

Sensory processing patterns link alcohol consumption in undergraduate students

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ABSTRACT

Background: Alcohol consumption among undergraduate students is a public health concern. Sensory processing refers to how individuals receive, organize, and respond to sensory information from their environment, influencing their emotions and behavior. However, no research has yet explored the relationship between sensory processing patterns in specific modalities and alcohol consumption among undergraduate students.

Objective: The purpose of this study was to examine the relationship between sensory processing patterns and alcohol consumption among undergraduate students.

Materials and methods: Participants included 430 students. Participants completed a demographic questionnaire, the Functional-Belief-Based Alcohol Use Questionnaire and the Thai Sensory Patterns Assessment. Descriptive statistics, Spearman's correlation analysis, Mann-Whitney U test, Kruskal-Wallis H test, and chi-squared test were used to analyze the data.

Results: The findings indicated that alcohol consumption was positively correlated with sensory arousal in the auditory and proprioceptive modalities ($r=0.176$ and 0.186 , respectively; $p<0.01$), as well as with sensory preferences across all modalities (r_s ranged from 0.116 to 0.204 ; $p<0.01$; $p<0.05$).

Conclusion: This research found that sensory processing patterns may be associated with alcohol consumption. Further research and public health efforts could contribute to developing strategies to assist students in managing sensory cues and preventing alcohol abuse.

Introduction

Alcohol is the most widely used substance worldwide, including in Thailand. Globally, more than half (57%) of people consumed alcohol¹, while nearly 30% of Thais drank alcohol.² In addition, it was a leading contributor to the burden of alcohol-attributable disability-adjusted life years (DALYs), with approximately 115.9 million DALYs in 2019.¹ In Thailand, alcohol consumption was the second highest risk factor for DALYs lost in 2019.³ Alcohol use among undergraduate students was a significant concern, as they were at an age when many new drinkers emerge, and heavy consumption was common.² In Thailand, the prevalence of hazardous or harmful drinking among undergraduate students has increased from 10.8% to 15.6% between 2015 and 2019.^{4,5}

Undergraduate students are in a transition period and are an important human resource in the future. Undergraduate students' experiences of alcohol use were linked with stressful times,⁶ daily stressors,⁷ influence of

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friends,⁸ and the lack of self-awareness of how to solve problems.⁹ In addition, a study in Thailand illustrated that religion, attitudes, access to alcohol, age, academic success, and family assets were potential factors for alcohol consumption among undergraduate students.¹⁰

Sensation serves as a foundation for perception, learning, behavior, and emotion.¹¹ Sensory processing refers to an individual's ability to receive, organize, and respond to sensory information in daily activities.¹² Difficulties in these processes are associated with emotions and behaviors.¹² According to sensory restriction concepts, low or high levels of stimulation can cause difficulty processing sensory input. It increases physiological, perceptual, and affective impairments and has a maladaptive effect on behavior, including alcohol consumption.¹² Emotional and behavioral processing in the brain begins with the reception of sensory input. If the brain perceives this information as stressful or threatening, it triggers the release of glucocorticoids, leading to physiological and behavioral responses. These reactions may lead to alcohol use and addiction, both of which are associated with the brain's reward system.^{13,14} Every person varies in their sensory preferences and in their style of processing sensory information, called sensory processing patterns (SPPs). Previous studies showed that the sensory processing patterns of people with substance use were significantly different from those of the general population¹⁵, and young people with sensory sensitivity contributed to increasing stress, resulting in alcohol consumption to manage stress.¹⁶ However, no research has examined the relationship between sensory processing patterns in specific modalities and alcohol consumption among undergraduate students.

Materials and methods

Participants

The current study included 430 students aged between 18-25 years old. The sample size was calculated using Yamane's formula.¹⁷ The sampling method was purposive sampling followed by an inclusion criteria. The inclusion criteria were students at Chiang Mai University, Thailand, who had been exposed to alcohol consumption within the past year. The study protocol was approved by the Ethics Committee of the Faculty of Associated Medical Sciences, Chiang Mai University (AMSEC-67EX-007).

Measurement

Demographic questionnaire

The demographic questionnaire includes questions to gather information from the research participants, such as their gender, age, overall grade point average (GPAX), field of study, monthly income, and part-time job.

The Functional-Belief-Based Alcohol Use Questionnaire (FBAQ)

The FBAQ consists of three straightforward belief questions. The three items in the FBAQ address participants

about self-regulation and focusing on consumption for stress relief or socialization. Participants would rate their agreement to the given statement on a 5-point Likert scale from 1 to 5 (totally disagreed to totally agreed). The total FBAQ score is then categorized into two groups, low-risk drinking and high-risk drinking. Three functional-belief items independently predict high-risk drinking (score ≥ 6). Previous research validated the FBAQ with Chiang Mai University undergraduates, which is the same group as the participants in this study. The FBAQ showed strong discriminative performance and high sensitivity in identifying high-risk drinkers. The pooled sensitivity and specificity at the FBAQ score cutoff of 6 were 92.8% (95% CI 88.0-95.7%) and 51.6% (95% CI 41.1-62.0%).¹⁸

The Thai Sensory Patterns Assessment (TSPA)

This self-reported assessment consists of two modules, including sensory preferences and sensory arousals. Each module has six categories based on the types of sensory modality (visual, auditory, smell and taste, tactile, proprioceptive, and vestibular senses). To interpret the scores, the items are rated on a 5-point scale from 1 to 5 (never to always), and the scores for each sensory modality are combined separately and are reported as a percentage. Each participant's types of sensory modalities mean scores are then categorized into the corresponding three classifications of score results: Low (<25%), Moderate (25-75%), and High (>75%). The TSPA had valid content (IOC=0.60-1.00 in modules I and II) and reliable tests (ICC=0.93 and 0.77, Cronbach's alpha=0.89 and 0.62 in modules I and II, respectively). Additionally, the Cronbach's alpha of the TSPA among undergraduate students was equal to 0.86 (Cronbach's alpha=0.85 and 0.74 in modules I and II, respectively).¹⁹

Data collection procedures

After the research received approval from the ethics committee, students were invited through advertisement via sheet posters, online posters, and face-to-face contact. All participants who agreed to participate in the study signed informed consent and completed the assessments in a paper-based format or through an online format.

Data analysis

Data analysis was conducted using SPSS (version 27). Descriptive statistics, including percentage, mean, and standard deviation, were used to describe sensory processing patterns, alcohol consumption scores, and demographic characteristics. The Mann-Whitney U test and Kruskal-Wallis H test analyzed differences in alcohol consumption across demographics, while the chi-squared test examined correlations between demographic characteristics and alcohol consumption scores. Spearman's correlation was used to explore the relationship between sensory processing patterns and alcohol consumption, as well as between demographic characteristics and alcohol consumption scores.

Results

Characteristics of participants

Table 1 showed that most participants were female (66.0%). High-risk drinkers had a slightly higher proportion of males (35.5%) compared to low-risk drinkers (26.1%). The average age was around 20.3 years. Humanities and

Social Sciences had the highest representation (41.4%). High-risk drinkers slightly skewed toward lower GPAX ranges. High-risk drinkers had a slightly higher proportion in the lowest income category (<5,000 Bht). About 15.2% of students had part-time jobs, with a similar distribution occurring between high- and low-risk groups.

Table 1. Demographic characteristics among undergraduate students with alcohol consumption.

Variables	High risk (N=361) N (%)	Low risk (N=69) N (%)	Overalls (N=430) N (%)
Gender			
Male	128 (35.5)	18 (26.1)	146 (34.0)
Female	233 (64.5)	51 (73.9)	284 (66.0)
Age (mean±SD)	20.3±11.16	20.1±1.10	20.3±1.15
Field of study			
Science and technology group	122 (33.8)	25 (36.2)	147 (34.2)
Health science group	81 (22.4)	24 (34.8)	105 (24.4)
Humanities and social sciences group	158 (43.8)	20 (29.0)	178 (41.4)
Overall grade point average (GPAX)			
<2.00	10 (2.8)	3 (4.3)	13 (3.0)
2.00-2.49	65 (18.0)	6 (8.7)	71 (16.5)
2.50-2.99	98 (27.1)	20 (29.0)	118 (27.4)
3.00-3.49	115 (31.9)	21 (30.4)	136 (31.6)
3.50-4.00	73 (20.2)	19 (27.5)	92 (21.4)
Income per month (Bht)			
<5,000	83 (23.0)	18 (26.1)	101 (23.5)
5,001-10,000	207 (57.3)	32 (46.4)	239 (55.6)
10,001-15,000	50 (13.9)	14 (20.3)	64 (14.9)
15,001-20,000	19 (5.3)	3 (4.3)	22 (5.1)
>20,001	2 (0.6)	2 (2.9)	4 (0.9)
Part-time job			
Yes	55 (15.2)	10 (14.5)	65 (15.1)
No	306 (84.8)	59 (85.5)	365 (84.9)

Sensory processing patterns

Table 2 showed sensory preferences, and the auditory sense stood out: High-risk drinkers scored a high level (82.96 ± 12.91), while low-risk drinkers scored a moderate level (79.83 ± 15.22). The overall group had a high level (82.46 ± 13.34). Both groups rated all other senses as moderate, with minor differences in mean scores. Sensory arousal for students across both high- and low-risk groups

showed moderate levels in all senses. High-risk drinkers had slightly higher levels in the auditory (50.91 ± 13.60 vs. 48.21 ± 14.43) and proprioceptive (43.34 ± 15.20 vs. 39.48 ± 14.16) senses compared to low-risk drinkers.

Alcohol consumption

Table 3 revealed that most students (84.0%) were classified as high-risk drinkers.

Table 2. Sensory processing patterns in specific sensory modalities of undergraduate students with alcohol consumption.

Modules	Sensory processing patterns					
	High risk (N=361)		Low risk (N=69)		Overalls (N=430)	
	Mean $\pm$ SD	Result	Mean $\pm$ SD	Result	Mean $\pm$ SD	Result
Sensory preferences						
Auditory	82.96 ± 12.91	High	79.83 ± 15.22	Moderate	82.45 ± 13.34	High
Touch	72.71 ± 14.35	Moderate	72.54 ± 19.15	Moderate	72.68 ± 15.19	Moderate
Smell and taste	72.89 ± 12.40	Moderate	70.92 ± 12.99	Moderate	72.57 ± 12.51	Moderate
Visual	63.74 ± 15.77	Moderate	61.30 ± 15.33	Moderate	63.35 ± 15.71	Moderate
Proprioceptive	59.99 ± 14.86	Moderate	56.74 ± 16.79	Moderate	59.47 ± 15.21	Moderate
Vestibular	55.84 ± 15.46	Moderate	57.13 ± 18.65	Moderate	56.05 ± 15.99	Moderate
Sensory arousals						
Visual	69.42 ± 16.42	Moderate	66.47 ± 16.65	Moderate	68.94 ± 16.47	Moderate
Smell and taste	64.59 ± 19.25	Moderate	62.90 ± 20.05	Moderate	64.32 ± 19.36	Moderate
Auditory	50.91 ± 13.60	Moderate	48.21 ± 14.44	Moderate	50.48 ± 13.76	Moderate
Touch	46.04 ± 16.21	Moderate	46.52 ± 18.46	Moderate	46.12 ± 16.56	Moderate
Vestibular	45.34 ± 20.47	Moderate	43.08 ± 19.21	Moderate	44.98 ± 20.27	Moderate
Proprioceptive	43.34 ± 15.20	Moderate	39.48 ± 14.16	Moderate	42.72 ± 15.09	Moderate

Table 3. FBAQ scores and levels of alcohol consumption among undergraduate students (N=430).

Variables	Minimum	Maximum	Mean	SD
Alcohol use behavior				
FBAQ scores	3	15	8.76	3.12
Alcohol use levels				
Low risk drinking	N	%		
High risk drinking	69	16.0		
	361	84.0		

Alcohol differences among certain demographic characteristics

Table 4 showed that there was no significant difference in FBAQ scores between males and females ($p>0.05$). As for the field of study, a significant difference was discovered among low-risk drinkers ($p=0.005$), but not in high-risk or general groups. Overall, there was a significant difference ($p=0.049$) in GPAX and alcohol use. In terms of monthly income, there were no significant differences overall. However, variances were observed among low-risk drinkers ($p=0.033$).

Correlation between demographic characteristics and alcohol consumption scores

Table 5 shows that the field of study has a significant correlation with alcohol consumption in both low-risk ($p=0.019$) and overall groups ($p=0.020$). Gender, age, GPAX, monthly income, and part-time job showed no significant correlation with alcohol consumption ($p>0.05$).

Table 4. Alcohol difference among certain demographic characteristics.

Variables	FBAQ score					
	High risk (N=361)		Low risk (N=69)		Overalls (N=430)	
	Mean±SD	p value	Mean±SD	p value	Mean±SD	p value
Gender						
Male	9.77±2.52	0.511 ^a	3.94±0.94	0.883 ^a	9.05±3.06	0.157 ^a
Female	9.62±2.47		3.98±0.91		8.69±3.14	
Field of study						
STG	9.82±2.46	0.601 ^b	3.52±0.82	0.005 ^{*b}	8.75±3.28	0.401 ^b
HSG	9.73±2.71		4.13±0.90		8.45±3.38	
HSSG	9.54±2.40		4.35±0.81		8.96±2.81	
Overall grade point average (GPAX)						
<2.00	10.90±2.42	0.092 ^b	4.33±1.15	0.149 ^b	9.38±3.59	0.049 ^{*b}
2.00-2.49	10.09±2.50		3.67±1.03		9.55±3.01	
2.50-2.99	9.79±2.55		4.10±0.91		8.82±3.18	
3.00-3.49	9.60±2.59		3.62±0.86		8.68±3.24	
3.50-4.00	9.11±2.12		4.26±0.81		8.11±2.75	
Income per month (Bht)						
<5,000	9.17±2.36	0.165 ^b	3.50±0.86	0.033 ^{*b}	8.16±3.07	0.137 ^b
5,001-10,000	9.76±2.45		4.25±0.84		9.03±2.97	
10,001-15,000	9.80±2.70		4.07±0.92		8.55±3.40	
15,001-20,000	10.42±2.65		4.00±1.00		9.55±3.35	
>20,001	11.50±2.12		3.00±0.00		7.25±5.06	
Part-time job						
Yes	9.80±2.59	0.706 ^a	3.80±0.92	0.520 ^a	8.88±3.25	0.724 ^a
No	9.65±2.47		4.00±0.90		8.74±3.10	

Note: STG: science and technology Group, HSG: health science group, HSSG: humanities and social sciences group, a: Mann-Whitney U test, b: Kruskal-Wallis H test; * $p<0.05$.

Table 5. Correlation between demographic characteristics and alcohol consumption score.

Variables	FBAQ score		
	High risk	Low risk	Overalls
Gender	0.665 ^a	0.953 ^a	0.684 ^a
Age	0.303 ^b	0.529 ^b	0.851 ^b
Field of study	0.206 ^a	0.019 ^{*a}	0.020 ^{*a}
Overall grade point average	0.772 ^a	0.196 ^a	0.570 ^a
Income per month	0.272 ^a	0.078 ^a	0.075 ^a
Part-time job	0.209 ^a	0.805 ^a	0.398 ^a

Note: a: Chi-squared test, b: Spearman correlation test, * $p<0.05$.

The relationship between sensory processing patterns and alcohol consumption

Table 6 showed that for sensory preferences, significant positive correlations were found between alcohol consumption and all senses in the high-risk and overall groups ($p < 0.05$ to $p < 0.001$). No significant correlations existed in the low-risk group. As for sensory

arousal, auditory and proprioceptive senses showed significant positive correlations with alcohol consumption in the high-risk and overall groups ($p < 0.01$). Touch sense showed a weak correlation in the high-risk group ($p = 0.032$). There were no significant correlations in the low-risk group.

Table 6. Correlation between sensory modalities and alcohol consumption score in undergraduate students.

Sensory processing patterns	FBAQ score		
	High risk rs (p -value)	Low risk rs (p -value)	Overalls rs (p -value)
Sensory preferences			
visual	0.235 (0.001)**	0.083 (0.499)	0.204 (0.000)**
auditory	0.145 (0.006)**	-0.147 (0.227)	0.146 (0.002)**
smell and taste	0.211 (0.001)**	0.157 (0.628)	0.186 (0.000)**
Touch	0.179 (0.001)**	0.059 (0.204)	0.117 (0.015)*
vestibular	0.176 (0.001)**	0.106 (0.387)	0.116 (0.016)*
proprioceptive	0.172 (0.001)**	0.159 (0.191)	0.167 (0.001)**
Sensory arousals			
visual	0.014 (0.791)	0.095 (0.436)	0.059 (0.222)
auditory	0.175 (0.001)**	0.112 (0.359)	0.176 (0.000)**
smell and taste	0.076 (0.150)	0.117 (0.338)	0.084 (0.081)
Touch	0.113 (0.032)*	-0.056 (0.649)	0.078 (0.105)
vestibular	0.030 (0.571)	0.139 (0.258)	0.051 (0.292)
proprioceptive	0.182 (0.001)**	-0.134 (0.272)	0.186 (0.000)**

Note: p : the Spearman correlation test; * $p < 0.05$, ** $p < 0.01$ (significant).

Discussion

Demographic characteristics and alcohol consumption

The findings indicated that certain demographic factors, such as the field of study, academic performance, and income, may influence alcohol consumption among undergraduate students. The field of study on alcohol consumption may be more significant among students. Previous research indicated that students majoring in social sciences and business consumed more alcohol than those majoring in arts,²⁰ and medical students drank alcohol more frequently. These findings emphasized the role of academic stress and the cultural context within various fields in shaping students' drinking habits.²¹ Further research into how the field of study influences alcohol consumption among both low- and high-risk drinkers might give a deeper understanding of this relationship.

Moreover, GPAX may be more significant for alcohol use ($p = 0.049$). Similarly, research conducted at Chiang Mai University in 2019 revealed that increased alcohol consumption among students was significantly related to lower GPAX ($p < 0.001$). The study also noted associations between higher alcohol intake and behaviors such as skipping classes and withdrawing from courses.²² Income may impact those in the low-risk drinking category ($p = 0.033$). A previous study suggested that high socioeconomic status might increase the risk of

problematic alcohol use among university students.²³ Overall, these findings emphasized the importance of considering academic factors, such as field of study and GPAX, when examining alcohol consumption patterns among students.

The relationship between sensory arousal and alcohol consumption

The findings showed a positive correlation between the high-risk and overall groups' alcohol consumption and sensory arousal in auditory and proprioceptive senses. Low and high levels of sensory stimulation can create challenges in processing sensory input, leading to maladaptive behaviors, including alcohol use as a coping mechanism. Individuals with high sensory arousal may experience sensory overload, resulting in stress, prompting them to use alcohol for relaxation and self-regulation. Conversely, those with lower sensory arousal may seek out intense sensory input, including alcohol's effects, to compensate for their reduced responsiveness to stimuli.^{12,24} This result is consistent with prior research demonstrating a correlation between sensory arousal and alcohol use.^{15,16,25} One research study found that high sensory arousal correlated with alcohol use ($r = 0.137$; $p < 0.05$).²⁵ However, this earlier research generally studied mentally healthy adults. Moreover, the prior studies did not explicitly determine

whether specific sensory modalities were associated with alcohol consumption. This study indicated that sensory arousals were correlated with attitudes and alcohol use behavior scores, especially in the proprioceptive sense. In Dunn's Model of Sensory Processing, individuals with high sensory arousal in the proprioceptive sense are more prone to sensory overload during physical activity and physical movement. This can contribute to a preference for a sedentary lifestyle, potentially leading to alcohol use as a coping mechanism.^{26,27} Therefore, it is important to carefully regulate proprioceptive stimulation.

The relationship between sensory preferences and alcohol consumption

The results demonstrated a positive correlation between the high-risk and overall groups' alcohol consumption and sensory preferences in all senses. These results also indicated that individuals who have high sensory preference can drive increased alcohol consumption. This finding aligns with the mechanisms underlying the pleasurable effects of alcohol, as alcohol consumption activates reward circuits in the brain and increases dopamine levels, which are associated with feelings of pleasure and reward.^{28,29} Preferred sensory stimuli promote pleasure in mammals.³⁰ While most previous research has not clearly established the relationship between specific sensory modalities and alcohol consumption scores, this study provided new insight into these associations. For instance, some individuals may prefer listening to music, whereas others may favor the taste of beverages to satisfy their sensory preferences. However, this study has limitations, as it does not delve deeply into why individuals drink, the environment in which alcohol consumption occurs, or the social contexts surrounding drinking behavior. As evidenced by current literature, external factors such as stress, peer influence, social environment, and cultural norms can play a significant role in explaining alcohol consumption patterns.³¹ These factors, when combined with individual characteristics such as sensory processing patterns, can contribute to the development of drinking behaviors and influence how individuals use alcohol as a coping mechanism.

Limitation

Statistically significant findings were observed at low levels. Future research should increase sample size, minimize confounding variables, and use random sampling to improve generalizability. Longitudinal studies are needed to explore the temporal relationship between sensory processing and alcohol use. Methodological limitations, such as reliance on self-reports, should be addressed by incorporating peer reports and objective physiological measures. However, self-reports are useful for large-scale studies and capture the environmental and emotional context of alcohol use.

Conclusion

The findings indicated that sensory processing patterns, particularly sensory arousal in auditory and proprioceptive modalities, as well as sensory preference across all senses, were associated with alcohol consumption. This study identified only relationships. Future research incorporating perspectives of occupational therapists and assessment of public health initiatives could provide a deeper understanding of how to deal with drinking behaviors, further guiding the development of ways to assist students in regulating external and internal cues more successfully to prevent alcohol abuse.

Conflict of interest

There are no conflicts of interest to declare in this study.

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