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Impact of Amphetamine and Captagon abuse on the liver and renal function

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ABSTRACT

Background. *Addiction is a multifaceted brain disorder characterized by compulsive substance use despite harmful consequences. The physiological effects of drugs, such as amphetamines and captagon, on organ functions remain a significant concern, with varying impacts based on substance type and duration of use.*

Aim of study. *This study aimed to investigate the impact of amphetamine and captagon abuse on liver and kidney functions. By comparing physiological parameters between individuals with substance abuse history and a control group, the study sought to elucidate the health implications of long-term drug use.*

Methods. *The study involved 50 participants: 30 with a history of substance abuse and 20 healthy controls. It assessed liver and kidney functions using biochemical and ELISA tests to measure AST, ALT, ALP, Total Serum Bilirubin, Serum Albumin, Serum Creatinine, and Blood Urea.*

Results. *The study revealed a significant difference between drug users and controls, with drug users exhibiting higher levels of urea and serum creatinine. Liver function tests showed increased GOT, GPT and ALP levels in drug users. Furthermore, total serum bilirubin was significantly higher in drug users, indicating liver impairment. Age-related analysis showed more severe renal and liver dysfunction in older drug users, with notable increases in urea and serum creatinine levels with age ($p=0.001$ and $p=0.009$, respectively).*

Conclusion. *Both amphetamines and captagon pose a significant health risk to renal and liver functions. This underscores the need for awareness and interventions targeted at mitigating the health implications of substance abuse, highlighting the importance of continuous monitoring and treatment strategies for affected individuals.*

Keywords: drug addiction, Amphetamines and Captagon, liver and kidney functions, physiological impacts, biochemical analysis

INTRODUCTION

Addiction is a complex, chronic brain disorder characterized by compulsive engagement in substance use or behaviors like drugs, alcohol, gambling, and gaming, despite harmful consequences. It leads to physical and psychological dependence, marked by tolerance and withdrawal symptoms, negatively affecting health, relationships, and quality of life. Addiction changes the brain's structure and function, necessitating treatment through therapy, counseling, and medication for recovery [1-3].

In the medical field, addiction encompasses excessive, compulsive activities or substance use, driven by the pursuit of pleasure or relief from discomfort. It's categorized into substance-use addictions (e.g., alcohol, drugs) and behavioral addictions (e.g., gambling, gaming), with "dependence" referring to the severe stages of addiction, characterized by withdrawal symptoms. The DSM-5 and ICD-11 offer differing definitions, highlighting the complexity of diagnosing and treating addiction [4-6].

Drugs, legal or illegal, medical or recreational, impact the body and brain by altering neurotransmitter

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activity, affecting mood, cognition, and behavior. Their effects vary by type, dose, and individual factors, leading to potential harm, especially when misused. Depressants, stimulants, psychedelics, and cannabinoids each have unique effects on the central nervous system, influencing emotions, perception, and physical health [7-12].

Global drug use in 2021 affected 275 million people, a 22% increase since 2010. Prevalence and substance preferences vary by region, with notable differences in the use of cannabis, opioids, cocaine, and new psychoactive substances across the United States, Europe, Japan, Turkey, Iran, and the Middle East. In Iraq, drug use prevalence was 1.1%, with drug-related deaths accounting for 0.30% of all deaths, underscoring the global public health challenge of addiction [13,14].

The study aims to investigate the impact of drug addiction on human health, focusing on the effects of amphetamine and captagon abuse on liver and kidney functions. It compares physiological parameters between addicted individuals and a healthy control group, including liver and renal function, to understand the broader health implications of addiction.

PATIENTS AND METHODS

This research aimed to assess the effects of Amphetamines and Captagon on liver and kidney functions, conducted in Nasiriyah, Thi-Qar governorate, from March to November 2023. Fifty participants were divided into two groups: 30 individuals with a history of substance abuse (26 young adults aged 18-45 and 4 middle-aged aged 45-65) and 20 healthy controls. The study utilized equipment and instruments from various countries, including pipettes, centrifuges, and refrigerators from China, Malaysia, Korea, the UAE, and Germany, among others. Chemicals for testing, such as Aspartate Transaminase (AST) and Alanine Transaminase (ALT) kits, were sourced from England, Spain, France, and Germany.

Blood samples were collected from suspected drug users, with a 5 ml draw split between EDTA (K3 Tube) and Gel tubes for analysis, including Complete Blood Count (CBC) and biochemical and ELISA tests. The methodology encompassed liver function tests measuring AST, ALT, Alkaline Phosphatase (ALP), Total Serum Bilirubin (TSB), and Serum Albumin through various biochemical reactions and spectrophotometry. Kidney function was assessed via Serum Creatinine and Blood Urea measurements, employing the Jaffe reaction and spectrophotometry for accurate quantification. Prothrombin Time (Pt) testing was conducted to evaluate blood coagulation effectiveness.

All procedures were carried out with strict adherence to ethical considerations, ensuring the privacy, consent, and welfare of all participants. The study's results were analyzed using SPSS version 26, employing one-way ANOVA for mean and standard deviation variation, least significant difference, and Pearson correlation at $P < 0.05$. This comprehensive approach aimed to provide insights into the physiological impacts of Amphetamine and Captagon use on vital organ functions, contributing to a broader understanding of drug addiction's health consequences, with a strong commitment to ethical research practices.

RESULTS

This comprehensive study engaged 50 participants to assess the effects of Amphetamines and Captagon on renal and liver function. The cohort comprised 60% drug users and 40% controls, with a detailed demographic breakdown indicating a majority of younger adults (82% under 45 years, average age 35.32 years) (Table 1, Figure 1). The drug users were further divided based on their substance of choice, revealing a predominant use of Amphetamines (76.7%) over Captagon (23.3%).

TABLE 1. *Age distribution of the participants*

Variable		No	%
Age	Young (≤44 years old)	41	82.0
	Middle (45-65 years old)	9	18.0
	Mean±SD	35.32±11.61	

Renal and liver function tests offered insightful data on the physiological impact of drug use. Notably, drug users exhibited significantly elevated urea and serum creatinine levels compared to controls, underscoring potential renal impairment. Liver enzyme analyses (GOT, GPT, ALP) and total serum bilirubin levels were markedly higher in the drug user group, suggesting liver function compromise. These findings were complemented by lower serum albumin levels and prolonged prothrombin time in drug users, showing liver damage and altered coagulation profiles (Table 2).

TABLE 2. *Comparative Analysis of Renal and Liver Parameters Between Drug Users and Non-Drug Users*

Variable	Control	Drugs users	P value
Age	37.65±13.17	33.77±10.38	0.251
Urea	30.15±7.02	40.50±11.67	0.001
Serum creatinine	0.775±0.148	0.977±0.254	0.002
GOT	25.85±5.50	47.17±19.03	0.0001
GPT	21.50±6.77	40.23±19.25	0.0001
ALP	145.20±19.25	203.27±77.06	0.002
TSB	0.745±0.153	1.017±0.269	0.0001
WBC	7.68±1.04	9.21±3.22	0.045
HB	13.19±1.31	13.26±1.85	0.885
Serum Albumin	4.33±0.354	3.65±0.741	0.0001
PT	12.87±0.87	18.68±8.77	0.005

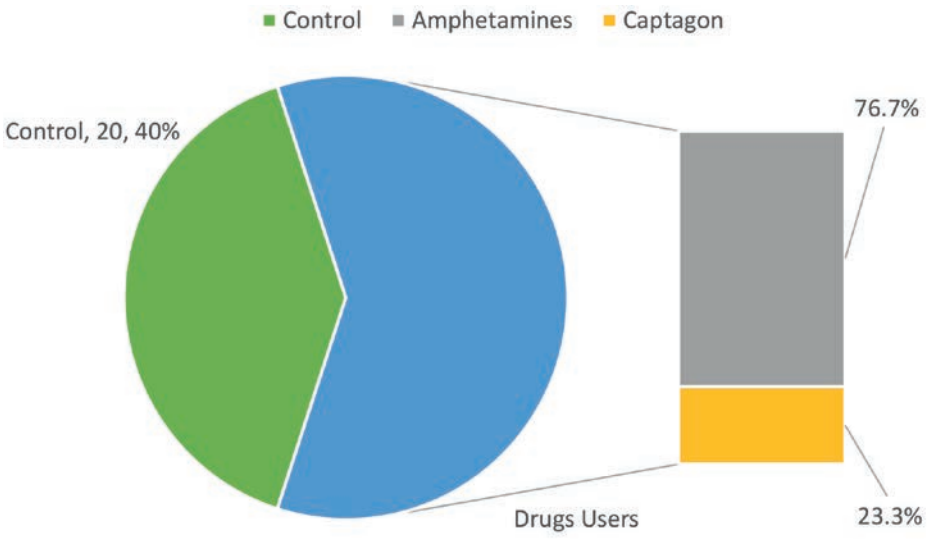

FIGURE 1. *The distribution of the participants*

Age-related analysis within the drug user population revealed an interesting trend: urea and serum creatinine levels increased with age, suggesting an age-enhanced effect of drugs on renal function. This pattern extended to liver health, with older drug users showing significantly higher liver enzyme levels, pointing towards an accumulative detrimental effect of prolonged drug use on liver function (Table 3).

TABLE 3. *Age-Related Differences in Renal and Liver Parameters Among Drug Users*

Variable	Drugs users		P value
	Young	Middle	
Urea	37.96±10.32	57.00±3.16	0.001
Serum creatinine	0.93±0.24	1.27±0.05	0.009
GOT	44.15±18.36	66.75±10.14	0.024
GPT	37.38±18.59	58.75±13.22	0.036
ALP	194.62±66.34	259.5±125.92	0.119
TSB	0.985±0.260	1.225±0.263	0.097
WBC	9.15±3.18	9.60±3.95	0.803
HB	13.59±1.69	11.1±1.51	0.010
Serum Albumin	3.74±0.64	3.05±1.150	0.080
PT	17.58±7.42	25.82±14.37	0.080

When comparing Amphetamines and Captagon users, the study found no significant differences in the impact on renal and liver parameters. This suggests that both drugs similarly affect organ health, regardless of the specific substance used (Table 4).

Correlation analyses offered a nuanced view of how drug use intersects with age to influence physiological parameters. Figures 2 to 6 delineate a clear trajectory of increasing urea and serum creatinine levels with age, a trend more pronounced in drug users. This underscores the compounded risk that drug use and aging pose to renal health. Liver enzyme levels (GOT, GPT, ALP) consistently registered higher in drug users across all age groups, emphasizing the sustained liver health risk associated with drug consumption.

TABLE 4. *Association of Renal and Liver Parameters Among Drug Users*

Variable	Drugs users		P value
	Amphetamines	Captagon	
Age	35.70±11.043	27.43±3.599	0.064
Urea	41.61±12.38	36.86±8.72	0.355
Serum creatinine	0.991±0.282	0.929±0.125	0.577
GOT	48.87±19.12	41.57±19.06	0.384
GPT	42.74±17.96	32.00±22.48	0.202
ALP	203.87±79.62	201.29±73.80	0.940
TSB	1.048±0.262	0.914±0.285	0.258
WBC	9.06±3.25	9.71±3.32	0.650
HB	13.08±1.91	13.82±1.66	0.365
S. Albumine	3.67±0.78	3.57±0.60	0.745
PT	18.78±8.98	18.34±8.69	0.909

The total serum bilirubin levels and white blood cell counts presented a subtle but indicative variance, suggesting a possible influence of drug use on the immune system, particularly in older participants. This was mirrored in the hemoglobin levels, which showed a decline with age in both groups, albeit at a slower rate in drug users. Such trends hint at the complex interplay between drug use, aging, and health.

Serum albumin levels, indicative of nutritional status and liver health, decreased with age across both groups, with drug users consistently showing lower levels. This suggests that drug use might exacerbate the natural decline in albumin levels associated with aging, potentially indicating poorer nutritional status or more significant liver function impairment in this population. Prothrombin time, a measure of blood clotting efficiency, exhibited slight increases in older drug users, further complicating the health landscape for individuals with a history of drug use.

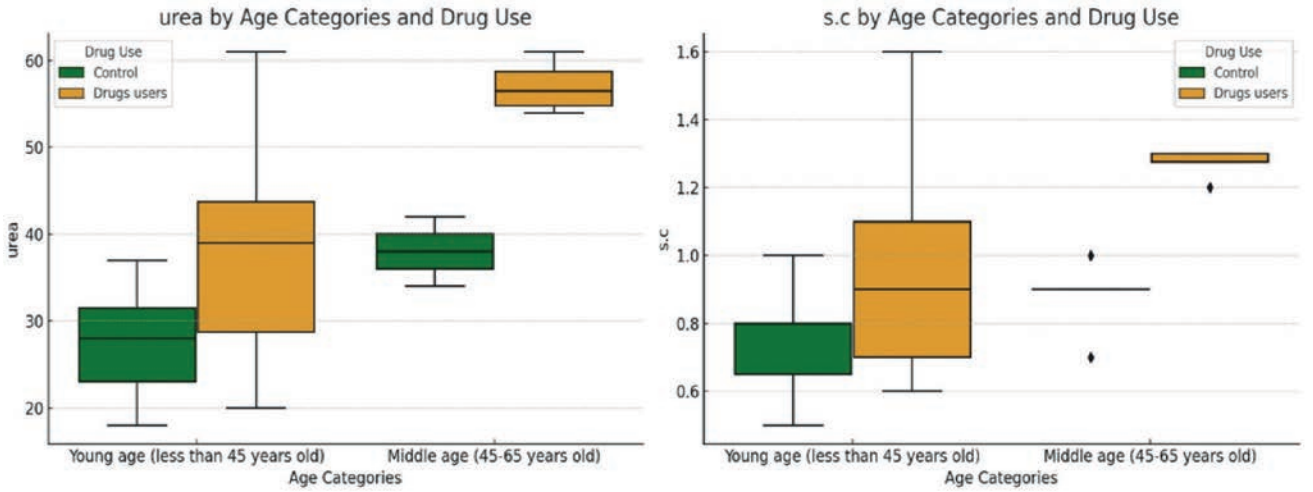

FIGURE 2. *The correlation of the blood urea and serum creatinine of the participants regarding their age*

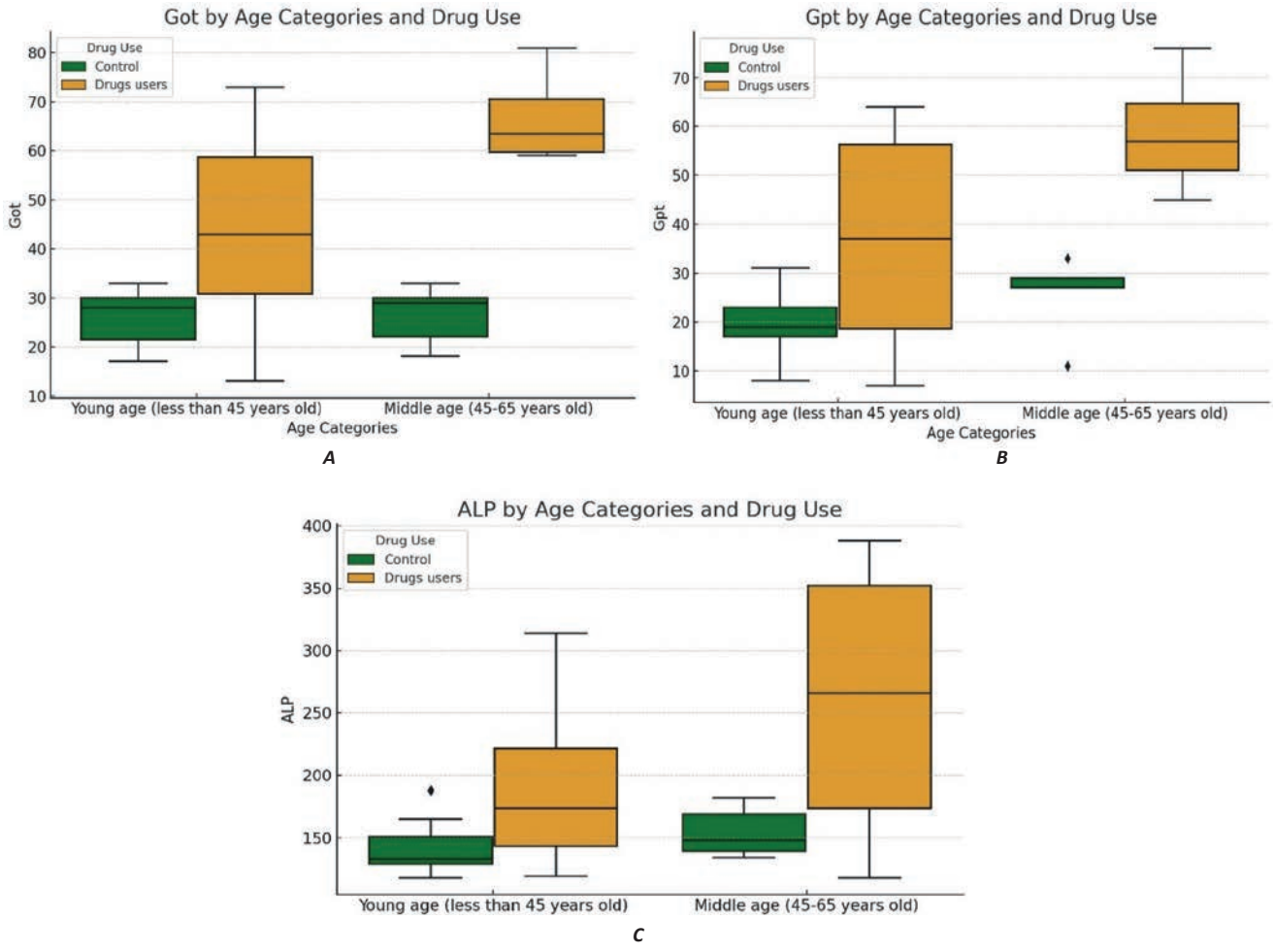

FIGURE 3. *The correlation of the liver enzymes of the participants regarding their age. A - GOT, B - GPT, C - ALP*

DISCUSSION

The study explored the impact of Amphetamine and Captagon addiction on renal and liver functions, revealing significant physiological alterations in drug users compared to controls. Elevated urea and serum creatinine levels in drug users suggest renal dysfunction, while increased liver enzyme levels (GOT, GPT, ALP) and total serum bilirubin indicate hepatocellular damage and impaired liver function.

These findings align with previous research by Alharbi et al. (2022) and Hamdan et al. (2021) [15,16], emphasizing the health risks associated with substance abuse.

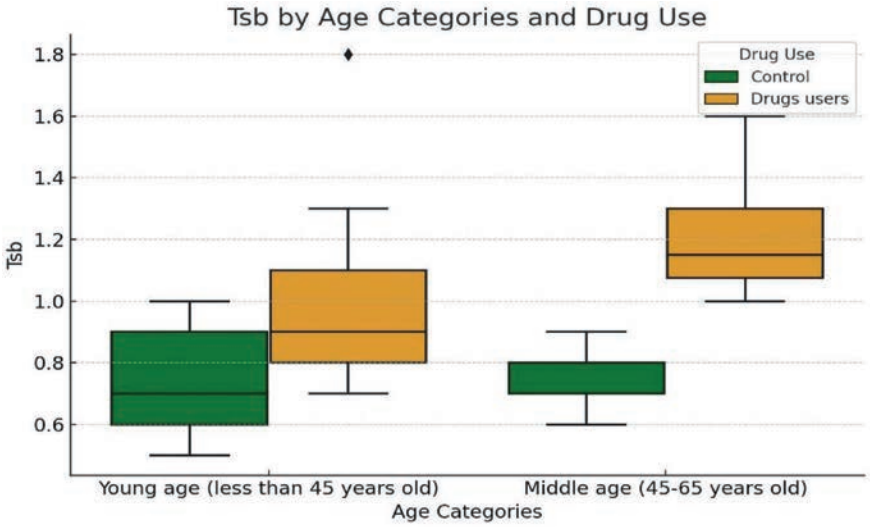

FIGURE 4. *Distribution of the total serum bilirubin among participants regarding their age*

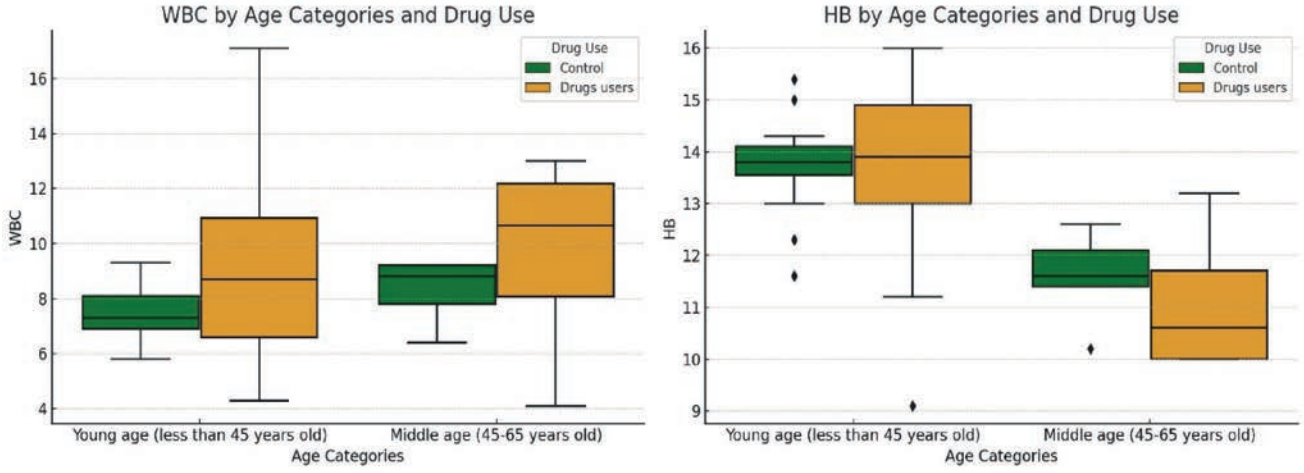

FIGURE 5. *Distribution of the WBC and HB levels among participants regarding their age*

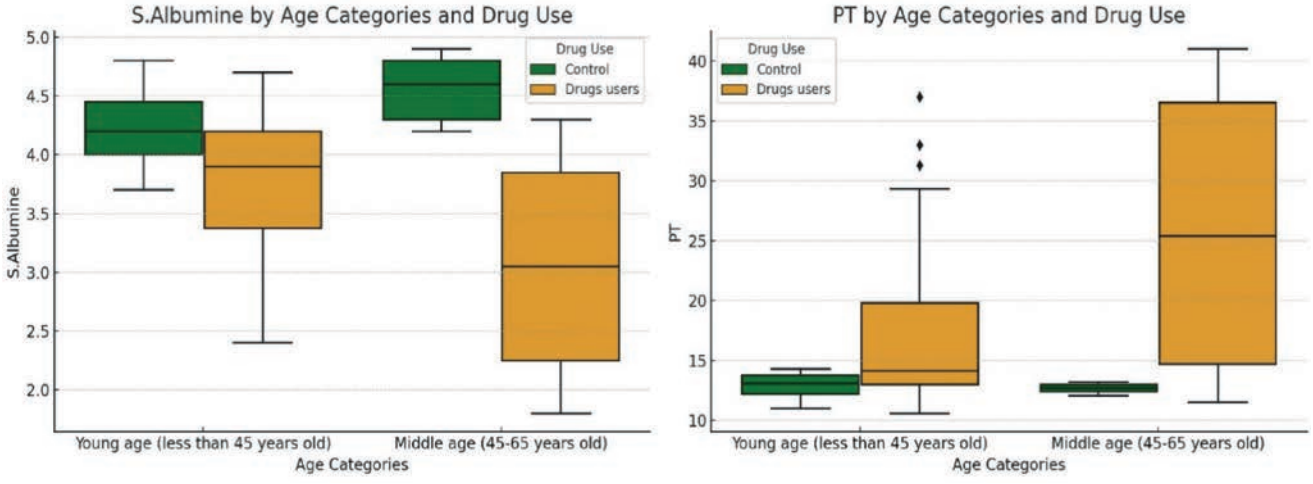

FIGURE 6. *Distribution of the serum albumin levels and prothrombin time among participants regarding their age*

Age-related analysis within the drug-using cohort underscored a more pronounced effect of drug use on older individuals, with significant differences in urea, serum creatinine, and hemoglobin levels between young and middle-aged drug users. This suggests that the pharmacokinetics and dynamics of drug metabolism could vary with age, potentially exacerbating the adverse effects on renal and liver functions in older

populations, as supported by Docherty et al. (2021) and Hussain et al. (2021) [17,18].

The comparative assessment of Amphetamines and Captagon revealed no significant differences in their impact on renal and liver functions, indicating that both substances pose similar health risks. This challenges the notion of differential toxicity between these drugs and calls for a broader understanding of substance abuse's physiological consequences, resonating with findings from Basmadjian et al. (2021) and Li et al. (2022) [19,20].

Age played a critical role in the severity of drug-induced organ damage. The study highlighted significant age-related disparities in key biomarkers, indicating an age-dependent effect on renal and liver functions among drug users. Middle-aged users exhibited worse renal and liver parameters, suggesting that age exacerbates the health risks of drug use, which is consistent with the broader literature on drug metabolism and organ function decline with age (Mark Ruscin J et al., 2022; Rochon PA et al., 2019) [21,22].

The study's limitations include a small sample size and potential biases due to its cross-sectional design and reliance on self-reported data, limiting the generalizability of findings. However, its strengths lie in the comprehensive analysis of renal and liver functions, the inclusion of a control group for comparative analysis, and the detailed examination of age-related trends, providing valuable insights into the health implications of Amphetamine and Captagon use across different age groups.

CONCLUSION

The study concluded that Amphetamines are more prevalently used among the younger population, but the middle-aged group exhibited more pronounced kidney health issues, as indicated by elevated urea and serum creatinine levels, suggesting a cumulative effect of prolonged drug use. Both Amphetamines and Captagon users showed significantly higher levels of liver enzymes and total serum bilirubin, underscoring potential liver damage or dysfunction regardless of the drug type. Middle-aged drug users experienced more severe renal and liver impairments, highlighted by increased urea, serum creatinine, liver enzymes, and decreased hemoglobin levels, pointing to age-exacerbated drug effects. Additionally, drug users demonstrated higher white blood cell counts and lower serum albumin levels, indicating possible immune activation and nutritional or liver function issues related to substance abuse.

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