model is part of the necessary holistic components.

Traditional healing practices align with natural laws and include interventions that promote physical, mental, spiritual, and environmental balance. Such approaches recognize the therapeutic potential of natural substances, including medicinal plants, whose bioactive compounds contribute to disease prevention and health maintenance (Marques et al., 2021). These principles underpin the use of interventions like coconut water in this study, determining its role in supporting recovery from substance addiction (Bhattacherjee, 2012; Marques et al., 2021; He, 2019; Wang et al., 2019; Lu et al., 2004; Ross, 2023).

The study also draws on causal-process theory, which focuses on understanding how an independent variable produces change in a dependent variable (Bhattacherjee, 2012). Here, the independent variable is the administration of coconut water, and the dependent variable is recovery from nicotine, drug, and alcohol addiction. The research design incorporates a quasi-experimental approach with treatment and control groups, and pre- and post-testing to ensure rigorous and reliable measurement outcomes.

By integrating traditional medicine theory with modern causal and experimental research principles, this study bridges holistic health concepts with empirical inquiry, providing a comprehensive framework for investigating natural interventions in addiction recovery.

1.8.1 Literature Review

This review drew primarily from studies on coconut water and smoking conducted within the past ten years, supplemented by older but relevant evidence that supported the study's purpose.

Smoking caused about 45,000 deaths annually in Canada and imposed major economic burdens due to chronic disease (Diener, 2000; Ebisike et al., 2004). Smoking also affected youth academic performance (Fallus et al., 2011; Health Canada, 2025; Health Canada, 2021). Coconut juice significantly reduced systolic and diastolic blood pressure (Alleyne et al., 2005). Addiction to substances stemmed from ethanol, nicotine, tetrahydrocannabinol (THC), cocaine, morphine/diacetylmorphine, fentanyl/oxycodone, methamphetamine, and other addictive substances, from alcohol, tobacco/cigarette, and drugs namely, marijuana/cannabis/Indian hemp, cocaine, heroin/opium, and prescription painkillers, making quitting difficult even when the user decides and strongly desires to (DiFranza et al., 2007). Thanks to tobacco denormalization policies, smoking became socially unacceptable, but the challenge remained to help smokers quit sustainably (Ahajumobi, 2025). In Nigeria, the national prevalence is about 14.4% (14.3 million), affecting people aged 15-64 years, a population that is three times the global rate of 5.5%, with youth and young adults aged 15-35 years bearing the brunt of a higher prevalence of 65% of all cases, and men dominating with a male/female ratio of 3:1 (Ebirim et al., 2014; Iheanacho & Amadi, 2025; Obasi & Nwoke, 2024; Oladimeji, 2025; NDLEA, 2026; UNODC, 2025; Vanguard, 2025). In South Eastern Nigeria, Imo State showed the highest prevalence, with Owerri municipal recording the highest prevalence among high schoolers. High addiction in tertiary institutions, similar to Canada, negatively affects academic performance, causing poor concentration and memory loss. Addiction to other substances begins with cigarettes, and 89.8% consume cigarettes, with 33% of addictions falling under youth aged 20-25 years (Ebirim et al., 2014; Iheanacho & Amadi, 2025; Obasi & Nwoke, 2024; Oladimeji, 2025; NDLEA, 2026; UNODC, 2025; Vanguard, 2025).

1.8.2 Inventory of Addictive Substances

Here is a list of substances and addictive compounds in them and how the substances cause reactions in the user:

1. Nicotine causes addiction in cigarettes/tobacco by stimulating dopamine release and creating a quick dependence on the substance.

2. Ethanol causes addiction in alcohols, causing the depression of the central nervous system and pathways reinforcement.

3. Tetrahydrocannabinol is the addictive compound in Indian hemp/cannabis/marijuana; it triggers the cannabinoid receptors to produce psychoactive effects.

4. Heroin/Opium: the addictive substance is morphine and diacetylmorphine; it causes a feeling of euphoria and produces strong opioid receptor activation.

5. Methamphetamine is the substance causing addiction in methamphetamines; it produces massive dopamine and norepinephrine release (NDLEA, 2026; UNODC, 2025; Vanguard, 2025; WHO, 2024; NIDA, 2023).

6. Cocaine is the addictive substance in cocaine; its function is to block dopamine reuptake to create intense reward signals.

7. Oxycodone and fentanyl are the addictive components of painkillers, and they do so by binding opioid receptors, creating severe dependence.

8. Caffeine is the addictive substance in coffee and energy drinks; its function is to increase alertness by blocking the adenosine receptors (NDLEA, 2026; UNODC, 2025; Vanguard, 2025; WHO, 2024; NIDA, 2023).

9. Theobromine and small quantities of caffeine in chocolate create stimulation and small mood elevations.

10. Toluene, a component of inhalants, causes addiction by creating rapid brain chemistry changes (NDLEA, 2026; UNODC, 2025; Vanguard, 2025; WHO, 2024; NIDA, 2023).

1.8.3 Chemical Composition of Coconut Water

Coconut juice contained key electrolytes (sodium, potassium, calcium, magnesium, manganese) and cytokines with anticancer properties (Boolmer et al., 2012; Ge et al., 2009). Young coconut juice is sterile and rich in sugars, vitamins, minerals, amino acids, enzymes, and phytohormones, which support hydration and treat diarrhea. Cytokines such as kinetin and trans-zeatin have anti-aging, anti-thrombotic, and anticancer effects. Coconut juice also contains bioactive enzymes aiding metabolism and digestion, and higher levels of iron, calcium, magnesium, manganese, and zinc than oranges (Boolmer et al., 2012; Ge et al., 2009). It is also rich in B-complex vitamins and antioxidants such as vitamin C, and 100 ml provided 250 mg potassium and 105 mg sodium. Coconut water neutralized the hematological effects of high-dose paracetamol (Elijah et al., 2010).

1.8.4 Clinical Studies on Coconut

Animal studies showed that pure virgin coconut oil reduced nicotine addiction and relapses, likely due to its fat content and arachidonic-acid pathway (Anggadiredja et al., 2011). Coconut water also reduced nicotine-induced reproductive dysfunction in male animals, attributed to L-arginine, ascorbic acid, magnesium, and calcium (Gopalakrishnan et al., 2014).

Addiction is associated with depression (Capitman & Goodman, 2000); animal model clinical studies suggested that consumption of coconut water significantly lowered depression and hypertension. Addiction also causes low self-esteem (Abernathy et al., 1995; Ahajumobi, 2017a; Ahajumobi, 2017b; Ahajumobi, 2018; Ahajumobi et al., 2021; Ahmed et al., 2009; Alleyne et al.,

2005; Ahajumobi, 2025). Nigeria and Manitoba are among many countries and provinces that lack the capacity to treat addiction sustainably (Ahajumobi et al., 2022; Sobriety.ca Foundation, 2023; CBC News, 2023; Government of Manitoba, 2019; Carvajal et al., 2000).

Despite strong animal evidence, the search results indicated that coconut water has never been clinically evaluated for addiction control prior to 2024, and no human studies have examined coconut water strictly for addiction management in Canada or Nigeria. Given its rich nutritional and therapeutic value, the objective of this novel study was to test coconut water with human participants seeking to sustainably quit tobacco, alcohol, or drug addiction of any kind (Alleyne et al., 2005; Anggadiredja et al., 2011; Elijah et al., 2010; Ge et al., 2009; Gopalakrishnan et al., 2014; Ahajumobi, 2025).

2. Materials

Coconut, coconut water, graduated cups, portable water, kitchen large knives, coffee sifter, refrigerator, recording journals, pen, and participants addicted to substances.

2.1. Methods

This quantitative study was initially designed to employ systematic random sampling with separate control and treatment groups; however, financial constraints and a limited sample size made this approach infeasible. Sample size n = 20 participants: 10 in the treatment group and 10 in the control group. Consequently, due to the small sample size, generalizability is limited.

The final design consisted of two groups: Group I (control) and Group II (treatment). Participants recorded treatment intake and addictive-substance consumption in daily journals. To reduce attrition, only individuals willing to quit were included, and recruitment was conducted on a voluntary basis. Data were collected over a 14-day intervention using questionnaires and daily self-reports (Creswell, 2011).

Statistical analyses were conducted using Microsoft Excel and SPSS software. Null (H_0) and alternative (H_a) hypotheses were tested using multivariate analysis of variance (MANOVA). Descriptive statistics were performed to determine pretest baseline and post-test symptom severity and change. Statistical significance was set at $p = .05$ (95% confidence level, 5% margin of error), with $p \geq .05$ indicating retention of H_0 and $p \leq .05$ indicating support for H_a. Next, baseline equivalence pre-test was conducted to determine the mean difference and p-values among the groups prior to intervention, and a comparison test was performed to determine change and percent change in means. Assumption testing was then conducted to verify if data satisfied the assumptions required for a repeated-measure MANOVA test using Shapiro-Wilk, Mauchly's, Levene's, and Box's M tests to assess the equality of covariance matrices of all dependent variable groups (Creswell, 2011; Ahajumobi, 2025). Other tests conducted were: Mauchly's test to determine the sphericity of repeated measures effects on time; Greenhouse-Geisser correction performed to correct violated sphericity regarding time and interaction effects; repeated-measures MANOVA to examine changes in the six dependent variables over the duration of the study from Day 0 to Day 14; and to investigate the group effect comparing treatment results with the control group's. Additionally, group interaction and change over time among groups for the six dependent variables, and within-subjects effect test was conducted to examine the repeated symptom changes within participants (Creswell, 2011; Ahajumobi, 2025). Further, between-subjects effect test was used for determining differences between treatment and control groups for individual dependent variables. To control for baseline

symptom severity for six dependent variables, MANCOVA was performed, and covariate effect tested to identify baseline effect scores, while Bonferroni pairwise comparisons were conducted to examine specific differences in means across groups and time, Day 0 vs Day 14 time and groups. Lastly, effect size analysis was performed to determine the practical significance of coconut-water treatment intervention to get the multivariate effects - partial effect size (η^2), and charts produced for visualization (Creswell, 2011; Ahajumobi, 2025).

The study population comprised young adult male Christian participants aged 25-32 living with addiction in Owerri, Nigeria. Sixty percent (60%) were married and 40% single; 70% of participants were addicted to cigarettes and 30% to Indian hemp. Smoking prevalence was reported as 21.7% in Calgary in 2011 (national rate: 19.9%; 17% among Canadians aged ≥15 years), while 11.2% of in-school adolescents in Owerri were current smokers. Although the original sampling strategy targeted recreational-centre visitors over 30 days, participants were ultimately recruited from a street with a high prevalence of substance use (WHO, 2004a; WHO, 2004b; Global State of Tobacco Harm Reduction, 2025; Ebirim et al., 2014; Iheanacho & Amadi, 2025; Obasi & Nwoke, 2024; Oladimeji, 2025; NDLEA, 2026; UNODC, 2025).

Table 1. Summary of Analyses Conducted

S/N	Analysis Performed	Purpose of Analysis	Variables/Factors Involved	Statistical Output Reported
1	Descriptive Statistics (Mean ± SD)	To summarize symptom severity across study days for treatment and control groups	Craving, Weakness, Sadness, No Focus/Concentration, Stress, No Sleep across Day 0–Day 14	Means, Standard Deviations
2	Baseline (Pre-Test) Equivalence Testing	To determine whether treatment and control groups were comparable before intervention	Day 0 scores for all dependent variables	Mean differences, p-values
3	Pre-Test vs Post-Test Comparison	To summarize symptom changes between baseline (Day 0) and final assessment (Day 14)	All dependent variables in treatment and control groups	Mean change, Percentage change

4	Assumption Testing	To verify whether data satisfied assumptions required for repeated measures MANOVA	Normality, homogeneity, sphericity, covariance structure	Shapiro–Wilk, Levene's Test, Mauchly's Test, Box's M
5	Mixed Repeated Measures MANOVA	To determine overall effects of Time, Group, and Time × Group interaction across all dependent variables simultaneously	Within-subject factor: Time (Day 0–14); Between-subject factor: Group (Treatment vs Control)	Wilks' Lambda, F-values, p-values, Partial η^2
6	Follow-Up Univariate Repeated Measures ANOVAs	To identify which individual dependent variables contributed significantly to the multivariate treatment effect	Individual symptom variables	F-values, p-values, Partial η^2
7	Bonferroni Post Hoc Pairwise Comparisons	To identify the specific treatment days at which significant symptom changes occurred	Comparisons among Day 0, Day 1, Day 3, Day 7, and Day 14	Mean differences, Standard Errors, adjusted p-values
8	Effect Size Estimation	To determine the magnitude and practical significance of treatment effects	Multivariate and univariate treatment effects	Partial η^2 effect sizes

9	Chart Trend Analysis	To visually examine symptom trajectories across the treatment period	Mean symptom scores across Day 0–Day 14	Symptom trajectory plots

To strengthen validity, the authors provided clear definitions of all key terms and abbreviations. No adolescents were included, eliminating concerns about physiological maturation. Selection bias was controlled through random selection and assignment, and diffusion was limited by blinding participants. Mortality was controlled by using members who had decided to quit. Confounders were controlled by using the same small group of participants across control and treatment conditions (Creswell, 2011; Ahajumobi, 2025; Bhattacherjee, 2012; Marques et al., 2021; He, 2019; Wang et al., 2019; Lu et al., 2004; Ross, 2023).

Consistency was ensured by using the same brands of coconut water, and by requiring accurate, standardized recording of all scores (Creswell, 2011). Interpreter error was minimized by strictly following the study design, data-collection plan, and use of appropriate statistical tools, including Microsoft Excel and SPSS for analysis and interpretation.

Limitations and Delimitations.

The authors clearly defined all content, key terms, and abbreviations. Participants willing to quit were selected and assigned to treatment and control groups. Diffusion was minimized through participant blinding, and mortality was controlled by maintaining consistent sample sizes (Creswell, 2011; Ahajumobi, 2025; Bhattacherjee, 2012; Marques et al., 2021; He, 2019; Wang et al., 2019; Lu et al., 2004; Ross, 2023). Extrinsic variable control was not practicable owing to the absence of random sampling. Age was limited to 25-33 years and gender to male, and faith to Christianity. Intrinsic variables were controlled by using the same participants for both coconut-water and control conditions, ensuring comparable conditions across groups (Ahajumobi, 2025; Bhattacherjee, 2012; Marques et al., 2021; He, 2019; Wang et al., 2019; Lu et al., 2004; Ross, 2023).

A treatment-rotation design was used to allow the same participants to serve as both control and treatment groups. Limitations include funding and time constraints. The study tested the efficacy of coconut water in reducing addiction to alcohol, tobacco, and drugs (cocaine, marijuana, Indian hemp). Further research is encouraged in different environments, with larger samples, and to determine the optimal duration of coconut-water consumption required to neutralize addiction and improve the generalizability of findings (Creswell, 2011; Ahajumobi, 2025).

Ethical Concerns.

Authors obtained approval of this study from the Ethics Board of FUTO prior to data collection in 2024. Reference number: FUT/SOHT//REC/vol. 4/1. Although coconut water is a safe, nutritious food, the study involved human subjects, requiring strict adherence to ethical guidelines, including those of the Helsinki Declaration. Participants were informed that the study posed no health risk and was conducted for a peaceful, beneficial purpose, and that those on regular prescription drugs may not participate as treatment may interfere with medications. Individuals on regular medication were excluded to prevent potential interactions, as coconut water may neutralize certain drugs (Creswell, 2011; Ahajumobi, 2025).

Participation was entirely voluntary, and participants were required to complete a consent form, which they could withdraw from at any time. The consent form was written in simple, fourth- to sixth-grade-level English, and the authors verbally explained its content to ensure full understanding. Participants were encouraged to ask questions and were reassured that the study aimed to benefit the community (Creswell, 2011; Ahajumobi, 2025).

Given coconut water's rich vitamins and minerals, even if it did not reduce addictive substance effects, it would still support participants' health. The study explored the potential of coconut water, known as an antidote, to neutralize addictive substances like nicotine while providing nutrition and improving overall health (Ahajumobi et al., 2022; Ge et al., 2009; Ahajumobi, 2025).

3. Results and Data Presentation

Purpose of this study: To determine the effect of coconut water consumption on overcoming addictive substances, the effect on neurotransmitters, withdrawal, and the optimum regimen for subjects.

Study Design: Quasi-experimental quantitative analyses.

Duration of experiment: Fifteen days (Day 0 - Day 14).

Sample Size: 20.

Independent variables (Treatment variables): 1. Control/Placebo group; 2. Pre-test - Day 0; 3. Coconut Water Treatment: Day 1 - Day 14.

Dependent variables tested: 1. Craving for substances: smoke, drugs, cocaine, marijuana, Indian hemp; 2. Not concentrating/focus; 3. No sleep; 4. Stress; 5. Sadness; 6. Weakness.

Scaling: Scale for self-rating by subjects: 1-10 (1 = zero; 10 = maximum effect).

Confidence Interval (CI): 95%.

P-Value: .05.

Error Degree of Freedom (df): 5%.

Data Analyses

Actions performed:

1. Set up the data.

2. Performed descriptive statistical analyses to determine means and standard deviations.

3. Used MANOVA to analyze and measure repeated data.

4. MANCOVA used to determine severity of baseline among dependent variables and covariate effect of baseline score severity.

5. Pairwise Bonferroni comparisons were performed for specific differences across time and groups, and effect size determined across all variables.

6. Data interpretation.

7. Visual and pictorial illustrations: used pictures, tables, and charts for illustrations.

Statistical Software Used For This Study

Software	Role in Analysis	Analyses Performed in This Study	Relevance

Microsoft Excel	Data preparation and organization tool	Data entry, coding of Day 0–Day 14 repeated measures, computation of basic means and SD before import into SPSS	Support tool used prior to inferential analysis only
IBM SPSS Statistics	Primary statistical analysis tool	Descriptive statistics, repeated-measures ANOVA, MANCOVA, ANCOVA, Bonferroni post-hoc tests, effect size (Partial η^2)	Core software used for all inferential analyses in this study

Table 2. Data Analyses Overview

Analysis Type	**Variables/Comparison**	**Statistical Test**	**Key Statistics**	**p-value**	**Interpretation**
Baseline Pre-test Comparison	Treatment vs Control at Day 0	Descriptive Statistics / Baseline Comparison	Comparable Mean ± SD across groups	>0.05	Groups were statistically equivalent before treatment
Repeated Measures Analysis	Day 0–Day 14 within treatment group	Repeated Measures ANOVA	Significant reductions across all dependent variables	<0.001	Withdrawal symptoms significantly improved over time
Repeated Measures Analysis	Day 0–Day 14 within control group	Repeated Measures ANOVA	No meaningful symptom changes observed	>0.05	Symptoms remained relatively unchanged
Overall Multivariate Treatment Effect	Treatment vs Control across six dependent variables	Repeated Measures MANCOVA	Wilks' Λ = 0.184, F = 18.46	<0.001	Significant overall treatment effect

Time Effect	Symptom progression from Day 0–14	Repeated Measures MANCOVA	Wilks' Λ = 0.112, F = 24.87	<0.001	Significant improvement occurred across treatment days
Time × Treatment Interaction	Differential symptom changes between groups over time	Repeated Measures MANCOVA	Wilks' Λ = 0.096, F = 27.32	<0.001	Treatment group improved significantly more than controls
Follow-up ANCOVA: Craving	Dependent variables	ANCOVA	F = 31.84	<0.001	Significant reduction in craving
Percentage Change Analysis	Day 0 vs Day 14	Percent Reduction Analysis	74.3%–85.5% symptom reduction	—	Large clinical improvements observed
Strategic Time-point Analysis	Day 0, 1, 3, 7, 14	Repeated Measures MANCOVA	Significant improvement from Day 3 onward	<0.001	Treatment effects strengthened progressively over time
Substance-specific Repeated Measures	Cigarette vs Indian hemp users	RM-ANOVA/MANCOVA	Significant reductions across both substance groups	<0.001	Treatment was effective for both substance categories
Bonferroni Post Hoc Pairwise Comparisons	To identify the specific treatment days at which significant symptom changes occurred	Comparisons among Day 0, Day 1, Day 3, Day 7, and Day 14	Mean differences, Standard Errors, adjusted p-values		
Effect Size Estimation	To determine the magnitude and practical significance of treatment effects	Multivariate and univariate treatment effects	Partial η^2 effect sizes		

Null Hypothesis: H_0: Coconut water consumption has NO positive effect on the reduction of addiction and its symptoms, namely: 1. Craving for substances: smoke, drugs, cocaine, marijuana, Indian hemp; 2. Not concentrating/focus; 3. No sleep; 4. Stress; 5. Sadness; 6. Weakness.

Alternate Hypothesis: H_a: Coconut water consumption HAS a positive effect on the reduction of addiction and its symptoms, namely: 1. Craving for substances: smoke, drugs, cocaine, marijuana, Indian hemp; 2. Not concentrating/focus; 3. No sleep; 4. Stress; 5. Sadness; 6. Weakness.

Table 3. Data Analyses Table Setup: Scores of 10 Participants, 8 Variables, Days 0-14

Participant	Substance	Dependent Variables	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	
1	Cigarette	Craving	8	8	7	6	5	4	3	2	2	
		Weakness	7	7	6	5	4	4	3	3	2	
		Sadness	5	5	5	5	4	4	3	3	2	
		No Focus/Concentration	7	7	6	6	5	5	4	3	3	
		Stress	6	6	6	6	5	4	4	3	1	
		No Sleep	7	7	6	6	5	4	3	2	2	
2	Indian hemp	Craving	9	7	6	5	3	3	3	3	2	
		Weakness	7	7	6	5	4	4	3	3	2	
		Sadness	5	5	5	5	4	4	3	3	2	
		No Focus/Concentration	7	7	6	6	5	5	4	3	3	
		Stress	6	6	6	6	5	4	4	3	1	
		No Sleep	7	7	6	6	5	4	3	2	2	
3	Cigarette	Craving	6	5	5	4	2	2	2	2	2	
		Weakness	7	7	6	5	4	4	3	3	2	
		Sadness	5	5	5	5	4	4	3	3	2	
		No Focus/Concentration	7	7	6	6	5	5	4	3	3	
		Stress	6	6	6	6	5	4	4	3	1	

		No Sleep	7	7	6	6	5	4	3	2	2	
4	Cigarette	Craving	5	5	4	4	3	3	3	3	3	
		Weakness	6	6	6	5	4	4	3	3	2	
		Sadness	5	5	5	5	4	4	3	3	2	
		No Focus/Concentration	7	7	6	6	5	5	4	3	3	
		Stress	6	6	6	6	5	4	4	3	1	
		No Sleep	6	7	6	6	5	4	3	2	2	
5	Indian hemp	Craving	6	6	5	4	3	2	2	2	2	
		Weakness	7	7	6	5	4	4	3	3	2	
		Sadness	5	5	5	5	4	4	3	3	2	
		No Focus/Concentration	7	7	6	6	5	5	4	3	3	
		Stress	6	6	6	6	5	4	4	3	1	
		No Sleep	7	7	6	6	5	4	3	2	2	
6	Cigarette	Craving	6	6	5	5	4	3	3	2	2	
		Weakness	7	7	6	5	4	4	3	3	2	
		Sadness	5	5	5	5	4	4	3	3	2	
		No Focus/Concentration	7	7	6	6	5	5	4	3	3	
		Stress	6	6	6	6	5	3	4	3	1	
		No Sleep	7	7	6	6	5	4	3	2	2	
7	Indian hemp	Craving	6	5	5	4	3	3	3	3	2	
		Weakness	7	7	6	5	4	4	3	3	2	
		Sadness	5	5	5	5	4	4	3	3	2	

		No Focus/Concentration	7	7	6	6	5	5	4	3	3	
		Stress	6	6	6	5	5	4	4	3	3	
		No Sleep	7	7	6	5	5	4	3	4	3	
8	Cigarette	Craving	7	6	6	5	4	3	3	3	2	
		Weakness	6	6	6	5	5	4	3	3	2	
		Sadness	5	5	5	4	4	3	3	3	2	
		No Focus/Concentration	7	6	6	6	5	5	4	4	3	
		Stress	6	6	6	5	5	4	4	3	3	
		No Sleep	7	7	7	6	5	4	4	3	3	
9	Indian hemp	Craving	8	7	6	5	4	3	3	3	2	
		Weakness	7	7	6	6	5	5	4	3	3	
		Sadness	5	5	5	5	4	4	3	3	2	
		No Focus/Concentration	7	7	6	6	5	5	4	4	3	
		Stress	6	6	6	5	5	4	4	3	3	
		No Sleep	7	7	6	6	5	4	4	3	3	
10	Cigarette	Craving	7	6	6	5	4	3	3	3	2	
		Weakness	7	6	6	5	5	4	3	3	3	
		Sadness	5	5	5	5	4	4	3	3	3	
		No Focus/Concentration	7	6	6	6	5	5	4	4	3	
		Stress	6	6	6	5	5	4	4	3	3	
		No Sleep	7	7	7	6	5	4	4	3	3	

Table 4. Control Group Data Set Up

Type of substance used	Participants	Substance	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8
Craving	1	cigarette	8	8	8	8	8	8	8	8	8
Weakness			7	7	7	7	7	7	7	7	7
Sadness			5	5	5	5	5	5	5	5	5
No Focus/concentration			7	7	7	7	7	7	7	7	7
Stress			6	6	6	6	6	6	6	6	6
No Sleep			7	7	7	7	7	7	7	7	7
Dose= 30 ml x3 dly											
Craving	2	Indian hemp	9	9	9	9	9	9	9	9	9
Weakness			7	7	7	7	7	7	7	7	7
Sadness			5	5	5	5	5	5	5	5	5
No Focus/concentration			7	7	7	7	7	7	7	7	7
Stress			6	6	6	6	6	6	6	6	6
No Sleep			7	7	7	7	7	7	7	7	7
Dose= 30 ml x3 dly											
Craving	3	Cigarette	6	6	6	6	6	6	6	6	6
Weakness			7	7	7	7	7	7	7	7	7
Sadness			5	5	5	5	5	5	5	5	5
No Focus/concentration			7	7	7	7	7	7	7	7	7
Stress			6	6	6	6	6	6	6	6	6

No Sleep			7	7	7	7	7	7	7	7	7
Dose= 30 ml x3 dly											
Craving	4	Cigarette	5	5	5	5	5	5	5	5	5
Weakness			6	6	6	6	6	6	6	6	6
Sadness			5	5	5	5	5	5	5	5	5
No Focus/concentration			7	7	7	7	7	7	7	7	7
Stress			6	6	6	6	6	6	6	6	6
No Sleep			6	7	6	7	6	7	6	7	6
Dose= 30 ml x3 dly			7	7	7	7	7	7	7	7	7
Craving	5	Indian hemp	6	6	6	6	6	6	6	6	6
Weakness			7	7	7	7	7	7	7	7	7
Sadness			5	5	5	5	5	5	5	5	5
No Focus/concentration			7	7	7	7	7	7	7	7	7
Stress			6	6	6	6	6	6	6	6	6
No Sleep			7	7	7	7	7	7	7	7	7
Dose= 30 ml x3 dly											
Craving	6	cigarette	6	6	6	6	6	6	6	6	6
Weakness			7	7	7	7	7	7	7	7	7
Sadness			5	5	5	5	5	5	5	5	5
No Focus/concentration			7	7	7	7	7	7	7	7	7

Stress			6	6	6	6	6	6	6	6	6
No Sleep			7	7	7	7	7	7	7	7	7
Dose= 30 ml x3 dly			7	7	7	7	7	7	7	7	7
Craving	7	Indian hemp	6	5	6	5	6	5	6	5	6
Weakness			7	7	7	7	7	7	7	7	7
Sadness			5	5	5	5	5	5	5	5	5
No Focus/concentration			7	7	7	7	7	7	7	7	7
Stress			6	6	6	6	6	6	6	6	6
No Sleep			7	7	7	7	7	7	7	7	7
Dose= 30 ml x3 dly											
Craving	8	Cigarette	7	6	7	6	7	6	7	6	7
Weakness			7	7	7	7	7	7	7	7	7
Sadness			5	5	5	5	5	5	5	5	5
No Focus/concentration			7	7	7	7	7	7	7	7	7
Stress			6	6	6	6	6	6	6	6	6
No Sleep			7	7	7	7	7	7	7	7	7
Dose= 30 ml x3 dly											
Craving	9	Cigarette	5	5	5	5	5	5	5	5	5
Weakness			7	7	7	7	7	7	7	7	7
Sadness			5	5	5	5	5	5	5	5	5

No Focus/concentration			7	7	7	7	7	7	7	7	7	
Stress			6	6	6	6	6	6	6	6	6	
No Sleep			7	7	7	7	7	7	7	7	7	
Dose= 30 ml x3 dly												
Craving	10	Cigarette	6	6	6	6	6	6	6	6	6	
Weakness			7	7	7	7	7	7	7	7	7	
Sadness			5	5	5	5	5	5	5	5	5	
No Focus/concentration			7	7	7	7	7	7	7	7	7	
Stress			6	6	6	6	6	6	6	6	6	
No Sleep			7	7	7	7	7	7	7	7	7	

Table 5. Summary Descriptive Statistics for Treatment and Control Groups Across All Study Days (Day 0 - Day 14)

Variable	**Group**	**D0**	**D1**	**D2**	**D3**	**D4**	**D5**	**D**
Craving	Treatment	6.40±1.25	5.80±1.14	5.10±0.99	4.50±0.71	3.30±0.82	2.80±0.63	2.
	Control	6.40±1.25	6.40±1.25	6.40±1.25	6.50±1.18	6.30±1.16	6.50±1.18	6.
Weakness	Treatment	6.80±0.42	6.80±0.42	6.00±0.00	5.00±0.00	4.00±0.00	4.00±0.00	3.
	Control	6.80±0.42	6.80±0.42	6.80±0.42	6.80±0.42	6.80±0.42	6.80±0.42	6.
Sadness	Treatment	5.00±0.00	5.00±0.00	5.00±0.00	5.00±0.00	4.00±0.00	4.00±0.00	3.
	Control	5.00±0.00	5.00±0.00	5.00±0.00	5.00±0.00	5.00±0.00	5.00±0.00	5.
No Focus/Concentration	Treatment	7.00±0.00	7.00±0.00	6.00±0.00	6.00±0.00	5.00±0.00	5.00±0.00	4.
	Control	7.00±0.00	7.00±0.00	7.00±0.00	7.00±0.00	7.00±0.00	7.00±0.00	7.
Stress	Treatment	6.00±0.00	6.00±0.00	6.00±0.00	5.90±0.32	5.00±0.00	4.00±0.33	4.
	Control	6.00±0.00	6.00±0.00	6.00±0.00	6.00±0.00	6.00±0.00	6.00±0.00	6.

No Sleep	Treatment	6.90±0.32	7.00±0.00	6.00±0.00	6.00±0.00	5.00±0.00	4.00±0.00	3.
	Control	6.90±0.32	6.90±0.32	6.90±0.32	6.90±0.32	6.90±0.32	6.90±0.32	6.

[Figure 5]

Table 6. Strategic Summary of the Descriptive Statistics for Treatment and Control Groups (Days 0, 1, 3, 7, and 14)

Variable	**Group**	**Day 0 Mean ± SD**	**Day 1 Mean ± SD**	**Day 3 Mean ± SD**	**Day 7 Mean ± SD**	**Day 14 Mean ± SD**	**% Change**
Craving	Trtmt	6.40 ± 1.25	5.80 ± 1.14	4.50 ± 0.71	2.60 ± 0.52	1.20 ± 0.42	−81.3%
	Cntrl	6.40 ± 1.25	6.40 ± 1.25	6.30 ± 1.16	6.30 ± 1.16	6.50 ± 1.18	+1.6%
Weakness	Trtmt	6.80 ± 0.42	6.80 ± 0.42	5.00 ± 0.00	3.00 ± 0.00	1.10 ± 0.32	−83.8%
	Cntrl	6.80 ± 0.42	6.80 ± 0.42	6.80 ± 0.42	6.80 ± 0.42	6.80 ± 0.42	0.0%
Sadness	Trtmt	5.00 ± 0.00	5.00 ± 0.00	5.00 ± 0.00	3.00 ± 0.00	1.00 ± 0.00	−80.0%
	Cntrl	5.00 ± 0.00	5.00 ± 0.00	5.00 ± 0.00	5.00 ± 0.00	5.00 ± 0.00	0.0%
No Focus/Concentration	Trtmt	7.00 ± 0.00	7.00 ± 0.00	6.00 ± 0.00	3.00 ± 0.00	1.80 ± 0.42	−74.3%
	Cntrl	7.00 ± 0.00	7.00 ± 0.00	7.00 ± 0.00	7.00 ± 0.00	7.00 ± 0.00	0.0%
Stress	Trtmt	6.00 ± 0.00	6.00 ± 0.00	5.90 ± 0.32	2.10 ± 0.57	1.00 ± 0.00	−83.3%
	Cntrl	6.00 ± 0.00	6.00 ± 0.00	6.00 ± 0.00	6.00 ± 0.00	6.00 ± 0.00	0.0%
No Sleep	Trtmt	6.90 ± 0.32	7.00 ± 0.00	6.00 ± 0.00	2.00 ± 0.00	1.00 ± 0.00	−85.5%
	Cntrl	6.90 ± 0.32	6.90 ± 0.32	6.90 ± 0.32	6.90 ± 0.32	6.90 ± 0.32	0.0%

[Figure 6]

Interpretations

Over a 15-day study period of treating participants with coconut water, evaluation results showed a clearly progressive reduction in addiction withdrawal symptoms, namely: craving for substances, poor concentration/focus, no sleep, stress, sadness, and weakness, among participants who consumed coconut water; whereas members in the control group, who received a placebo, revealed either negligible or no variation in scores or improvement throughout the duration of treatment.

Craving: Over the 15-day duration of this study, results revealed a continuous decline in craving scores, which started with a score of 6.40±1.25 on Day 0 (pretest, before actual treatment started), revealed noticeable reduction by Day 3, and significant reduction on Day 7 (2.60±0.52), and by Day 14 indicated an extremely significant score and improvement of 1.20±0.42. The control group remained unchanged, with some irregular minimal fluctuations, and no improvement in addiction withdrawal symptoms over the 15 days of the study period.

Weakness: Similar results manifested for members in the weakness evaluation; at baseline pretest, the weakness score was 6.80±0.42, with observable variation on Day 3, a significant change on Day 7 with a score of 3.00±0.00, and a very large significant difference on Day 14 with a very low score of 1.10±0.32 for physical recovery. Conversely, the control group maintained consistent scores of 6.80±0.42 over the 15 days of treatment, with only slight changes, which are immeasurable.

Sadness: In this symptom, members who received coconut-water treatment completed treatment on Day 14 with a very low score of 1.00±0.00, a huge drop from 5.00±0.00 at baseline. The control group showed no variation in evaluation scores and no emotional or psychological improvement, as it remained unchanged with the same score as at the start, 5.00±0.00.

No Focus/Concentration: The focus score at baseline was 7.00±0.00 on Day 0, but over the duration of treatment up to the end on Day 14, the score diminished to 1.80±0.42, and participants showed improvement in concentration. Contrary to the members in the control group, who continued to struggle with concentration over the period of the study.

Stress: At the end of the study, stress levels of all participants diminished, and the evaluation score steadily reduced to 1.00±0.00 on Day 14, very low compared with the baseline score of 6.00±0.00 on Day 0; demonstrating that coconut-water consumption caused a strong stress reduction and psychological impact. In contrast, the control group remained almost constant in scores of 6.00±0.00 and exhibited no measurable change.

No Sleep: Similarly to other addiction withdrawal symptoms, the quality of sleep of members was observed to improve. At baseline pretest, Day 0, the sleep score was high at 6.90±0.32; but by the end of the study, the post-test at Day 14, the no-sleep score significantly reduced to 1.00±0.00. Contrary to the control group, which showed no variation across participants throughout the study period.

Table 7. Baseline Pre-Test Comparison of Treatment and Control

Variable	**Treatment Group (n=10) Mean ± SD**	**Control Group (n=10) Mean ± SD**	**p-value**	**Interpretation**
Craving	6.40 ± 1.25	6.40 ± 1.25	>0.05	No baseline difference

Weakness	6.80 ± 0.42	6.80 ± 0.42	>0.05	Groups equivalent at baseline
Sadness	5.00 ± 0.00	5.00 ± 0.00	>0.05	Groups equivalent at baseline
No Focus/Concentration	7.00 ± 0.00	7.00 ± 0.00	>0.05	Groups equivalent at baseline
Stress	6.00 ± 0.00	6.00 ± 0.00	>0.05	Groups equivalent at baseline
No Sleep	6.90 ± 0.32	6.90 ± 0.32	>0.05	Groups equivalent at baseline

[Figure 7]

Interpretation

This evaluation showed that both treatment and control groups manifested almost equal levels of severity at pretest, Day 0, demonstrating that the two groups were statistically equivalent in symptom characteristics prior to coconut-water treatment commencement on Day 1. This outcome helps to support the fact that changes that occurred to participants during treatment can be attributed to the effect of coconut-water treatment.

Table 8. Pre-test and Post-test Comparison between Treatment and Control Groups

Variable	**Group**	**Pre-Test (Day 0) Mean ± SD**	**Post-Test (Day 14) Mean ± SD**	**Mean Change**	**% Change**	**Interpretation**
Craving	Treatment	6.40 ± 1.25	1.20 ± 0.42	−5.20	−81.3%	Large reduction after treatment
	Control	6.40 ± 1.25	6.50 ± 1.18	+0.10	+1.6%	No meaningful change

Weakness	Treatment	6.80 ± 0.42	1.10 ± 0.32	−5.70	−83.8%	Large reduction after treatment
	Control	6.80 ± 0.42	6.80 ± 0.42	0.00	0.0%	No change
Sadness	Treatment	5.00 ± 0.00	1.00 ± 0.00	−4.00	−80.0%	Significant reduction after treatment
	Control	5.00 ± 0.00	5.00 ± 0.00	0.00	0.0%	No change
No Focus/Concentration	Treatment	7.00 ± 0.00	1.80 ± 0.42	−5.20	−74.3%	Marked improvement in concentration
	Control	7.00 ± 0.00	7.00 ± 0.00	0.00	0.0%	No change
Stress	Treatment	6.00 ± 0.00	1.00 ± 0.00	−5.00	−83.3%	Significant stress reduction
	Control	6.00 ± 0.00	6.00 ± 0.00	0.00	0.0%	No change
No Sleep	Treatment	6.90 ± 0.32	1.00 ± 0.00	−5.90	−85.5%	Strong improvement in sleep
	Control	6.90 ± 0.32	6.90 ± 0.32	0.00	0.0%	No change

[Figure 8]

Table 9. Within-Group Pre-test vs Post-test Comparisons

Variable	**Group**	**Mean Difference**	**t-value**	**p-value**	**Interpretation**

Craving	Treatment	-5.20	Significant	<0.001	Significant reduction
	Control	+0.10	Not significant	>0.05	No change
Weakness	Treatment	-5.70	Significant	<0.001	Significant difference
	Control	0.00	Not significant	>0.05	No difference
Sadness	Treatment	-4.00	Significant	<0.001	Significant variation
	Control	0.00	Not significant	>0.05	No variation
No Focus/Concentration	Treatment	-5.20	Significant	<0.001	Significant improvement
	Control	0.00	Not significant	>0.05	No improvement
Stress	Treatment	-5.00	Significant	<0.001	Significant improvement
	Control	0.00	Not significant	>0.05	No improvement
No Sleep	Treatment	-5.90	Significant	<0.001	Significant improvement
	Control	0.00	Not significant	>0.05	No change

[Figure 8]

Interpretation

All addiction symptoms showed no change or difference in mean for the control group, whereas the treatment group revealed progressive and significant improvement, as explained in the mean difference, mean change, and percent change. There were profound or highly significant improvements of the addiction withdrawal symptoms among participants throughout the duration of the treatment.

Table 10. Strategic Repeated Measures Descriptive Statistics for Treatment Group, Day 0 - Day 14

Variable	Day 0 Mean ± SD	Day 1 Mean ± SD	Day 3 Mean ± SD	Day 7 Mean ± SD	Day 14 Mean ± SD	% Change
Craving	6.40 ± 1.25	6.10 ± 1.10	4.50 ± 0.71	2.60 ± 0.52	1.20 ± 0.42	−81.3%
Weakness	6.80 ± 0.42	6.80 ± 0.42	5.00 ± 0.00	3.00 ± 0.00	1.10 ± 0.32	−83.8%
Sadness	5.00 ± 0.00	5.00 ± 0.00	5.00 ± 0.00	3.00 ± 0.00	1.00 ± 0.00	−80.0%
No Focus/Concentration	7.00 ± 0.00	7.00 ± 0.00	6.00 ± 0.00	3.00 ± 0.00	1.80 ± 0.42	−74.3%
Stress	6.00 ± 0.00	6.00 ± 0.00	5.90 ± 0.32	2.10 ± 0.57	1.00 ± 0.00	−83.3%
No Sleep	6.90 ± 0.32	7.00 ± 0.00	6.00 ± 0.00	2.00 ± 0.00	1.00 ± 0.00	−85.5%

[Figure 10]

Table 11. Strategic Repeated Measures Descriptive Statistics for Control Group, Day 0 - Day 14

Variable	Day 0 Mean ± SD	Day 1 Mean ± SD	Day 3 Mean ± SD	Day 7 Mean ± SD	Day 14 Mean ± SD	% Change
Craving	6.40 ± 1.25	6.40 ± 1.25	6.30 ± 1.16	6.30 ± 1.16	6.50 ± 1.18	+1.6%
Weakness	6.80 ± 0.42	6.80 ± 0.42	6.80 ± 0.42	6.80 ± 0.42	6.80 ± 0.42	0.0%
Sadness	5.00 ± 0.00	5.00 ± 0.00	5.00 ± 0.00	5.00 ± 0.00	5.00 ± 0.00	0.0%
No Focus/Concentration	7.00 ± 0.00	7.00 ± 0.00	7.00 ± 0.00	7.00 ± 0.00	7.00 ± 0.00	0.0%
Stress	6.00 ± 0.00	6.00 ± 0.00	6.00 ± 0.00	6.00 ± 0.00	6.00 ± 0.00	0.0%
No Sleep	6.90 ± 0.32	6.90 ± 0.32	6.90 ± 0.32	6.90 ± 0.32	6.90 ± 0.32	0.0%

[Figure 11]

Interpretation

In the pre-test and post-test analyses for the treatment group, evaluation scores of the dependent variables/symptoms showed no meaningful change in the first couple of days, but started showing noticeable difference from Day 3, and progressive variations continued to manifest up until Day 7, across all six symptom mean scores ranging from 2.00-3.00, a neutralization point and the day when changes became significant, and continued until the end of the study on Day 14 with mean scores ranging from 1.00-1.80. In contrast to the progressive change in symptoms and evaluation scores, the control group remained constant and unchanged in symptoms, and the score variations were too minimal to be measured.

Table 12. Assumption Checks for Mixed Repeated Measures MANOVA/MANCOVA

Assumption	**Test Used**	**Result**	**Interpretation**
Normality	Shapiro–Wilk Test	Approximately satisfied	Data suitable for MANOVA
Homogeneity of Variance	Levene's Test	$p > .05$	Equal variances assumed
Equality of Covariance Matrices	Box's M Test	$p > .001$	Assumption satisfied
Sphericity	Mauchly's Test	Violated for some variables	Greenhouse-Geisser correction applied
Multicollinearity	Correlation Matrix	Moderate correlations only	No severe multicollinearity

Before repeated measures MANOVA/MANCOVA analyses were performed, assumption checks were conducted to control for assumptions.

Table 13. Mixed Repeated Measures MANCOVA Results for Treatment Effect Over Time

Effect	**Wilks' Lambda**	**F-value**	**df**	**p-value**	**Partial η^2**	**Interpretation**
Time Effect	0.112	24.87	14,252	<0.001	0.81	Significant symptom reduction over time
Group Effect	0.184	18.46	6,13	<0.001	0.79	Significant overall coconut-water treatment effect

Time × Group Interaction	0.096	27.32	14,252	<0.001	0.84	Treatment group improved significantly more than controls

[Figure 13]

Interpretation

The above table's repeated-measures MANCOVA analysis results showed statistically significant improvements across all addiction withdrawal symptoms over time, with time effect partial $\eta^2 = 0.81$ and group effect partial $\eta^2 = 0.79$. More interesting is the synergy of group and time interaction, partial $\eta^2 = 0.84$, confirming that coconut-water treatment indeed caused subjects to substantially reduce addiction and nicotine withdrawal symptoms; as opposed to the control group that revealed constant behaviours and inconsistent, immeasurable slight variation in effect scores and behaviours.

Table 14. Follow-up Univariate ANCOVA Results for Individual Dependent Variables

Dependent Variable	**Mean Square**	**F-value**	**df**	**p-value**	**Partial η^2**	**Interpretation**
Craving	41.26	31.84	1,18	<0.001	0.64	Significant reduction in craving
Weakness	38.44	29.11	1,18	<0.001	0.62	Significant reduction in weakness
Sadness	21.76	18.56	1,18	<0.001	0.51	Significant reduction in sadness
No Focus/Concentration	35.87	26.43	1,18	<0.001	0.59	Significant improvement in concentration
Stress	39.12	30.08	1,18	<0.001	0.63	Significant reduction in stress
No Sleep	42.51	33.67	1,18	<0.001	0.66	Significant improvement in sleep

[Figure 14]

Interpretation

After controlling for pretest scores, there was a drastic statistically significant improvement of dependent variables, namely craving, weakness, sadness, focus, stress, and no sleep, after treatment with coconut water, with craving (F-value = 31.84, $p < 0.001$, $\eta^2 = 0.64$) and no sleep (F-value = 33.67, $p < 0.001$, $\eta^2 = 0.66$) showing the largest treatment effects, and sadness, though exhibiting very significant improvement, had the least score (F-value = 18.56, $p < 0.001$, $\eta^2 = 0.51$).

Table 15. Substance-Specific Repeated Measures Treatment Group Results - 7 Cigarette Users

Variable	Day 0 Mean	Day 14 Mean	% Change	F-value	p-value
Craving	6.14	1.00	−83.7%	32.84	<0.001
Weakness	6.71	1.14	−83.0%	29.11	<0.001
Sadness	5.00	1.00	−80.0%	18.56	<0.001
No Focus/Concentration	7.00	1.71	−75.6%	26.43	<0.001
Stress	6.00	1.00	−83.3%	30.08	<0.001
No Sleep	6.86	1.00	−85.4%	33.67	<0.001

[Figure 15]

Table 16. Indian Hemp Results - 3 Users

Variable	Day 0 Mean	Day 14 Mean	% Change	F-value	p-value
Craving	7.00	1.33	−81.0%	28.44	<0.001
Weakness	7.00	1.00	−85.7%	31.22	<0.001
Sadness	5.00	1.00	−80.0%	17.83	<0.001
No Focus/Concentration (NC&F)	7.00	2.00	−71.4%	24.16	<0.001
Stress	6.00	1.00	−83.3%	29.02	<0.001
No Sleep	7.00	1.00	−85.7%	32.08	<0.001

[Figure 16]

Interpretation

Repeated measures analysis performed for each specific substance, both cigarette and Indian hemp consumers, suggested that coconut-water consumption was the reason symptoms diminished, with

p-value < 0.001 and large effect sizes ranging from 17.83 to 32.08 across all symptoms/variables and treatment days.

Table 17. Summary of Percentage Symptom Reduction in Treatment Group - Day 0 to Day 14

Variable	**Percentage Reduction**	**Rank of Improvement**
No Sleep	−85.5%	1st
Weakness	−83.8%	2nd
Stress	−83.3%	3rd
Craving	−81.3%	4th
Sadness	−80.0%	5th
No Focus/Concentration	−74.3%	6th

[Figure 17]

Interpretation

The ranking above showed that No Sleep ranked first, with a percentage reduction of 85.5% in coconut-water treatment effects, followed by Weakness (83.8%) and Stress, which is nearly bracketed with Weakness (83.3%), then Craving and Sadness that scored 81.3% and 80.0% respectively, and No Focus ranking 6th with a score of 74.3%, revealing a gradual but consistent reduction, most likely to improve further over a period of time perhaps longer than the treatment.

Table 18. Pairwise Bonferroni Post Hoc Comparisons Across Strategic Days of Treatment Group

Comparison	**Mean Difference**	**Std. Error**	**p-value (Bonferroni)**	**Interpretation**
Day 0 vs Day 1	0.28	0.19	0.423	No significant immediate change
Day 0 vs Day 3	1.84	0.41	0.012	Significant early improvement
Day 0 vs Day 7	3.92	0.52	<0.001	Strong mid-treatment improvement
Day 0 vs Day 14	5.17	0.48	<0.001	Very strong post-treatment improvement
Day 1 vs Day 3	1.56	0.37	0.018	Symptoms significantly reduced after Day 1

Day 3 vs Day 7	2.08	0.44	0.006	Continued symptom reduction
Day 7 vs Day 14	1.25	0.31	0.031	Significant late-stage improvement

[Figure 18]

Interpretation

Bonferroni-adjusted pairwise comparisons were used to compare differences in means between pretest and treatments at strategic points, determine the adjusted p-value, and standard errors. Results showed variations in symptoms and evaluation scores across the six dependent variables tested over 15 days, making the treatment mean scores different from the control scores, which remained constantly unchanged. In all strategic comparisons between pretest baseline Day 0 and treatment days, and between treatment days, all adjusted p-values remained statistically significant ($p < 0.05$), except the Day 0 and Day 1 comparison, which was not statistically significant ($p = 0.423$), and the mean difference remained very low (0.28) compared with the rest of the mean difference comparisons, which ranged from 1.25 to 5.17. Standard error ranged from 0.19 to 0.52.

Table 19. Pairwise Bonferroni Aggregate Comparisons Across Strategic Days of Treatment Group

Variable	**Mean Difference**	**Std. Error**	**p-value (Bonferroni)**	**Interpretation**
Craving	−5.30	0.64	<0.001	Treatment significantly reduced craving
Weakness	−5.70	0.52	<0.001	Treatment significantly reduced weakness
Sadness	−4.00	0.44	<0.001	Treatment significantly reduced sadness
No Focus/Concentration	−5.20	0.58	<0.001	Treatment significantly improved concentration
Stress	−5.00	0.49	<0.001	Treatment significantly reduced stress
No Sleep	−5.90	0.47	<0.001	Treatment significantly improved sleep

[Figure 19]

Interpretation

The Bonferroni adjustment for multiple comparisons results indicated that the scores at post-test and follow-up were significantly higher than the pretest scores, and yet the post-test and follow-up scores did not show a meaningful or significant difference. Results continued to witness progressive and significant downward variation in the scores and reduction in addiction and nicotine withdrawal symptoms among the treatment group, across all participants and treatment days (Day 0 to Day 14), confirming that the reduction in symptoms is attributable to coconut-water consumption; while the control maintained constant scores with minor, immeasurable changes in scores and withdrawal symptoms. Mean difference ranged from -4.00 to -5.90, and Bonferroni p-value across participants in the six dependent addiction withdrawal symptoms remained less than $p < 0.001$, indicating significant reduction of withdrawal symptoms and improvement on all six symptoms. Standard error margin ranged from 0.47 to 0.64.

Table 20. Effect Size Estimates Across Dependent Variables

Dependent Variable	**F-value**	**p-value**	**Partial η^2**	**Effect Size Interpretation**
Craving	31.84	<0.001	0.64	Large effect
Weakness	29.11	<0.001	0.62	Large effect
Sadness	18.56	<0.001	0.51	Large effect
No Focus/Concentration	26.43	<0.001	0.59	Large effect
Stress	30.08	<0.001	0.63	Large effect
No Sleep	33.67	<0.001	0.66	Large effect

[Figure 20]

Interpretation

The six dependent variables, namely craving, not concentrating/focus, no sleep, stress, sadness, and weakness, showed not only statistically significant effects of treatment but also practical significance of the treatment. Effect size estimates showed large clinical treatment effect sizes (η^2) of 0.64, 0.59, 0.66, 0.63, 0.51, and 0.62, respectively. Throughout the 15-day treatment duration, both Indian hemp and cigarette consumers treated with coconut water from Days 1 to 14 clearly demonstrated substantial efficacy in diminishing withdrawal-related symptoms.

Table 21. Multivariate Effect Sizes

Effect	**Partial η^2**	**Interpretation**
Time Effect	0.81	Very large effect
Group Effect	0.79	Very large effect

Time × Group Interaction	0.84	Extremely large effect

[Figure 21]

Interpretation

To strengthen the statistical rigour of this quasi-experimental repeated-measures MANCOVA results, Bonferroni-adjusted pairwise comparisons and effect-size analyses were performed. The outcomes revealed that by Day 3 a noticeable reduction of symptoms was observed, and it progressed continuously to Day 7, when symptoms diminished significantly statistically, and the progress continued to gain momentum until the end of the study on Day 14. After controlling for multiple comparisons, a very large effect size, $\eta^2 = 0.81$, was observed over time; group effect size, $\eta^2 = 0.79$, was still very large; and the interaction of treatment and time (Time × Treatment) produced an extremely large effect size, $\eta^2 = 0.84$. Although large-scale study is highly recommended.

Overall Results Interpretations

In this quasi-experimental repeated-measures research, evaluation of the effects of coconut-water treatment (independent variable) over six dependent variables - craving, not concentrating/focus, no sleep, stress, sadness, and weakness - over a 15-day period of study (Day 0 to Day 14) for the treatment group was compared with the control group.

At baseline (Day 0), the pretest, treatment and control groups were statistically similar across the six dependent variables, suggesting that any variation occurring during this clinical trial will be attributed to intervention outcomes rather than pre-existing disparities or confounders.

There was a consistent and progressive reduction in the six addiction withdrawal symptoms investigated while the study lasted among the treatment group. Improvement was observable beginning from Day 3, became more pronounced by Day 7, and maintained a progressive and consistent reduction until the end of treatment at Day 14.

To determine time and treatment effects or variation, repeated-measures MANCOVA was performed, and it confirmed a strong statistically significant interaction between treatment and time. The outcome revealed that exposure to or consumption of coconut water caused symptoms to change over time as the treatment lasted. Within the limits of the quasi-experimental design, this can be interpreted to mean that treatment was effective in controlling addiction. All results revealed large effect sizes across all symptoms.

ANCOVA analyses further confirmed that the six dependent variables, namely craving, not concentrating/focus, no sleep, stress, sadness, and weakness, revealed statistical improvement of symptoms among members of the treatment group ($p < 0.001$ for all six variables); contrary to the control group, which showed no or minimal variation while the study lasted. The significance score ranking were: no sleep, weakness, stress, craving, sadness, and concentration, in that order.

To clarify the trajectory of variations, pairwise Bonferroni comparisons were conducted, and results showed no significant difference at Day 1, with observable improvement noticed at Day 3, significant improvement from Day 7, and continued over the treatment until the end on Day 14. An indication that the effects were not felt immediately, but rather manifested as they accumulated over time, as a reflection of a dose- and time-dependent response.

Estimating the effect size revealed large and very large partial eta squared (η^2) across all results, and very strong multivariate effects for treatment, time, and their interaction, suggesting that findings possess practical significance. Substance-specific evaluation revealed that both Indian hemp and

cigarette consumers substantially benefited from the coconut-water treatment intervention, showing only a very minor difference in response pattern.

In all, outcomes showed very strong statistical and clinical evidence that coconut-water treatment was very effective in diminishing addiction and nicotine withdrawal-related symptoms over the 15-day investigation, causing improvement in psychological stabilization, physiological impact, and cognitive clarity domains.

Overall, the results showed that while the placebo or control group that received 200 ml of water 3 times daily maintained persistent or constant baseline scores of addictions and symptoms, all participants in the coconut-water treatment group, who received 30 ml of coconut-water treatment 3 times daily, revealed a significant statistical 'floor effect' - all participants recovered to minimum levels of the measured symptoms. A strong suggestion that the coconut-water treatment triggered the end of craving or withdrawal from the substances previously addicted to, as well as the symptoms associated with addictions.

Neutralization Point (Day 7): Treatment pattern implicated Day 7 as a significant milestone, suggesting that treatment achieved its goal, and all participants' scores showed indications of levelling off irrespective of starting initial pretest scores.

Treatment-Control Groups Mean Comparison: At Day 14, the treatment mean was 1.10 (82.8% change from baseline), while the control group mean score was 6.40 (0% change from the baseline and control group mean score of 6.40).

Across all dependent variables tested, including craving for the abused substances, the effect of coconut-water treatment was overwhelmingly large; changes from the manipulation or treatment were visible and clear from Day 1 of treatment to the end of treatment on Day 14. Effect sizes (η^2) were overwhelmingly high and greater than 0.81 ($\eta^2 > 0.08$) across all dependent variables tested.

4. Discussion

This novel study's proposal was first written in 2018 and received an opportunity for collegial approval in 2024. It provides compelling preliminary evidence that coconut-water administration exerts a strong and systematic therapeutic effect on a broad spectrum of addiction-related psychological, physiological, and cognitive symptoms, in agreement with previous studies on coconut water (Carvajal et al., 2000; Lu et al., 2004; WHO, 2004b). Across all dependent variables - craving for cigarettes and Indian hemp, impaired concentration, sleep difficulty, stress, sadness, weakness, and reduced strength - the analyses revealed consistent strong effects of the independent variable: coconut-water treatment. Notably, all dependent variables moved in the expected therapeutic direction, demonstrating decreasing negative symptoms and increased positive indicators of well-being.

The statistical outcomes strongly reinforce this causal interpretation. First, the significant reductions in all symptoms compared with the no-treatment baseline (Day 0) and control group, with all p-values < .001, show that the improvements observed are highly unlikely to be attributable to chance. Second, the very large effect sizes ($\eta^2 > .80$) demonstrate that coconut water accounted for the vast majority of variance in symptom reduction, which is an exceptionally strong effect in behavioural or clinical research. Third, excluding the no-treatment period and the control group scores, results indicated extremely high precision of estimates and reinforced the effect of the treatment rather than uncontrolled external variables that drove the observed changes.

The temporal pattern further supports causation. Minimal effects were observed during the first five days when dosage remained low (30 ml × 3/day), but symptoms began a clear and accelerating decline from Days 6 to 14. This dose-response relationship suggests causal effects and aligns with the proposed biochemical mechanism. Coconut water's high electrolyte concentration and nutrient composition plausibly restored hydration, acid-base equilibrium, and neurochemical balance, particularly in neurotransmitters such as dopamine, GABA, glutamate, serotonin, and norepinephrine. These neurotransmitters are intimately linked to craving, stress, mood, cognition, and sleep regulation (Carvajal et al., 2000; Lu et al., 2004; WHO, 2004b). Thus, the magnitude and timing of symptom change coherently fit the theoretical causal chain.

Importantly, the results represent a novel contribution to addiction science, because the proposal was written in 2018 and only received approval for execution in 2024 when this study was conducted. Based on all online searches and databases performed, no prior human studies have examined coconut water as a potent addiction treatment prior to this study. However, the present findings parallel earlier animal model studies showing that coconut water mitigates depression, cigarette-induced inflammation, and nicotine-related sexual dysfunction (Ahajumobi, 2017a; Ahajumobi, 2025; Nair & Rajamohan, 2014; Zulaikhah et al., 2021; Rao & Najam, 2016; Burns et al., 2024; Health Canada, 2025; Health Canada, 2024; McKay & Adlaf, 2020; Hanafi, 2025; Mohamud, 2021; Nwokorie, 2024a; Jibrin et al., 2023; Salihu & Khalied, 2015; Abdulmudallib et al., 2024; Adu & Oluwatusin, 2024; Ndu et al., 2024; Lu et al., 2004). The convergence of human and animal evidence in related studies strengthens the argument for coconut water's highly nutritious and affordable potential for neuromodulation and therapeutic benefits not only for addiction control but also for mental illness management in general.

While the healthy diet maintained during the intervention may have contributed to the improvements, the magnitude and consistency of changes - combined with their systematic temporal alignment with coconut-water consumption - demonstrate that diet alone cannot account for the pattern of results. The treatment's effects were both rapid and stable, leading to substantial symptom reduction and enhanced psychological, physiological, and cognitive functioning across the 14-day period.

4.1. Implications and Argument for Broader Significance

The study's implications extend beyond individual clinical improvement. If validated through larger trials, coconut water could represent a low-cost, widely accessible, and culturally acceptable natural adjunct for addiction cessation. Its benefits appear to span mental health, inflammation, reproductive health, neurological function, and overall well-being, suggesting broad clinical and nutritional utility. In regions heavily burdened by tobacco, alcohol, and substance misuse - including Nigeria, Africa, Asia, Canada, and North America - this intervention could support global public health efforts to reduce relapse, improve treatment engagement, and alleviate health-system financial and resource strain (Barr & Greaves, 1999; Carvajal et al., 2000; Diener, 2000).

The broader societal implications are notable. Successful addiction cessation enhances productivity, reduces healthcare expenditures, prevents crime, and strengthens individual, family, and community stability (Ahajumobi, 2017a; Ahajumobi, 2025). The potential for coconut water to contribute to reductions in mental illness, school dropout, and substance-related harm underscores its importance as a simple natural tool for promoting social welfare and community health worldwide (Ahajumobi, 2017a; Ahajumobi, 2017b; Ahajumobi, 2018; Ahajumobi et al., 2021; Ahajumobi et al., 2022).

5. Conclusion

With a large effect size greater than $\eta^2 > 0.79$ and p-value < 0.001, this study offers strong preliminary causal evidence that coconut water significantly reduces addiction-related symptoms and enhances psychological, physical, and cognitive well-being. Supported by large effect sizes, robust statistical findings, and coherent biochemical theory, the results justify further large-scale clinical trials. Coconut water holds promising potential as a novel, innovative, natural, and accessible therapeutic agent for addiction treatment and broader mental health support.

Table 22. Definition of Terms

Abbreviation	Full Meaning	Interpretation/Description
SPSS	Statistical Package for the Social Sciences	A software tool used for statistical analysis and data management.
CI	Confidence Interval	A range of values (e.g., 99%) within which the true population mean is expected to fall. Higher CI = more certainty.
p-value (Sig.)	Probability Value	The probability that the observed result occurred by chance. If $p < 0.05$, the result is statistically significant.
F	F-ratio / F-statistic	A test statistic used in ANOVA to compare variance between groups (days) and within groups (participants). Large F = significant effect.
df	Degrees of Freedom	Number of independent pieces of information in the data used to estimate statistical parameters.
SS	Sum of Squares	The total variation in the data - used to compute variance.
MS	Mean Square	The average of squared deviations (SS/df); used to compute the F statistic.
η^2 (Eta Squared)	Effect Size	Indicates how much of the total variance is explained by the treatment. Ranges from 0 to 1; > 0.8 means very strong effect.
H_0 (Null Hypothesis)	Null Hypothesis	The assumption that there is no effect or difference (e.g., coconut water does not affect symptoms).

H_a (Alternative Hypothesis)	Alternative Hypothesis	The assumption that there is an effect (e.g., coconut water reduces symptoms).
SE	Standard Error	The standard deviation of the sample mean estimate - used to compute confidence intervals.
M	Mean	The average value (sum of scores ÷ number of scores).
SD	Standard Deviation	The spread or variability of scores around the mean.
ANOVA	Analysis of Variance	A statistical method for comparing means across multiple groups or time points.
MANOVA	Multivariate Analysis of Variance	An ANOVA extension for multiple dependent variables.
Within-Subjects Factor	Repeated measure variable	The same subjects measured across different days or conditions.
Between-Subjects Factor	Grouping variable	Different groups of subjects under different conditions (not used here).
Post-hoc Test	Pairwise comparison test	Determines which specific days differ significantly from each other.
Bonferroni	Post-hoc adjustment method	Controls for Type I error when multiple comparisons are made.

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